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EUnetHTA Core HTA of other technologies using the HTA Core Model®

COMPARATIVE EFFECTIVENESS OF SURGICAL TECHNIQUES AND DEVICES FOR THE TREATMENT OF BENIGN PROSTATIC HYPERPLASIA

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LIST OF ABBREVIATIONS

AUA	American Urological Association
AUR	Acute urinary retention
BEEP	Bipolar endoscopic enucleation
BPE	Benign prostate enlargement
BPEP	Bipolar plasmakinetic enucleation of the prostate
BPH	Benign prostatic hyperplasia
BPHII	Benign Prostatic Hyperplasia Impact Index
BOO	Bladder outlet obstruction
BPVP	Bipolar button plasma vaporisation of the prostate
B-TUEP	Bipolar transurethral enucleation of the prostate
B-TUERP	Bipolar transurethral enucleation and resection (enucleoresection) of the prostate
B-TURP	Bipolar transurethral resection of the prostate
B-TUVP	Bipolar transurethral vaporisation of the prostate
B-VEP	Bipolar vapoenucleation of the prostate
C-BPVP	Continuous bipolar plasma vaporisation of the prostate
CI	Confidence interval
DALY	Disability-adjusted life year
DioLEP	Diode laser enucleation of the prostate
DioLVP/DioVAP	Diode laser vaporisation of the prostate
DOICU	Declaration of interest and confidentiality undertaking
ELEP	Eraser laser enucleation of the prostate
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
H	High (quality of evidence)
HoLEP	Holmium laser enucleation of the prostate
HoVAP	Holmium laser vaporisation of the prostate
HRQoL	Health-related quality of life
ICD	International Classification of Diseases
ICIQ-MLUTS	International Consultation on Incontinence Questionnaire-Male Lower Urinary Tract Symptoms module
IIEF	International Index of Erectile Function
IPSS	International Prostate Symptom Score
ISI	Incontinence Severity Index
ITT	Intention to treat
KTP	Potassium titanyl phosphate
L	Low (quality of evidence)
LBO	Lithium triborate
LUTS	Lower urinary tract symptoms

M	Moderate (quality of evidence)
MCID	Minimal clinically important difference
MD	Mean difference
MeSH	Medical subject headings
MSHQ-EjD	Male Sexual Health Questionnaire for Ejaculatory Dysfunction
MIST	Minimally invasive surgical treatment
M-TUERP	Monopolar transurethral enucleoresection of the prostate
M-TURP	Monopolar transurethral resection of the prostate
n.a.	Not available
n.r.	Not reported
OAB-SF	Overactive bladder questionnaire-short form
OP	Open prostatectomy
PAE	Prostate artery embolisation
PKEP	Plasmakinetic enucleation of the prostate
PKRP	Plasmakinetic resection of the prostate
PKVP	Plasmakinetic vaporisation
PP	Per protocol
PSA	Prostate-specific antigen
PUL	Prostatic urethral lift
PVA	Poly(vinyl alcohol)
PVEP	Plasmakinetic vapoenucleation of the prostate
PVP	Photoselective vaporisation of the prostate
PVR	Postvoid residual
Qmax	Peak/maximum flow rate
Qmed	Average flow rate
QoL	Quality of life
RCT	Randomised controlled trial
REA	Relative effectiveness assessment
RR	Risk ratio
S-BPVP	Standard bipolar plasma vaporisation of the prostate
SD	Standard deviation
SMD	Standardised mean difference
STURP	Selective transurethral resection of the prostate
ThuLEP	Thulium laser enucleation of the prostate
ThuVAP	Thulium laser vaporisation of the prostate
ThuVARP	Thulium laser vaporesection of the prostate
ThuVEP	Thulium laser vapoenucleation of the prostate
TIND	Temporary implantable nitinol device
TmLRP	Thulium laser resection of the prostate

TUEB	Transurethral enucleation with bipolar energy
TUIBN	Transurethral incision of the bladder neck
TUIP	Transurethral incision of the prostate
TUMT	Transurethral microwave therapy
TUR syndrome	Transurethral resection syndrome
TURiS	Transurethral resection in saline
TURP	Transurethral resection of the prostate
TUViS	Transurethral vaporisation in saline
TUVRP	Transurethral vaporesection of the prostate
UTI	Urinary tract infection
VL	Very low (quality of evidence)
WAVE	Water vapour energy

EXECUTIVE SUMMARY OF THE ASSESSMENT OF SURGICAL TECHNIQUES AND DEVICES FOR THE TREATMENT OF BENIGN PROSTATIC HYPERPLASIA

Scope

The aim of this rapid assessment is to provide comparisons among different minimally invasive surgical treatments for benign prostatic hyperplasia (BPH) to assess their relative effectiveness and safety in patients with an indication for surgical treatment.

Health problem

BPH is a common nonmalignant urological condition that involves progressive proliferation of the glandular epithelium, smooth muscle and connective tissue in the transition zone of the prostate. In a large proportion of BPH patients, prostate enlargement causes bladder outlet obstruction (BOO), which has an adverse impact on lower urinary tract function, resulting in lower urinary tract symptoms (LUTS). On average, approximately one in four men are likely to develop BPH over their lifetime. Bothersome LUTS occur in up to 30% of men older than 65 years, of whom one-quarter will develop severe LUTS. As many as 30% of those who develop BPH receive treatment for the condition.

The most common indication for surgical intervention is moderate to severe BOO attributed to BPH that is refractory to conservative or medical therapy (relative indications for surgery).

Description of the technologies and comparators

Transurethral resection of the prostate (TURP) has remained the cornerstone of BPH surgical treatment for decades. Despite its high rate of success, TURP has a perioperative morbidity rate of approximately 20% and long-term complications that include ejaculatory dysfunction, erectile dysfunction, urethral strictures, urinary tract infection (UTI) and urinary incontinence. Open prostatectomy (OP) is infrequently used, mainly for large prostates, because of the complications outlined above.

The development of different minimally invasive technologies has provided alternatives that are expected to have similar effectiveness, or else lower effectiveness but with a more favourable impact on patient quality of life (QoL) and better safety profile, compared to TURP. Therefore, patients are (or should be) involved in therapeutic decisions in light of their personal trade-off between expected effectiveness and QoL.

Different ablative technologies have been developed that remove excess prostatic tissue in different ways. These include the following:

- Resection with holmium or thulium lasers (e.g., thulium laser resection of the prostate [TmLRP]) as an alternative to classical TURP;
- Enucleation using a holmium (HoLEP), thulium (ThuLEP) or diode (DioLEP) laser, or different electrodes delivering bipolar energy (bipolar transurethral enucleation of the prostate [B-TUEP]) to peel the enlarged prostate from the prostatic capsule without cutting into it or dissecting the gland;

- Vaporisation with a bipolar electrode (B-TUVP) or a laser system (e.g., potassium titanyl phosphate [KTP] or lithium triborate [LBO] photoselective vaporisation [PVP] or with a diode laser [DioLVP]) to remove excess prostate tissue by heating and evaporating it;
- Hybrid techniques such as vapoenucleation of the prostate (e.g., with a thulium laser [ThuVEP] or with bipolar energy [B-VEP]), vaporesection of the prostate (resection with an electric current or laser and vaporisation with a vaporisation electrode [TUVRP and ThuVARP]) and transurethral enucleoresection of the prostate (using monopolar [M-TUERP] or bipolar [B-TUERP] energy);
- Aquablation, which uses a high-speed jet of saline (waterjet) to remove excess prostate tissue;
- Transurethral microwave therapy (TUMT), which uses electromagnetic waves to thermoablate prostatic tissue; and
- Water vapour thermal therapy (WAVE), in which convective water vapour generated with a radiofrequency current is injected into the prostate to destroy excess tissue.

Nonablative techniques have also been developed. These include the following:

- Transurethral incision of the prostate (TUIP), which involves cutting into the bladder neck to reduce the pressure of the gland on the urethra;
- Prostate artery embolisation (PAE), which uses poly(vinyl alcohol) (PVA) and other newer synthetic biocompatible materials to reduce blood flow in the prostate, causing the gland to undergo ischaemic necrosis;
- Prostatic urethral lift (PUL), which involves the insertion of small, adjustable, permanent implants that create an open channel to increase urinary flow; and
- Temporary implantable nitinol devices (TINDs), which create new channels in the urethra to increase urinary flow.

In this relative effectiveness assessment (REA) we assessed the effectiveness and safety of 21 of these technologies as compared to TURP.

Methods

We included randomised controlled trials (RCTs) comparing each of the technologies of interest to comparators (TURP and/or OP). RCTs comparing each of the technologies of interest to sham procedures were considered only if head-to-head comparative RCTs were not found for those technologies.

A systematic review of the literature was performed according to the Cochrane methodology. As one high-quality systematic review was published in November 2019, the systematic search was performed with January 2019 as the start date for technologies included in that review. For all of the other technologies, no time limits were considered.

Five review authors independently extracted data using a data extraction form developed for this review. The study quality of the RCTs included was rated using the Cochrane risk of bias (RoB) tool. The level of confidence/certainty in the body of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) scheme. Whenever possible, quantitative analysis methods for meta-analysis were applied for the SAF and EFF domains using RevMan 5.3.

Results

Eighty-four RCTs (described in 94 publications) were eventually selected; all but three of these RCTs were two-arm trials. Sixty-six RCTs (3 multiarm trials) compared newer technologies versus TURP, 18 (3 multiarm trials) compared two newer technologies to each other; one (multiarm) compared newer technologies to OP and one to a sham procedure. All trials were relatively small in size: the highest number of patients per study arm was 205, with an average size of 63. The vast majority of studies included heterogeneous populations in terms of prostate size and it was not possible to assess the effectiveness and safety of the different technologies in subgroups according to prostate size.

Clinical effectiveness: direct comparisons

New technologies versus TURP: IPSS and Qmax

Pooled data, and some of the available RCTs when pooling was not possible, showed the following results:

- Statistically significant improvements versus TURP for the International Prostate Symptom Score (IPSS) in favour of HoLEP, B-TUEP, TUVRP and ThuLEP from pooled data, and in favour of B-TUERP from single RCTs.
- For IPSS, statistically significant improvements in favour of TURP versus TUMT, PVP and PAE from pooled data, and versus PUL and DioLVP from single RCTs.
- Statistically significant improvements versus TURP for the maximum flow rate (Qmax) in favour of HoLEP, B-TUEP and TUVRP from pooled data, and in favour of TUIP + TURP and B-TUERP from single RCTs.
- Statistically significant improvements in Qmax in favour of TURP versus TUMT, PVP and TUIP from pooled data, and versus PAE, PUL, DioLVP and ThuVARP from single RCTs.

Nevertheless, the clinical relevance of the differences observed is either low or difficult to establish: pooled estimates of the mean difference (MD) are in most cases below the minimal clinically important difference (MCID) values reported in the literature. While this suggests that choosing one specific technology often may not make any difference for the majority of patients, we cannot exclude the possibility that some patients may experience a relevant benefit by choosing one technology instead of another one.

New technologies versus TURP: PVR and QoL

A few RCTs showed statistically significant improvements for both postvoid residual (PVR) and QoL in favour of HoLEP (pooled data) and B-TUERP (single RCT) versus TURP. Conversely, TURP showed better PVR versus PVP and TUMT from pooled data, and versus PUL and PAE from single RCTs. TURP also showed better QoL data versus ThuLEP from pooled data. However, it is not possible to establish the clinical relevance of the differences observed since MCID has not been established for PVR and QoL. In addition, these differences were numerically small and therefore, even though the range of the score is unknown, it seems unlikely that these differences were clinically relevant.

New technologies versus OP

OP was used as comparator in only one of the RCTs selected, and showed quite longer hospitalisation time (>4 days more) compared to B-TUEP and B-TUVP.

Comparisons between new technologies

Regarding comparisons among newer technologies, a few of the studies available show statistically significant differences in favour of the following:

- B-TUEP versus HoLEP for Qmax;
- ThuLEP versus HoLEP for Qmax, IPSS, PVR and QoL;
- ThuVEP versus HoLEP for QoL (from a single RCT);
- PVP versus HoLEP for QoL;
- HoLEP versus PVP for IPSS, Qmax, PVR and the reintervention rate;
- PVP versus B-TUVP for PVR; and
- DioLEP versus B-TUEP and versus B-TUERP for irritative symptoms (the latter from a single RCT).

Safety: direct comparisons

The available comparisons did not show differences for bladder perforation, bladder or ureteral injury, erectile dysfunction, TUR syndrome, urethral stricture or bladder neck contracture.

Comparisons of new technologies versus TURP

Some of the RCTs and pooled data showed statistically significant improvements in favour of newer technologies compared to TURP for some of the critical outcomes considered in this REA (plus recatheterisation, graded as important). The specific details are as follows:

- A rate ratio of 0.4 for retrograde ejaculation for TUIP, an absolute reduction of 16% for Aquablation and an absolute reduction (from 34% to 0%) for anejaculation for PUL (the latter 2 from single RCTs);
- A rate ratio for transfusion requirement of the order of 0.1–0.3 for HoLEP, ThuLEP, B-TUVP and PVP, and a reduction of 9% for M-TUERP (the latter from a single RCT);
- A rate ratio for UTI between 0.2 and 0.5 for HoLEP and PAE;
- A rate ratio for urinary incontinence of 0.1 for PAE and a reduction of 15% for PUL (the latter from a single RCT); and
- A 7% reduction in recatheterisation and an 11% reduction in urinary retention for M-TUERP (from a single RCT).

Outcomes that are worse for some technologies in comparison to TURP are as follows:

- Urinary incontinence for HoLEP, B-TUEP (rate ratio 1.9) and PVP (rate ratio 2.6);
- UTI for PVP (rate ratio 1.8); and
- Acute urinary retention (AUR) for PAE (rate ratio 2.2).

RCTs generally showed a shorter catheterisation time for the newer technologies, but the wide statistical heterogeneity, probably explained by different policies in different centres, precluded data pooling.

Comparisons among newer technologies

Some data from single RCTs are available and show statistically significant differences in favour of ThuLEP versus HoLEP for incontinence (rate ratio 3.4) and in favour of ThuVEP versus HoLEP for urinary retention (13% absolute difference from a single RCT).

Quality of evidence

The quality of the evidence for all these outcomes has been judged low to very low in most cases because of internal and external validity, inconsistency in results, low precision of the estimates and the heterogeneity of the study populations.

Concluding summary

Minimally invasive technologies are expected to reduce the short- and long-term side effects of standard surgical treatments for BPH (in particular in comparison to TURP) while preserving the effectiveness for functional outcomes.

For functional outcomes, a few comparisons revealed statistically significant differences, although the results in most cases are below the MCID threshold. The quality of the related evidence has been graded as low to very low, suggesting limited confidence in the estimates and that further research is likely to change these estimates.

Regarding the impact on sexual activity, ThuLEP, TUIP, Aquablation and PUL may provide some advantage over TURP, for which the quality of the evidence ranges from moderate (reduced impact on retrograde ejaculation for patients with small prostates undergoing TUIP) to low or very low.

For other possible safety concerns and side effects, some newer technologies may offer some advantage over TURP by reducing the transfusion requirement; a few technologies showed evidence of a positive or negative effect on UTI and incontinence.

Small sample sizes, biases in study design, heterogeneous populations and (in most cases) an undefined primary hypothesis indicate the need for more and better research so that the advantages and disadvantages of all these technologies can be more clearly defined.

1 BACKGROUND

1.1 Overview of the disease, health condition and target population

HTA CORE MODEL DOMAIN: CUR[1]

BPH, also known as benign prostate enlargement (BPE), is a common nonmalignant urological condition that involves progressive proliferation of the glandular epithelium, smooth muscle and connective tissue in the transition zone of the prostate (the area around the urethra). In a large proportion of BPH patients, prostate enlargement causes BOO, which has an adverse impact on lower urinary tract function, resulting in LUTS.

LUTS attributed to BPH can be divided into storage (irritative), voiding and postmicturition symptoms. Storage symptoms include urgency, frequency, urgency incontinence and nocturia. Voiding symptoms comprise slow urinary stream, straining to void, urinary intermittency (stream starting and stopping during micturition) or hesitancy, splitting of the voiding stream and terminal dribbling [1]. Postmicturition symptoms include a feeling of incomplete emptying and postmicturition dribble. Storage symptoms are often more bothersome than voiding symptoms and BPH becomes clinically significant when it starts contributing to bothersome LUTS [2]. If left untreated, BPH leads to a reduction in Qmax and an increase in the risk of AUR, which is a medical emergency [3].

Aging and androgens are the two clearly established determinants for the development of BPH. In addition, race, obesity, metabolic syndrome, family history of BPH and genetic factors probably contribute to higher risk of BPH [4, 5]. The prostate normally undergoes two growth phases during a man's life. The first, in which the prostate doubles in size (rapid growth phase), starts as early as age 10 years and lasts until age 30 years. The second phase of growth begins around the age of 30 years and continues at a slower pace during most of a man's life (slow growth phase) [6]. BPH often occurs during the second growth phase.

Although the transition zone of the prostate (the part of the gland surrounding the urethra as it passes through the prostate) accounts for only 10% of prostate glandular tissue in young men, with aging it undergoes significant glandular proliferation (static component) and increases in smooth muscle tone and resistance (dynamic component), which can further lead to BOO and LUTS [4]. This process begins with the development of stromal nodules in the transition zone. The pathogenesis underlying these changes is still not well understood; however, several processes, such as age-related hormonal changes (androgen-induced increases in dihydrotestosterone levels) and systemic and localised inflammation, cause an increase in the rate of cell proliferation, a decrease in the rate of apoptosis (cell death) or both [7].

BPH represents a significant burden for patients since it leads to deterioration in their QoL. Disability-adjusted life year (DALY) is a term for the equivalent years of healthy life lost because of poor health or disability, with 1 DALY equating to 1 year of healthy life lost. According to the latest World Health Organization estimates for the European region (data from 2016), BPH was responsible for ~751,000 DALYs, accounting for 0.25% of the total DALYs caused by all conditions. By contrast, the proportion of DALYs attributable to prostate cancer and hypertensive heart disease is 0.71% and 0.87%, respectively [8].

[1] This section addresses the following assessment elements: A0002, A0003, A0004, A0005, A0006, A0007, A0011 and A0023.

LUTS/BPH is associated with high personal and societal burdens, both directly through increased medical costs and indirectly through loss of daily functioning and a negative impact on QoL for patients and their partners. A recent Spanish study of 610 patients reported and estimated median annual cost of €1070 per patient, including diagnostic tests and/or monitoring (54.6%), medical visits (20.5%) and treatment (29.6%), highlighting that the overall cost was higher for patients with a higher symptom score (€1127 vs. €920; p<0.001) [9].

Overall, the global lifetime prevalence of BPH is 26.2% (95% confidence interval [CI] 22.8–29.6%) meaning that nearly one in four men will suffer from BPH over their lifetime [10]. Bothersome LUTS occur in up to 30% of men older than 65 years, of whom one-quarter develop severe LUTS over a period of 6 years [11]. The global prevalence of BPH was estimated in a recent meta-analysis that included 30 epidemiological studies from 25 countries [10]. Pooled global prevalence estimates increased with age, from 14.8% in the group aged 40–49 years to 20% in the group aged 50–59 years, 29.1% in the group aged 60–69 years, 36.8% in the group aged 70–79 years and 38.4% in the group aged 80 years and older. However, the level of heterogeneity was high. The authors concluded that some heterogeneity could probably be attributed to methodological differences across the different studies and different definitions of BPH.

Some 30% of men who develop BPH receive treatment for the condition. Decreasing mortality and increasing life expectancy mean that the elderly population is rapidly growing, so the prevalence of BPH and its associated burden are expected to increase.

According to the latest European guidelines [12] and advice received from external clinical experts involved in the assessment, the target population for this REA is adult men (>18 years of age) with LUTS attributed to BPH of non-neurological cause who do not find adequate relief with conservative or medical treatment or find side effects of medical treatment bothersome, and who may benefit from surgical treatment. Three subpopulations often identified in guidelines (prostate size <30 ml, 30–80 ml and >80 ml, or the same intervals for prostate weight measured in grammes) were considered as relevant patient subgroups.

The only available real-life study in Europe, conducted in France in 2013, showed that of 2,620,269 patients who required treatment for LUTS/BPO, 301,834 (11.5%) received surgical treatment over the period from 2004 to 2008 [13]. The average number of surgical procedures related to BPH management performed annually was estimated as approximately 60,000–70,000 [13, 14].

Regarding data outside of Europe, 44,000 men underwent surgical treatment in Korea during the period 2004–2008 [15]. In the USA, 54,399 TURP and 29,457 laser prostatectomy procedures were performed from 2001 to 2009 [16]. In Japan the total number of procedures decreased by 30%, from 20,413 in 2009 to 14,152 in 2014 [17], while in Australia a 39% increase in the rate of total procedures for BPH was reported from 2000 to 2018 (92/100,000 in 2000 and 133/100,000 in 2018) [18].

1.2 Current clinical practice

HTA CORE MODEL DOMAIN: CUR[2]

BPH is typically diagnosed clinically according to the presence of LUTS. Prostatic enlargement can be detected via manual rectal examination or transrectal ultrasonography. According to the latest European guidelines, primary diagnostic evaluation of patients with LUTS involves medical history, symptom score questionnaires (such as IPSS), urinalysis (dipstick and sediment), physical examination and measurement of prostate-specific antigen (PSA) and postvoid residual urine volume (PVR) urine [12]. A high baseline PVR indicates a higher likelihood of symptomatic deterioration over time, while increasing PVR over time may indicate treatment failure or provide indication for surgical intervention [1]. In the case of bothersome symptoms or significant PVR, the assessment should also include frequency volume charts and bladder diaries, together with ultrasound assessment and uroflowmetry. If the symptoms are not significantly bothersome or not impacting the patient's health, no further evaluation is needed [12, 19]. For men with suspected neurological disease or bladder hypocontractility in cases of very small prostate (high PVR even in the absence of BPH) urodynamic examination can be useful to assess whether the functionality of the bladder is preserved. Prostate imaging may also help in choosing the optimal treatment technique for patients.

While BPH alone does not need to be treated, BPH associated with LUTS may require treatment. Conservative treatment (watchful waiting and behavioural and dietary modifications) or medical treatments are usually the first choice of therapy for men with mild or moderate symptoms who are minimally bothered by their symptoms. According to the latest European guideline [12], the choice of treatment depends on the findings from patient evaluations, the ability of the treatment to change these findings, the treatment preferences of the individual patient and expectations to be met in terms of the speed of onset, efficacy, side effects, health-related QoL (HRQoL) and disease progression.

The most common indication for surgical intervention is moderate to severe voiding symptoms attributed to BPH that are refractory to conservative or medical therapy (relative indications for surgery). Surgical treatment is also required when patients have experienced recurrent or refractory urinary retention, overflow incontinence, recurrent UTIs, bladder stones or diverticula, treatment-resistant macroscopic haematuria because of BPH and/or BPE, or dilatation of the upper urinary tract because of BPH, with or without renal insufficiency (absolute indications for surgery).

The choice of surgical technique depends on several factors. These include prostate size, patient comorbidities, ability to undergo anaesthesia, patient preferences, willingness to accept surgery-associated specific side effects, the availability of surgical techniques in a particular centre and the experience of the surgeon with these techniques. The experience and preference of the treating surgeon, as well as the organisational and economic impact of different technologies in different countries, often have an important role in the choice of surgical treatment for BPH. Detailed treatment algorithms (that include the current standard or first choice and the alternative treatments) for bothersome LUTS refractory to conservative or medical treatment or in cases with absolute indications for intervention, stratified by the patient's ability to undergo anaesthesia and their cardiovascular risk and prostate size, are provided in the European Association of Urology guidelines for management of non-neurogenic male LUTS including BPH [12].

[2] This section addresses the following assessment elements: A0024 and A0025.

1.3 Features of the intervention

HTA CORE MODEL DOMAIN: TEC[3]

Most surgical procedures for BPH are performed via the urethra using a cystoscope. The majority of these therapies require hospitalisation. Potential complications of surgical procedures include TUR syndrome (a potentially life-threatening complication of TURP caused by excessive absorption of electrolyte-free irrigation fluids), bleeding, infection, urethral strictures, incontinence and sexual dysfunction. Hence, it is important that the treating surgeon informs the patient about the potential side effects so that an informed decision can be made considering these and the surgeon's preference and experience with the various methods.

According to the treatment principle (i.e., the mechanism of action), treatment strategies can be divided into ablative and nonablative technologies. Ablative therapies consist of treatments in which prostatic tissue is resected (removed) or ablated (destroyed) using a variety of energy sources, such as electrocautery (electrodes with monopolar or bipolar energy), lasers (holmium, thulium, diode, KTP or LBO), convective steam, high-pressure saline and microwaves [20]. There has been a shift from monopolar to bipolar electrodes and to laser treatments in the last couple of decades. The various lasers differ mainly in their absorption properties, penetration depth and wavelength mode (pulsed or continuous). All of the lasers use normal saline instead of distilled water to avoid TUR syndrome [21]. The general properties of the four types of lasers, regardless in which technology they are used, are as follows.

- Holmium (Ho:YAG) lasers have been commercially available since 1994. Ho:YAG is a type of solid-state, pulsed laser that is ideal for endoscopic use because of its fibre optic delivery and ability to treat tissue in a liquid-filled environment (e.g., saline or blood) [22]. The laser has a wavelength of 2140 nm [12, 23].
- Thulium (Tm:YAG) lasers, which have a wavelength between 1940 and 2013 nm, are also solid-state lasers that emit waves in continuous mode. A thulium laser has water and tissue absorption characteristics comparable to those of a holmium laser, but the continuous-wave output allows better tissue vaporisation [23, 24].
- Diode lasers are available with several different wavelengths (940, 980, 1064, 1318 and 1470 nm) [12]. The wavelength depends on the semiconductor used. A diode generates the laser light. Diode lasers can be applied continuously or in pulsed mode and their energy is absorbed by haemoglobin and water. Diode lasers use side-firing techniques to ensure better direct visual control by the surgeon. The tissue ablative property of a diode laser is twice that of a KTP laser, but less than in TURP [25]. Diode laser light can also be conveyed through optical fibres introduced transperineally or perineally into the prostate. The approach using this modification is called interstitial diode laser coagulation.
- A KTP or LBO laser produces light of the same wavelength of 532 nm within the visible green region of the electromagnetic spectrum. The energy is selectively absorbed by haemoglobin within prostatic tissue. The coagulation zone of a KTP laser is more than twice as deep as that of the diode laser owing to its affinity for haemoglobin [25].

In the nonablative therapy options the prostatic tissue is compressed. The various techniques use contrasting mechanisms of action (mechanical decompression vs. angiographic embolisation) to decrease the stress on the urethra [20].

[3] This section addresses the following assessment elements: B0001, B0002, B0004, B0009, and A0020 (Appendix 5).

A) Ablative therapies

1) **Transurethral resection of the prostate.** TURP is considered the gold standard for surgical treatment of BPH. However, TURP is associated with some morbidity and long-term complications, including haematuria, urethral stricture, UTI, incontinence, and ejaculatory and erectile dysfunction. In TURP, prostate tissue is removed from the transition zone of the gland piece by piece and extracted at the end of the procedure using irrigation under general or spinal anaesthesia. TURP procedures require the use of a resectoscope, camera system and irrigation fluid. TURP can be divided into electrosurgical and laser resection subcategories according to the energy used to resect tissue.

   a) *Electrocautery:* For monopolar (M-TURP) or bipolar (B-TURP) TURP, the system consists of a generator unit and a wire loop with an electrical current running through the loop used to cut prostate tissue and cauterise blood vessels.

      - In M-TURP, energy travels through the body to reach a skin pad. The procedure requires the use of sterile water or a sorbitol or glycine solution.
      - In B-TURP, bipolar circuitry is completed locally; the energy travels between an active and a passive pole situated on the resectoscope tip and requires less energy than M-TURP. B-TURP overcomes the limitation of M-TURP by allowing energy transmission in iso-osmolar solution (rather than hypo-osmolar solution), which results in excitation of sodium ions to form plasma and reduces the risk of TUR syndrome. Several device types are available that mostly differ in the way in which the electric current flow is delivered, the passive electrodes (two loops, single loop, resectoscope sheath), the shape of the active electrodes and the specialised electrosurgical generators. Operating frequencies differ between the generator units [12, 20, 23, 26]. The most common bipolar resection systems are the plasmakinetic system (plasmakinetic resection of the prostate [PKRP]), TURiS system (transurethral resection in saline) and the controlled tissue resection system [27].

   b) Laser resection with the so-called cutting lasers:

      - Thulium laser resection (TmLRP) was first reported in 2005. In TmLRP, a wavelength of approximately 2000 nm is emitted in continuous-wave mode, which is a wavelength that matches the water absorption peak in tissue, allowing very precise incision [28].
      - Holmium laser resection (HoLRP) is performed with a modified continuous-flow resectoscope. An end-firing laser fibre is used as a cutting instrument to resect large pieces of prostate. The laser is then used to cut the resected tissue into smaller pieces before their removal. It is suitable for large prostates of up to 100 g. The coagulative ability of the holmium laser effectively seals tissue planes, which makes HoLRP a relatively bloodless operation and hence reduces possible transfusion requirements and avoids the dangers of TUR syndrome [29].

2) **Transurethral enucleation of the prostate.** TUEP involves peeling the enlarged prostate from the prostate capsule without cutting into or dissecting the gland. The transition zone of the prostate is removed along its surgical capsule under general or spinal anaesthesia. The resultant tissue is morcellated (removal of large masses of tissue) using a separate device called a morcellator. In some new-generation systems the morcellator is built into the enucleation device. The energy used for tissue enucleation is generated either via a laser, which is used to destruct prostatic tissue with minimal deep-tissue penetration, or via a bipolar system using different electrodes [21].

a) *Transurethral enucleation with bipolar energy:* TUEB is also called bipolar transurethral enucleation (B-TUEP) or plasmakinetic enucleation (PKEP) or bipolar plasma enucleation (BPEP). This procedure allows enucleation of whole lobes of the prostate [30]. In this technique a plasma electrode and an enucleation loop, designed specifically for transurethral enucleation, are used [31].

b) *Transurethral enucleation with laser:* There are several laser systems available fortransurethral enucleation, all comprising a power unit and laser fibres. The differences, as outlined in the general laser descriptions, lie in the penetration depth, wave mode and absorption properties:

- Holmium laser enucleation of the prostate: In HoLEP the tissue penetration is 0.4 mm [23]. The laser creates bubbles of steam that separate tissue layers by tearing the tissue apart. The tissue effect is rapid and results in excellent haemostasis. HoLEP was an important technical improvement. The entire lobes of the gland are enucleated, moved into the bladder and morcellated [24].
- Thulium laser enucleation of the prostate: In ThuLEP the tissue penetration is 0.2 mm [23].
- Diode laser enucleation of the prostate: The penetration levels with DioLEP are deeper than with Ho:YAG or Tm:YAG lasers [23, 24]. Eraser laser is a type of diode laser and therefore this procedure is also referred to as eraser laser enucleation (ELEP) [32].

3) **Transurethral vaporisation.** TUVP involves removing excess prostate tissue by heating and evaporating it under general or spinal anaesthesia. Laser vaporisation and vaporesection (which is the combination of vaporisation and resection) are more widely used owing to the relatively short learning curve compared to enucleation [33]. The energy can be delivered via various systems. The following subcategories are introduced according to the energy source used.

a) *Transurethral (electro-)vaporisation with bipolar energy:* B-TUVP was introduced in the late 1990s and as it was derived from (plasmakinetic) B-TURP, it is also called bipolar plasma vaporisation of the prostate (BPVP) or transurethral plasma vaporisation. The procedure is performed using a bipolar electrode and a high-frequency generator to create a plasma effect that can vaporise prostatic tissue. Energy can be delivered through a spherical rolling electrode (rollerball), a grooved roller electrode (Vaportrode) or a hemispherical mushroom electrode (button). Saline is typically used for irrigation [23]. Direct tissue contact and heat production are minimised. The bipolar electrode produces a constant plasma field that allows the electrode to glide over the tissue and vaporise a thin layer of the prostate without affecting the underlying tissue. Some sources call this transurethral vaporisation in saline (TUViS) [23, 34]. An indwelling urethral catheter is left in place at the end of the procedure [35].

b) Laser-based systems

- Holmium laser vaporisation: HoVAP/HoLVP was first reported in 1994. A side-firing fibre is moved across the surface of the prostatic lobes to immediately vaporise or ablate prostatic tissue and obtain a prostatic cavity similar to that obtained with traditional TURP [36].
- Thulium laser vaporisation: ThuVAP/ThuLVP is a purely vaporising technique. The beam is fully absorbed by water and therefore there is no need for side-firing delivery, as with Ho:YAG, KTP and LBO lasers [24].

- Diode laser vaporisation: In DioVAP/DioLVP, a large amount of energy is absorbed on the surface, resulting in vaporisation of the tissue [25].
- KTP (GreenLight laser) and LBO (GreenLight High Performance System) lasers for photoselective vaporisation (PVP): KTP and LBO energies are selectively absorbed by haemoglobin within prostatic tissue, which facilitates photoselective vaporisation and removal of prostatic tissue via rapid photothermal vaporisation of heated intracellular water. The penetration depth is 0.8 mm because of the shorter wavelength and absorption by haemoglobin, and the resulting coagulation zone is 1–2 mm. The procedure is usually performed with saline irrigation to prevent TUR syndrome. During the procedure, the prostate adenoma is vaporised sequentially outwards until the surgical capsule is exposed and a defect is created within the prostate parenchyma through which voiding becomes possible [23]. The GreenLight system was introduced in 2005 with power output of 80 W. This was upgraded to 120 W in 2010, after which a second upgrade resulted in the current GreenLight XPS with power output of 180 W. The 180-W GreenLight XPS system represents the current standard of generators for PVP [12]. The procedure can be performed either as day-case or inpatient treatment and is appropriate for vaporisation of larger prostates in a shorter time and for patients taking anticoagulants [37].

There are hybrid techniques that combine the three basic resection, enucleation and vaporisation approaches. The hybrid techniques most commonly performed are as follows.

4) **Vapoenucleation**

a) *Bipolar vapoenucleation of the prostate:* In B-VEP, the vapoenucleation electrode for mechanical anatomical enucleation of the prostate is a combination of a vaporisation electrode and a mechanical dissection probe [38].

b) *Thulium laser vapoenucleation:* ThuVEP was introduced in 2008 for patients with larger prostates [24].

c) *Photoselective vapoenucleation:* PVEP starts with initial vaporisation of the anterior zone of the prostate to simplify the subsequent enucleation procedure. The PVEP technique involves a gradual learning path. As a start, localising the capsule for anatomic vaporisation can be achieved, followed by performing partial enucleations; then, when the necessary skills are developed, the whole en bloc enucleation procedure can be performed [39].

5) **Vaporesection**

a) *Transurethral (electro-)vaporesection:* TUVRP with bipolar energy combines resection with the help of electric current and vaporisation with a vaporisation electrode. The term plasmakinetic vaporesection (PKVP) is often used as a synonym as it is a type of TUVRP in which a plasmakinetic system serves as the resection device [40]. With advances in bipolar technology, the popularity of TUVRP has increased and new developments have arisen, such as transurethral resection in saline with plasma vaporisation (TURiS-PVP). The plasma vaporisation electrode vaporises the tissue in a similar way to a laser, but without developing excessive heat. TURiS-PVP is performed with an Olympus SurgMaster UES-40 bipolar generator, a special ‘mushroom’ type or plasma button vaporesection electrode with continuous-flow saline irrigation. The spherical shape of the electrode with a plasma corona on its surface is gradually moved into direct contact with the tissue (the ‘hovering’ technique) and thus yields virtually bloodless vaporisation at 280–320 W [41].

b) *Holmium laser vaporesection:* HoVARP utilises both vaporisation and laser resection techniques. This is a new application of the holmium laser and the procedure does not require the use of a morcellator [42].

c) *Thulium laser vaporesection:* ThuVARP is a laser procedure that vaporises and resects the prostate using a technique similar to TURP. ThuVARP uses a Tm:YAG fibre to deliver light of 2000 nm in wavelength to vaporise and resect the prostate. Unlike other laser technologies, ThuVARP uses a surgical technique similar to TURP, involving visual resection of prostatic tissue using a working element and resecting in so-called chips. The similarity in technique to TURP allows a short learning curve for surgeons [43]. Although Tm:YAG is similar to Ho:YAG regarding its shallow tissue and water penetration and haemostasis, the vaporisation capacity is significantly increased by the continuous wave-emitting mode. Therefore, tissue ablation is achieved not only via resection but also via simultaneous vaporisation [24].

d) *Diode laser vaporesection* is a recent development in diode laser applications. Procedures executed with diode lasers use side-firing techniques to ensure better direct visual control by the surgeon of the point of impact of the laser beam on the tissue [24].

6) **Enucleoresection**

a) *Monopolar transurethral enucleoresection:* M-TUERP is a hybrid procedure combining enucleation and resection applied to larger prostates [44].

b) *Bipolar transurethral enucleoresection:* in B-TUERP (or bipolar PKEP) the prostate is transurethrally enucleated and resected using a bipolar plasmakinetic resectoscope [45]. In this procedure the wire loop of the electrode is used to locate the layers and coagulate bleeding. Once the right layers have been located, the prostate lobes are peeled off as a whole piece. The lobes are then pushed into the bladder, where they are cut and eventually removed; therefore, this method combines enucleation and resection [46].

7) **Aquablation:** Aquablation, also called transurethral waterjet ablation, uses a specialised system that combines image guidance (transrectal ultrasound) and a robotic handpiece for targeted heat-free removal of prostate tissue. The procedure is usually performed with the patient under general or spinal anaesthesia. The device consists of a robotic handpiece, a console and a planning unit. The robotic handpiece with an integrated cystoscope and ablation probe is inserted transurethrally into the bladder. Transrectal ultrasound is used before surgery to map the region that needs to be resected, as well as during the treatment to monitor the tissue resection in real time. After mapping, a high-speed jet of saline (waterjet) is delivered from the robotic handpiece to the prostate at various flow rates according to the depth of penetration required. The prostate is ablated, while major blood vessels and prostatic capsule are spared. The ablated tissue is aspirated through ports in the handpiece and can be used for histological analysis. Haemostasis can be achieved via cautery or by inflating a Foley balloon catheter inside the prostatic cavity. The average resection time is typically approximately 3–5 min. After the procedure, electrocautery via a cystoscope or resectoscope or traction from a three-way catheter balloon is used to achieve haemostasis, and continuous bladder irrigation is then started. Traction is removed a few hours after the procedure and irrigation is progressively decreased. The catheter is removed before the patient is discharged from hospital, usually the day after the procedure. The procedure is heat-free, which removes the risk of complications arising from thermal injury [20, 23, 47].

8) **Water vapour thermal therapy:** WAVE involves transurethral thermal therapy using convective water-vapour energy to destroy excess prostate tissue to achieve LUTS symptom relief. Radiofrequency current is used to generate wet thermal energy in the form of steam

[48, 49]. This method should not to be confused with vaporisation of the prostate, in which (as described earlier) prostate tissue is heated and hence evaporates; in WAVE the water vapour is injected into the prostate through a device attached to a urological endoscope. This device is only for single use. The process is intended to disrupt cell membranes, leading to cell death and shrinkage of the prostate. The aim is to relieve obstructive symptoms without interfering with surrounding tissues that might impair sexual function. The vapour is injected for 9 s during treatment. The number of times this has to be performed in each lobe of the gland depends on the length of the prostatic urethra. The treatment can be customised to the configuration of the gland. Each device can deliver a maximum of 15 full injections, although fewer injections are needed for most treatments. The procedure is usually carried out under general anaesthesia or local anaesthesia with sedation, and lasts for up to 20 min [50]. WAVE is performed in the office or at an outpatient surgical centre with minimal anaesthesia [51]. There is currently just one device, called the Rezūm System, available on the market, which received US Food and Drug Administration approval in 2015 [52]. Rezūm is intended for treatment of prostates of >30 cm^3 in volume (equivalent to 30 g) and is contraindicated for patients with a urinary sphincter implant or a penile prosthesis [50].

9) **Simple prostatectomy:** This involves surgical removal of the inner core of the prostate gland. Various techniques can be used for prostate removal, including OP and laparoscopic robot-assisted prostatectomy. Open surgery can use a suprapubic or retropubic approach. Laparoscopic prostatectomy is performed with the patient under general anaesthesia, using either a transperitoneal or an extraperitoneal approach with or without robotic assistance. Incisions are made in the lower abdomen to provide access for the laparoscope and surgical instruments. A transverse incision is made in the anterior wall of the prostate capsule. If a transvesical approach is used, an incision is made in the bladder neck to expose the prostate. The glandular tissue of the prostate is freed from the prostate capsule and removed through an umbilical-port incision. A catheter is inserted and the prostate capsule is closed with sutures [53].

10) **Transurethral microwave therapy:** In TUMT a specialised urethral catheter with an antenna that emits electromagnetic waves at a frequency of 915–1296 MHz is used to induce changes with localised heat. With this technique, prostate tissue can be locally thermoablated while normal temperatures in the surrounding tissue can be maintained [20]. TUMT is generally performed on an outpatient basis. Cooling fluid is circulated around the microwave antenna to prevent heat from damaging the urethra. To prevent the temperature outside the prostate from getting too high, a temperature sensor is inserted into the rectum during the procedure. If the temperature in the rectum increases too much, the treatment is turned off automatically until the temperature goes back down. General or spinal anaesthetic is needed during the procedure. A catheter is placed in the bladder after the procedure to help with urination [54].

B) Nonablative techniques

1) **Prostatic urethral lift:** In PUL, small permanent implants in the form of sutures are placed transurethrally through a cystoscope via a hand-held device. The implants mechanically open the urethra and relieve obstruction. PUL is performed using the Urolift device, which was developed in 2004 [20, 23]. The PUL implants consist of a nitinol capsular tab, a polyethylene terephthalate monofilament and a stainless steel urethral endpiece [55]. PUL can be performed under local anaesthesia with oral or intravenous sedation. PUL is indicated for the treatment of symptoms due to urinary outflow obstruction secondary to BPH, including lateral- and median-lobe hyperplasia, in men aged 45 years or older. The upper limit for prostate size for PUL is 100 cm^3 [56].

2) **Prostate artery embolisation:** PAE is an emerging technology according to the latest guidelines [12, 20, 23]. This procedure is usually carried out under local anaesthesia, with access through the left or right femoral or radial artery. The arterial anatomy is displayed via digital subtraction angiography and the appropriate prostatic arterial supply is selectively embolised. Superselective catheterisation of the small prostatic arteries is performed using fine microcatheters through the pelvic arteries. Embolisation involves the introduction of microparticles to completely block the prostatic vessels. Embolisation agents include PVA and other newer synthetic biocompatible materials. The aim of the procedure is to reduce the blood flow in the prostate, causing it to undergo ischaemic necrosis and subsequent volume reduction, which relieves LUTS. PAE targets the whole prostate, and not just the critical areas, like the other technologies [12, 20]. It is common for patients to experience pelvic pain during and after the procedure but this does not usually last for more than 1–3 days. PAE is a technically demanding procedure and must be performed by an interventional radiologist with specific training. The procedure is usually carried out as a day surgery [57].
3) **Temporary implantable nitinol device:** The aim of TIND is to relieve the symptoms of BPH by creating new channels in the urethra to increase urine flow. The device is made of nitinol and consists of struts and an anchoring leaflet. Under local anaesthesia or light sedation, the device is placed in the prostatic urethra via a cystoscope under direct visualisation. The device expands in the prostatic urethra and hence compresses obstructive tissue. Over the following days, the pressure applied by struts in the device creates areas of ischaemia in the prostatic urethra and bladder neck. This creates new longitudinal channels through which urine can flow. TIND is left in position for 5 days, until the nitinol wires reach their complete expansion. After 5–7 days the device is removed in an outpatient procedure via a standard urethroscope. Insertion and removal of the device are both conducted as day-case procedures and take approximately 5 min [12, 58]. A second-generation implant was recently introduced; the iTIND comprises three nitinol elongated struts and an anchoring leaflet [59].
4) **Transurethral incision of the prostate:** TUIP involves cutting into the bladder outlet without tissue removal. Incising the bladder neck may reduce the pressure of the gland on the urethra, making urination easier. This procedure is an option for some men, such as those with smaller prostates. Usually, two deep incisions that go down to the capsule of the prostate are made. Bleeding is controlled with electrocautery [20].

TURP has remained the cornerstone of LUTS/BPO surgical treatment despite the development of the new minimally invasive surgical treatments (MISTs) described above and alternative surgical treatments. They are considered minimally invasive because they can be performed either in an office or outpatient setting with minimal recovery time and morbidity for the patient. Despite its high rate of success, TURP has a perioperative morbidity rate of approximately 20% and long-term complications including ejaculatory dysfunction (65%), erectile dysfunction (10%), urethral strictures (7%), UTI (4%), urinary incontinence (2%), and bleeding requiring transfusion (2%) [60]. MISTs may have lower effectiveness than TURP but a better safety profile, so the trade-off between effectiveness and complications might be important in some cases, as some patients might opt for lower effectiveness to avoid adverse effects.

Table 1-1: Synonyms, abbreviations, full name, energy sources and the name used in this assessment for technologies used for the treatment of benign prostatic hyperplasia

Abbreviation	Full name	Category and abbreviation applied in the report	Energy source
Resection			
M-TURP	Monopolar transurethral resection	TURP	Monopolar
B-TURP	Bipolar transurethral resection	TURP	Bipolar
PKRP	Plasmakinetic resection	TURP	Bipolar
TURiS	Transurethral resection in saline	TURP	Bipolar
TmLRP	Thulium laser resection	TmLRP	Thulium laser
HoLRP	Holmium laser resection	HoLRP	Holmium laser
Enucleation			
HoLEP	Holmium laser enucleation	HoLEP	Holmium laser
ThuLEP	Thulium laser enucleation	ThuLEP	Thulium laser
DioLEP	Diode laser enucleation	DioLEP	Diode laser
ELEP	Eraser laser enucleation	DioLEP	Diode laser
B-TUEP	Bipolar transurethral enucleation	B-TUEP	Bipolar
B-PEP	Bipolar plasma enucleation	B-TUEP	Bipolar
BEEP	Bipolar endoscopic enucleation	B-TUEP	Bipolar
PKEP	Plasmakinetic enucleation	B-TUEP	Bipolar
TUEB	Transurethral enucleation with bipolar energy	B-TUEP	Bipolar
Vaporisation			
HoVAP	Holmium laser vaporisation	HoVAP	Holmium laser
ThuVAP	Thulium laser vaporisation	ThuVAP	Thulium laser
DioVAP	Diode laser vaporisation	DioLVP	Diode laser
B-TUVP	Bipolar transurethral vaporisation	B-TUVP	Bipolar
BPVP	Bipolar plasma vaporisation	B-TUVP	Bipolar
PKVP	Plasmakinetic vaporisation	B-TUVP	Bipolar
TUViS	Transurethral vaporisation in saline	B-TUVP	Bipolar
PVP	Photoselective vaporisation/potassium titanyl phosphate laser vaporisation	PVP	GreenLight laser
Enucleoresection			
M-TUERP	Monopolar transurethral enucleoresection	M-TUERP	Monopolar
B-TUERP	Bipolar transurethral enucleoresection	B-TUERP	Bipolar
B-ERP	Bipolar enucleoresection	B-TUERP	Bipolar
PKERP	Plasmakinetic enucleoresection	B-TUERP	Bipolar
Enucleovaporisation/vapoenucleation			
ThuVEP	Thulium laser vapoenucleation	ThuVEP	Thulium laser
PVEP	Photoselective vapoenucleation	PVEP	GreenLight laser
B-VEP	Bipolar vapoenucleation	B-VEP	Bipolar
B-PKVEP	Bipolar plasmakinetic vapoenucleation	B-VEP	Bipolar

Abbreviation	Full name	Category and abbreviation applied in the report	Energy source
Vaporesection			
TURiS-PVP	Transurethral resection in saline plasma vaporisation	TUVRP	Bipolar
TUVRP	Transurethral vaporesection	TUVRP	Bipolar
PKVP	Plasmakinetic vaporesection	TUVRP	Bipolar
ThuVARP	Thulium laser vaporesection	ThuVARP	Thulium laser
Incision			
TUIP	Transurethral incision	TUIP	-
Other			
Aquablation	Aquablation	-	Waterjet
PAE	Prostate artery embolisation	PAE	-
WAVE	Water vapour thermal therapy	WAVE	Water vapour
TUMT	Transurethral microwave therapy	TUMT	Electromagnetic waves
TIND	Temporary implantable nitinol device	TIND	-
PUL	Prostatic urethral lift	PUL	-
OP	Open prostatectomy	OP	-

Appendix 4 in the appendix presents a non-exhaustive list of products for the included technologies, their intended use and their regulatory status.

2 OBJECTIVES AND SCOPE

The rationale for this multitechnology assessment was to collaboratively produce structured (rapid) core HTA information on MISTs for BPH. In particular, the aim was to perform multiple comparisons between different interventions, either comparing minimally invasive treatments to each other or to a standard surgical treatment such as TURP or OP. An additional aim was to apply this collaboratively produced assessment in the national and/or regional context.

The aim of this rapid assessment is to provide comparisons among different MISTs for BPH to assess their relative effectiveness and safety for patients with an indication for surgical treatment and for different subpopulations according to prostate size.

This topic was chosen on the basis of a request from local decision-makers who commissioned the agency to carry out a HTA to assess the relative effectiveness and safety of MISTs compared to available alternatives. A specific interest was expressed for technologies included or recommended in guidelines from the European Association of Urology [12] and the American Urological Association [61]. In addition, the EUnetHTA Prioritisation List for Other Technologies contains other innovative interventions, such as water vaporisation and PAE, which are also proposed for the treatment of BPH. The topic was relevant to other partnering agencies that joined in a collaborative Assessment Team and decided to extend the scope for multiple technologies intended for BPH treatment.

The relevance of the topic lies in the fact that new technologies are intensely marketed in both public and private institutions but have not yet been widely introduced in the public sector and could have relevant organisational and economic impacts on services for patients needing surgery for BPH.

The project scope was discussed during the scoping e-meeting attended by the Assessment Team and external experts. During the meeting, it was agreed to adopt the GRADE approach to finalise the list of outcomes and rate the importance of each outcome (see Section 3).

Table 2-1: Scope of the assessment

Description	Project scope
Population	• The target condition is lower urinary tract symptoms (LUTS) attributed to non-neurological benign prostatic hyperplasia (BPH) (ICD-9 600.0; ICD-10 N40; MeSH term “Prostatic Hyperplasia”) • The target population is adult men (>18 years of age) with LUTS attributed to BPH of non-neurological cause. • Either prostate weight or size will be used to define three relevant subpopulations often identified in guidelines (prostate size <30 ml, 30–80 ml and >80 ml, or the same intervals measured as prostate weight in grammes) which will be addressed by subgroup analyses. *Rationale*: According to the American Urological Association guidelines [61], men with clinically significant LUTS attributable to BPH who do not find adequate relief with medical treatment or find the side effects of medical treatment bothersome may benefit from surgical treatment. Surgical treatment should be chosen for patients who: - Did not improve after medical therapy; - Do not want medical therapy but request active treatment (patient preference); or - Present with a strong indication for therapy (refractory urinary retention, renal insufficiency due to BPH, bladder stones, recurrent urinary tract infection, recurrent haematuria refractory to 5α-reductase-inhibitors).

Description	Project scope	
Interventions[a]	• Resection: bipolar (plasmakinetic), holmium laser, thulium laser • Enucleation: bipolar (plasmakinetic), holmium laser, thulium laser, diode laser • Vaporisation: bipolar (plasmakinetic, electrovaporisation), holmium laser, thulium laser, diode laser, KTP laser (photoselective vaporisation with 180 W) • Enucleoresection • Enucleovaporisation/vapoenucleation • Vaporesection • Aquablation • Photoselective vaporisation with enucleation • Prostate artery embolisation (PAE) • Prostatic urethral lift (PUL) • Transurethral incision (TUIP) • Transurethral microwave therapy (TUMT) • Water vapour therapy (WAVE) • Temporary implantable nitinol device (TIND)	
Comparisons (standards) [a]	• Transurethral resection of the prostate (TURP. monopolar or bipolar) • Open prostatectomy or adenomectomy (OP)	
Outcomes	**Effectiveness**	
		Importance rating
	IPSS	9 (6–9), critical
	Qmax	8.5 (2–9), critical
	PVR	8 (2–9), critical
	Reintervention	7.5 (6–9), critical
	BPH Impact Index	7 (1–9), critical
	Quality of life measures (generic)	6.5 (2–9), critical
	Qmed	4.5 (1–8), important
	Persistent irritative symptoms	6.5 (1–9), critical
	Postoperative LUTS	5.5 (1–9), important
	Safety	
	Intraoperative complications	**Importance rating**
	Procedural blood loss and transfusion requirement	7 (5–9), critical
	Bladder perforation	7 (4–9), critical
	Bladder or ureteral injury	6 (4–9), important
	Capsular perforation	6 (5–9), important
	Intraoperative mortality	6 (3–9), important
	Decrease in serum sodium	4 (2–7), important
	Haemoglobin alteration	3 (2–8), not important
	Intraoperative complications (technology-specific)	**Importance rating**
	Bowel injury (OP)	7 (2–8), critical
	Rectal injury (OP)	7 (2–8), critical
	Injury to adjacent structures (OP)	6.5 (2–8), important

Description	Project scope	
	Inadvertent embolisation of other sites (PAE)	6 (2–8), important
	Vascular thrombosis (PAE)	6 (2–9), important
	Incisional hernia (OP)	6 (2–9), important
	Pseudoaneurysms (PAE)	5 (2–7), important
	Dissection	5 (2–9), important
	Damage to perivascular, neural or muscular structures (PAE)	5 (2–8), important
	Vesicocutaneous fistula (OP)	5 (2–8), important
	Epididymo-orchitis (OP)	4.5 (2–8), important
	Haematomas (PAE)	4 (2–6), important
	Vascular access (PAE)	3 (2–6), not important
	Postoperative complications	**Importance rating**
	Erectile dysfunction	8.5 (7–9), critical
	Urinary incontinence	8 (7–9), critical
	Catheterisation time	7 (1–9), critical
	TUR syndrome	7 (5–9), critical
	Urethral stricture	7 (4–9), critical
	Bladder neck contracture	7 (5–9), critical
	Acute urinary retention	7 (5–9), critical
	Urinary tract infection	7 (3–9), critical
	Retrograde ejaculation	7 (5–9), critical
	Recatheterisation	6.5 (3–9), important
	Long-term mortality	3.5 (1–9), not important
	Postoperative complications (technology-specific)	**Importance rating**
	Implant encrustation (PUL)	6 (2–7), important
	Migration rate of the implant (PUL)	6 (2–8), important
	Radiodermatitis (PAE)	4 (2–6), important
	Other outcomes	**Importance rating**
	Hospitalisation time	8 (5–9), critical
	Procedure time	6 (3–9), important
Study design	Randomised controlled trials	

[a] The aim was to perform multiple comparisons and therefore the distinction between interventions and comparisons is merely indicative.

3 METHODS

The EUnetHTA Guidelines, available at https://eunethta.eu/methodology-guidelines/, were consulted throughout the assessment process. To provide transparency regarding the development of the scope questions, the Assessment Team agreed to form a panel and to apply the GRADE method (https://gdt.gradepro.org/app/handbook/handbook.html) during the scoping phase to structure the process for the selection of outcomes and the rating of their importance. This process was developed as follows:

- An initial draft of the project plan, developed and agreed on by the authors and the co-authors, was circulated to dedicated reviewers and external experts.
- A scoping e-meeting was arranged with the Assessment Team and external experts to discuss the project plan and to agree on a preliminary list of outcomes of interest. During the scoping meeting it was also agreed to use GRADE and GRADEpro (an electronic tool that facilitates participation by panel members in the process; https://gradepro.org/) to conduct and finalise the scoping phase. For this purpose, a GRADE panel was established, comprising authors, co-authors, dedicated reviewers and external experts (organisations and not single individuals counted as panel members). Participation by patient representatives was actively sought, but without success.
- The research question (target population, intervention and comparator) and the list of outcomes were uploaded by the authors on GRADEpro and all members were registered for participation.
- Each member received an e-mail with access details for the GRADEpro system to check and approve the research question and the list of outcomes.
- Following approval by the panel, each member received an e-mail with an invitation to rate the importance of each of the listed outcomes using a predefined scale. The scale provided a choice between three categories of outcomes according to their importance for decision-making: “critical” (score between 7 and 9); “important” (score between 4 and 6); and “not important” (score between 1 and 3).
- Using the scores applied by all panel members, the median scores were calculated by the authors and a final overall rating of importance was assigned to each outcome. If median values could not be an integer, the mean was considered.

In the PICO table, ratings of importance are reported for each outcome. Summary-of-findings tables were completed only for outcomes rated as critical.

3.1 Clinical effectiveness and safety

3.1.1 Information retrieval

We included RCTs that compared the technologies of interest (see the PICO table) to each other and/or to comparators (TURP and/or OP). RCTs comparing each of the technologies of interest versus sham procedures were considered only if head-to-head comparative RCTs were not found for those technologies.

A systematic review of the literature was performed according to the Cochrane Handbook methodology (2019 version). The RevMan 5 tool for systematic reviews was also used for data extraction, RoB representation and summary-of-findings tables. As one high-quality systematic review was published in November 2019 [21] the systematic search was performed with January 2019 as

the starting date for technologies included in that review (HoLEP, ThuLEP, DioLEP, B-TUEP, DioLVP, M-TURP, B-TURP, B-TUVP and PVP). For all the other technologies, no time limits were considered.

The following sources of information and search techniques were considered.

Main information sources

- Bibliographic databases
  - MEDLINE
  - Embase
  - Cochrane Central Register of Controlled Trials

Further information sources and search techniques

A search of international guidelines, systematic and narrative reviews was performed in UpToDate to fulfil information required for the CUR domain (health problem and current use). Publicly available information on the technologies identified as relevant for the assessment was used for the TEC domain (description and technical characteristics) for the technologies being assessed.

3.1.2 Selection of relevant studies and documents

Assessment elements were selected in accordance with the HTA Core Model for Rapid Relative Effectiveness Assessment Version 4.2. EndNote was used for citation management. Details for the search strategy are available in Appendix 1.

RCTs were checked for inclusion for the assessment of clinical effectiveness and safety. All RCTs included in the systematic review published in 2019 were retrieved and assessed for inclusion.

3.1.3 Data extraction

Five review authors (LB, OD, JE, GF and AP) independently extracted data using a data extraction form developed for this review (Appendix 4). For each study included, we recorded the following information: study design, length of follow-up, number of participants in the intervention and control groups, average age, sex, country, inclusion and exclusion criteria, data collection period, number of participants, description of the intervention and control, and outcomes. Data available from figures were extracted using PlotDigitizer version 2.6.9 for Windows. When values for the standard deviation or mean and standard deviation were missing, they were calculated according to the Cochrane recommendations [62], which were also used when combining data from two arms of the same study dealing with the same technology. When the median and range were available, mean and standard deviation values were calculated according to McGrath et al. [63]. Arms related to the same technology in the same multiarm study were combined according to the Cochrane recommendations [62]. Disagreements were discussed and resolved between reviewers.

The clinical relevance of results observed can be better discussed if MCID values are available and validated. MCIDs could be found only for IPSS (Barry et al. [64] reported an MCID of 3 points) and Qmax (the UK National Institute for Health and Care Excellence [11] reported an MCID of 2 ml/s). These MICDs are referred to when discussing the relevance of the IPSS and Qmax outcomes.

Some of the outcomes listed in the scope could overlap or need to be specifically defined. The working group agreed on the following specifications.

- Persistent irritative symptoms should include everything that refers to these symptoms, including early irritative symptoms. Dysuria was included among irritative symptoms. Whenever “urge incontinence” or “urgency” (or “micturition urgency”) was reported, these were classified as a “persistent irritative symptom”. Data for “mixed incontinence” were reported for both the persistent irritative symptoms and urinary incontinence outcomes.
- Urinary incontinence refers to symptoms specified simply as “urinary incontinence” or “stress incontinence” or “transient incontinence”. Data for “mixed incontinence” were reported for both the persistent irritative symptoms and urinary incontinence outcomes.
- For operative versus enucleation/vaporisation/resection time, only the overall operative time was considered.
- For blood loss during the procedure and the transfusion requirement, only data on blood loss leading to transfusion (discrete data) were considered.
- Erectile dysfunction was considered both as a discrete outcome and when measured using the International Index of Erectile Function (IIEF) questionnaire.
- For bladder neck contracture, data on infravesical obstruction, bladder neck stenosis and bladder neck sclerosis were aggregated under this outcome.
- For retrograde ejaculation, data on anejaculation were also considered under this outcome, since these are strictly related from a clinical perspective. Regarding the denominator for this outcome, either all patients or just sexually active patients were considered.

3.1.4 Quality rating and RoB assessment

For the TEC and CUR domains, no quality assessment tool was used, but multiple sources were used to validate and cross-check individual sources.

For the EFF (clinical effectiveness) and SAF (safety) domains, study quality for the RCTs included was rated using the Cochrane RoB tool [65].

Five review authors (LB, OD, JE, GF and AP) independently assessed RoB in the studies using the aforementioned methodology according to the following seven criteria:

- Random sequence generation, which influences the likelihood that allocation to treatments is randomised.
- Allocation concealment, which influences the unpredictability of treatment allocation and the possibility that selection bias occurs.
- Performance bias, which may influence surgery and approaches to patient care during follow-up. It should be noted that all the trials selected had an open-label design. Blinding of surgeons was not possible given the interventions being assessed. Patients and the clinicians in charge (not the surgeon) may have been blinded or not; in the latter case, they may have been somewhat “influenced” in the postoperative period by knowing the surgery technique.
- Detection bias, which is related to blinding of outcome assessors. A distinction has been made between subjective outcomes (those self-assessed by patients) and objective outcomes (assessed by external assessors). In the case of a difference in blinding between patients and assessors (e.g., if just patients or just assessors were blinded), detection bias was considered separately for subjective and objective outcomes.

- Incomplete outcome data, leading to attrition bias. Besides situations for which no attrition was declared and apparent, we considered studies to be at low risk of attrition bias when loss to follow-up was <5% and at high risk to attrition bias if the loss was ≥20% (overall or in any group) [66] or if there was a difference of >15% in attrition between groups.
- Selective outcome reporting. Study protocols and trial registries were searched to assess whether data were reported for all of the prespecified primary outcomes and whether they were reported in the prespecified way. Unclear risk was assigned for cases for which a protocol or trial registry was not available. High risk was assigned in the case of a difference between reported outcomes and the protocol/registry or methods section, or if at least two outcomes had incomplete data (e.g., data shown as a figure and without statistical comparison between groups).
- In cases for which other possible sources of bias were deemed important (e.g., presence of conflicts of interest), these were recorded.

RCTs were judged at high RoB if there was at least one high-risk item among these categories (except for conflicts of interest); at low RoB if there were at least four low-risk items (except for conflicts of interest) and no high-risk items; and at uncertain RoB in all other cases.

3.1.5 Data analyses and synthesis

Measures of the treatment effect

For meta-analysis, we used the risk ratio (RR) with 95% CI for binary outcomes and the MD with 95% CI for continuous outcomes.

Data synthesis

Whenever possible, quantitative analysis methods were used in a meta-analysis for the SAF and EFF domains using RevMan 5.3. We pooled data using a fixed-effects model, or a random-effects model only when pooling data from more than five RCTs (to better control for heterogeneity). We avoided pooling of data when two studies showed results in different directions. We also avoided pooling of data for hospitalisation time, catheterisation time and procedure time, considering the possibility of high heterogeneity due to different policies in different centres.

We expressed dichotomous outcomes as the RR with 95% CI and we used the MD and 95% CI when outcomes were continuous. When urological symptom scores different from the IPSS were used, data were combined using the standardised mean difference (SMD).

A descriptive analysis of information is provided for other domains and whenever meta-analysis was not possible or was inappropriate. In some instances (i.e., in the case of wide statistical heterogeneity), even though pooled estimates could not be calculated, forest plots are presented to provide a visual representation of results from each study.

Assessment of heterogeneity

Heterogeneity was evaluated through visual inspection of forest plots (evaluating the amount of overlap of CIs) and through the I^2 statistic. According to the I^2 statistic, heterogeneity was judged as follows [67]:

- 0% to 40%: might not be important;
- 30% to 60%: may represent moderate heterogeneity;
- 50% to 90%: may represent substantial heterogeneity; and
- 75% to 100%: considerable heterogeneity.

These results were interpreted carefully, with consideration of the number of studies involved and their characteristics.

Sensitivity and subgroup analyses

To explore heterogeneity, in particular when statistical significance could be affected, we performed sensitivity analyses excluding studies considering their RoB and baseline characteristics (in terms of prostate size and age). Subgroup analyses were also performed if sufficient studies were available with subgroup data by patient age and prostate size.

Unit of analysis issues

Patients were the unit of analysis. When composite outcomes (e.g., irritative symptoms) were assessed, the number of events was counted instead.

Dealing with missing data

Given the high number of studies available, we did not contact principal investigators to retrieve possible unreported data.

We used only the number of patients with follow-up available as the denominator [68, 69].When no loss to follow-up was specified, we used baseline denominators.

We evaluated methodological and statistical heterogeneity of included studies by considering their RoB, characteristics of study populations, by examining forest plots of their results and the I^2 statistic to assess inconsistency between studies.

Deviations from project plan

The heterogeneity of the study populations, which often encompassed wide and different ranges for prostate size, precluded subgroup analyses for the specific subpopulations initially considered according to prostate size (<30 ml, 30–80 ml and >80 ml, or <30 g, 30–80 g and >80 g) and network meta-analyses, as the transitivity assumption would have been violated. A prerequisite for network meta-analysis is that the transitivity assumption is warranted: all studies should be similar on average for all important effect modifiers. Analysis of baseline characteristics revealed quite wide heterogeneity, in particular regarding age and prostate size. However, visualisation of networks of parallel comparisons is provided for relevant functional and safety outcomes, together with information on the statistical significance, clinical relevance (for IPSS and Qmax) and the quality of the evidence.

3.1.5.1 Certainty of the evidence (if applicable)

The level of confidence/certainty in the body of evidence was assessed using the GRADE approach [70]. Judgements were based on study limitations (RoB), inconsistency of results, imprecision, indirectness of evidence and publication bias. Indirectness was considered in cases with pooling of heterogeneous RCTs in terms of prostate size. Outcomes assessed through single small RCTs were downgraded by two levels for imprecision. In addition, imprecision associated with rare events led to downgrading by two levels. The quality of the evidence was eventually assessed according to one of four grades (high, moderate, low and very low) as described in Table 3-1.

Table 3-1: Definition of the quality of the evidence

Quality	Definition
High	“We are very confident that the true effect lies close to that of the estimate of the effect”
Moderate	“We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different”
Low	“Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect”
Very low	“We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect”

3.1.6 Patient involvement

Participation by patient organisations/patient representatives was actively sought. An Open Call for Patient Input was published on the EUnetHTA website and was open for 1 month with a time extension of 2 weeks. Selected patient organisations were contacted via e-mail to inform them about the open call. However, the efforts made were unsuccessful and there was no response to the open call from any of the patient organisations contacted or from any individual patients.

3.1.7 External expert involvement

To guarantee quality assurance throughout the whole assessment process, external experts in the field of urology and radiology were involved in reviewing the project plan and the assessment draft. The external experts also participated in the scoping e-meeting and in rating the importance of outcomes using the GRADEpro software. They were also consulted during the assessment process if questions arose.

4 RESULTS: CLINICAL EFFECTIVENESS AND SAFETY

4.1 Information retrieval

Figure 4-1 shows the result of the information retrieval process for the main and further information sources according to the predefined inclusion criteria. References for the documents that were excluded after full-text checking are presented in Appendix 2 with the reason for exclusion.

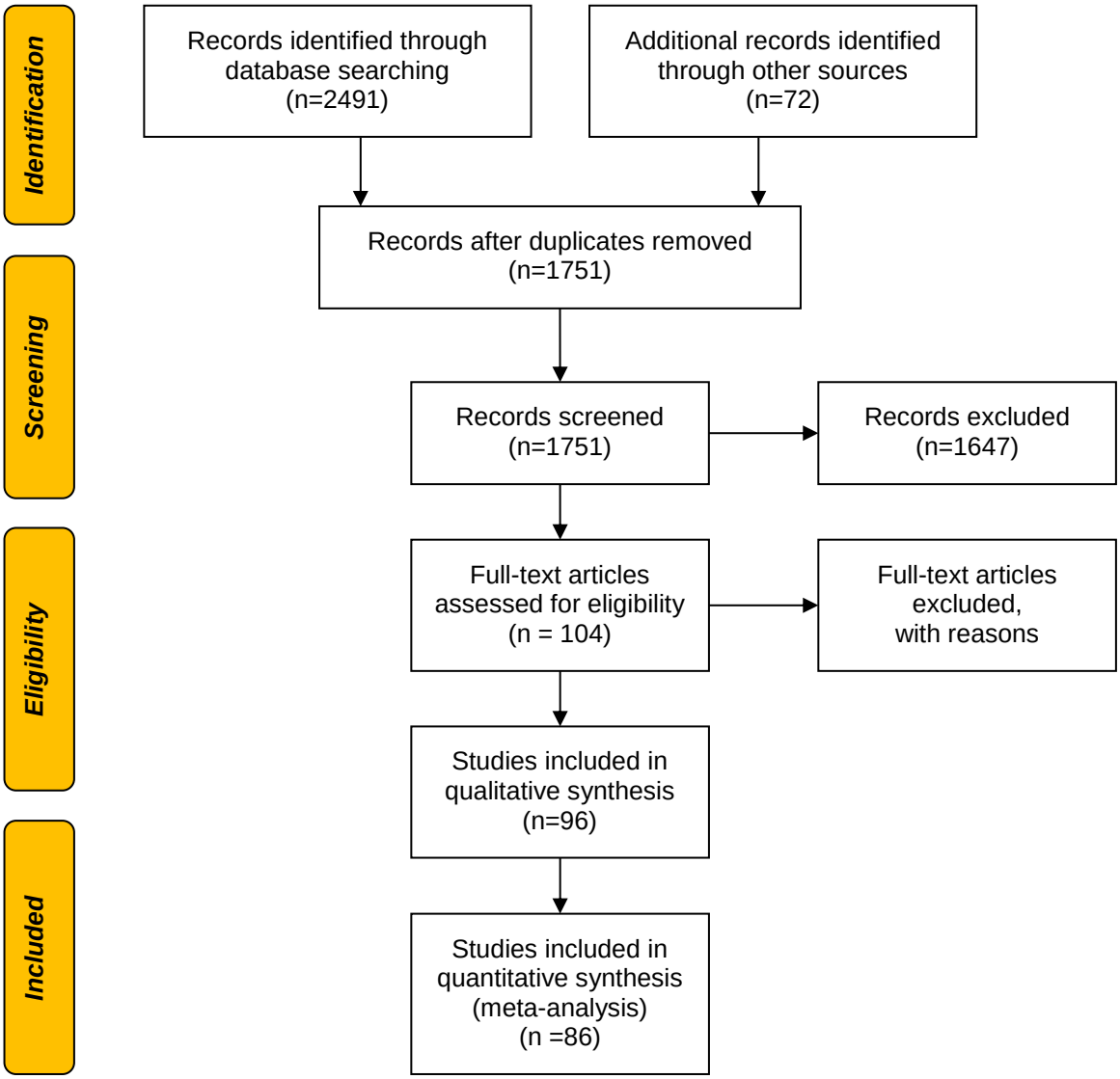


Figure 4-1: Flow chart of information retrieval for clinical effectiveness and safety.

The electronic search yielded 2491 references. To these we added all RCTs included in the aforementioned systematic review. Four reviewers (LB, OD, JE and GF) carried out the study selection process independently, in accordance with the previously defined PICO question. Disagreements were discussed and resolved between reviewers. After removing 812 duplicate records, we screened the remaining 1751 manuscripts. We excluded 1647 records after reading the abstract, and obtained the full-text report for 104 references for further assessment. Eight studies were excluded (Figure 4-1); the 96 records that met the inclusion criteria were finally included for qualitative analyses, corresponding to 86 RCTs.

The first search was carried out on 28 February 2020 and the last search on 18 January 2021.

4.2 Studies included in the assessment

Besides the technologies in the 2019 systematic review [21], the search identified 16 other technologies (TUIP, TUVRP, TUMT, PAE, TmLRP, TURP + TUIP, B-VEP, PVEP, Aquablation, WAVE, OP, PUL, M-TUERP, B-TUERP, ThuVARP and ThuVEP). Table 4-1 shows the number of studies addressing each comparison.

Table 4-1: Number of studies addressing each comparison between technologies of interest and comparators, in descending order

Comparison	Number of RCTs	Study IDs (in alphabetical order) [a]
HoLEP vs. TURP	14	Bai 2019, Basic 2013, Chen 2013, Elshal 2020, Eltabey 2010, Fayad 2015, Gupta 2006, Hamouda 2014, Jhanwar 2017, Kuntz 2004, Mavuduru 2009 Montorsi 2004, Sun 2014, Tan 2003
B-TUVP vs. TURP	10	Elsakka 2016, Geavlete 2011, Geavlete 2014, Geavlete 2015, Hon 2006, Karadag 2014, Kaya 2007, Nuhoglu 2011, Tefekli 2005, Zhang S 2012
TUIP vs. TURP	5	Abd-El Kader 2012, Dørflinger 1992, Jahnson 1998, Riehmann 1995, Tkocz 2002
B-TUEP vs. TURP	5	Geavlete 2015, Luo 2014, Ran 2013, Zhao 2010, Zhu 2013
ThuLEP vs. TURP	5	Bozzini 2017, Enikeev 2019, Shoji 2020, Swiniarski 2012, Yang 2013
TUVRP vs. TURP	5	Dunsmuir 2003, Geavlete 2010, Gupta 2006, Tefekli 2005, Yee 2015, Yip 2011
PAE vs. TURP	5	Abt 2018, Carnevale 2016, Gao 2014, Insausti 2020, Radwan 2020
TUMT vs. TURP	4	Dahlstrandt 1995, D'Ancona 1998, Floratos 2001, Wagrell 2002
PVP vs. TURP	3	Elshal 2020, Goliath study (Bachmann 2014, 2015, Thomas 2016), Jovanovic 2014
HoLEP vs. B-TUEP	3	Habib 2020, Higazy 2020, Neill 2006
HoLEP vs. ThuLEP	3	Bozzini 2020, Zhang F 2012, Zhang 2020
DioLEP vs. TURP	2	Lusuardi 2011, Zhang 2019
TmLRP vs. TURP	2	Xia 2008, Yan 2013
TURP + TUIP vs. TURP	2	Li 2013, Yeni 2002
DioLEP vs. B-TUEP	2	Wu 2016, Zou 2018
PVP vs. B-TUVP	2	Ghobrial 2020, Kini 2020
DioLVP vs. TURP	2	Cetinkaya 2015, Razzaghi 2014
B-VEP vs. TURP	1	Wang 2020
PVEP vs. TURP	1	Zhang 2015
PVEP vs. HoLEP	1	Elshal 2015
Aquablation vs. TURP	1	WATER study (Gilling 2018, 2019a, 2019b, 2020)
ThuLEP vs. B-TUEP	1	Feng 2016
B-TUERP vs. TURP	1	Samir 2019
DioLEP vs. B-TUERP	1	Xu 2013
DioLEP vs. HoLEP	1	He 2019
DioLVP vs. B-TUVP	1	Skinner 2017
HoLEP vs. ThuVEP	1	Netsch 2017
B-TUEP vs. B-TUVP	1	Geavlete 2015

Comparison	Number of RCTs	Study IDs (in alphabetical order) [a]
ThuVARP vs. TURP	1	Hashim 2020
M-TUERP vs. TURP	1	Li 2018
PUL vs. TURP	1	BPH6 study (Sonksen 2015, Gratzke 2017)
HoLEP vs. PVP	1	Elshal 2020
HoLEP vs. TUVRP	1	Gupta 2006
ThuVEP vs. TURP	1	Chang 2015
B-TUEP vs. OP	1	Geavlete 2015
B-TUVP vs. OP	1	Geavlete 2015
WAVE vs. sham	1	Rezūm II study (McVary 2016a, 2016b, 2018, 2019, Roehrborn 2017)

[a] Reference list numbers for all the studies are included in Table 4-3.

Table 4-2 lists the RCTs that included a formal power calculation and stated the hypothesis being tested.

Table 4-2: RCTs presenting a formal power calculation and the hypothesis tested among the RCTs included in the assessment

Study	Technologies assessed	Primary outcome(s)	Hypothesis	Sample size
Abt 2018 [71]	PAE vs. TURP	IPSS	Noninferiority	103
Cetinkaya 2015 [72]	DioLVP vs. TURP	IPSS	Superiority	72
Chen 2013 [73]	HoLEP vs. TURP	Operative time	Superiority	280
Elshal 2015 [74]	PVP vs. HoLEP	IPSS	Noninferiority	103
Elshal 2020 [75]	PVP, TURP vs. HoLEP	Retreatment	Noninferiority	182
Ghobrial 2020 [76]	PVP vs. B-TUVP	IPSS	Noninferiority	119
GOLIATH study [77-79]	PVP vs. TURP	IPSS	Noninferiority	281
Hashim 2020 [80]	ThuVARP vs. TURP	IPSS, Qmax	Noninferiority	410
Insausti 2020 [81]	PAE vs. TURP	Qmax	Noninferiority	45
Kuntz 2004 [82]	HoLEP vs. TURP	Qmax	Superiority	200
Lusuardi 2011 [83]	DioLEP vs. TURP	Hospitalisation time, catheterisation time	Superiority	60
Neill 2006 [84]	HoLEP vs. B-TUEP	Catheterisation time	Superiority	40
Tan 2003 [85]	HoLEP vs. TURP	Hospitalisation time, catheterisation time	Superiority	61
WATER study [86-90]	Aquablation vs. TURP	IPSS	Noninferiority	181
WAVE study [48, 49, 51, 52, 91]	WAVE vs. sham	IPSS	Superiority	197
Xia 2008 [92]	TmLRP vs. TURP	IPSS, Qmax	Superiority	100
Yee 2015 [93]	TUVRP vs. TURP	Hospitalisation time	Superiority	168
Yip 2011 [94]	TUVRP vs. TURP	Catheterisation time	Superiority	86
Zhang 2020 [95]	ThuLEP vs. HoLEP	Qmax	Superiority	116
Zhu 2013 [96]	B-TUEP vs. TURP	Catheterisation time	Superiority	80
Zou 2018 [97]	DioLEP vs. B-TUEP	IPSS, Qmax	Superiority	114

4.3 Description of the evidence used

Appendix 4 provides a full description of the evidence used. Table 4-3 lists the characteristics of all the studies included in the assessment.

Table 4-3: Characteristics of the studies included in the assessment

The abbreviation for the technology as used in each publication is displayed in the table, with the abbreviation used in the assessment for consistency included in parentheses.

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Abd-El Kader 2012 [98]	Egypt, 2005–10	RCT	TUIP (n=40)	TURP (n=40)	Prostate weight ≤30 g (mean: 28)	IPSS, Qmed, Qmax, PVR, blood transfusion, catheterisation time, hospitalisation time, retrograde ejaculation, erectile dysfunction, bladder neck contracture, urethral stricture, reoperation
Abt 2018 [71]	Switzerland, 2014–17	RCT	PAE (n=51)	TURP (n=52)	Prostate volume 25–80 ml (mean: 52)	IPSS, Qmax, PVR, ejaculatory dysfunction, catheterisation time, hospitalisation time, IIEF, persistent irritative symptoms, urinary retention, urinary incontinence, UTI, urethral stricture
Bai 2019 [99]	China, 2015–17	RCT	HoLEP (n=33)	TURP (n=32)	Mean prostate volume: 82 ml	Qmax, PVR, IPSS, QoL, catheterisation time, hospitalisation time
Basic 2013 [100]	Serbia, 2011–12	RCT	HoLEP (n=20)	TURP (n=20)	Prostate weight ≤50 g (mean: 46)	IPSS, QoL, PVR, blood transfusion, catheterisation time, hospitalisation time, bladder mucosal injury, urinary incontinence, AUR, persistent irritative symptoms, bladder neck stricture, reintervention
Bozzini 2017 [101]	Italy, 2014–15	RCT	ThuLEP (n=102)	TURiS (n=106) (TURP)	Mean prostate volume: 86 ml	IPSS, Qmax, PVR, QoL, catheterisation time, hospitalisation time, blood transfusion, urinary retention, stress incontinence, urge incontinence, urethral stricture, bladder injury
Bozzini 2020 [102]	Italy, France, 2015–18	RCT	HoLEP (n=121)	ThuLEP (n=115)	Mean prostate volume (SD): HoLEP: 86.3 ml (46.7) ThuLEP: 90.2 ml (42.7)	Hospital stay, operative time, catheterisation time, IPSS, Qmax, PVR, QoL, urinary retention, blood transfusion, bladder injury, stress incontinence, urge incontinence, urethral stricture

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
BPH6 study: Gratzke 2017 [103] Sonksen 2015 [104]	Germany, Denmark, UK, 2012–13	RCT	PUL (n=44)	TURP (n=35)	Mean prostate volume (SD), range: PUL: 38 ml (12), 16–59 TURP: 41 ml (13), 17–68	*Gratzke 2017:* IPSS, MSHQ-EjD, ISI, adverse events, QoL *Sonksen 2015:* IPSS, MSHQ-EjD, ISI, adverse events, QoL, BPH II, Qmax, PVR, reintervention at ≤30 d and >30 – 365 d (due to bleeding, urethral stricture, return of LUTS)
Carnevale 2016 [105]	Brazil, 2010–11	RCT	PAE (n=15)	TURP (n=15)	Mean prostate volume (SD), range: PAE: 63.0 ml (17.8), 34–97 TURP: 56.6 ml (21.5), 32–89	IPSS, QoL, IIEF-5, PVR, Qmax, procedure time, hospital stay, blood transfusion requirement, capsular perforation, retrograde ejaculation, urinary incontinence, postoperative LUTS, recatheterisation, radiodermatitis
Cetinkaya 2015 [72]	Turkey, 2010–11	RCT	PVP (n=36)	TURP (n=36)	Prostate volume <80 ml (mean: 53)	IPSS, Qmax, catheterisation time, hospital-isation time, urinary retention, retreatment, blood transfusion, capsule perforation, TUR syndrome, UTI, urethral stricture
Chang 2015 [106]	Taiwan, 2010–12	RCT	ThuVEP (n=29)	TURP (n=30)	Mean prostate weight: 61 g	Qmed, QoL, IIEF-5, IPSS, Qmax, PVR, catheterisation time, hospitalisation time, AUR, recatheterisation, UTI, haemorrhage/ haematuria requiring transfusion, TUR syndrome
Chen 2013 [73]	China, 2008–10	RCT	PKRP (n=140) (TURP)	HoLEP (n=140)	Mean prostate size: 59 ml	Catheterisation time, hospitalisation time, IPSS, QoL, Qmax, PVR, IIEF-5, TUR syndrome, recatheterisation, blood transfusion, urinary incontinence, reoperation, retrograde ejaculation, urethral stricture, bladder neck contracture
D'Ancona 1998 [107]	The Netherlands, 1994–95	RCT	TUMT (n=31)	TURP (n=21)	Prostate volume 30–100 ml, (mean: 44)	IPSS, Qmax, PVR, catheterisation time, UTI, hospitalisation time, irritative symptoms, retreatment
Dahlstrandt 1995 [108]	Sweden, n.r.	RCT	TUMT (n=37)	TURP (n=32)	Prostate length 35–50 mm (size not available)	Qmax, PVR, reintervention, urinary retention, urethral stricture, UTI, erectile dysfunction, blood loss, hospitalisation time

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Dørflinger 1992 [109]	Denmark, n.r.	RCT	TUIP (n=29)	TURP (n=31)	Prostate weight <20 g	Persistent irritative symptoms, LUTS, Qmax, blood transfusion, urethral stricture, bladder neck contracture, catheterisation time, reoperation, recatheterisation, retrograde ejaculation
Dunsmuir 2003 [110]	Australia, n.r.	RCT	B-TUVP(n=30)	TURP (n=21)	Mean prostate volume: 39 ml	Qmax, PVR, AUA symptom score, catheter removal, time to discharge, recatheterisation
Elsakka 2016 [111]	Egypt, 2020–12	RCT	B-TUVP (n=40)	TURP (n=42)	Prostate volume <80 ml (mean:52)	IPSS, Qmax, PVR, catheterisation time, bladder perforation, recatheterisation, UTI, stress urinary incontinence, bladder neck obstruction, bleeding necessitating transfusion, TUR syndrome, urethral stricture, reintervention
Elshal 2015 [74]	Canada, 2012–13	RCT	PVEP (n=53)	HoLEP (n=50)	Prostate volume 40–150 ml (mean: 85)	Qmax, PVR, IPSS, QoL, IIEF-15, catheterisation time, hospitalisation time, dysuria, urge incontinence, stress incontinence, capsular violation, bladder injury, anaemia requiring transfusion, UTI, bladder neck contracture, urethral stricture
Elshal 2020 [75]	Egypt, 2014–16	RCT	PVP (n=60) HoLEP (n=60)	TURiS (n=60) (TURP)	Mean prostate volume (SD): PVP: 103 ml (25) HoLEP: 107 ml (21) TURiS: 106 ml (23)	Retreatment, hospital stay, operative time, time to catheter removal, dysuria, IIEF, IPSS, Qmax, PVR, QoL, capsular perforation, blood transfusion, bladder wall injury, UTI
Eltabey 2010 [112]	Saudi Arabia, 2008–09	RCT	HoLEP (n=40)	TURP (n=40)	Prostate volume 30–100 ml (mean: 60)	Qmax, PVR, AUA symptom score, cathe-terisation time, hospitalisation time, irritative voiding symptoms, urge incontinence, stress incontinence, mixed incontinence, blood transfusion, urethral stricture
Enikeev 2019 [113]	Russia, n.r.	RCT	ThuLEP (n=51)	TURP (n=52)	Prostate volume <80 cm^3 (mean: 62)	PVR, IPSS, Qmax, QoL, catheterisation time, hospitalisation time, urinary incontinence, UTI, AUR, urethral stricture, bladder neck contracture, retrograde ejaculation

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Fayad 2015 [114]	Egypt, 2008–13	RCT	HoLEP (n=60)	TURP (n=60)	Mean prostate volume: 68 ml	IPSS, Qmax, PVR, blood loss, intraoperative and postoperative complications, catheterisation time, hospitalisation time
Feng 2016 [115]	China, 2011–13	RCT	ThuLEP (n=61)	PKEP (n=66) (B-TUEP)	Mean prostate volume: 68 ml	IPSS, QoL, Qmax, PVR, catheterisation time, hospitalisation time, complications
Floratos 2001 [116]	The Netherlands, 1996–97	RCT	TUMT (n=78)	TURP (n=66)	Prostate volume ≥30 ml (mean: 45)	PVR, IPSS, Qmax, QoL, retreatment, urethral stricture, bladder neck contracture
Gao 2014 [117]	China, 2007–12	RCT	PAE (n=57)	TURP (n=57)	Mean prostate volume (SD): PAE: 64.7 ml (19.7) TURP: 63.5 ml (8.6)	IPSS, QoL, PVR, Qmax, operative time, decrease in serum sodium levels within 24 hours after the procedure, transfusion requirement, hospital stay, catheter requirements, reintervention, TUR syndrome, AUR, UTI, urethral stricture, bladder neck contracture
Geavlete 2010 [41]	Romania, n.r.	RCT	TURiS-PVP (n=75) (TUVRP)	TURP (n=80)	Prostate volume 30–80 ml (mean: 56)	IPSS, HRQoL, Qmax, PVR, catheterisation time, capsular perforation, intraoperative bleeding, blood transfusion, UTI, AUR, dysuria, urinary urgency
Geavlete 2011 [118]	Romania, n.r.	RCT	BPVP (n=170) (B-TUVP)	Total TURP (n=340) TURiS (n=170) M-TURP (n=170)	Mean prostate volume: 54 ml (range 30–80)	IPSS, QoL, Qmax, PVR, catheterisation time, hospitalisation time, intraoperative bleeding, blood transfusion, capsular perforation, TUR syndrome, early irritative symptoms, dysuria, bladder neck sclerosis, urinary stricture, urinary incontinence, UTI, retreatment
Geavlete 2014 [119]	Romania, n.r.	RCT	Total BPVP (n=120) C-BPVP (n=60)[4] S-BPVP (n=60) (B-TUVP)	TURP (n=60)	Mean prostate volume: 54 ml	IPSS, QoL, Qmax, PVR, capsular perforation, catheterisation time, hospitalisation time

[4] C-BPVP and S-BPVP are types of B-PVP

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Geavlete 2015 [120]	Romania, 2009-13	RCT	BPEP (n=80) (B-TUEP) TUViS (n=80) (B-TUVP)	TURiS (n=80) (TURP) Open prostatectomy (n=80)	Prostate volume ≥80 ml (mean: 127)	IPSS, QoL, Qmax, PVR, catheterisation time, hospitalisation time, blood transfusion, recatheterisation, urinary stricture, urinary incontinence, UTI
Ghobrial 2020 [76]	Egypt, 2014–15	RCT	PVP (n=58)	B-TUVP (n=61)	Prostate volume 30–80 ml (mean: 58)	Qmax, PVR, IPSS, QoL, IIEF-15, catheterisation time, hospitalisation time, UTI, postoperative LUTS, bladder neck contracture, urethral stricture, urinary incontinence, urinary retention, anaemia necessitating blood transfusion, bladder wall injury, capsular violation, retrograde ejaculation-anejaculation
Goliath study: Bachmann 2014 [77] Bachmann 2015 [78] Thomas 2016 [79]	Nine European countries, 2011–12	RCT	PVP (n=136)	TURP (n=133)	Prostate volume ≤100 ml (mean: 47)	IPSS, Qmax, PVR, IIEF-5, UTI, irritative symptoms, stricture (meatal, urethral, bladder neck), urinary incontinence, urinary retention, reoperation, catheterisation time, hospitalisation time, transfusion, retrograde ejaculation
Gupta 2006 [121]	India, 2002–03	RCT	HoLEP (n=50) TUVRP (n=50)	TURP (n=50)	Prostate weight >40 g (mean: 60)	IPSS, Qmax, PVR, catheterisation time, blood transfusion, capsular perforation, bladder mucosal injury, transient dysuria, urethral stricture, incontinence
Habib 2020 [122]	Egypt, 2016–18	RCT	HoLEP (n=33)	PKEP (n=31) (B-TUEP)	Prostate weight ≥80 g (range: 80–270)	PVR, IPSS, Qmax, QoL, IIEF, catheterisation time, hospitalisation time, capsule perforation, urinary retention, transient urinary incontinence, irritative symptoms, UTI, blood transfusion, bladder neck contracture
Hamouda 2014 [123]	Egypt, 2009–10	RCT	HoLEP (n=30)	TURP (n=30)	Prostate weight 20–80 g (mean: 56)	AUA symptom score (corresponding 7/8 to IPSS), Qmax, PVR, UTI, blood transfusion, urethral stricture, irritative symptoms, incontinence, catheterisation time, hospitalisation time

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Hashim 2020 [43]	UK, 2014–16	RCT	ThuVARP (n=205)	TURP (n=205)	Median prostate weight (range): ThuVARP 35 g (25–50) TURP 40 g (20–50)	Qmax, IPSS, complications until 12-month follow-up, hospitalisation time, perioperative complications, postoperative catheterisation time, PVR, blood loss during surgery (change in haemoglobin and blood transfusion rate), absorption of irrigation fluid, LUTS (IPSS, ICIQ-MLUTS), sexual function (ICIQ-MLUTS sex, IIEF), quality of life (IPSS QoL subscore, ICIQ-LUTS QoL), patient satisfaction (ICIQ Satisfaction questionnaire)
He 2019 [124]	China, 2016–17	RCT	DioLEP (n=63)	HoLEP (n=63)	Mean prostate volume (SD): DioLEP: 83.0 ml (34.8) HoLEP: 75.6 ml (28.9)	Qmax, PVR, IPSS, QoL, decrease in serum sodium, bladder injury, blood transfusion, capsule perforation, TUR syndrome, urinary retention, recatheterisation, retrograde ejaculation, urinary incontinence, UTI, urethral stricture, bladder neck contracture, operative time, catheterisation time, hospitalisation time
Higazy 2020 [125]	Egypt, 2018	RCT	HoLEP (n=60)	B-PEP (n=60) (B-TUEP)	Mean prostate volume (SD), range: HoLEP: 135.19 ml (34.84), 90–200 B-PEP: 125.00 ml (26.93), 95–180	Operative time (from initiation of the endoscopic procedure to catheter insertion), enucleation and morcellation time, volume of resected tissue, perioperative complications according to the Clavien–Dindo classification, catheterisation time, hospitalisation time, PSA, Qmax, PVR, IPSS, QoL (1-, 3- and 12-month follow-up)
Hon 2006 [126]	UK, n.r.	RCT	PKVP (n=81) (B-TUVP)	TURP (n=79)	Mean prostate volume: 39 ml	Intraoperative blood loss, postoperative hospitalisation time, transfusion, urethral stricture, reintervention, IPSS, Qmax, Qmed, PVR, QoL
Insausti 2020 [81]	Spain, 2014–17	RCT	PAE (n=23)	TURP (n=22)	Prostate volume (SD): PAE: 60.0 cm^3 (21.6) TURP: 62.8 cm^3 (23.8)	Qmax, IPSS, QoL, prostate volume, PVR, IIEF-6, PSA, adverse events according to Clavien–Dindo classification, patient satisfaction, pain
Jahnson 1998 [127]	Sweden, 1991	RCT	TUIP (n=43)	TURP (n=42)	Prostate weight 20–40 g (mean: 26)	Qmax, PVR, blood loss, transfusion, catheterisation time, reinterventions

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Jhanwar 2017 [128]	India, 2012–15	RCT	HoLEP (n=72)	TURP (n=72)	Prostate weight >60 g (mean: 75)	IPSS, PVR, Qmax, blood transfusion, TUR syndrome, UTI, urinary incontinence, urethral stricture, recatheterisation, IIEF, hospitalisation time, catheterisation time
Jovanovic 2014 [129]	Serbia, 2011–13	RCT	PVP (n=31)	TURP (n=31)	Prostate volume <100 ml (mean: 61)	IPSS, Qmax, PVR, operative time, catheterisation time, hospitalisation time, blood transfusion, capsule perforation, TUR syndrome, dysuria/urge, bladder neck contracture, urethral stricture, urinary incontinence
Karadag 2014 [130]	Turkey, 2008–12	RCT	PKVP (n=96) (B-TUVP)	PKRP (n=87) (TURP)	Mean prostate volume: 51 ml	Qmax, PVR, IPSS, blood loss, catheterisation time, infravesical obstruction, incontinence, UTI
Kaya 2007 [131]	Turkey, 2001–13	RCT	PKVP (n=25) (B-TUVP)	TURP (n=15)	Mean prostate volume (SD)l: PKVP: 50 ml (2) TURP: 51 ml (1)	IPSS, Qmax, urethral stricture, erectile dysfunction, retrograde ejaculation, overall satisfaction
Kini 2020 [132]	USA, 2016–18	RCT	PVP (n=13)	BPVP (n=14) (B-TUVP)	Mean prostate volume ≤80 ml	Ejaculation preservation, erection preservation, IPSS, QoL, PVR, OAB-SF, free flow uroflowmetry, PSA
Kuntz 2004 [82]	n.r., 1999–2001	RCT	HoLEP (n=100)	TURP (n=100)	Mean prostate volume (SD), range: HoLEP: 53.5 ml (20), 20–95 TURP: 49.9 ml (21.1), 20–99	AUA symptom score (corresponding 7/8 to IPSS), Qmax, catheterisation time, post-operative hospitalisation time, operative time, decrease in serum sodium, PVR, sexual function, continence, intraoperative and postoperative complications
Li 2013 [133]	China, 2009–10	RCT	TURP (n=61)	STURP + TUIBN (n=63) (TURP + TUIP)	Mean prostate volume (SD): TURP: 29.01 ml (4.96) STURP + TUIBN: 31.54 ml (6.93)	Operative time, intraoperative blood loss, hospitalisation time, changes in serum sodium, catheterisation time, TUR syndrome, perioperative complications, IPSS, Qmax, PVR, major adverse events (AUR, need for prostate biopsy, gross haematuria, acute UTI, urinary stricture, bladder contracture, prostate cancer, QoL

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Li 2018 [134]	China, 2012–14	RCT	B-TURP (n=44) (TURP)	M-TUERP (n=42)	Mean prostate volume (SD): B-TURP: 88.02 ml (9.38) M-TUERP: 87.5 ml (8.27)	PVR, QoL, IPSS, Qmax, change in serum sodium, change in haemoglobin, operative time, trocar cystostomy time, debris evacuation time, intraoperative intravesical pressure, catheterisation time, immediate or late postoperative complications, TUR syndrome, micturition parameters, duration of bladder irrigation, weight of resected tissue
Luo 2014 [135]	China, 2009–11	RCT	PKEP (n=155) (B-TUEP)	PKRP (n=155) (TURP)	Mean prostate volume (SD): PKEP: 61.8 ml (18.7) PKRP: 61.7 ml (19)	IPSS, Qmax, QoL, PVR, TURS, UTIs, incontinence, recatheterisation, bladder neck contracture, urethral stricture, blood transfusion, hospitalisation time, catheterisation time, blood loss, operative time
Lusuardi 2011 [83]	Austria, 2010	RCT	ELEP (n=30) (DioLEP)	B-TURP (n=30) (TURP)	Mean prostate volume (SD), range: ELEP: 59.5 ml (15.13), 34–89 B-TURP: 59.1 ml (14.2), 35–89	Blood loss, operative time, catheterisation time, hospitalisation time, intraoperative irrigation, Qmax, IPSS, QoL, PVR
Mavuduru 2009 [136]	India, n.r.	RCT	HoLEP (n=15)	TURP (n=15)	Mean prostate weight (SD): HoLEP: 36.33 g (11.4) TURP: 36.53 g (12.33)	Operative time, intraoperative adverse events, blood transfusion, TUR syndrome, catheterisation time, complications after catheter removal, median time to discharge, IPSS, PVR, adverse events, urethral stricture
Montorsi 2004 [137]	Italy, 2002	RCT	HoLEP (n=52)	TURP (n=48)	Mean prostate volume (SD): HoLEP: 70.3 ml (36.7) TURP: 56.2 ml (19.4)	Operative time, blood loss, catheterisation time, hospitalisation time, Qmax, Qmed, IPSS, QoL, IIEF, early and late adverse events
Neill 2006 [84]	New Zealand, 2001–03	RCT	HoLEP (n=20)	PKEP (n=20) (B-TUEP)	Mean prostate volume (SD): HoLEP 57 cm^3 (5.1) PKEP 51 cm^3 (3.9)	Operative time, pathology specimen weight, energy requirement, amount of intraoperative and postoperative irrigant used, duration of indwelling catheter, time spent in the postoperative recovery room, hospitalisation time, adverse events, IPSS, sexual function, continence and dysuria, adverse events (only 12 months: bladder irrigation required,

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Neill 2006 [84] *(continuation)*						UTI, urethral stricture, urinary incontinence, reoperation, transfusion), Qmax. urodynamic pressure flow, prostate volume
Netsch 2017 [138]	Germany, 2015–16	RCT	ThuVEP (n=48)	HoLEP (n=46)	Median prostate volume (range): ThuVEP 82.5 ml (47.75–100.00) HoLEP 77.5 ml (45.75–110.25)	IPSS, QoL, Qmax, PVR, operative time, catheterisation time, hospitalisation time, complication rate
Nuhoglu 2011 [139]	Turkey, 2009–10	RCT	B-TUVP (n=43)	TURP (n=47)	Mean prostate volume (SD): TUVP 51.7 ml (19.6) TURP 53.2 ml (21.4)	IPSS, PVR, Qmax, prostate volume, operative time, amount of bleeding, post-operative hyponatraemia, catheter retention time, blood transfusion, urethral stricture, recatheterisation, urinary retention, re-TURP, bladder neck incision, urethral stricture, reoperation, TUR syndrome, urinary incontinence
Radwan 2020 [140]	Egypt, 2016-2018	RCT	PAE (n=20)	Total TURP (n=40) M-TURP (n=20) B-TURP (n=20)	Prostate volume (range): PAE: 31–95 g M-TURP: 25–99 g B-TURP: 30–99 g	IPSS, PVR, Qmed, AUR, catheter time, operative time, TUR syndrome.
Ran 2013 [141]	China, 2011	RCT	PKEP (n=30) (B-TUEP)	PKRP (n=30) (TURP)	Mean prostate volume (SD): PKEP 71.6 ml (20.0) PKEP 67.2 ml (24.9)	Weight of resected prostate tissue, absorption of irrigation fluid, operative time, hospitalisation time, catheterisation time, intra-operative complications (capsular perforation, obturator nerve reflection, transfusion), reduction in haemoglobin, decrease in sodium, reduction in haematocrit, severe complications (TUR syndrome, myocardial arrhythmia)

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Razzaghi 2014 [142]	Iran, 2010–12	RCT	DioLVP (n=57)	TURP (n=58)	Mean prostate volume (SD): TURP 59.6 ml (14.1) DioLVP 61.1 ml (16.1)	IPSS, PVR, Qmax, prostate volume, PSA level, operative time, changes in haemoglobin, serum sodium, perioperative and post-operative complications, hospitalisation time, catheterisation time
Rezūm II study: McVary 2016a [48] McVary 2016b [91] McVary 2018 [52] McVary 2019 [49] Roehrborn 2017 [51]	USA, 2013-14	RCT	WAVE (n=136)	Sham (n=61)	Mean prostate volume (SD): WAVE: 45.8 cm^3 (13) Sham: 44.5 cm^3 (13.3)	IPSS, QoL, Qmax, BPHII, IIEF-15 (erectile function), MSHQ-EjD (ejaculatory function)
Riehmann 1995 [143]	USA, 1985–90	RCT	TURP (n=56)	TUIP (n=61)	n.r.	Obstructive and irritative symptom scores, Qmax
Samir 2019 [144]	Egypt, 2015–19	RCT	B-TUERP (n=120)	B-TURP (n=120) (TURP)	Mean prostate volume (SD): B-TUERP 105.3 ml (20.26) B-TURP 112.7 ml (23.15)	Operative time, resected prostate tissue weight, catheterisation time, hospitalisation time, IPSS, QoL, residual prostate volume, Qmax, PVR, TUR syndrome, haemoglobin decrease, blood transfusion, urethral stricture, urinary incontinence
Shoji 2020 [145]	Japan, 2017–2019	RCT	ThuLEP (n=70)	B-TURP (n=70) (TURP)	Median prostate size (range): ThuLEP 53 ml (40–143) B-TURP 53 ml (34–116)	IPSS, IPSS QoL, Qmax, PVR, IIEF-5, urinary incontinence, operative time, hospitalisation time, catheterisation time, UTI, capsule perforation, blood transfusion, recatheterisation, urethral stricture, bladder neck contracture, erectile dysfunction

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Skinner 2017 [146]	Canada, 2014–16	RCT	DioLVP (n=25)	B-TUVP (n=30)	Mean prostate weight: DioLVP 46.6 g B-TUVP 47.8 g	IPSS, QoL, surgical team satisfaction, side effects and complications, costs
Sun 2014 [147]	China, 2010–11	RCT	HoLEP (n=82)	TURP (n=82)	Mean prostate weight (SD) HoLEP 55.11 g (29.03) TURP 56.22 g (30.48)	Qmax, PVR, IPSS, QoL, operative time, bladder irrigation time, time of indwelling catheter, hospitalisation time, weight of resected prostate, haemoglobin level 1 day after surgery, blood sodium level 1 day after surgery, hyponatraemia, blood transfusion, urethral stricture
Swiniarski 2012 [148]	Poland, 2007–09	RCT	ThuLEP (n=54)	TURP (n=52)	Mean prostate volume (SD): ThuLEP 62.03 cm^3 (23.7) TURP 66.5 cm^3 (22.0)	Laser use time, morcellation time, catheteri-sation time, hospitalisation time, energy used, haemoglobin loss, tissue weight removed, IPSS, QoL, Qmax, PVR, perioperative and postoperative complications
Tan 2003 [85]	New Zealand, 1997–2000	RCT	HoLEP (n=31)	TURP (n=30)	Mean prostate volume: HoLEP 77.8 ml TURP 70.0 ml	Catheterisation time, hospitalisation time, blood transfusion, QoL, IPSS, Qmax, time that the resectoscope sheath was in place, time that the laser or electrocautery unit was in action, morcellation time in the HoLEP group, amount of tissue resected, total irrigation volume, continence and sexual function, PVR, adverse events, reoperation, recatheterisation, UTIs
Tefekli 2005 [149]	Turkey, 2001–02	RCT	PKVP (n=51) (TUVRP)	TURP (n=50)	Mean prostate weight (SD): PKVP 50.1 g (17.3) TURP 54 g (15.2)	IPSS, uroflowmetry scores, operative time, catheterisation time, hospitalisation time, complications
Tkocz 2002 [150]	Poland, n.r.	RCT	TUIP (n=50)	TURP (n=50)	Prostate weight <30 g	Mean weight of the resected adenoma, mean weight of the incised adenoma, IPSS, QoL, daily and nocturnal micturition frequency, mean volume of a single urine portion, Qmax during free flowmetry and during pressure-flow study, PVR, urine retention,

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Tkocz 2002 [150] *(continuation)*						maximal cystometric capacity, detrusor pressure and detrusor pressure Qmax, compliance of the bladder, opening detrusor pressure, linearised passive urethral resistance relation, detrusor instability, transfusion, retrograde ejaculation, urine incontinence
Wagrell 2002 [151]	USA, Sweden Denmark, 1998–99	RCT	TUMT (n=100)	TURP (n=46)	Mean prostate volume (SD): TUMT: 48.9 cm^3 (15.8) TURP: 52.7 cm^3 (17.3)	IPSS, Qmax, PVR, QoL, adverse events (serious adverse events defined separately), catheterisation time
Wang 2020 [152]	China, 2017–18	RCT	PVEP (n=50) (B-VEP)	PKRP (n=51) (TURP)	Mean prostate volume (SD): PVEP: 119.51 ml (18.14) PKRP: 121.72 ml (18.78)	Qmax, IPSS, PVR, QoL, IIEF-5, erectile dysfunction, anejaculation
WATER study: Gilling 2018 [86] Gilling 2019a [87] Gilling 2019b [88] Gilling 2020 [90]	USA, UK, Australia, New Zealand, 2015–16	RCT	Aquablation (n=116)	TURP (n=65)	Mean prostate volume (SD): Aquablation: 54.1 ml (16.2) TURP: 51.8 ml (13.8)	*Gilling 2018:* IPSS, adverse events, resection time, total operative time, hospitalisation time, reoperation or repeat intervention rate, proportion of sexually active subjects who reported worsening sexual function through 6 months on IIEF-5 (6-point decrease) or MSHQ-EjD (2-point decrease), serious device- or procedure-related adverse event *Gilling 2019a:* IPSS, QoL, Qmax, PVR, complications *Gilling 2019b:* Procedure-related complications occurring between months 12 and 24, IPSS, QoL, Qmax, MSHQ-EjD change and PVR at 24 months *Gilling 2020:* IPSS, IIEF, PVR, QoL, bladder neck contracture, dysuria, retrograde ejaculation, urethral stricture, urinary retention, UTI, urinary urgency, frequency, difficulty or leakage, dysuria, erectile dysfunction, reintervention

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Wu 2016 [153]	China, 2013–14	RCT	DioLEP (n=40)	PKEP (n=40) (B-TUEP)	Mean prostate volume (SD): PKEP 93.3 ml (18.5) DioLEP 98.6 ml (21.6)	IIEF-5, perioperative or postoperative complications, IPSS, Qmax, PVR, QoL, operative time, resected prostate volume, catheterisation time, hospitalisation time, haemoglobin decrease
Xia 2008 [92]	China, 2004–05	RCT	TmLRP (n=52)	TURP (n=48)	Prostate weight <100 g	IPSS, QoL, IIEF-5, PVR, Qmax, operative time, serum sodium decrease, catheterisation time, hospitalisation time, blood transfusion, TUR syndrome, UTI, recatheterisation, acute urinary incontinence, retrograde ejaculation, urethral stricture
Xu 2013 [154]	China, 2011	RCT	PKERP (n=40) (B-TUERP)	DioLEP (n=40)	Mean prostate volume (SD): PKERP: 65.79 ml (24.63) DioLEP: 68.72 ml (22.28)	PVR, Qmax, IPSS, QoL, operative time, changes in serum sodium, blood transfusion, catheterisation time, hospitalisation time, mortality, TUR syndrome, bladder injury, transient incontinence, urethral stricture, irritative symptoms
Yan 2013 [155]	China, 2010–11	RCT	TmLRP (n=40)	TURP (n=40)	Mean prostate volume (SD), range: TmLRP: 52.9 ml (12.3), 37–92 TURP: 54.3 ml (11.1), 39–90	IPSS, Qmax, TUR syndrome, blood transfu-sion, recatheterisation, urinary incontinence, urethral stricture, retrograde ejaculation, reoperation, decrease in serum sodium, catheterisation time, operative time, mortality
Yang 2013 [156]	China, 2009–10	RCT	ThuLEP (n=79)	PKRP (n=79) (TURP)	Prostate weight <100 g	IPSS, QoL, Qmax, PVR, blood transfusion, operative time, AUR, postoperative catheterisation time, hospitalisation time
Yee 2015 [93]	China, 2013	RCT	TURiS-PVP (n=84) (TUVRP)	TURP (n=84)	Mean prostate volume (SD) TURiS-PVP: 57.2 ml (25.4) TURP: 66.1 ml (30.2)	IPSS, QoL, Qmax, PVR, operative time, catheterisation time, dysuria, hospitalisation time, TUR syndrome, blood transfusion
Yeni 2002 [157]	Turkey, n.r.	RCT	M-TURP + TUIP (n=20) (TURP + TUIP)	TURP (n=20)	Prostate volume ≤25 ml	IPSS, Qmax, operative time, length of hospital stay, bladder neck contracture, procedural blood loss and transfusion requirement, retrograde ejaculation, erectile dysfunction, TUR syndrome

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Yip 2011 [94]	China, n.r.	RCT	TURiS-PVP (n=46) (TUVRP)	B-TURP (n=40) (TURP)	Mean prostate volume (SD): TURiS-PVP: 61 cm^3 (23.8) B-TURP: 61.5 cm^3 (34.5)	IPSS, Qmax, catheter time, length of hospital stay, dysuria score, reintervention, blood transfusion
Zhang 2015 [158]	China, 2012–14	RCT	PVEP (n=56)	PKRP (n=56) (TURP)	Prostate volume >90 ml	IPSS, QoL, Q max, PVR, operative time, serum sodium decrease, transfusion, catheterisation time, hospitalisation time, urinary incontinence and urethral stricture
Zhang 2019 [159]	China, 2016–17	RCT	DioLEP (n=76)	PKRP (n=76) (TURP)	Prostate volume ≤80 ml	Qmax, PVR, IPSS, QoL, serum sodium decrease, operative time, catheterisation time, hospitalisation time, blood transfusion, TUR syndrome, urinary incontinence, capsular perforation, urethral stricture
Zhang 2020 [95]	China, 2016–2017	RCT	HoLEP (n=58)	ThuLEP (n=58)	Mean prostate volume (SD): HoLEP 93.0 ml (7.2) ThuLEP 91.8 ml (6.9)	IPSS, QoL, Qmax, PVR, operative time, catheterisation time, hospitalisation time, urinary incontinence, urinary retention, bladder injury, UTI, urethral stricture, bladder-neck contracture, recatheterisation
Zhang F 2012 [160]	China, 2007–09	RCT	ThuLEP (n=71)	HoLEP (n=62)	Prostate weight <80 g	IPSS, Qmax, PVR, bleeding, reoperation, urethral/bladder neck stricture, operative time, serum sodium decrease, postoperative catheterisation time
Zhang S 2012 [161]	China, 2009–12	RCT	BPVP (n=15) (B-TUVP)	TURP (n=15)	Prostate volume 25–125 ml	IPSS, QoL, Qmax, catheterisation time, blood loss, hospitalisation time
Zhao 2010 [162]	China, 2004–06	RCT	PKEP (n=102) (B-TUEP)	TURP (n=102)	Prostate weight >20 g	IPSS, QoL, IIEF-5, Qmax, PVR, sexual function, operative time, change in serum sodium, blood transfusion, TUR syndrome, UTI, transient incontinence, retrograde ejaculation, urethral stricture, bladder neck contracture, dysuria, catheterisation time, hospitalisation time, reintervention

Study reference/ID	Sites or regions, countries, study period	Study type	Intervention (number of randomised/ enrolled patients)	Comparator(s) (number of randomised/ enrolled patients)	Patient population (prostate size/volume)	Critical endpoints
Zhu 2013 [96]	China, 2004–06	RCT	PKEP (n=40) (B-TUEP)	B-TURP (n=40) (TURP)	Prostate volume 70–200 ml	IPSS, Qmax, QoL, PVR, IIEF-5, operative time, catheterisation time, postoperative hospitalisation time, urinary retention, transient incontinence, UTI
Zou 2018 [97]	China, 2015	RCT	DioLEP (n=57)	BEEP (n=57) (B-TUEP)	Prostate volume (SD) DioLEP: 59.5 ml (28.8) BEEP: 63.4 ml (36.4)	Operative time, enucleation time, morcellation time, enucleated prostate weight, decrease in haemoglobin, decrease in serum sodium, catheterisation time, hospitalisation time, Qmax, IPSS, PVR, IIEF-5, QoL, PSA, adverse events

Abbreviations: AUA=American Urological Association; AUR=AUR; BPHII=Benign Prostatic Hyperplasia Impact Index; B-TUEP=bipolar transurethral enucleation of the prostate; B-TURP=bipolar transurethral resection of the prostate; B-TUERP=bipolar transurethral enucleoresection of the prostate; B-TUVP=bipolar transurethral vaporisation of the prostate; B-VEP=bipolar vapoenucleation of the prostate; BPVP=bipolar plasma vaporisation of the prostate; C-BPVP=continuous bipolar plasma vaporisation of the prostate; DioLEP=diode laser enucleation of the prostate; DioLVP=diode laser vaporisation of the prostate; ELEP=eraser laser enucleation of the prostate; HoLEP=holmium laser enucleation of the prostate; HRQoL=health-related quality of life; ICIQ-MLUTS=International Consultation on Incontinence Questionnaire-Male Lower Urinary Tract Symptoms module; IIEF=International Index of Erectile Function; IPSS=International Prostate Symptom Score; ISI=Incontinence Severity Index; LUTS=lower urinary tract symptoms; MSHQ-EjD=Male Sexual Health Questionnaire-Ejaculatory Dysfunction; M-TUERP=monopolar transurethral enucleoresection of the prostate; n=number of randomised (included) patients; n=relevant subpopulation; n.r.=not reported; OAB-SF=Overactive Bladder Questionnaire-Short Form; PAE=prostate artery embolisation; PKEP=plasmakinetic enucleation of the prostate; PKRP=plasmakinetic resection of the prostate; PSA=prostate-specific antigen; PVEP=photoselective vapoenucleation of the prostate; PVP=photoselective vaporisation of the prostate; PVR=postvoid residual; Qmax= peak/maximum flow rate; Qmed=average flow rate; QoL=quality of life; RCT=randomised controlled trial; S-BPVP=standard bipolar plasma vaporisation of the prostate; SD=standard deviation; STURP=selective transurethral resection of the prostate; ThuLEP=thulium laser enucleation of the prostate; TmLRP=thulium laser resection of the prostate; TUIP=transurethral incision of the prostate; TUMT=transurethral microwave therapy; TURP=transurethral resection of the prostate; TUR syndrome=transurethral resection syndrome; ThuVAP=thulium laser vaporisation of the prostate; ThuVARP=thulium laser vaporesection of the prostate; ThuVEP=thulium laser vapoenucleation of the prostate; TUIBN=transurethral incision of the bladder neck; TURiS=transurethral resection in saline; TUVRP=transurethral vaporesection of the prostate; TUViS=transurethral vaporisation in saline; UTI=urinary tract infection.

Table 4-4: Summary of the applicability of the body of studies

Domain	Description of the applicability of the evidence
Population	Patient candidates for benign prostatic hyperplasia (BPH) surgery were included, with prostate size ranging from <20 ml to >150 ml. Few technologies were studied in relatively homogeneous patient populations in terms of prostate size. Most of the studies included patients with a wide prostate size range, precluding the possibility of performing subgroup analyses.
Intervention	Twenty-one technologies as an alternative to transurethral resection of the prostate (TURP) and open prostatectomy, using either ablative or nonablative methodologies.
Comparators	TURP, representing the standard of care for BPH surgery up to now, and open prostatectomy in the case of large prostates.
Outcomes	Functional outcomes were assessed in almost all randomised controlled trials (RCTs) at different/repeated follow-up times, ranging from 1 week to 48 months after surgery. Limited information on minimal clinically important differences may limit the relevance of related data for decision-making. Reintervention was assessed in a few studies, as well as irritative symptoms. Most studies reported data on hospitalisation and operative time. Data on different perioperative and postoperative complications were also available in most of the studies. Outcomes related to sexual function were available in some of the trials, whereas data on TUR syndrome were available in few studies.
Setting	The selected RCTs were conducted in centres in different countries and geographic areas, mostly in Europe, China and North America.

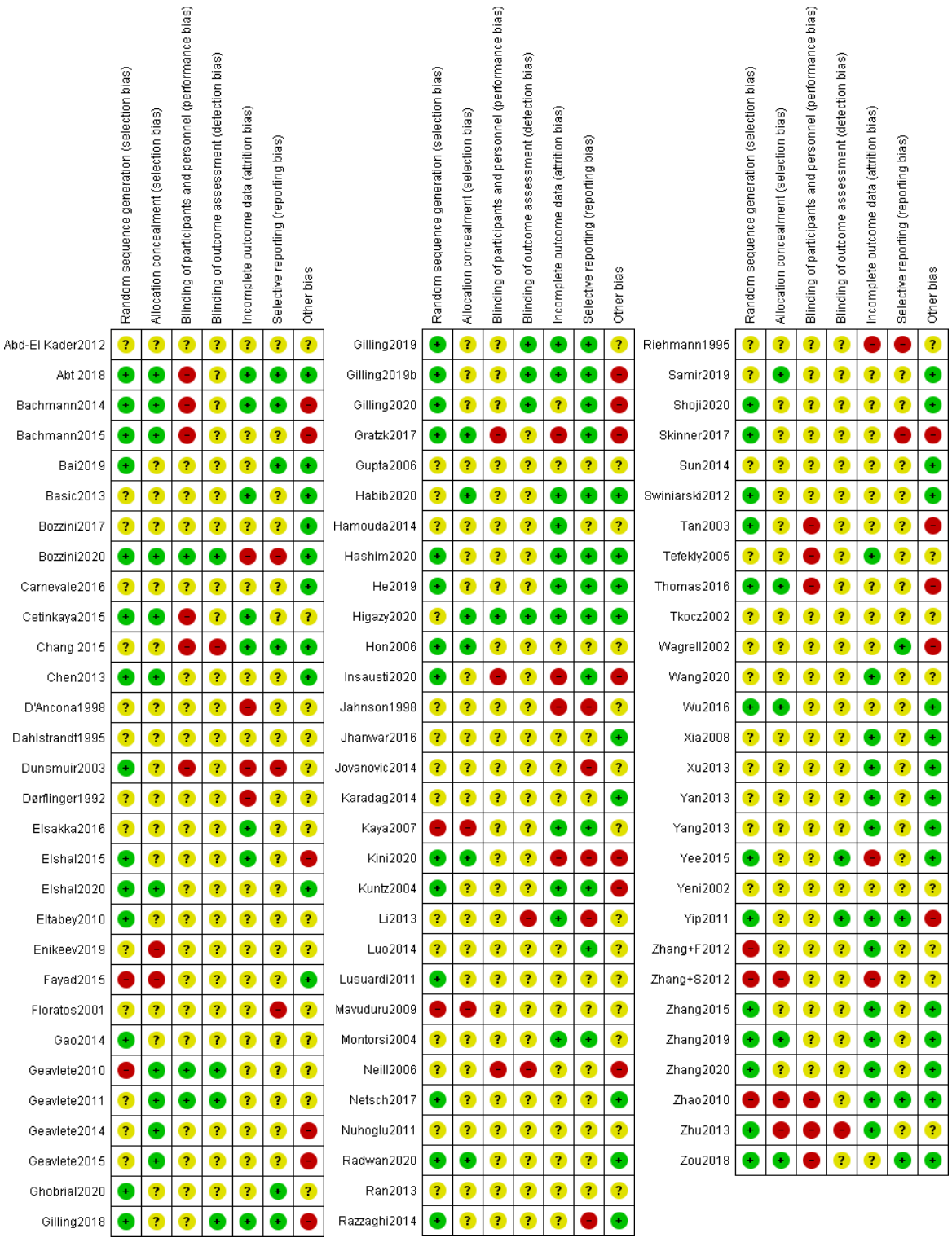


Figure 4-2: Risk of bias in the studies included in the assessment.

4.4 Results for clinical effectiveness and safety

4.4.1 Clinical effectiveness

HTA CORE MODEL DOMAIN: EFF[5]

4.4.1.1 Resection techniques

TmLRP

TmLRP was assessed in two of the RCTs, with comparison to TURP (n=180).

TmLRP versus TURP

Two RCTs (Xia 2008, n=100; Yan 2013, n=80) compared TmLRP versus TURP for the outcomes listed in Table 4-5. No data were available for Qmed, BPHII, irritative symptoms or postoperative LUTS (as a binary outcome).

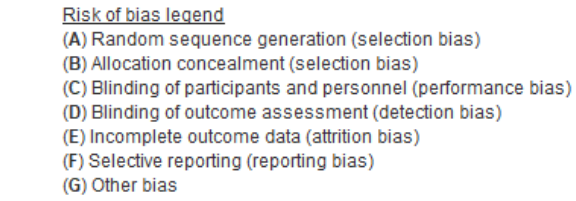
Table 4-5: Effectiveness outcomes assessed in RCTs comparing TmLRP versus TURP

Study ID	Xia 2008	Yan 2013
IPSS at 1 month	x	
IPSS at 3 months		x
IPSS at 6 months	x	
IPSS at 12 months	x	
Qmax at 1 month	x	
Qmax at 3 months		x
Qmax at 6 months	x	
Qmax at 12 months	x	
PVR at 1 month	x	
PVR at 6 months	x	
PVR at 12 months	x	
QoL at 1 month	x	
QoL at 6 months	x	
QoL at 12 months	x	
Hospitalisation time	x	
Procedure time	x	x
Reintervention total		x

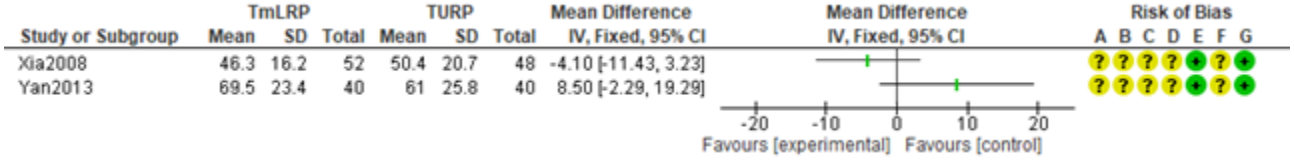
Patients included in the studies had a prostate size between 30 and 97 ml, mostly falling within the 30–80 ml subgroup.

[5] This section addresses the following assessment elements: D0005, D0011, D0012 and D0013

Pooling of data was not possible for any of the available outcomes. Operative time is in favour of TmLRP in Xia 2008 and in favour of TURP in Yan 2013.



Procedure time (min)



In Xia 2008 a shorter hospital stay was observed for TmLRP (115.1 vs. 161.1 h; p<0.001, 95% CI not available, uncertain RoB).

4.4.1.2 Enucleation techniques

HoLEP

HoLEP was assessed in 23 of the RCTs, including a total of 2701 patients. Twenty-two were two-arm studies and one (Elshal 2020) was a three-arm RCT. Fourteen studies compared HoLEP versus TURP (n=1549), three compared HoLEP versus ThuLEP (n=485) and HoLEP versus B-TUEP (n=224), two compared HoLEP versus PVP (n=223), and one compared HoLEP versus DioLEP (n=126) and ThuVEP (n=94).

HoLEP versus TURP

Fourteen RCTs compared HoLEP versus TURP, providing data on the outcomes indicated in Table 4-6. No data were available for BPHII or postoperative LUTS (as a binary outcome).

Table 4-6: Effectiveness outcomes assessed in RCTs comparing HoLEP versus TURP

Study ID	Sun 2014	Tan 2003	Bai 2019	Basic 2013	Chen 2013	Eltabey 2010	Fayad 2015	Hamouda 2014	Jhanwar 2017	Gupta 2006	Kuntz 2004	Mavuduru 2009	Montorsi 2004	Elshal 2020 [a]
IPSS at 1 month	x	x		x	x	x	x	x	x		x		x	x
IPSS at 3 months		x		x				x	x			x		x
IPSS at 6 months		x		x	x	x		x	x	x	x		x	
IPSS at 12 months	x	x		x	x	x	x	x	x	x	x		x	x
IPSS at 24 months					x				x					x
IPSS at 36 months														x
Qmax at 1 month	x	x			x	x	x	x	x		x		x	x

Study ID	Sun 2014	Tan 2003	Bai 2019	Basic 2013	Chen 2013	Eltabey 2010	Fayad 2015	Hamouda 2014	Jhanwar 2017	Gupta 2006	Kuntz 2004	Mavuduru 2009	Montorsi 2004	Elshal 2020 [a]
Qmax at 3 months		x						x	x			x		x
Qmax at 6 months		x			x	x		x	x	x	x		x	
Qmax at 12 months	x	x			x	x	x	x	x	x	x		x	x
Qmax at 24 months					x				x					x
Qmax at 36 months														x
PVR at 1 month	x			x		x		x	x		x			x
PVR at 3 months				x				x	x			x		x
PVR at 6 months		x		x	x	x		x	x	x	x			
PVR at 12 months	x			x		x		x	x	x	x			x
PVR at 24 months									x					x
PVR at 36 months														x
Reintervention total		x		x							x		x	x
QoL at 1 month	x	x		x	x								x	x
QoL at 3 months		x		x										x
QoL at 6 months		x		x	x								x	
QoL at 12 months	x	x		x	x								x	x
QoL at 24 months					x									x
QoL at 36 months														x
Qmed at 1 month													x	
Qmed at 6 months													x	
Qmed at 12 months													x	
Persistent irritative symptoms				x		x		x		x				x
Postoperative LUTS														x
Hospitalisation time	x	x	x	x	x	x		x	x		x		x	x [b]
Procedure time	x		x	x	x	x		x	x	x	x	x	x	x

[a] Data for IPSS, Qmax, QoL and PVR were extrapolated from graphs.

[b] Data were estimated according to McGrath et al. [63].

The patient cohorts in the studies were heterogeneous in terms of prostate size category. Average size was available in 13 of 14 the studies, whereas information on the range was available in only five studies (range from 20 to 156 ml). Prostate size was used as an inclusion criterion in only six studies. For our prespecified prostate size subgroups, none of the studies included patients that could be assigned exclusively to one of these. All but three studies included patients with prostate size in the range 30–80 ml.

Pooling of data was possible for IPSS, Qmax and PVR (at 1, 3, 6, 12 and 24 months), QoL (1, 3, 6 and 12 months), reintervention, persistent irritative symptoms, hospitalisation time and procedure time. Data from Basic 2013 were excluded from the analyses since this study appears to be an outlier in all the analyses and the patient cohort had a smaller prostate size and was younger than

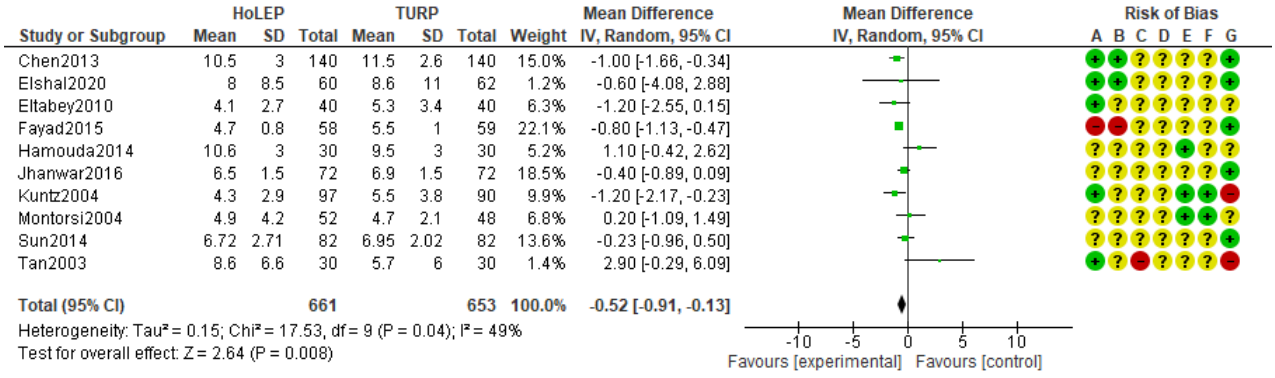
in most of the other studies. Exclusion of this study helped to somewhat reduce the heterogeneity, although substantial heterogeneity remained in some analyses.

Differences in favour of HoLEP were found for IPSS at 1 month (mean –0.52, 95% CI –0.91 to –0.13; I^2=49%, high RoB); Qmax at 12 months (mean 0.63 ml/s, 95% CI 0.07–1.20; I^2=28%, high RoB) and 24 months (mean 0.92 ml/s, 95% CI 0.19–1.66; I^2=63%, uncertain RoB); PVR at 6 months (mean –4.98 ml, 95% CI –9.34 to –0.63; I^2=83%, uncertain RoB) and 12 months (mean –7.56 ml, 95% CI –14.30 to –0.81; I^2=86%, uncertain RoB); QoL at 12 months (mean –0.21, 95% CI –0.33 to –0.10; I^2=74%, uncertain RoB); and reintervention (RR 0.46, 95% CI 0.23–0.94; I^2=64%, high RoB). Hospitalisation time was shorter in all but one study (up to 2 days less), whereas procedure time was shorter for TURP in almost all studies (up to 26 min less). Pooled differences in favour of HoLEP for IPSS and Qmax (as well as their CIs) were below the MCID reported in the scientific literature. Pooled results do not show differences for persistent irritative symptoms. Subgroup analyses by age and baseline IPSS did not substantially reduce heterogeneity, whereas subgroup analyses by prostate size showed that response in larger prostates was more homogeneous. The quality of the evidence for all these outcomes was judged as low to very low because of indirectness, inconsistency and RoB.

No data were available for BPHII or postoperative LUTS (as a binary outcome). Qmed was assessed in one RCT, which showed differences in favour of HoLEP at 1 month (13.3 vs. 10.1 ml/s; p=0.02, 95% CI not available), 6 months (13.3 vs. 9.1 ml/s; p=0.01, 95% CI not available) and 12 months (15.5 vs. 12.1 ml/s; p=0.01, 95% CI not available). Postoperative LUTS were assessed in one RCT, which showed lower incidence with HoLEP (3.3%) than with TURP (17.7%; p=0.01, 95% CI not available). All these differences were judged to be associated with uncertain RoB.

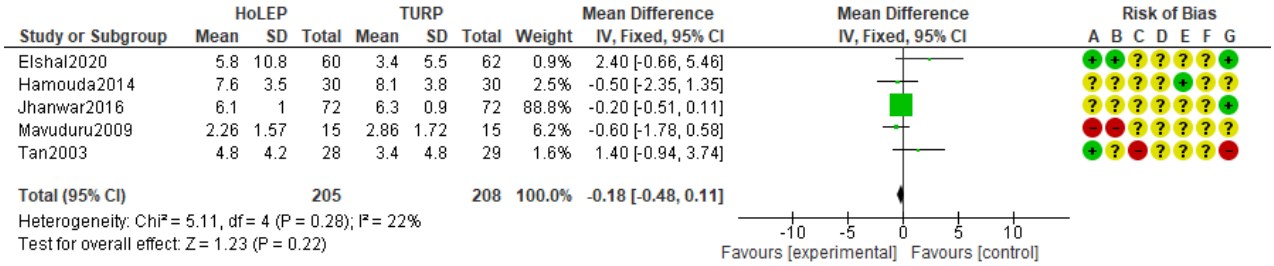
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



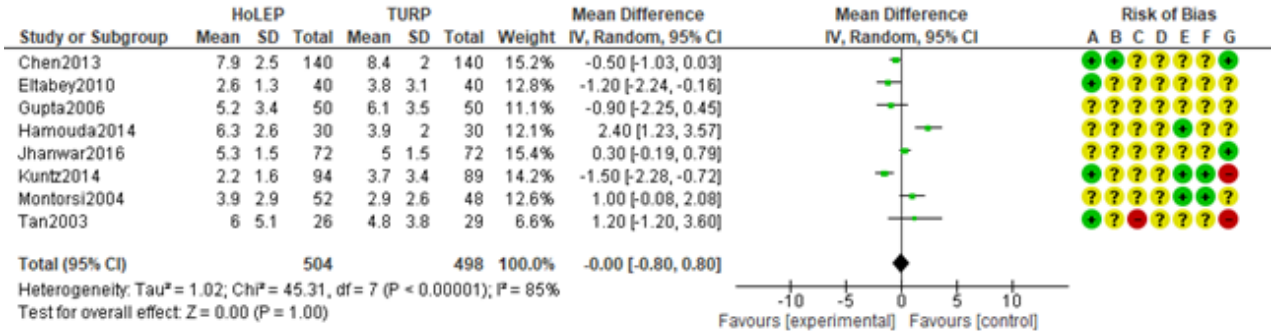
Note: lower IPSS scores are better.

IPSS at 3 months



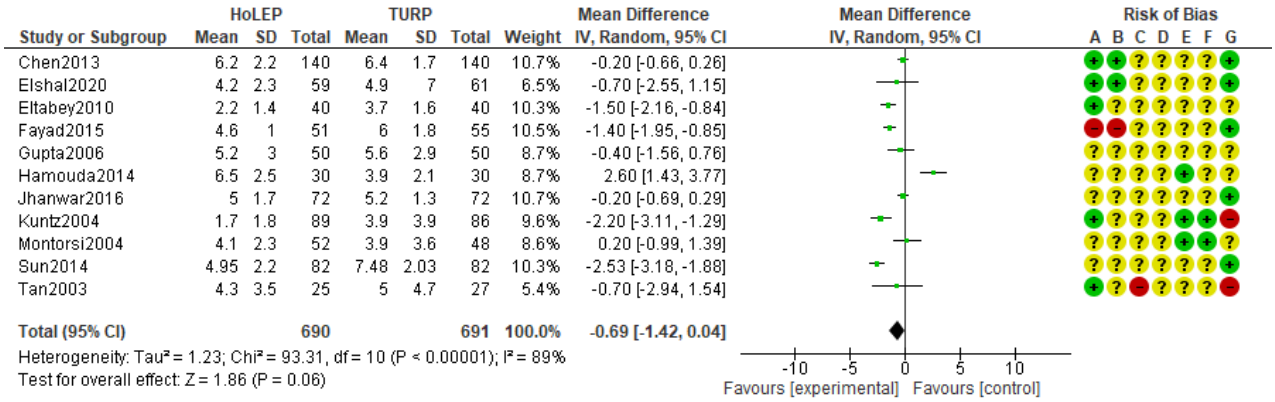
Note: lower IPSS scores are better.

IPSS at 6 months



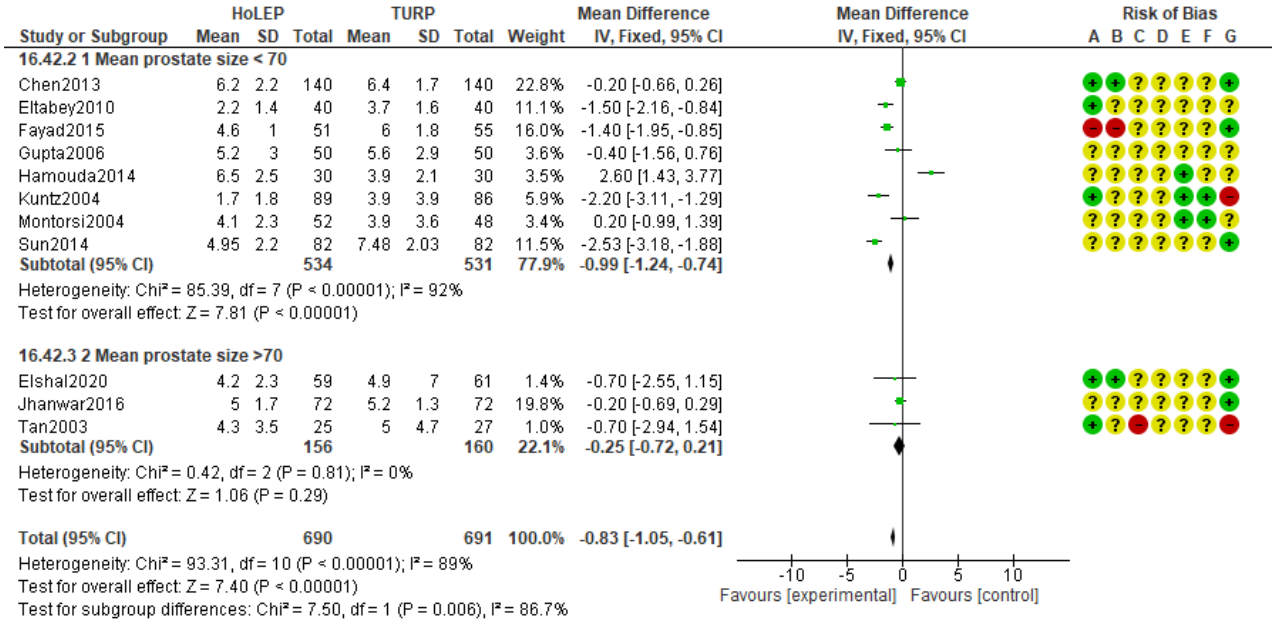
Notes: SD values for Gupta 2006 were estimated using the mean of SDs from Chen 2013, Eltabey 2010, Homouda 2014 and Kuntz2004, which are the studies with the most similar prostate size. Lower IPSS values are better.

IPSS at 12 months



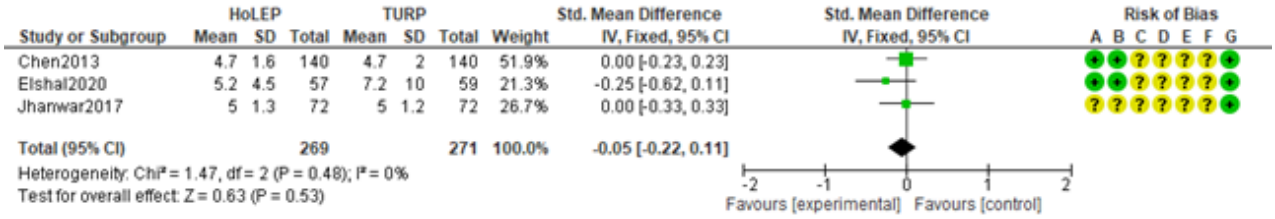
Notes: SD values for Gupta 2006 were estimated using the mean of SDs from Chen 2013, Eltabey 2010, Homouda 2014 and Kuntz2004 which are the studies with the most similar prostate size. Lower IPSS values are better.

IPSS at 12 months with subgroups by prostate size



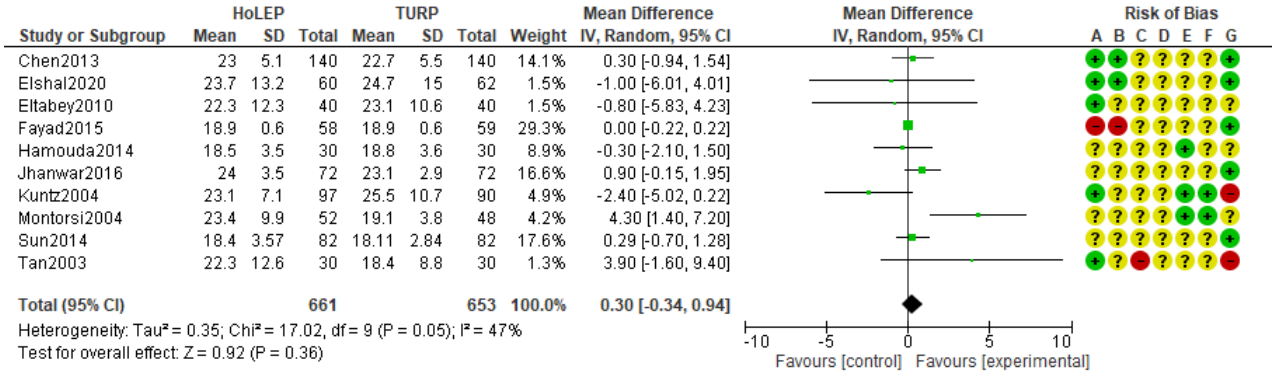
Note: lower IPSS scores are better.

IPSS at 24 months



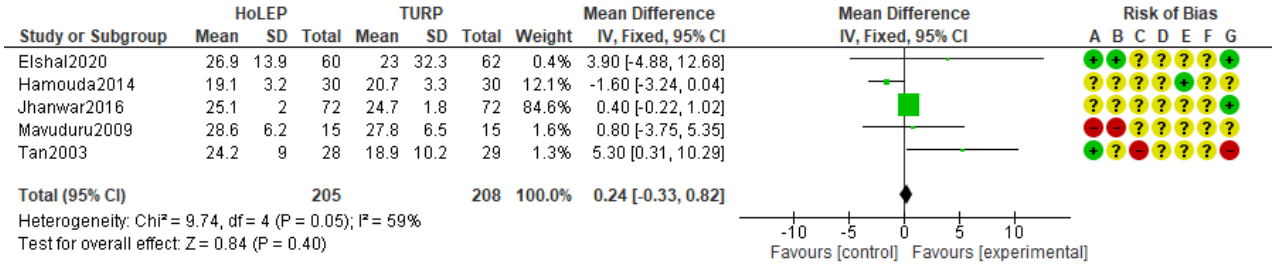
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



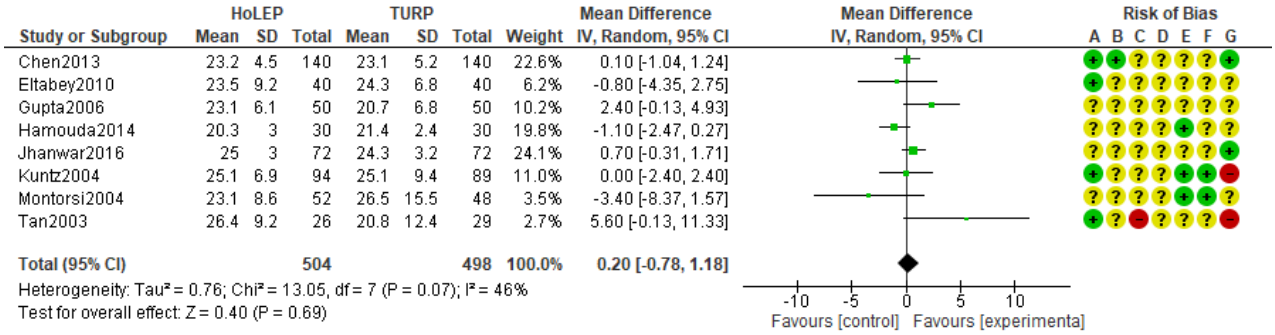
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



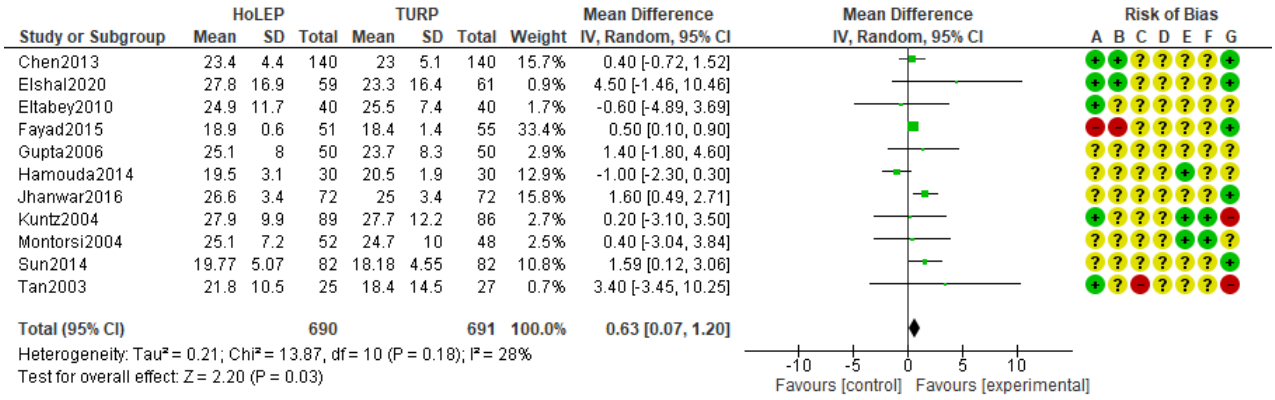
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



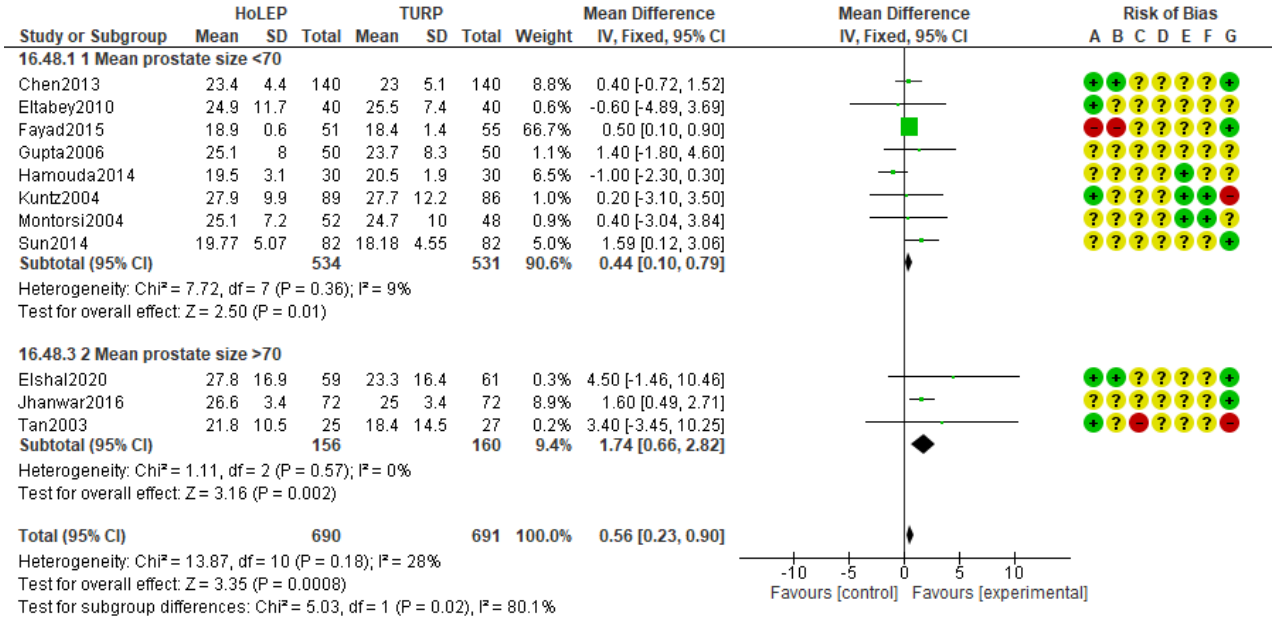
Notes: SD values for Gupta 2006 were estimated using the mean of SDs from Chen 2013, Eltabey 2010, Homouda 2014 and Kuntz 2004, which are the studies with the most similar prostate size. Higher Qmax values are better.

Qmax (ml/s) at 12 months



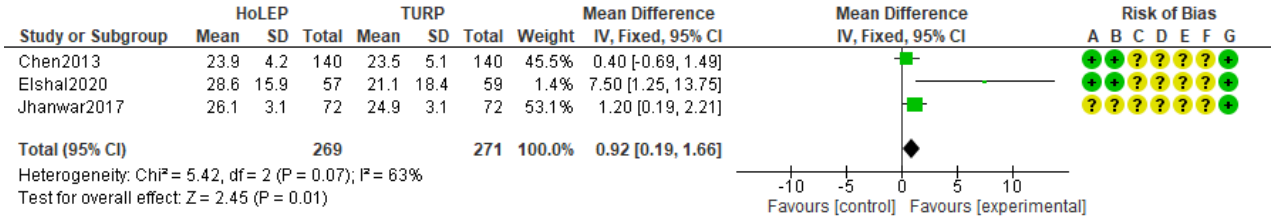
Notes: SD values for Gupta 2006 were estimated using the mean of SDs from Chen 2013, Eltabey 2010, Homouda 2014 and Kuntz 2004, which are the studies with the most similar prostate size. Higher Qmax values are better.

Qmax (ml/s) at 12 months with subgroups by prostate size



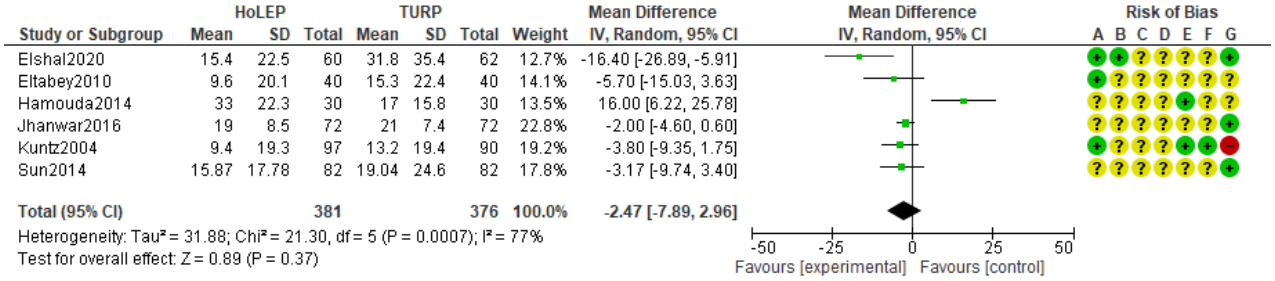
Notes: SD values for Gupta 2006 were estimated using the mean of SDs from Chen 2013, Eltabey 2010, Homouda 2014 and Kuntz 2004, which are the studies with the most similar prostate size. Higher Qmax values are better.

Qmax (ml/s) at 24 months



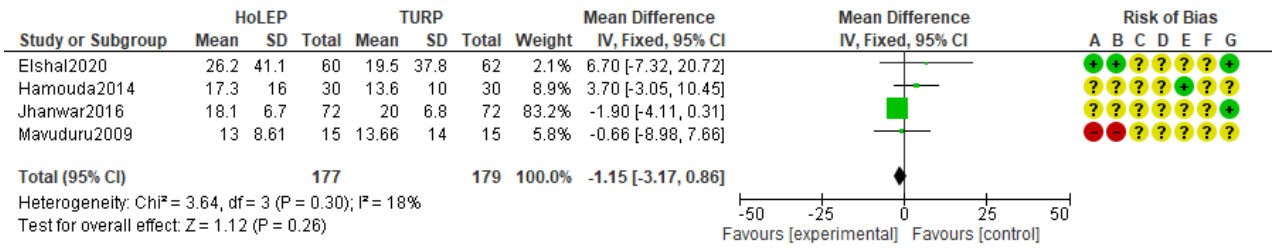
Note: higher Qmax values are better.

PVR (ml) at 1 month



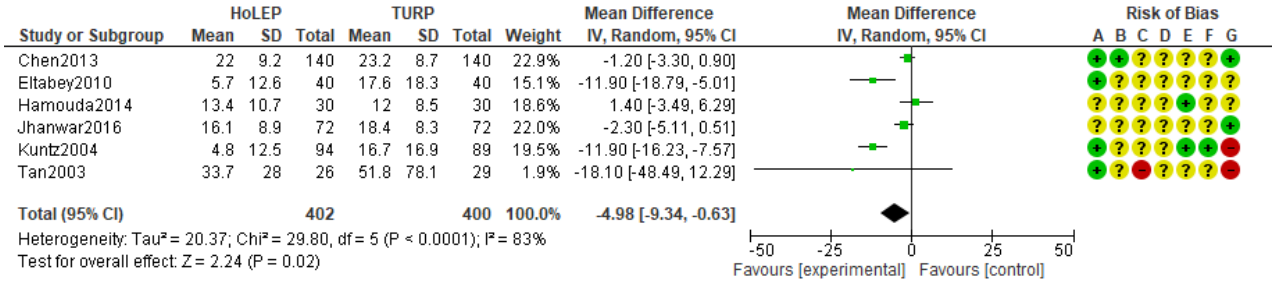
Note: lower PVR values are better.

PVR (ml) at 3 months



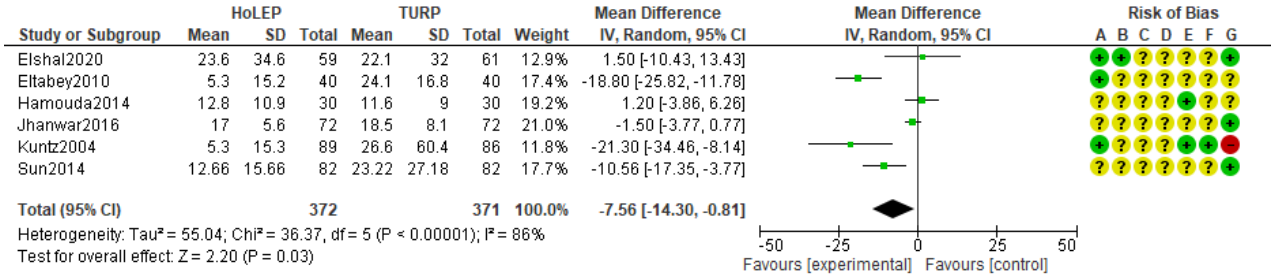
Note: lower PVR values are better.

PVR (ml) at 6 months



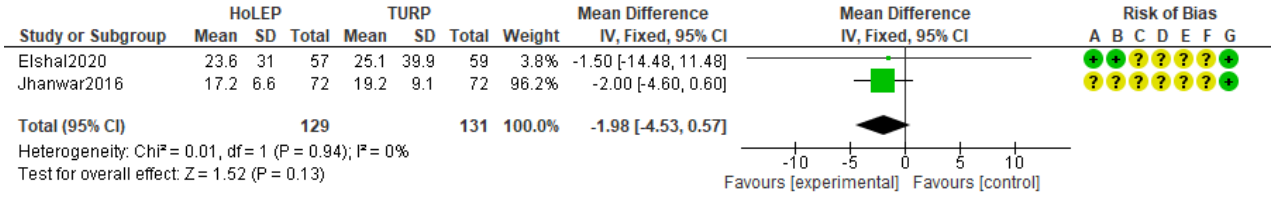
Note: lower PVR values are better.

PVR (ml) at 12 months



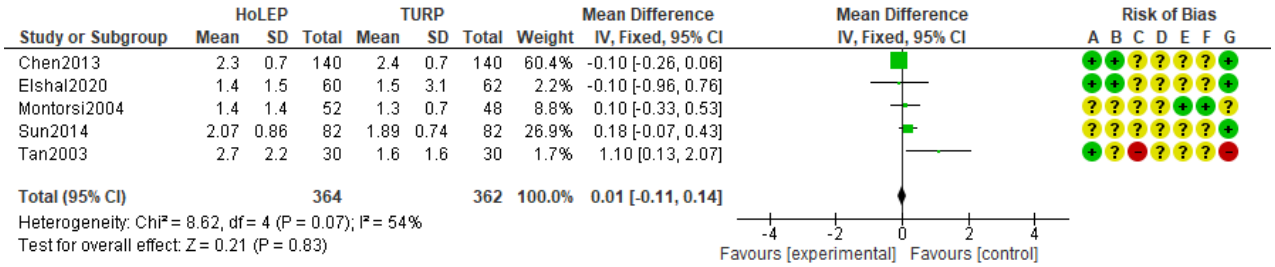
Note: lower PVR values are better.

PVR (ml) at 24 months



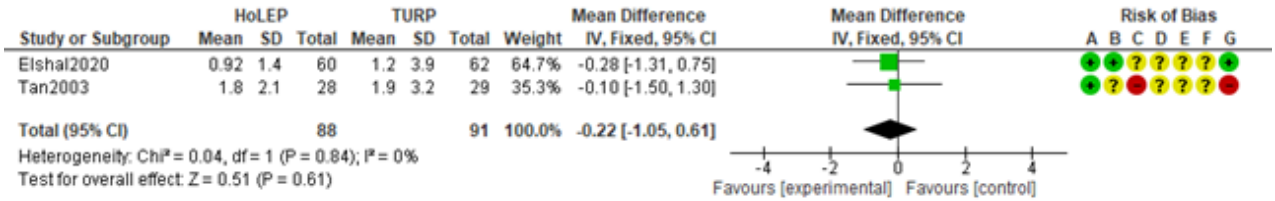
Note: lower PVR values are better.

QoL at 1 month



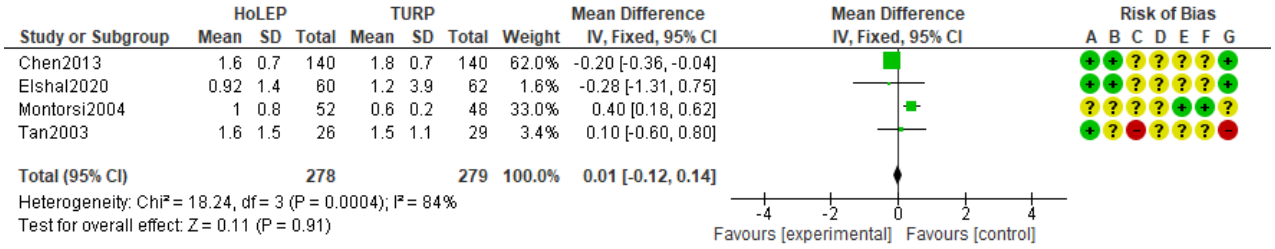
Note: lower QoL scores are better.

QoL at 3 months



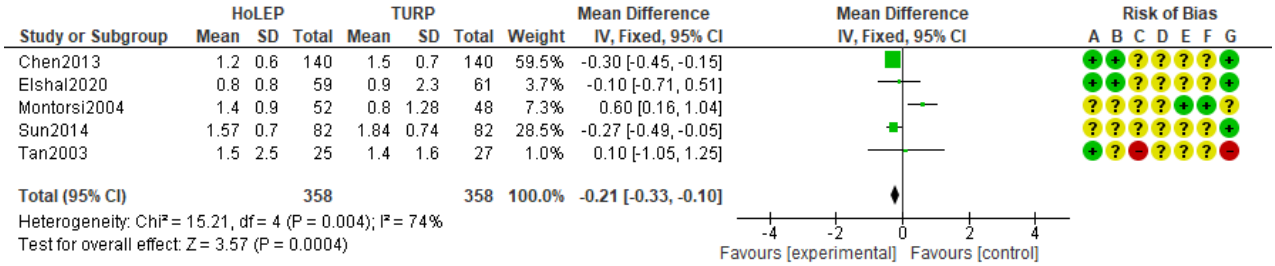
Note: lower QoL scores are better.

QoL at 6 months



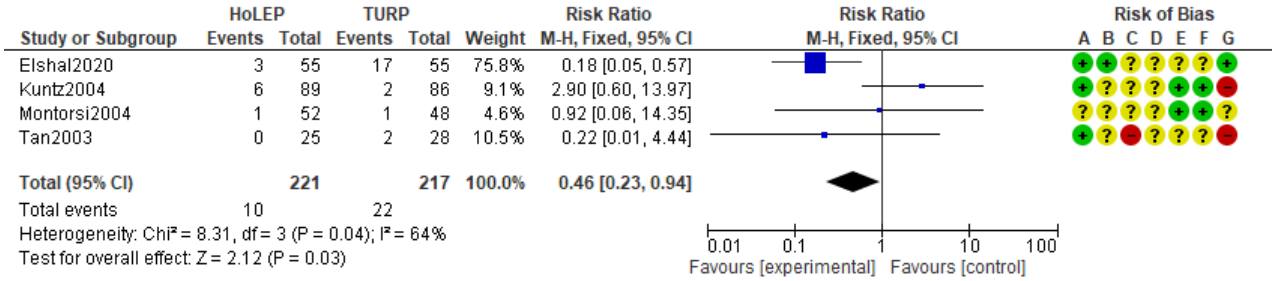
Note: lower QoL scores are better.

QoL at 12 months

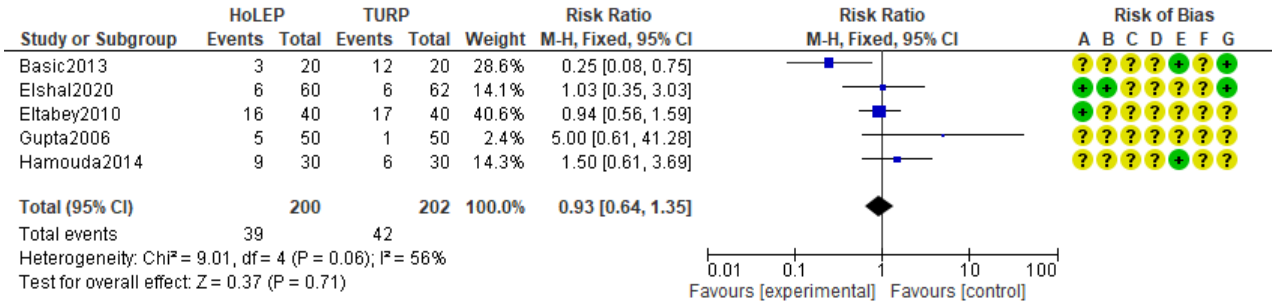


Note: lower QoL scores are better.

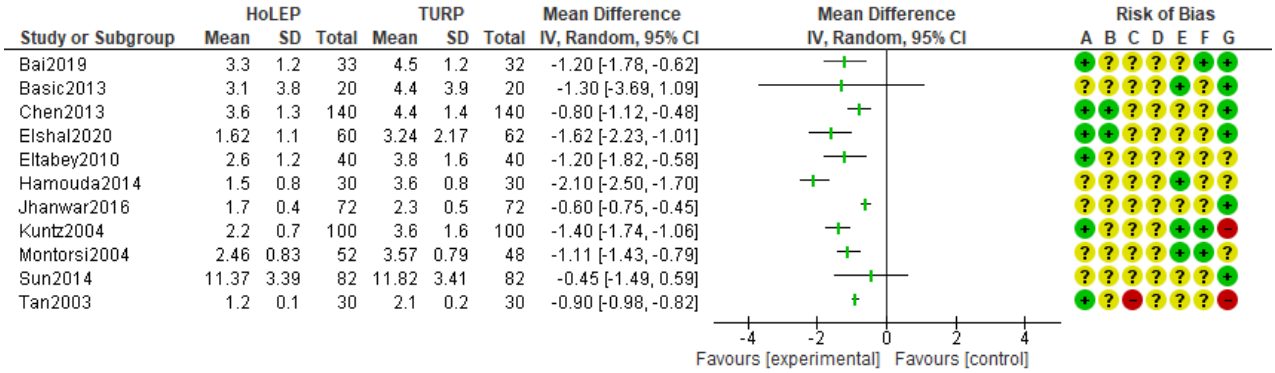
Reintervention



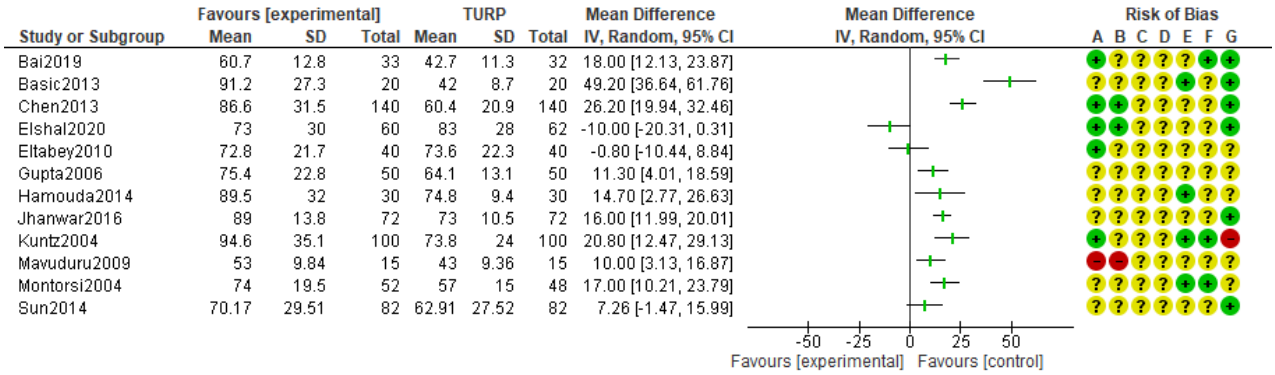
Persistent irritative symptoms



Hospitalisation time (days)



Procedure time (min)



HoLEP versus B-TUEP

Three RCTs (Neill 2006, n=40; Habib 2020, n=64; Higazy 2020, n=120) compared HoLEP versus B-TUEP. Patients included in Habib 2020 and Higazy 2020 had a prostate size >80 ml and can be classified in the large prostate subgroup, whereas patients in Neill 2006 were mostly in the 30–80 ml subgroup. These three studies provided data for the outcomes indicated in Table 4-7. No data were available for Qmed, BPHII or postoperative LUTS (as a binary outcome).

Table 4-7: Effectiveness outcomes assessed in RCTs comparing HoLEP versus B-TUEP

Study ID	Neill 2006	Habib 2020 [a]	Higazy 2020
IPSS at 1 month	x		x
IPSS at 3 months	x		x
IPSS at 6 months	x		
IPSS at 12 months	x	x	x
Qmax at 1 month	x		x
Qmax at 3 months	x		x
Qmax at 6 months	x		
Qmax at 12 months	x	x	x
PVR at 1 month			x
PVR at 3 months			x
PVR at 6 months	x		
PVR at 12 months		x	x

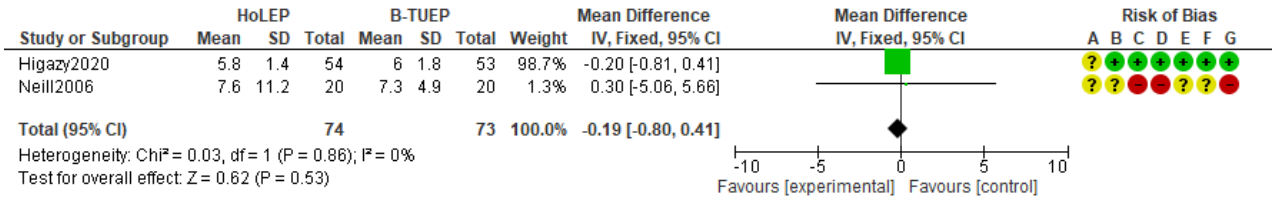
Study ID	Neill 2006	Habib 2020 [a]	Higazy 2020
QoL at 12 months		x	x
Reintervention	x		
Procedure time	x	x	x
Hospitalisation time	x	x	x
Persistent irritative symptoms		x	

[a] Only data on IPSS could be estimated according to the Cochrane Handbook method.

Pooling of data was possible for IPSS and Qmax at 1, 3 and 12 months and PVR at 12 months. Regarding functional outcomes, sensitivity analyses were performed with exclusion of Neill 2006 owing to its large SD and high RoB; the direction of the effect and the statistical significance did not change in these analyses. In particular, a difference in favour of B-TUEP was shown for Qmax at 1 month (1.5 ml/s, 95% CI 0.8–2.3; I^2=26%, high RoB) and at 12 months (0.72 ml/s, 95% CI 0.06–1.38; I^2=0%, high RoB); the quality of the evidence was judged as low because of indirectness and inconsistency. A shorter procedure time was observed for HoLEP in all three studies (up to 22 min less).

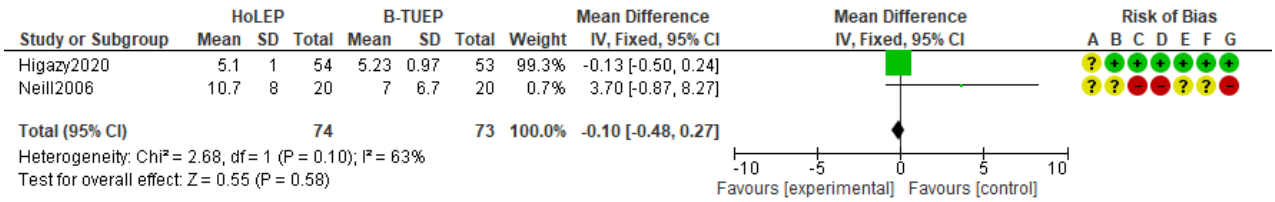
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



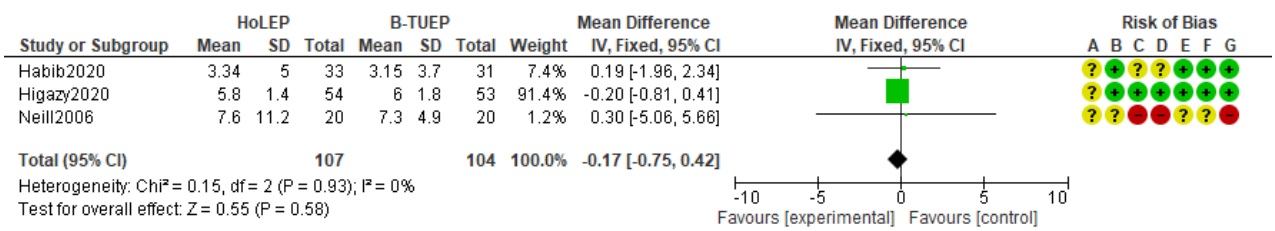
Note: lower IPSS scores are better.

IPSS at 3 months



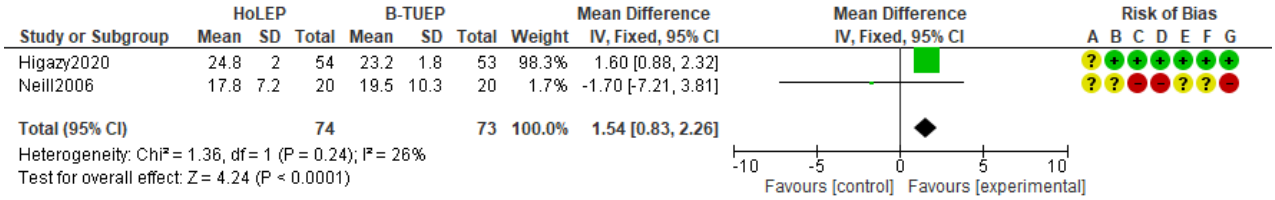
Note: lower IPSS scores are better.

IPSS at 12 months



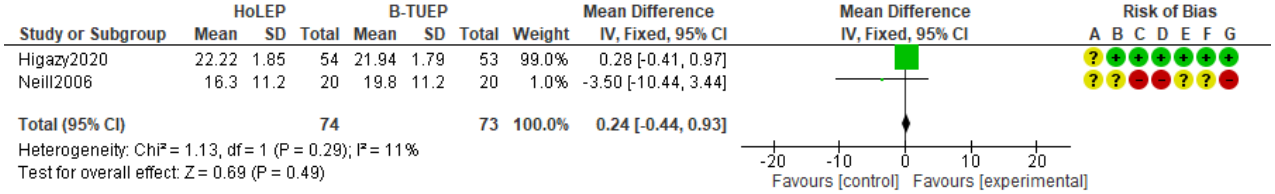
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



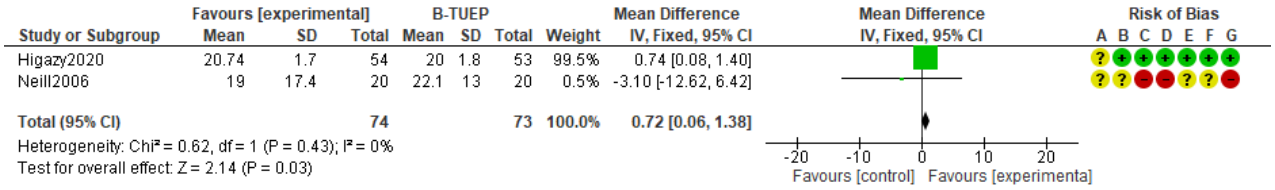
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



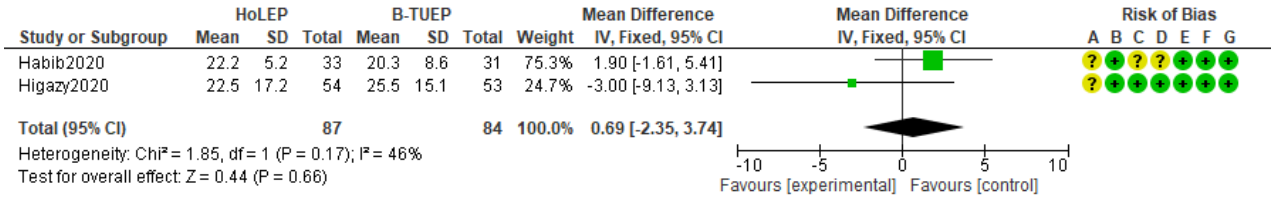
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



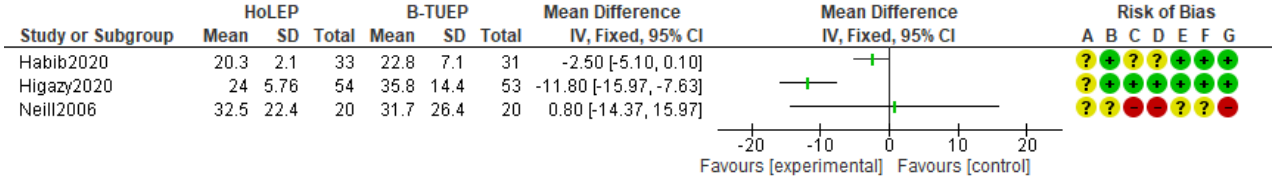
Note: higher Qmax values are better.

PVR (ml) at 12 months

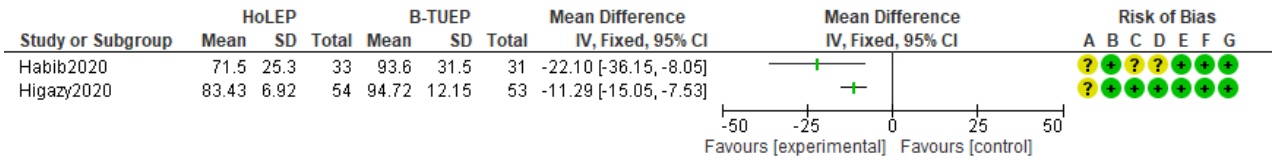


Note: lower PVR values are better.

Hospitalisation time (days)



Procedure time (min)



HoLEP versus DioLEP

One RCT (He 2019, n=126; low RoB) compared HoLEP versus DioLEP among patients with an average prostate size of 79.3 ml for the outcomes Qmax, PVR, IPSS and QoL at 3, 6 and 12 months, operative time and hospital stay. No differences between the groups were observed for any of these outcomes.

HoLEP versus ThuLEP

Three RCTs (Zhang F 2012, n=133; uncertain RoB; Bozzini 2020, n=236; high RoB; Zhang 2020, n=116; uncertain RoB) compared HoLEP versus ThuLEP for the outcomes presented in Table 4-8.

Table 4-8: Effectiveness outcomes assessed in RCTs comparing HoLEP versus ThuLEP

Study ID	Bozzini 2020	Zhang F 2012 [a]	Zhang 2020 [b]
IPSS at 1 month		x	x
IPSS at 3 months	x		x
IPSS at 6 months		x	x
IPSS at 12 months		x	x
IPSS at 18 months		x	x
Qmax at 1 month		x	x
Qmax at 3 months	x		x
Qmax at 6 months		x	x
Qmax at 12 months		x	x
Qmax at 18 months		x	x
PVR at 1 month		x	x
PVR at 3 months	x		x
PVR at 6 months		x	x
PVR at 12 months		x	x
PVR at 18 months		x	x
QoL at 1 month		x	x
QoL at 3 months	x		x
QoL at 6 months		x	x
QoL at 12 months		x	x
QoL at 18 months		x	x
Persistent irritative symptoms		x	
Hospitalisation time		x	x
Procedure time	x	x	x

[a] Data for IPSS, Qmax, QoL and PVR were extrapolated from graphs.

[b] Data for IPSS, PVR, QoL and hospitalisation time were estimated according to the Cochrane Handbook method.

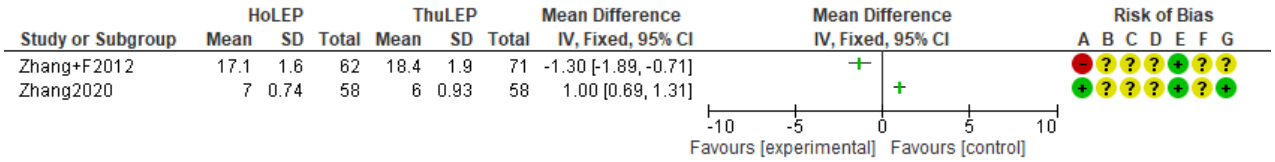
Patients included in these studies were heterogeneous in terms of prostate size category. In particular, in Zhang F 2012 the mean size was 45 ml, whereas in Bozzini 2020 and Zhang 2020 the mean size was 88 and 92 ml, respectively. Pooling of data was avoided in light of such population heterogeneity when statistical heterogeneity was also apparent.

Pooled analyses were possible for IPSS at 3 and 12 months, Qmax at 1 and 18 months, PVR at 1, 3, 6 and 18 months and QoL at 6 and 12 months.

Differences in favour of ThuLEP were found for IPSS at 3 months (mean 0.96, 95% CI 0.53–1.39; I^2=0%, high RoB); PVR at 1 month (mean 3.86 ml, 95% CI 1.19–6.52; I^2=3%, high RoB); and QoL at 6 months (mean 0.09, 95% CI 0.01–0.17; I^2=0%, high RoB). Hospitalisation time was shorter in all but one study (up to 2 days less), whereas procedure time was shorter for TURP in almost all studies (up to 26 min less). The quality of the evidence for all these outcomes was judged as low to very low because of indirectness, inconsistency and RoB. No data were available for BPHII or postoperative LUTS (as a binary outcome). Qmed was assessed in one RCT, which showed differences in favour of HoLEP at 1 month (13.3 vs. 10.1 ml/s; p=0.02, 95% CI not available), 6 months (13.3 vs. 9.1 ml/s; p=0.01, 95% CI not available) and 12 months (15.5 vs. 12.1 ml/s; p=0.01, 95% CI not available). Postoperative LUTS were assessed in one RCT, which showed lower incidence with HoLEP (3.3%) than with TURP (17.7%; p=0.01, 95% CI not available).

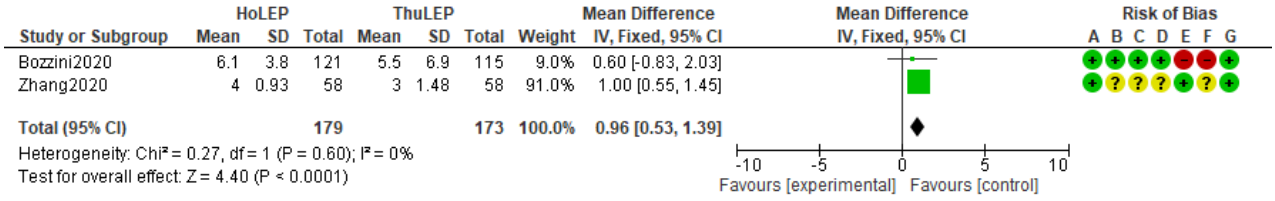
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



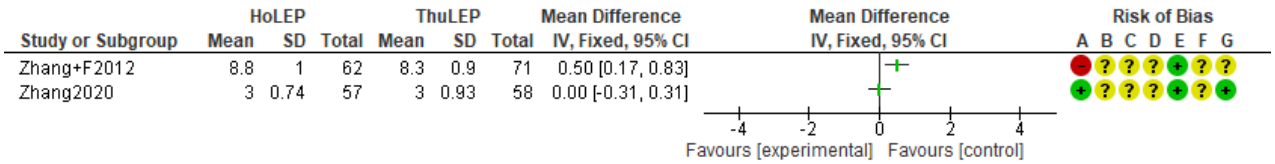
Note: lower IPSS scores are better.

IPSS at 3 months



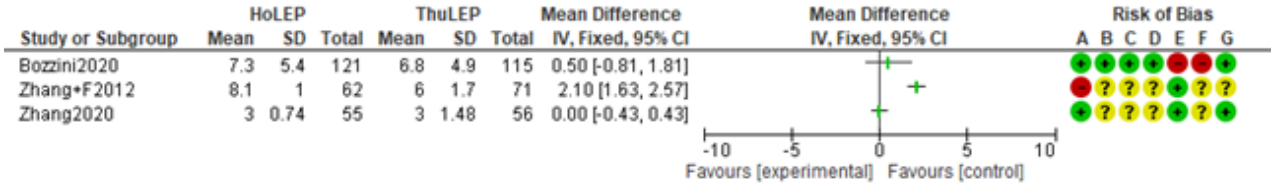
Note: lower IPSS scores are better.

IPSS at 6 months



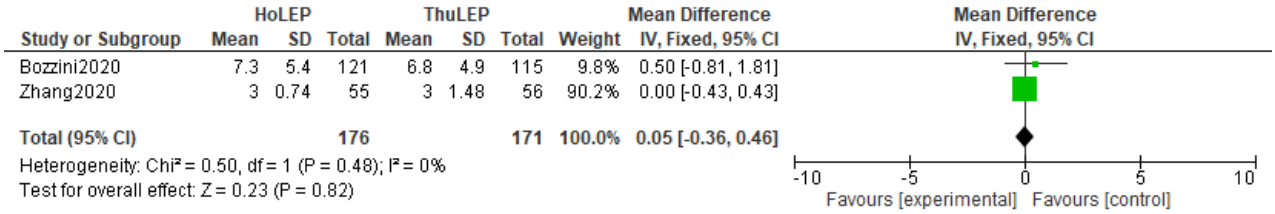
Note: lower IPSS scores are better.

IPSS at 12 months



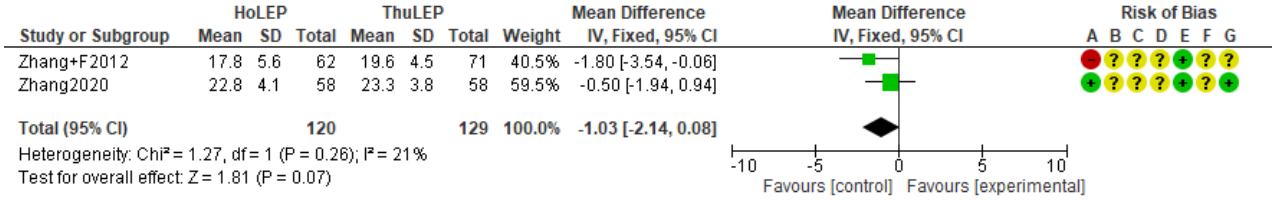
Note: lower IPSS scores are better.

IPSS at 12 months in a sensitivity analysis without Zhang F 2012



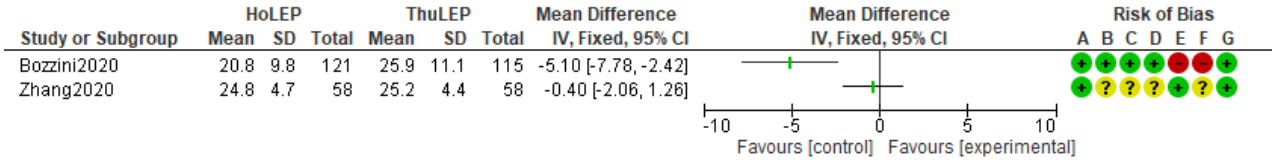
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



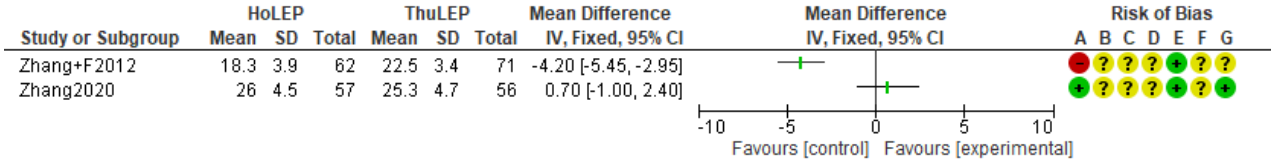
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



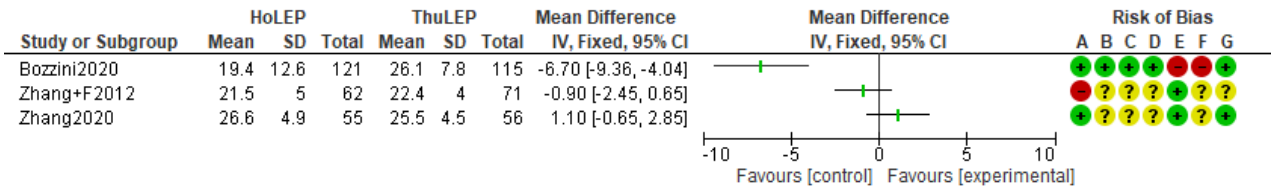
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



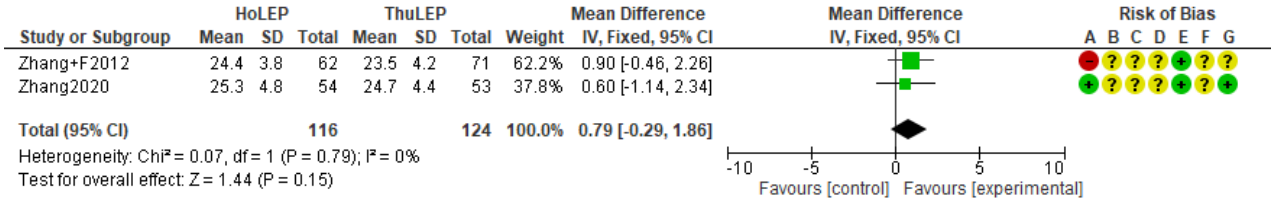
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



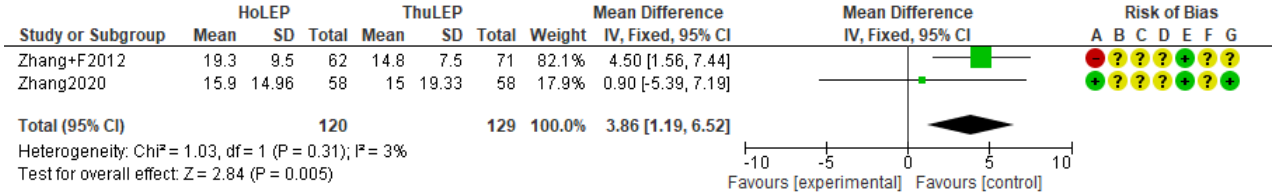
Note: higher Qmax values are better.

Qmax (ml/s) at 18 months



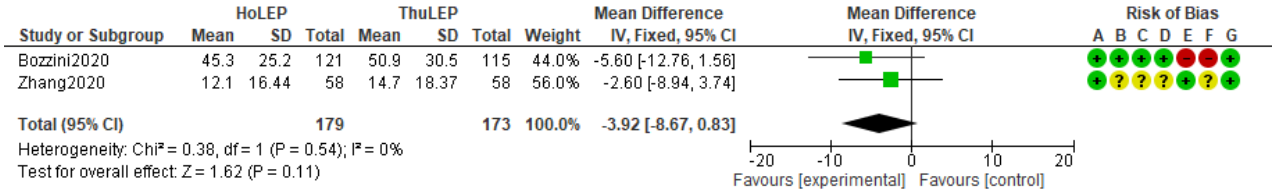
Note: higher Qmax values are better.

PVR (ml) at 1 month



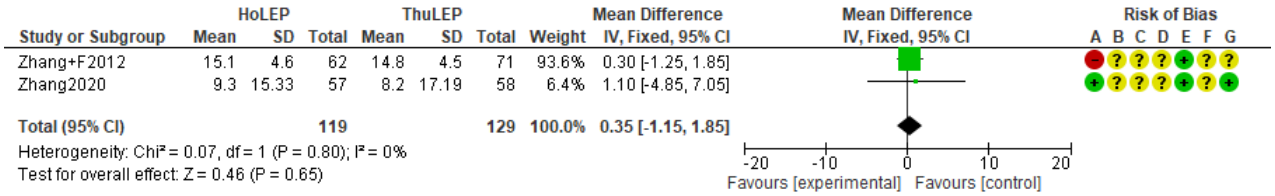
Note: lower PVR values are better.

PVR (ml) at 3 months



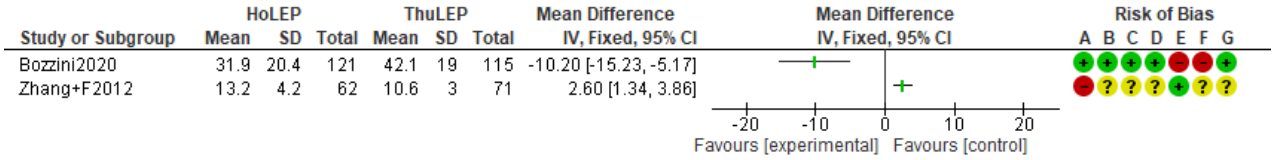
Note: lower PVR values are better.

PVR (ml) at 6 months



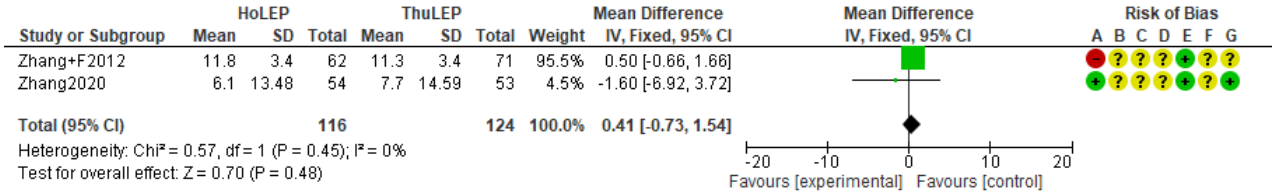
Note: lower PVR values are better.

PVR (ml) at 12 months



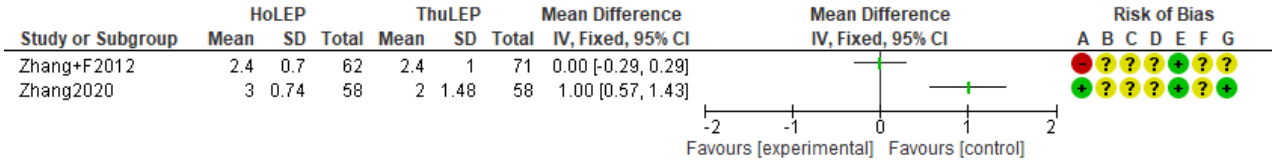
Note: lower PVR values are better.

PVR (ml) at 18 months



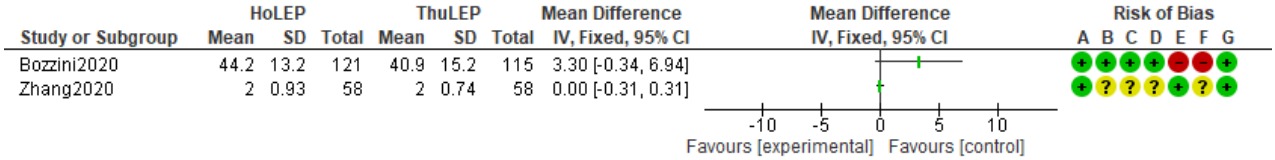
Note: lower PVR values are better.

QoL at 1 month



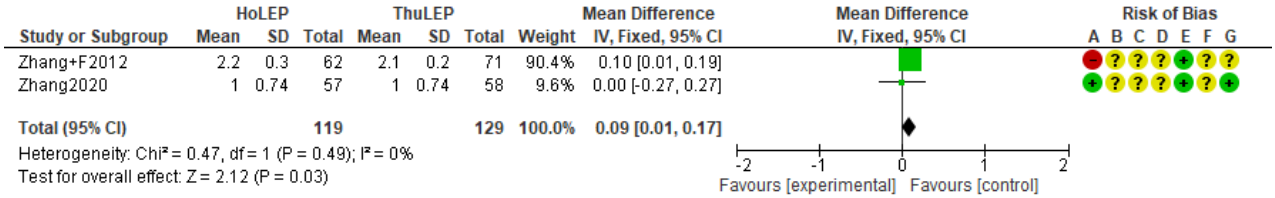
Note: lower QoL scores are better.

QoL 3 months



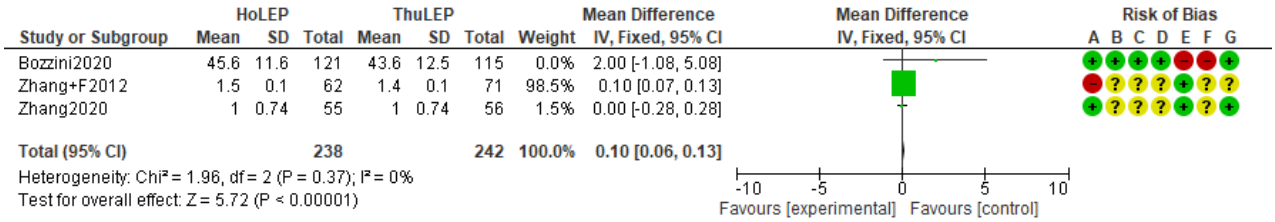
Note: lower QoL scores are better.

QoL at 6 months



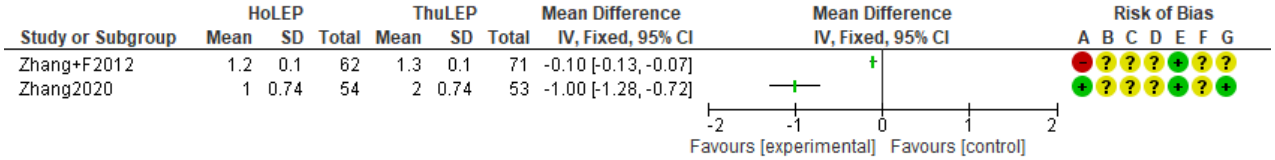
Note: lower QoL scores are better.

QoL at 12 months



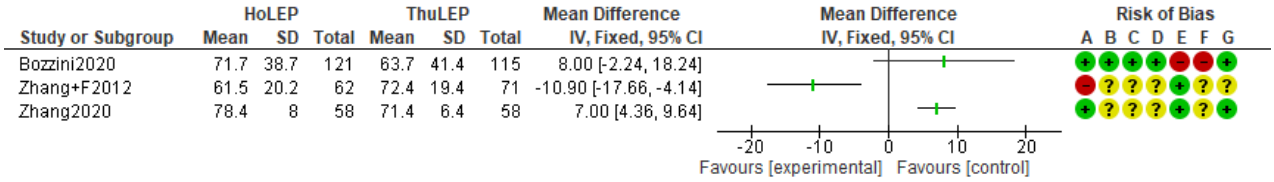
Note: lower QoL scores are better.

QoL at 18 months

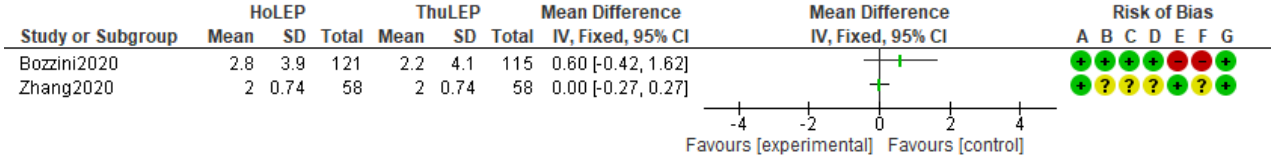


Note: lower QoL scores are better.

Procedure time (min)



Hospitalisation time (days)



HoLEP versus ThuVEP

One RCT (Netsch 2017, n=94; uncertain RoB) compared HoLEP versus ThuVEP among patients with prostate size ranging from 46 to 110 ml, assessing IPSS, QoL, Qmax and PVR (at 1 month), operative time, postoperative stay and irritative symptoms (urge incontinence). A difference of uncertain clinical relevance in favour of ThuVEP was observed for QoL at 1 month (score of 3 vs. 2; p=0.04; 95% CI not available).

HoLEP versus PVP

Two RCTs (Elshal 2015, n=103; Elshal 2020, n=120) compared HoLEP versus PVP among patients with prostate size ranging from 40 to 150 ml, assessing the outcomes indicated in Table 4-9.

Table 4-9: Effectiveness outcomes assessed in RCTs comparing HoLEP versus PVP

Study ID	Elshal 2015 [a]	Elshal 2020 [a]
IPSS at 1 month	x	x
IPSS at 3 months	x (at 4 months)	x
IPSS at 12 months	x	x
IPSS at 24 months		x
IPSS at 36 months		x
Qmax at 1 month	x	x
Qmax at 3 months	x (at 4 months)	x
Qmax at 12 months	x	x
Qmax at 24 months		x
Qmax at 36 months		x
PVR at 1 month	x	x
PVR at 3 months	x (at 4 months)	x
PVR at 12 months	x	x
PVR at 24 months		x
PVR at 36 months		x
QoL at 1 month	x	x
QoL at 3 months	x (at 4 months)	x
QoL at 6 months		x

Study ID	Elshal 2015 [a]	Elshal 2020 [a]
QoL at 12 months	x	x
QoL at 24 months		x
QoL at 36 months		x
Reintervention total		x
Persistent irritative symptoms	x	x
Postoperative LUTS		x
Hospitalisation time	x	x [b]
Procedure time	x	x

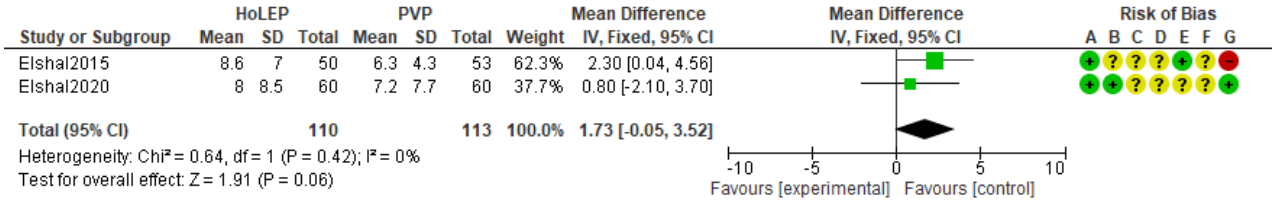
[a] Data for IPSS, Qmax, QoL and PVR were extrapolated from graphs.

[b] Data were estimated according to McGrath et al. [63].

Pooling of data was possible for IPSS, Qmax, PVR and QoL at 1, 3, and 12 months, for reintervention and for persistent irritative symptoms. Differences in favour of HoLEP were observed for IPSS at 3 months (mean –3.05, 95% CI –4.96 to –1.14; I^2=50%, uncertain RoB) and 12 months (mean –2.61, 95% CI –3.94 to –1.28; I^2=46%, uncertain RoB); Qmax at 3 months (mean 5.51, 95% CI 1.93–9.08; I^2=0%, uncertain RoB) and 12 months (mean 11.77, 95% CI 8.39–15.16; I^2=93%, uncertain RoB); PVR at 1 month (mean –14.96, 95% CI –25.41 to –4.51; I^2=0%, uncertain RoB) and 12 months (mean –13.78, 95% CI –24.39 to –3.17; I^2=19%, uncertain RoB); and reintervention (RR 0.26, 95% CI 0.10–0.67; I^2=37%, uncertain RoB). A difference in favour of PVP was observed for QoL at 1 month (mean 0.50, 95% CI 0.10–0.90; I^2=0%, uncertain RoB). The quality of the evidence was considered moderate to low for functional outcomes (owing to imprecision, and inconsistency when I^2>40%) and moderate for reintervention (owing to inconsistency). These differences are higher than the 2 ml/s MCID threshold for Qmax and around the MCID for IPSS.

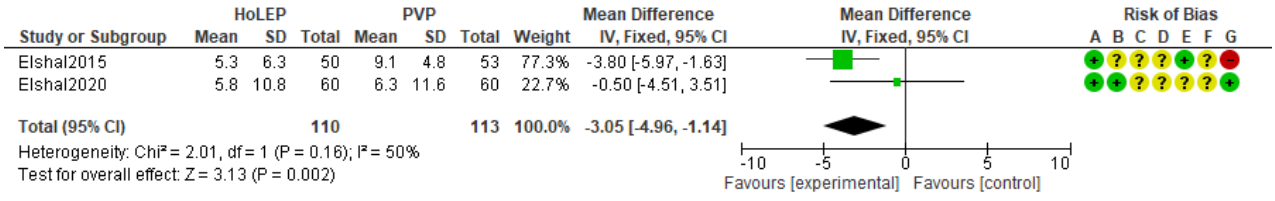
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



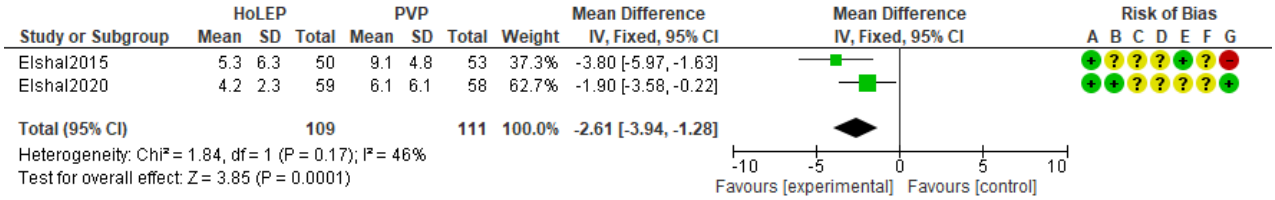
Note: lower IPSS scores are better.

IPSS at 3 months



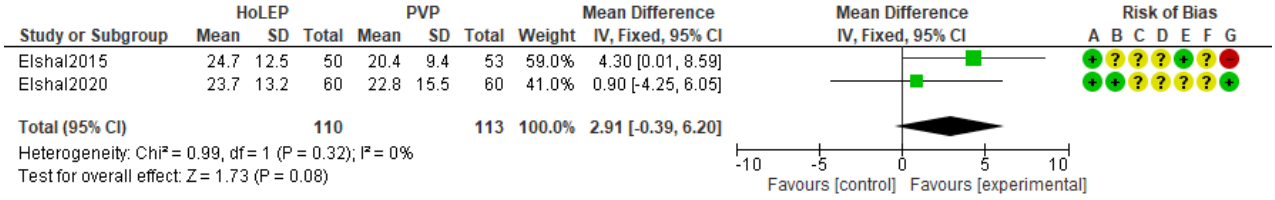
Note: lower IPSS scores are better.

IPSS at 12 months



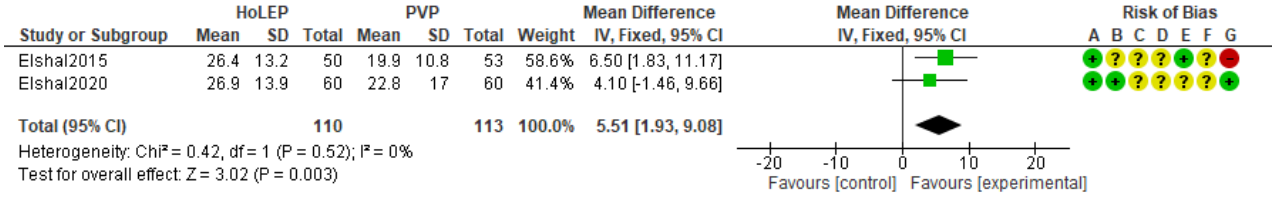
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



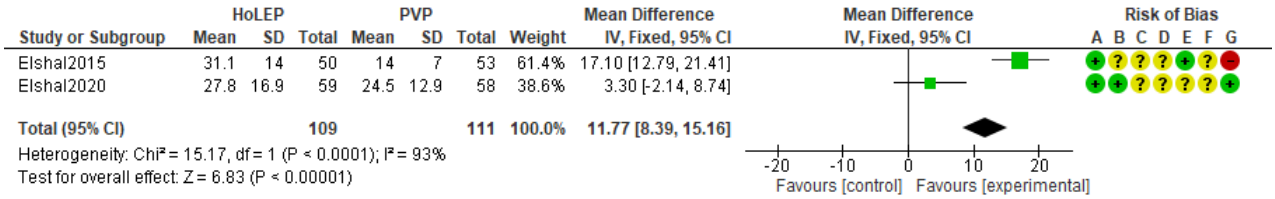
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



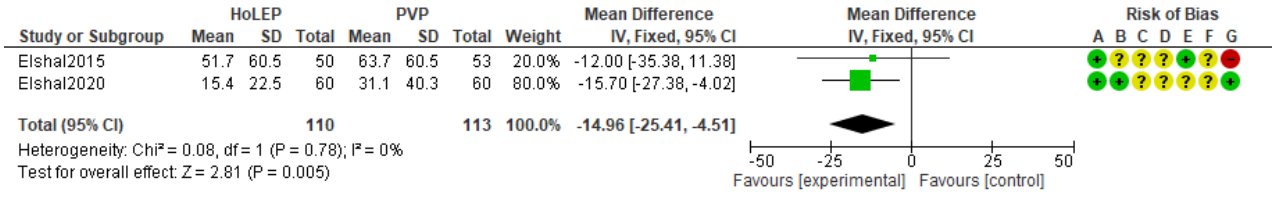
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



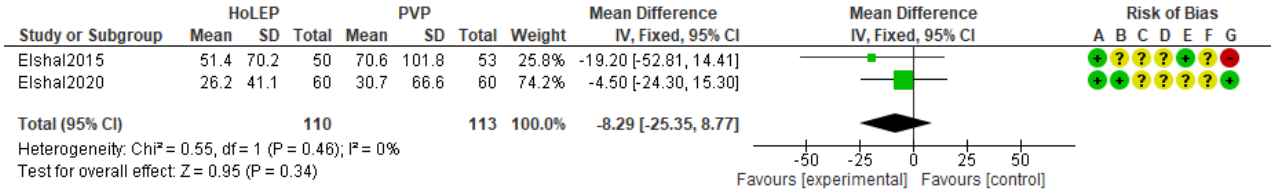
Note: higher Qmax values are better.

PVR (ml) at 1 month



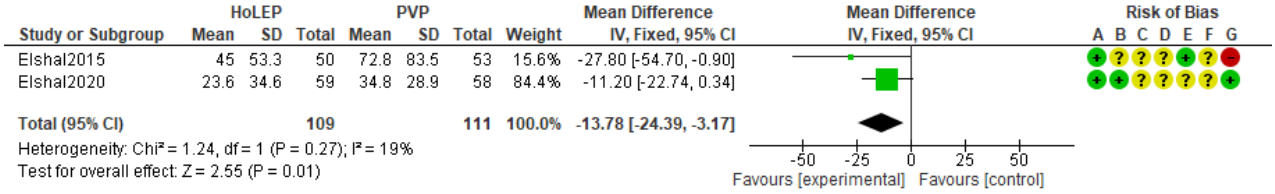
Note: lower PVR values are better.

PVR (ml) at 3 months



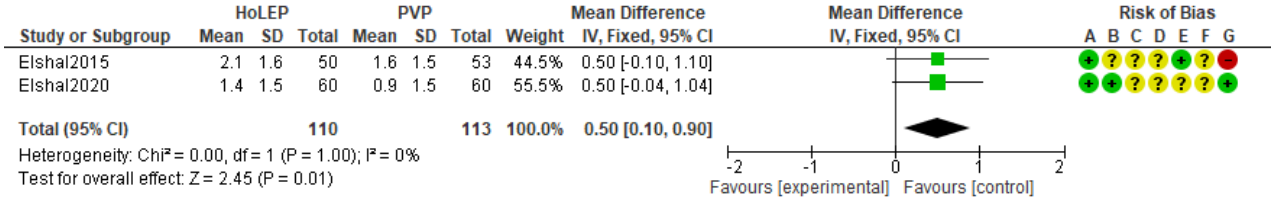
Note: lower PVR values are better.

PVR (ml) at 12 months



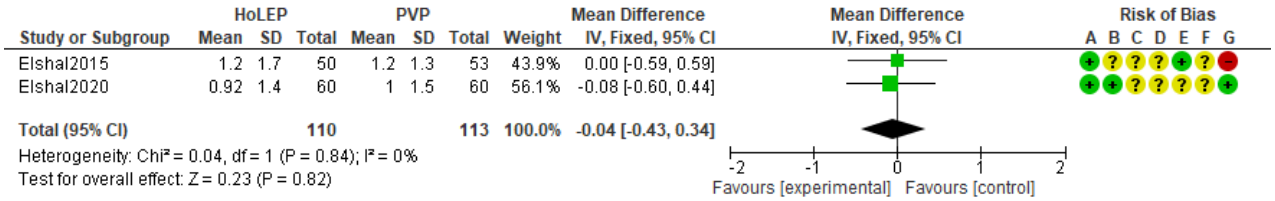
Note: lower PVR values are better.

QoL at 1 month



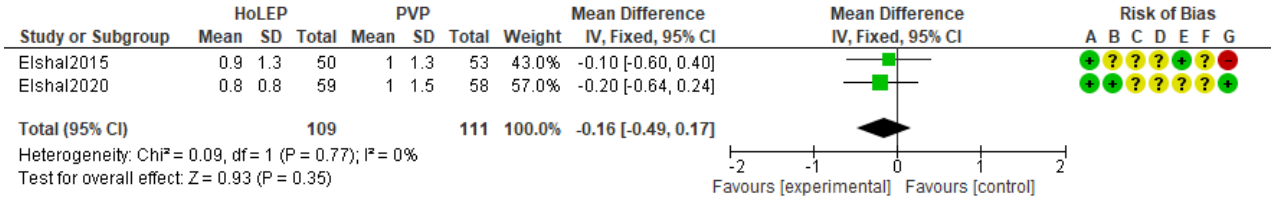
Note: lower QoL scores are better.

QoL at 3 months



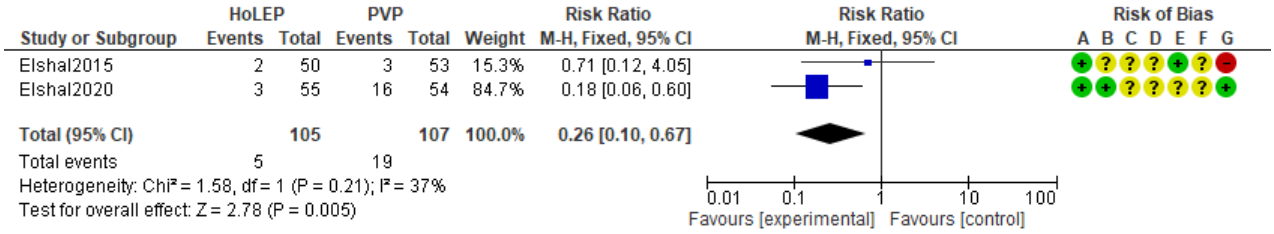
Note: lower QoL scores are better.

QoL at 12 months

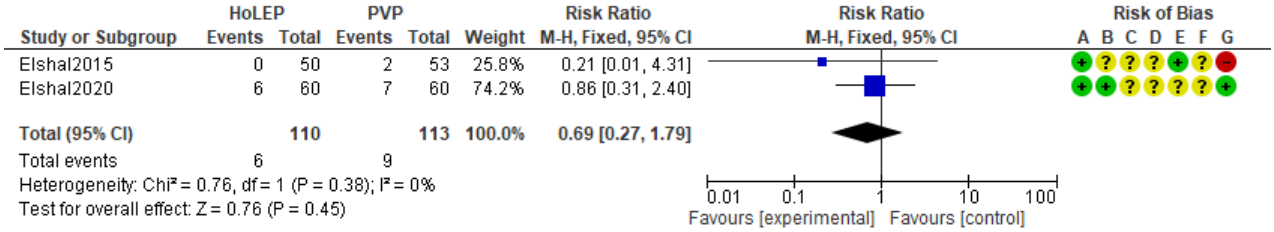


Note: lower QoL scores are better.

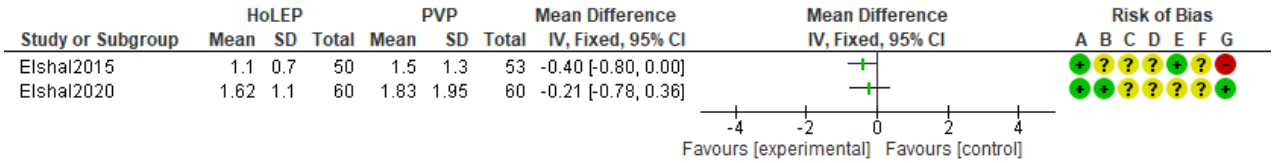
Reintervention



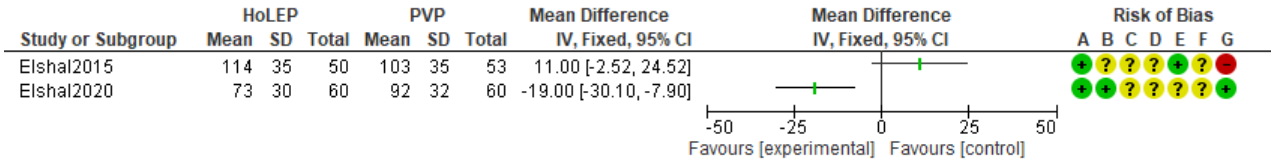
Persistent irritative symptoms



Hospitalisation time (days)



Procedure time (min)



ThuLEP

ThuLEP was assessed in nine of the RCTs, including a total of 1327 patients: five RCTs versus TURP (n=715), three RCTs versus HoLEP (n=485) and one RCT versus B-TUEP (n=127).

ThuLEP versus TURP

Five RCTs (Bozzini 2017, n=208; Yang 2013, n=158, Enikeev 2019, n=103; Swiniarski 2012, n=106; Shoji 2020, n=140), all with uncertain RoB, compared ThuLEP versus TURP. One study (Yang 2013) included patients with prostate volume <100 ml. The other four studies (Bozzini 2017, Swiniarski 2012, Enikeev 2019 and Shoji 2020) included patients on the basis of other inclusion criteria and regardless of prostate size. Consequently, mean/median prostate size differed between the studies (from 53 to 89.3 ml for ThuLEP and from 53 to 81.9 ml for TURP). Three studies reported prostate volume ranges that overall comprised prostates from 28 to 149 ml. Outcomes assessed in these studies are indicated in Table 4-10. There were no data for BPHII or reintervention.

Table 4-10: Effectiveness outcomes assessed in RCTs comparing ThuLEP versus TURP

Study ID	Bozzini 2017	Enikeev 2019	Swiniarski 2012	Yang 2013	Shoji 2020 [a]
IPSS at 1 month			x	x	x
IPSS at 3 months	x		x	x	x
IPSS at 6 months		x		x	x
IPSS at 12 months		x		x	x
IPSS at 18 months				x	
Qmax at 1 month			x	x	x
Qmax at 3 months	x		x	x	x
Qmax at 6 months		x		x	x
Qmax at 12 months		x		x	x
Qmax at 18 months				x	
PVR at 1 month			x	x	
PVR at 3 months	x		x	x	
PVR at 6 months		x		x	
PVR at 12 months		x		x	
PVR at 18 months				x	
QoL at 1 month			x	x	x
QoL at 3 months	x		x	x	x
QoL at 6 months		x		x	x
QoL at 12 months		x		x	x
QoL at 18 months				x	
Persistent irritative symptoms	x		x		
Hospitalisation time	x	x	x	x	x [b]
Procedure time	x	x	x	x	x [b]

[a] Data for IPSS, Qmax and QoL were extrapolated from graphs.

[b] Data estimated according to McGrath et al. [63].

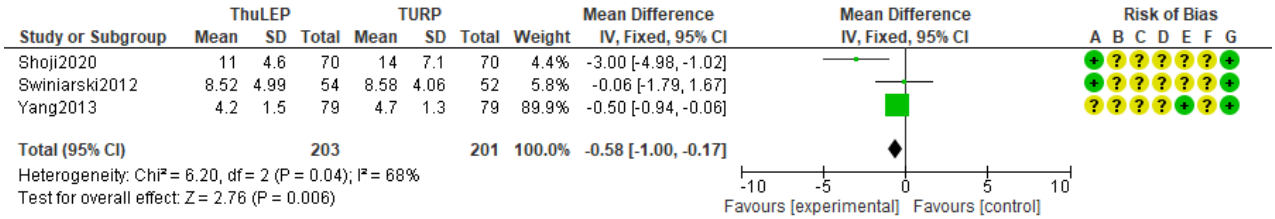
Pooling of data was possible for IPSS, Qmax, PVR and QoL at 1, 3, 6 and 12 months, intervention, persistent irritative symptoms, procedure time and hospitalisation time. Differences in favour of ThuLEP were observed for IPSS at 1 month (mean –0.58, 95% CI –1.00 to -0.17; I^2=68%, uncertain R6oB) and 6 months (mean –0.72, 95% CI –1.14 to –0.29; I^2=0%, uncertain RoB). PVR at 3 months was in favour of ThuLEP, although high heterogeneity observed in this analysis could be explained by Bozzini 2017 (higher prostate size than other studies) and exclusion of this study led to loss of statistical significance. Heterogeneity is not easy to explain for IPSS at 1 month. Hospitalisation time was shorter for ThuLEP in three of the four studies, with great heterogeneity of results. Differences in favour of TURP were observed for QoL at 1 month (mean 0.10, 95% CI 0.04–0.16; I^2=0%, uncertain RoB). Procedure time was shorter for TURP in three of the four studies, with great heterogeneity of results. The quality of the evidence for these outcomes was judged to be low for IPSS at 1 month and for QoL at 1 month because of inconsistency and imprecision (small sample size).

For the other outcomes, no significant differences were observed. It should be noted that Swiniarski 2012 considered only patients without an indwelling catheter for calculation of Qmax and PVR values.

Yang 2013 also reported results for IPSS, Qmax, PVR and QoL at 18 months for ThuLEP versus TURP, with no significant differences between the groups. Owing to the different scale used to calculate QoL, data from Bozzini 2017 could not be pooled; however, no significant difference was found for this outcome at 3 months.

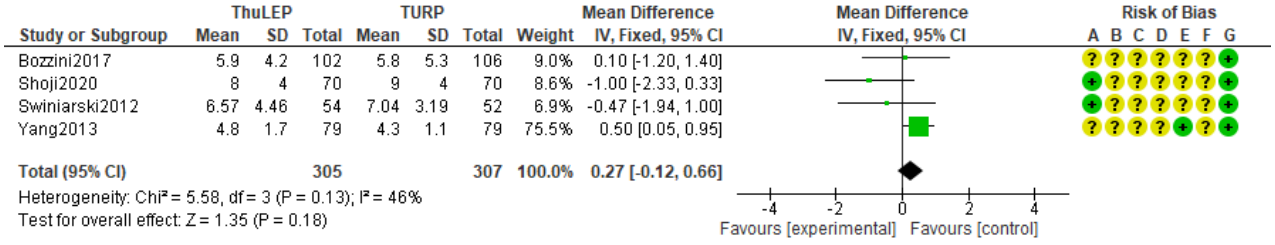
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



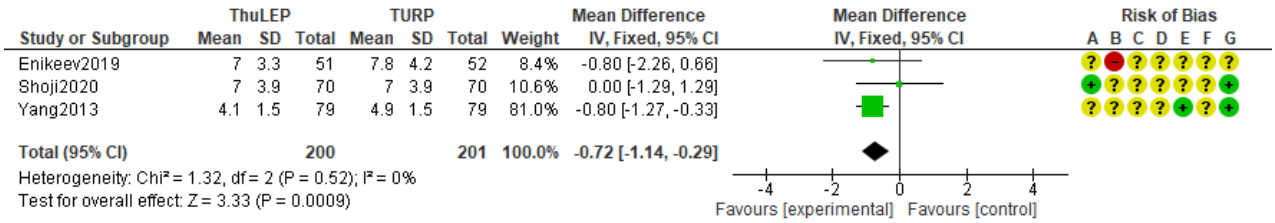
Note: lower IPSS scores are better,

IPSS at 3 months



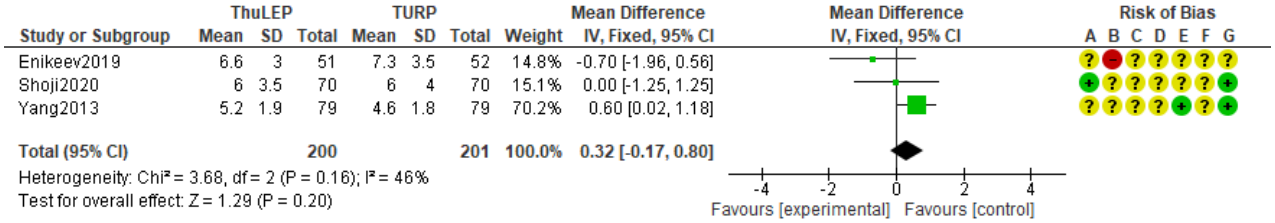
Note: lower IPSS scores are better.

IPSS at 6 months



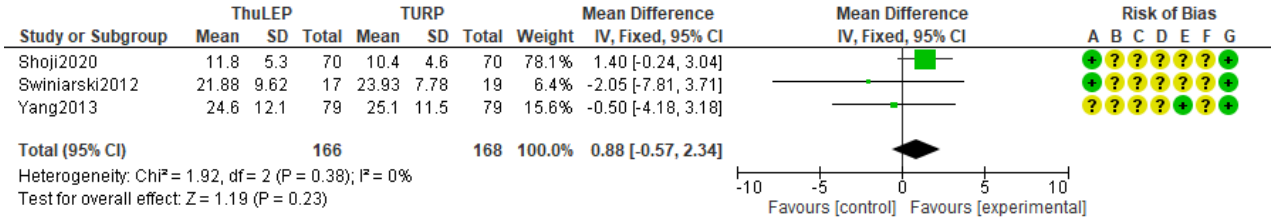
Note: lower IPSS scores are better.

IPSS at 12 months



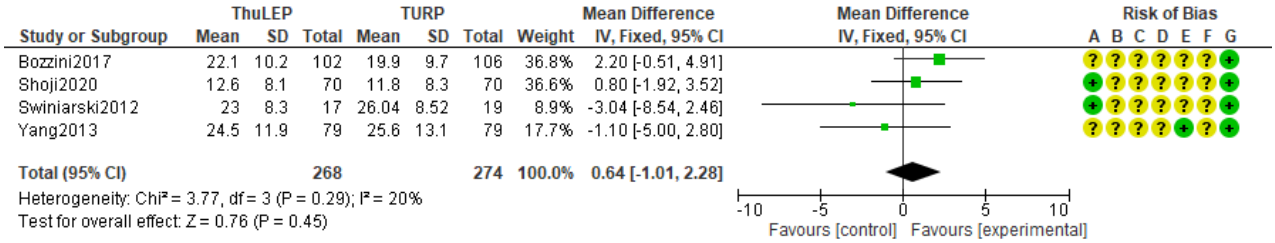
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



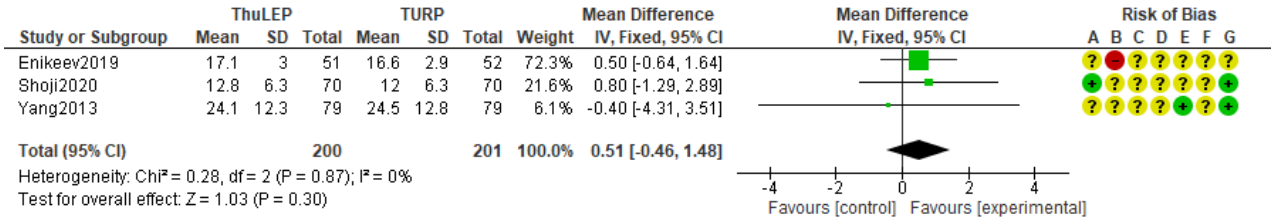
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



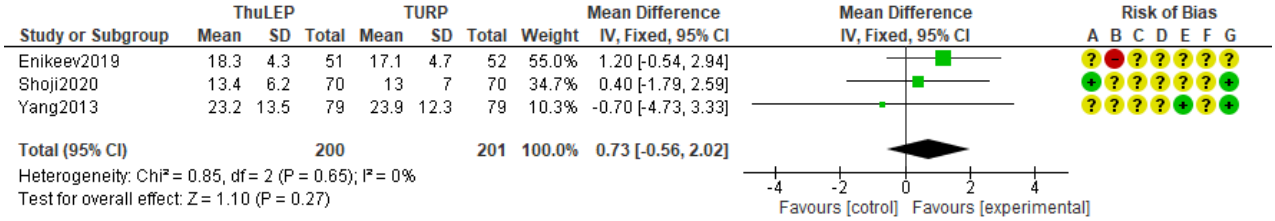
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



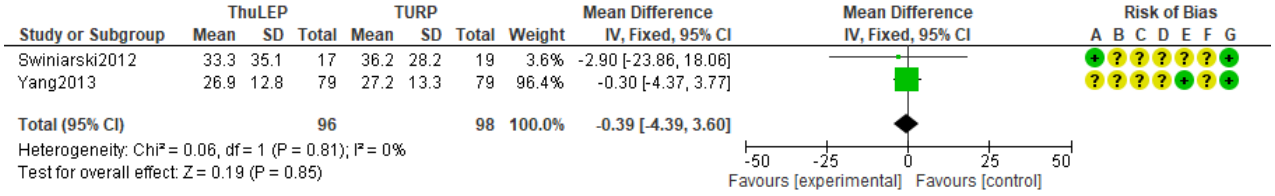
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



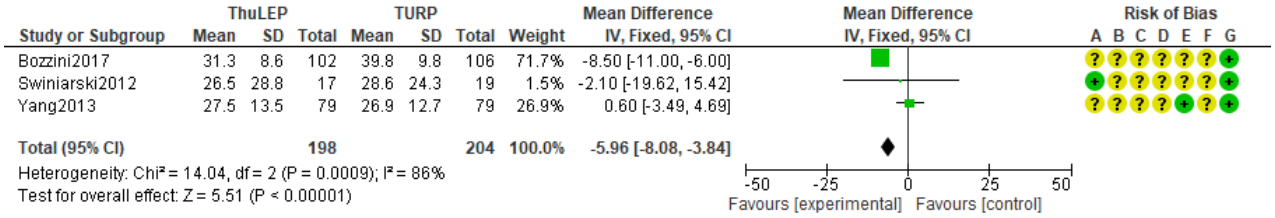
Note: higher Qmax values are better.

PVR (ml) at 1 month



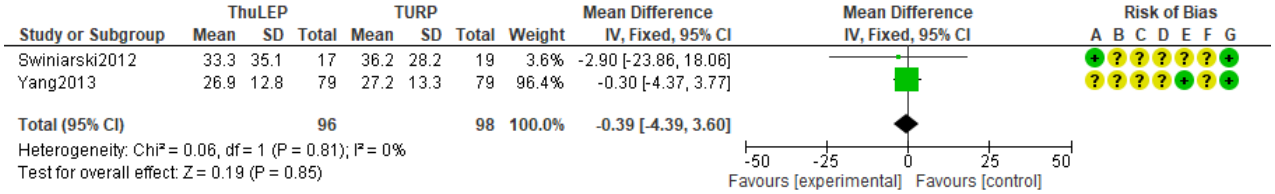
Note: lower PVR values are better.

PVR (ml) at 3 months



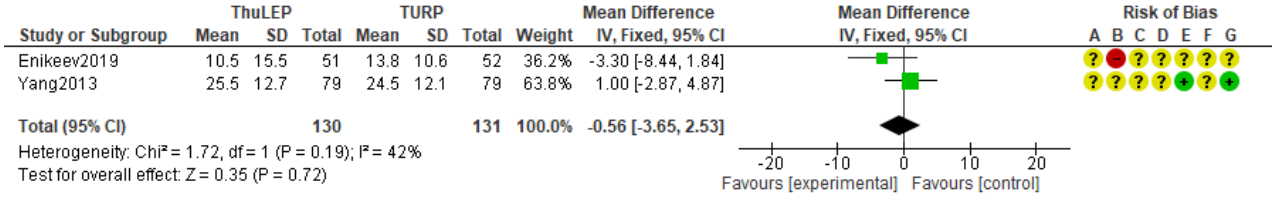
Note: lower PVR values are better.

PVR (ml) at 3 months in a sensitivity analysis excluding Bozzini 2017



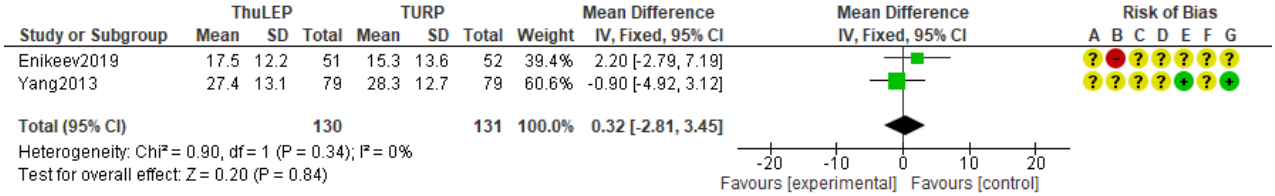
Note: lower PVR values are better.

PVR (ml) at 6 months



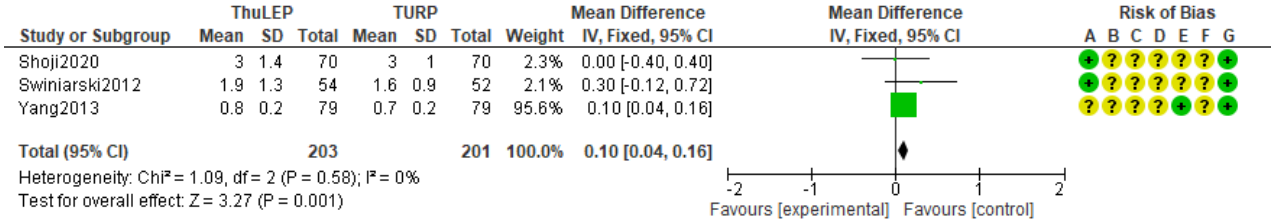
Note: lower PVR values are better.

PVR (ml) at 12 months



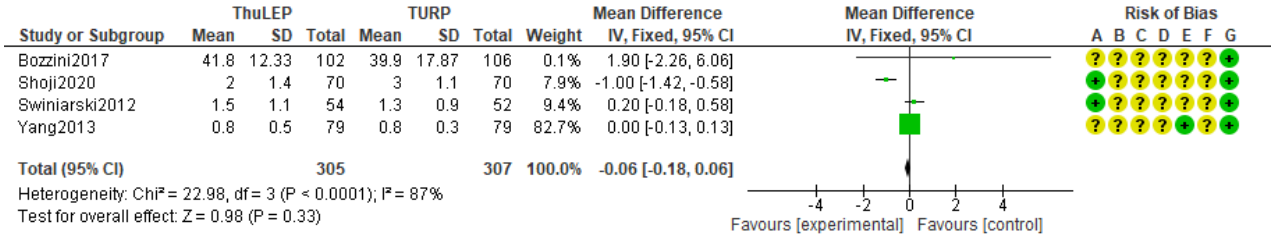
Note: lower PVR values are better.

QoL at 1 month



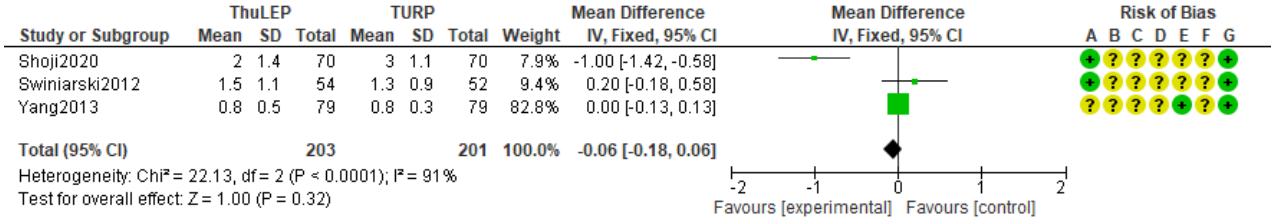
Note: lower QoL scores are better.

QoL at 3 months



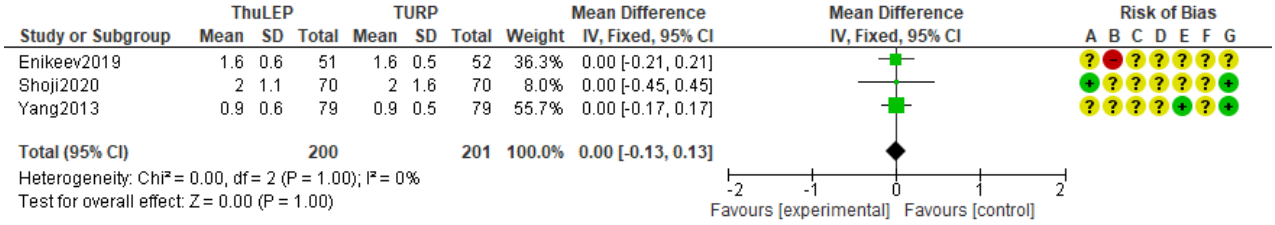
Note: lower QoL scores are better.

QoL at 3 months in a sensitivity analysis excluding Bozzini 2017



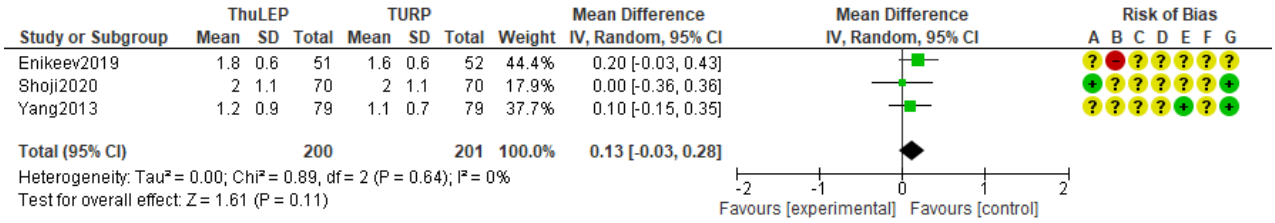
Note: lower QoL scores are better.

QoL at 6 months



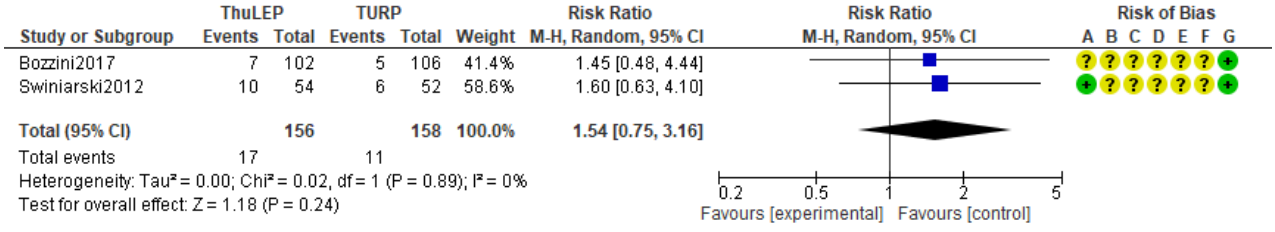
Note: lower QoL scores are better.

QoL at 12 months

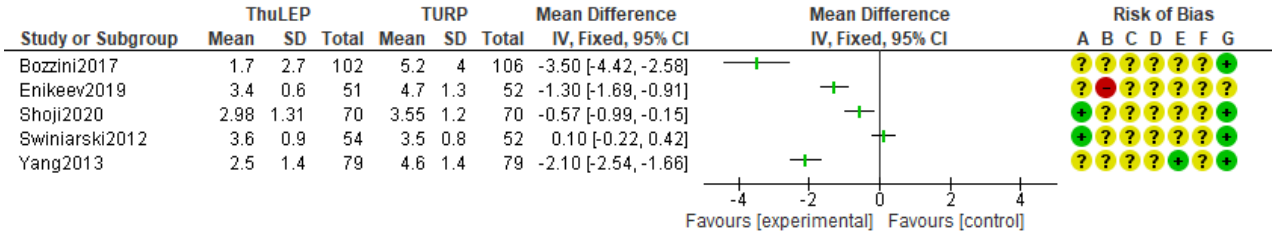


Note: lower QoL scores are better.

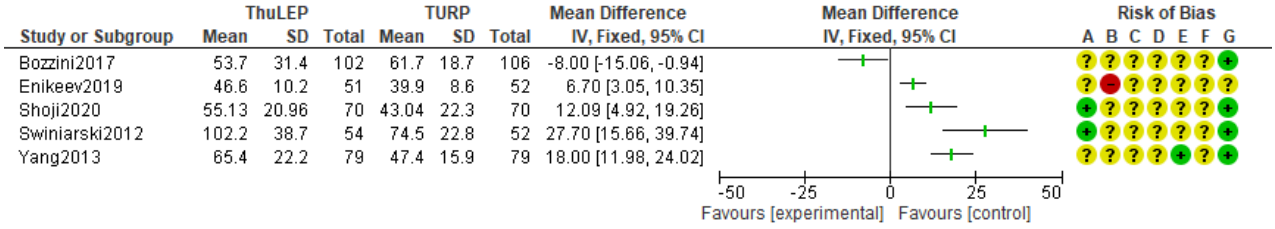
Persistent irritative symptoms



Hospitalisation time (days)



Procedure time (min)



ThuLEP versus B-TUEP

See the section on B-TUEP.

ThuLEP versus HoLEP

See the section on HoLEP.

DioLEP

DioLEP was assessed in six of the RCTs, including a total of 612 patients: two RCTs versus TURP (212 patients), two RCTs versus B-TUEP (n=194) and one RCT versus each of HoLEP (n=126) and B-ERP (n=80).

DioLEP versus TURP

Two RCTs (Lusuardi 2011, n=60; uncertain RoB; Zhang 2019, n=152; low RoB) compared DioLEP versus TURP. Outcomes assessed in these studies are indicated in Table 4-11. There were no data for BPHII or reintervention.

Table 4-11: Effectiveness outcomes assessed in RCTs comparing DioLEP versus TURP

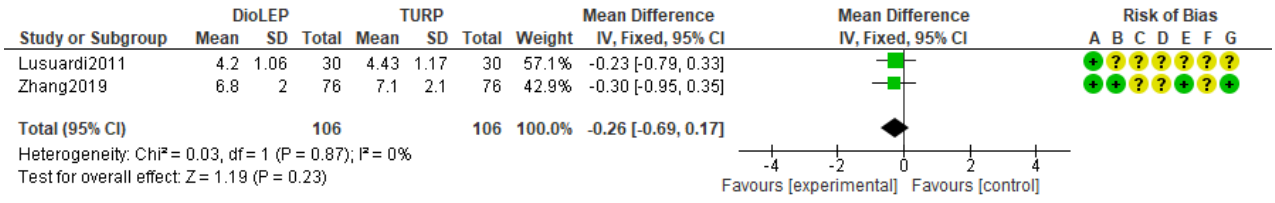
Study ID	Lusuardi 2011	Zhang 2019
IPSS at 1 month	x	
IPSS at 3 months		x
IPSS at 6 months	x	x
IPSS at 12 months		x
Qmax at 1 month	x	
Qmax at 3 months		x
Qmax at 6 months	x	x
Qmax at 12 months		x

Study ID	Lusuardi 2011	Zhang 2019
PVR at 1 month	x	
PVR at 3 months		x
PVR at 6 months	x	x
PVR at 12 months		x
QoL at 1 month	x	
QoL at 3 months		x
QoL at 6 months	x	x
QoL at 12 months		x
Hospitalisation time	x	x
Procedure time	x	x
Persistent irritative symptoms	x	

The patient cohorts in both studies had similar prostate volume ranges (32–80 ml and 34–89 ml in the DioLEP arms, and 34–80 ml and 35–89 ml in the TURP arms). Pooling of data was possible for IPSS, Qmax PVR and QoL at 6 months. No differences were observed for these outcomes. Hospitalisation time was in favour of DioLEP, although the mean hospital stay was very different in the two studies (DioLEP vs. TURP: 1.8 vs. 3.8 days in Lusuardi 2011, MD –2.0, 95% CI –2.3 to –1.7; and 7.9 vs. 9.5 days in Zhang 2019, MD –1.6, 95% CI –1.95 to –1.25). Results for procedure time were in opposite directions in the two studies: 8.6 min shorter for TURP in Lusuardi 2011 (95% CI 4.6–12.6) and 33.2 min shorter for DioLEP in Zhang 2019 (95% CI –41.5 to –24.9).

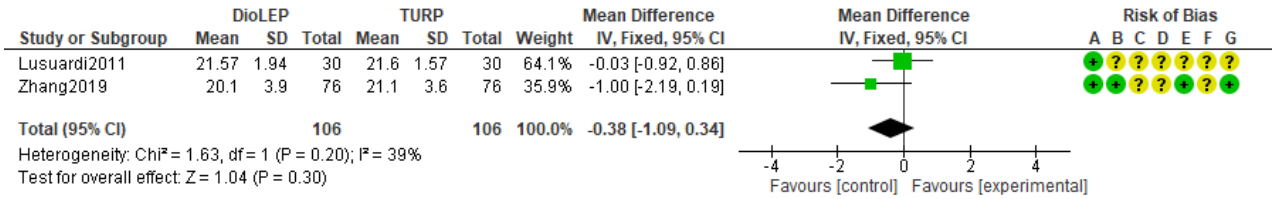
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 6 months



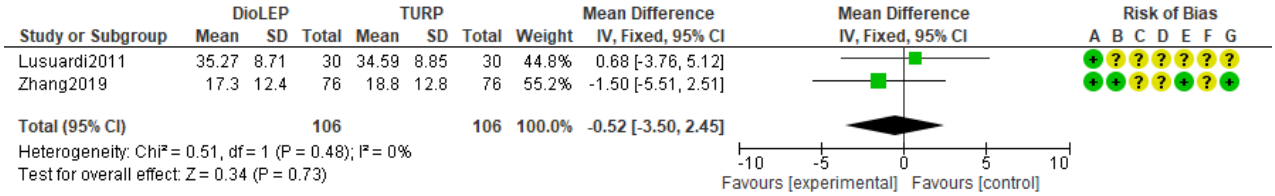
Note: lower IPSS scores are better.

Qmax (ml/s) at 6 months



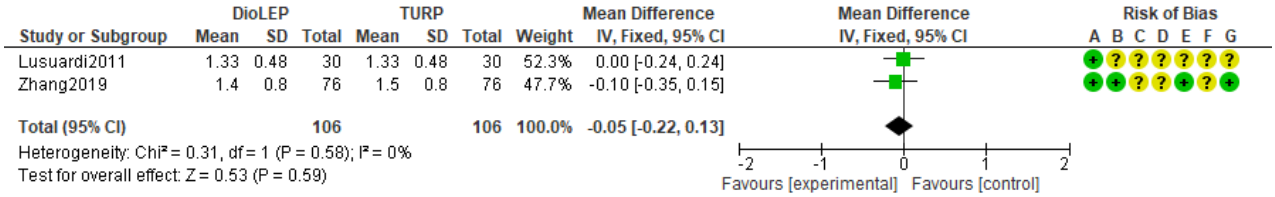
Note: higher Qmax values are better.

PVR (ml) at 6 months



Note: lower PVR values are better.

QoL at 6 months



Note: lower QoL scores are better.

DioLEP versus B-TUEP

See the section on B-TUEP.

DioLEP versus HoLEP

See the section on HoLEP.

DioLEP versus B-ERP

See the section on B-TUERP.

B-TUEP

B-TUEP was assessed in twelve of the RCTs, in comparisons with TURP (5 RCTs; n=974), HoLEP (3 RCT; n=224), DioLEP (2 RCT; n=194), ThuLEP (1 RCT; n=127), B-TUVP and OP (1 RCT; n=320).

B-TUEP versus TURP

Five RCTs compared B-TUEP versus TURP, providing data for the outcomes listed in Table 4-12. No data were available for Qmed, BPHII, reintervention or postoperative LUTS (as a binary outcome).

Table 4-12: Effectiveness outcomes assessed in RCTs comparing B-TUEP versus TURP

Study ID	Luo 2014	Ran 2013	Zhao 2010	Zhu 2013 [a]	Geavlete 2015
IPSS at 1 month	x		x	x	x
IPSS at 3 months	x		x		x
IPSS at 6 months	x		x	x	x

Study ID	Luo 2014	Ran 2013	Zhao 2010	Zhu 2013 [a]	Geavlete 2015
IPSS at 12 months	x		x	x	x
IPSS at 18 months			x		
IPSS at 24 months	x		x	x	
IPSS at 36 months			x	x	
Qmax at 1 month	x		x	x	x
Qmax at 3 months	x		x		x
Qmax at 6 months	x		x	x	x
Qmax at 12 months	x		x	x	x
Qmax at 18 months			x		
Qmax at 24 months	x		x	x	
Qmax at 36 months			x	x	
PVR at 1 month			x	x	x
PVR at 3 months			x		x
PVR at 6 months			x	x	x
PVR at 12 months			x	x	x
PVR at 18 months			x		
PVR at 24 months			x	x	
PVR at 36 months			x	x	
QoL at 1 month	x		x	x	x
QoL at 3 months	x		x		x
QoL at 6 months	x		x	x	x
QoL at 12 months	x		x	x	x
QoL at 18 months			x		
QoL at 24 months	x		x	x	
QoL at 36 months			x	x	
Persistent irritative symptoms			x		
Hospitalisation time	x	x	x	x	x
Procedure time	x	x	x	x	x

[a] Data for QoL and PVR data were estimated according to the Cochrane Handbook method.

Patients included in the studies were heterogeneous in terms of prostate size category. Patients with prostate size >70 ml and >80 ml were included in Zhu 2013 and Geavlete 2015, respectively, whereas patients in the other three studies had an average prostate size between 62 and 69 ml (no range or inclusion criteria available).

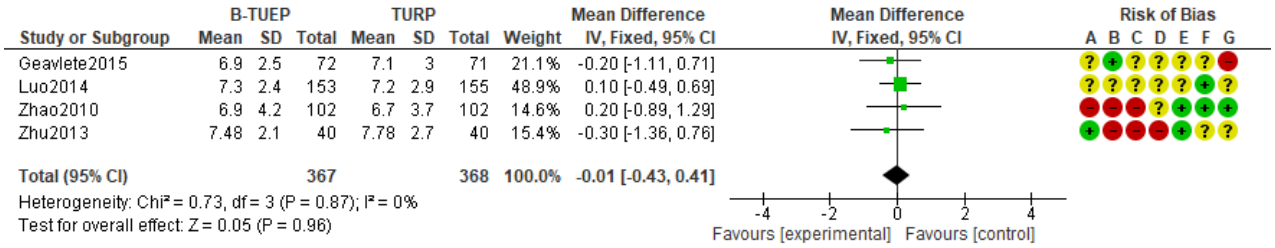
Pooling of data was possible for IPSS (1, 3, 6, 12, 24 and 36 months), Qmax (1, 3, 6, 12, 24 and 36 months), PVR (1, 3, 6, 12, 24 and 36 months) QoL (1, 3, 6, 12, 24 and 36 months), hospitalisation time and procedure time.

Differences in favour of B-TUEP were found for IPSS at 6 months (mean –0.36, 95% CI –0.71 to 0.00; I^2=0%, high RoB) and 24 months (mean –0.62, 95% CI –1.02 to –0.23; I^2=93%, high RoB) and Qmax at 6 months (mean 0.95, 95% CI 0.33–1.58; I^2=82%, high RoB). Hospitalisation time was shorter for B-TUEP in three of the four RCTs (MD was up to 1.5 days less). Considering the

statistical heterogeneity observed, sensitivity analyses were performed for Qmax at 6 months, IPSS at 12 months (showing borderline significance) and 24 months, and PVR 12 months after excluding Zhao 2010 (outlier and high RoB for random sequence generation). For PVR at 12 months, these sensitivity analyses did not reduce the statistical heterogeneity and no differences were observed, whereas the heterogeneity (as well as the significance or borderline significance) disappeared in the analyses of IPSS at 12 and 24 months and Qmax 6 months. The overall quality of the evidence for these outcomes was judged as very low (owing to indirectness, inconsistency and RoB in the studies).

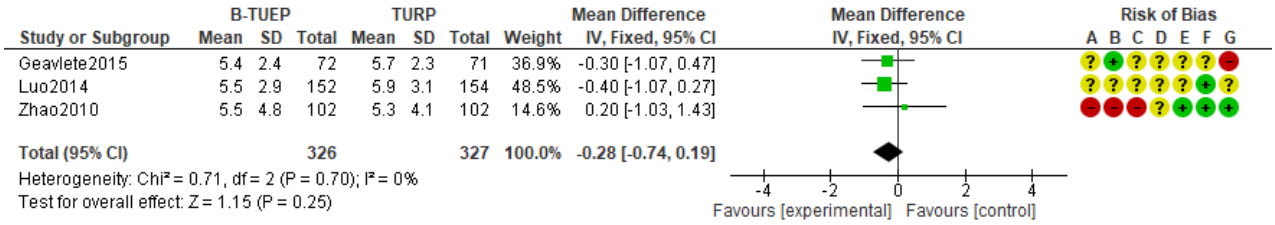
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



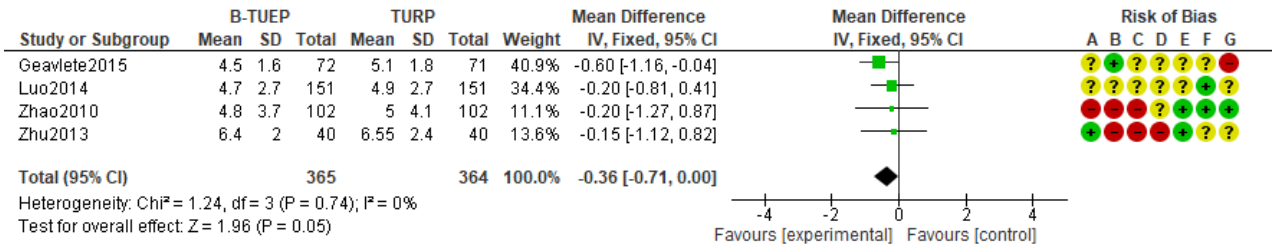
Note: lower IPSS scores are better.

IPSS at 3 months



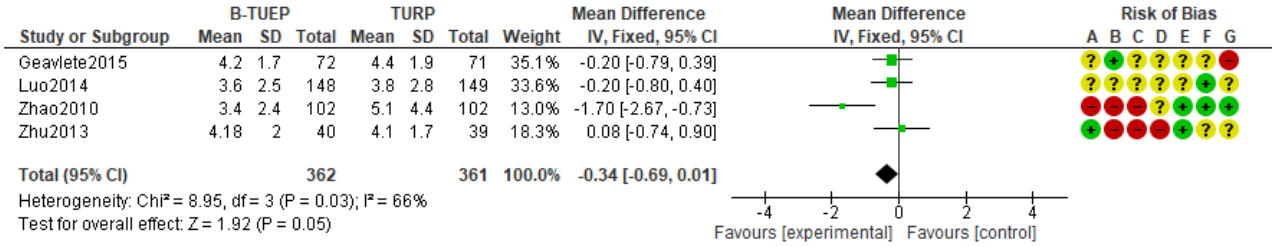
Note: lower IPSS scores are better.

IPSS at 6 months



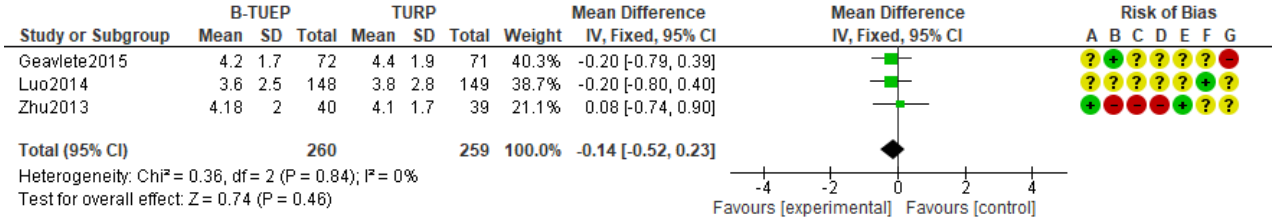
Note: lower IPSS scores are better.

IPSS at 12 months



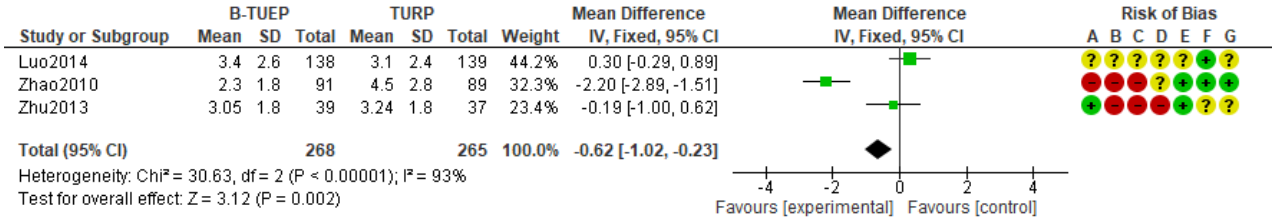
Note: lower IPSS scores are better.

IPSS at 12 months in the sensitivity analysis excluding Zhao 2010



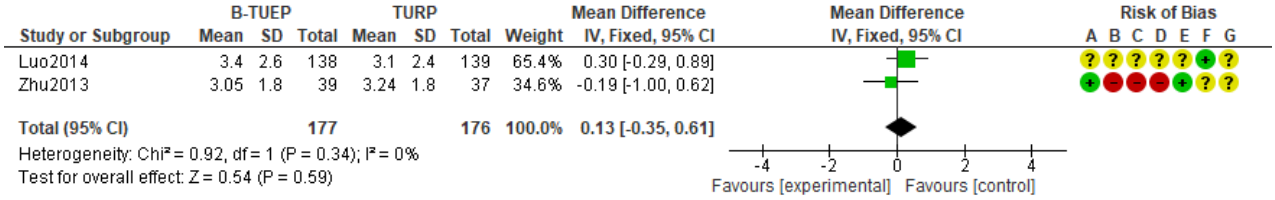
Note: lower IPSS scores are better.

IPSS at 24 months



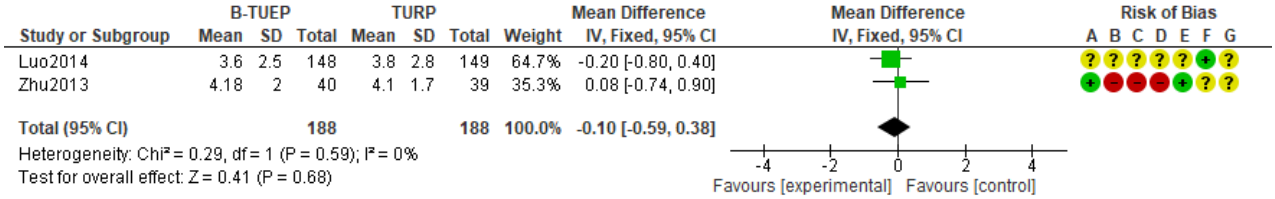
Note: lower IPSS scores are better.

IPSS at 24 months in the sensitivity analysis excluding Zhao 2010



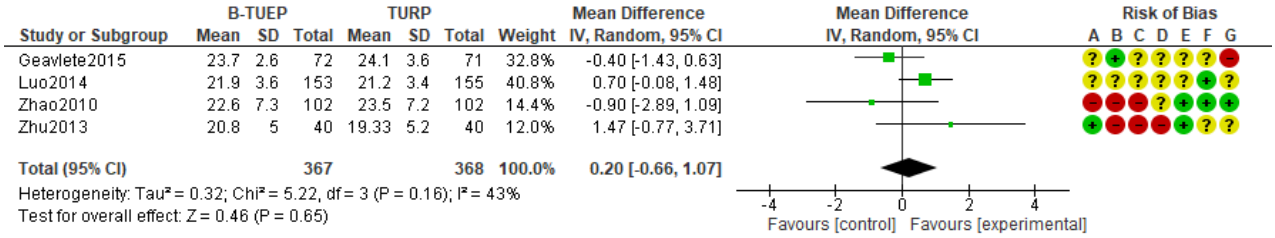
Note: lower IPSS scores are better.

IPSS at 36 months



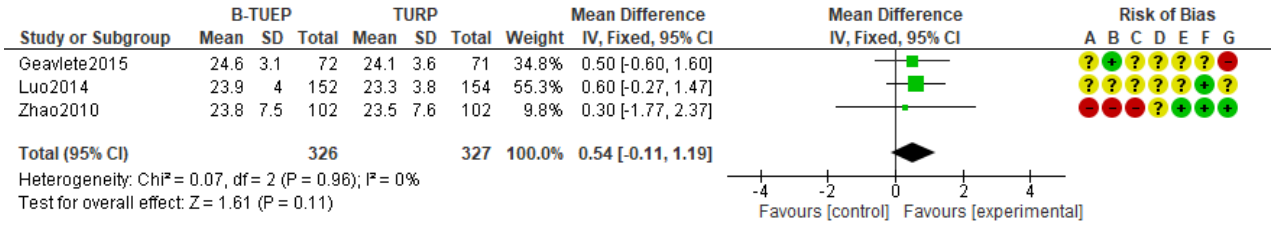
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



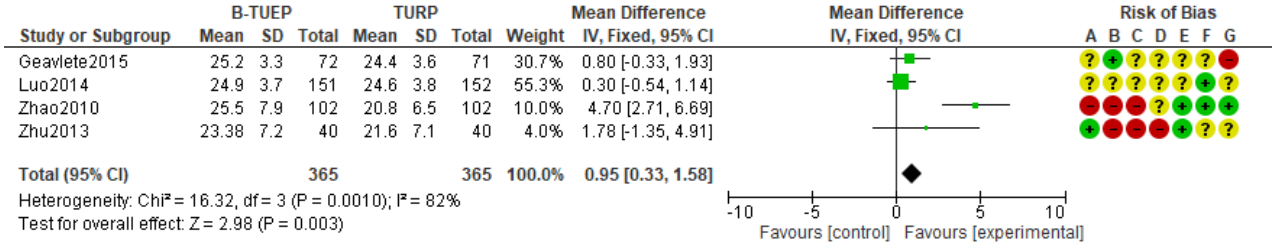
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



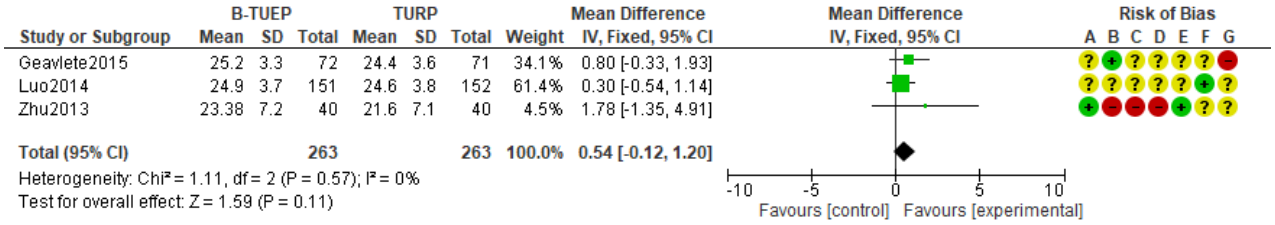
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



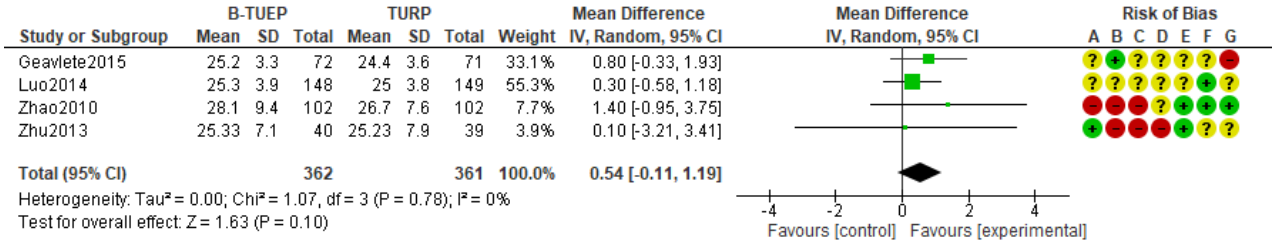
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months in the sensitivity analysis excluding Zhao 2010)



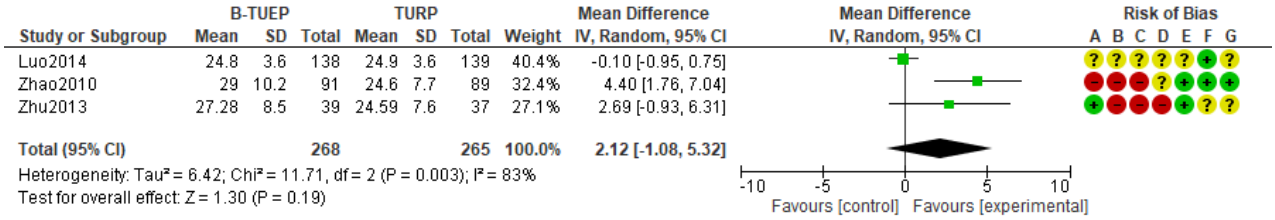
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



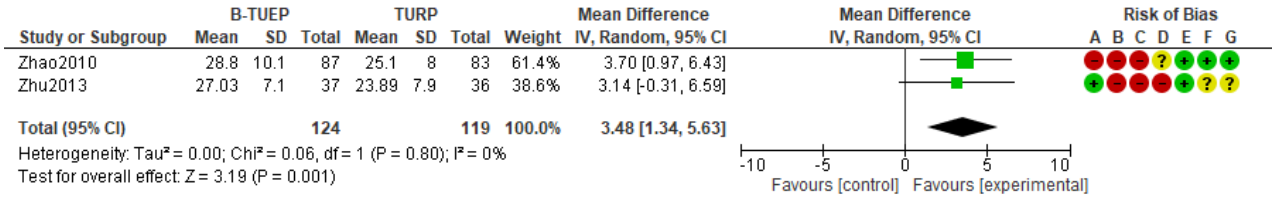
Note: higher Qmax values are better.

Qmax (ml/s) at 24 months



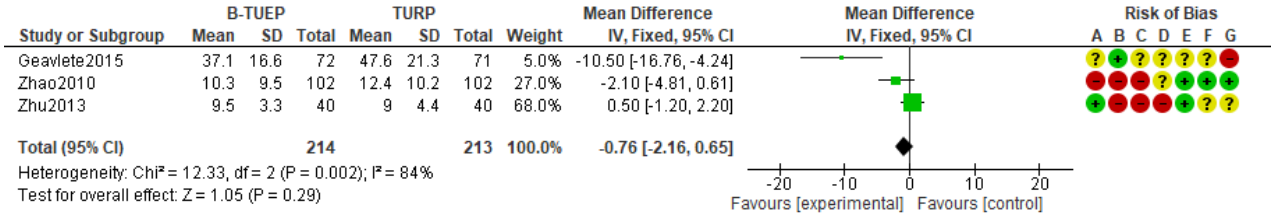
Note: higher Qmax values are better.

Qmax (ml/s) at 36 months



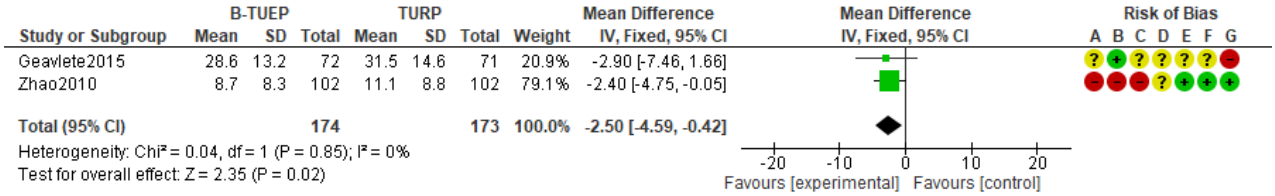
Note: higher Qmax values are better.

PVR (ml) at 1 month



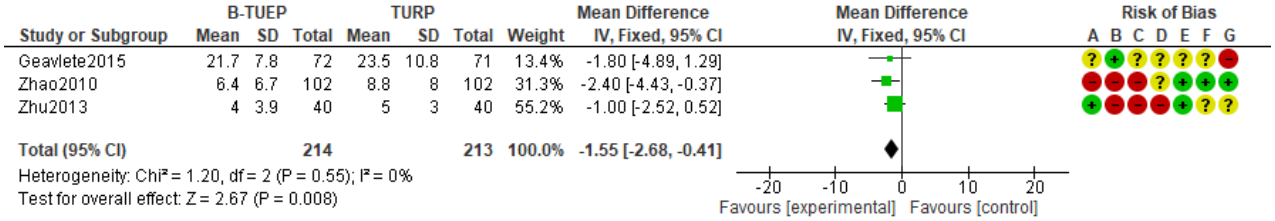
Note: lower PVR values are better.

PVR (ml) at 3 months



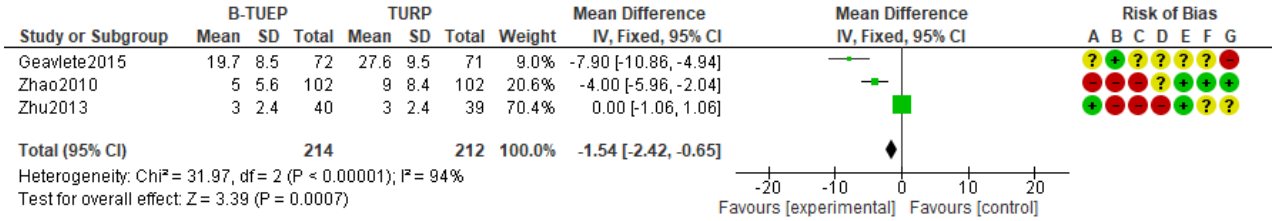
Note: lower PVR values are better.

PVR (ml) at 6 months



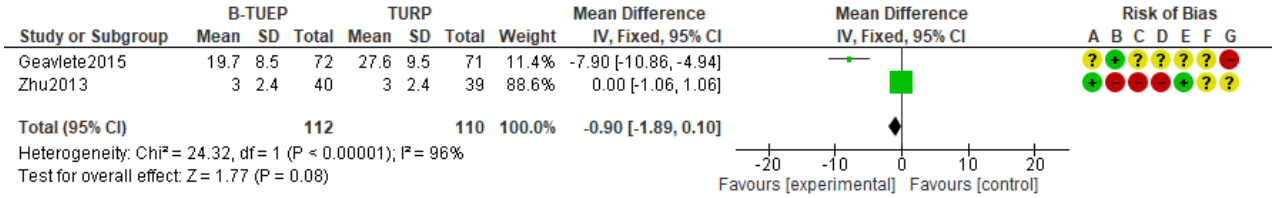
Note: lower PVR values are better.

PVR (ml) at 12 months



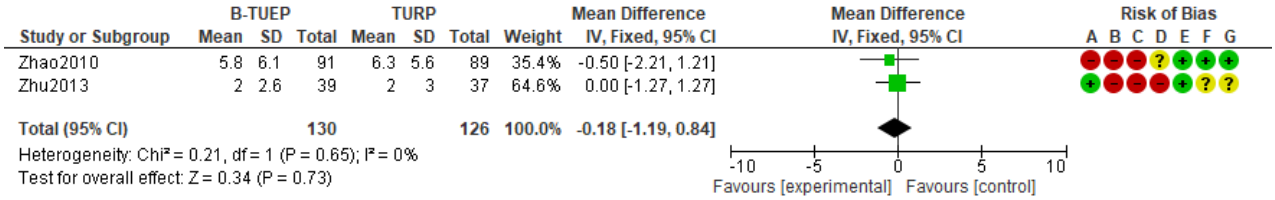
Note: lower PVR values are better.

PVR (ml) at 12 months in the sensitivity analysis excluding Zhao 2010



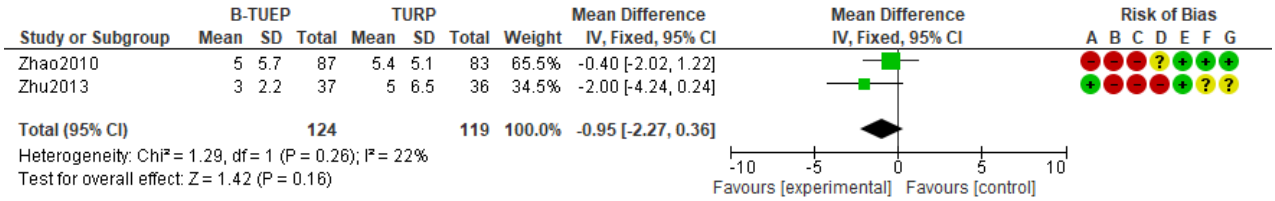
Note: lower PVR values are better.

PVR (ml) at 24 months



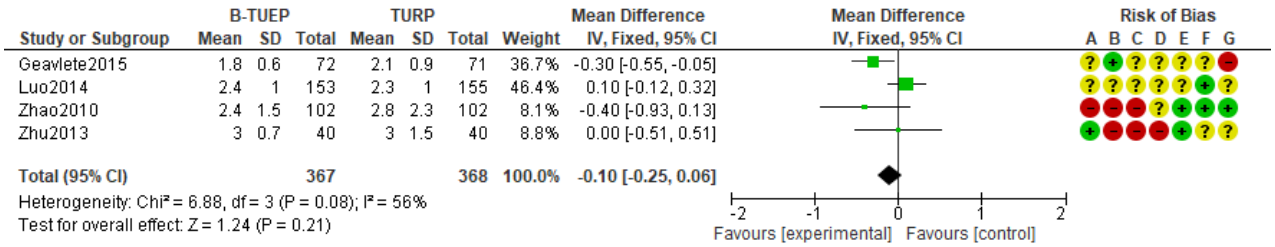
Note: lower PVR values are better.

PVR (ml) at 36 months



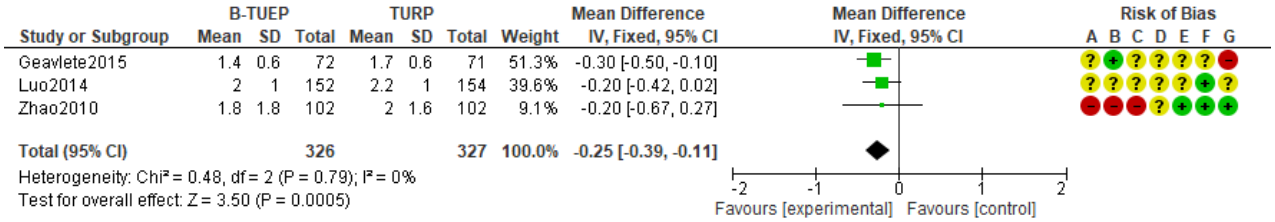
Note: lower PVR values are better.

QoL at 1 month



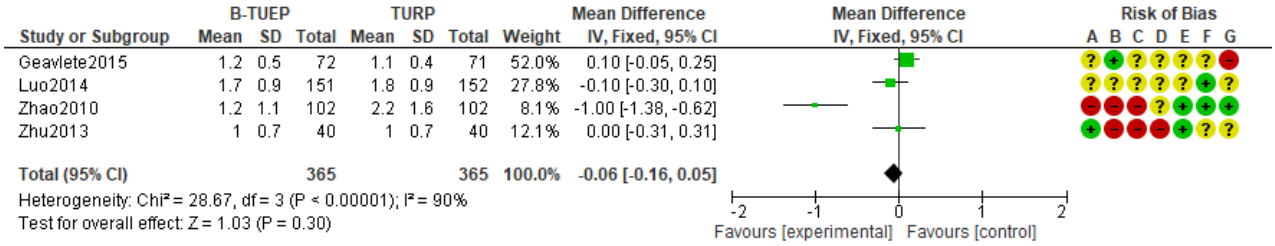
Note: lower QoL scores are better.

QoL at 3 months



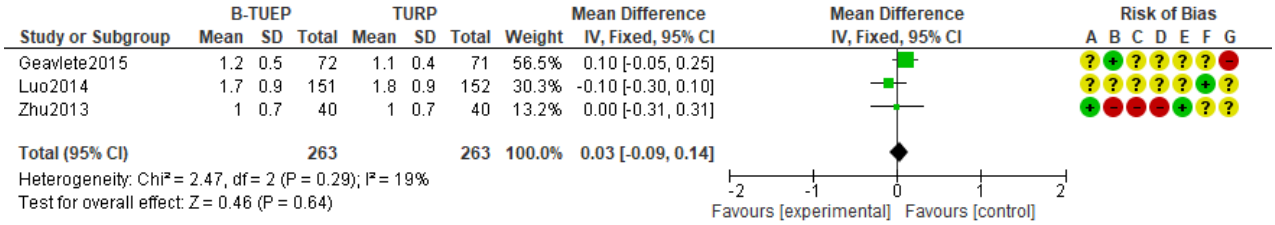
Note: lower QoL scores are better.

QoL at 6 months



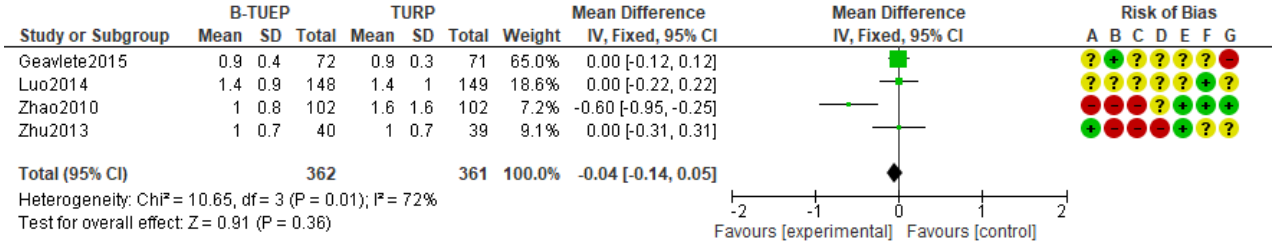
Note: lower QoL scores are better.

QoL at 6 months in the sensitivity analysis excluding Zhao 2010



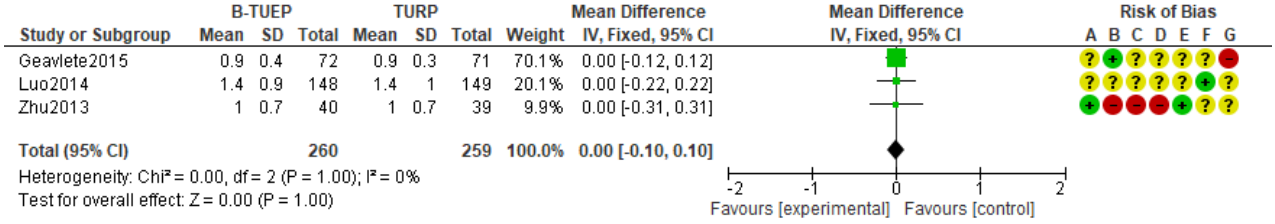
Note: lower QoL scores are better.

QoL at 12 months



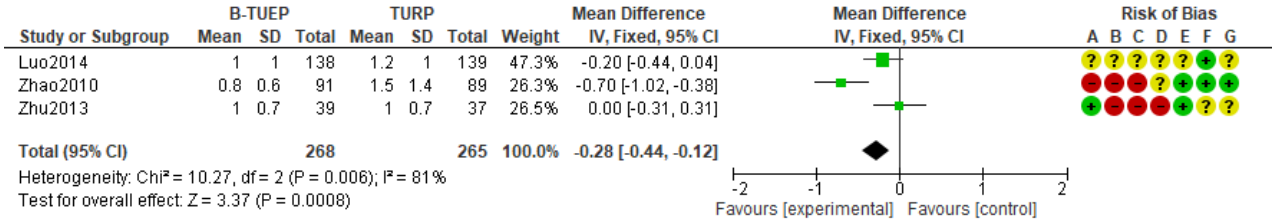
Note: lower QoL scores are better.

QoL at 12 months in the sensitivity analysis excluding Zhao 2010



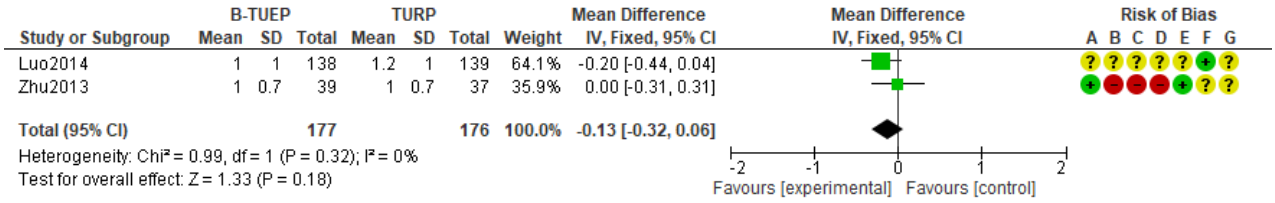
Note: lower QoL scores are better.

QoL at 24 months



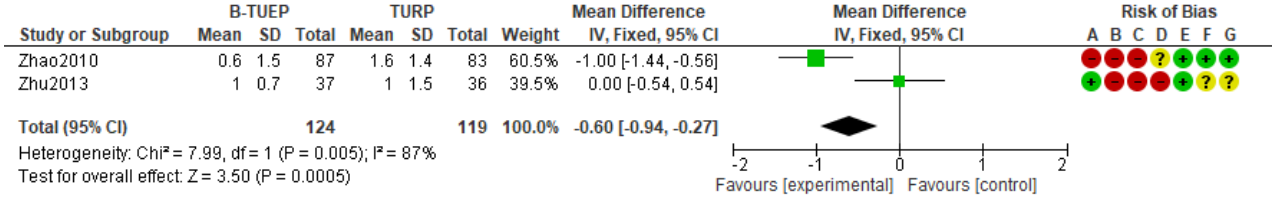
Note: lower QoL scores are better.

QoL at 24 months in the sensitivity analysis excluding Zhao 2010



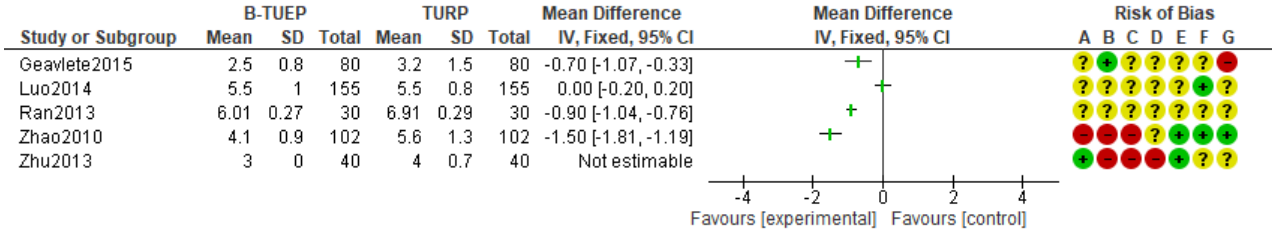
Note: lower QoL scores are better.

QoL at 36 months

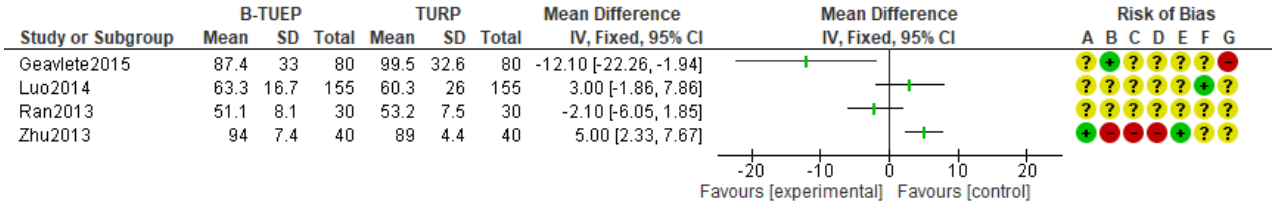


Note: lower QoL scores are better.

Hospitalisation time (days)



Procedure time (min)



B-TUEP versus HoLEP

See the section on HoLEP.

B-TUEP versus DioLEP

Two RCTs (Wu 2016, n=80; uncertain RoB; Zou 2018, n=114; high RoB) compared B-TUEP versus DioLEP. Patients included in Wu 2016 had a prostate size >80 ml and can be classified in our large prostate subgroup, whereas patients in Zou 2018 had a prostate size between 20 and 160 ml (mean: 62 ml). These two studies provided data for the outcomes listed in Table 4-13. No data were available for Qmed, BPHII, reintervention or postoperative LUTS (as a binary outcome).

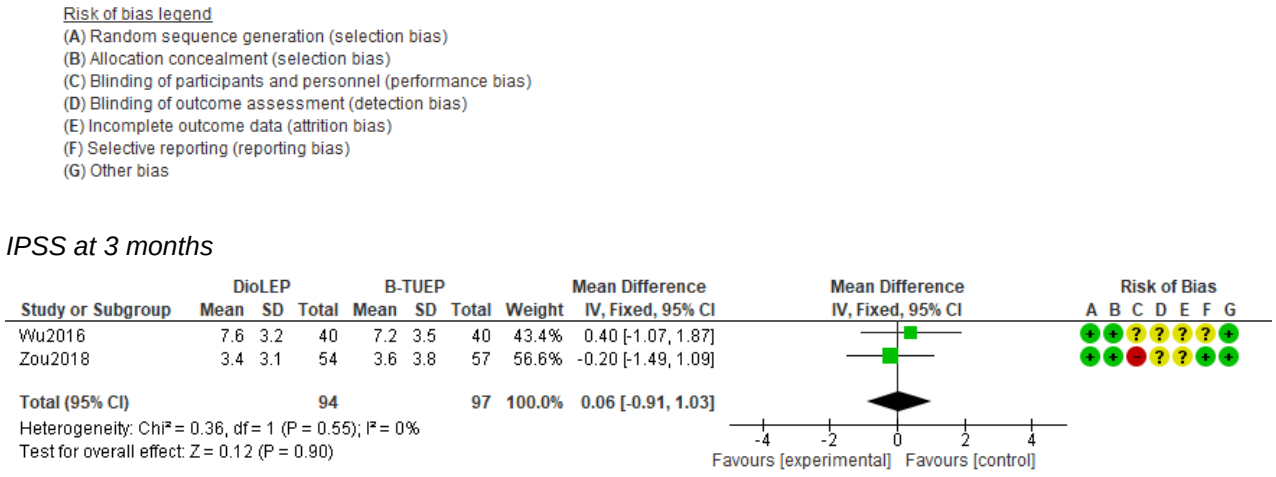
Table 4-13: Effectiveness outcomes assessed in RCTs comparing B-TUEP versus DioLEP

Study ID	Wu 2016	Zou 2018 [a]
IPSS at 3 months	x	x
IPSS at 6 months	x	x
IPSS at 12 months	x	x
Qmax at 3 months	x	x
Qmax at 6 months	x	x
Qmax at 12 months	x	x
PVR at 3 months	x	x
PVR at 6 months	x	
PVR at 12 months	x	x
QoL at 3 months	x	x
QoL at 6 months	x	x
QoL at 12 months	x	x
Hospitalisation time	x	x [b]
Procedure time	x	x
Persistent irritative symptoms	x	x

[a] Data for IPSS, Qmax and QoL were extrapolated from graphs; data for PVR could not be extrapolated.

[b] Data estimated according to the Cochrane Handbook method.

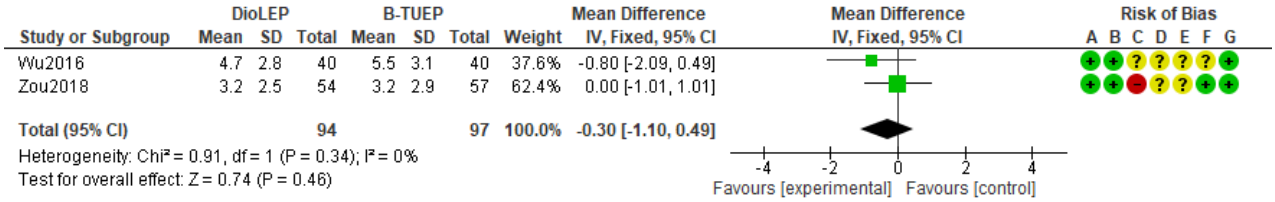
Pooling of data was possible for IPSS, Qmax, QoL (at 3, 6 and 12 months) and persistent irritative symptoms. A difference was observed for persistent irritative symptoms in favour of DioLEP (RR 0.48, 95% CI 0.30–0.79; I^2=43%, high RoB). The quality of the evidence was judged as low because of indirectness and RoB.



IPSS at 3 months

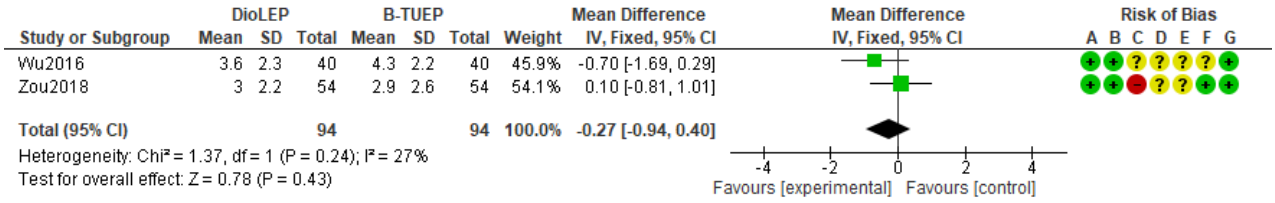
Note: lower IPSS scores are better.

IPSS at 6 months



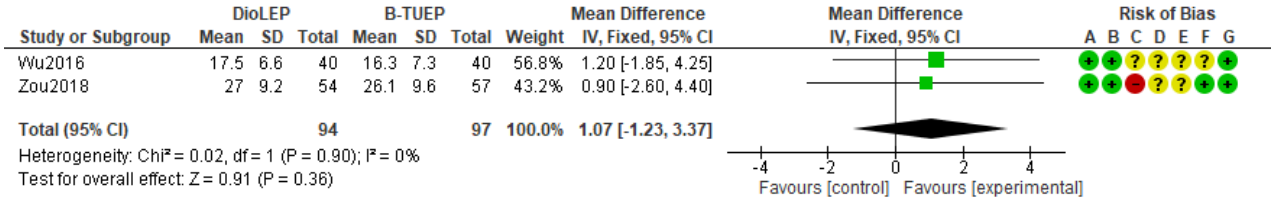
Note: lower IPSS scores are better.

IPSS at 12 months



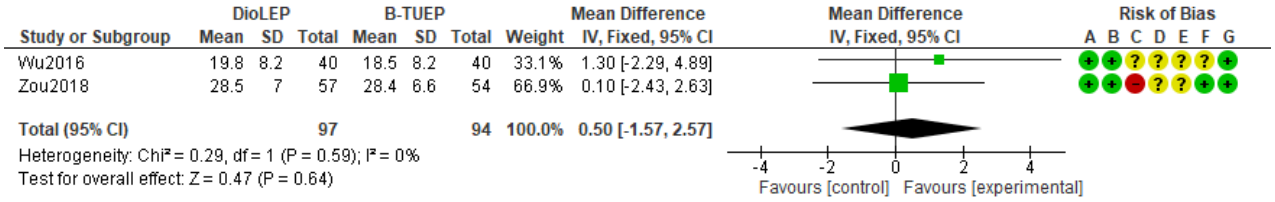
Note: lower IPSS scores are better.

Qmax (ml/s) at 3 months



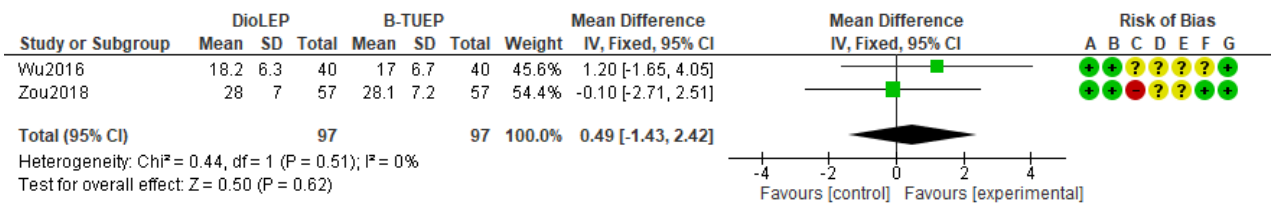
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



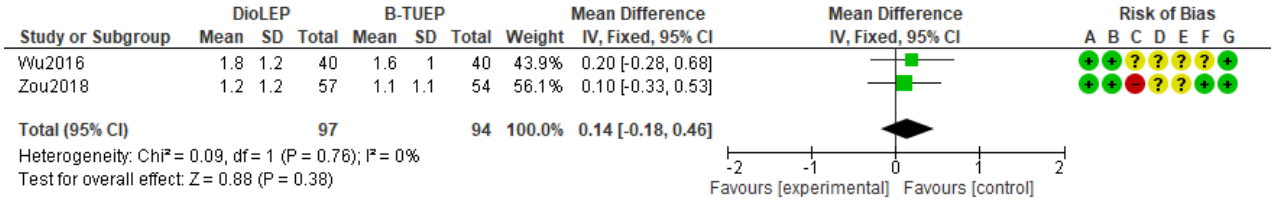
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



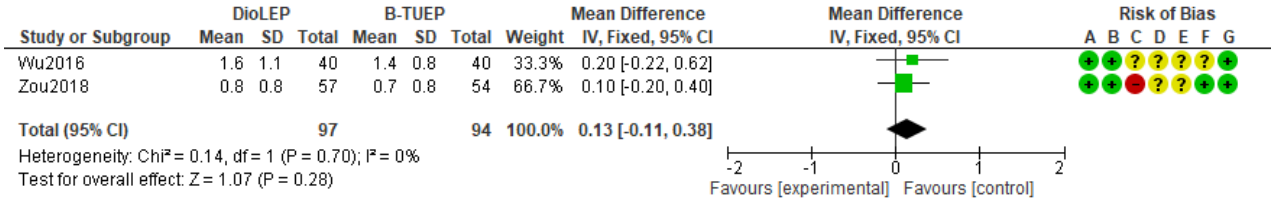
Note: higher Qmax values are better.

QoL at 3 months



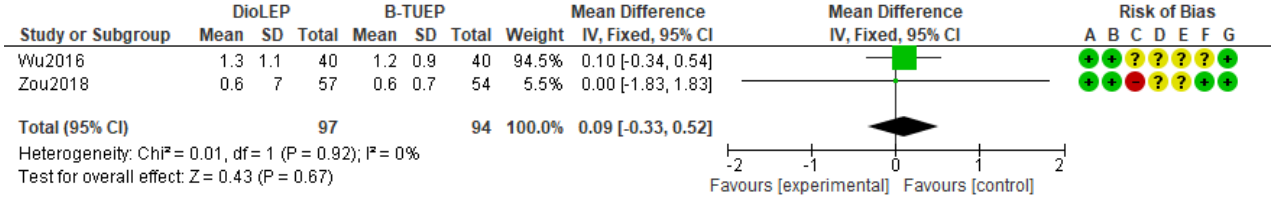
Note: lower QoL scores are better.

QoL at 6 months



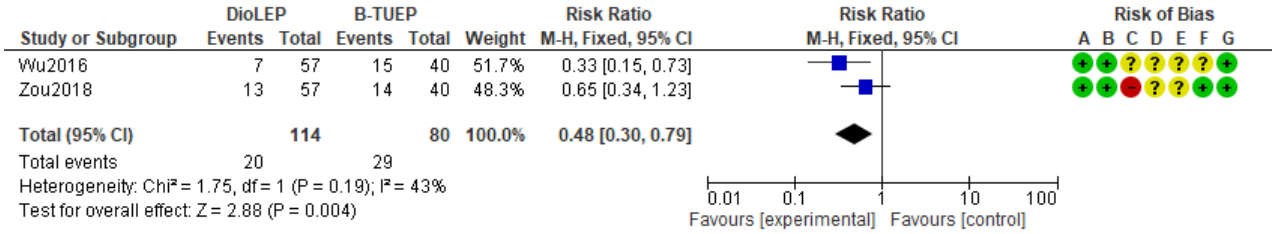
Note: lower QoL scores are better.

QoL at 12 months

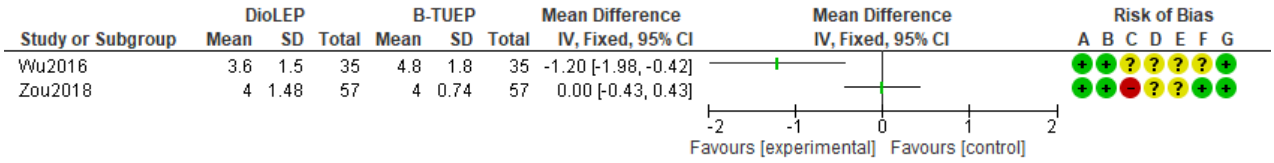


Note: lower QoL scores are better.

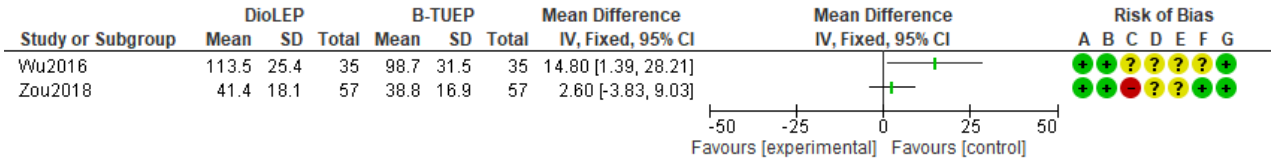
Persistent irritative symptoms



Hospitalisation time (days)



Procedure time (min)



B-TUEP versus ThuLEP

One RCT with uncertain RoB (Feng 2016, n=127) compared B-TUEP versus ThuLEP among patients with an average prostate size of 68 ml, assessing IPSS, Qmax, PVR and QoL at 3, 6 and 12 months, as well as operative time and hospital stay. Analyses did not show any differences between the treatment groups.

B-TUEP versus B-TUVP

One RCT with high RoB (Geavlete 2015, n=160) compared B-TUEP versus B-TUVP among patients with a prostate size >80 ml, assessing the outcomes shown in Table 4-14. Differences were observed in favour of B-TUEP for Qmax (with possible borderline clinical relevance) and operative time. As 95% CIs were not available, it was not possible to assess the uncertainty associated with these estimates.

Table 4-14: Effectiveness outcomes for B-TUEP versus B-TUVP assessed in Geavlete 2015 (n=160; high RoB)

Outcome	B-TUEP	B-TUVP	p value [a]
IPSS at 1 month	6.9	6.6	Not significant
IPSS at 3 months	5.4	5.3	Not significant
IPSS at 6 months	4.5	4.9	Not significant
IPSS at 12 months	4.2	4.5	Not significant
Qmax at 1 month (ml/s)	23.7	21.4	Not significant
Qmax at 3 months (ml/s)	24.6	21.9	Significant
Qmax at 6 months (ml/s)	25.2	22.3	Significant
Qmax at 12 months (ml/s)	25.6	22.8	Significant
PVR at 1 month (ml)	37.1	39.9	Not significant
PVR at 3 months (ml)	28.6	29.9	Not significant
PVR at 6 months (ml)	21.7	31.3	Not significant
PVR at 12 months (ml)	19.7	25.2	Not significant
QoL at 1 month	1.8	1.9	Not significant
QoL at 3 months	1.4	1.3	Not significant
QoL at 6 months	1.2	0.9	Not significant
QoL at 12 months	0.9	0.8	Not significant
Operative time (min)	87.4	118.1	Significant
Hospital stay (days)	2.5	2.1	Not significant

[a] Confidence intervals and exact p values unavailable.

B-TUEP versus OP

One RCT with high RoB (Geavlete 2015, n=160) compared B-TUEP versus OP among patients with a prostate size >80 ml, assessing IPSS, Qmax, PVR and QoL at 1, 3, 6 and 12 months, as well as operative time and hospital stay. A shorter hospital stay (2.5 vs. 6.7 days; p<0.01, 95% CI not available) was observed in favour of B-TUEP. As the 95% CI was not available, it was not possible to assess the uncertainty associated with this estimate.

4.4.1.3 Vaporization techniques

B-TUVP

B-TUVP was assessed in 14 of the RCTs, including a total of 1866 patients: nine RCTs versus TURP (n=1371), two RCTs versus PVP (n=144), and one RCT versus each of DioLVP (n=55), B-TUEP (n=147) and OP (n=149).

B-TUVP versus TURP

B-TUVP was assessed in comparison to TURP in ten of the RCTs (Elsakka 2016, Geavlete 2011, Geavlete 2014, Geavlete 2015, Hon 2016, Karadag 2014, Kaya 2007, Nuhoglu 2011, Tefekli 2005, Zhang S 2012), including a total of 1371 patients. Outcomes assessed in these studies are indicated in Table 4-15. No data were available for BPHII.

Table 4-15: Effectiveness outcomes assessed in RCTs comparing B-TUVP versus TURP

Study ID	Elsakka 2016	Geavlete 2011 [a,b]	Geavlete 2014 [b]	Geavlete 2015	Hon 2006	Karadag 2014	Kaya 2007	Nuhoglu 2011	Tefekli 2005	Zhang S 2012
IPSS at 1 month		x	x	x		x		x		
IPSS at 3 months	x	x	x	x				x	x	
IPSS at 6 months	x	x	x	x					x	
IPSS at 12 months		x		x	x	x		x	x	
IPSS at 18 months		x								
IPSS at 24 months							x			
IPSS at 36 months							x			
IPSS at 48 months										
Qmax at 1 month		x	x	x		x		x		
Qmax at 3 months	x	x	x	x				x	x	
Qmax at 6 months	x	x	x	x					x	
Qmax at 12 months		x		x	x	x		x	x	
Qmax at 18 months		x								
Qmax at 24 months							x			
Qmax at 36 months							x			
PVR at 1 month		x	x	x		x				
PVR at 3 months	x	x	x	x						
PVR at 6 months	x	x	x	x						
PVR at 12 months		x		x	x	x		x		
PVR at 18 months		x								
QoL at 1 month		x	x	x						
QoL at 3 months		x	x	x						

Study ID	Elsakka 2016	Geavlete 2011 [a,b]	Geavlete 2014[b]	Geavlete 2015	Hon 2006	Karadag 2014	Kaya 2007	Nuhoglu 2011	Tefekli 2005	Zhang S 2012
QoL at 6 months		x	x	x						
QoL at 12 months		x		x	x					
QoL at 18 months		x								
Qmed at 12 months					x					
Reintervention total	x	x					x	x	x	
Persistent irritative symptoms		x	x						x	
Postoperative LUTS		x								
Hospitalisation time		x	x	x	x					x
Procedure time	x	x	x	x	x	x		x	x	x

[a] Date for IPSS, Qmax, PVR and QoL were estimated using the quantile estimation method of McGrath et al. [63].

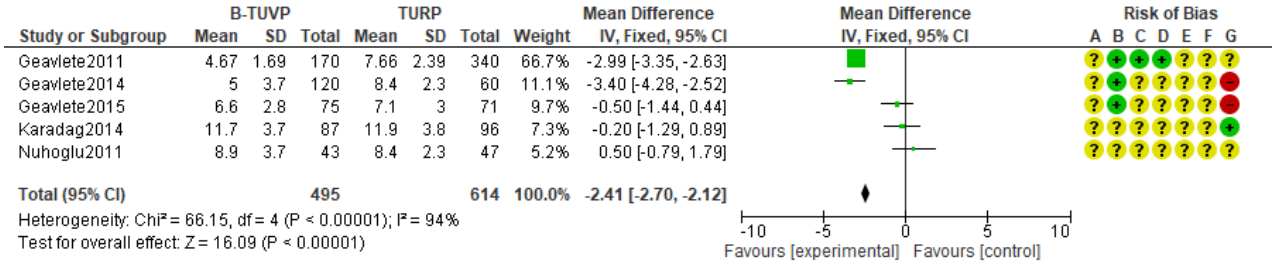
[b] Data from arms with the same technology were combined according to the Cochrane method.

Prostate size was used as an inclusion criterion in seven of these ten studies. Patients included were heterogeneous in terms of prostate size category. While four studies included patients with a prostate volume of <80 ml, Kaya 2007 included patients with prostate volumes <60 ml, Zhang S 2012 with prostate size between 25 and 125 ml, and Geavlete 2015 with prostate size >80 ml. The latter is the only study providing information on the range for prostate volume (80–297 ml). Data could be pooled for IPSS, Qmax, PVR and QoL at 1, 3, 6 and 12 months; reintervention; and persistent irritative symptoms. For functional outcomes, B-TUVP showed more favourable effects than TURP, except for PVR at 3 and 6 months, for which B-TUVP and TURP, respectively, was more favourable. However, very high statistical heterogeneity was detected in analyses of IPSS, Qmax and PVR that could not be explained and that limits the reliability of the results. Sensitivity analyses were performed excluding Elsakka 2016 (the trial with the youngest population, more than 10 years younger in comparison to the other RCTs), but no impact on heterogeneity or statistical significance was observed, except for PVR at 3 months.

Pooled estimates showed significant differences, in particular for IPSS at 1 month (mean –2.41, 95% CI –2.70 to –2.12; I^2=94%, uncertain RoB), 3 months (without Elsakka 2016: mean –2.31, 95% CI –2.58 to –2.04; I^2=95%, uncertain RoB) and 6 months (without Elsakka 2016: mean –2.37, 95% CI –2.58 to –2.16; I^2=98%, uncertain RoB); Qmax at 1 month (mean 1.45, 95% CI 0.92–1.98; I^2=94%, uncertain RoB), 3 months (without Elsakka 2016: mean 1.59, 95% CI 1.03–2.14; I^2=95%, uncertain RoB) and 6 months (without Elsakka 2016: mean 1.74, 95% CI 1.19–2.30; I^2=95%, uncertain RoB); PVR at 3 months (without Elsakka 2016: mean –2.20, 95% CI –3.74 to –0.66; I^2=0%, uncertain RoB) and 6 months (without Elsakka 2016: mean 4.63, 95% CI 1.63–7.64; I^2=67%, uncertain RoB); and QoL at 1 month (mean –0.30, 95% CI –0.35 to –0.25; I^2=0%, uncertain RoB), 3 months (mean –0.29, 95% CI –0.36 to –0.22; I^2=40%, uncertain RoB), 6 months (mean –0.27, 95% CI –0.34 to –0.20; I^2=32%, uncertain RoB) and 12 months (mean –0.15, 95% CI –0.22 to –0.07; I^2=62%, uncertain RoB). The quality of the evidence for these estimates is low because of indirectness and inconsistency.

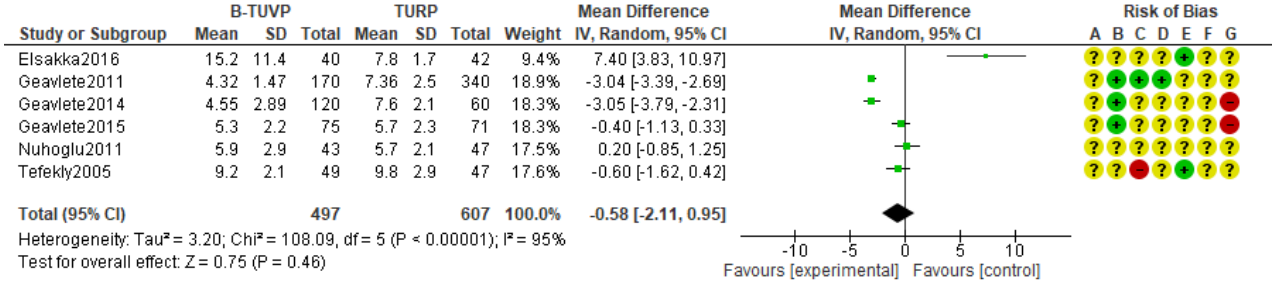
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



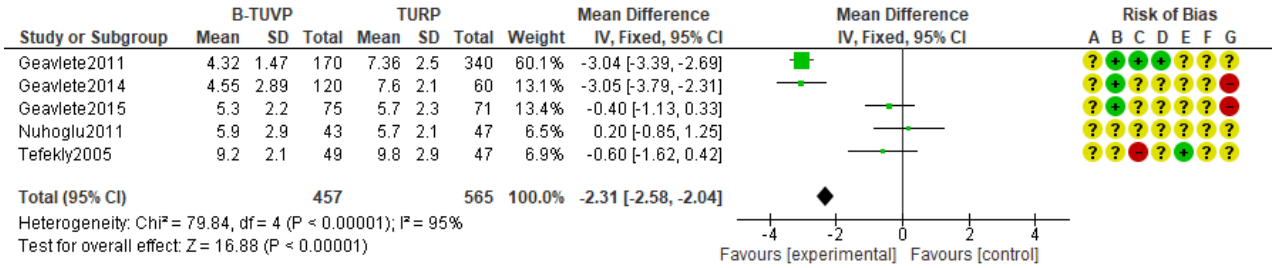
Notes: SD values for Geavlete 2014 are from Nuhoglu 2011, the study with the most similar prostate size.
Lower IPSS scores are better.

IPSS at 3 months



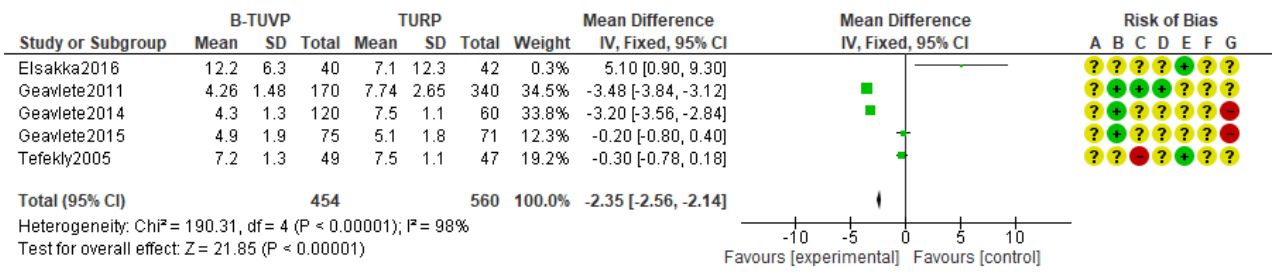
Note: lower IPSS scores are better.

IPSS at 3 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



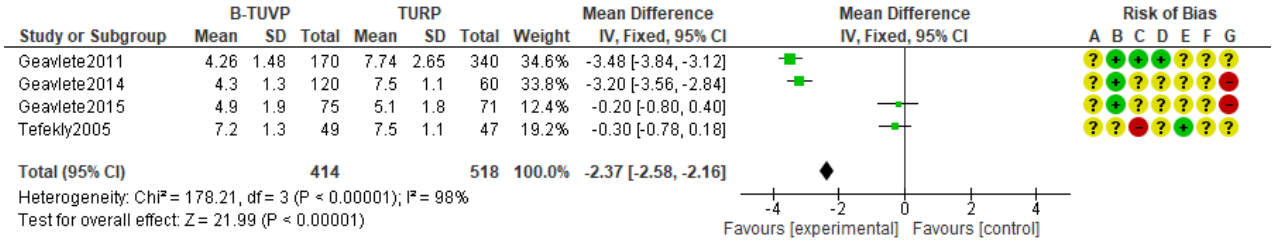
Notes: SD values for Geavlete 2014 are from Nuhoglu 2011, the study with the most similar prostate size.
Lower IPSS scores are better.

IPSS at 6 months



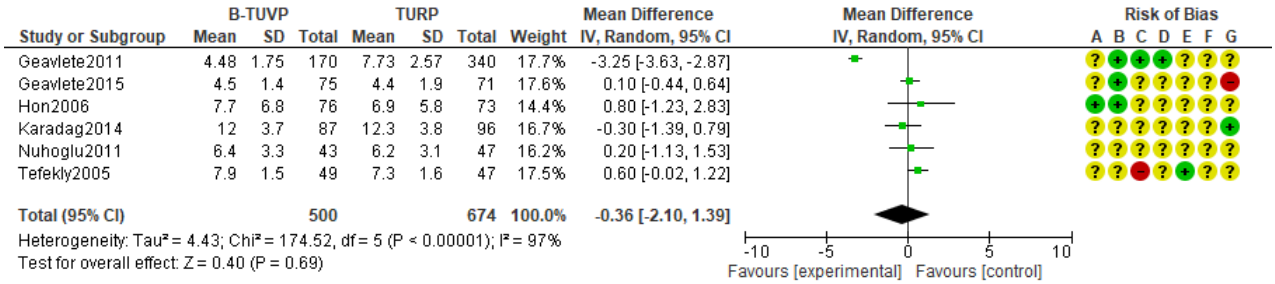
Notes: SD values for Geavlete 2014 are from Tefekli 2005, the study with the most similar prostate size.
Lower IPSS scores are better.

IPSS at 6 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



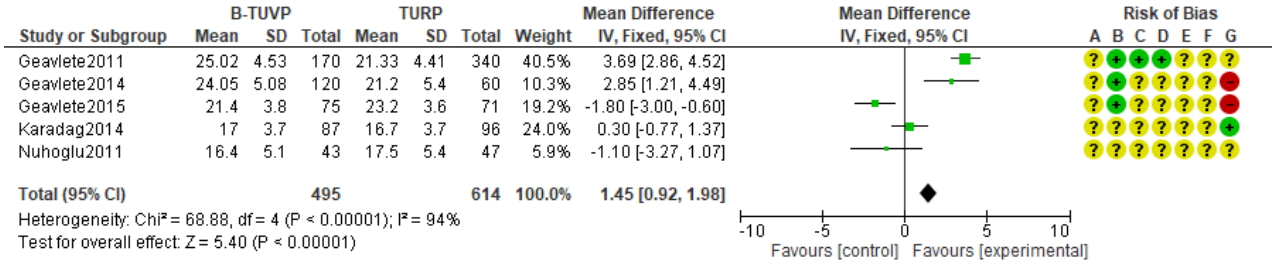
Notes: SD values for Geavlete 2014 are from Tefekli 2005, the study with the most similar prostate size.
Lower IPSS scores are better.

IPSS at 12 months



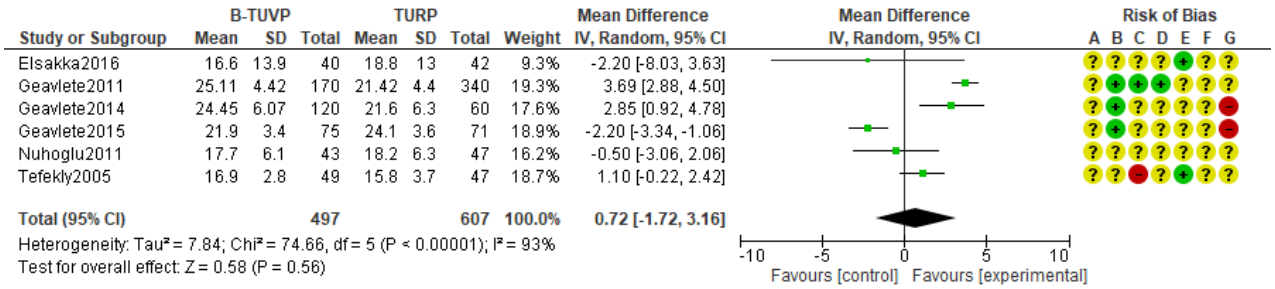
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



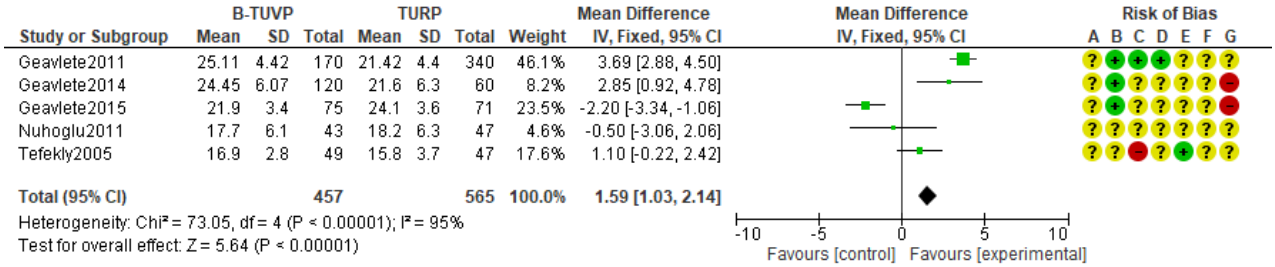
Notes: SD values for Geavlete 2014 are from Nuhoglu 2011, the study with the most similar prostate size.
Higher Qmax values are better.

Qmax (ml/s) at 3 months



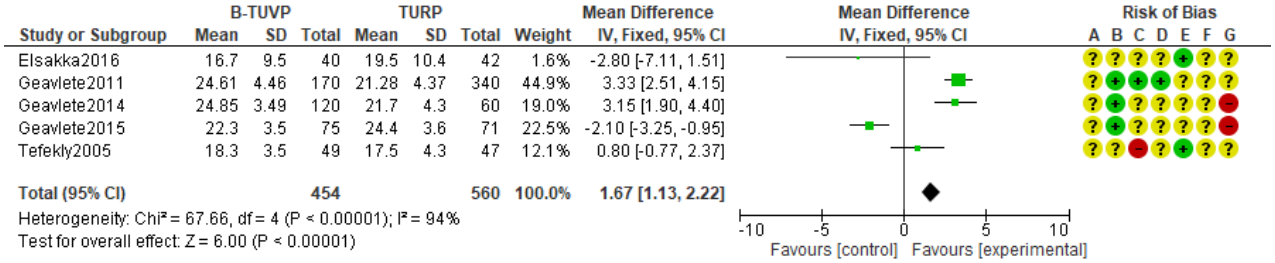
Notes: SD values for Geavlete 2014 are from Nuhoglu 2011, the study with the most similar prostate size.
Higher Qmax values are better.

Qmax (ml/s) at 3 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



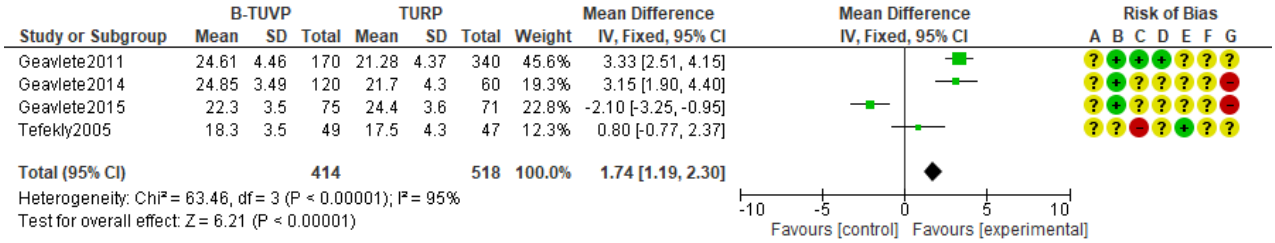
Notes: SD values for Geavlete 2014 are from Nuhoglu 2011, the study with the most similar prostate size.
Higher Qmax values are better.

Qmax (ml/s) at 6 months



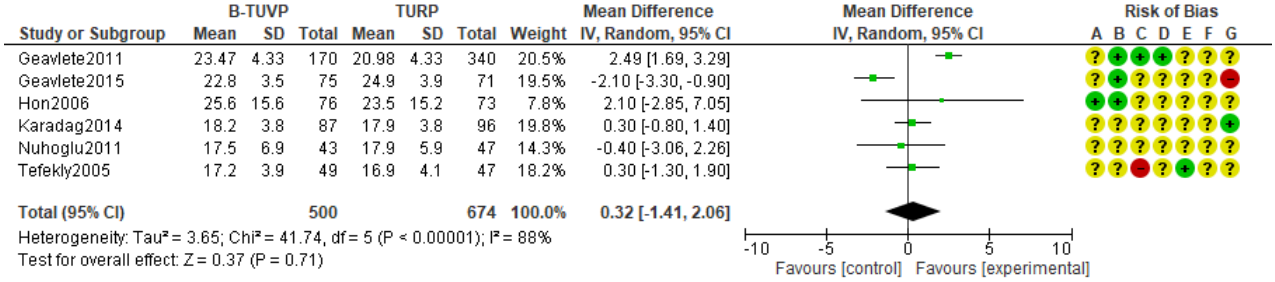
Notes: SD values for Geavlete 2014 are from Tefekli 2005, the study with the most similar prostate size.
Higher Qmax values are better.

Qmax (ml/s) at 6 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



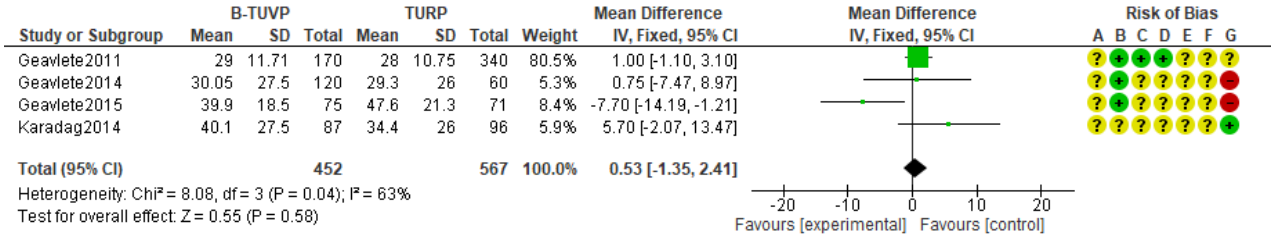
Notes: SD values for Geavlete 2014 are from Tefekli 2005, the study with the most similar prostate size.
Higher Qmax values are better.

Qmax (ml/s) at 12 months



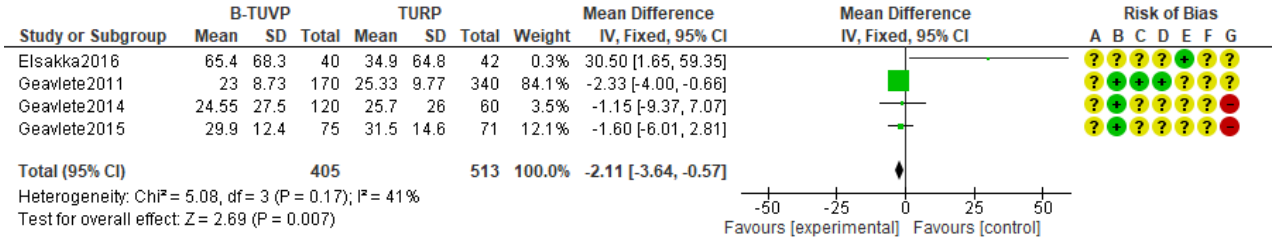
Note: higher Qmax values are better.

PVR (ml) at 1 month



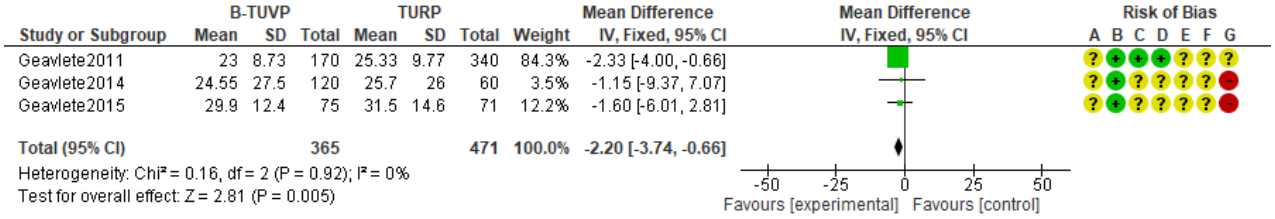
Notes: SD values for Geavlete 2014 are from Karadag 2014, the study with the most similar prostate size.
Lower PVR values are better.

PVR (ml) at 3 months



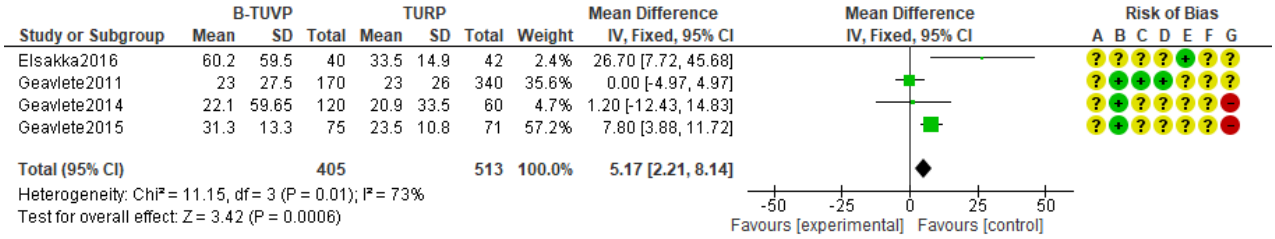
Notes: SD values for Geavlete 2014 are from the data for PVR at 1 month in Karadag 2014,
the study with the most similar prostate size. Lower PVR values are better.

PVR (ml) at 3 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



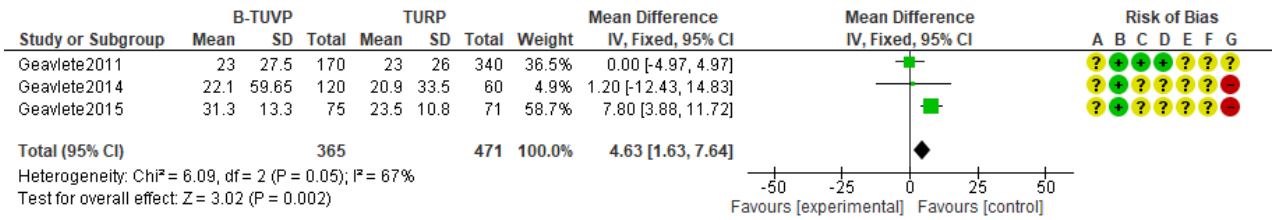
Notes: SD values for Geavlete 2014 are from the data for PVR at 1 month in Karadag 2014,
the study with the most similar prostate size. Lower PVR values are better.

PVR (ml) at 6 months



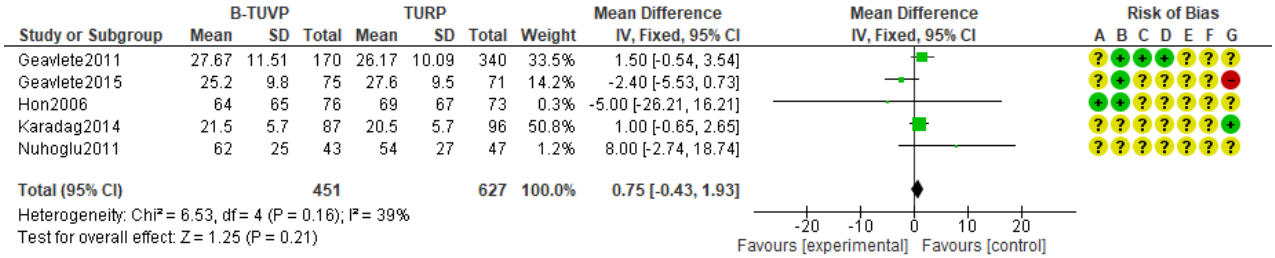
Notes: SD values for Geavlete 2014 are from the data for PVR at 1 month in Karadag 2014,
the study with the most similar prostate size. Lower PVR values are better.

PVR (ml) at 6 months in the sensitivity analysis excluding Elsakka 2016 (younger patients)



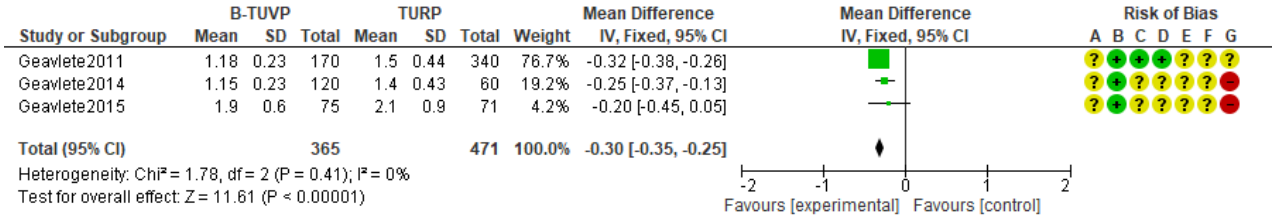
Notes: SD values for Geavlete 2014 are from the data for PVR at 1 month in Karadag 2014,
the study with the most similar prostate size. Lower PVR values are better.

PVR at 12 months



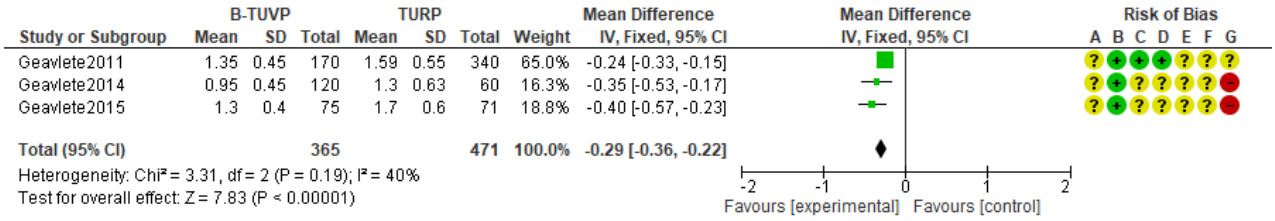
Note: Lower PVR values are better.

QoL at 1 month



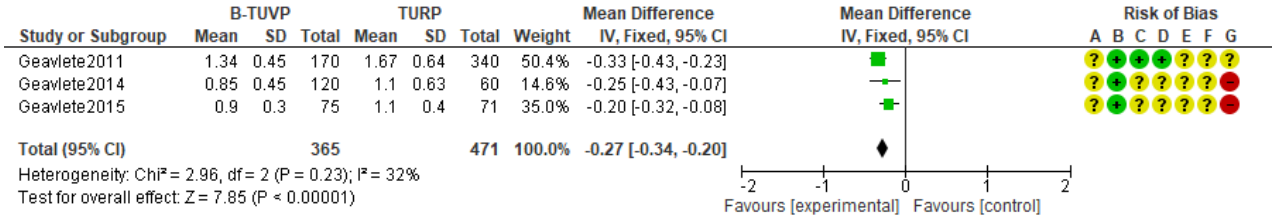
Notes: SD values for Geavlete 2014 are from Geavlete 2011, the study with the most similar prostate size.
Lower QoL scores are better.

QoL at 3 months



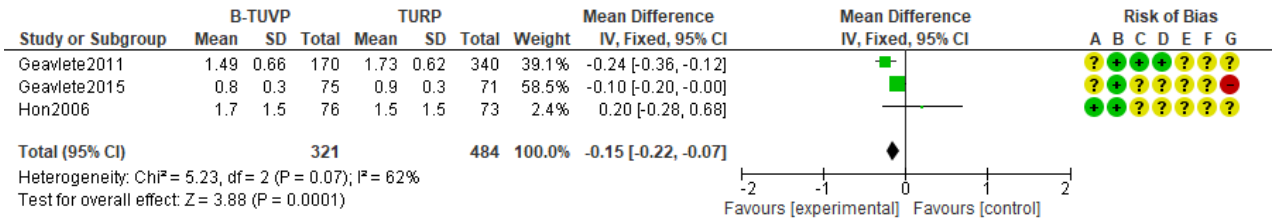
Notes: SD values for Geavlete 2014 are from Geavlete 2011, the study with the most similar prostate size.
Lower QoL values are better.

QoL at 6 months



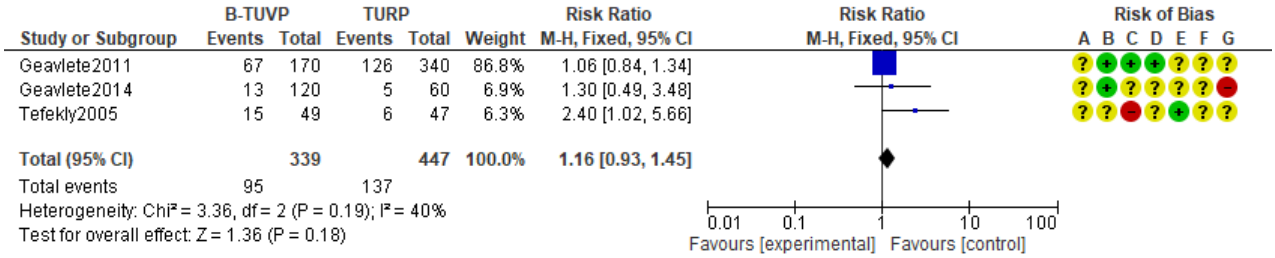
Notes: SD values for Geavlete 2014 are from Geavlete 2011, the study with the most similar prostate size.
Lower QoL values are better.

QoL at 12 months

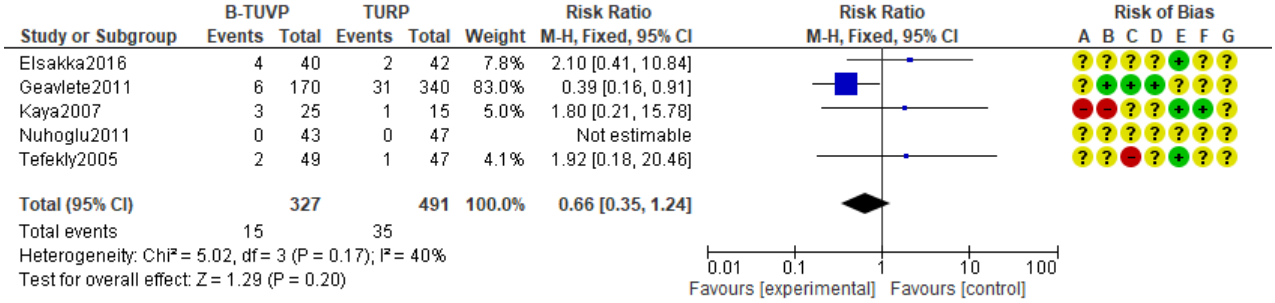


Note: lower QoL values are better.

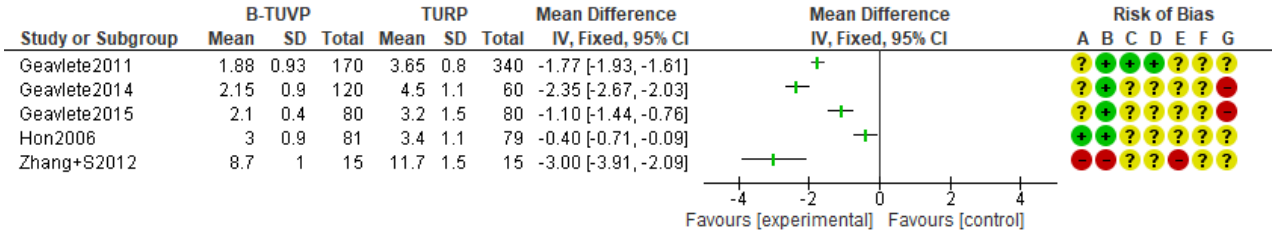
Irritative symptoms



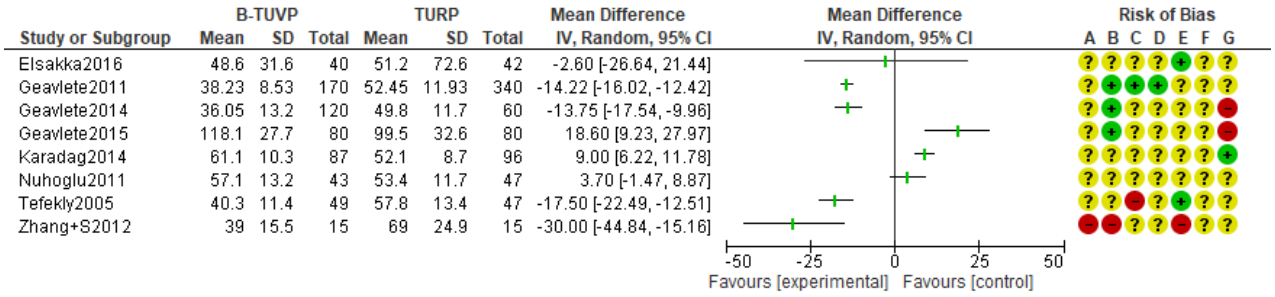
Reintervention



Hospitalisation time (days)



Procedure time (min)



B-TUVP versus PVP

See the section on PVP.

B-TUVP versus DioLVP

One study (Skinner 2017, n=55; unclear RoB) compared B-TUVP versus DioLVP for the outcomes IPSS and QoL (at 3 months) and operative time. The mean prostate size was 47 ml (no range or inclusion criteria available). A significant difference in operative time in favour of B-TUVP (24.3 vs. 33.5 min; p<0.05, 95% CI not available) was observed. No differences were found for IPSS or QoL (at 3 months).

B-TUVP versus B-TUEP

See the section on B-TUEP.

B-TUVP versus OP

One study (Geavlete 2015, n=160; high RoB) compared B-TUVP versus OP among patients with a prostate size >80 ml for the outcomes Qmax, PVR, IPSS and QoL at 1, 3, 6 and 12 months, as well as operative time and hospital stay. Significant differences in favour of OP were observed for operative time (118.1 vs. 79.4 min; p value and 95% CI not available) and in favour of B-TUVP for hospital stay (2.1 vs. 6.7 days; p value and 95% CI not available).

DioLVP

DioLVP was assessed in three of the RCTs, including a total of 242 patients: two RCTs versus TURP (n=187) and one RCT versus B-TUVP (n=55).

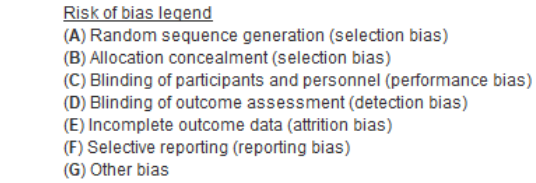
DioLVP versus TURP

Two RCTs (Cetinkaya 2015, n=72; high RoB; Razzaghi 2014, n=115; uncertain RoB) compared DioLVP versus TURP. Outcomes assessed in these studies are indicated in Table 4-16. There were no data on BPHII.

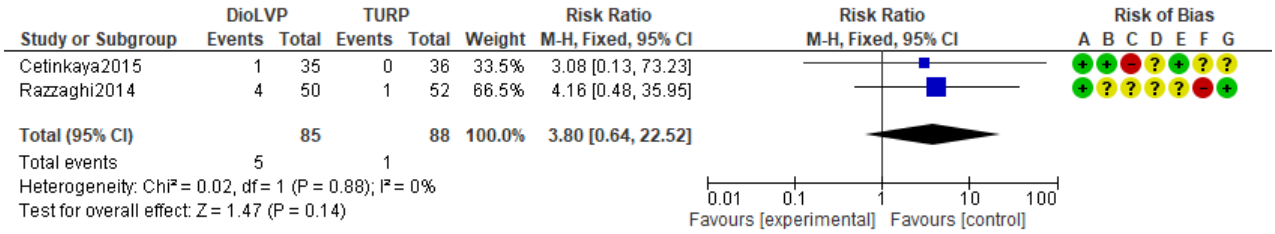
Table 4-16: Effectiveness outcomes assessed in RCTs comparing DioLVP versus TURP

Study ID	Razzaghi 2014	Cetinkaya 2015
IPSS at 1 month	x	
IPSS at 3 months		x
IPSS at 6 months	x	
IPSS at 12 months	x	
IPSS at 24 months	x	
Qmax at 1 month	x	
Qmax at 3 months		x
Qmax at 6 months	x	
Qmax at 12 months	x	
Qmax at 24 months	x	
PVR at 6 months	x	
PVR at 12 months	x	
PVR at 24 months	x	
Reintervention	x	x
Hospitalisation time	x	x
Procedure time	x	x

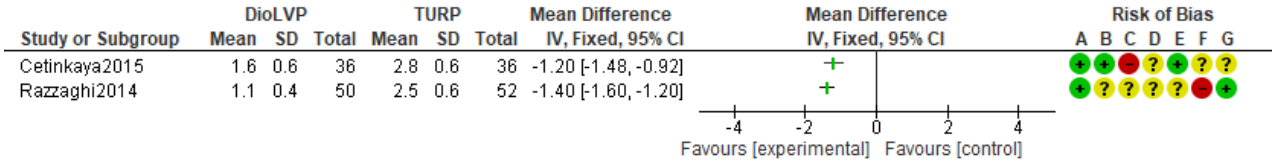
Prostate volume was an inclusion criterion in both studies, and differed between them: >100 ml for Razzaghi 2014 and <80 ml for Cetinkaya 2015. Neither of the studies reported the range for prostate volume. Pooling of data was possible for reintervention. Hospitalisation time was shorter for DioLVP in both studies (MD up to 1.4 days less). Meta-analysis was not possible for the other outcomes since the follow-up times were substantially different. Comparison results for IPSS and Qmax in each of the two studies are presented in Table 4-17 and Table 4-18. Razzaghi 2014 showed significant differences for both IPSS and Qmax at 12 and 24 months in favour of TURP that are close to the MCID thresholds of 3 points for IPSS and 2 ml/s for Qmax.



Reintervention



Hospitalisation time (days)



Procedure time (min)

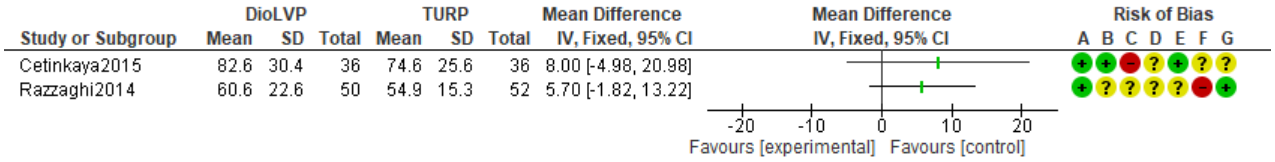


Table 4-17: Differences in IPSS for DioLVP versus TURP in Cetinkaya 2015 and Razzaghi 2014

Study	Risk of bias	DioLVP	TURP	Follow-up	Statistical significance
Cetinkaya 2015	High	8.38	8.31	3 months	n.a.
Razzaghi 2014	Uncertain	10.6	11.4	1 month	p=0.26
		8.5	7.8	6 month	p=0.1
		8.7	7.4	12 months	p=0.01; 95% CI n.a.
		10.4	7.7	24 months	p=0.04; 95% CI n.a.

Abbreviations: n.a.=not available.

Table 4-18: Differences in Qmax for DioLVP versus TURP in Cetinkaya 2015 and Razzaghi 2014

Study	Risk of bias	DioLVP	TURP	Follow-up	Statistical significance
Cetinkaya 2015	High	16.34	18.5	3 months	n.a.
Razzaghi 2014	Uncertain	15.6	15.7	1 month	p=0.85
		20.6	19.8	6 month	p=0.24
		19.8	21.7	12 months	p=0.004; 95% CI n.a.
		18.5	21.1	24 months	p=0.0001; 95% CI n.a.

Abbreviations: n.a.=not available.

DioLVP versus B-TUVP

See the section on B-TUVP.

PVP

PVP was assessed in five of the RCTs, with comparisons to TURP (3 RCTs; n=465), B-TUVP (2 RCTs; n=146) and HoLEP (1 RCT; n=103).

PVP versus TURP

Three RCTs (Goliath study [Bachmann 2014, Bachmann 2015, Thomas 2016], n=281; Jovanovic 2014, n=62; Elshal 2020, n=122) compared PVP versus TURP for the outcomes listed in Table 4-19. No data were available for Qmed, BPHII or postoperative LUTS (as a binary outcome).

Table 4-19: Effectiveness outcomes assessed in RCTs comparing PVP versus TURP

Study ID	Jovanovic 2014	Goliath study (Bachmann 2014, 2015; Thomas 2016)	Elshal 2020 [a]
IPSS at 1 month			x
IPSS at 3 months		x	x
IPSS at 6 months		x	
IPSS at 12 months		x	x
IPSS at 24 months		x	x
IPSS at 36 months			x
Qmax at 1 month			x
Qmax at 3 months		x	x
Qmax at 6 months		x	
Qmax at 12 months		x	x
Qmax at 24 months		x	x
Qmax at 36 months			x
PVR at 1 month			x
PVR at 3 months		x	x
PVR at 6 months		x	
PVR at 12 months		x	x

Study ID	Jovanovic 2014	Goliath study (Bachmann 2014, 2015; Thomas 2016)	Elshal 2020 [a]
PVR at 24 months		x	x
PVR at 36 months			x
PVR at 48 months			
Reintervention total		x	x
QoL at 1 month			x
QoL at 3 months		x	x
QoL at 6 months		x	
QoL at 12 months		x	x
QoL at 24 months		x	x
Persistent irritative symptoms		x	x
Hospitalisation time	x	x	x [b]
Procedure time	x	x	x

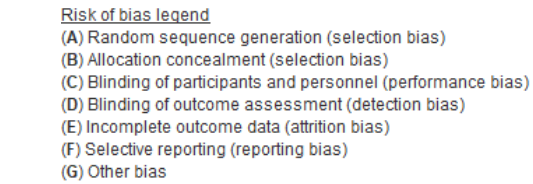
[a] Data for IPSS, Qmax, QoL and PVR were extrapolated from graphs.

[b] Data estimated according to McGrath et al. [63].

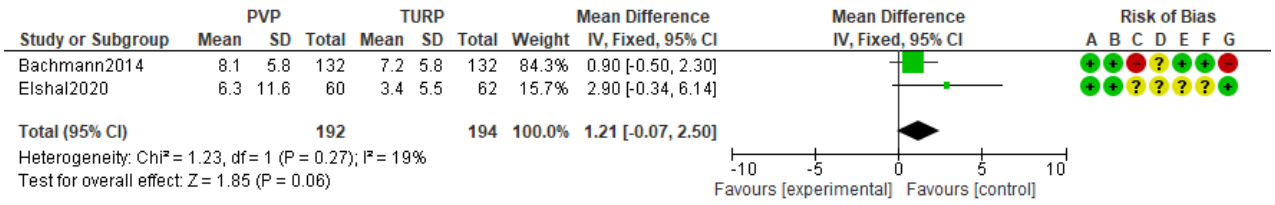
Patient populations were heterogeneous in terms of prostate size: in the Goliath study and Jovanovic 2014 the prostate size was <100 ml (mean 47 ml in the Goliath study and 61 ml in Jovanovic 2014; no ranges were available); Elshal 2020 enrolled patients with prostate size between 80 and 150 ml (mean 106 ml).

Pooling of data was possible for IPSS (3 and 12 months), Qmax (3 and 12 months), PVR (3, 12 and 24 months), QoL (3,12 and 24 months) and reintervention. Differences were found in favour of TURP for IPSS at 12 months (mean 1.20, 95% CI 0.00–2.40; I^2=0%, high RoB) and PVR at 12 months (mean 11.23 ml, 95% CI 2.98–19.48; I^2=0%, high RoB). The quality of the evidence for these outcomes was judged as low because of RoB and indirectness. Hospitalisation time was shorter for PVP (up to 2.5 days less) and procedure time was shorter for TURP (~10 min less).

No differences were found between the two technologies for Qmax, QoL, reintervention or irritative symptoms.

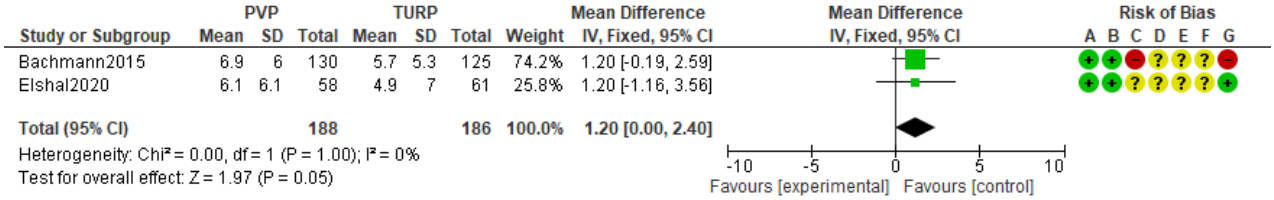


IPSS at 3 months



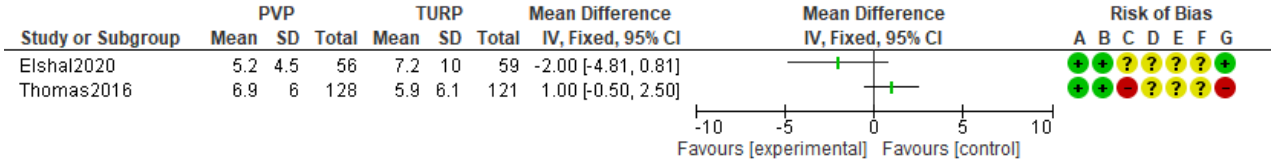
Note: lower IPSS scores are better.

IPSS at 12 months



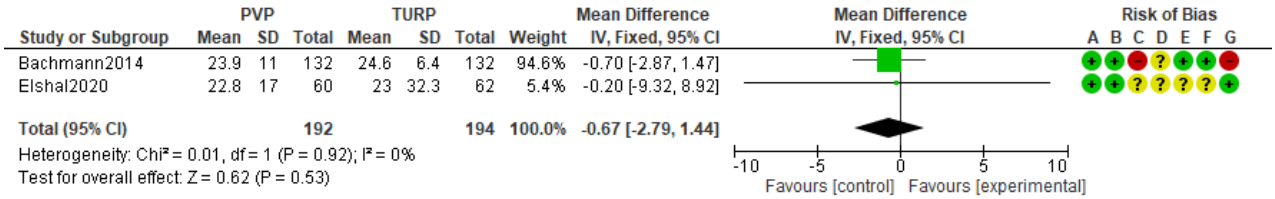
Note: lower IPSS values are better.

IPSS at 24 months



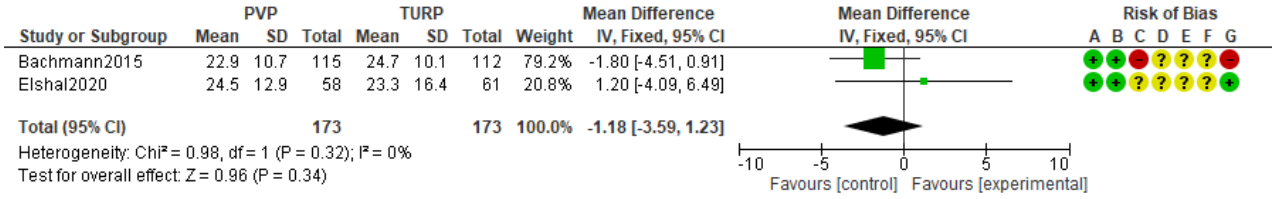
Note: lower IPSS values are better.

Qmax (ml/s) at 3 months



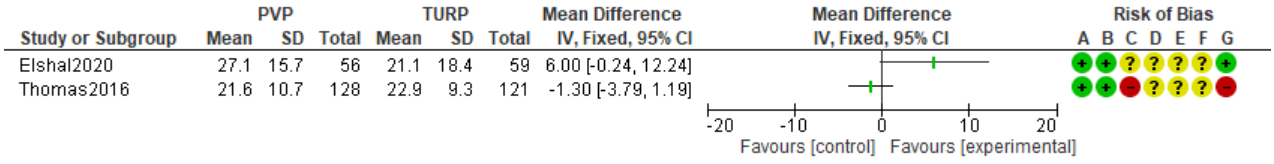
Note: higher Qmax values are better.

Qmax at 12 months



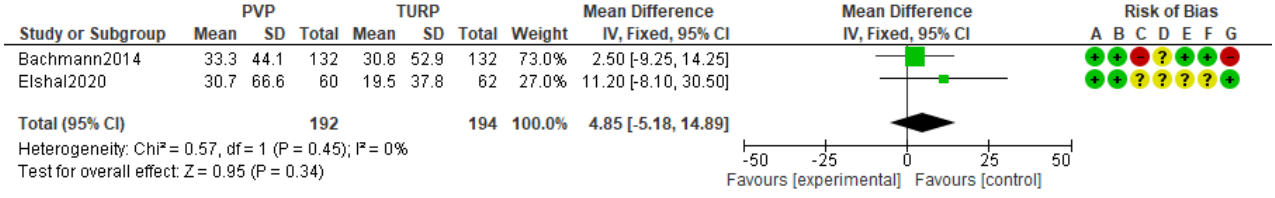
Note: higher Qmax values are better.

Qmax at 24 months



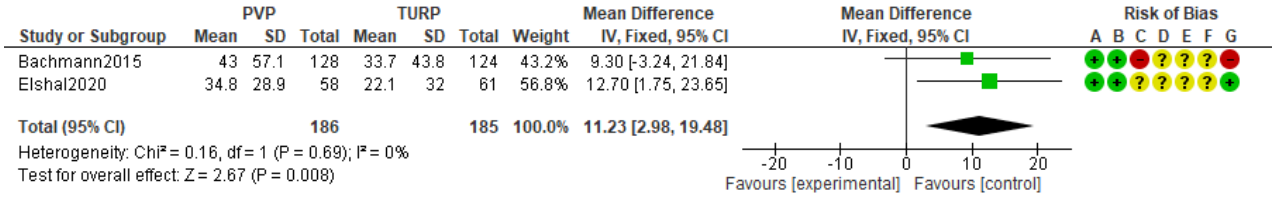
Note: higher Qmax values are better.

PVR at 3 months



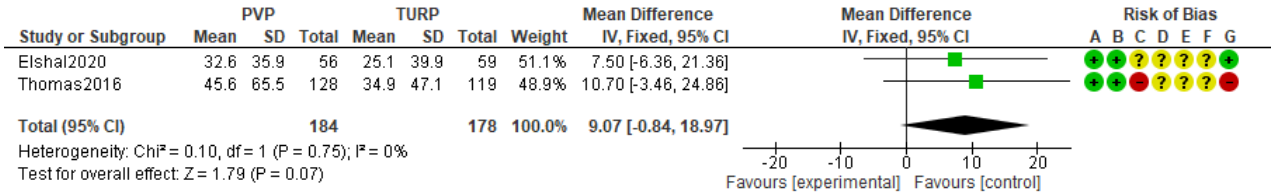
Note: lower PVR values are better.

PVR at 12 months



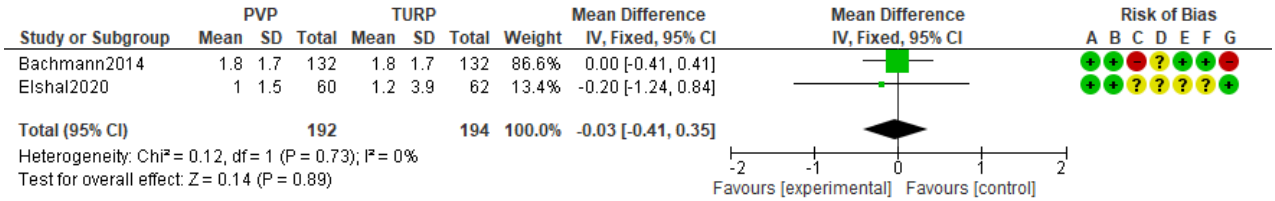
Note: lower PVR values are better.

PVR at 24 months



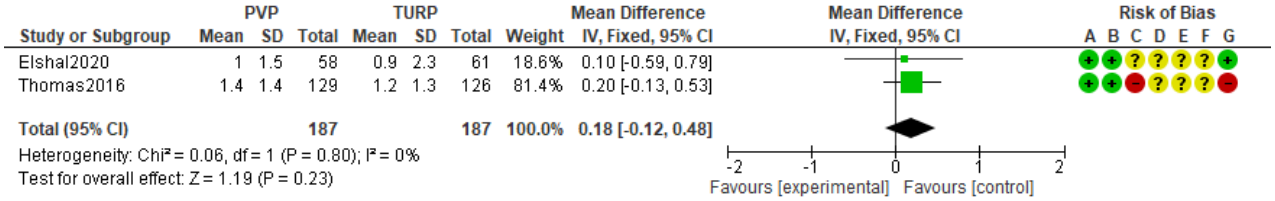
Note: lower PVR values are better.

QoL at 3 months



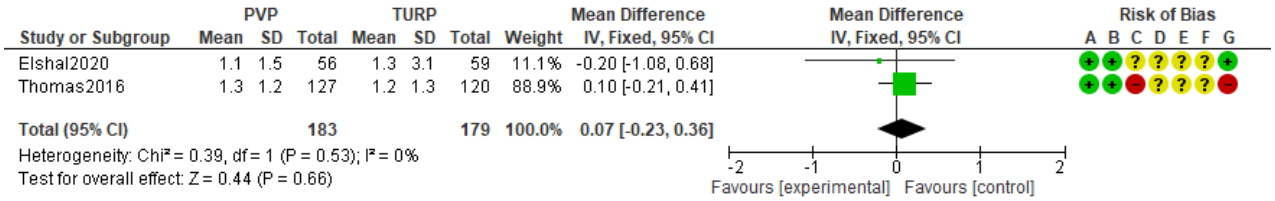
Note: lower QoL scores are better.

QoL at 12 months



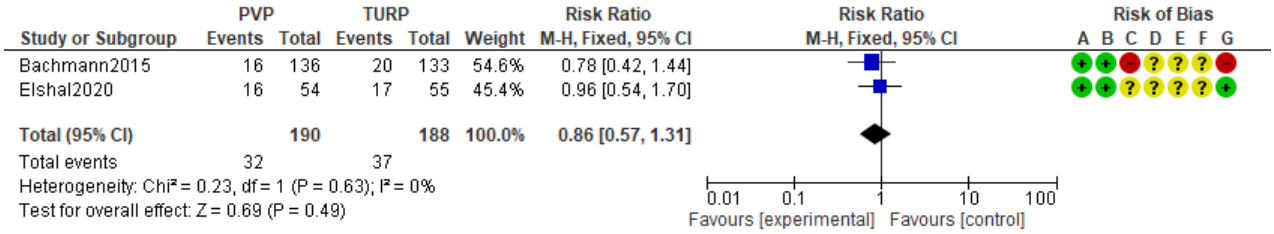
Note: lower QoL scores are better.

QoL at 24 months

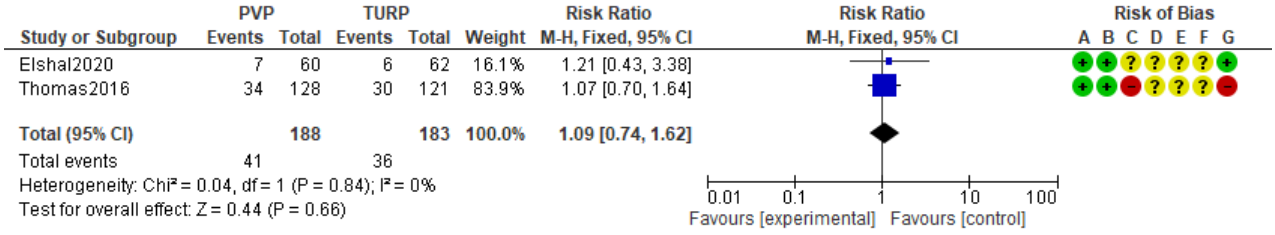


Note: lower QoL scores are better.

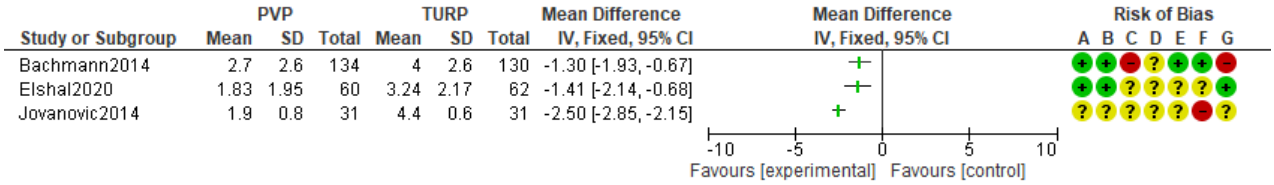
Reintervention



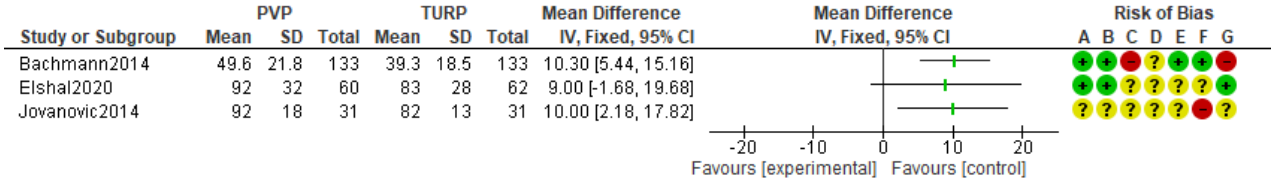
Persistent irritative symptoms



Hospitalisation time



Procedure time



PVP versus B-TUVP

Two RCTs (Ghobrial 2020, n=119; Kini 2020, n=27) compared PVP versus B-TUVY for the outcomes listed in Table 4-20. No data were available for Qmed, BPHII, reintervention or persistent irritative symptoms.

Table 4-20: Effectiveness outcomes assessed in RCTs comparing PVP versus B-TUVP

Study ID	Ghobrial 2020 [a]	Kini 2020
IPSS at 1 month	x	x
IPSS at 3 months	x (at 4 months)	x
IPSS at 6 months		x
IPSS at 12 months	x	
IPSS at 24 months	x	
Qmax at 1 month		x
Qmax at 3 months	x (at 4 months)	x
Qmax at 6 months		x

Study ID	Ghobrial 2020 [a]	Kini 2020
Qmax at 12 months	x	
Qmax at 24 months	x	
PVR at 3 months	x (at 4 months)	
PVR at 12 months	x	
PVR at 24 months	x	
QoL at 1 month		x
QoL at 3 months	x (4 months)	x
QoL at 6 months		x
QoL at 12 months	x	
QoL at 24 months	x	
Hospitalisation time	x	
Procedure time	x	

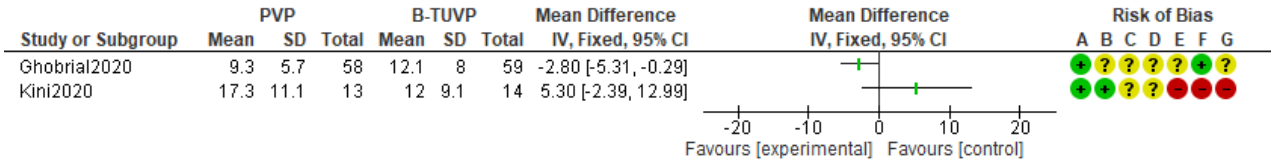
[a] Data for IPSS, Qmax and PVR were extrapolated from graphs.

Prostate size was between 30 and 80 ml in Ghobrial 2020 and <80 ml in Kini 2020.

Pooling of data was possible for IPSS at 3 months, Qmax at 1 and 3 months and QoL at 1 month. A difference in favour of PVP was found for IPSS at 3 months (mean –2.20, 95% CI –4.03 to –0.38; I^2=63%, high RoB). The quality of the evidence was judged as low because of RoB and inconsistency.

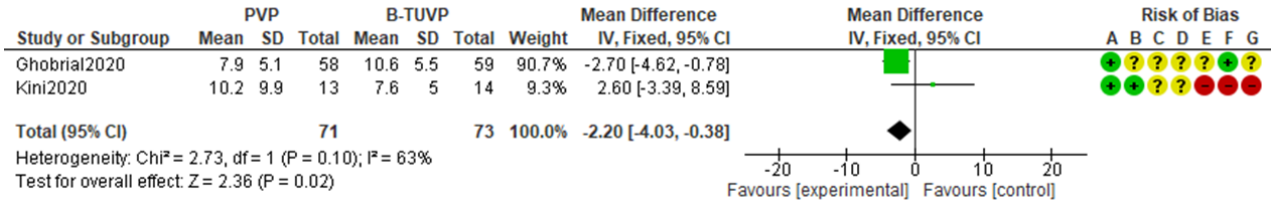
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



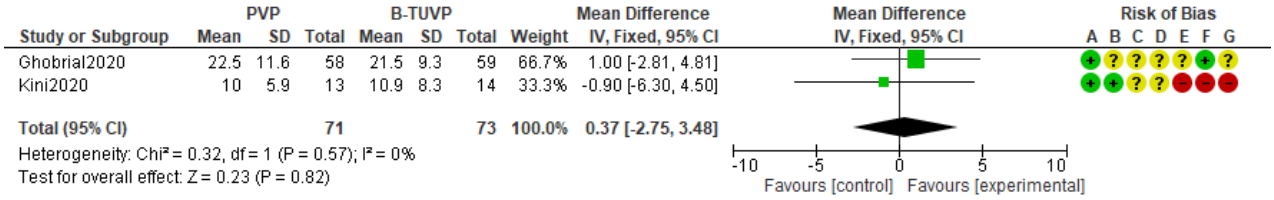
Note: lower IPSS scores are better.

IPSS at 3 months



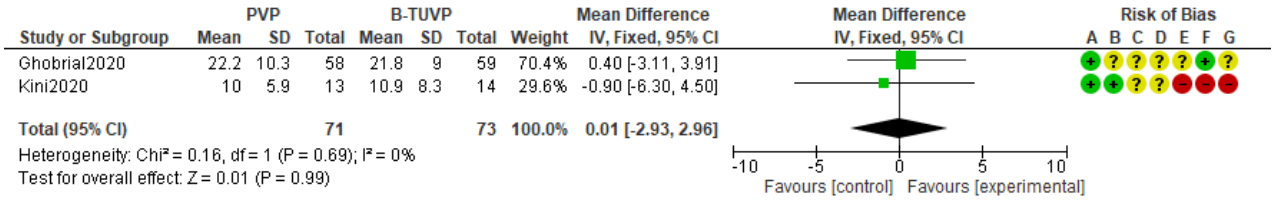
Note: lower IPSS scores are better.

Qmax (ml/s) at 1 month



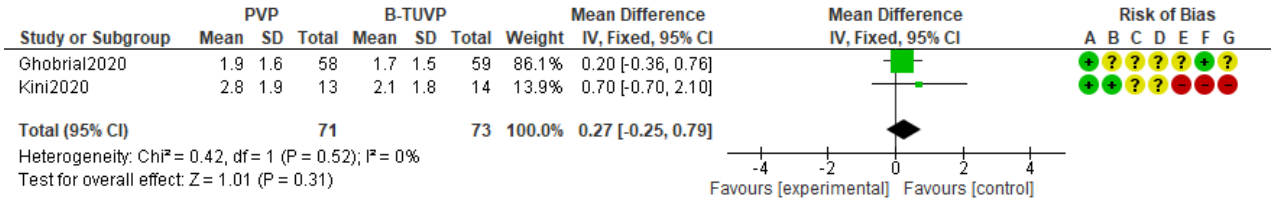
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



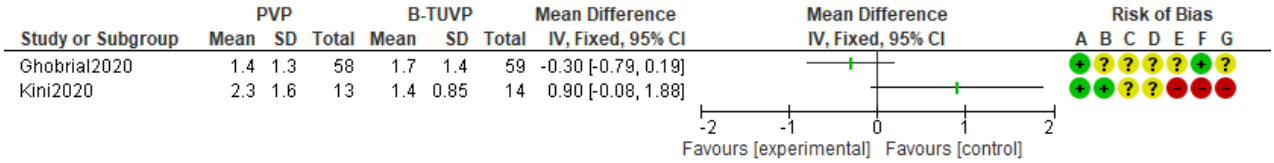
Note: higher Qmax values are better.

QoL at 1 month



Note: lower QoL scores are better.

QoL at 3 months



Note: lower QoL scores are better.

PVP versus HoLEP

See the section on HoLEP.

4.4.1.4 Hybrid techniques: Vapoenucleation

ThuVEP

ThuVEP was assessed in two of the RCTs, including a total of 153 patients: one RCT versus TURP (n=59) and one RCT versus HoLEP (n=94).

ThuVEP versus TURP

One study (Chang 2015, n=59; uncertain RoB) compared ThuVEP versus TURP. Prostate volume was not considered as an inclusion criterion; the mean prostate weight was 57.2 g in the ThuVEP group and 64.7 g in the TURP group. Only PVR and hospital stay data could be retrieved from this study, with no significant differences between the technologies. There were no data on IPSS, Qmax, QoL, BPHII, reintervention or operative time.

ThuVEP versus HoLEP

See the section on HoLEP.

B-VEP

B-VEP versus TURP

Two RCTs (Wang 2020, n=101; uncertain RoB; Zhang 2015, n=112; uncertain RoB) including 213 patients compared B-VEP versus TURP. Outcomes assessed in these studies are indicated in Table 4-21. There were no data for BPHII or reintervention.

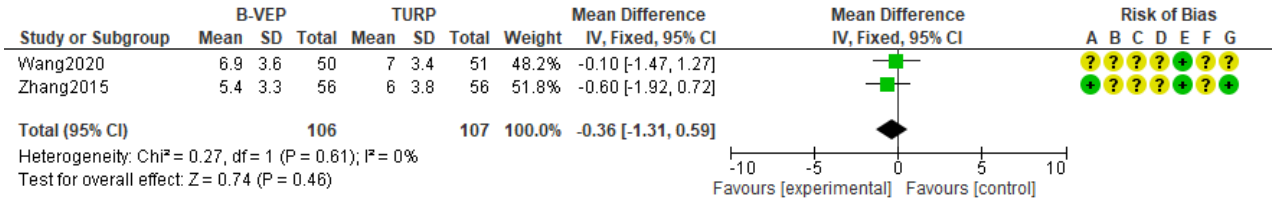
Table 4-21: Effectiveness outcomes assessed in RCTs comparing B-VEP versus TURP

Study ID	Zhang 2015	Wang 2020
IPSS at 3 months	x	x
IPSS at 6 months		x
Qmax at 3 months	x	x
Qmax at 6 months		x
PVR at 3 months	x	x
PVR at 6 months		x
QoL at 3 months	x	x
QoL at 6 months		x
Hospitalisation time	x	
Procedure time	x	

Both studies included patients with prostate volume >90 ml. Pooling of data was possible for IPSS, Qmax, PVR and QoL at 3 months, for which no significant differences were observed. In the study by Zhang 2015, both procedure time (63.9 vs. 78.1 min; p<0.001, 95% CI not available) and hospitalisation time (100.2 vs. 116.0 h; p=0.004, 95% CI not available) were significantly shorter in the B-VEP group compared to TURP.

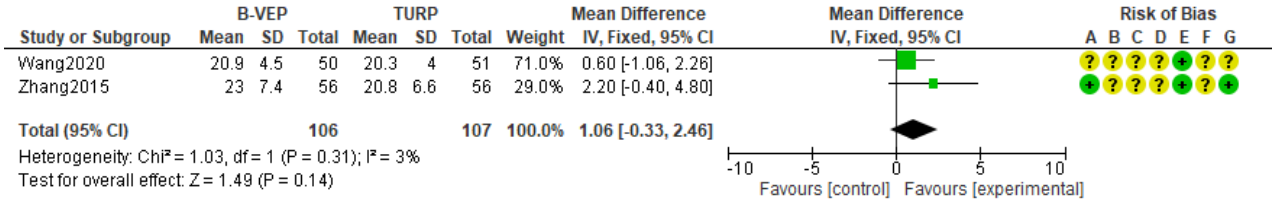
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 3 months



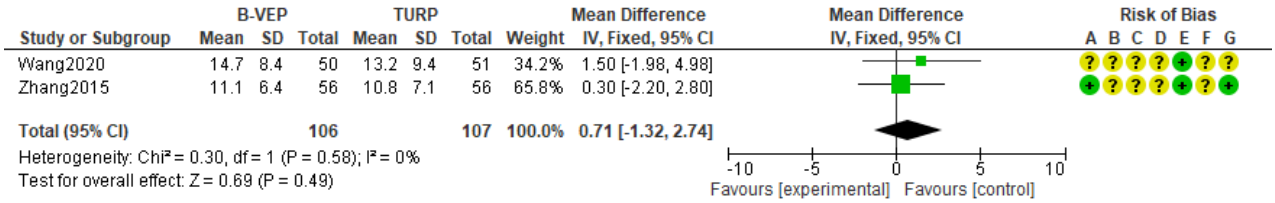
Note: lower IPSS scores are better.

Qmax (ml/s) at 3 months



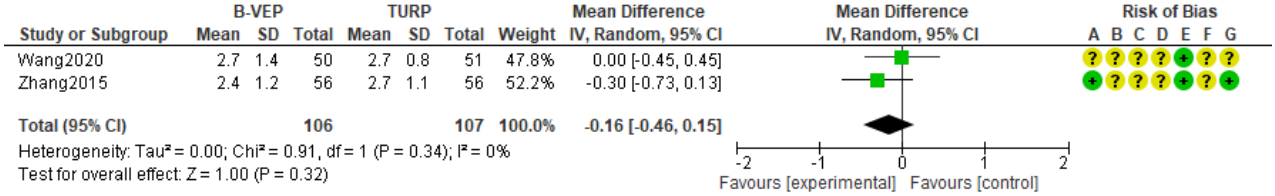
Note: higher Qmax values are better.

PVR (ml) at 3 months



Note: lower PVR values are better.

QoL at 3 months



Note: lower QoL scores are better.

4.4.1.5 Hybrid techniques: Vaporesection

TUVRP

TUVRP was assessed in comparison to TURP in four of the RCTs, including a total of 560 patients.

TUVRP versus TURP

Five RCTs (Dunsmsuir 2003, n=51; Geavlete 2010, n=155; Gupta 2006, n=100; Yip 2011, n=86; Yee 2015, n=168) compared TUVRP versus TURP for the outcomes listed in Table 4-22. No data were available for Qmed, BPHII or postoperative LUTS (as a binary outcome).

Table 4-22: Effectiveness outcomes assessed in RCTs comparing TUVRP versus TURP

Study ID	Dunsmuir 2003 [a]	Geavlete 2010	Yee 2015	Yip 2011	Gupta 2006
IPSS at 1 month		x		x	
IPSS at 3 months	x	x	x		
IPSS at 6 months	x	x	x		x
IPSS at 12 months	x				x
Qmax at 1 month		x		x [b]	
Qmax at 3 months	x	x	x		
Qmax at 6 months	x	x	x		x
Qmax at 12 months	x				x
PVR at 1 month		x			
PVR at 3 months	x	x	x		
PVR at 6 months	x	x	x		x [c]
PVR at 12 months	x				x [c]
QoL at 1 month		x			
QoL at 3 months		x	x		
QoL at 6 months		x	x		
Reintervention at 1 month				x	
Persistent irritative symptoms			x	x	
Hospitalisation time	x	x	x	x	
Procedure time	x	x	x	x	x

[a] Data for IPSS, Qmax, QoL and PVR were extrapolated from graphs.

[b] Data for IPSS at 1 month were extrapolated from a graph.

[c] Data not available.

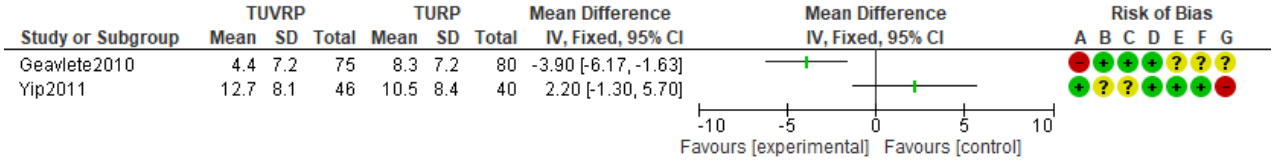
Patients included in one study (Geavlete 2010) had prostate size falling entirely within the 30–80 ml subgroup, whereas two studies (Yip 2011 and Yee 2015) included patients with an average prostate size of 61 ml and one study (Dunsmuir 2003) included patients with a prostate size between 16 and 60 ml.

Pooling of data was possible for IPSS (at 3, 6 and 12 months), Qmax (at 1, 3, 6 and 12 months) and PVR and QoL (at 3 and 6 months). Differences were found in favour of TUVRP for IPSS at 3 months (mean –1.45, 95% CI –2.55 to –0.34; I^2=88%, high RoB), but high heterogeneity, possibly

due to RoB (random sequence generation in Geavlete 2010) and differences in the homogeneity of the populations studied, may limit the value of the pooled result (sensitivity analyses without Geavlete 2010 do not show significant differences); and for Qmax at 1 month (mean 2.12, 95% CI 0.39–3.85; I^2=0%, high RoB). The quality of the evidence was judged as low for IPSS at 3 months (owing to inconsistency and RoB) and for Qmax at 1 month (downgraded for imprecision and RoB).

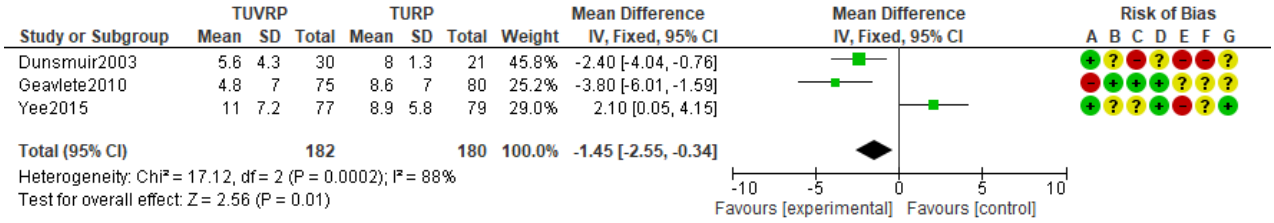
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 1 month



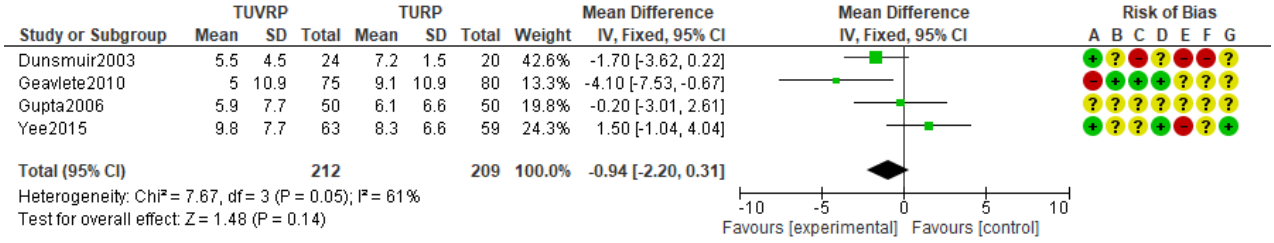
Note: lower IPSS scores are better.

IPSS at 3 months



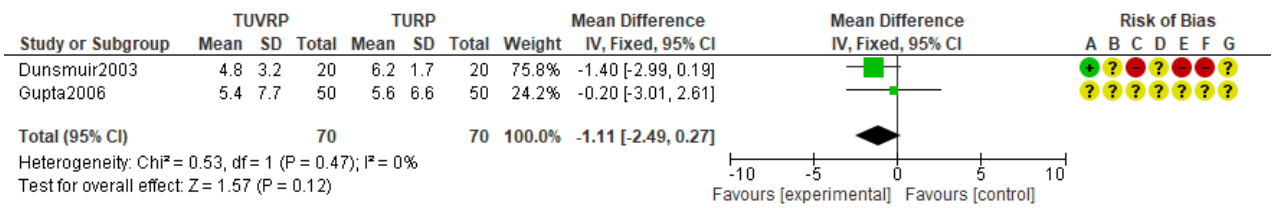
Note: lower IPSS scores are better.

IPSS at 6 months



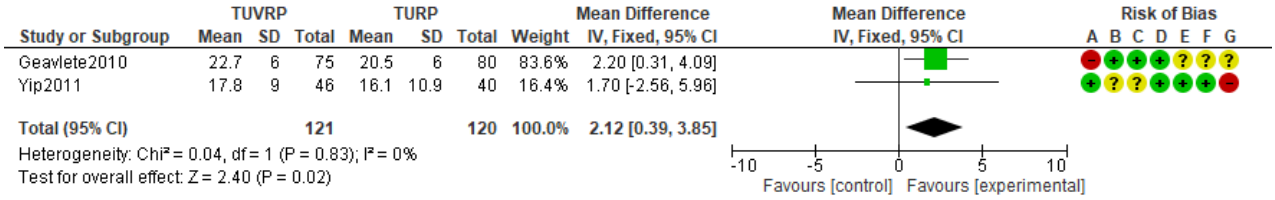
Notes: SD values for Gupta 2006 are from Yee 2015, the study with the most similar prostate size.
Lower IPSS scores are better.

IPSS at 12 months



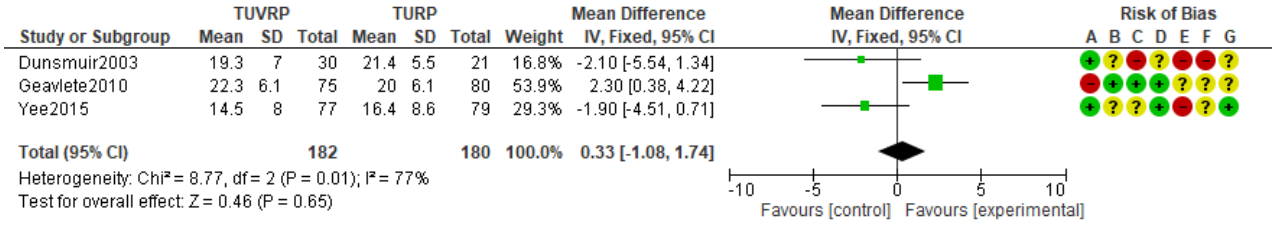
Notes: SD values for Gupta 2006 are from the data for IPSS at 6 months in Yee 2015 since prostate size in the two studies is similar and IPSS SDs are stable. Lower IPSS scores are better.

Qmax (ml/s) at 1 month



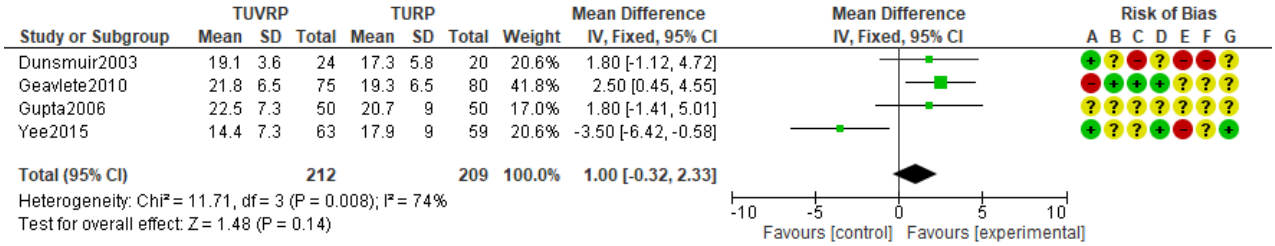
Note: higher Qmax values are better.

Qmax (ml/s) at 3 months



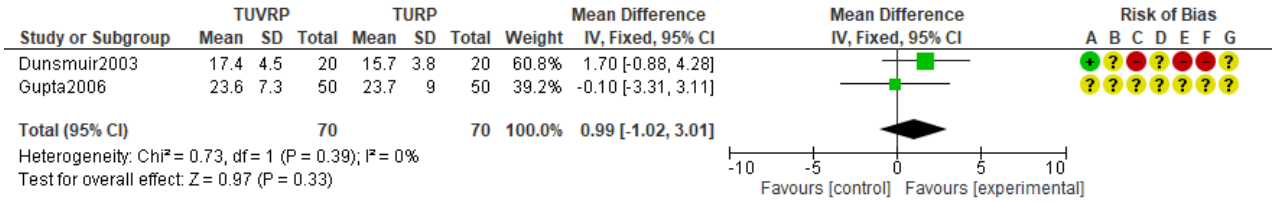
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



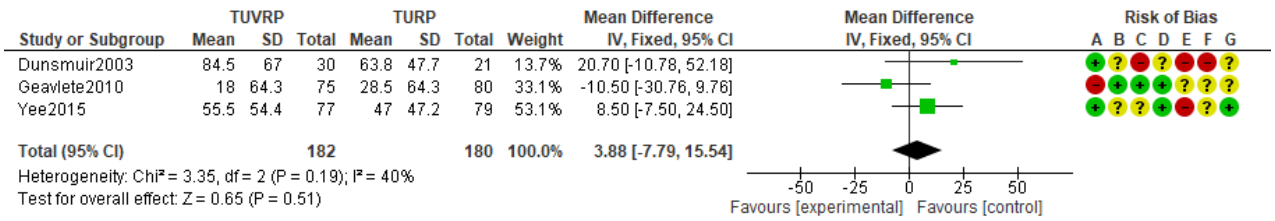
Notes: SD values for Gupta 2006 are from Yee 2015, the study with the most similar prostate size. Higher Qmax values are better.

Qmax (ml/s) at 12 months



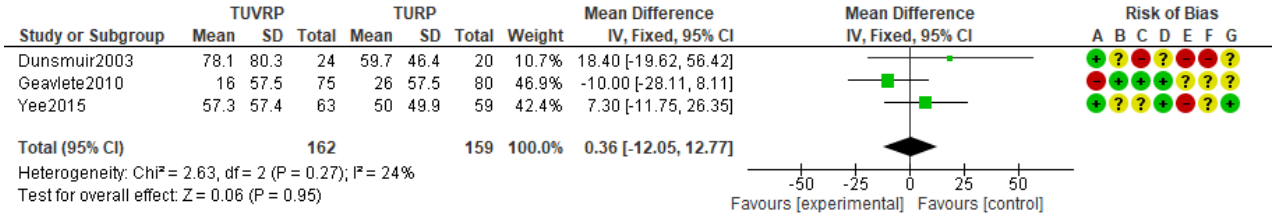
Notes: SD values for Gupta 2006 are from the data for Qmax at 6 months in Yee 2015 since prostate size in the two studies is similar and the Qmax SDs are stable. Higher Qmax values are better.

PVR (ml) at 3 months



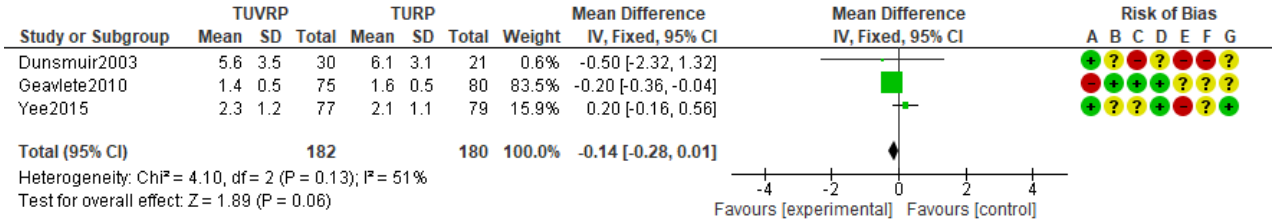
Note: lower PVR values are better.

PVR (ml) at 6 months



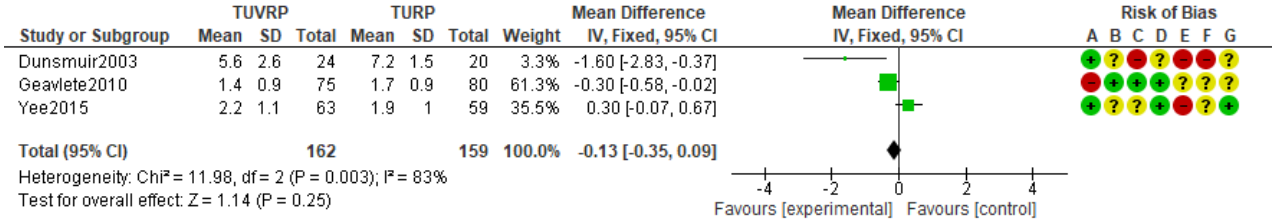
Note: lower PVR values are better.

QoL at 3 months



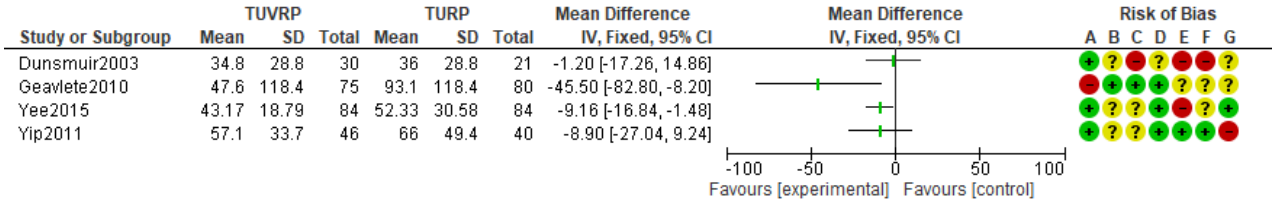
Note: lower QoL scores are better.

QoL at 6 months

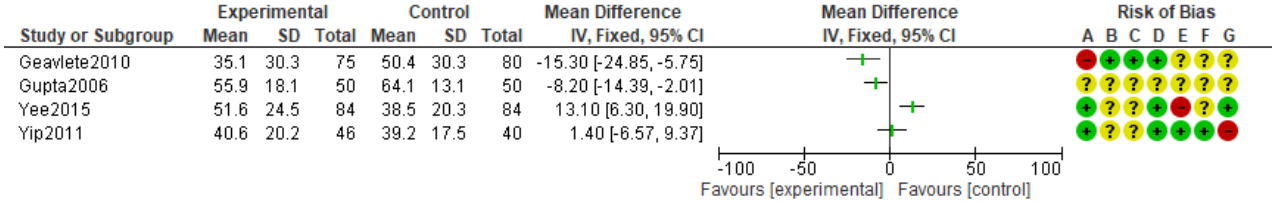


Note: lower QoL scores are better.

Hospitalisation time (h)



Procedure time



ThuVARP

ThuVARP was assessed in one RCT (Hashim 2020, uncertain RoB), comparing ThuVARP versus TURP and including a total of 410 patients with prostate size between 20 and 50 ml.

A noninferiority hypothesis was postulated for IPSS and Qmax at 12 months (co-primary endpoints) for a difference of <2.5 points and <4 ml/s, respectively. In the intention-to-treat analysis, ThuVARP was noninferior to TURP for IPSS, while TURP was superior to ThuVARP for Qmax (MD 3 ml/s, 95% CI –5.8 to –0.5). The latter result is around the MCID, although it should be considered that 26% of patients allocated to ThuVARP were eventually switched to TURP for several reasons (e.g., equipment issues, large prostate, bleeding, poor visibility) and 2% did not undergo TURP. A complete list of reasons for failure to undergo the randomised treatment is available in the supplementary appendix of the RCT [43]. No data are available for PVR, QoL, procedure time or postoperative LUTS (as a binary outcome). Table 4-23 shows the available results.

Table 4-23: Effectiveness outcomes assessed in Hashim 2020 comparing TUVRP versus TURP

Outcome	ThuVARP	TURP	p value (95% CI)
IPSS at 12 months	6.4	6.3	(–0.9 to 1.5)
IPSS quality of life	1.7	1.5	0.29
Qmax at 12 months (ml/s)	20.2	23.2	(–5.8 to–-0.5)
Reintervention (%)	2.0	1.0	–
Frequency >8 times/day (%)	12	10	0.60
Nocturia (%)	44	37	0.10
Frequency >8 times/day (%)	12	10	0.60
Hospital stay (h)	48	48	0.31

4.4.1.6 Hybrid techniques: Enucleoresection

B-TUERP

B-TUERP was assessed in two RCTs, including a total of 320 patients.

B-TUERP versus TURP

One RCT (Samir 2019, n=240; uncertain RoB) compared B-TUERP versus TURP among patients with a prostate size >80 ml for the outcomes listed in Table 4-24. The authors reported significant differences in favour of B-TUERP versus TURP for functional outcomes (except Qmax at 6 months and QoL at 24 months) and hospital stay; operative time was longer with B-TUERP. Since 95% CIs were not available, it was not possible to assess imprecision associated with the reported estimates.

No data were available for Qmed, BPHII, reintervention, irritative symptoms or postoperative LUTS (as a binary outcome).

Table 4-24: Effectiveness outcomes assessed in Samir 2019 comparing B-TUERP versus TURP

Outcome	B-TUERP	TURP	p value
IPSS at 1 month	15	19	<0.01
IPSS at 6 months	12	13	0.002
IPSS at 24 months	6	7	0.009
Qmax at 1 month (ml/s)	19.0	15.4	<0.001
Qmax at 6 months (ml/s)	22.0	19.0	0.76
Qmax at 24 months (ml/s)	24.9	20.1	0.03
PVR at 1 month (ml)	22.1	32.6	<0.001
PVR at 6 months (ml)	19.4	22.7	0.02
PVR at 24 months (ml)	18.6	24.7	0.001
QoL at 1 month	2.5	3	0.01
QoL at 6 months	2	2.5	<0.001
QoL at 24 months	1	2	0.24
Operative time (min)	105.1	61.1	<0.001
Hospital stay (h)	52.5	60.4	<0.001

B-TUERP versus DioLEP

One RCT (Xu 2013, n=80, uncertain risk of bias) compared these two technologies in patients with average prostate size of 67 ml (no range or inclusion criteria available), assessing the outcomes listed in Table 4-25. Compared to DioLEP, B-TUERP needed a longer operative time and was associated with higher incidence of irritative symptoms. Since 95% CIs were not available, it was not possible to assess uncertainty associated with the reported estimates.

No data are available for Qmed, BPHII, reintervention or postoperative LUTS (as a binary outcome).

Table 4-25: Effectiveness outcomes assessed in Xu 2013 (n=80; uncertain RoB) comparing B-TUERP versus DioLEP

Outcome	B-TUERP	DioLEP	p value
IPSS at 3 months	7.5	7.0	0.24
IPSS at 6 months	6.3	6.1	0.51
IPSS at 12 months	5.3	4.9	0.17
Qmax at 3 months (ml/s)	22.9	23.1	0.82
Qmax at 6 months (ml/s)	23.1	23.3	0.81
Qmax at 12 months (ml/s)	23.3	23.5	0.87
PVR at 3 months (ml)	20.3	16.0	0.55
PVR at 6 months (ml)	4.8	4.1	0.80
PVR at 12 months (ml)	2.2	1.3	0.34
QoL at 3 months	1.9	1.7	0.25
QoL at 6 months	1.6	1.5	0.56
QoL at 12 months	1.2	1.2	0.63
Operative time (min)	50.3	33.7	<0.001

Outcome	B-TUERP	DioLEP	p value
Hospital stay (days)	5.3	5.0	0.10
Irritative symptoms (%)	35.0	12.5	0.02

M-TUERP

M-TUERP was assessed in one RCT (Li 2018, n=86; high RoB) in comparison to TURP for 86 patients. The study included patients with prostate volume >80 ml. Operative time was the only effectiveness outcome retrievable and it did not significantly differ between the groups. There were no data on IPSS, Qmax, PVR, QoL, hospitalisation time or BPHII.

4.4.1.7 Aquablation

Aquablation was assessed in one RCT (WATER study), with four publications presenting results at different follow-up times for comparison to TURP among 181 patients (Gilling 2018, 2019a, 2019b, 2020; uncertain RoB). The outcomes assessed in these papers are listed in Table 4-26. No data were available for BPHII.

Table 4-26: Effectiveness outcomes assessed in RCTs comparing Aquablation versus TURP

Study ID	Gilling 2018	Gilling 2019a	Gilling 2019b	Gilling 2020
IPSS at 1 month			x	x
IPSS at 3 months			x	x
IPSS at 6 months	x	x	x	x
IPSS at 12 months			x	x
IPSS at 24 months			x	x
IPSS at 36 months				x
Qmax at 1 month			x	x
Qmax at 3 months			x	x
Qmax at 6 months	x	x	x	x
Qmax at 12 months			x	x
Qmax at 24 months			x	x
Qmax at 36 months				x
PVR at 1 month			x	x
PVR at 3 months			x	x
PVR at 6 months	x	x	x	x
PVR at 12 months			x	x
PVR at 24 months			x	x
PVR at 36 months				x
Reintervention at baseline	x			
Reintervention at 12 months		x		
Reintervention at 24 months			x	
Reintervention at 36 months				x

Study ID	Gilling 2018	Gilling 2019a	Gilling 2019b	Gilling 2020
QoL at 1 month				x
QoL at 3 months				x
QoL at 6 months				x
QoL at 12 months				x
QoL at 24 months				x
QoL at 36 months				x
Hospitalisation time	x			
Procedure time	x			

The WATER study presented data for 6, 12, 24 and 36 months of follow-up and included patients with prostate size in the range 30–80 ml. Mean prostate size was 54.1 ml in the Aquablation group and 51.8 ml in the TURP group. At 6 months, the primary efficacy endpoint was the change in IPSS from baseline, with noninferiority declared if the lower bound for the two-sided 95% CI for the difference in score change at 6 months exceeded –4.7 points. The MD in score change at 6 months was 1.8 points greater for Aquablation (16.9 points for Aquablation vs. 15.1 points for TURP) showing noninferiority of Aquablation versus TURP (p<0.0001), whereas superiority was not shown for this or for the other outcomes (results presented in Table 4-27). The quality of the evidence was rated as low owing to uncertain RoB for allocation, performance and attrition bias and considering the imprecision of the estimates.

Table 4-27: Main effectiveness results from the WATER study

Aquablation vs. TURP (Gilling 2018, 2019a, 2019b, 2020, n=181; uncertain risk of bias)				
Outcome	**Aquablation**	**TURP**	**Follow-up**	**Statistical significance**
Qmax (ml/s)	20.3	18	6 months	0.14
	10.3 [a]	10.6 [a]	12 months	0.863
	11.2 [a]	8.6 [a]	24 months	0.188
	11.6 [a]	8.2 [a]	36 months	0.084
PVR (ml)	42	48	6 months	–
	52 [a]	63 [a]	12 months	0.462
	57 [a]	70 [a]	24 months	0.389
	52 [a]	53 [a]	36 months	0.980
IPSS	5.9	6.8	6 months	Noninferiority p<0.0001 Superiority p=0.1347)
	15.1 [a]	15.1 [a]	12 months	0.989
	14.7 [a]	14.9 [a]	24 months	0.830
	14.4 [a]	13.9 [a]	36 months	0.684
QoL	1.3	1.5	6 months	0.458
	3.2 [a]	3.5 [a]	12 months	0.317
	3.2 [a]	3.3 [a]	24 months	0.700
	3.2 [a]	3.2 [a]	36 months	0.784
Operative time (min)	33	36		0.27
Postoperative stay (days)	1.4	1.4		0.34

[a] Mean improvement.

4.4.1.8 TUMT

TUMT was assessed in four RCTs, all of which were comparisons versus TURP (n=419).

TUMT versus TURP

Four studies including 419 patients (D'Ancona 1989, n=52; uncertain RoB; Dahlstrandt 1995, n=69; uncertain RoB; Wagrell 2002, n=154; high RoB, Floratos 2001, n=144; uncertain RoB) compared TUMT versus TURP. Outcomes assessed in these studies are indicated in Table 4-28. There were no data on BPHII, hospitalisation time or procedure time.

Table 4-28: Effectiveness outcomes assessed in RCTs comparing TUMT versus TURP

Study ID	Dahlstrandt 1995	Floratos 2001 [a]	D'Ancona 1998	Wagrell 2002
IPSS at 3 months	x		x	x
IPSS at 6 months	x		x	x
IPSS at 12 months	x	x	x	x
IPSS at 24 months	x	x		
IPSS at 30 months			x	
IPSS at 36 months		x		
Qmax at 3 months	x		x	x
Qmax at 6 months	x		x	x
Qmax at 12 months	x	x	x	x
Qmax at 24 months	x	x		
Qmax at 30 months			x	
Qmax at 36 months		x		
PVR at 3 months	x		x	
PVR at 6 months	x		x	
PVR at 12 months	x	x	x	x
PVR at 24 months	x	x		
PVR at 30 months			x	
PVR at 36 months		x		
Reintervention	x	x		
QoL at 3 months				x
QoL at 6 months				x
QoL at 12 months		x		x
QoL at 24 months		x		
QoL at 36 months		x		

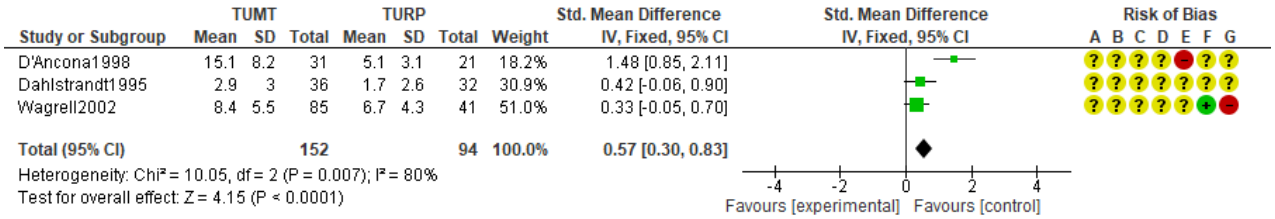
[a] Data for IPSS and Qmax were extracted from graphs; data for PVR and QoL were not extracted.

Two studies used prostate volume (>30 ml Floratos 2001; 30–100 ml Wagrell 2002) as an inclusion criterion. One study (Dahlstrandt 1995) used prostate length as an inclusion criterion (35–50 mm), while another (D'Ancona 1998) used both prostate length (25–50 mm) and prostate volume (30–100 ml) to select patients. Mean prostate volume was similar in the three studies that reported it (42–48.9 ml for TUMT and 44–52.7 ml for TURP). Only one study reported a prostate volume range (30–82 for ml TUMT and 31–86 ml for TURP).

Dahlstrandt 1995 used the Madsen Symptom Score, so in pooling of data this was considered together with IPSS for symptom score as an outcome (using SMD) at 3, 6, 12 and 24 months; pooling of data was also possible for Qmax (same timing), PVR at 3, 6 and 12 months, and reintervention. Significant differences were observed in favour of TURP for symptom score at 3 months (mean 0.36, 95% CI 0.07–0.66; I^2=0%, uncertain RoB), 6 months (mean 0.44, 95% CI 0.18–0.70; I^2=2%, high RoB), 12 months (mean 0.63, 95% CI 0.40–0.85; I^2=85%, high RoB) and 24 months (mean 2.04, 95% CI 0.96–3.12; I^2=88%, high RoB); Qmax at 3 months (mean –4.31 ml/s, 95% CI –6.25 to –2.37; I^2=59%, high RoB), 6 months (mean –2.94 ml/s, 95% CI –4.43 to –1.44; I^2=91%, high RoB), 12 months (mean –5.52 ml/s, 95% CI –7.18 to –3.87; I^2=79%, high RoB) and 24 months (mean –5.52 ml/s, 95% CI –7.72 to –3.33; I^2=0%, high RoB); and PVR at 12 months (mean 22.56 ml, 95% CI 6.82–38.31; I^2=66%, high RoB). The latter analysis lacks statistical significance when data from Dahlstrandt 1995 (showing very high values) are excluded. High heterogeneity could be explained by attrition bias in one study (D'Ancona 1998, for longer follow-up), a possible impact of unequal randomisation on study power in two studies (D'Ancona 1998 and Wagrell 2002), and data reliability in Floratos 2001 (data extracted from figures). The differences were below the MCID for IPSS and higher than the MCID for Qmax. The quality of the evidence was judged moderate for symptom score at 3 months (owing to imprecision) and 6 months (owing to RoB); low for symptom score and Qmax at 12 months (owing to inconsistency and RoB) and Qmax at 24 months (owing to imprecision and RoB); and very low for symptom score at 24 months and for Qmax at 3 and 6 months (owing to imprecision, inconsistency and RoB).

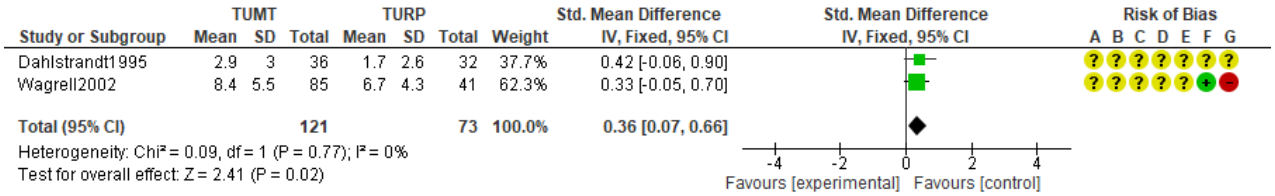
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

Symptom intensity score at 3 months (Dahlstrandt 1995 reported the Madsen Symptom Score; SMDs used)



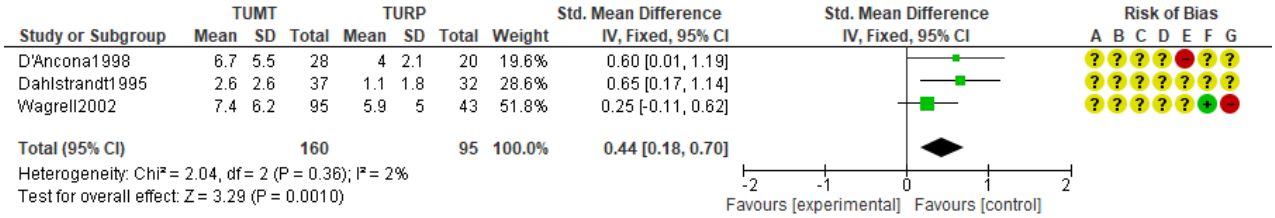
Note: lower scores are better.

Symptom intensity score at 3 months in the sensitivity analysis excluding D'Ancona 1998 (imbalanced randomisation, possibly underpowered)



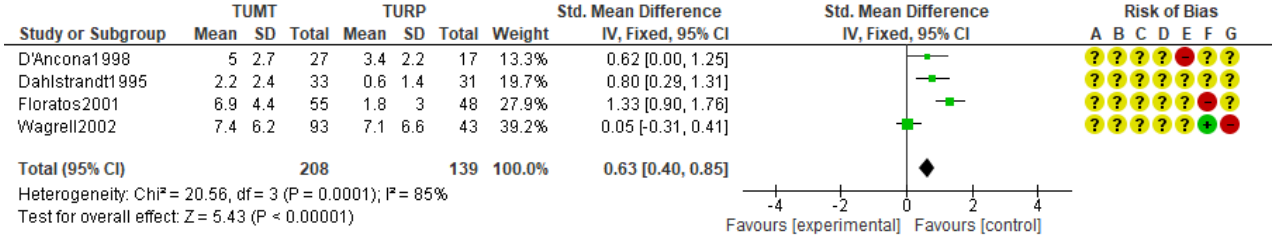
Note: lower scores are better.

Symptom intensity score at 6 months (Dahlstrandt 1995 reported the Madsen Symptom Score; SMDs used)



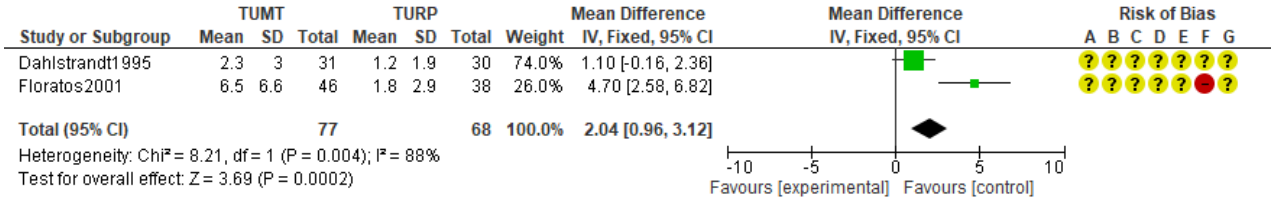
Note: lower scores are better.

Symptom intensity score at 12 months (Dahlstrandt 1995 reported the Madsen Symptom Score; SMDs used)



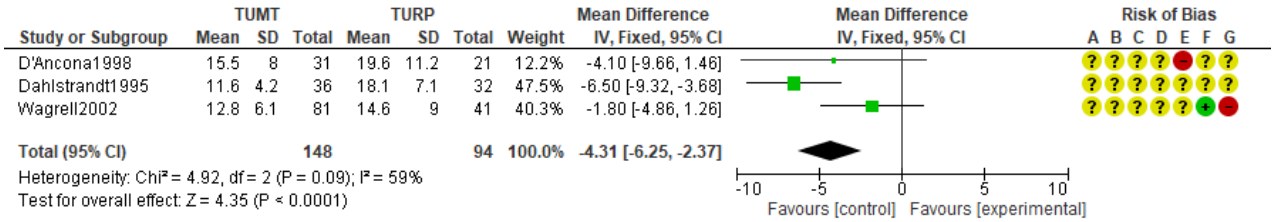
Note: lower scores are better.

Symptom intensity score at 24 months



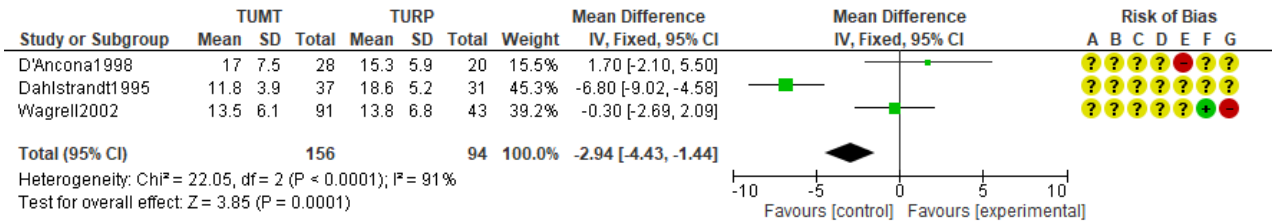
Note: lower scores are better.

Qmax (ml/s) at 3 months



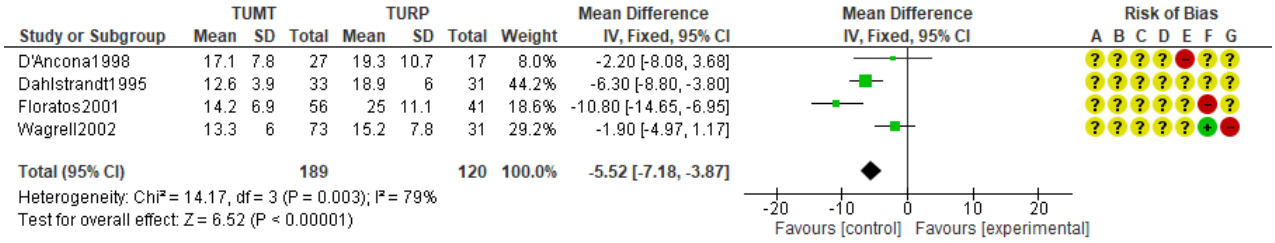
Note: higher Qmax values are better.

Qmax (ml/s) at 6 months



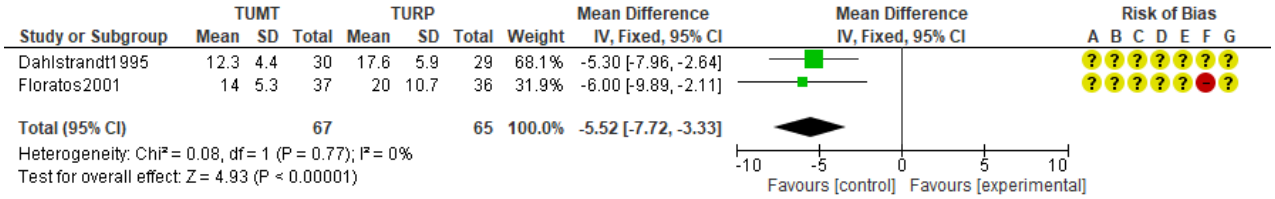
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



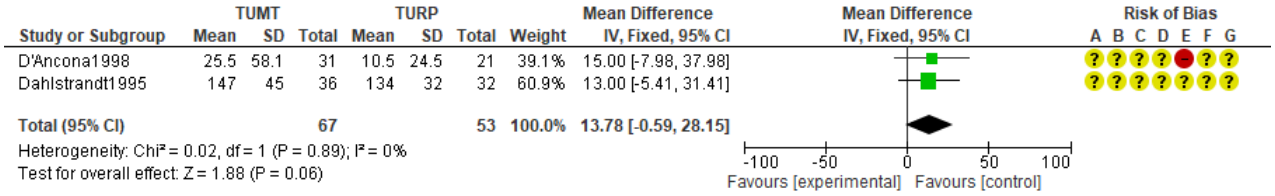
Note: higher Qmax values are better.

Qmax (ml/s) at 24 months



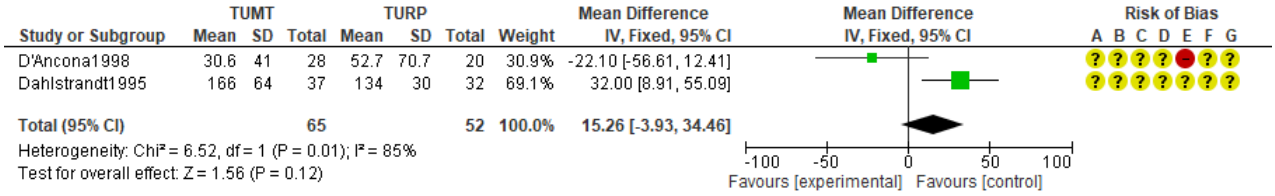
Note: higher Qmax values are better.

PVR (ml) at 3 months



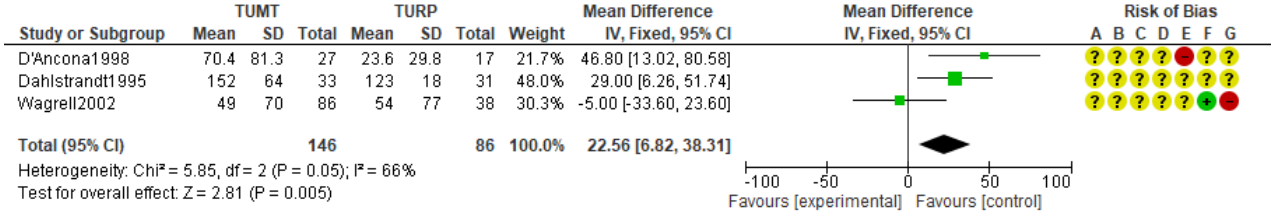
Note: lower PVR values are better.

PVR (ml) at 6 months



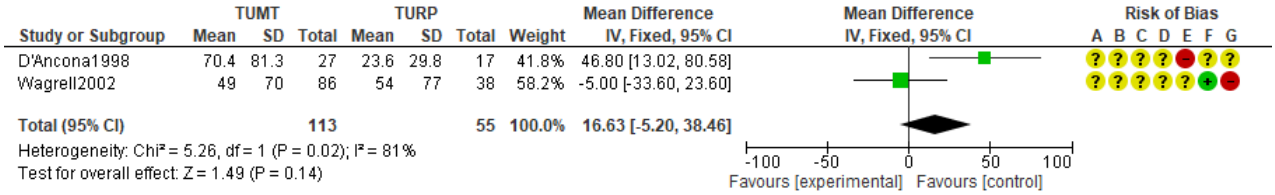
Note: lower PVR values are better.

PVR (ml) at 12 months



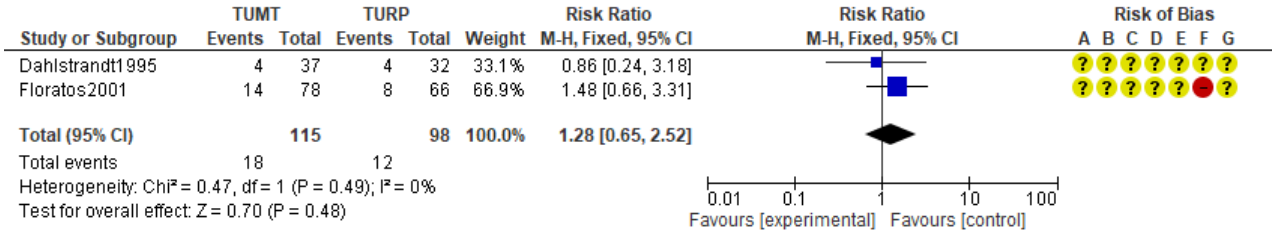
Note: lower PVR values are better.

PVR (ml) at 12 months in the sensitivity analysis excluding Dahlstrandt 1995 (very high values)



Note: lower PVR values are better.

Reintervention



4.4.1.9 WAVE

WAVE was assessed in one RCT versus sham, including 197 patients (136 WAVE vs. 61 sham) with a prostate size of 30–80 ml, with the possibility for patients in the sham arm to cross over after 3 months. Multiple publications are available with different follow-up periods. Only 3-month data (before crossover) were extracted (McVary 2016b; low RoB). Outcomes assessed in the RCT are indicated in Table 4-29. No data for reintervention, hospitalisation time or procedure time were reported.

Table 4-29: Effectiveness outcomes assessed in McVary 2016b comparing WAVE versus sham

Study ID	McVary 2016b
IPSS at 1 month	x
IPSS at 3 months	x
IPSS at 6 months	x
IPSS at 12 months	x
Qmax at 1 month	x
Qmax at 3 months	x
Qmax at 6 months	x
Qmax at 12 months	x
BPH II at 3 months	x
QoL at 1 month	x
QoL at 3 months	x
QoL at 6 months	x
QoL at 12 months	x
PVR at 3 month	x

IPSS, Qmax, QoL and PBHII at 3 months significantly differed between the groups, in favour of WAVE (Table 4-30). Lack of CIs for these estimates precluded assessment of their variability. The mean change in IPSS at 3 months was –11.2 (95% CI –12.5 to –9.9) in the WAVE arm and –4.3 (95% CI –6.1 to –2.5) in the sham arm, which was a significant difference in favour of WAVE (p< 0.0001). The reduction in both arms was above the MCID of 3 points, but whether the difference between the two technologies is above the MCID is unclear. For Qmax the mean change at 3 months was 6.2 ml/s in the WAVE arm and 0.5 ml/s in the sham arm, a significant difference in favour of WAVE (p<0.0001). The mean change in the WAVE arm was above the MCID of 2 ml/s. At 3 months, the decrease in mean BPHII score was –3.4 (95% CI -4.0 to –2.4) in the WAVE arm and –0.9 (95% CI –1.3 to –0.5) in the sham arm, a significant difference in favour of WAVE (p= 0.0003). The mean reduction in QoL score at 3 months (a lower score indicates a patient benefit) was –2.1 (95% CI –2.4 to –1.8) in the WAVE arm and –0.9 (95% CI –1.3 to –0.5) in the sham arm, a significant difference in favour of WAVE (p<0.0001).

It was not possible to assess how WAVE compares to other technologies because of the lack of head-to-head comparisons.

Table 4-30: Effectiveness outcomes assessed in RCTs comparing WAVE versus sham

WAVE vs. sham (McVary 2016a, McVary 2016b, Roehrborn 2017, McVary 2018, McVary 2019; n=135; high risk of bias)			
Outcome	**WAVE**	**Sham**	**p value**
Qmax at 3 months (ml/s)	16.1	10.8	<0.01; 95% CI n.a.
BPHI at 3 months	2.9	4.7	<0.01; 95% CI n.a.
IPSS at 3 months	10.8	17.5	<0.01; 95% CI n.a.
QoL at 3 months	2.3	3.5	<0.01; 95% CI n.a.

Abbreviations: n.a.=not available.

4.4.1.10 Nonablative techniques

TUIP

TUIP versus TURP

TUIP was assessed in five RCTs in comparison to TURP (Abd-El Kader 2012, Dørflinger 1992, Jahnson 1998, Riehmann 1995, Tkocz 2002), including a total of 451 patients with prostate size of <30 ml (except Jahnson 1998, in which patients with prostate size between 20 and 40 ml were included; the mean size was 26 ml). Outcomes assessed in these studies are listed in Table 4-31; it should be noted that Dørflinger 1992 and Jahnson 1998 used the Madsen-Iversen Symptom Score instead of IPSS, and Rihmann 1995 used the Nedsen BPH questionnaire; all have been used as symptom intensity scores). No data were available for BPHII.

Table 4-31: Effectiveness outcomes assessed in RCTs comparing TUIP versus TURP

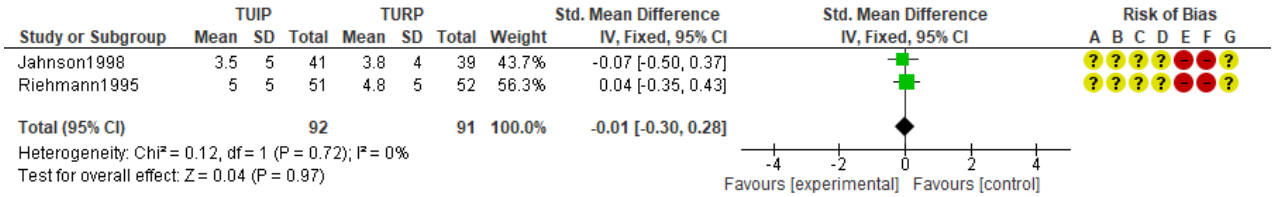
Study ID	Abd-El Kader 2012	Dørflinger 1992	Jahnson 1998	Rihmann 1995	Tkocz 2002
IPSS at 3 months					
IPSS at 12 months					
IPSS at 24 months				x	x
IPSS at 48 months	x			x	
Qmax at 3 months		x			
Qmax at 12 months		x			
Qmax at 24 months				x	x
Qmax at 48 months	x			x	
Qmed at 48 months	x				
PVR at 48 months	x				
QoL at 24 months					x
Reintervention total			x		
Reintervention at 12 months		x			
Reintervention at 48 months	x			x	
Persistent irritative symptoms		x			
Postoperative LUTS		x			
Hospitalisation time	x			x	
Procedure time	x	x	x	x	

Pooling of data was possible for symptom intensity scores (at 3, 12 and 24 months), Qmax (at 3, 12, 24 and 48 months) and reintervention. Significant differences were observed in favour of TURP for Qmax at 3 months (mean –4.87 ml/s, 95% CI –7.32 to –2.42; I^2=0%, high RoB), 12 months (mean –4.71 ml/s, 95% CI –7.54 to –1.88; I^2=0%, high RoB), 24 months (mean –1.12 ml/s, 95% CI –1.80 to –0.44; I^2=89%, high RoB) and 48 months (mean –1.80 ml/s, 95% CI –2.20 to –1.40; I^2=0%, high RoB) and reintervention (RR 1.80, 95% CI 1.08–3.00; I^2=0%, high RoB). Hospitalisation time was shorter for TUIP (~1 day less) as well as procedure time (up to 40 min less). No differences were observed for symptom score (from pooled data), PVR, QoL, Qmed, persistent irritative symptoms or postoperative LUTS (from single RCTs). No data were retrieved for BPHII.

Three of the five studies included for direct comparison of TUIP versus TURP (Jahnson 1998, Rihmann 1995, Dørflinger 1992) were judged at high RoB and two at uncertain RoB. Results for functional outcomes seem to indicate that for patients with a small prostate (<30–40 ml) TURP performs better for Qmax at all time points. The MD values are higher than the MCID up to 1 year (decreasing thereafter), with low quality of evidence at 3, 12 and 48 months (RoB and imprecision) and very low quality of evidence at 24 months (with additional inconsistency, which was not easy to explain given the quite homogeneous populations in the studies, except for the slightly older population in Jahnson 1998). There was also 80% higher relative risk of reintervention with TUIP, for which the quality of the evidence was judged as low owing to RoB and imprecision. It should be noted that three of the five studies were carried out in the 1990s and the technology might have undergone some technical changes since then.

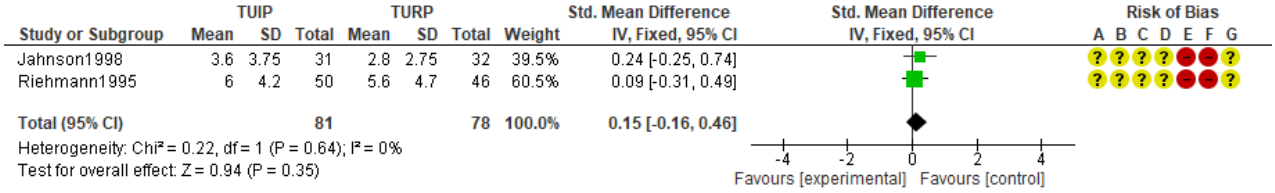
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

Symptom intensity score at 3 months (different questionnaires; SMDs used)



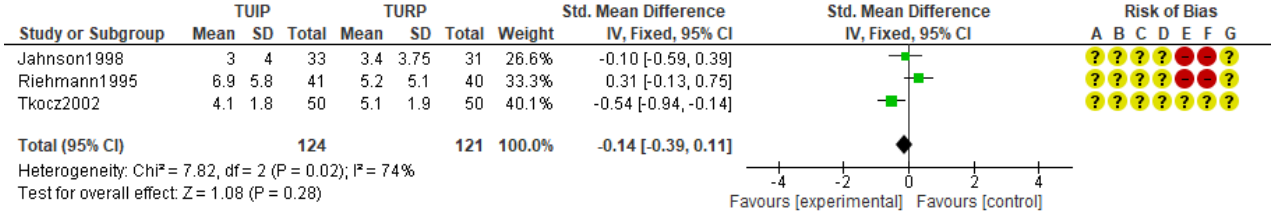
Note: lower scores are better.

Symptom intensity score at 12 months (different questionnaires; SMDs used)



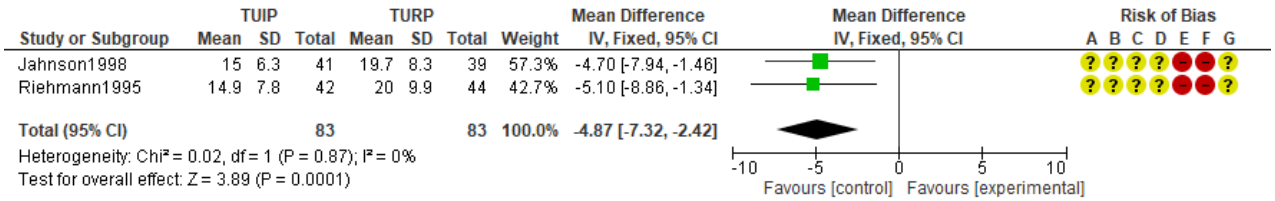
Note: lower scores are better.

Symptom intensity score at 24 months (different questionnaires; SMDs used)



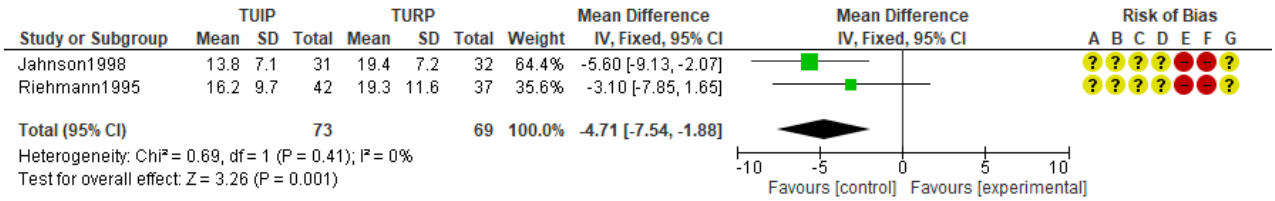
Note: lower scores are better.

Qmax (ml/s) at 3 months



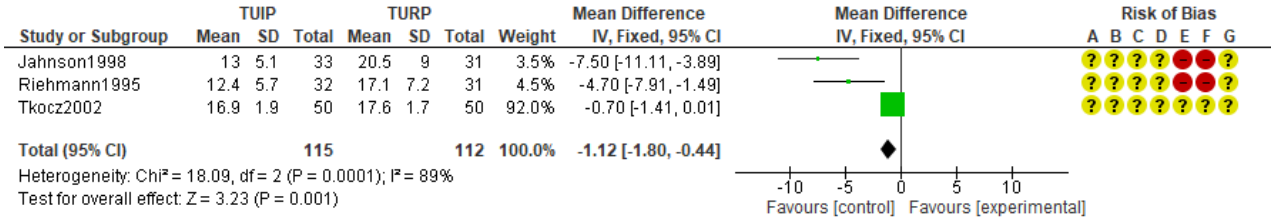
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



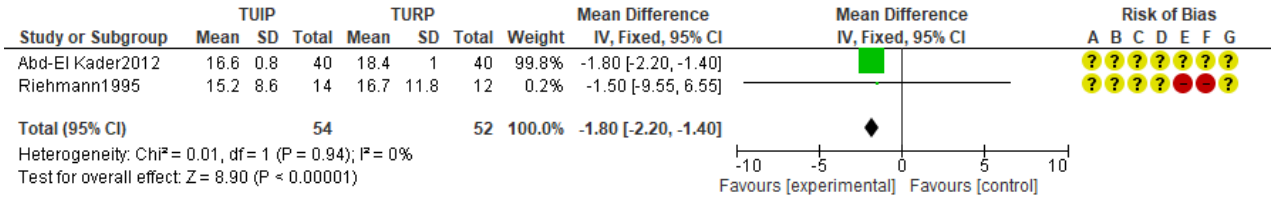
Note: higher Qmax values are better.

Qmax (ml/s) at 24 months



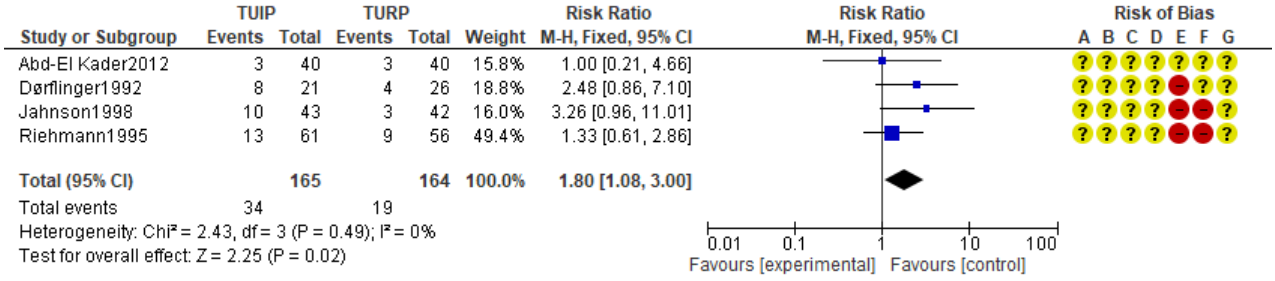
Note: higher Qmax values are better.

Qmax (ml/s) at 48 months

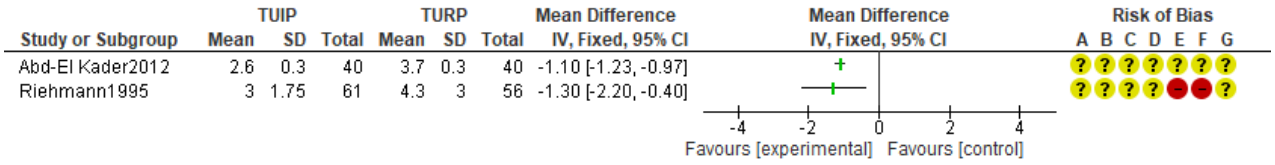


Note: higher Qmax values are better.

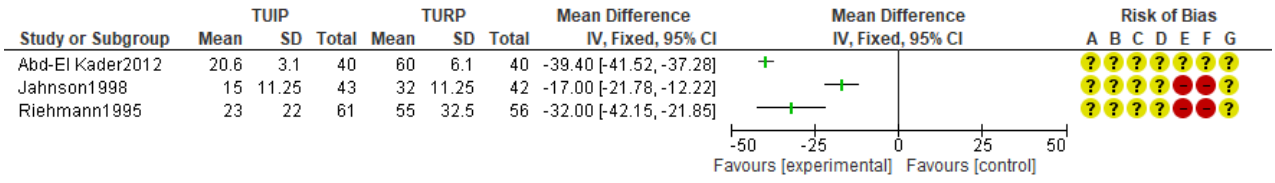
Reintervention within 48–60 months



Hospitalisation time (days)



Procedure time (min)



TUIP + TURP versus TURP

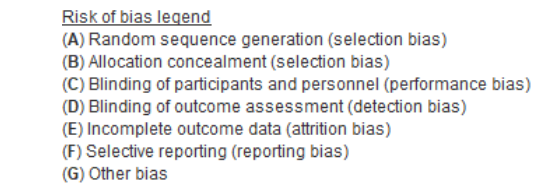
TUIP was also tested in association with TURP in two RCTs, including a total of 164 patients, with TURP alone as the comparator. Yeni 2002 (n=40) and Li 2013 (n=124) included patients with a small prostate (<25 ml in Yeni 2002 and 20–40 ml in Li 2013), assessing the outcomes listed in Table 4-32. Yeni 2002 reported changes from baseline for IPSS and Qmax and these data could

not be pooled. Li 2013 reported higher Qmax at 6 months for TUIP + TURP (mean 6.69, 95% CI 4.29–9.09; high RoB). Data for procedure time showed high heterogeneity (favouring TURP in Li 2013 and TURP + TUIP in Yeni 2002). No data are available for PVR, Qmed, BPHII, reintervention, irritative symptoms or postoperative LUTS (as a binary outcome).

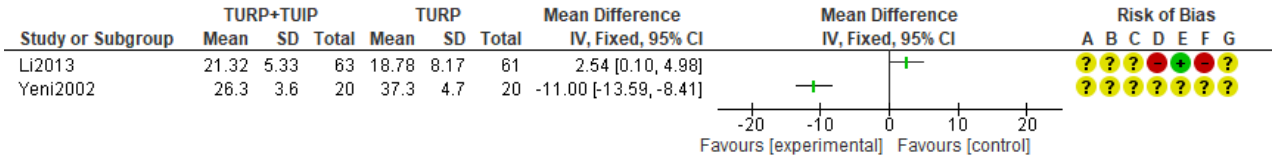
Table 4-32: Effectiveness outcomes assessed in RCTs comparing TUIP + TURP versus TURP

Study ID	Li 2013	Yeni 2002
IPSS at 6 months	x	x [a]
Qmax at 6 months	x	x [a]
QoL at 6 months	x	
Hospitalisation time	x	x
Procedure time	x	x

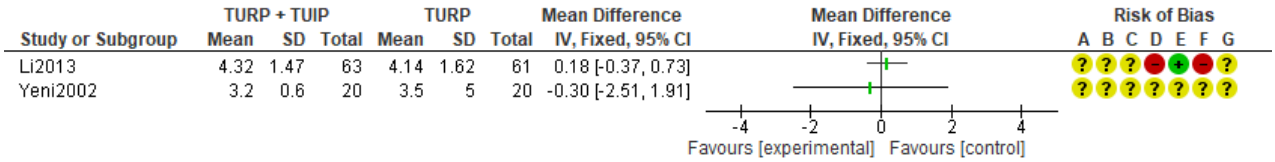
[a] Data could not be extrapolated.



Procedure time (min)



Hospitalisation time (days)



PAE

PAE was assessed in five RCTs: Abt 2018 (n=103; prostate size 25–80 ml), Carnevale 2016 (n= 30; prostate size 32–97 ml), Gao (n=114; prostate size 20–100 ml), Insausti 2020 (n=45; average prostate size 60 ml) and Radwan 2020 (n=60; prostate size <100 ml), comparing PAE to TURP for the outcomes listed in Table 4-33 and including a total of 352 patients. Two of these RCTs postulated a noninferiority hypothesis for PAE versus TURP: Abt 2018 for IPSS at 3 months (primary endpoint) for a difference of <3 points, which was rejected as an adjusted analysis showed an estimated difference of 2.9, with the CI including differences up to 5.2 that may be clinically relevant. Insausti 2020 hypothesised a difference for noninferiority < -0.5 ml/s for Qmax at 1 year, that was also rejected.

Pooling of data was only possible for IPSS at 3 months (MD 3.48, 95% CI 2.86–4.11; I^2=0%, uncertain RoB, moderate quality of evidence owing to imprecision) and persistent irritative symptoms (RR 0.59, 95% CI 0.28–1.21; I^2=20%, high RoB, low quality of evidence owing to imprecision and RoB). Pooling was not performed for other outcomes because of statistical heterogeneity (unexplained) and lack of SD values in Insausti 2020 and Radwan 2020. Insausti 2020 reported within-group differences for QoL that favoured TURP (MD 0.69, 95% CI not available). Radwan 2020 presented data for two TURP groups (M-TURP and B-TURP) that could not be combined, and also reported within-group differences favouring TURP for IPSS at 6 months (MD 4; p value and 95% CI not available) and Qmed (MD 5; p>0.001, 95% CI not available),

Table 4-33: Effectiveness outcomes assessed in RCTs comparing PAE versus TURP

Study ID	Abt 2018 [a]	Insausti 2020 [b]	Radwan 2020 [b]	Carnevale 2016	Gau 2014 [a]
IPSS at 1 month			x		x
IPSS at 3 months	x	x			x
IPSS at 6 months		x	x		x
IPSS at 12 months		x		x	x
IPSS at 24 months					x
Qmax at 1 month					x
Qmax at 3 months	x	x			x
Qmax at 6 months		x	x		x
Qmax at 12 months		x		x	x
Qmax at 24 months					x
PVR at 1 month					x
PVR at 3 months	x	x			x
PVR at 6 months		x			x
PVR at 12 months		x		x	x
PVR at 24 months					x
QoL at 1 month					x
QoL at 3 months	x	x			x
QoL at 6 months		x			x
QoL at 12 months		x		x	x
QoL at 24 months					x
Qmed at 1 month			x		
Persistent irritative symptoms	x	x			
Postoperative LUTS				x	
Hospitalisation time	x	x [c]		x [c]	x
Procedure time	x		x	x	x

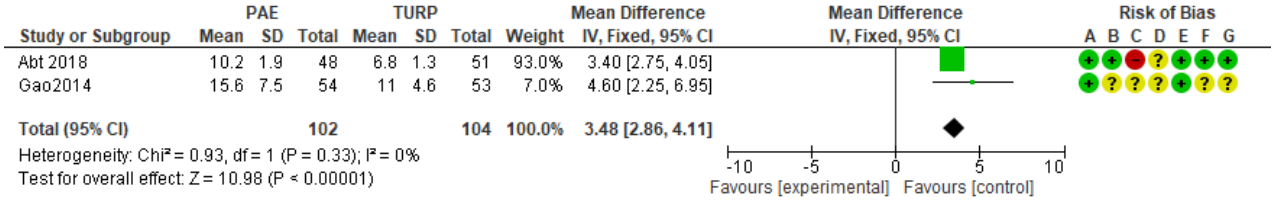
[a] Data for IPSS, Qmax, PVR and QoL were extracted from graphs.

[b] SD values for IPSS, Qmax, PVR and QoL data in Insausti 2020 and IPSS and Qmax data in Radwan 2020 were not extrapolated.

[c] It was not possible to use these data.

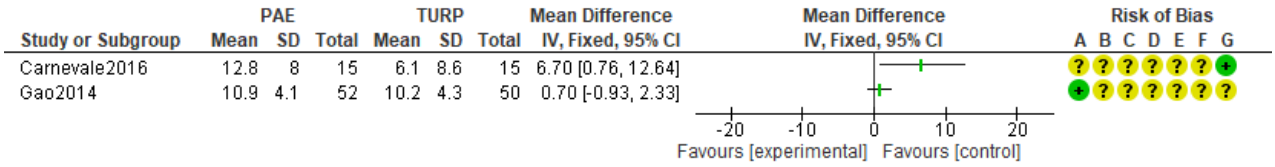
Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

IPSS at 3 months



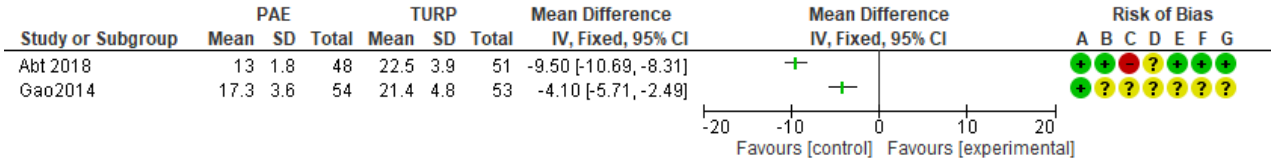
Note: lower IPSS scores are better.

IPSS at 12 months



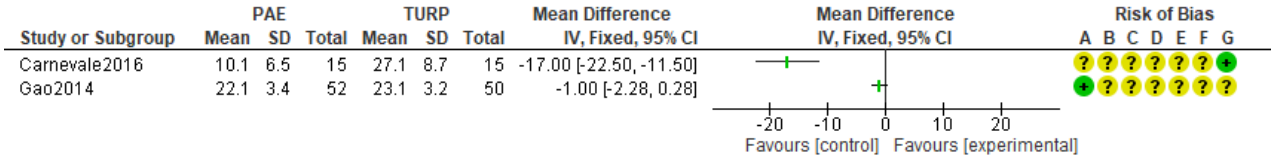
Note: lower IPSS scores are better.

Qmax (ml/s) at 3 months



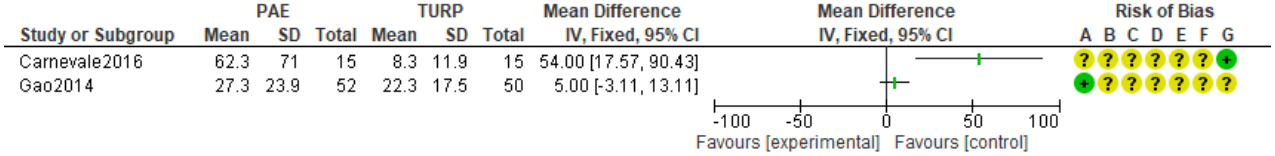
Note: higher Qmax values are better.

Qmax (ml/s) at 12 months



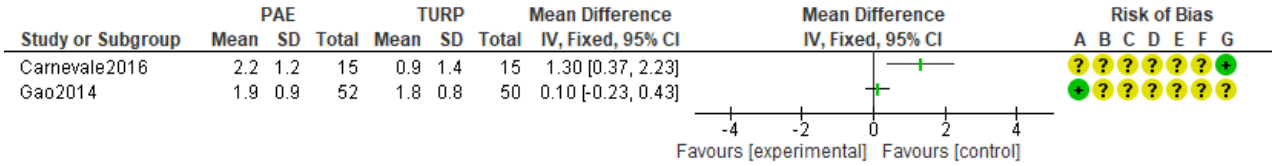
Note: higher Qmax values are better.

PVR (ml) at 12 months



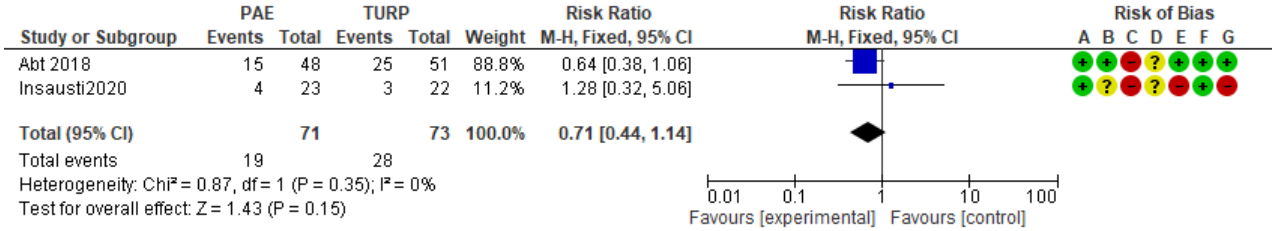
Note: lower PVR values are better.

QoL at 12 months

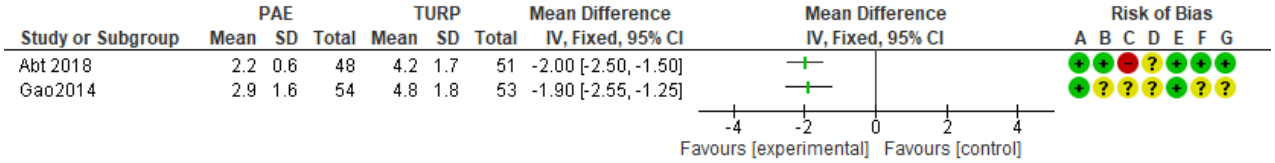


Note: lower QoL scores are better.

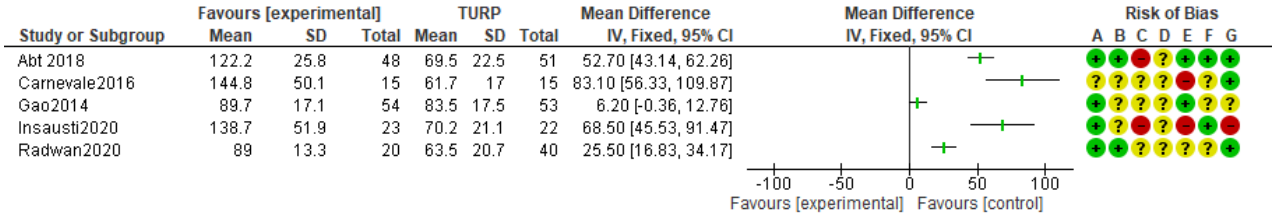
Persistent irritative symptoms



Hospitalisation time (days)



Procedure time (min)



Prostatic urethral lift

PUL was assessed in two publications (Sonksen 2015, n=79; Gratzke 2017, n=80; high RoB) presenting data at different follow-up times for the same RCT in comparison to TURP. The outcomes assessed are listed in Table 4-34. There were no unassessed functional outcomes.

Table 4-34: Effectiveness outcomes assessed in RCTs comparing PUL versus TURP

Study ID	Gratzke 2017	Sonksen 2015
IPSS at 1 month	x	x
IPSS at 3 months	x	x
IPSS at 6 months	x	x
IPSS at 12 months	x	x
IPSS at 24 months	x	
Qmax at 3 months	x	x
Qmax at 6 months	x	x

Study ID	Gratzke 2017	Sonksen 2015
Qmax at 12 months	x	x
Qmax at 24 months	x	
PVR at 3 months	x	x
PVR at 6 months	x	x
PVR at 12 months	x	x
PVR at 24 months	x	
Reintervention at 1 month		x
Reintervention at 12 months		x
Reintervention at 24 months	x	
BPHII at 1 month	x	x
BPHII at 3 months	x	x
BPHII at 6 months	x	x
BPHII at 12 months	x	x
BPHII at 24 months	x	
QoL at 1 month	x	x
QoL at 3 months	x	x
QoL at 6 months	x	x
QoL at 12 months	x	x
QoL at 24 months	x	
Hospitalisation time		x
Procedure time		x

This RCT included patients with a prostate volume ≤60 ml. Prostate volume ranged from 16 ml to 59 ml in the PUL group, and from 17 ml to 68 ml in the TURP group. Qmax at 3, 6, 12 and 24 months, PVR at 3, 6 and 12 months, and IPSS at 12 and 24 months after surgery showed significant differences between the groups in favour of TURP (Table 4-35). Differences were also above the MCID for both IPSS reduction (–11.4 PUL vs. –15.4 TURP at 12 months, and –9.2 PUL vs. –15.3 TURP at 24 months) and Qmax improvement (4.0 ml/s PUL vs. 13.7 ml/s TURP at 12 months and 5.0 ml/s PUL vs. 15.5 ml/s TURP at 24 months). There were no significant differences in QoL or BPHII.

Table 4-35. Effectiveness results from the RCT comparing PUL versus TURP

PUL vs. TURP (Sonksen 2015, n=79; Gratzke 2017, n=80; high risk of bias)			
Outcome	**PUL**	**TURP**	**p value**
Qmax at 3 months (ml/s)	13.6	21.7	<0.001; 95% CI n.a.
Qmax at 6 months (ml/s)	13.5	19.0	0.003; 95% CI n.a.
Qmax at 12 months (ml/s)	13.6	23.2	<0.001; 95% CI n.a.
Qmax at 24 months (ml/s)	14.3	25.5	0.002; 95% CI n.a.
PVR at 3 months (ml)	77.3	47.6	0.01; 95% CI n.a.
PVR at 6 months (ml)	80.7	46.2	0.01; 95% CI n.a.
PVR at 12 months (ml)	93.7	33.6	0.002; 95% CI n.a.

PUL vs. TURP (Sonksen 2015, n=79; Gratzke 2017, n=80; high risk of bias)			
Outcome	**PUL**	**TURP**	**p value**
PVR at 24 months (ml)	69.9	56.4	0.09
IPSS at 1 month	10.5	12.9	0.42
IPSS at 3 months	10.5	10.8	0.98
IPSS at 6 months	9.2	8.0	0.42
IPSS at 12 months	10.9	7.3	0.01; 95% CI n.a.
IPSS at 24 months	12.2	7.4	0.004; 95% CI n.a.
QoL at 1 month	2.2	3.0	0.14
QoL at 3 months	2.1	2.4	0.55
QoL at 6 months	1.9	1.8	0.79
QoL at 12 months	1.9	1.5	0.44
QoL at 24 months	2.1	1.3	0.07
BPHII at 1 month	4.0	5.3	0.14
BPHII at 3 months	2.6	3.8	0.10
BPHII at 6 months	2.3	2.2	0.79
BPHII at 12 months	2.3	1.8	0.84
BPHII at 24 months	3.0	1.5	0.13

Abbreviations: n.a.=not available.

4.4.2 Safety

HTA CORE MODEL DOMAIN: SAF[6]

4.4.2.1 Resection techniques

TmLRP

TmLRP versus TURP

TmLRP was assessed in two of the RCTs (Xia 2008, n=100; Yan 2013, n=80) against TURP as the comparator for the outcomes listed in Table 4-36.

Table 4-36: Safety outcomes assessed in RCTs comparing TmLRP versus TURP

Study ID	Xia 2008	Yan 2013
Intraoperative complications		
Transfusion requirement	x	x (0 events)
Decrease in serum sodium	x	x

[6] This section addresses the following assessment element: C0002, C0005, C0007, C0008.

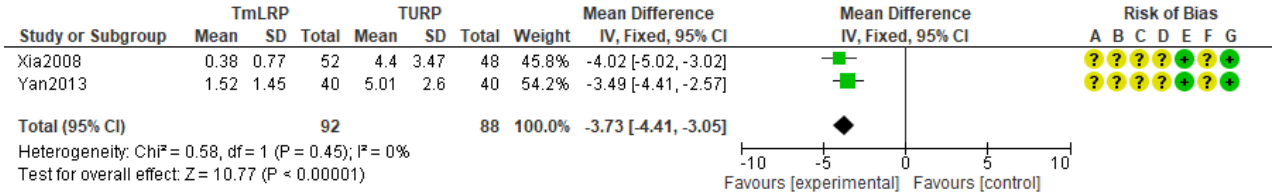
Study ID	Xia 2008	Yan 2013
Postoperative complications		
IIEF (erectile dysfunction score) at 6 months	x	
IIEF (erectile dysfunction score) at 12 months	x	
Urinary incontinence	x	x
Catheterisation time	x	x
TUR syndrome	x	x (0 events)
Urethral stricture	x	x
Acute urinary retention	x	
Urinary tract infection	x	
Retrograde ejaculation	x	x
Recatheterisation	x (0 events)	x

Patients included in these studies had prostate size between 30 and 97 ml, mostly falling within 30–80 ml.

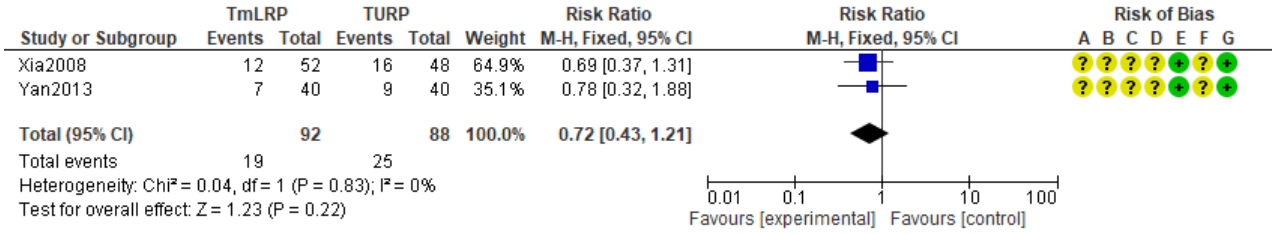
Pooling of data was possible for decrease in serum sodium, urinary incontinence, urethral stricture and retrograde ejaculation. Decrease in serum sodium was the only outcome showing a difference, which was in favour of TmLRP (mean –3.73 mmol/l, 95% CI –4.41 to –3.05; I^2=0%, uncertain RoB). The quality of the evidence for this outcome was moderate owing to uncertain RoB for several domains.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

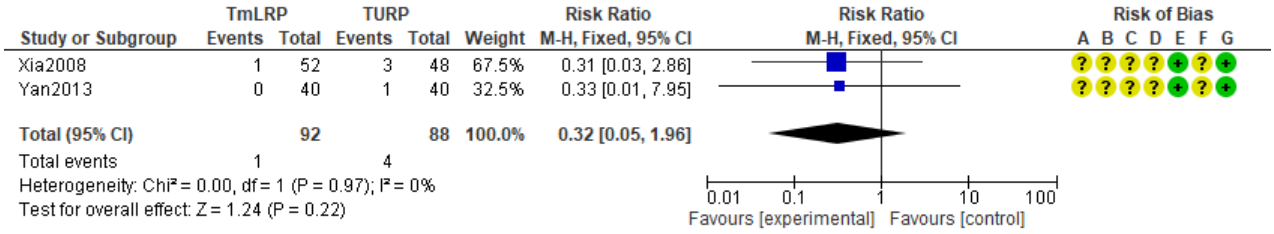
Decrease in serum sodium (mmol/l)



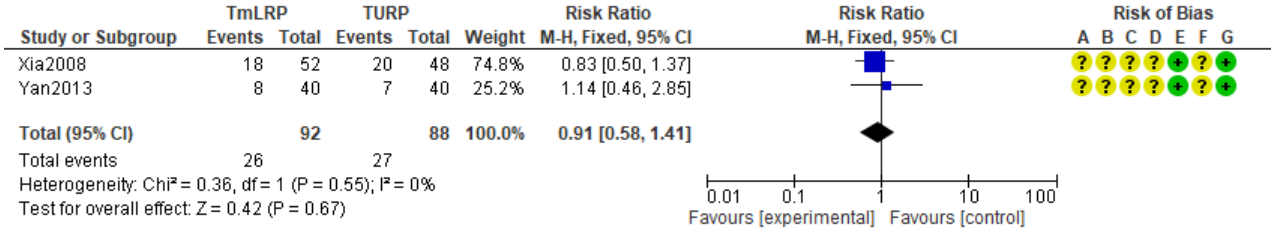
Urinary incontinence



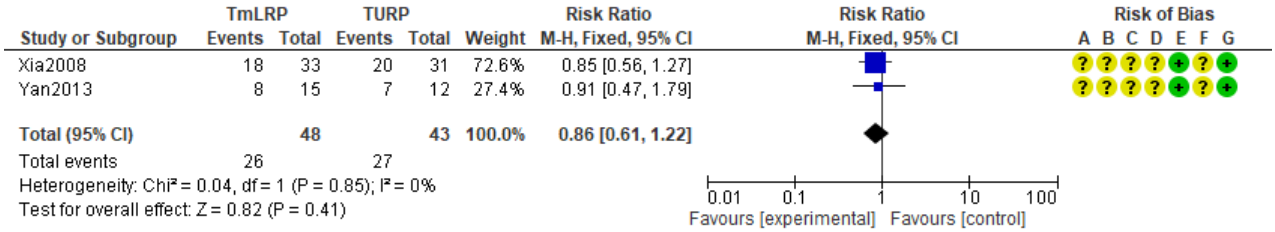
Urethral stricture



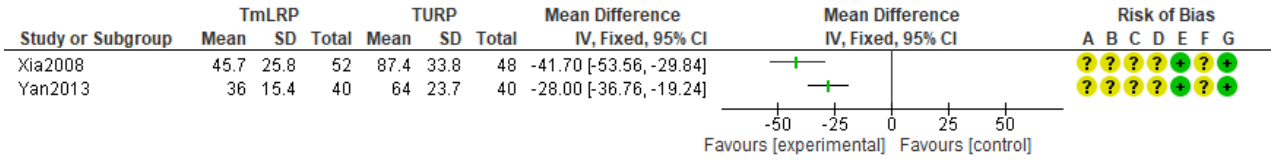
Retrograde ejaculation for all patients



Retrograde ejaculation for sexually active patients



Catheterisation time (h)



4.4.2.2 Enucleation techniques

HoLEP

HoLEP was assessed in 23 of the selected RCTs (see Table 4-3), including a total of 2688 patients. Twenty-two RCTs were two-arm studies and one (Elshal 2020) was a three-arm RCT. Fourteen studies compared HoLEP versus TURP (n=1549), three compared HoLEP versus ThuLEP (n=485) and versus B-TUEP (n=211), two compared HoLEP versus PVP (n=223), and one compared HoLEP versus DioLEP (n=126) and versus ThuVEP (n=94).

HoLEP versus TURP

Fourteen RCTs compared HoLEP versus TURP for the outcomes indicated in Table 4-37. No study provided data on bladder perforation.

Table 4-37: Safety outcomes assessed in RCTs comparing HoLEP versus TURP

Study ID	Sun 2014	Tan 2003	Bai 2019	Basic 2013	Chen 2013	Eltabey 2010	Fayad 2015	Hamouda 2014	Jhanwar 2017	Gupta 2006	Kuntz 2004	Mavuduru 2009	Montorsi 2004	Elshal 2020
Transfusion requirement	x	x		x	x	x	x	x	x	x	x	x	x	x
Bladder or ureteral injury				x						x				x [c]
Capsular perforation										x		x		x
Decrease in serum sodium	x				x		x		x	x	x			
Erectile dysfunction									x					
Urinary incontinence		x		x	x	x	x	x	x	x	x	x	x	x
Catheterisation time	x	x	x	x	x	x	x	x	x	x	x	x	x	x [b]
TUR syndrome					x [c]				x [c]				x	
Urethral stricture	x	x			x [a]	x	x	x	x	x	x	x	x	
Bladder neck contracture				x	x [a]						x			X
Acute urinary retention				x			x						x	
Urinary tract infection		x						x	x					x [c]
Retrograde ejaculation					x						x [a]			
Recatheterisation		x			x				x [c]	x	x	x		x

[a] Could not be extrapolated since only the percentage of sexually active patients with this complication is reported and there is no indication of the number of sexually active patients.

[b] Data estimated according to McGrath et al. [63].

[c] Zero events.

Patients included in the selected studies were heterogeneous in terms of prostate size category. The average size was available in 13 of the 14 studies, whereas information on prostate size range was available in only five studies (range: from 20 to 156 ml). Prostate size was used as an inclusion criterion in only six studies. Regarding our prespecified prostate size subgroups, none of the studies included patients that could be assigned exclusively to one of these. All but three studies included patients in the 30–80 ml range.

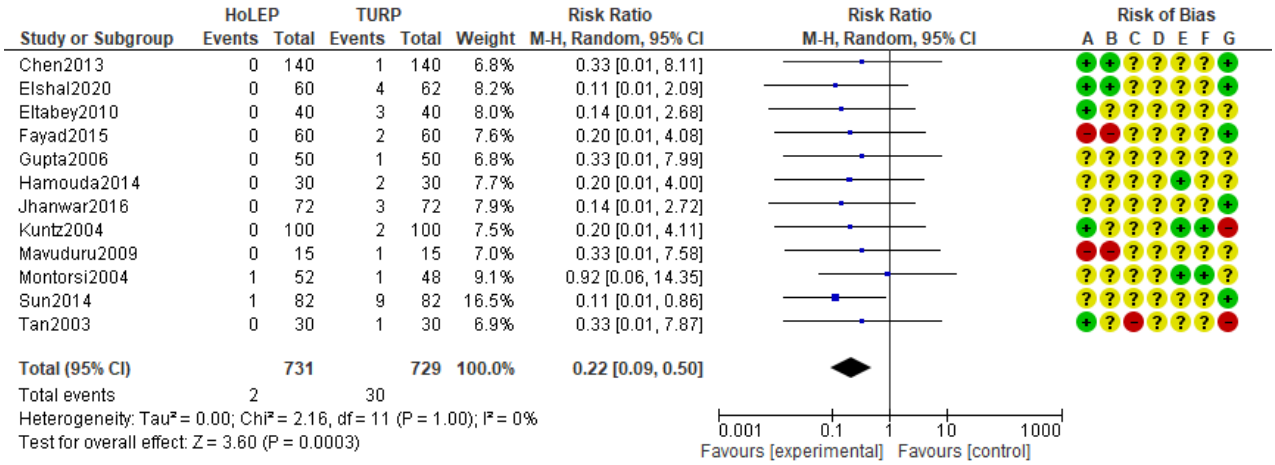
Pooling of data was possible for all of the outcomes above, except for erectile dysfunction (but IIEF-5 was available) and retrograde ejaculation, for which no differences were found. Data from Montorsi 2004 were excluded from analyses because of a relevant baseline imbalance in mean prostate size. Data from Basic 2013 were excluded since this study appears to be an outlier among all the analyses and the patient cohort had a smaller prostate size and was younger than in most of the other studies.

Differences in favour of HoLEP were found for transfusion requirement (RR 0.19, 95% CI 0.08–0.45; I^2=0%, high RoB), decrease in serum sodium (–0.86 mmol/l, 95% CI –1.47 to –0.26; I^2=72%, high RoB), catheterisation time (–15.72 h, 95% CI –17.88 to –13.56; I^2=62%) and UTI (RR 0.19, 95% CI 0.07–0.50; I^2=0%, uncertain RoB). Differences in favour of TURP were found for urinary incontinence (RR 1.89, 95% CI 1.09–3.27; I^2=3%, high RoB). Pooled results do not show differences for bladder or ureteral injury, capsular perforation, IIEF-5, urethral stricture, bladder neck contracture, AUR or recatheterisation. No study provided data on bladder perforation.

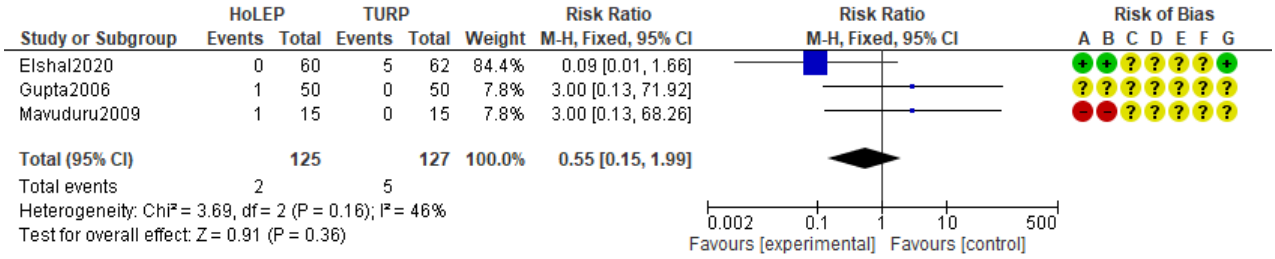
Heterogeneity does not seem to be associated with prostate size. The quality of the evidence was judged as moderate for transfusion requirement and urinary incontinence (owing to high to uncertain RoB in the studies included) and UTI (owing to imprecision) and low for decrease in serum sodium (owing to RoB and inconsistency).

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

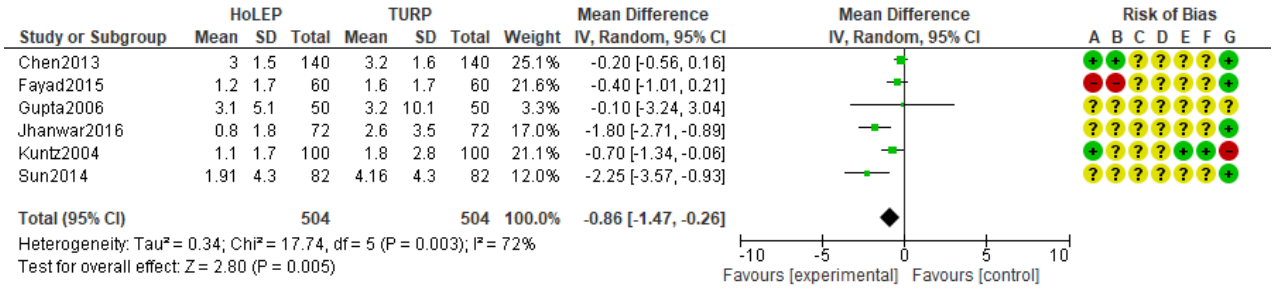
Transfusion requirement



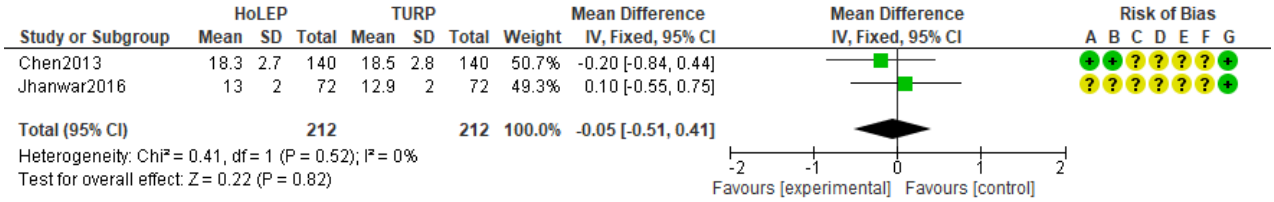
Capsular perforation



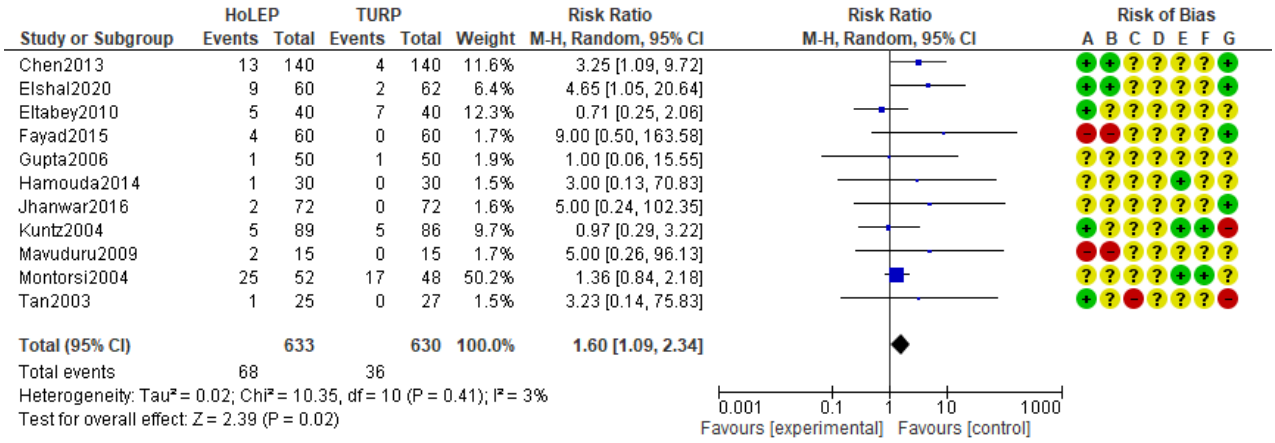
Decrease in serum sodium (mmol/l)



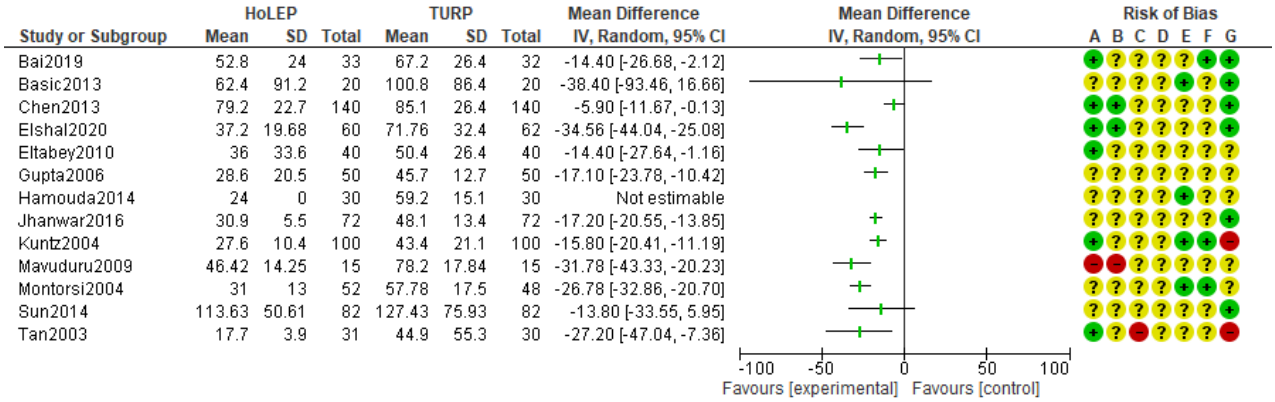
IIEF-5 at 6 months



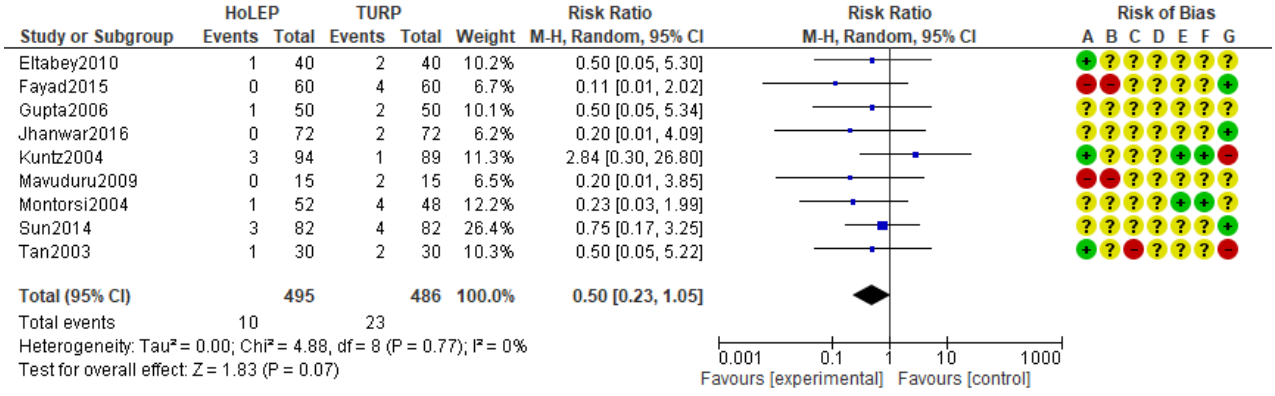
Urinary incontinence



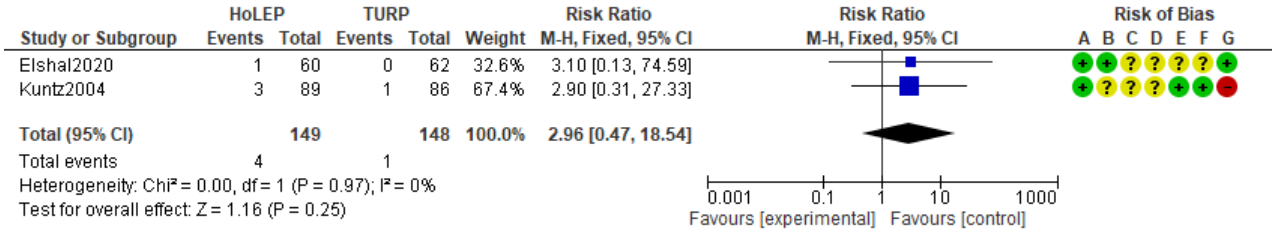
Catheterisation time (h)



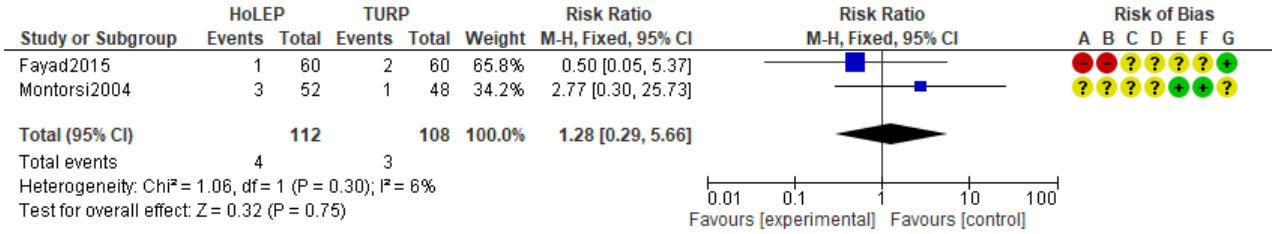
Urethral stricture



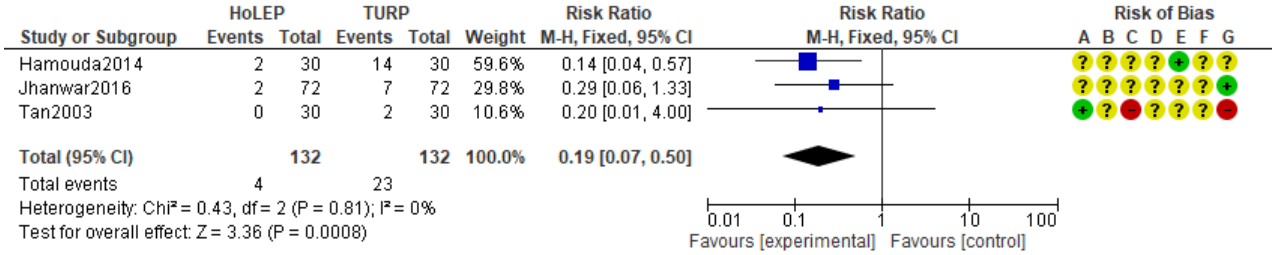
Bladder neck contracture



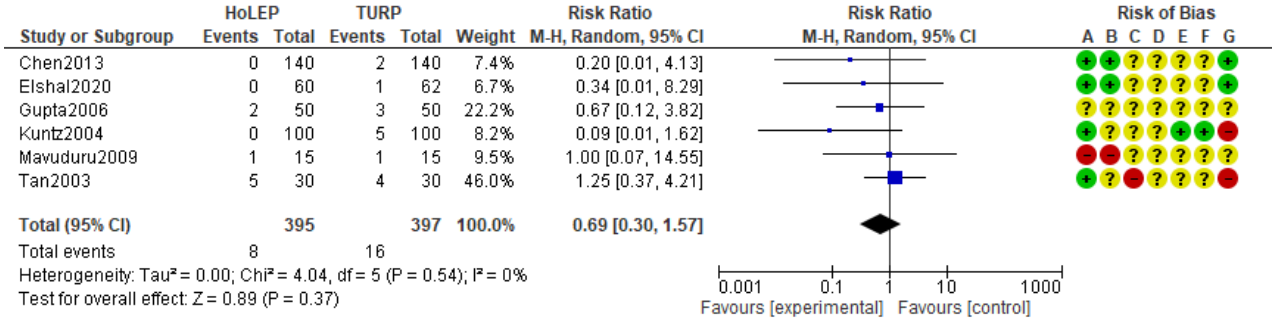
Acute urinary retention



Urinary tract infection



Recatheterisation



HoLEP versus B-TUEP

Three RCTs compared HoLEP versus B-TUEP. Patients included in Habib 2020 and Higazy 2020 had a prostate size >80 ml and can be classified in the large prostate subgroup, whereas patients in Neill 2006 mostly had prostate size within the 30–80 ml subgroup. These three studies provided data for the outcomes listed in Table 4-38. No data were available for bladder perforation, bladder or ureteral injury, erectile dysfunction, TUR syndrome or retrograde ejaculation.

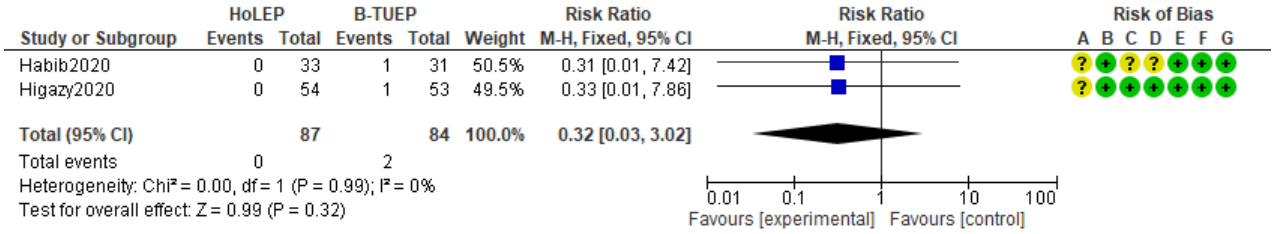
Table 4-38: Safety outcomes assessed in RCTs comparing HoLEP versus B-TUEP

Study ID	Neill 2006	Habib 2020	Higazy 2020
Intraoperative complications			
Transfusion requirement	x (0 events)	x	
Bladder or ureteral injury			x
Capsular perforation		x	x
Intraoperative mortality			x
Decrease in serum sodium		x	
Postoperative complications			
Urinary incontinence	x	x	x
Catheterisation time	x	x	x
Urethral stricture	x (0 events)		x
Bladder neck contracture		x	x
Acute urinary retention		x	
Urinary tract infection	x	x	x
Recatheterisation	x		

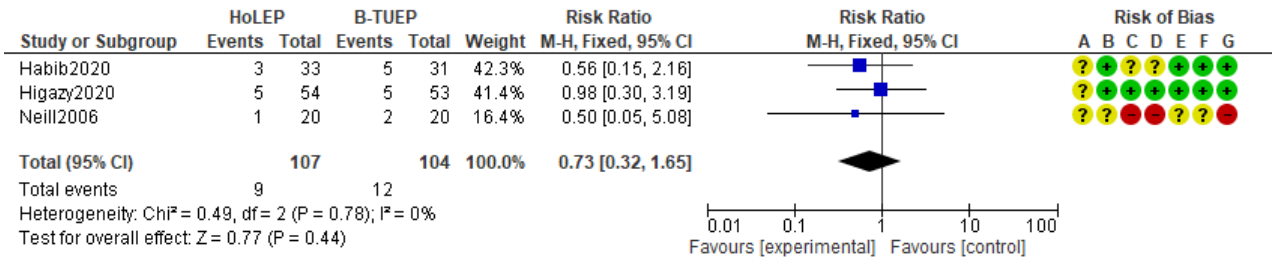
Pooling of data was possible for capsular perforation, urinary incontinence, bladder neck contracture and UTI. Catheterisation time was shorter for HoLEP in two out of the three RCTs (pooling was not carried out owing to heterogeneity). No differences were found for other outcomes.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

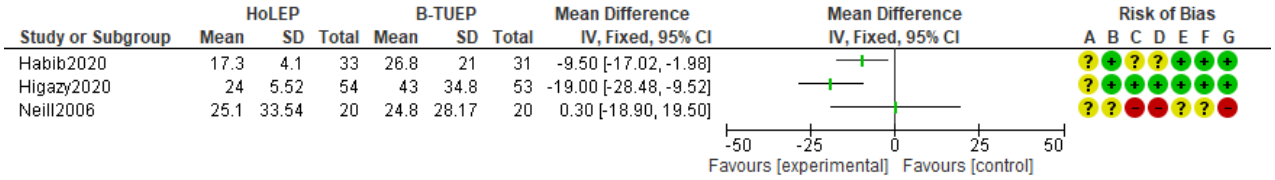
Capsular perforation



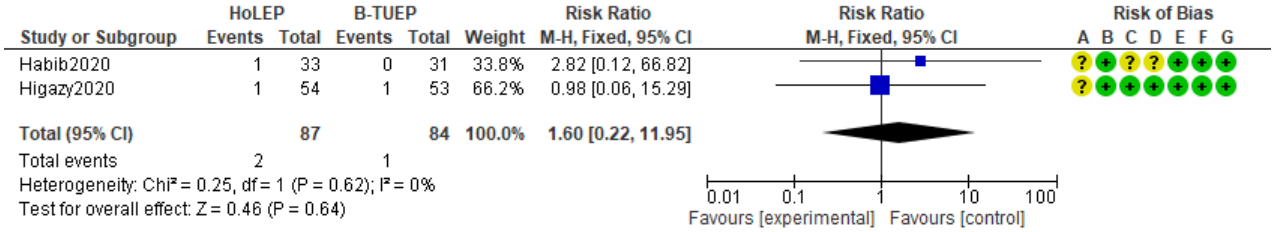
Urinary incontinence



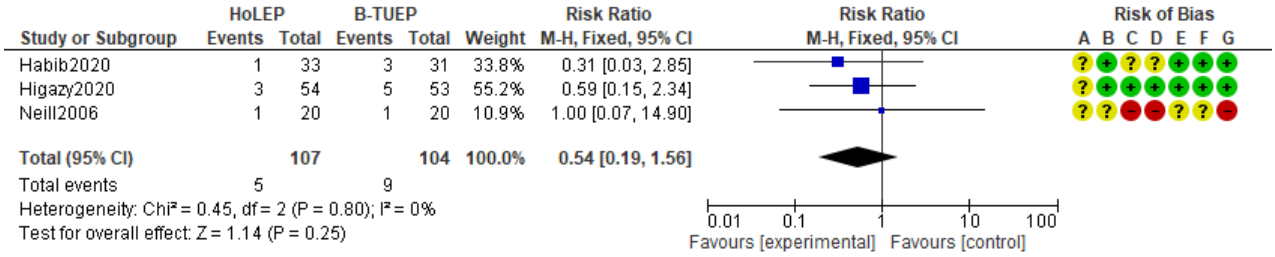
Catheterisation time (h)



Bladder neck contracture



Urinary tract infection



HoLEP versus DioLEP

One RCT (He 2019; n=126; low RoB) compared HoLEP versus DioLEP among patients with an average prostate size of 79.3 ml, assessing catheterisation time, decrease in serum sodium, dysuria/urinary retention, recatheterisation, retrograde ejaculation, urinary incontinence, UTI, urethral stricture, bladder neck contracture, bladder injury, blood transfusion, capsule perforation and TUR syndrome. No differences for any outcome were observed between the groups.

HoLEP versus ThuLEP

Three RCTs (Zhang F 2012, n=133; uncertain RoB; Zhang 2020, n=116; uncertain RoB; Bozzini 2020, n=236; high RoB) compared HoLEP versus ThuLEP for the outcomes listed in Table 4-39. The three studies enrolled different populations in terms of prostate size (mean 45 ml in Zhang F 2012, 88 ml in Bozzini 2020 and 92 ml in Zhang 2020). Data could be pooled for bladder or ureteral injury, urinary incontinence, urethral stricture, bladder neck contracture and AUR. A difference in favour of ThuLEP was found for urinary incontinence (RR 3.40, 95% CI 1.14–10.14; I^2=0%, high RoB). The quality of the evidence was judged as moderate because of RoB.

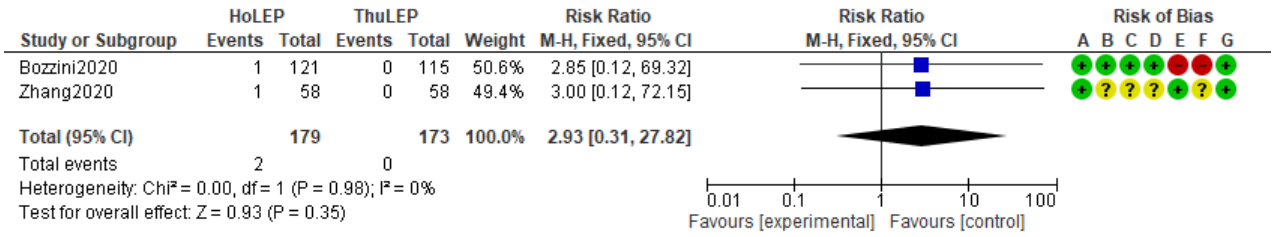
Table 4-39: Safety outcomes assessed in RCTs comparing HoLEP versus ThuLEP

Study ID	Zhang F 2012	Bozzini 2020	Zhang 2020
Transfusion requirement	x (0 events)	x	
Bladder or ureteral injury		x	x
Capsular perforation	x		

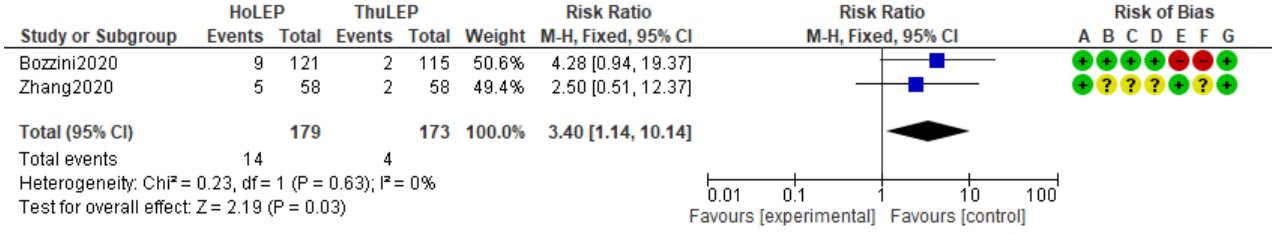
Study ID	Zhang F 2012	Bozzini 2020	Zhang 2020
Urinary incontinence		x	x
Catheterisation time	x	x	x
Urethral stricture		x	x
Bladder neck contracture	x		x
Acute urinary retention		x	x
Urinary tract infection			x
Recatheterisation			x

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

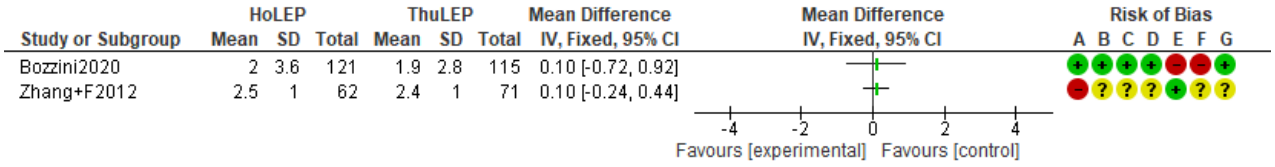
Bladder or ureteral injury



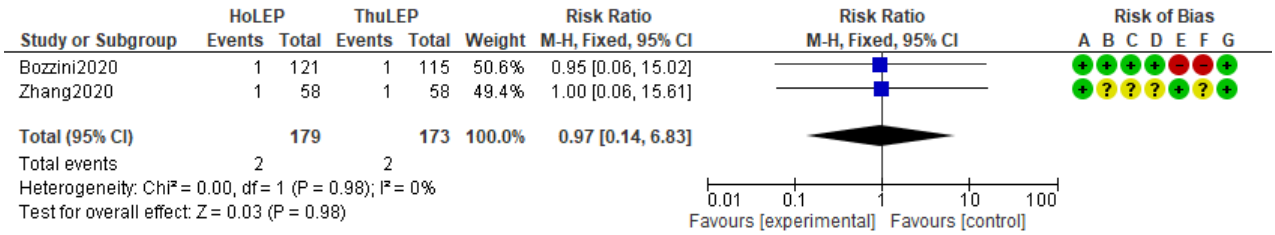
Urinary incontinence



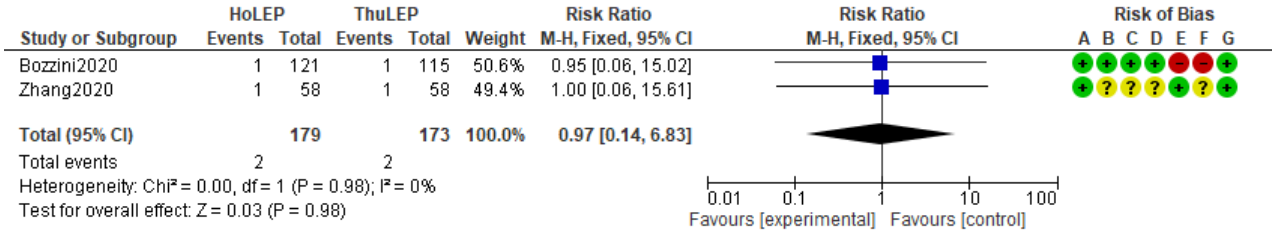
Catheterisation time (days)



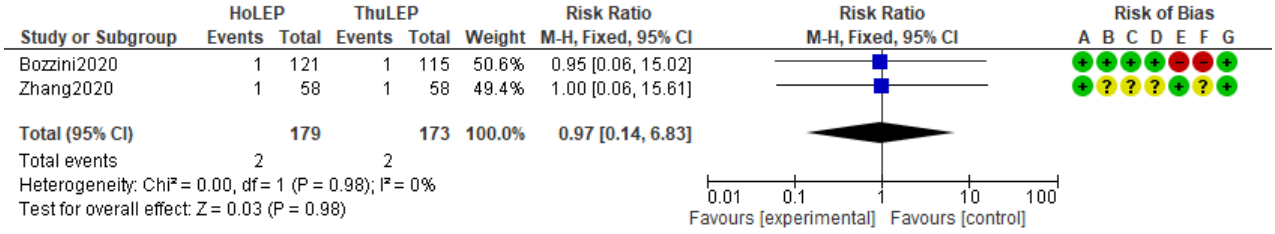
Urethral stricture



Bladder neck contracture



Acute urinary retention



HoLEP versus ThuVEP

One RCT (Netsch 2017; n=94; uncertain RoB) compared HoLEP versus ThuVEP among patients with prostate size ranging from 46 to 110 ml, assessing AUR, bladder injury, UTI and urinary incontinence. A difference in favour of ThuVEP was shown for AUR (15.2% vs. 2.1%; p=0.02, 95% CI not available).

HoLEP versus PVP

Two RCTs (Elshal 2015, n=103; uncertain RoB; Elshal 2020, n=120; uncertain RoB) compared HoLEP versus PVP among patients with prostate size ranging from 40 to 150 ml for the outcomes listed in Table 4-40. Pooling of data was possible for bladder or ureteral injury, capsular perforation, bladder neck contracture, UTI and recatheterisation. No differences for any of the outcomes assessed were observed between the groups.

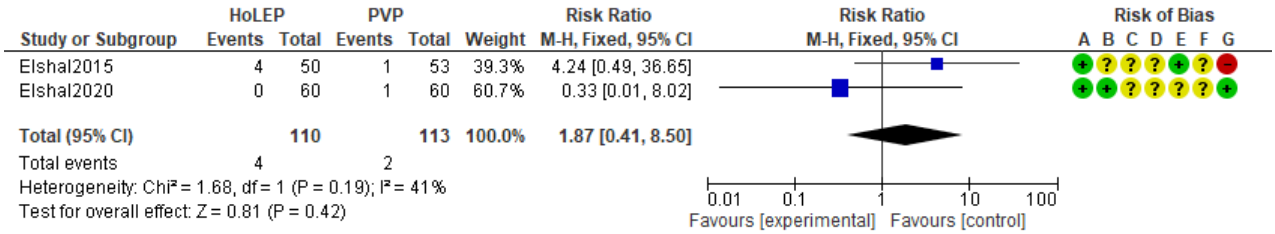
Table 4-40: Safety outcomes assessed in RCTs comparing HoLEP versus PVP

Study ID	Elshal 2015	Elshal 2020
Transfusion requirement	x	x (0 events)
Bladder or ureteral injury	x	x
Capsular perforation	x	x
Decrease in serum sodium	x	
IIEF (erectile dysfunction score)		x
Urinary incontinence	x (0 events)	x
Catheterisation time	x	x [a]
Urethral stricture	x	
Bladder neck contracture	x	x
Acute urinary retention		x
Urinary tract infection	x	x
Retrograde ejaculation		x
Recatheterisation	x	x

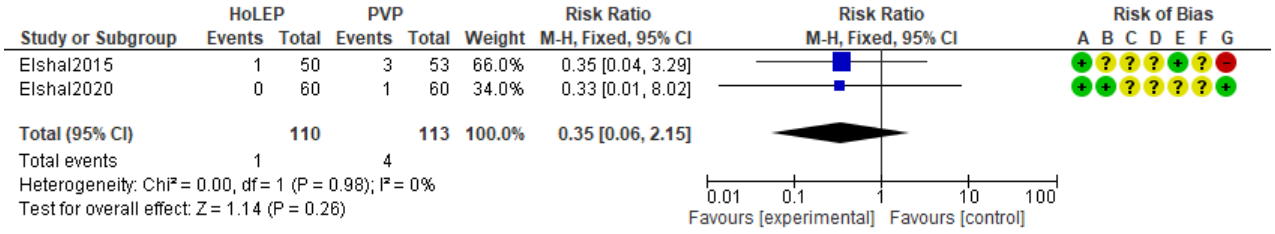
[a] Data estimated according to McGrath et al. [63].

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

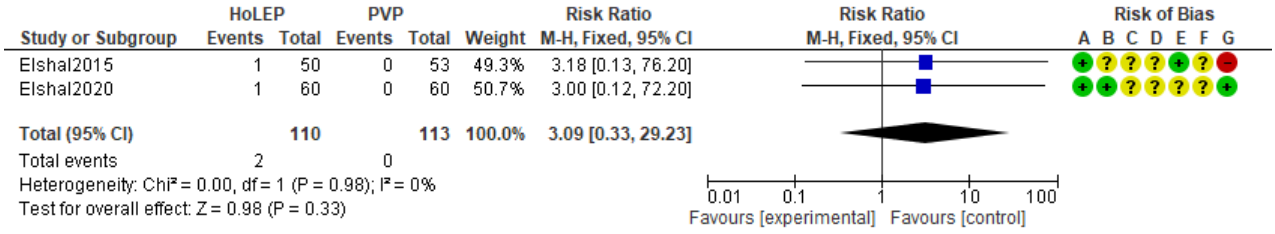
Bladder or ureteral injury



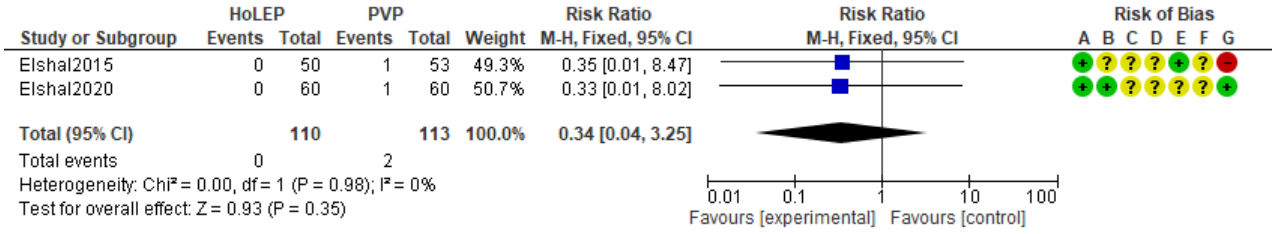
Capsular perforation



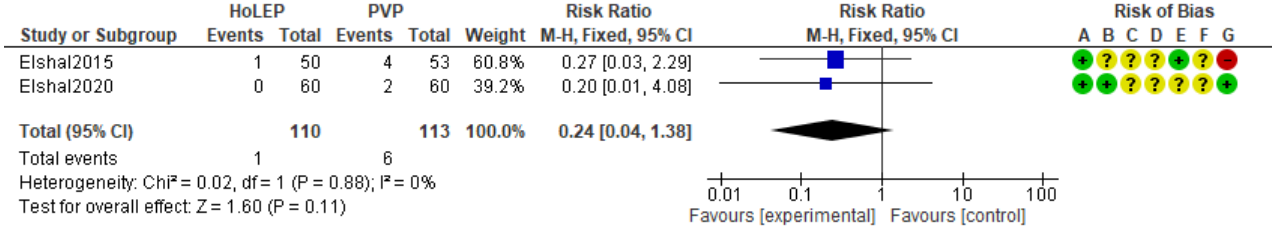
Bladder neck contracture



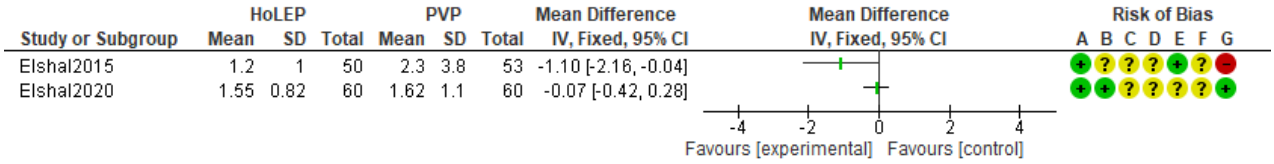
Urinary tract infection



Recatheterisation



Catheterisation time (days)



ThuLEP

ThuLEP was assessed in nine of the RCTs, including a total of 1327 patients: five RCTs versus TURP (n=715), three RCTs versus HoLEP (n=485) and one RCT versus B-TUEP (n=127).

ThuLEP versus TURP

Five RCTs (Bozzini 2017, n=208; Yang 2013, n=158, Enikeev 2019, n=103; Swiniarski 2012, n= 106; Shoji 2020, n=140) compared ThuLEP versus TURP. Outcomes assessed in these studies are listed in Table 4-41.

Table 4-41: Safety outcomes assessed in RCTs comparing ThuLEP versus TURP

Study ID	Bozzini 2017	Enikeev 2019	Swiniarski 2012	Yang 2013	Shoji 2020
Transfusion requirement	x		x	x	x
Bladder perforation			x		
Bladder or ureteral injury	x		x (0 events)		
Capsular perforation			x		x (0 events)
Decrease in serum sodium		x			
Erectile dysfunction					x
IIEF (erectile dysfunction score) at 1 month					x
IIEF (erectile dysfunction score) at 3 months					x
IIEF (erectile dysfunction score) at 6 months					x
IIEF (erectile dysfunction score) at 12 months					x
Urinary incontinence	x	x	x		x
Catheterisation time	x	x	x	x	x [a]
TUR syndrome			x		
Urethral stricture	x	x	x		x
Bladder neck contracture		x	x		x
Acute urinary retention	x	x	x	x	
Urinary tract infection		x	x		x
Retrograde ejaculation		x	x		
Recatheterisation					x

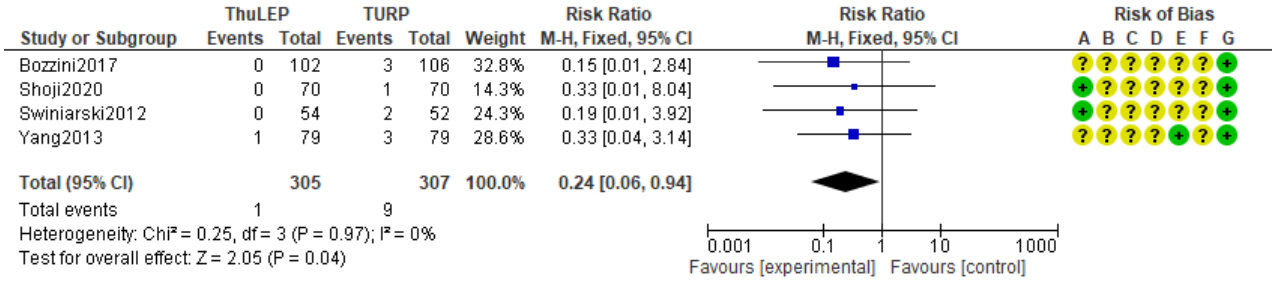
[a] Data estimated according to McGrath et al. [63].

Two studies included patients with prostate volume either <80 ml (Enikeev 2019) or <100 ml (Yang 2013). The other three studies enrolled patients using other inclusion criteria and regardless of prostate size. Consequently, mean prostate size differed between the studies (from 53 to 89.3 ml for ThuLEP and from 53 ml to 81.9 ml for TURP). Three studies reported prostate volume ranges that overall comprised prostates from 28 ml to 149 ml.

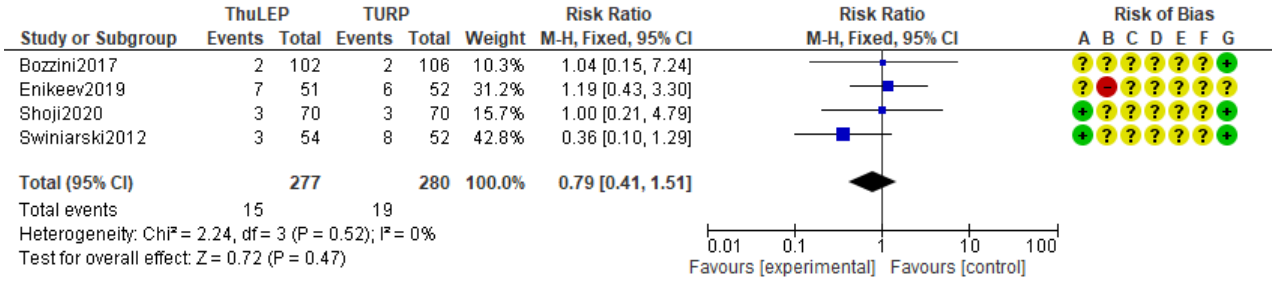
Pooling of data was possible for the majority of the safety outcomes. Data were in favour of ThuLEP for transfusion requirement (RR 0.24, 95% CI 0.06–0.94; I^2=0%, uncertain RoB). The quality of the evidence was judged as moderate (owing to imprecision). Catheterisation time was shorter for ThuLEP in three of the four RCTs, with highly heterogeneous results. There were no statistically significant differences between the groups for the other outcomes.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

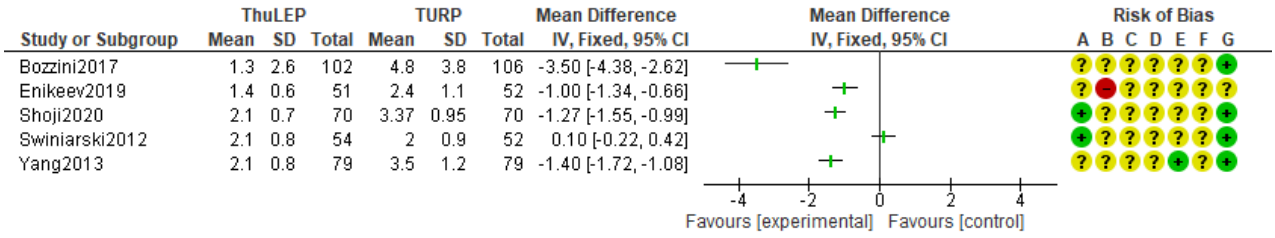
Transfusion requirement



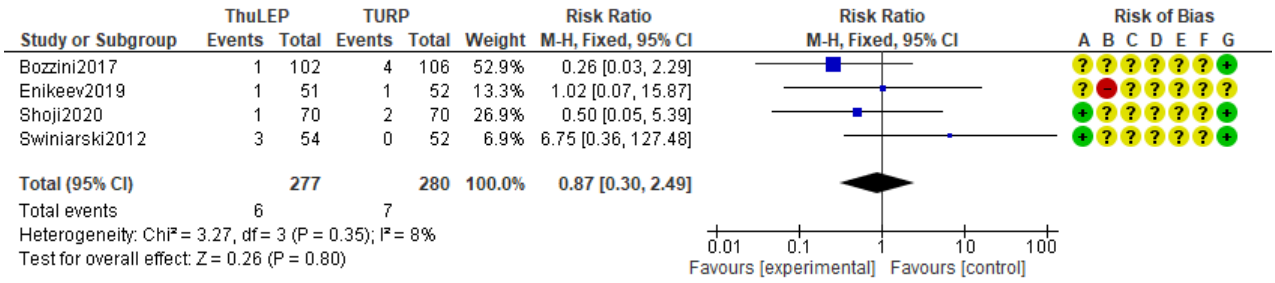
Urinary incontinence



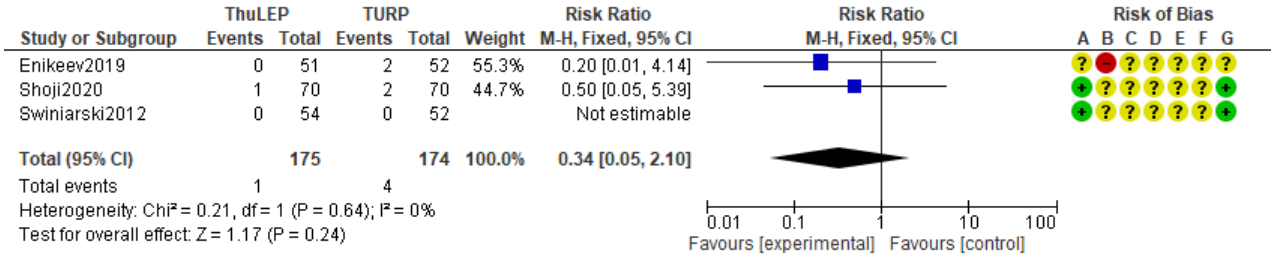
Catheterisation time (days)



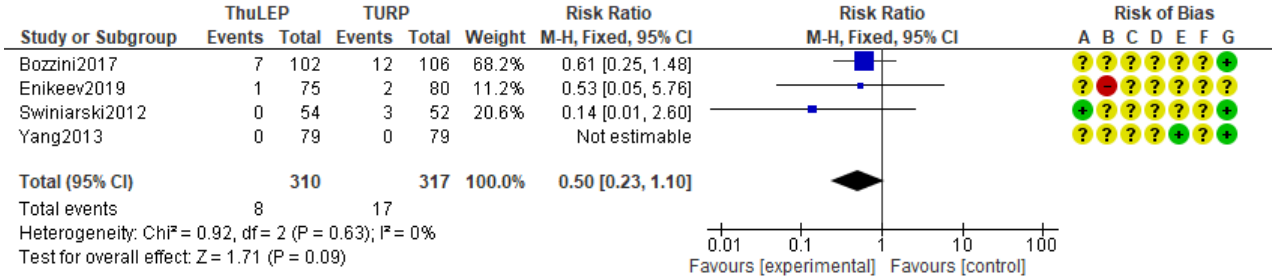
Urethral stricture



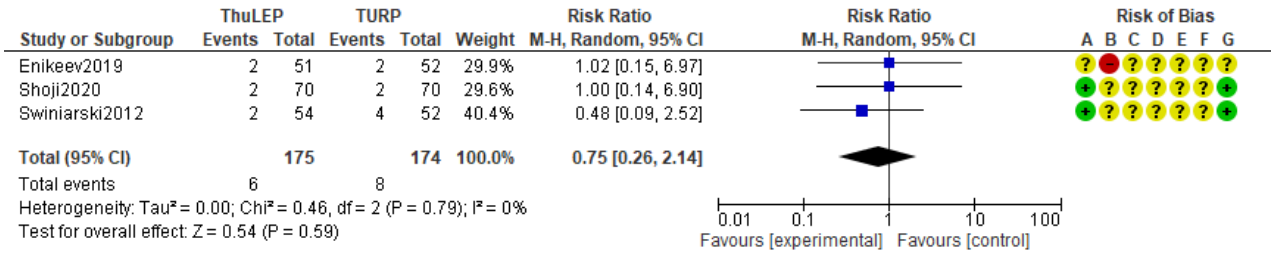
Bladder neck contracture



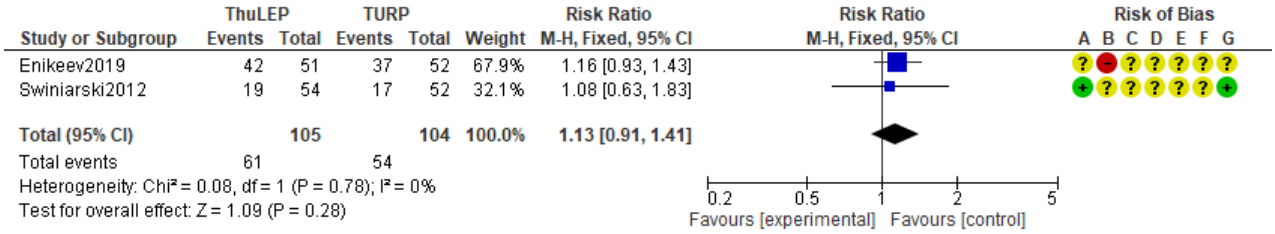
Acute urinary retention



Urinary tract infection



Retrograde ejaculation



ThuLEP versus B-TUEP

See the section on B-TUEP.

ThuLEP versus HoLEP

See the section on HoLEP.

DioLEP

DioLEP was assessed in six of the RCTs, including a total of 506 patients: two RCTs versus TURP (n=212), two RCTs versus B-TUEP (n=194), and one RCT versus each of HoLEP (n=126) and B-ERP (n=80).

DioLEP versus TURP

Two RCTs (Lusuardi 2011, n=60; uncertain RoB; Zhang 2019, n=152; low RoB) compared DioLEP versus TURP. The prostate volume range was similar in both studies (32–80 ml and 34–89 ml for DioLEP and 34–80 ml and 35–89 ml for TURP). Outcomes assessed in these studies are indicated in Table 4-42. There were no data on bladder perforation, intraoperative mortality, erectile dysfunction, retrograde ejaculation or long-term mortality.

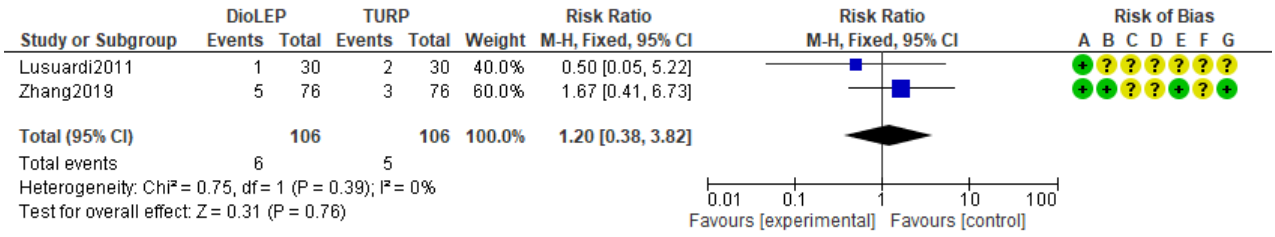
Table 4-42: Safety outcomes assessed in RCTs comparing DioLEP versus TURP

Study ID	Lusuardi 2011	Zhang 2019
Intraoperative complications		
Transfusion requirement	x (0 events)	x (0 events)
Bladder or ureteral injury		x
Capsular perforation		x
Decrease in serum sodium		x
Postoperative complications		
Urinary incontinence	x	x
Catheterisation time	x	x
TUR syndrome		x
Urethral stricture	x (0 events)	x
Bladder neck contracture	x	
Urinary tract infection	x	
Recatheterisation		x

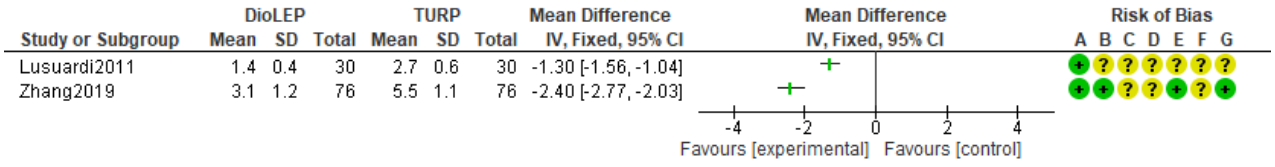
Pooling of data was only possible for urinary incontinence and catheterisation time. The latter was shorter for DioLEP (up to 2.4 days less). In both studies there was no need for blood transfusion. No differences between the groups were reported for any of the other outcomes of interest assessed in each study.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

Urinary incontinence



Catheterisation time (days)



DioLEP versus B-TUEP

See the section on B-TUEP.

DioLEP versus HoLEP

See the section on HoLEP.

DioLEP versus B-TUERP

See the section on B-TUERP.

B-TUEP

B-TUEP was assessed in ten of the RCTs, with comparisons to TURP (4 RCTs; n=911), DioLEP (2 RCTs; n=194), HoLEP (2 RCTs; n=104), ThuLEP (1 RCTs; n=127) and B-TUVP and OP (1 RCT; n=320), for a total of 1656 patients.

B-TUEP versus TURP

Five RCTs compared B-TUEP versus TURP, providing data for the outcomes listed in Table 4-43. No data were available for bladder perforation or bladder or ureteral injury.

Table 4-43: Safety outcomes assessed in RCTs comparing B-TUEP versus TURP

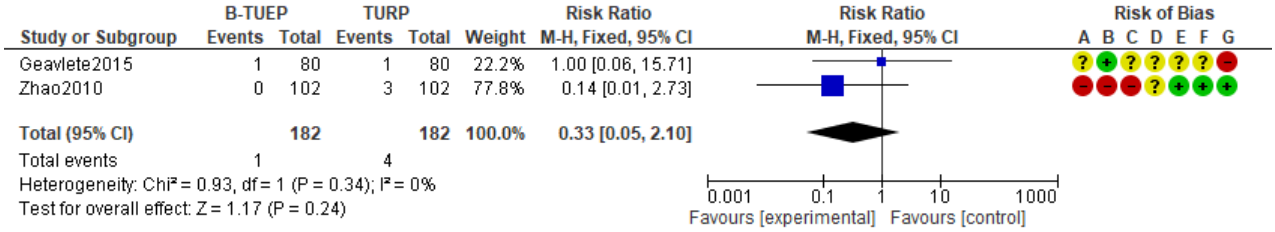
Study ID	Luo 2014	Ran 2013	Zhao 2010	Zhu 2013	Geavlete 2015
Intraoperative complications					
Transfusion requirement	x (0 events)	x (0 events)	x		x
Capsular perforation		x			
Decrease in serum sodium		x			
Postoperative complications					
IIEF (erectile dysfunction score) at baseline			x	x	
IIEF (erectile dysfunction score) at 6 months			x	x	
IIEF (erectile dysfunction score) at 12 months			x	x	
IIEF (erectile dysfunction score) at 24 months			x	x	
IIEF (erectile dysfunction score) at 36 months			x	x	
Urinary incontinence	x		x	x	x
Catheterisation time	x	x	x	x	x
TUR syndrome	x (0 events)	x (0 events)	x		
Urethral stricture	x		x		x
Bladder neck contracture	x		x		x
Acute urinary retention				x	
Urinary tract infection	x		x	x	x
Retrograde ejaculation			x		
Recatheterisation	x				x

Patients included in the studies were heterogeneous in terms of prostate size category. Patients with prostate size >70 ml and >80 ml were included in Zhu 2013 and Geavlete 2015, respectively, whereas patients in the other three studies had an average prostate size between 62 and 69 ml (no range or inclusion criteria available). Pooling of data was possible for all of the outcomes assessed by (or with data in) more than one study.

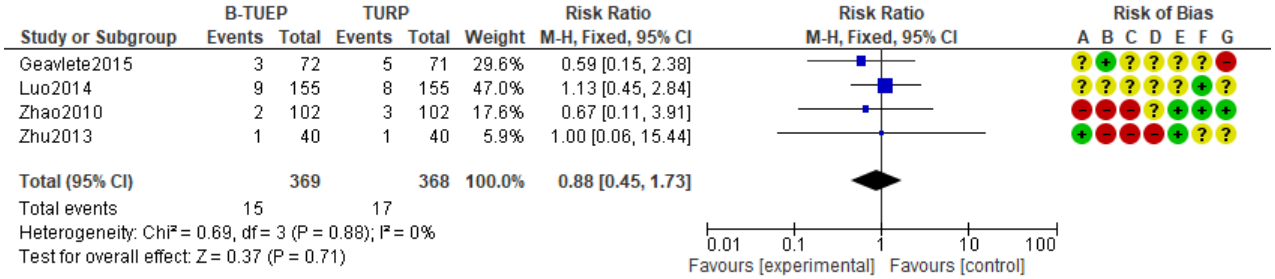
Catheterisation time was shorter for B-TUEP in four of the five RCTs (MD up to 29 h less). The risk of urinary incontinence was higher for B-TUEP (RR 1.88, 95% CI 1.14–3.10; I^2=22%, high RoB), with the quality of evidence judged as very low because of indirectness, inconsistency and high RoB.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

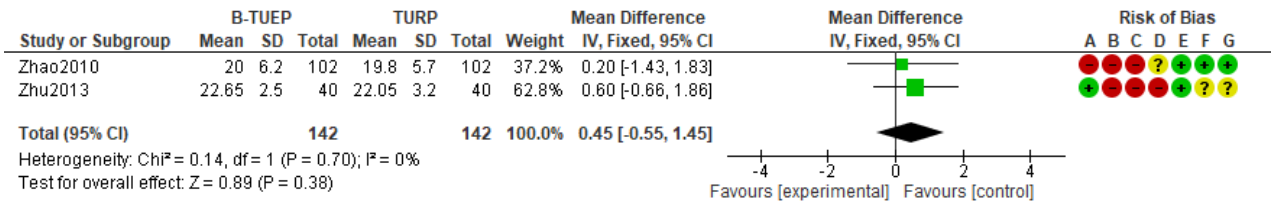
Transfusion requirement



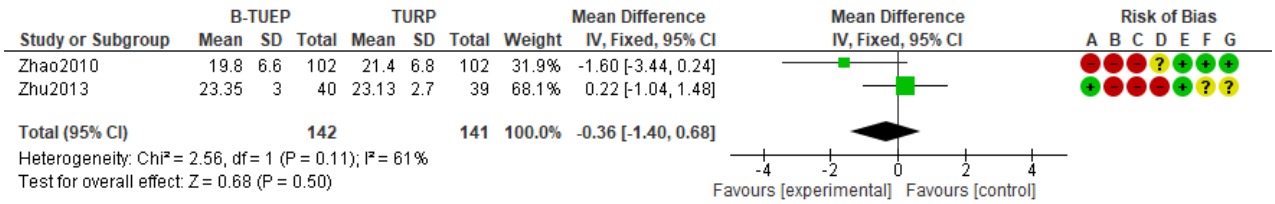
Urinary tract infection



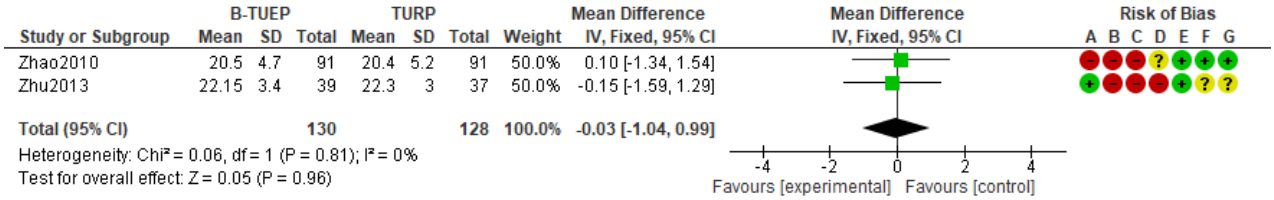
IIEF at 6 months



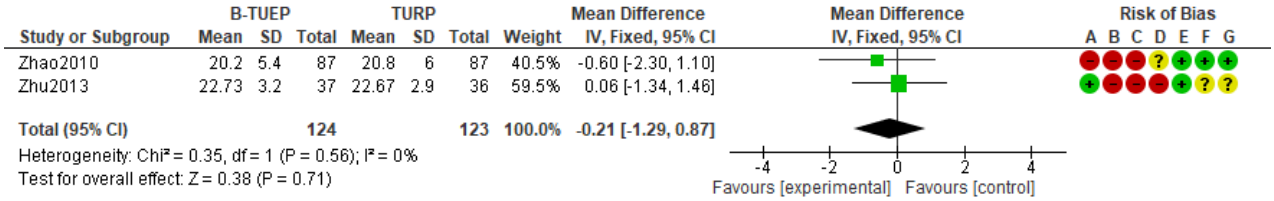
IIEF at 12 months



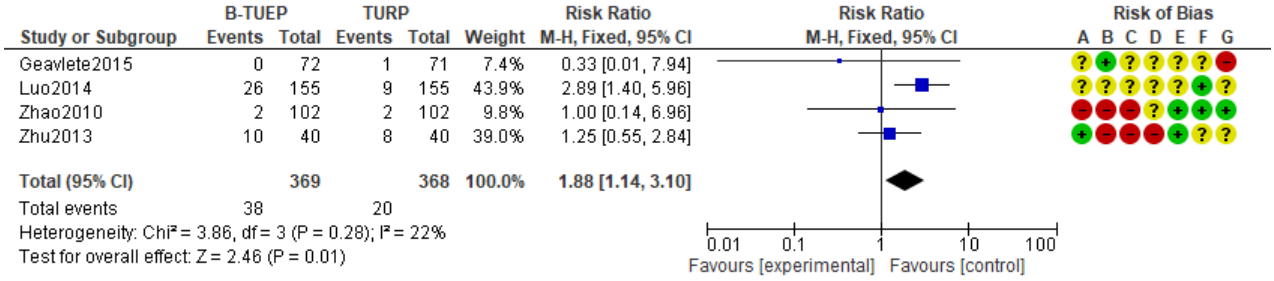
IIEF at 24 months



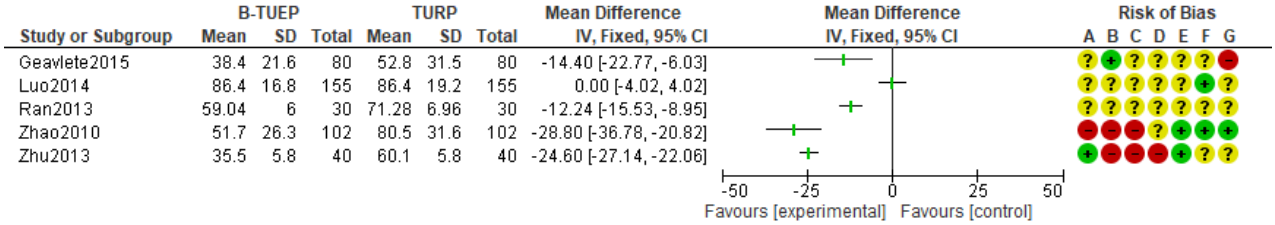
IIEF at 36 months



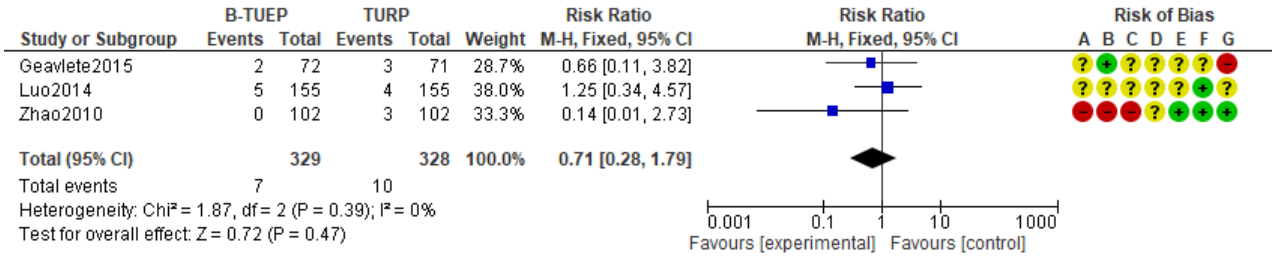
Urinary incontinence



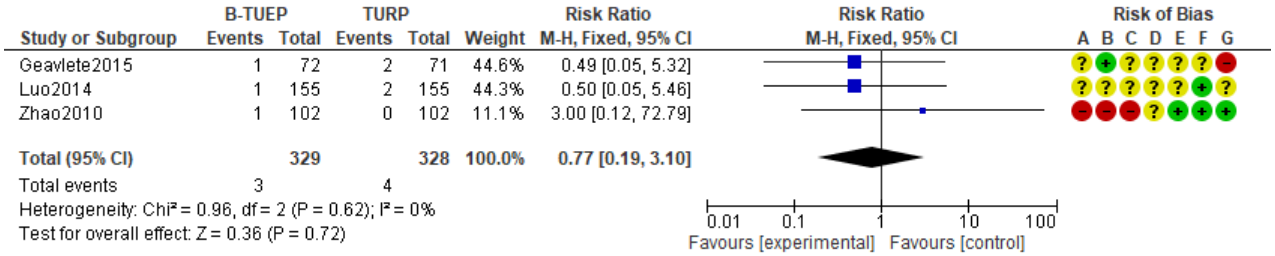
Catheterisation time (h)



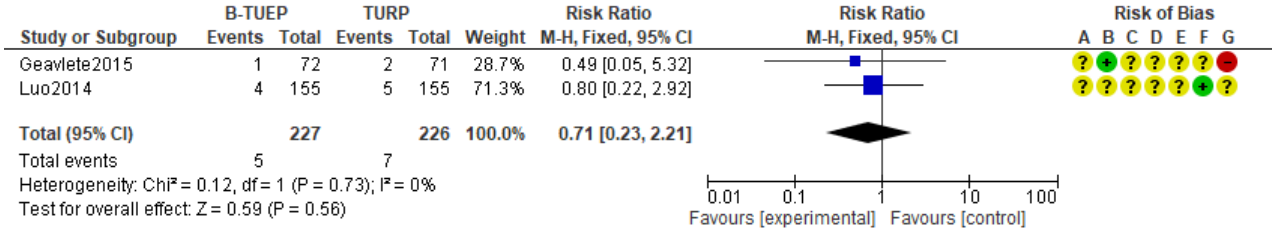
Urethral stricture



Bladder neck contracture



Recatheterisation



B-TUEP versus HoLEP

See the section on HoLEP.

B-TUEP versus DioLEP

Two RCTs with uncertain RoB (Wu 2016; Zou 2018) compared B-TUEP versus DioLEP. Patients included in Wu 2016 had a prostate size >80 ml and can be classified in the large prostate sub-group, whereas patients in Zou 2018 had prostate size between 20 and 160 ml (mean: 62 ml). These two studies provided data for the outcomes listed in Table 4-44. No data were available for bladder perforation, bladder or ureteral injury, decrease in serum sodium or AUR.

Table 4-44: Safety outcomes assessed in RCTs comparing B-TUEP versus DioLEP

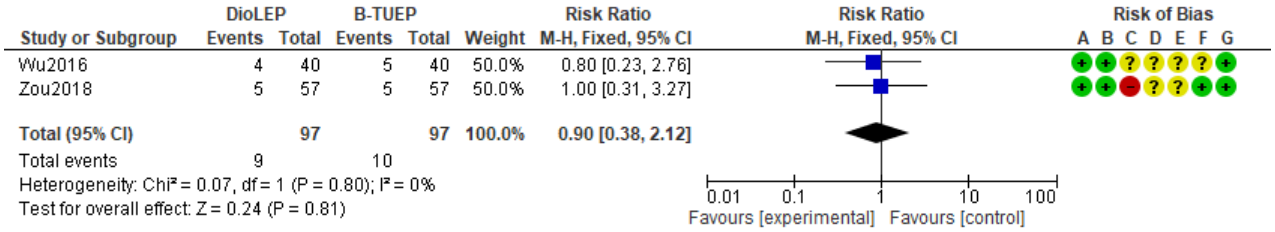
Study ID	Wu 2016	Zou 2018
Intraoperative complications		
Transfusion requirement	x	
Capsular perforation	x	
Postoperative complications		
IIEF (erectile dysfunction score) at 3 months	x	
IIEF (erectile dysfunction score) at 6 months	x	x
IIEF (erectile dysfunction score) at 12 months	x	x [a]
Urinary incontinence	x	x
Catheterisation time	x	x [a]
TUR syndrome	x	
Urethral stricture	x	
Bladder neck contracture		x
Urinary tract infection		x
Retrograde ejaculation	x	x
Recatheterisation	x	x

[a] Data calculated according to the Cochrane Handbook method.

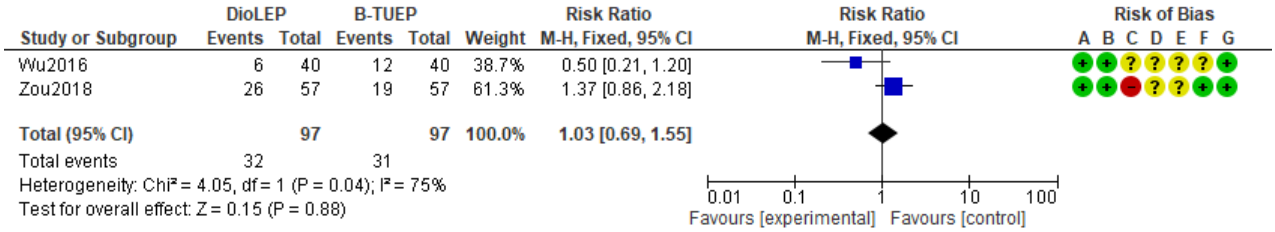
Pooling of data was possible for urinary incontinence, retrograde ejaculation, recatheterisation, IIEF at 6 months and irritative symptoms. No differences between the groups were found for any of these outcomes.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

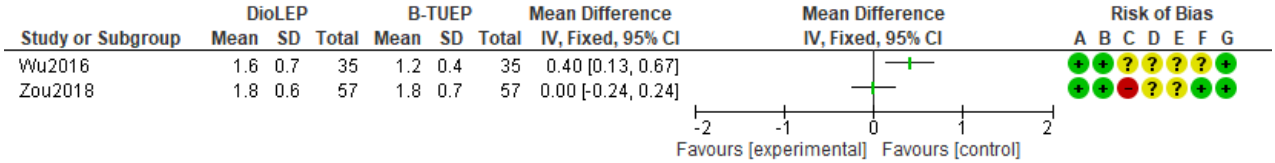
Urinary incontinence



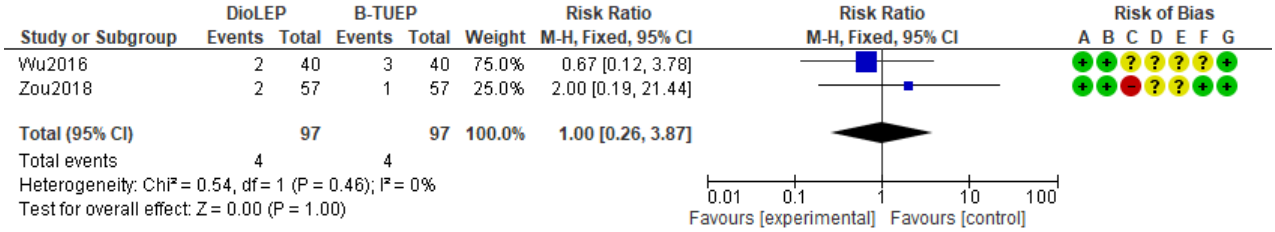
Retrograde ejaculation



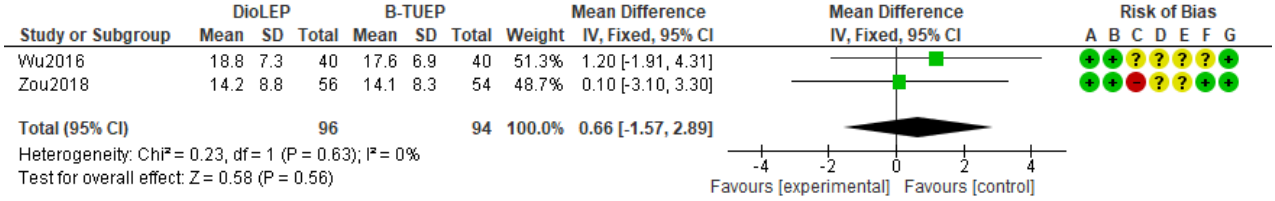
Catheterisation time (days)



Recatheterisation



IIEF at 6 months



B-TUEP versus ThuLEP

One RCT with uncertain RoB (Feng 2016; n=127) compared B-TUEP versus ThuLEP among patients with an average prostate size of 68 ml, assessing catheterisation time, TUR syndrome, urinary incontinence, decrease in serum sodium, capsule perforation, urethral stricture, bladder mucosal damage, blood transfusion requirement, UTI, recatheterisation and bladder neck contracture. A shorter catheterisation time was observed in favour of ThuLEP (1.9 vs. 2.3 days; p=0.04, 95% CI not available).

B-TUEP versus B-TUVP

One RCT with high RoB (Geavlete 2015; n=160) compared B-TUEP versus B-TUVP among patients with a prostate size >80 ml, assessing catheterisation time and blood transfusion requirement. No differences between the groups were observed.

B-TUEP versus OP

One RCT with high RoB (Geavlete 2015; n=160) compared B-TUEP versus OP among patients with a prostate size >80 ml, assessing catheterisation time and blood transfusion requirement. A shorter catheterisation time was observed in favour of B-TUEP (1.6 vs. 5.4 days; p value and 95% CI not available).

4.4.2.3 Vaporisation techniques

B-TUVP

B-TUVP was assessed in 15 RCTs including a total of 2170 patients: ten RCTs versus TURP (n=1691), two RCTs versus PVP (n=117) and one RCT each versus DioLVP (n=55), B-TUEP (n=147) and OP (n=160).

B-TUVP versus TURP

B-TUVP was assessed in comparison to TURP in ten RCTs (Elsakka 2016, Geavlete 2011, Geavlete 2014, Geavlete 2015, Hon 2016, Karadag 2014, Kaya 2007, Nuhoglu 2011, Tefekli 2005, Zhang S. 2012) that included a total of 1691 patients. Outcomes assessed in these studies are listed in Table 4-45.

Table 4-45: Safety outcomes assessed in RCTs comparing B-TUVP versus TURP

Study ID	Elsakka 2016	Geavlete 2011	Geavlete 2014	Geavlete 2015	Hon 2006	Karadag 2014	Kaya 2007	Nuhoglu 2011	Tefekli 2005	Zhang S 2012
Intraoperative complications										
Transfusion requirement	x	x		x	x	x		x	x	x
Bladder perforation	x									
Bladder or ureteral injury			x							
Capsular perforation		x								
Intraoperative mortality	x									
Decrease in serum sodium	x				x					

Study ID	Elsakka 2016	Geavlete 2011	Geavlete 2014	Geavlete 2015	Hon 2006	Karadag 2014	Kaya 2007	Nuhoglu 2011	Tefekli 2005	Zhang S 2012
Postoperative complications										
Erectile dysfunction							x		x [a]	
Urinary incontinence	x	x		x		x	x [a]	x [a]	x	
Catheterisation time	x	x	x	x		x		x	x	x
TUR syndrome	x	x						x [a]		
Urethral stricture	x	x		x	x		x	x	x	
Bladder neck contracture	x	x		x		x				
Acute urinary retention								x	x	
Urinary tract infection	x	x		x		x [a]				
Retrograde ejaculation							x		x	
Recatheterisation	x	x	x	x				x	x	

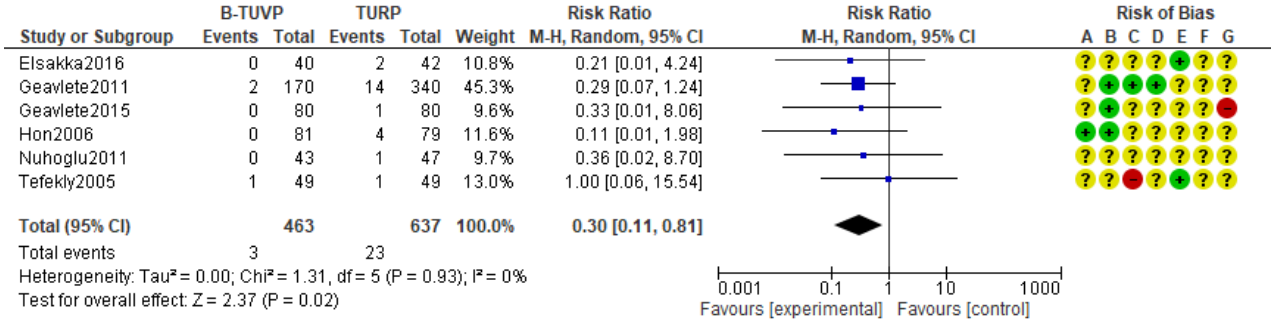
[a] Zero events.

Prostate size was used as an inclusion criterion in seven of these ten studies. Patients included were heterogeneous in terms of the prostate size category. While four studies included patients with prostate volume of <80 ml, Kaya 2007 included patients with prostate volume of <60 ml, Zhang S 2012 with prostate size between 25 and 125 ml and Geavlete 2015 with prostate size >80 ml. The latter is the only study providing information on the range for prostate volume (80–297 ml).

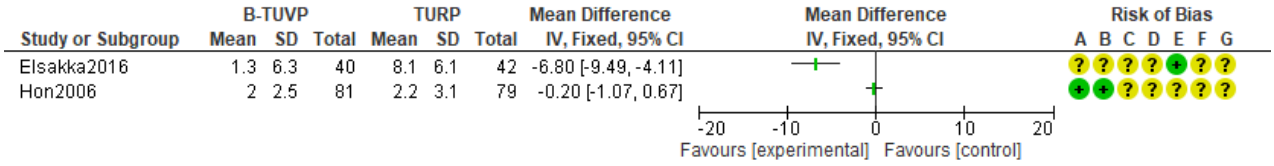
Pooling of the data was possible for all outcomes in Table 4-45 except for bladder perforation, bladder or ureteral injury, capsular perforation, erectile dysfunction. Data on decrease of serum sodium were not pooled for high heterogeneity of the two available studies. A significant difference in favour of B-TUVP was found for blood transfusion requirement (RR 0.30, 95% CI 0.11–0.81; I^2=0%, uncertain RoB); the quality of the evidence was rated as moderate (owing to uncertain RoB).

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

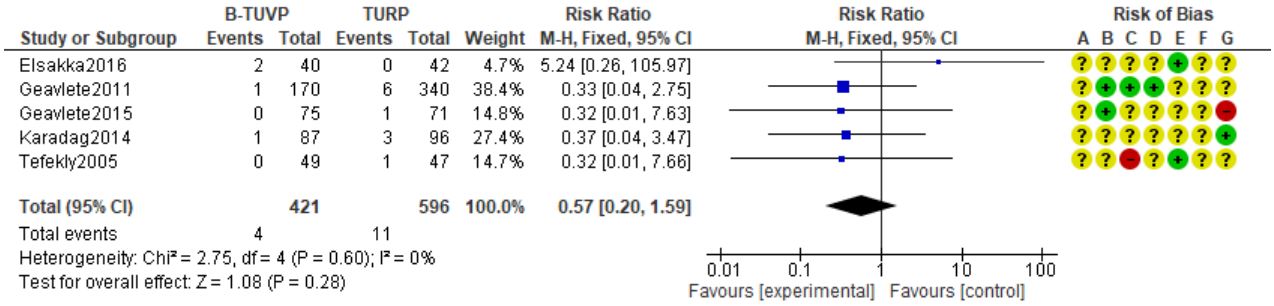
Transfusion requirement



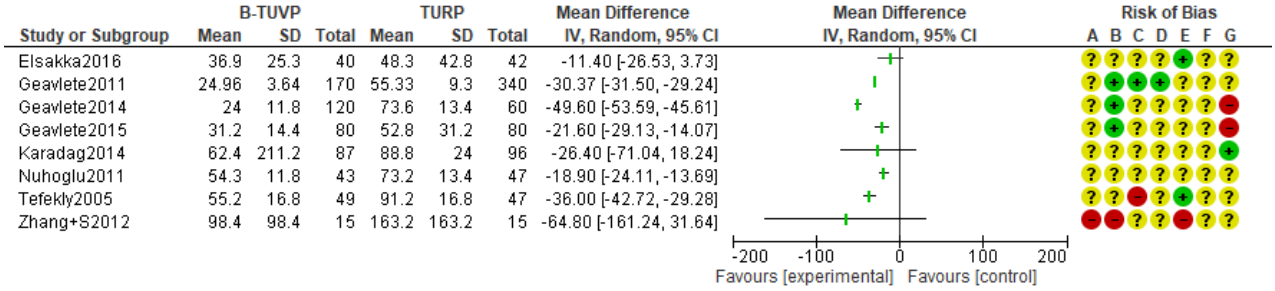
Decrease in serum sodium (mmol/l)



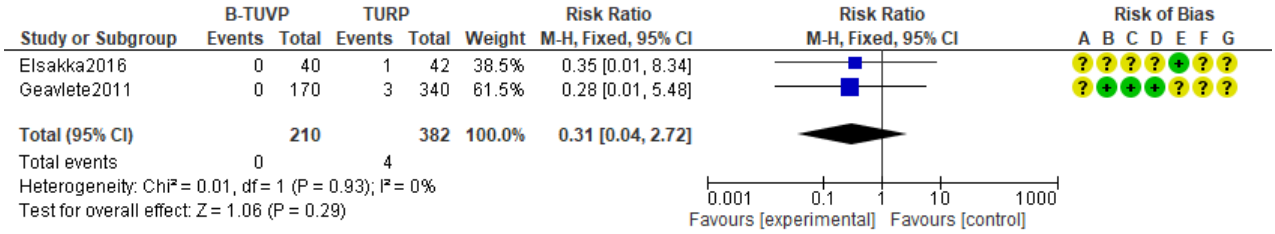
Urinary incontinence



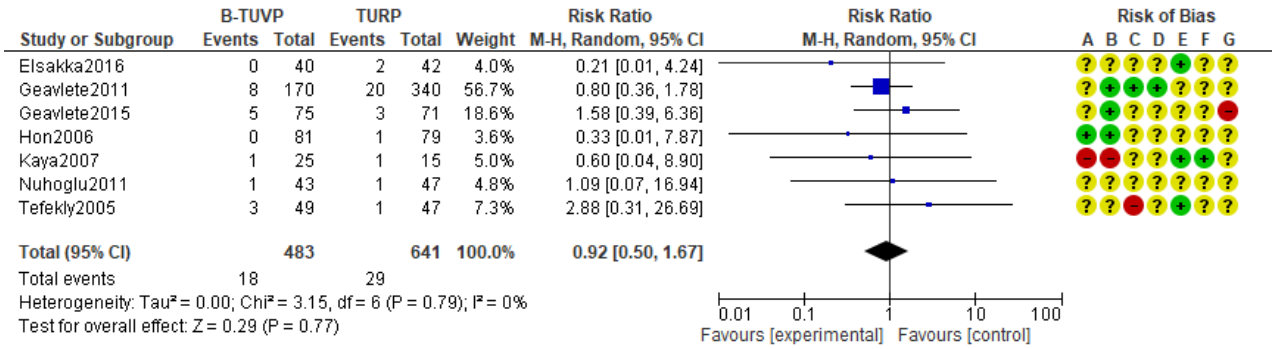
Catheterisation time (h)



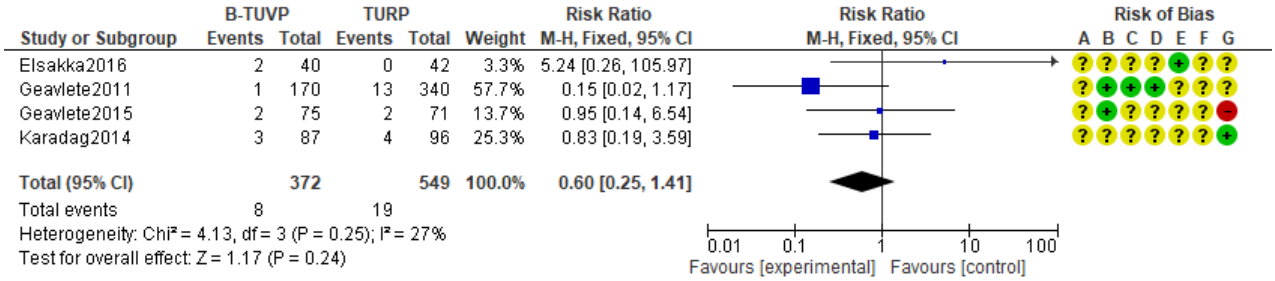
TUR syndrome



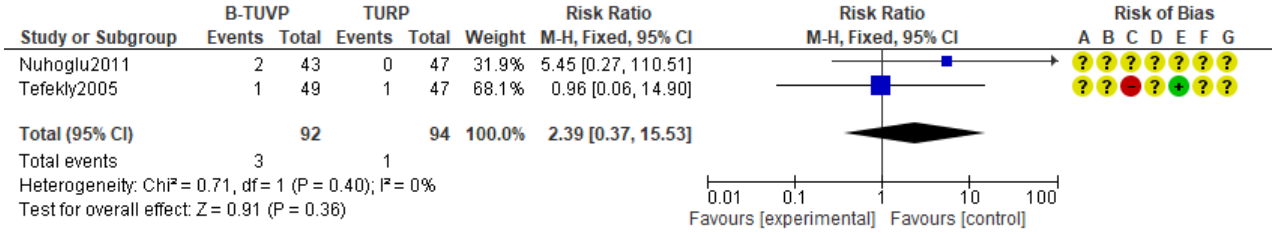
Urethral stricture



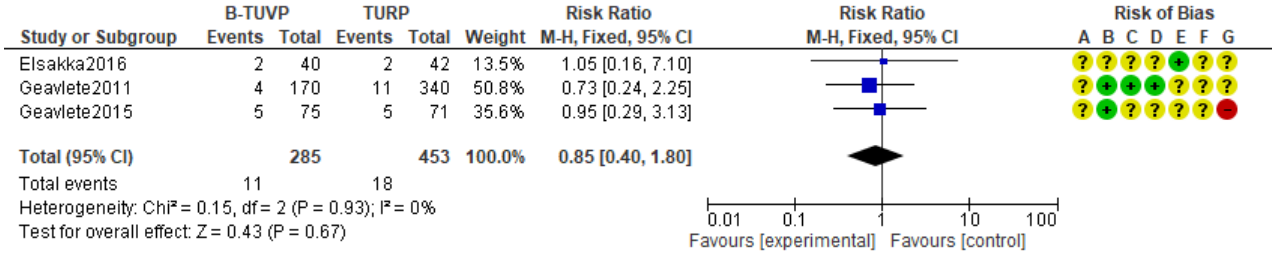
Bladder neck contracture



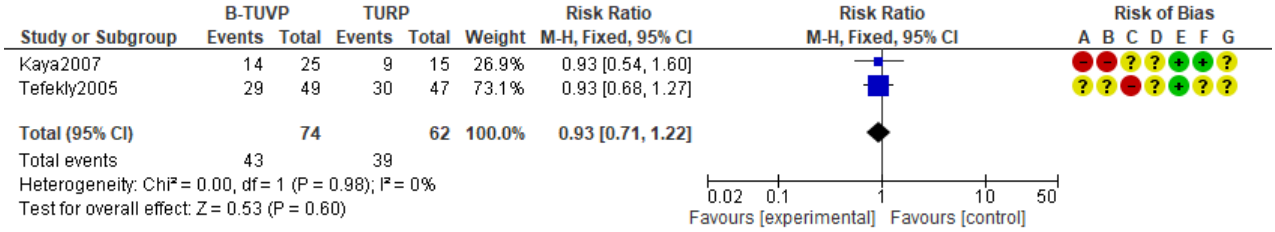
Acute urinary retention



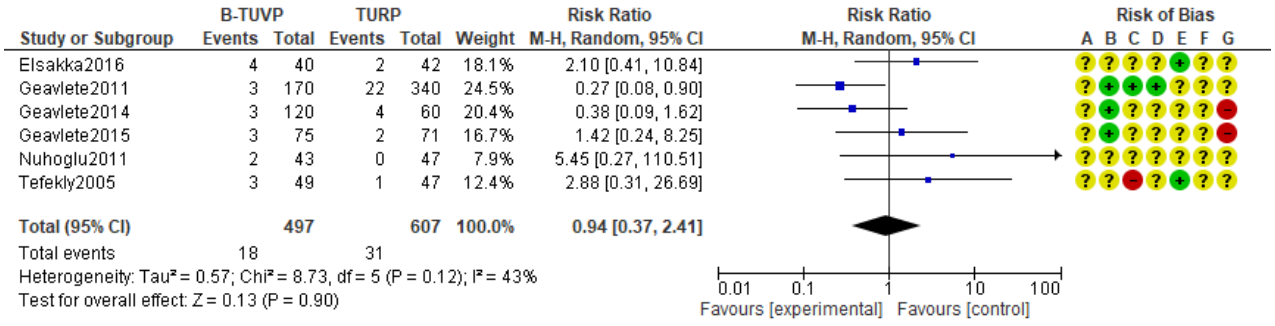
Urinary tract infection



Retrograde ejaculation



Recatheterisation



B-TUVP versus PVP

See the section on PVP.

B-TUVP versus DioLVP

One study (Skinner 2017, n=55; unclear RoB) compared B-TUVP versus DioLVP for the outcomes catheterisation time, stricture and bladder injury. The mean prostate size was 47 ml (no range or inclusion criteria available). No statistically significant differences between the groups were observed for any of the outcomes reported.

B-TUVP versus B-TUEP

See the section on B-TUEP.

B-TUVP versus OP

One study (Geavlete 2015, n=160; high RoB) compared B-TUVP versus OP in a cohort of patients with a prostate size >80 ml. Only data for catheterisation time and blood transfusion requirement were reported, with no significant differences observed between the groups.

DioLVP

DioLVP was assessed in three of the RCTs, including a total of 242 patients: two trials versus TURP (n=204) and one versus B-TUVP (n=55).

DioLVP versus TURP

Two RCTs (Cetinkaya 2015, n=72; high RoB; Razzaghi 2014, n=115; uncertain RoB) compared DioLVP versus TURP. Outcomes assessed in these studies are listed in Table 4-46. No data for bladder perforation, bladder or ureteral injury, intraoperative mortality, retrograde ejaculation or long-term mortality were reported.

Table 4-46: Safety outcomes assessed in RCTs comparing DioLVP versus TURP

Study ID	Razzaghi 2014	Cetinkaya 2015
Intraoperative complications		
Transfusion requirement	x	x
Capsular perforation	x	x
Decrease in serum sodium	x	
Postoperative complications		
Erectile dysfunction	x	
Urinary incontinence	x	
Catheterisation time	x	x
TUR syndrome	x	x [a]
Urethral stricture	x	x (0 events)
Bladder neck contracture	x	

Study ID	Razzaghi 2014	Cetinkaya 2015
Acute urinary retention		x
Urinary tract infection	x	x (0 events)
Recatheterisation	x	

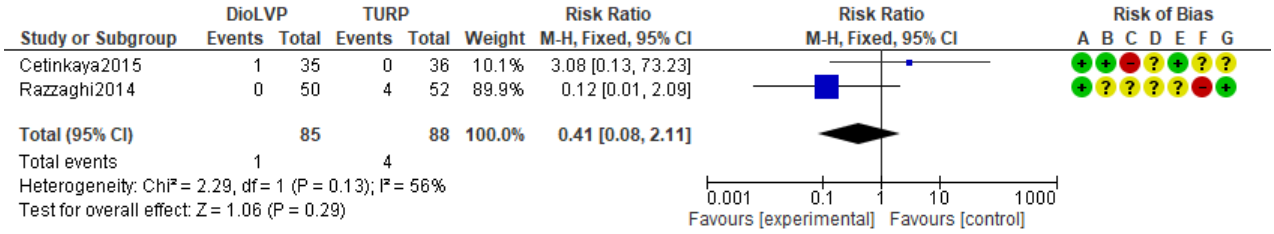
[a] Incomplete data.

Inclusion criteria for prostate volume varied substantially. Razzaghi 2014 excluded patients with a prostate volume >100 ml, while Cetinkaya 2015 considered prostate volumes of <80 ml. Neither of the studies reported the range for prostate volume; mean values were only slightly higher in the first study (61.1 and 50.6 ml in the DioLVP group and 59.6 and 54.8 ml in the TURP group).

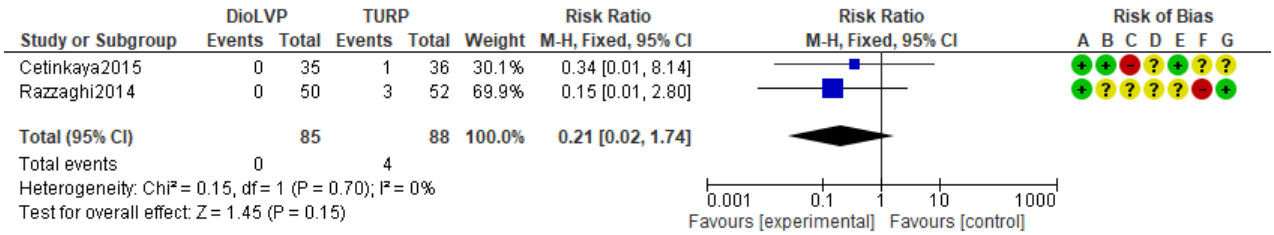
Pooling of data was possible for transfusion requirement and capsular perforation. Catheterisation time was shorter for DioLVP in both studies, with very heterogeneous results. Other safety outcomes were not significantly different between the groups. Outcomes reported only in Razzaghi 2014 (decrease in serum sodium, erectile dysfunction, urinary incontinence, bladder neck contracture and recatheterisation) or only in Cetinkaya 2015 (AUR) showed no significant differences between the groups. TUR syndrome was reported in both studies, but only Razzaghi 2014 tested the difference between the DioLVP and TURP groups, which was not statistically significant.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

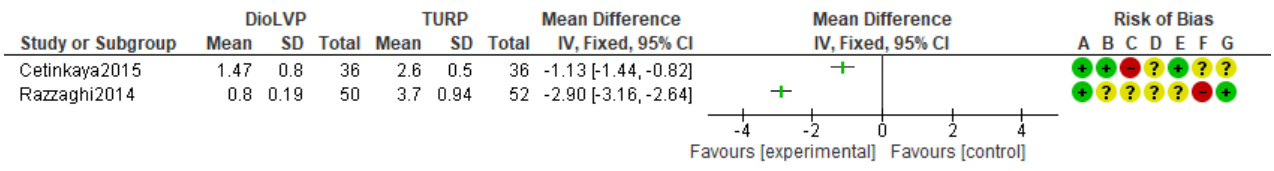
Transfusion requirement



Capsular perforation



Catheterisation time (days)



DioLVP versus B-TUVP

See the section on B-TUVP.

PVP

PVP was assessed in six of the RCTs, with comparisons to TURP (3 RCTs; n=465), B-TUVP (2 RCTs; n=146) and HoLEP (1 RCT; n=103).

PVP versus TURP

Three RCTs (Goliath study, with 3 publications: Bachmann 2014, Bachmann 2015, Thomas 2016, n=281; Jovanovic 2014, n=62; Elshal 2020, n=122) compared PVP versus TURP for the outcomes listed in Table 4-47. Patients in the Goliath study and Jovanovic 2014 had a prostate size <100 ml (mean: 47 ml in the Goliath study and 61 ml in Jovanovic 2014; no ranges available); Elshal 2020 enrolled patients with a prostate size between 80 and 150 ml.

No data were available for bladder perforation or decrease in serum sodium

Table 4-47: Safety outcomes assessed in RCTs comparing PVP versus TURP

Study ID	Jovanovic 2014	Goliath study	Elshal 2020
Transfusion requirement	x	x	x
Bladder or ureteral injury			x
Capsular perforation	x		x
IIEF at 3 months			x
IIEF at 12 months		x	x
IIEF at 24 months		x	x
IIEF at 36 months			x
Urinary incontinence		x	x
Catheterisation time	x	x	x [a]
TUR syndrome	x		
Urethral stricture		x	
Bladder neck contracture	x		x (0 events)
Acute urinary retention		x	x
Urinary tract infection		x	x
Retrograde ejaculation		x	x [b]
Recatheterisation			x

[a] Data estimated according to McGrath et al. [63].

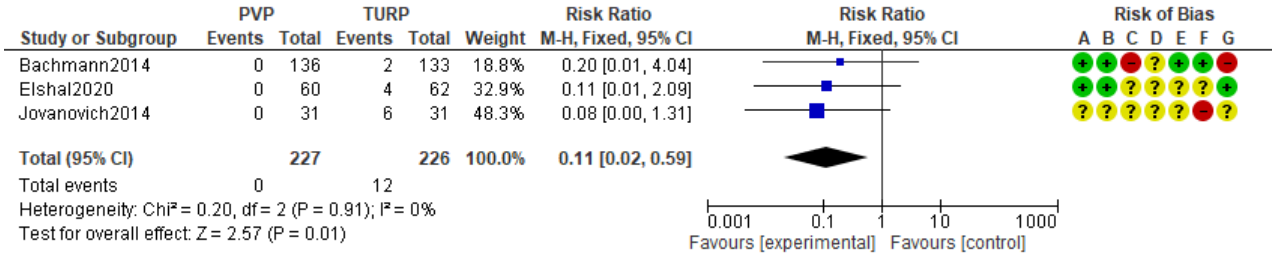
[b] Data not extractable.

Pooling of data was possible for blood transfusion, capsular perforation, urinary incontinence, bladder neck contracture, AUR, UTI, and IIEF at 12 and 24 months. Differences were found in favour of PVP for transfusion requirement (RR 0.11, 95% CI 0.02–0.59; I^2=0%, high RoB) and capsular perforation (RR 0.15, 95% CI 0.03–0.78; I^2=0%, high RoB). Catheterisation time was shorter for PVP in both studies, with very heterogeneous results. Differences were found in favour of TURP for urinary incontinence (RR 2.60, 95% CI 1.18–5.72; I^2=0%, high RoB) and UTI (RR 1.75, 95%

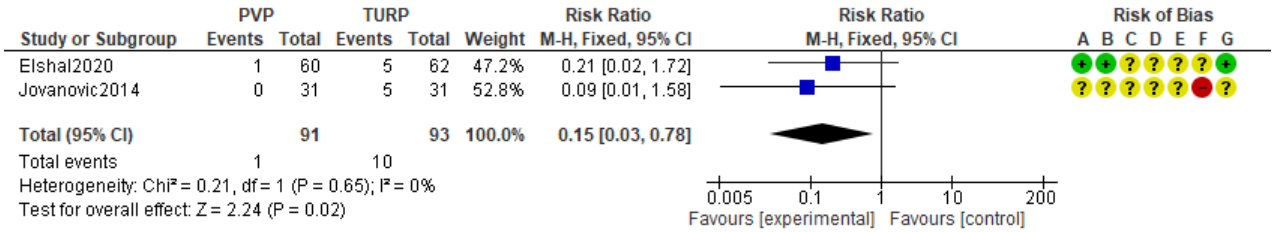
CI 1.01–3.04; I^2=0%, high RoB). The quality of the evidence was judged as low because of indirectness and RoB for all these outcomes.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

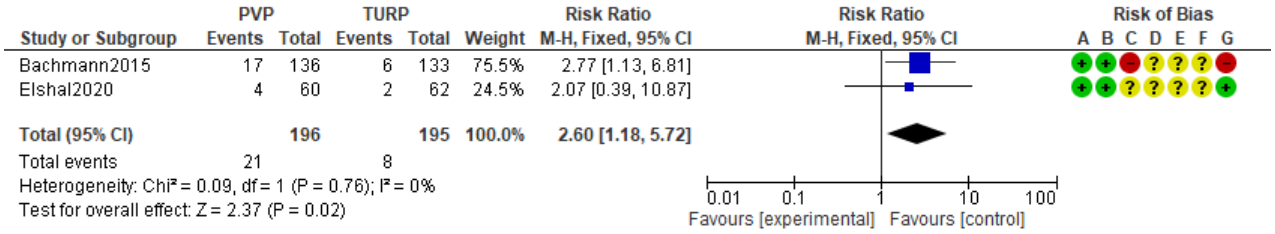
Transfusion requirement



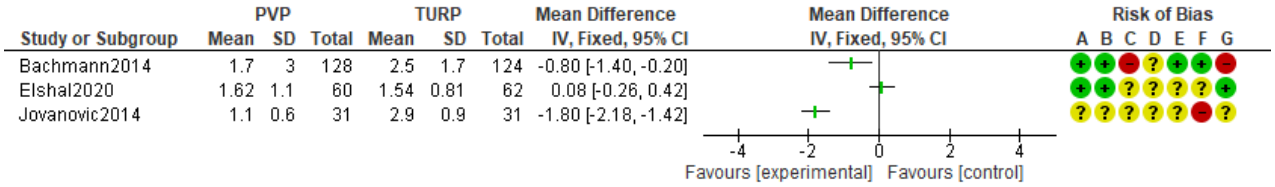
Capsular perforation



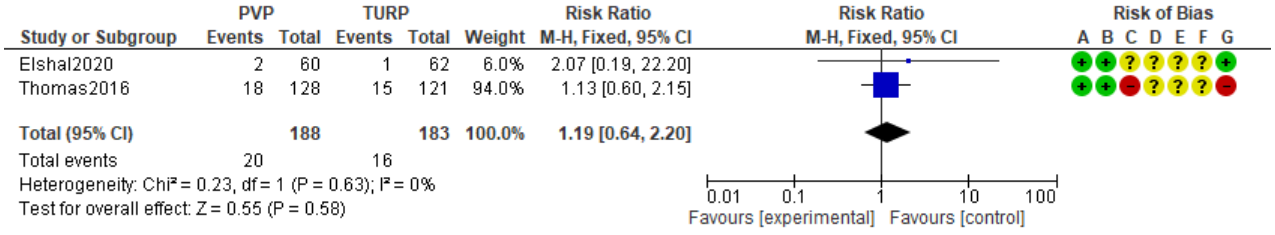
Urinary incontinence



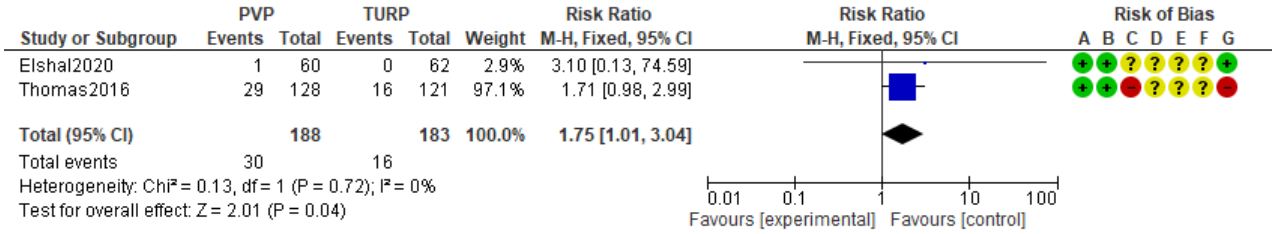
Catheterisation time (days)



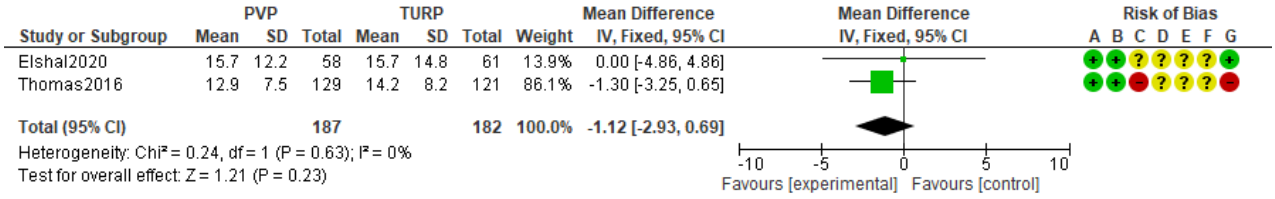
Acute urinary retention



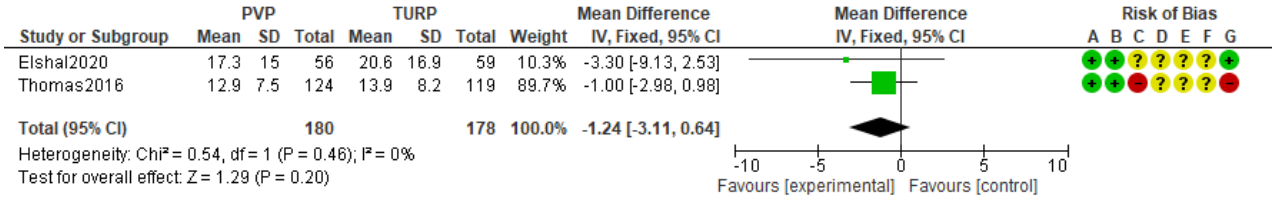
Urinary tract infection



IIEF-5 at 12 months



IIEF-5 at 24 months



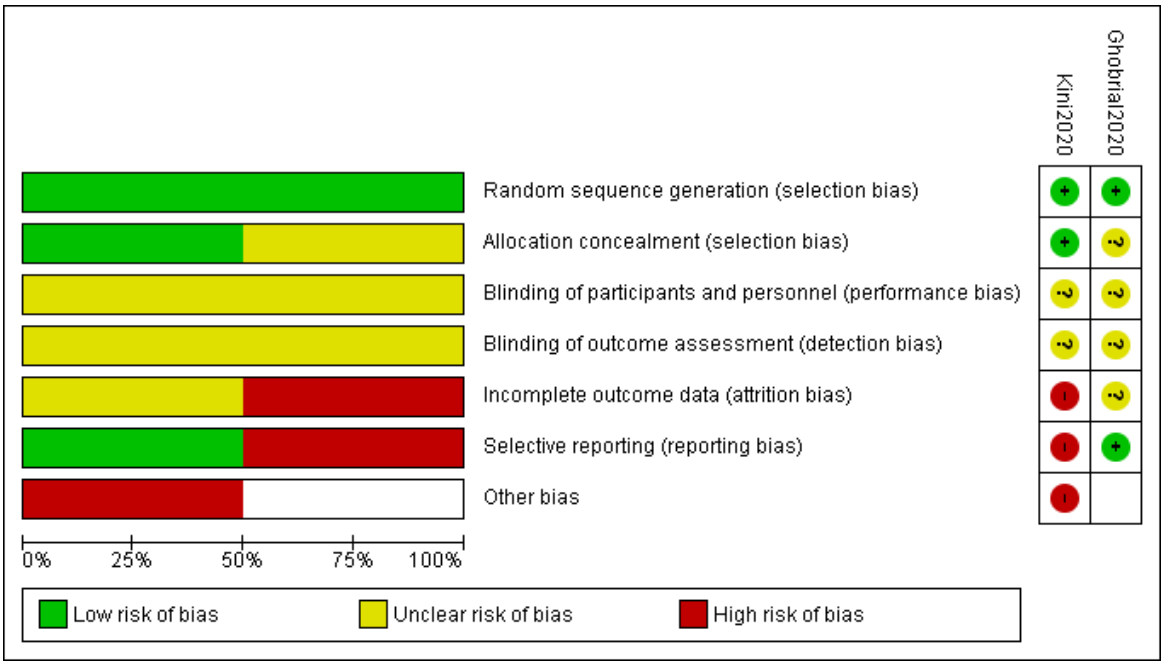
PVP versus B-TUVP

Two RCTs (Ghobrial 2020, n=119; Kini 2020, n=27) compared PVP versus B-TUVP for the outcomes listed in Table 4-48. No data were available for bladder perforation or TUR syndrome. Prostate size was between 30 and 80 ml in Ghobrial 2020 and <80 ml in Kini 2020. Pooling of data was not possible for any outcome. No differences were observed between the PVP and B-TUVP groups in either of the studies for the outcomes assessed.

Table 4-48: Safety outcomes assessed in RCTs comparing PVP versus B-TUVP

Study ID	Ghobrial 2020	Kini 2020
Intraoperative complications		
Transfusion requirement	x	
Bladder or ureteral injury	x	
Capsular perforation	x	
Decrease in serum sodium	x	
Postoperative complications		
Erectile dysfunction		x
Urinary incontinence	x	
Catheterisation time	x	
Urethral stricture	x	

Study ID	Ghobrial 2020	Kini 2020
Bladder neck contracture	x	
Acute urinary retention	x	
Urinary tract infection	x	
Retrograde ejaculation	x	
Recatheterisation	x	



PVP versus HoLEP

See the section on HoLEP.

4.4.2.4 Hybrid techniques: Vapoenucleation

ThuVEP

ThuVEP was assessed in two RCTs, including a total of 153 patients: one RCT versus TURP (n=59) and one RCT versus HoLEP (n=94).

ThuVEP versus TURP

One study (Chang 2015; n=59; uncertain RoB) compared ThuVEP versus TURP. Of the four safety outcomes assessed (Table 4-49), only catheter time was significantly shorter in the ThuVEP group (1.8 vs. 2.3 days; p=0.001, 95% CI not available). The lack of CIs for these estimates precluded assessment of their variability. There were no data for transfusion requirement, bladder perforation, bladder or ureteral injury, capsular perforation, intraoperative mortality, erectile dysfunction, urinary incontinence, urethral stricture, bladder neck contracture, AUR, retrograde ejaculation, recatheterisation, persistent irritative symptoms or long-term mortality.

Table 4-49: Safety outcome results in the RCT comparing ThuVEP versus TURP

ThuVEP vs. TURP (Chang 2015; n=59; uncertain risk of bias)			
Outcome	**ThuVEP n=29**	**TURP n=30**	**p value; 95% CI**
Catheterisation time (days)	1.8	2.3	0.001; 95% CI n.a.
Decrease in serum sodium (mmol/l)	0.3	1.6	0.47; 95% CI n.a.
Urinary tract infection (%)	0	0	–
TUR syndrome (%)	0	0	–

Abbreviations: n.a.=not available.

ThuVEP versus HoLEP

See the section on HoLEP.

B-VEP

B-VEP was assessed in two RCTs (n=213) with TURP as the comparator in both.

B-VEP versus TURP

Two RCTs (Wang 2020 n=101; uncertain RoB; Zhang 2015, n=112; uncertain RoB) compared B-VEP versus TURP. Outcomes assessed in these studies are listed in Table 4-50. There were no data reported for bladder perforation, bladder or ureteral injury, capsular perforation, intraoperative mortality, TUR syndrome, bladder neck contracture, AUR, UTI, retrograde ejaculation, recatheterisation, persistent irritative symptoms or long-term mortality.

Table 4-50: Safety outcomes assessed in RCTs comparing B-VEP versus TURP

Study ID	Zhang 2015	Wang 2020
Intraoperative complications		
Transfusion requirement	x	
Decrease in serum sodium	x	

Study ID	Zhang 2015	Wang 2020
Postoperative complications		
Erectile dysfunction		x
IIEF (erectile dysfunction score) 3 months		x
IIEF (erectile dysfunction score) 6 months		x
Urinary incontinence	x	
Catheterisation time	x	
Urethral stricture	x	

Pooling of data was not possible for any of the outcomes. In Zhang 2015, decrease in serum sodium, catheterisation time, incontinence and urethral stricture at 3 months were reported (Table 4-51). Of these, catheterisation time was significantly shorter in the B-VEP group (49.3 vs. 78.1 h; p<0.001). There were no 95% CIs reported, which precluded assessment of the variability of the estimate.

Table 4-51: Safety outcome results in Zhang 2015 comparing B-VEP versus TURP

Outcome	B-VEP	TURP	p value; 95% CI
Catheterisation time (h)	49.3	78.1	<0.001; 95% CI n.a.
Urethral stricture	3.6%	8.9%	0.27; 95% CI n.a.
Urinary incontinence	5.4%	12.5%	0.18; 95% CI n.a.

Abbreviations: n.a.=not available.

4.4.2.5 Hybrid techniques: Vaporesection

TUVRP

TUVRP was assessed in five RCTs, comparing it to TURP for a total of 560 patients.

TUVRP versus TURP

Five RCTs (Dunsmsuir 2003, n=51; Geavlete 2010, n=155; Gupta 2006, n=100; Yip 2011, n=86; Yee 2015, n=168) compared these two technologies for the outcomes listed in the Table 4-52. No data were available for bladder perforation, erectile dysfunction, bladder neck contracture or retrograde ejaculation.

Table 4-52: Safety outcomes assessed in RCTs comparing TUVRP versus TURP

Study ID	Dunsmuir 2003	Yee 2015	Yip 2011	Geavlete 2010	Gupta 2006
Intraoperative complications					
Transfusion requirement	x (0 events)	x	x	x	x
Capsular perforation				x	x (0 events)
Decrease in serum sodium	x [a]		x		
Postoperative complications					
Urinary incontinence					x

Study ID	Dunsmuir 2003	Yee 2015	Yip 2011	Geavlete 2010	Gupta 2006
Catheterisation time	x	x	x	x	x
TUR syndrome		x			
Acute urinary retention				x	
Urinary tract infection				x	x
Recatheterisation	x		x		
Urethral stricture					x

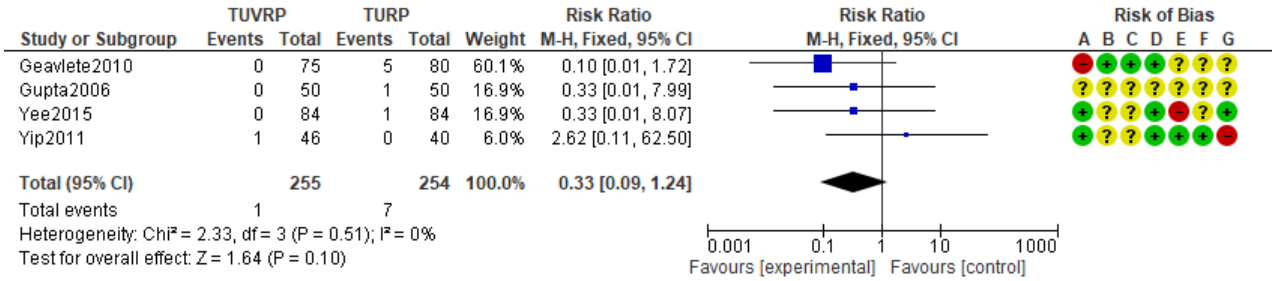
[a] Data could not be extrapolated.

Patients included in Geavlete 2010 had a prostate size in the 30–80 ml subgroup, whereas Yip 2011 and Yee 2015 included patients with an average prostate size of 61 ml (no inclusion criteria or range available), Dunsmuir 2003 included patients with a prostate size between 16 and 60 ml and Gupta 2006 included patients with a prostate size between 40 and 133 ml.

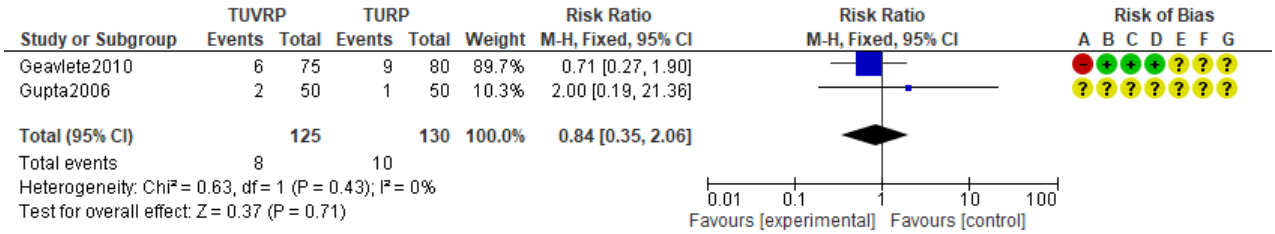
Pooling of data was possible for transfusion requirement, UTI and recatheterisation. No differences between the groups were found for these outcomes.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

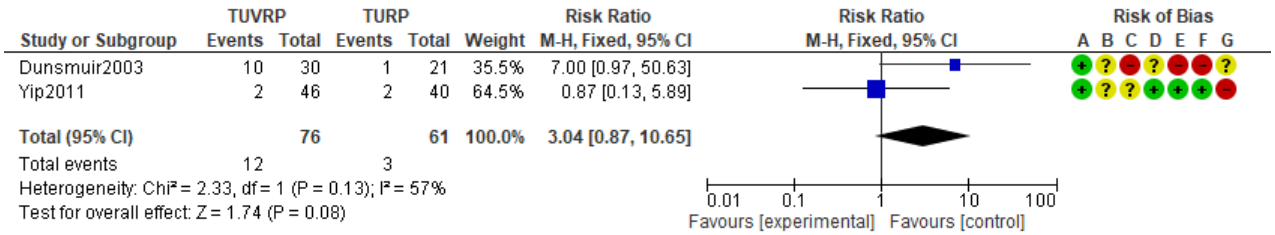
Transfusion requirement



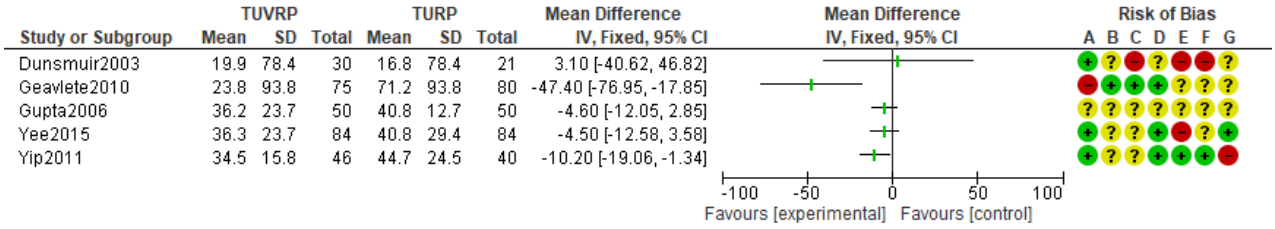
Urinary tract infection



Recatheterisation



Catheterisation time (h)



ThuVARP

ThuVARP was assessed in one RCT (Hashim 2020) comparing ThuVARP versus TURP for the outcomes TUR syndrome, urethral stricture, UTI, blood transfusion, catheter time, decrease in serum sodium, erectile dysfunction, reduced or no ejaculation and IIEF among 410 patients with a prostate size between 20 and 50 ml. No differences were reported for the outcomes assessed. Some 26% of the patients allocated to ThuVARP were eventually switched to TURP for several reasons (e.g., equipment issues, large prostate, bleeding, poor visibility) and 2% did not undergo TURP. A complete list of reasons for failure to undergo the randomised treatment is available in the supplementary appendix for the RCTl. [43]. No data were available for bladder perforation, bladder or ureteral injury, capsular perforation, urinary incontinence, bladder neck contracture, AUR or recatheterisation.

4.4.2.6 Hybrid techniques: Enucleoresection

B-TUERP

B-TUERP was assessed in two RCTs, including a total of 320 patients.

B-TUERP versus TURP

One RCT (Samir 2019, n=240; uncertain RoB) compared B-TUERP versus TURP among patients with a prostate size > 80 ml, assessing the outcomes listed in Table 4-53. Catheterisation time was shorter with B-TUERP than with TURP. Since 95% CIs were not available, it was not possible to assess the imprecision associated with the estimates reported.

No data were available for bladder perforation, bladder or ureteral injury, capsular perforation, bladder neck contracture, AUR, UTI, retrograde ejaculation or recatheterisation.

Table 4-53: Safety outcome results in Samir 2019 comparing B-TUERP versus TURP

Outcome	B-TUERP	TURP	p value
Catheterisation time (days)	43.9	54.0	<0.001
TUR syndrome (%)	0	0	–
Urinary incontinence (%)	1.9	2.7	–
Decrease in serum sodium (mmol/l)	1	1	0.59
Blood transfusion requirement (%)	4.2	5.0	0.76
Urethral stricture (%)	0.9	0	0.48

B-TUERP versus DioLEP

One RCT (Xu 2013, n=80; uncertain RoB) compared B-TUERP versus DioLEP among patients with an average prostate size of 67 ml (no range or inclusion criteria available), assessing the outcomes listed in Table 4-54. Catheterisation time was longer with B-TUERP than with DioLEP. Since 95% CIs were not available, it was not possible to assess the imprecision associated with the estimates reported.

No data were available for bladder perforation, bladder neck contracture, AUR, UTI, retrograde ejaculation, erectile dysfunction or recatheterisation.

Table 4-54: Safety outcome results in Xu 2013 comparing B-TUERP versus DioLEP

Outcome	B-TUERP	DioLEP	p-value
Catheterisation time (days)	46.7	27.5	<0.001
TUR syndrome (%)	0	0	–
Urinary incontinence (%)	10	7.5	0.69
Decrease in serum sodium (mmol/l)	4.3	3.0	0.12
Blood transfusion (%)	0	0	–
Urethral stricture (%)	0	0	–
Bladder injury (%)	0	0	–
Capsule perforation (%)	2.5	5.0	0.56

M-TUERP

M-TUERP was assessed in one RCT (Li 2018, n=86; high RoB) in a comparison versus TURP among 86 patients. Data were retrieved for blood transfusion requirement, decrease in serum sodium, urethral stricture, catheterisation time, urinary retention, recatheterisation and urinary incontinence. There were no data for bladder perforation, bladder or ureteral injury, capsular perforation, intraoperative mortality, erectile dysfunction, TUR syndrome, bladder neck contracture, AUR, UTI, retrograde ejaculation, persistent irritative symptoms or long-term mortality. The M-TUERP group had a significantly shorter catheterisation time and significantly lower rates of urinary retention, recatheterisation and blood transfusion requirement (Table 4-55). Lack of CIs precluded assessment of the variability of the estimates.

Table 4-55: Safety outcome results in Li 2018 comparing M-TUERP versus TURP

Outcome	M-TUERP	TURP	p value; 95% CI
Catheterisation time (h)	41.57	48.77	0.01; 95% CI n.a.
Decrease in serum sodium (mmol/l)	1.41	1.42	0.69; 95% CI n.a.
Dysuria/urinary retention	0%	11.4%	<0.001; 95% CI n.a.
Recatheterisation	0%	6.8%	<0.001; 95% CI n.a.
Urinary incontinence	0%	0%	–
Urethral stricture	2.4%	2.3%	0.95; 95% CI n.a.
Blood transfusion	0%	9.1%	<0.001; 95% CI n.a.

Abbreviations: n.a.=not available.

4.4.2.7 Aquablation

Aquablation was assessed in one RCT (WATER study), with four publications presenting results at different follow-up times for comparison to TURP among a total of 181 patients (Gilling 2018, 2019a, 2019b, 2020; uncertain RoB). Outcomes reported in these publications are listed in Table 4-56. No data were available for procedural blood loss, bladder or ureteral injury, capsular perforation, urinary incontinence, intraoperative mortality, decrease in serum sodium, recatheterisation, TUR syndrome and long-term mortality.

Table 4-56: Safety outcomes assessed in publications comparing Aquablation versus TURP

Study ID	Gilling 2018	Gilling 2019a	Gilling 2019b	Gilling 2020
Intraoperative complications				
Transfusion requirement	x			
Bladder perforation				x
Postoperative complications				
Erectile dysfunction		x		x
Urethral stricture	x			x
Bladder neck contracture		x	x	x
Acute urinary retention	x		x	x
Urinary tract infection	x	x	x	x
Retrograde ejaculation	x		x	x
Persistent irritative symptoms	x	x	x	x

Retrograde ejaculation was the only outcome for which there was a significant difference. This difference was observed at 100-day follow-up (7.1% vs. 23.1%; p=0.005, 95% CI not available) in favour of Aquablation; there was no statistical comparison of the cumulative data at 3 years (11.3% vs. 31.1%).

4.4.2.8 TUMT

TUMT was assessed in four RCTs, all of which were comparisons versus TURP (n=419).

TUMT versus TURP

Four studies including 419 patients (D'Ancona 1989, n=52; uncertain RoB; Dahlstrandt 1995, n=69; uncertain RoB; Wagrell 2002, n=154; high RoB, Floratos 2001, n=144; uncertain RoB) compared TUMT versus TURP. Only postoperative outcomes were assessed in these studies (Table 4-57). There were no data for intraoperative complications (transfusion requirement, procedural blood loss, bladder perforation, bladder or ureteral injury, capsular perforation, intraoperative mortality, decrease in serum sodium), retrograde ejaculation, recatheterisation or long-term mortality.

Table 4-57: Safety outcomes assessed in RCTs comparing TUMT versus TURP

Study ID	Dahlstrandt 1995	Floratos 2001	D'Ancona 1998	Wagrell 2002
Postoperative complications				
Erectile dysfunction	x (0 events)			x
Urinary incontinence				x
Catheterisation time			x [a]	x
TUR syndrome				x
Urethral stricture	x	x		
Bladder neck contracture		x		
Acute urinary retention	x			x
Urinary tract infection	x		x	x
Persistent irritative symptoms				x

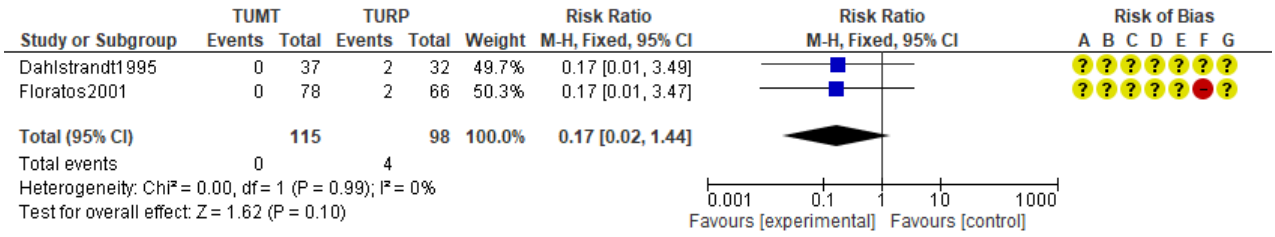
[a] Data could not be extrapolated.

Two studies used prostate volume of >30 ml (Floratos 2001) or 30–100 ml (Wagrell 2002) as an inclusion criterion. One study used prostate length as an inclusion criterion (Dahlstrandt 1995; 35–50 mm), while another study (D'Ancona 1998) used both prostate length (25–50 mm) and prostate volume (30–100 ml) to select patients. The mean prostate volume was similar in the three studies that reported this parameter (from 42 to 48.9 ml for TUMT and from 44 to 52.7 ml for TURP). Only one study reported the range for prostate volume (30–82 ml for TUMT and 31–86 ml for TURP).

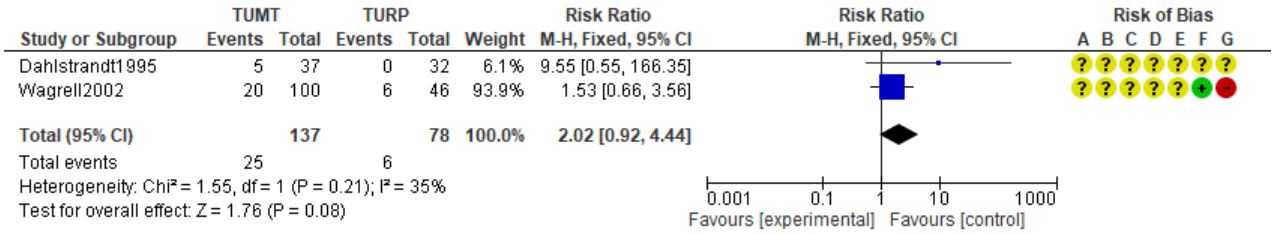
Pooling of data was possible for urethral stricture, AUR and UTI evaluated at 1 month in Dahlstrandt 1995 and at 36 months in Floratos 2001. No differences between the groups were observed for any outcome.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

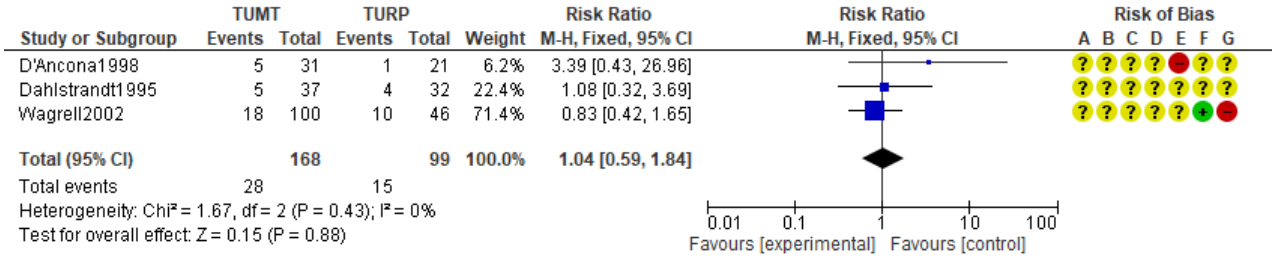
Urethral stricture



Acute urinary retention



Urinary tract infection



4.4.2.9 WAVE

WAVE was assessed in one RCT versus sham, including 197 patients with a prostate size of 30–80 ml, with the possibility for patients in the sham arm to cross over after 3 months. Multiple publications are available with results for follow-up at 3 months (before crossover), 12 months, and 2, 3 and 4 years (McVary 2016a, low RoB for the 3-month follow-up data, high RoB for the 12-month data; McVary 2016b low RoB for the 3-month data; Roehrborn 2017, high RoB; McVary 2018, high RoB; McVary 2019, high RoB). Outcomes assessed in these publications are listed in Table 4-58. The authors did not provide statistical comparisons. Data for intraoperative complications (transfusion requirement, procedural blood loss, bladder perforation, bladder or ureteral injury, capsular perforation, decrease in serum sodium), urethral stricture, bladder neck contracture, recatheterisation or long-term mortality were not reported. Three serious adverse events in two patients were reported: de novo urinary retention and nausea with vomiting due to sedative medication. Other nonserious procedural side effects were observed in 52 patients (38.2%). The most common side effects were dysuria (16.9%), haematuria (11.8%), haematospermia (7.4%), urinary frequency (5.9%), urgency (5.9%), urinary retention (3.7%), UTI (3.7%) and anejaculation (2.9%). These mild to moderate side effects were mostly resolved within 3 weeks. No late-occurring adverse events were reported at the 1-, 2-, 3-, and 4-year follow-up points. In the WAVE arm, 90.4% (122/135) of patients were catheterised for an average of 3.4±3.2 days. In the sham arm, 19.7% (12/61) of patients were catheterised for a mean of 0.9±0.8 days. Among patients treated with WAVE, there was an IIEF change of 0.1±7.4 points after 3 months, compared to –0.3±5.6 in the sham arm. This difference was not significant (p=0.795). Of the sexually active patients in the WAVE arm, 32% (29/90) achieved a clinically relevant difference after 3 months (difference of 2 points for patients with mild, 5 points for patients with moderate and 7 points for patients with severe erectile dysfunction).

Table 4-58: Safety outcomes assessed in publications comparing WAVE versus sham

Study ID	McVary 2016a, 2016b
Postoperative complications	
Erectile dysfunction	x
Urinary incontinence (frequency, urgency)	x
Acute urinary retention	x
Urinary tract infection	x
Retrograde ejaculation (anejaculation)	x
IIEF total score	x
Catheterisation time	x

4.4.2.10 Nonablative techniques

TUIP

TUIP was assessed in five RCTs in comparison to TURP (Abd-El Kader 2012, Dørflinger 1992, Jahnson 1998, Riehmann 1995, Tkocz 2002), including a total of 451 patients with a prostate size of <30 ml (except Jahnson 1998, which included patients with prostate size between 20 and 40 ml; the mean size was 26 ml). Outcomes assessed in these studies are listed in Table 4-59. No data were available for bladder perforation, bladder or ureteral injury, capsular perforation, decrease in serum sodium, TUR syndrome, AUR or UTI.

Table 4-59: Safety outcomes assessed in RCTs comparing TUIP versus TURP

Study ID	Abd-El Kader 2012	Dørflinger 1992	Jahnson 1998	Riehmann 1995	Tkocz 2002
Intraoperative complications					
Transfusion requirement	x	x	x		x (0 events)
Postoperative complications					
Erectile dysfunction	x	x			
Urinary incontinence					x
Catheterisation time	x	x [a]	x	x	
Urethral stricture	x	x			
Bladder neck contracture	x	x (0 events)			
Retrograde ejaculation	x	x		x	x
Recatheterisation		x			

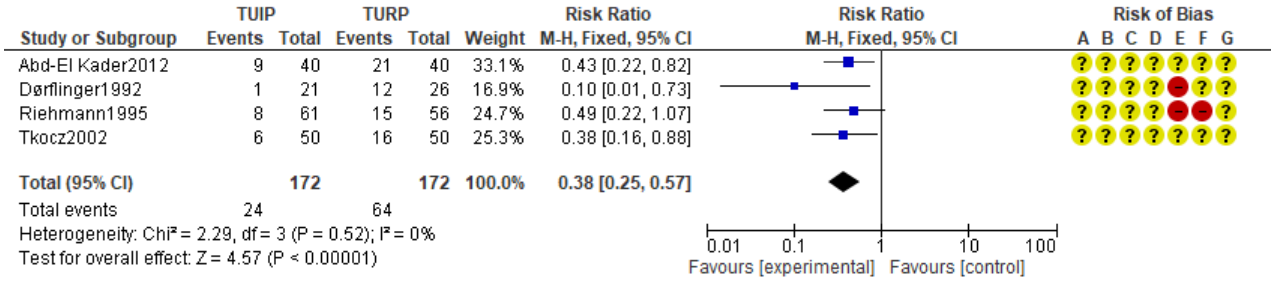
[a] Data could not be extrapolated.

Data could be pooled for retrograde ejaculation, transfusion requirement, urethral stricture and erectile dysfunction. A differences was found in favour of TUIP for retrograde ejaculation (RR 0.38, 95% CI 0.25–0.57; I^2=0%; high RoB); the quality of the evidence was judged as moderate (downgraded because of selective reporting in two studies). A difference with borderline significance was found for transfusion requirement (RR 0.18, 95% CI 0.03–1.01; I^2=0%; high RoB), whereas no differences were found between the groups for urethral stricture or erectile dysfunction. Catheterisation time was shorter for the TUIP group in both studies (MD of ~1 day).

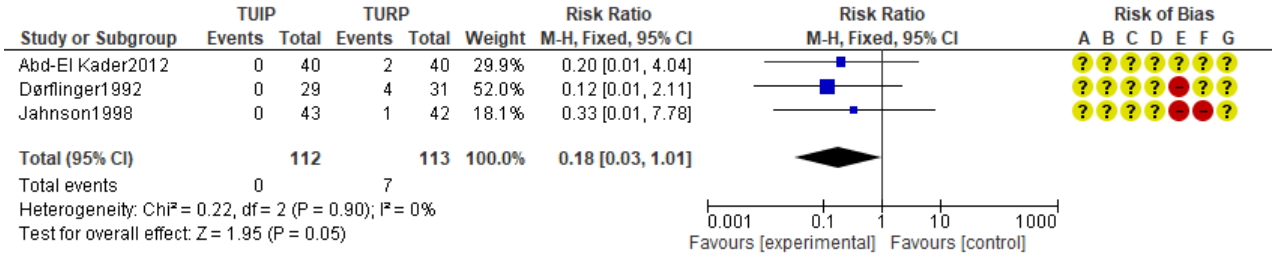
No data were available for bladder perforation, bladder or ureteral injury, capsular perforation, decrease in serum sodium, TUR syndrome, AUR or UTI.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

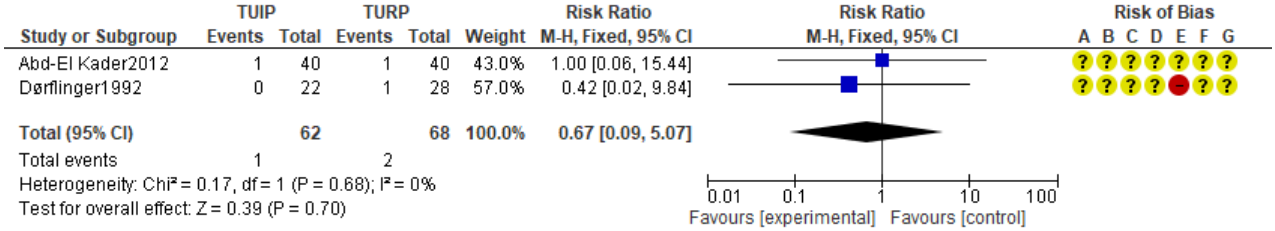
Retrograde ejaculation



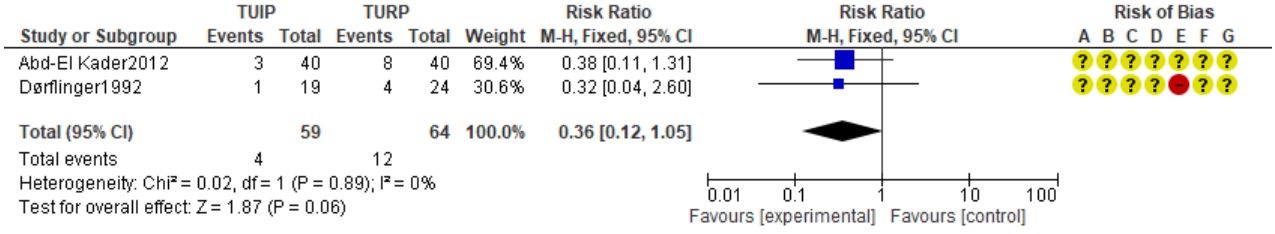
Transfusion requirement



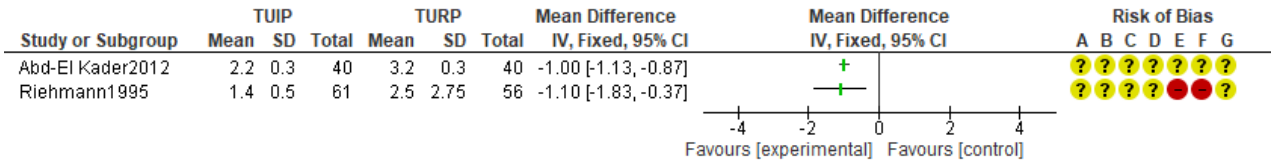
Urethral stricture



Erectile dysfunction



Catheterisation time (days)



TUIP + TURP

TUIP was also tested in association with TURP in two RCTs including a total of 164 patients, with TURP alone as the comparator.

TUIP + TURP versus TURP

TUIP + TURP were compared to TURP alone in Yeni 2002 (n=40) and Li 2013 (n=124) among patients with a small prostate (<25 ml in Yeni 2002 and between 20 and 40 ml in Li 2013), assessing the outcomes listed in Table 4-60. No data were available for bladder perforation, bladder or ureteral injury, capsular perforation, decrease in serum sodium, urinary incontinence, catheterisation time, AUR or recatheterisation.

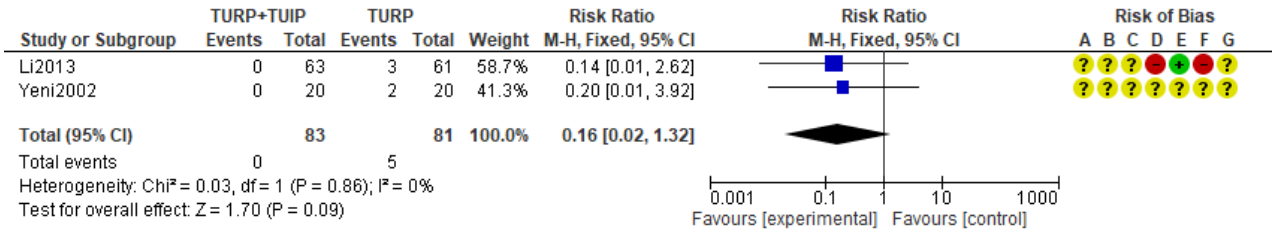
Table 4-60: Safety outcomes assessed in RCTs comparing TUIP + TURP versus TURP

Study ID	Li 2013	Yeni 2002
Intraoperative complications		
Transfusion requirement		x
Postoperative complications		
Erectile dysfunction		x
TUR syndrome		x
Urethral stricture	x	
Bladder neck contracture	x	x
Urinary tract infection	x	
Retrograde ejaculation		x

Among the outcomes assessed, only data for bladder neck contracture could be pooled, with five cases among 81 patients in the TURP arms and zero cases among 83 patients in the TUIP + TURP arms. This difference in incidence was not statistically significant. For the other outcomes, no differences were observed between the groups in either of the two studies.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

Bladder neck contracture



PAE

PAE was assessed in five RCTs: Abt 2018 (n=103; prostate size 25–80 ml), Carnevale 2016 (n=30; prostate size 32–97 ml), Gao (n=114; prostate size 20–100 ml), Insausti 2020 (n=45; average prostate size 60 ml) and Radwan 2020 (n=60; prostate size <100 ml). The five studies compared PAE versus TURP for the outcomes listed in Table 4-61 and included a total of 352 patients.

Table 4-61: Safety outcomes assessed in RCTs comparing PAE versus TURP

Study ID	Abt 2018	Insausti 2020	Radwan 2020	Carnevale 2016	Gau 2014
Intraoperative complications					
Transfusion requirement				x (0 events)	x
Postoperative complications					
Erectile dysfunction		x			
Urinary incontinence	x			x	
Catheterisation time	x		x [a]		
TUR syndrome			x (0 events)		x
Urethral stricture	x	x			x
Bladder neck contracture					x
Acute urinary retention	x	x	x		x
Urinary tract infection	x	x			x
Retrograde ejaculation	x	x		x	
Recatheterisation				x	

[a] Data could not be extrapolated.

Pooling of data was possible for urinary incontinence, urethral stricture, AUR and UTI. A difference in favour of PAE was found for urinary incontinence (RR 0.13, 95% CI 0.02–0.98; I^2=0%, high RoB) and UTI (RR 0.49, 95% CI 0.26–0.91; I^2=0%, high RoB). A difference in favour of TURP was found for AUR (RR 2.23, 95% CI 1.12–4.41; I^2=50%, high RoB). The quality of the evidence for these outcomes was judged a low because of RoB and imprecision.

Abt 2018 observed a shorter catheterisation time (by 2 days) and a trend towards lower incidence of ejaculatory dysfunction (56% vs. 84%; p=0.06) in the PAE group, although more than half of the patients in the PAE group suffered from this condition (highlighted by the study authors as an unexpected finding).

No data were available for inadvertent embolisation of other sites, vascular thrombosis, pseudoaneurysms, dissection, damage to perivascular, neural or muscular structures, radiodermatitis, transfusion requirement, bladder perforation, bladder or ureteral injury, capsular perforation, decrease in serum sodium, TUR syndrome, bladder neck contracture or recatheterisation.

Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
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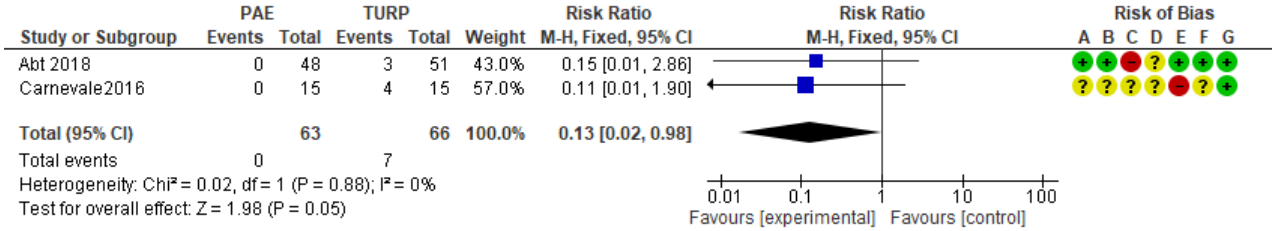
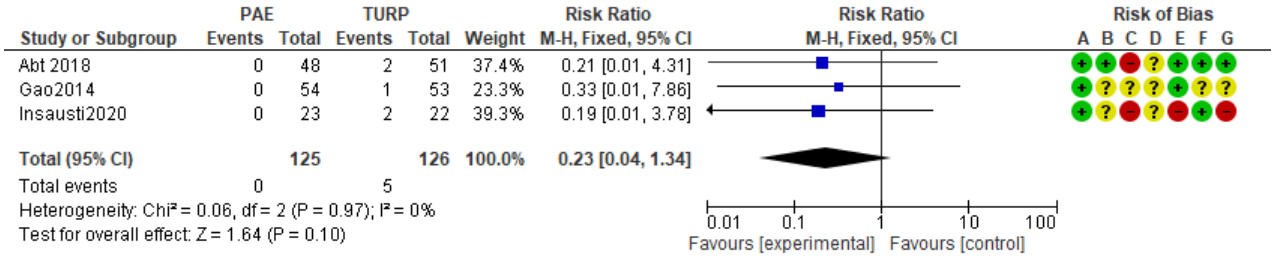
(F) Selective reporting (reporting bias)
(G) Other bias

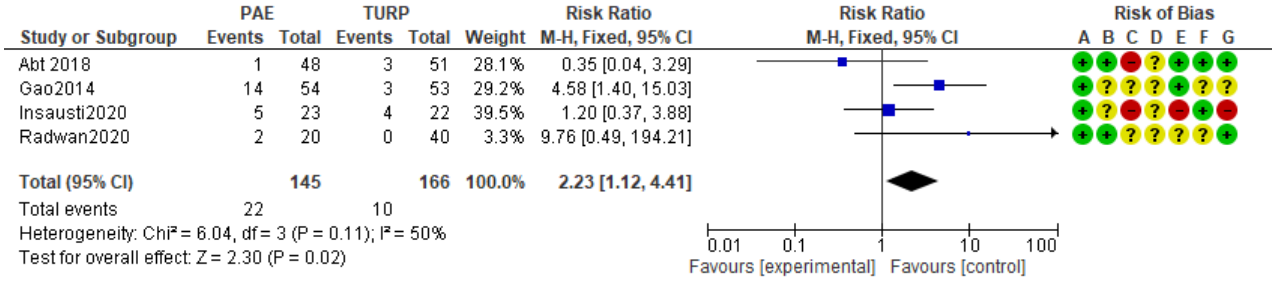
Urinary incontinence



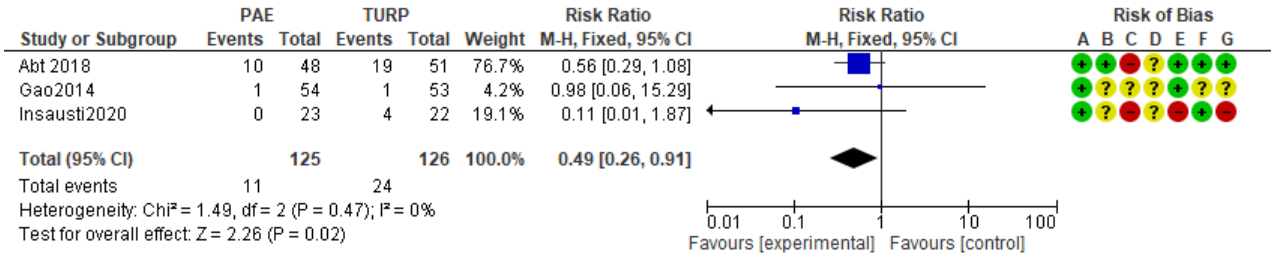
Urethral stricture



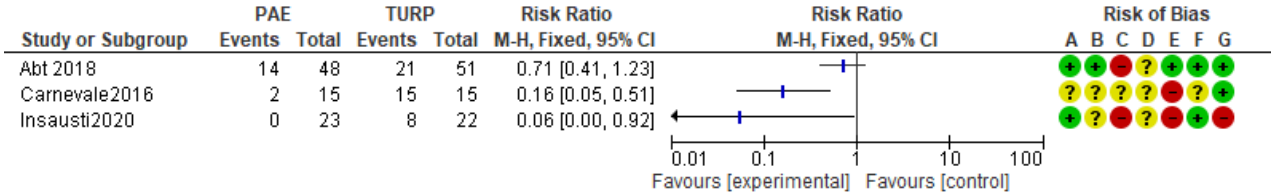
Acute urinary retention



Urinary tract infection



*Retrograde ejaculation**



*Notes: Abt2018: only sexually active: PAE 14/25=56%, TURP 21/25=84%; Carnevale2016: no mention of sexually active patients; Insausti2020: few patients had sexual relationships. All patients were asked about ejaculatory volume before and after interventions

PUL

PUL was assessed in two publications (Sonksen 2015, n=79; Gratzke 2017, n=80; high RoB) presenting results for different follow-up times for the same RCT comparing PUL versus TURP. The outcomes assessed are listed in Table 4-62. There were no data for bladder perforation, bladder or ureteral injury, capsular perforation, intraoperative mortality, decrease in serum sodium, catheterisation time, TUR syndrome, bladder neck contracture, recatheterisation or long-term mortality.

Table 4-62: Safety outcomes assessed in publications comparing PUL versus TURP

Study ID	Gratzke 2017	Sonksen 2015
Intraoperative complications		
Transfusion requirement		x
Postoperative complications		
Erectile dysfunction	x	x
Urinary incontinence	x	x
Urethral stricture		x
Acute urinary retention		x
Urinary tract infection		x
Retrograde ejaculation	x	x
Persistent irritative symptoms		x

This RCT included patients with prostate volume ≤60 ml. Only urinary incontinence (2% vs. 17%; p=0.04) and retrograde ejaculation (0% vs. 20%; p=0.002) significantly differed between the groups, in favour of PUL (Table 4-63). Since CIs were not available, it was not possible to assess the imprecision associated with these estimates.

Table 4-63: Results for safety outcomes in RCTs comparing PUL versus TURP

PUL vs. TURP (Sonksen 2015, n=79; Gratzke 2017, n=80; high risk of bias)			
Outcome	**PUL**	**TURP**	**p value; 95% CI**
Persistent irritative symptoms (%)	52	60	0.5; 95% CI n.a.
Urinary incontinence (%)	2	17	0.04; 95% CI n.a.
Acute urinary retention (%)	9	0	0.1; 95% CI n.a.
Retrograde ejaculation (%)	0	20	0.002; 95% CI n.a.
Erectile dysfunction (%)	0	9	0.08; 95% CI n.a.
Urethral stricture (%)	0	3	0.4; 95% CI n.a.
Urinary tract infection (%)I	7	6	0.9; 95% CI n.a.

Abbreviations: n.a.=not available.

5 OVERVIEW OF EFFECTIVENESS OUTCOMES

This section presents results for effectiveness outcomes by technology, with a synthesis of results for IPSS and Qmax at 6 and 12 months and for reintervention. Comments are provided on statistically significant differences, together with information on nonsignificant results.

IPSS at 6 months

- For 15 of the 21 technologies considered in this report, IPSS at 6 months was assessed using TURP as the comparator. B-TUEP, ThuLEP, B-TUVP and B-TUERP showed significantly better results than TURP, although the estimates and CIs are below the MCID threshold. The quality of the related evidence is low to very low.
- Conversely, TUMT and PAE showed significantly worse results for this outcome in comparison to TURP, although the estimates and CIs are below the MCID threshold. The quality of the related evidence is moderate.
- No differences in IPSS at 6 months were observed for the remaining ten comparisons versus TURP; the quality of the related evidence is low to very low, except for one comparison (DioLEP vs. TURP: moderate).
- Among seven comparisons between newer technologies, no significant differences were observed for this outcome. The quality of the evidence is low to very low.

Table 5-1: IPSS at 6 months: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
B-TUEP	VL	VL		L			L	VL	
HoLEP	L			VL			L		
DioLEP	M		L		L				L
B-TUVP	L	VL			VL	VL			
PVP								VL	
ThuLEP	L		VL		L				
DioLVP	VL								
TUVRP	VL								
Aquablation	L								
TUMT	M								
PUL	VL								
TmLRP	L								
B-TUERP	L						L		
PAE	VL								
B-VEP	L								
TURP + TUIP	L								

Key to quantitative differences

- Intervention statistically significantly better than control (CI crossing MCID)
- Intervention statistically significantly better than control (CI below MCID)
- No difference
- Intervention statistically significantly worse than control (CI below MCID)
- Intervention statistically significantly worse than control (CI crossing MCID)

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	RoB, indirectness, imprecision
B-TUEP	OP	RoB, indirectness, imprecision
B-TUEP	ThuLEP	Single RCT (imprecision)
B-TUEP	DioLEP	Indirectness, RoB
B-TUEP	B-TUVP	Single RCT (imprecision), RoB
B-TUERP	TURP	Single RCT (imprecision)
B-TUVP	TURP	Inconsistency, indirectness
B-TUVP	OP	Single RCT (imprecision), RoB
B-TUVP	PVP	Single RCT (imprecision), RoB
B-VEP	TURP	Single RCT (imprecision)
DioLEP	TURP	Imprecision
DioLEP	B-TUERP	Single RCT (imprecision)
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	ThuLEP	Indirectness, inconsistency, rob
HoLEP	TURP	Inconsistency, indirectness
HoLEP	DioLEP	Single RCT (imprecision)
PAE	TURP	Single RCT (imprecision), RoB
PUL	TURP	Single RCT (imprecision), RoB
ThuLEP	TURP	Indirectness, RoB
TmLRP	TURP	Single RCT (imprecision)
TUMT	TURP	RoB
TURP + TUIP	TURP	Imprecision (pooling not possible); RoB
TUVRP	TURP	Imprecision, RoB, inconsistency

IPSS at 12 months

- For 14 of the 21 technologies in this report, IPSS at 12 months was assessed using TURP as the comparator. Only HoLEP showed a statistically significant better result for IPSS at 12 months, although its estimate and CI are below the MCID threshold. The quality of the related evidence is very low.
- PVP, DioLVP, TUMT and PUL showed statistically significant worse results for this outcome compared to TURP, although this result could be clinically relevant only for PUL (CI crossing the MCID). The quality of the related evidence is low to very low.
- No differences were shown for the remaining eight comparisons; the quality of the related evidence is low to very low, except for one comparison (B-TUVP vs. TURP: moderate)
- Among nine comparisons between newer technologies, a statistically significant difference was evident in favour of HoLEP versus PVP, a result that could be clinically relevant (CI crossing the MCID). The quality of the related evidence is low to very low, except for one comparison (B-TUEP vs. DioLEP: moderate).

Table 5-2: IPSS at 12 months: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
B-TUEP	VL	VL	L	L			M	VL	
HoLEP	VL			VL	L	L	VL		
DioLEP			VL		M				L
B-TUVP	M	VL			VL	L			
PVP	VL		L					L	
ThuLEP	L		VL		L				
DioLVP	VL								
TUVRP	L								
ThuVARP	VL								
Aquablation	L								
TUMT	L								
TUIP	L								
PUL	VL								
TmLRP	L								
B-TUERP							L		.

Key to quantitative differences

- Intervention statistically significantly better than control (CI crossing MCID)
- Intervention statistically significantly better than control (CI below MCID)
- No difference
- Intervention statistically significantly worse than control (CI below MCID)
- Intervention statistically significantly worse than control (CI crossing MCID)

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	RoB, indirectness, imprecision
B-TUEP	DioLEP	Indirectness
B-TUEP	ThuLEP	Single RCT (imprecision)
B-TUEP	B-TUVP	Single RCT (imprecision), RoB
B-TUERP	DioLEP	Single RCT (imprecision)
B-TUVP	TURP	Imprecision
B-TUVP	OP	Single RCT (imprecision), RoB
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	ThuLEP	Indirectness, inconsistency, RoB
HoLEP	PVP	Imprecision, indirectness
HoLEP	TURP	Inconsistency, indirectness, RoB
HoLEP	B-TUEP	Indirectness, RoB

Intervention	Control	Reason
HoLEP	DioLEP	Single RCT (imprecision)
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	Imprecision, indirectness, RoB
PVP	B-TUVP	Single RCT (imprecision)
ThuLEP	TURP	Indirectness, RoB
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Single RCT (imprecision)
TUIP	TURP	RoB, imprecision
TUMT	TURP	RoB, inconsistency
TUVRP	TURP	Imprecision, RoB

Qmax at 6 months

- Fifteen of the 21 technologies in this report assessed Qmax at 6 months using TURP as the comparator. B-TUVP and the combination of TUIP plus TURP showed statistically significant better results for this outcome versus TURP, with CIs crossing the MCID threshold. The quality of the related evidence is low to very low.
- TUMT, PUL and PAE showed statistically significant worse results for this outcome compared to TURP, with CIs crossing the MCID threshold. The quality of the related evidence is very low.
- No differences were shown for the remaining eleven comparisons versus TURP; the quality of the related evidence is low to very low, except for one comparison (DioLEP vs. TURP: moderate)
- Among seven comparisons between newer technologies, one statistically significant difference was shown in favour of B-TUEP versus B-TUVP; the quality of evidence for this comparison is very low and the CI crosses the MCID threshold. The quality of evidence for the other comparisons is low to very low.

Table 5-3: Qmax at 6 months: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
B-TUEP	VL	VL		L			L	VL	
HoLEP	L			VL			L		
DioLEP	M		L		L				L
B-TUVP	L	VL			VL	VL			
PVP								VL	
ThuLEP	L		VL		L				
DioLVP	VL								
TUVRP	VL								
Aquablation	L								
TUMT	VL								
TUIP + TURP	VL								

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
PUL	VL								
TmLRP	L								
B-TUERP	L						L		
PAE	VL								
B-VEP	L								

Key to quantitative differences

- Intervention statistically significantly better than control (CI crossing MCID)
- Intervention statistically significantly better than control (CI below MCID)
- No difference
- Intervention statistically significantly worse than control (CI below MCID)
- Intervention statistically significantly worse than control (CI crossing MCID)

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	RoB, indirectness, imprecision
B-TUEP	DioLEP	Indirectness, imprecision
B-TUEP	ThuLEP	Single RCT (imprecision)
B-TUEP	B-TUVP	Single RCT (imprecision), RoB
B-TUERP	TURP	Single RCT (imprecision)
B-TUERP	DioLEP	Single RCT (imprecision)
B-TUVP	TURP	Indirectness, inconsistency
B-TUVP	OP	Single RCT (imprecision), RoB
B-VEP	TURP	Single RCT (imprecision)
DioLEP	TURP	Imprecision
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	ThuLEP	Indirectness, inconsistency, rob
HoLEP	TURP	Inconsistency, indirectness
HoLEP	DioLEP	Single RCT (imprecision)
PAE	TURP	Single RCT (imprecision), RoB
PUL	TURP	Single RCT (imprecision), RoB
PVP	B-TUVP	Single RCT (imprecision), RoB
ThuLEP	TURP	Indirectness, RoB
TmLRP	TURP	Single RCT (imprecision)
TUMT	TURP	RoB, inconsistency, imprecision
TUVRP	TURP	Imprecision, RoB, inconsistency

Qmax at 12 months

- Thirteen of the 21 technologies in this report assessed Qmax at 6 months using TURP as the comparator. Only HoLEP showed a statistically significant better result versus TURP, although the estimate and its CI are below the MCID threshold. The quality of the related evidence is low.
- DioLVP, ThuVARP, TUMT, TUIP and PUL showed statistically significant worse results for this outcome compared to TURP, with CIs crossing the MCID threshold (except for DioLVP). The quality of the related evidence is low to very low.
- No differences were shown for the remaining seven comparisons versus TURP; the quality of the related evidence is low to very low, except for one comparison (B-TUVP vs. TURP: moderate).
- Among nine comparisons between newer technologies, statistically significant differences were shown in favour of B-TUEP versus HoLEP and versus B-TUVP (with estimate and CI below the MCID threshold) and in favour of HoLEP versus PVP (with estimate and CI crossing the MCID threshold). The quality of evidence for these and for the other comparisons is low to very low.

Table 5-4: Qmax at 12 months: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
B-TUEP	VL	VL	L	L			L	VL	
HoLEP	L			VL	L	L	L		
DioLEP			L		L				L
B-TUVP	M	VL			VL	L			
PVP	VL		L					L	
ThuLEP	L		VL		L				
DioLVP	VL								
TUVRP	L								
ThuVARP	VL								
Aquablation	L								
TUMT	L								
TUIP	L								
PUL	VL								
TmLRP	L								
B-TUERP							L		

Key to quantitative differences

- Intervention statistically significantly better than control (CI crossing MCID)
- Intervention statistically significantly better than control (CI below MCID)
- No difference
- Intervention statistically significantly worse than control (CI below MCID)
- Intervention statistically significantly worse than control (CI crossing MCID)

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	RoB, indirectness, imprecision
B-TUEP	DioLEP	Indirectness, imprecision
B-TUEP	ThuLEP	Single RCT (imprecision)
B-TUEP	B-TUVP	Single RCT (imprecision), RoB
B-TUERP	DioLEP	Single RCT (imprecision)
B-TUVP	TURP	Imprecision
B-TUVP	OP	Single RCT (imprecision), RoB
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	TURP	Indirectness, RoB
HoLEP	ThuLEP	Indirectness, inconsistency, RoB
HoLEP	PVP	Inconsistency, indirectness
HoLEP	B-TUEP	Indirectness, RoB
HoLEP	DioLEP	Single RCT (imprecision)
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	Imprecision, indirectness, RoB
PVP	B-TUVP	Single RCT (imprecision)
ThuLEP	TURP	Indirectness, RoB
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Single RCT (imprecision)
TUIP	TURP	RoB, imprecision
TUMT	TURP	RoB, inconsistency
TUVRP	TURP	Imprecision, RoB

Reintervention

- Seven of the 21 technologies in this report assessed reintervention using TURP as the comparator. Only HoLEP showed a statistically significant better result for this outcome, although the quality of the related evidence is very low.
- Conversely, TUIP showed a statistically significant worse result for this outcome compared to TURP, although the quality of the related evidence is low. No differences were shown for the remaining five comparisons; the quality of the related evidence is low to very low
- There is only one comparison between newer technologies, showing a statistically significant difference in favour of HoLEP versus PVP. The quality of the related evidence is low.

Table 5-5: Reintervention: comparisons available, results and quality of evidence

Intervention	Control		
	TURP	**HoLEP**	**PVP**
HoLEP	VL		L
B-TUVP	VL		
PVP	L	L	
DioLVP	VL		
TUMT	L		
TUIP	L		
TmLRP	L		

Key to quantitative differences

- Intervention statistically significantly better than control
- No difference
- Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
B-TUVP	TURP	Inconsistency, imprecision, RoB
DioLVP	TURP	Imprecision, indirectness, RoB
HoLEP	TURP	Inconsistency, indirectness, imprecision
HoLEP	PVP	Imprecision, indirectness
PVP	TURP	Indirectness, RoB
TmLRP	TURP	Single RCT
TUIP	TURP	RoB, imprecision
TUMT	TURP	RoB, imprecision

6 OVERVIEW OF SAFETY OUTCOMES

This section presents results for some of the critical safety outcomes by technology. A synthesis of results for erectile dysfunction, retrograde ejaculation, transfusion requirement, UTI, urethral stricture and urinary incontinence is provided. Comments are provided regarding statistically significant differences, together with information on nonsignificant results.

Erectile dysfunction

- Fifteen of the 21 technologies in this report assessed erectile dysfunction using TURP as the comparator. Only ThuLEP showed a statistically significant better result versus TURP for this outcome; the quality of the related evidence is low.
- No differences were shown for the remaining 14 comparisons versus TURP; the quality of the related evidence is low to very low, except for HoLEP versus TURP (moderate).
- Three comparisons between newer technologies are available and showed no statistically significant differences with low to very low quality of evidence.

Table 6-1: Erectile dysfunction: comparisons available, results and quality of evidence

Intervention	Control					
	TURP	HoLEP	B-TUEP	PVP	DioLEP	B-TUVP
B-TUEP	VL				VL	
HoLEP	M			L		
DioLEP			VL			
B-TUVP	VL			VL		
PVP	VL	L				VL
ThuLEP	L					
DioLVP	VL					
ThuVARP	VL					
TUMT	L					
PAE	VL					
Aquablation	L					
TUIP	L					
TUIP + TURP	L					
PUL	VL					
TmLRP	L					
B-VEP	L					

Key to quantitative differences

- Intervention statistically significantly better than control
- No difference
- Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	Imprecision, RoB, indirectness
B-TUEP	DioLEP	Indirectness, RoB, imprecision
B-TUVP	TURP	Wide imprecision (pooling not possible; 1 trial with 0 events), RoB
B-VEP	TURP	Single RCT (imprecision)
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	TURP	Imprecision
HoLEP	PVP	Imprecision, two studies, pooling not possible
PAE	TURP	Single RCT (imprecision), RoB
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	RoB, indirectness, imprecision
PVP	B-TUVP	Single RCT (imprecision), RoB
ThuLEP	TURP	Single RCT (imprecision)
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Single RCT (imprecision)
TUIP	TURP	RoB, imprecision
TUIP + TURP	TURP	Single RCT (imprecision)
TUMT	TURP	Wide imprecision (pooling not possible; 1 trial with 0 events)

Retrograde ejaculation

- Twelve of the 21 technologies in this report assessed retrograde ejaculation using TURP as the comparator. TUIP, Aquablation and PUL showed statistically significant better results versus TURP for this outcome. The quality of evidence is moderate (TUIP vs. TURP) to very low (PUL vs. TURP).
- Conversely, HoLEP showed a statistically significant worse result for this outcome compared to TURP. The quality of the related evidence is low.
- No differences were shown for the remaining eight comparisons; the quality of the related evidence is low to very low, except for B-TURP versus TURP, and TmLRP versus TURP (moderate).
- Four comparisons between newer technologies are available. PVP showed a statistically significant better result versus HoLEP, with low quality of evidence. The quality of evidence is low to very low for the other three comparisons.

Table 6-2: Retrograde ejaculation: comparisons available, results and quality of evidence

Intervention	Control					
	TURP	HoLEP	B-TUEP	PVP	DioLEP	B-TUVP
B-TUEP	VL				VL	
HoLEP	L			L	L	
DioLEP		L	VL			
B-TUVP	M			VL		

Intervention	Control					
	TURP	HoLEP	B-TUEP	PVP	DioLEP	B-TUVP
PVP	L	L				VL
ThuLEP	L					
ThuVARP	VL					
Aquablation	L					
TUIP	M					
TUIP + TURP	L					
PAE	VL					
PUL	VL					
TmLRP	M					

Key to quantitative differences

Intervention statistically significantly better than control
No difference
Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT, wide difference but no confidence interval (imprecision)
B-TUEP	TURP	Single RCT (imprecision), RoB
B-TUEP	DioLEP	Indirectness, RoB, inconsistency
B-TUVP	TURP	RoB
HoLEP	TURP	Imprecision (pooling not possible)
HoLEP	DioLEP	Single RCT (imprecision)
HoLEP	PVP	Single RCT (imprecision)
PAE	TURP	Two RCTs, statistical assessment not available
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	Imprecision (pooling not possible)
PVP	B-TUVP	Limited data from two RCTs that could not be pooled
ThuLEP	TURP	RoB, imprecision
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Imprecision
TUIP	TURP	RoB
TUIP + TURP	TURP	Single RCT (imprecision)

Transfusion requirement

- Sixteen of the 21 technologies in this report assessed transfusion requirement using TURP as the comparator. HoLEP, B-TUVP, ThuLEP, PVP and M-TUERP showed statistically significant better results versus TURP for this outcome. The quality of evidence is moderate for HoLEP, B-TUVP and ThuLEP versus TURP, low for PVP versus TURP, and very low for M-TUERP versus TURP.
- No differences were shown for the remaining eleven comparisons; the quality of the related evidence is low to very low (very low in most cases).
- Eight comparisons between newer technologies are available. ThuLEP showed statistically significant better results versus HoLEP, with very low quality of evidence. Other comparisons did not show statistically significant differences, with low to very low quality of evidence (very low in most cases).

Table 6-3: Transfusion requirement: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	OP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	B-TUERP
B-TUEP	VL	VL		VL			VL	VL	
HoLEP	M			VL		VL	L		
DioLEP	VL		L		VL				VL
B-TUVP	M	VL			VL	VL			
PVP	L		VL					VL	
ThuLEP	M		VL		VL				
DioLVP	VL								
TUVRP	L								
ThuVARP	VL								
Aquablation	VL								
TUIP	L								
TUIP + TURP	VL								
TmLRP	VL								
B-TUERP	L						VL		
M-TUERP	VL								
B-VEP	VL								

Key to quantitative differences

- Intervention statistically significantly better than control
- No difference
- Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Wide imprecision (1 trial with 1 event)
B-TUEP	TURP	Imprecision, RoB, rare events
B-TUEP	DioLEP	Wide imprecision (1 RCT with 1 event)
B-TUEP	ThuLEP	Single RCT (imprecision), RoB
B-TUEP	B-TUVP	Single RCT (imprecision), RoB
B-TUEP	OP	Single RCT (imprecision), RoB
B-TUERP	DioLEP	Single RCT with zero events
B-TUERP	TURP	Single RCT (imprecision)
B-TUVP	TURP	Imprecision
B-TUVP	OP	Single RCT (imprecision), RoB
B-VEP	TURP	Wide imprecision (1 RCT with 3 events)
DioLEP	TURP	Zero events
DioLVP	TURP	RoB, inconsistency, imprecision
HoLEP	TURP	RoB
HoLEP	DioLEP	Single RCT (imprecision)
HoLEP	ThuLEP	Imprecision (pooling not possible; 1 trial with 0 events, another one with just 2 events)
HoLEP	PVP	Wide imprecision (pooling not possible; 1 trial with 0 events, 1 trial with just 1 event)
M-TUERP	TURP	Single RCT (imprecision), RoB
PVP	TURP	RoB, indirectness
PVP	B-TUVP	Wide imprecision (1 RCT with 1 event)
ThuLEP	TURP	Imprecision
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Wide imprecision (pooling not possible; 1 trial with 0 events, 1 trial with just 2 events)
TUIP	TURP	RoB, imprecision
TUIP + TURP	TURP	Single RCT, zero events
TUVRP	TURP	Imprecision, RoB

Urinary tract infection

- Sixteen of the 21 technologies in this report assessed UTI using TURP as the comparator. HoLEP and PAE showed statistically significant better results versus TURP for this outcome. The quality of evidence is moderate for HoLEP versus TURP and low for PAE versus TURP.
- Conversely, PVP showed a statistically significant worse result for this outcome in comparison to TURP. The quality of the related evidence is low.
- No differences were shown for the remaining 13 comparisons; the quality of the related evidence is low to very low, except for B-TUVP versus TURP (moderate).
- Seven comparisons between newer technologies are available and did not show any statistically significant differences, with low to very low quality of evidence.

Table 6-4: Urinary tract infection: comparisons available, results and quality of evidence

Intervention	Control						
	TURP	HoLEP	ThuLEP	B-TUEP	PVP	ThuVEP	DioLEP
B-TUEP	VL	L	VL				VL
HoLEP	M		L	L	VL	VL	L
DioLEP	VL	L		VL			
B-TUVP	M						
PVP	L	VL					
ThuVEP	VL	VL					
ThuLEP	L	L		VL			
DioLVP	VL						
TUVRP	L						
ThuVARP	VL						
Aquablation	L						
TUMT	L						
TUIP + TURP	VL						
PUL	VL						
TmLRP	L						
PAE	L						

Key to quantitative differences

Intervention statistically significantly better than control
No difference
Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT (imprecision)
B-TUEP	TURP	Imprecision, RoB, indirectness
B-TUEP	DioLEP	Single RCT (imprecision), RoB
B-TUEP	ThuLEP	Single RCT (imprecision), RoB
B-TUVP	TURP	Imprecision
DioLEP	TURP	Single RCT, rare event
DioLVP	TURP	Data from a single RCT (pooling not possible), RoB
HoLEP	TURP	Imprecision
HoLEP	B-TUEP	RoB, imprecision
HoLEP	DioLEP	Single RCT (imprecision)
HoLEP	ThuLEP	Single RCT (imprecision)
HoLEP	ThuVEP	Single RCT, just two events (imprecision)
HoLEP	PVP	Imprecision, very rare events

Intervention	Control	Reason
PAE	TURP	RoB, imprecision
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	RoB, indirectness
ThuLEP	TURP	RoB, imprecision
ThuVARP	TURP	Single RCT (imprecision), RoB
ThuVEP	TURP	Single RCT, no cases
TmLRP	TURP	Single RCT (imprecision)
TUIP + TURP	TURP	Single RCT (imprecision), RoB
TUMT	TURP	Imprecision, RoB
TUVRP	TURP	Imprecision, RoB

Urethral stricture

- Nineteen of the 21 technologies in this report assessed urethral stricture using TURP as the comparator. No statistically significant differences were shown. The quality of evidence is low to very low.
- Eight comparisons between newer technologies are available and showed no statistically significant differences, with very low quality of evidence (except for HoLEP vs. ThuLEP: low).

Table 6-5: Urethral stricture: comparisons available, results and quality of evidence

Intervention	Control								
	TURP	HoLEP	ThuLEP	B-TUEP	PVP	DioLEP	B-TUVP	DioLVP	B-TUERP
B-TUEP	VL	VL	VL			VL			
HoLEP	L		L	VL		VL			
DioLEP	VL	VL		VL					VL
B-TUVP	L				VL			VL	
PVP	VL						VL		
ThuLEP	L	L		VL					
DioLVP	VL						VL		
TUVRP	VL								
ThuVARP	VL								
Aquablation	VL								
TUMT	L								
TUIP	VL								
TUIP + TURP	VL								
PUL	VL								
TmLRP	L								
B-TUERP	VL					VL			
M-TUERP	VL								
B-VEP	L								
PAE	VL								

Key to quantitative differences

Intervention statistically significantly better than control

No difference

Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
Aquablation	TURP	Single RCT, rare event
B-TUEP	TURP	Imprecision, RoB, indirectness
B-TUEP	DioLEP	Single RCT, rare event
B-TUEP	ThuLEP	Single RCT (imprecision), RoB
B-TUERP	DioLEP	Single RCT, zero events
B-TUERP	TURP	Single RCT, rare event
B-TUVP	TURP	Imprecision, RoB
B-TUVP	DioLVP	Single RCT (imprecision), RoB
B-VEP	TURP	Single RCT (imprecision)
DioLEP	TURP	Imprecision, two studies not possible to pool, rare event
DioLVP	TURP	Data from a single RCT
HoLEP	TURP	RoB, imprecision
HoLEP	B-TUEP	Single RCT, zero events
HoLEP	DioLEP	Single RCT, rare event
HoLEP	ThuLEP	RoB, imprecision
M-TUERP	TURP	Single RCT (imprecision), RoB
PAE	TURP	RoB, imprecision, rare event
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	Single RCT, rare event
PVP	B-TUVP	Single RCT, rare event
ThuLEP	TURP	RoB, imprecision
ThuVARP	TURP	Single RCT (imprecision), RoB
TmLRP	TURP	Imprecision
TUIP	TURP	RoB, imprecision, rare event
TUIP + TURP	TURP	Single RCT, rare event
TUMT	TURP	Imprecision, RoB
TUVRP	TURP	Single RCT, rare event

Urinary incontinence

- Fifteen of the 21 technologies in this report assessed incontinence using TURP as the comparator. Only PUL showed significantly better results for this outcome versus TURP, with very low quality of evidence.
- Conversely, B-TUEP, HoLEP and PVP showed significantly worse results for this outcome versus TURP. The quality of the related evidence is low for HoLEP and PVP versus TURP to very low for B-TUEP versus TURP.
- No differences were found for the remaining eleven comparisons; the quality of the related evidence is low to very low, except for TmLRP versus TURP (moderate).
- There are nine comparisons between newer technologies. ThuLEP showed significantly better results for this outcome versus HoLEP, with low quality of evidence. Other comparisons do not show any statistically significant differences, with low to very low quality of evidence.

Table 6-6: Urinary incontinence: comparisons available, results and quality of evidence

	Control								
Intervention	**TURP**	**HoLEP**	**ThuLEP**	**B-TUEP**	**PVP**	**ThuVEP**	**DioLEP**	**B-TUVP**	**B-TUERP**
B-TUEP	VL	L	VL				L		
HoLEP	L		L	L	VL	L	L		
DioLEP	L	L		L					L
B-TUVP	L				VL				
PVP	L	VL						VL	
ThuVEP		L							
ThuLEP	L	L		VL					
DioLVP	VL								
TUVRP	VL								
TUMT	L								
PAE	L								
PUL	VL								
TmLRP	M								
B-TUERP	L						L		
M-TUERP	VL								
B-VEP	L								

Key to quantitative differences

- Intervention statistically significantly better than control
- No difference
- Intervention statistically significantly worse than control

Abbreviations:

H=high
M=moderate
L=low
VL=very low

Note: Comparison of each technology (intervention, left column) by row to the other technologies (control, other columns). The colours denote the quantitative difference for each comparison, as shown in the key. Letters denote the quality of the evidence.

Reasons for downgrading of evidence

Intervention	Control	Reason
B-TUEP	TURP	Imprecision, RoB, indirectness
B-TUEP	DioLEP	Indirectness, RoB
B-TUEP	ThuLEP	Single RCT (imprecision), RoB
B-TUERP	DioLEP	Single RCT (imprecision)
B-TUERP	TURP	Single RCT (imprecision)
B-TUVP	TURP	Imprecision, rare event
B-VEP	TURP	Single RCT (imprecision)
DioLEP	TURP	Imprecision, two studies not possible to pool
DioLVP	TURP	Single RCT (imprecision), RoB
HoLEP	TURP	RoB, imprecision
HoLEP	B-TUEP	RoB, imprecision
HoLEP	DioLEP	Single RCT (imprecision)
HoLEP	ThuLEP	RoB, imprecision
HoLEP	ThuVEP	Single RCT (imprecision)
HoLEP	PVP	Imprecision, two studies not possible to pool
M-TUERP	TURP	Single RCT (imprecision), RoB
PAE	TURP	RoB, imprecision
PUL	TURP	Single RCT (imprecision), RoB
PVP	TURP	RoB, indirectness
PVP	B-TUVP	Single RCT, rare event
ThuLEP	TURP	RoB, imprecision
TmLRP	TURP	Imprecision
TUMT	TURP	Single RCT (imprecision)
TUVRP	TURP	Two RCTs, not possible to pool

7 DISCUSSION

BPH is a common nonmalignant urological condition that involves progressive proliferation of glandular epithelium, smooth muscle and connective tissue in the transition zone of the prostate. In a large proportion of BPH patients, prostate enlargement causes BOO, which has an adverse impact on urinary tract function, resulting in LUTS. On average, approximately one in four men are likely to develop BPH over their lifetime. Bothersome LUTS occur in up to 30% of men older than 65 years, of whom one-quarter will develop severe LUTS. As many as 30% of those who develop BPH receive treatment for the condition.

BPH is associated with high personal and societal burdens, both directly through increased medical costs and indirectly because of losses in daily functioning, in addition to a negative impact on QoL for patients and their partners. According to the latest World Health Organization estimates for the European region, BPH was responsible for 0.25% of the total DALYs caused by all conditions.

The most common indication for surgical intervention is moderate to severe voiding symptoms attributed to BPH that are refractory to conservative or medical therapy (relative indications for surgery). Surgical treatment is also required when patients have experienced recurrent or refractory urinary retention, overflow incontinence, recurrent UTIs, bladder stones or diverticula, treatment-resistant macroscopic haematuria because of BPH and/or BPE, or dilatation of the upper urinary tract because of BPO, with or without renal insufficiency (absolute indications for surgery).

The choice of surgical technique depends on prostate size, patient comorbidities, ability to undergo anaesthesia, patient preferences, willingness to accept surgery-associated specific side effects, the availability of surgical techniques in a specific centre and the experience of the surgeon with these techniques. The experience and preference of the treating surgeon often have an important role in the choice of surgical treatment for BPH. TURP has remained the cornerstone of LUTS/BPO surgical treatment for decades. Despite its high rate of success, TURP has a perioperative morbidity rate of approximately 20% and has long-term complications that include ejaculatory dysfunction (65%), erectile dysfunction (10%), urethral stricture (7%), UTI (4%), urinary incontinence (2%) and bleeding requiring transfusion (2%) [60].The development of different minimally invasive technologies has provided alternatives that are expected to have similar effectiveness but a better safety profile in comparison to TURP.

- Different ablative technologies have been developed. These remove excess prostatic tissue in different ways, as follows:
- Resection with holmium or thulium lasers (e.g., TmLRP) as an alternative to classical TURP;
- Enucleation using either holmium (HoLEP), thulium (ThuLEP) or diode (DioLEP) laser or different electrodes delivering bipolar energy (B-TUEP) to peel the enlarged prostate from the prostate capsule without cutting into it or dissecting it;
- Vaporisation with a bipolar electrode (B-TUVP) or a laser system (e.g., KTP or LBO PVP or DioLVP) to remove excess prostate tissue by heating and evaporating it;
- Hybrid techniques such as vapoenucleation (e.g., with a thulium laser [ThuVEP] or with bipolar energy [B-VEP]), vaporesection (using resection with the help of electric current or laser and vaporisation with the use of a vaporisation electrode [TUVRP and ThuVARP]) or enucleoresection (using monopolar M-TUERP - or bipolar energy – B-TUERP);
- Aquablation using a high-speed jet of saline (waterjet) to remove excess prostate tissue;
- TUMT using electromagnetic waves to thermoablate prostatic tissue; and
- WAVE using convective water vapour generated via radiofrequency current and injected into the prostate to destroy excess tissue.

Nonablative techniques have also been developed. These include the following:

- Incision (TUIP) into the bladder neck reduces the pressure of the prostate on the urethra, which is an option especially suitable for men with smaller prostates, with a trade-off between minor efficacy and higher safety or a lesser impact on sexual function.
- PAE uses PVA and other newer synthetic biocompatible materials to reduce the blood flow in the prostate, causing it to undergo ischaemic necrosis.
- PUL uses small adjustable permanent implants to create an open channel to increase urine flow.
- TIND creates new channels in the urethra to increase urine flow.

According to the American Urological Association, some techniques (such as HoLEP and ThuLEP) are size-independent, while others (such as PVP, Aquablation, WAVE, TUMT, TUVP and PUL) are especially suitable for small to medium prostates and TUIP is only suitable for small prostates.

In this REA we assessed the effectiveness and safety of 21 of these technologies in comparison to TURP. Eighty-four RCTs (in 94 publications) were eventually selected; all but three of these RCTs were two-arm trials. Sixty-six RCTs (3 multiarm trials) compared newer technologies to TURP, 18 RCTs (3 multiarm trials) compared two newer technologies to each other, one RCT (multiarm) compared newer technologies to OP and one RCT compared newer technologies to sham. All trials were relatively small: the highest number of patients per study arm was 205, with an average size of 63. Among the newer technologies, HoLEP was the one most frequently assessed in the RCTs (in 25), followed by B-TUVP (in 13), B-TUEP (in 12), ThuLEP (in 9), DioLEP and PVP (in 6), TUIP (in 5), TUMT and TUVRP (in 4), DioLVP and PAE (in 5), B-TUERP, ThuVEP, TmLRP and TUIP + TURP (in 2), and Aquablation, B-VEP, M-TUERP, PUL, ThuVARP and WAVE (in 1). WAVE was only assessed in an RCT versus sham and no comparative data versus alternative technologies were available. No head-to-head RCTs assessing TIND were found.

Regarding potential conflicts of interest, there was disclosure of sponsorship or receipt of equipment from manufacturers in eight RCTs, while the authors' personal conflicts of interest were disclosed in six additional RCTs.

Only 20 RCTs provided power calculations for detection of defined differences for primary outcomes of interest for this REA; in five of these trials, two co-primary outcomes were declared. Among these RCTs, IPSS was the outcome most frequently declared as the primary endpoint (in 10), followed by Qmax (in 6), catheterisation time (in 5) and hospitalisation time (in 3). A noninferiority hypothesis was declared in eight RCTs, in which primary outcomes were IPSS in five of them, IPSS and Qmax (as a co-primary outcomes) in one, Qmax in one and reintervention rate in one.

The vast majority of the studies included populations that were heterogeneous in terms of prostate size and it was not possible to assess the effectiveness and safety of the different technologies in our predefined prostate size subgroups. Studies including relatively homogeneous populations were available for TUIP and its combination with TURP, targeted at patients with smaller prostates (<30-40 ml); DioLEP (in two RCTs); for WAVE and Aquablation (in one RCT), with studies including patients with prostate size between 30 and 80 ml; and for HoLEP, B-VEP (each in 2 RCTs), PVP, B-TUEP and M-TUERP (each in 1 RCT), with studies including patients with prostate size >80 ml.

Clinical effectiveness: direct comparisons

New technologies versus TURP: IPSS and Qmax (with follow-up >6 months)

Some of the available RCTs and pooled data showed the following.

- There were statistically significant better IPSS results versus TURP for HoLEP, B-TUEP, B-TUVP and ThuLEP from pooled data, and for B-TUERP from single RCTs.
- There were statistically significant better results for IPSS for TURP versus TUMT, PVP and PAE from pooled data, and versus PUL and DioLVP from single RCTs.
- There were statistically significant better results for Qmax versus TURP for HoLEP, B-TUEP and B-TUVP from pooled data, and for TUIP + TURP and B-TUERP from single RCTs.
- There were statistically significant better results for Qmax for TURP versus TUMT and TUIP from pooled data, and versus PAE, PUL, DioLVP and ThuVARP from single RCTs.

Nevertheless, the clinical relevance of the differences observed is either low or difficult to establish. Mean pooled estimates of the MD are in most cases below the MCID values reported in the literature (3 points for IPSS, 2 ml/sec for Qmax, the latter based on consensus among a panel of experts from the UK National Institute for Health and Care Excellence) and their CIs only infrequently cross the MCID (in particular for ThuVARP, TUMT, TUIP, PUL and PAE compared to TURP). In cases for which only data from single RCTs were available, even when the MDs cross the MCID threshold, CIs are either lacking or imply wide imprecision, so that the relevance is quite uncertain. Nevertheless, it is not possible to exclude the possibility that choosing one of these technologies instead of others may provide some patients with a clinically relevant benefit (depending on how wide the CI for the MD is). It should be noted that in five of the eight RCTs comparing newer technologies versus TURP with either IPSS or Qmax as the primary outcome and a rigorous sample size calculation, the aim was to demonstrate noninferiority of the newer technology. This could imply that the proposed techniques are intended to offer patients less invasive alternatives while accepting the lack of better functional outcomes over TURP. If this is the case, it should be noted that the trial investigators did not try to establish sufficient statistical power to demonstrate improvements in outcomes that may benefit from lower invasiveness.

New technologies versus TURP: PVR and QoL

A few RCTs showed statistically significant better PVR and QoL results in favour of HoLEP and B-TUERP versus TURP from pooled data, and in favour of TURP versus PVP and TUMT (for PVR), versus ThuLEP (for QoL), and versus PAE and PUL (the latter from single RCTs). However, it was not possible to establish the clinical relevance of the differences observed, since no MCID has been established for PVR or QoL (in terms of IPSS QoL, the scale that was probably used in most of the trials). In addition, these differences were numerically small and thus, even though the range for the scores is unknown, it seems unlikely that these differences were clinically relevant.

New technologies versus TURP: reintervention

Limited information is available on reintervention. Only HoLEP showed a lower incidence for this outcome compared to TURP and to PVP, although the quality of evidence is low to very low. Conversely, TUIP, an option for patients with smaller prostates, showed higher odds of reintervention, with low quality of evidence.

New technologies versus TURP: hospitalisation and operative times

Newer technologies showed a shorter hospitalisation time versus TURP that ranged from <1 day to 1–2 days less. Regarding operative time, more time is generally required for newer technologies compared to TURP (except for TUIP, which had a shorter surgery time than TURP). However, the differences are generally in the order of minutes and this outcome was not identified as critical for decision-making. For both outcomes, statistical heterogeneity was often observed, probably because of different policies in different centres (and surgeon experience). In light of these considerations, we decided that pooling of data for these outcomes would generally not be appropriate.

New technologies versus OP

OP was used as the comparator in only one RCT, and had a longer hospitalisation time (>4 days longer) compared to B-TUEP and B-TUVP.

Comparisons between new technologies

For comparisons among newer technologies, a few studies showed statistically significant differences in favour of the following:

- B-TUEP versus HoLEP and versus B-TUVP for Qmax;
- ThuLEP versus HoLEP for IPSS, PVR and QoL;
- ThuVEP versus HoLEP for QoL (from a single RCT);
- PVP versus HoLEP for QoL;
- HoLEP versus PVP for IPSS, Qmax, PVR and the reintervention rate;
- PVP versus B-TUVP for PVR; and
- DioLEP versus B-TUEP and versus B-TUERP for irritative symptoms (the latter from a single RCT).

Safety: direct comparisons

The available comparisons did not show any differences for bladder perforation, bladder or ureteral injury, erectile dysfunction, TUR syndrome, urethral stricture or bladder neck contracture.

Comparisons of new technologies versus TURP

Some of the RCTs and pooled data showed statistically significant benefits in favour of newer technologies compared to TURP for some of the critical and important outcomes considered in this REA, specifically:

- A rate ratio of 0.4 for retrograde ejaculation for TUIP, an absolute reduction of 16% for Aquablation and an absolute reduction (from 34% to 0%) for anejaculation for PUL (the latter two from single RCTs);
- A lower incidence (–27%) of erectile dysfunction for ThuLEP in a single RCT;
- A rate ratio for transfusion requirement of the order of 0.1–0.3 for HoLEP, ThuLEP, B-TUVP and PVP and a reduction of 9% for M-TUERP (the latter from a single RCT);
- A rate ratio for UTI between 0.2 and 0.5 for HoLEP and PAE;

- A rate ratio for urinary incontinence of 0.1 for PAE and a reduction of 15% for PUL (the latter from a single RCT); and
- A 7% reduction in recatheterisation and an 11% reduction in retention for M-TUERP (from a single RCT).

Outcomes that were worse for some technologies in comparison to TURP are as follows:

- Incontinence for HoLEP, B-TUEP (rate ratio 1.9) and PVP (rate ratio 2.6); and
- UTI for PVP (rate ratio 1.8).

RCTs generally showed a shorter catheterisation time for newer technologies, but large statistical heterogeneity, probably explained by different policies in different centres, precluded data pooling.

Comparisons among newer technologies

A few data from single RCTs are available, showing statistically significant differences in favour of ThuLEP versus HoLEP for incontinence (rate ratio 3.4) and in favour of ThuVEP versus HoLEP for urinary retention (13% absolute difference in a single RCT).

Since the claimed benefits of newer technologies mainly fall in the safety domain and are often centred on patient preferences and expectations, typically in relation to preserving sexual function and avoiding adverse effects such as incontinence, it is surprising that no RCTs were powered for any of these outcomes; only five trials were powered for catheterisation time, which is only indirectly related to safety.

Quality of the evidence

The quality of the evidence for all of these outcomes has been judged as moderate to very low, considering internal and external validity. Regarding internal validity, most studies provided limited information in terms of random allocation, allocation concealment and losses to follow-up; study protocols or trial registrations were rarely available to check for selective reporting. In addition, since surgery trials could be blinded to patients and to assessors (although rarely declared) but not to surgeons (although their optimal performance cannot be in doubt), biases in assessment of outcomes cannot be ruled out, especially in assessing subjective outcomes. Some inconsistency in results and relevant uncertainties (owing to low precision of estimates) also contributed to lower-quality judgements, as well as statistical heterogeneity and the uncertain external validity because of limited information about prostate size for the patients included or the inclusion of heterogeneous populations in this regard.

8 CONCLUDING SUMMARY

Minimally invasive technologies are expected to reduce short- and long-term side effects of standard surgical treatments for BPH (in particular TURP) even if this may result in lower effectiveness for functional outcomes. Using a systematic analysis of the available RCTs, we assessed parallel comparisons of 21 of these technologies versus TURP or OP (defined as standard interventions) or cross-comparisons. Eighty-four RCTs were eventually selected.

Most of the trials selected provide information on functional outcomes. Few comparisons show statistically significant differences in either direction and the results in most cases are below the MCID threshold. The quality of the related evidence has been graded as low to very low, suggesting limited confidence in the estimates and that further research is likely to change these estimates.

Limited information is available on reintervention. Only HoLEP showed a lower incidence for this outcome compared to TURP and to PVP, although the quality of the evidence is low to very low. Conversely, TUIP, an option for patients with smaller prostates, showed higher odds of reintervention compared to TURP, with low quality of evidence.

Regarding impact on sexual activity, ThuLEP, TUIP, Aquablation and PUL may provide some advantage over TURP, with the quality of evidence ranging from moderate (lower incidence of retrograde ejaculation among patients with small prostates undergoing TUIP) to low or very low.

Regarding other possible safety concerns and side effects, some newer technologies may offer some advantage over TURP in reducing the requirement for transfusion; mixed results (improvement or worsening), limited to very few technologies, are available for UTI and incontinence.

Small sample sizes, biases in study design, heterogeneous populations and (in most cases) an undefined primary hypothesis indicate the need for more and better research so that the advantages and disadvantages of all these technologies can be more clearly defined. In particular, adequately powered studies may help to identify preferred technologies according to prostate size.

Considering its wide scope in terms of the number of technologies, comparisons and outcomes that have been assessed, this HTA may help in providing a comprehensive and updated overview of the available evidence on technologies for BPH surgery. It should be noted that this report did not assess the organisational and economic impact of different technologies or their possible impact on equity of access; these issues were beyond the scope of the assessment but can be critical for decision-makers.

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APPENDIX 1

Documentation of the Search Strategies

The search strategy developed for all the three databases was the following:

("Prostatic Hyperplasia"[Mesh] OR "Lower Urinary Tract Symptoms"[Mesh]) OR "Prostatism"[Mesh] OR benign prostatic hyperplasia OR BPH OR lower urinary tract symptom* OR luts OR prostatism)

AND

(((thulium OR holmium OR diode OR eraser OR ktp OR greenlight) AND laser) OR KTP LVP OR Bipolar EP OR Bipolar VP OR bipolar transurethral resection OR Bipolar TURP OR plasmakinetic OR water vapour OR steam OR water vaporization OR rezum OR rezumTM OR nxthera OR (nx and thera) OR urolift OR prostatic urethral lift OR "Embolization, Therapeutic"[Mesh] OR embolization OR embolisation OR TUIP OR transurethral incision prostate OR TUMT OR transurethral microwave therapy OR aquablation OR TIND OR iTIND OR Nitinol OR robotic assisted prostatectomy OR "Transurethral Resection of Prostate"[Mesh] OR Transurethral Resection of Prostate OR TURP)

Language limitations: articles in English, German and Italian were included.

Scientific literature was monitored to check the availability of newly published RCTs that could be included.

APPENDIX 2

List of excluded Studies

Table A1: List of excluded studies (full text level) with reasons for exclusion)

Clinical effectiveness and safety

Reference	Main reason for exclusion (full text level)
Ahmed 1997	Selection of participants was partly outcome-based, and excluded patients were substituted out of a randomization process.
Norby 2002	Three-arm RCT with a control group considering patients who undertook either TURP or TUIP (mixed population), and with one of the other assessed technologies (ILC) outside the remit of this report.
Pimentel 2019	Reporting of the outcomes of interest is scarce, i.e. data available only in figures. This data is reported in other included publications on the trial (Gilling et.al publications).
Plante 2019	Post hoc exploratory subgroup analysis.
Peng 2016	2 PVP 80 W was used
Kasivisvanathan 2018	3 Assessed only the subgroup of patients of US centres
Enikeev 2020	4 Intervention (monopolar enucleation) out of scope.
Fuschi 2020	5 Intervenion (robotic and laparoscopic prostatectomy) not our comparator.

APPENDIX 3

Guidelines for diagnosis and management

Table A2: Overview of guidelines

Name of society / organisation issuing guidance	Date of issue	Country/ies to which applicable	Summary of recommendation	Level of evidence (A,B,C)*/ class of recommendation (I, IIa, IIb, III) #
American Urological Association (AUA)	May 2020	U.S.	Surgery is recommended for patients who have renal insufficiency secondary to BPH, refractory urinary retention secondary to BPH, recurrent urinary tract infections, recurrent bladder stones or gross hematuria due to BPH, and/or with LUTS attributed to BPH refractory to and/or unwilling to use other therapies.	Clinical principle
			TURP should be offered as a treatment option for men with LUTS attributed to BPH	Moderate recommendation, LE: B
			Clinicians may use a monopolar or bipolar approach to TURP, depending on their expertise with these techniques.	Expert opinion
			Clinicians should consider open, laparoscopic or robotic assisted prostatectomy, depending on their expertise with these techniques, for patients with large prostates.	Moderate recommendation; LE: C
			TUIP should be offered as an option for patients with prostates ≤30g for the surgical treatment of LUTS attributed to BPH	Moderate recommendation; LE: B
			Bipolar TUVP may be offered to patients for the treatment of LUTS attributed to BPH	Conditional Recommendation; LE: B
			Clinicians should consider PVP as an option using 120W or 180W platforms for patients for the treatment of LUTS attributed to BPH	Moderate recommendation; LE: B
			PUL may be offered as an option for patients with LUTS attributed to BPH provided prostate volume <80g and verified absence of an obstructive middle lobe.	Moderate recommendation; LE: C

Name of society / organisation issuing guidance	Date of issue	Country/ies to which applicable	Summary of recommendation	Level of evidence (A,B,C)*/ class of recommendation (I, IIa, IIb, III) #
			PUL may be offered to eligible patients who desire preservation of erectile and ejaculatory function.	Conditional recommendation; LE: C
			TUMT may be offered to patients with LUTS attributed to BPH.	Conditional recommendation; LE: C
			Water vapor thermal therapy may be offered to patients with LUTS attributed to BPH provided prostate volume <80g; however.	Moderate recommendation; LE: C
			Water vapor thermal therapy may be offered to eligible patients who desire preservation of erectile and ejaculatory function.	Conditional recommendation; LE: C
			Clinicians should consider HoLEP or ThuLEP, depending on their expertise with either technique, as prostate size-independent options for the treatment of LUTS attributed to BPH.	Moderate recommendation; LE: B
			Aquablation may be offered to patients with LUTS attributed to BPH provided prostate volume >30/<80g.	Conditional recommendation; LE: C
			PAE for the treatment of LUTS secondary to BPH is not supported by current data and trial designs, and benefit over risk remains unclear; therefore, PAE is not recommended outside the context of clinical trials.	Expert opinion
			HoLEP, PVP, and ThuLEP should be considered in patients who are at higher risk of bleeding, such as those on anti-coagulation drugs.	Expert opinion
European Association of Urology (EAU)	2018	Europe	TUIP should be offered to men with moderate-to-severe LUTS and prostate size < 30 mL, without a middle lobe.	Strong recommendation, LE:1
			M-TURP or B-TURP should be offered to men with moderate-to-severe LUTS and prostate size 30-80 mL.	Strong recommendation, LE:1
			B-TUVP should be offered as an alternative to M-TURP for men with moderate to severe LUTS and a prostate size of 30-80 mL.	Weak recommendation, LE:1
			Open prostatectomy should be offered in the absence of endoscopic enucleation to treat moderate-to-severe LUTS in men with prostate	Strong recommendation, LE:1

Name of society / organisation issuing guidance	Date of issue	Country/ies to which applicable	Summary of recommendation	Level of evidence (A,B,C)*/ class of recommendation (I, IIa, IIb, III) #
			size > 80 mL.	
			HoLEP should be offered to men with moderate-to-severe LUTS as an alternative to TURP or open prostatectomy.	Strong recommendation, LE:1a
			80-W 532-nm KTP laser vaporisation of the prostate should be offered to men with moderate-to-severe LUTS with a prostate volume of 30-80 mL as an alternative to TURP.	Strong recommendation, LE: 1a
			120-W 532-nm LBO laser vaporisation of the prostate should be offered to men with moderate-to-severe LUTS with a prostate volume of 30-80 mL as an alternative to TURP.	Strong recommendation, LE: 1a
			180-W 532-nm LBO laser vaporisation of the prostate should be offered to men with moderate-to-severe LUTS with a prostate volume of 30-80 mL as an alternative to TURP.	Strong recommendation, LE: 1b
			Laser vaporisation of the prostate using 80-W KTP, 120- or 180-W LBO lasers for the treatment of patients receiving antiplatelet or anticoagulant therapy with a prostate volume < 80 mL should be offered.	Weak recommendation, LE: 3
			120-W 980 nm DioVAP should be offered to men with moderate-to-severe LUTS as a comparable alternative to TURP.	Weak recommendation, LE: 1b, 3
			120-W 980 nm or 1,318 nm DioLEP should be offered to men with moderate-to-severe LUTS as a comparable alternative to TURP or bipolar enucleation.	Weak recommendation, LE: 1b
			ThuVEP and ThuLEP should be offered to men with moderate-to-severe LUTS as alternatives to TURP and HoLEP.	Weak recommendation, LE: 1b
			ThuVEP should be offered to patients receiving anticoagulant or antiplatelet therapy.	Weak recommendation, LE: 2b
			ThuVARP should be offered as an alternative to TURP.	Strong recommendation, LE: 1a

Name of society / organisation issuing guidance	Date of issue	Country/ies to which applicable	Summary of recommendation	Level of evidence (A,B,C)*/ class of recommendation (I, IIa, IIb, III) #
			ThuVARP should be offered to patients receiving anticoagulant or antiplatelet therapy.	Weak recommendation, LE: 1a
			PUL should be offered to men with LUTS interested in preserving ejaculatory function, with prostates < 70 mL and no middle lobe.	Strong recommendation, LE: 1b
			Aquablation should be offered to patients with moderate-to-severe LUTS and prostates between 30-80 mL as an alternative to TURP.	Weak recommendation, LE: 1b
			In Aquablation, patients should be informed about the risk of bleeding and the lack of long-term follow up data.	Strong recommendation, LE: 1b
			PAE should be offered to men with moderate-to-severe LUTS who wish to consider minimally invasive treatment options and accept less optimal objective outcomes compared with TURP.	Weak recommendation, LE: 1
			Perform PAE only in units where the work up and follow up is performed by urologists working collaboratively with trained interventional radiologists for the identification of PAE suitable patients.	Strong recommendation, LE: 1

* The AUA categorizes body of evidence strength as Grade A (well-conducted and highly-generalizable RCTs or exceptionally strong observational studies with consistent findings), Grade B (RCTs with some weaknesses of procedure or generalizability or moderately strong observational studies with consistent findings), or Grade C (RCTs with serious deficiencies of procedure or generalizability or extremely small sample sizes or observational studies that are inconsistent, have small sample sizes, or have other problems that potentially confound interpretation of data)

see https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009

Abbreviations: BPH *benign prostatic hyperplasia*, B-TURP *bipolar transurethral resection of the prostate*, DioLEP *diode laser enucleation of the prostate*, DioVAP *diode laser vaporisation of the prostate*, HoLEP *holmium laser enucleation of the prostate*, KTP *Potassium-Titanyl-Phosphate*, LBO *Lithium Borat*, LE *level of evidence,* LUTS *lower urinary symptoms,* M-TURP *monopolar transurethral resection of the prostate*, PAE *prostate artery embolization,* PUL *prostatic urethral lift*, PVP *photoselective vaporisation of the prostate*, ThuLEP *thulium laser enucleation of the prostate*, ThuVARP *thulium laser vaporesection of the prostate*, ThuVEP *thulium laser enucleation of the prostate*, TUIP *transurethral incision of the prostate*, TUMT *transurethral microwave therapy*

APPENDIX 4

Table A3: Studies included in the assessment: data extraction and risk of bias assessment

Study ID	**Abd-El Kader 2012**
Authors:	O. Abd-El Kader, K. Mohy El Den, A. El Nashar, A. Hussein, E. Yehya
Title:	Transurethral incision versus transurethral resection of the prostate in small prostatic adenoma: Long-term follow-up
Journal/Book/Source:	African Journal of Urology
Date of Publication:	2012
Volume:	18
Issue:	/
Pages:	29-33
METHODS (study design; length of follow up)	RCT 48 months follow up
PARTICIPANTS	
Total Number of Participants randomized	86
Country of participants	Egypt
Data collection period	Between January 2005 and December 2010
Inclusion criteria	being on the waiting list for surgical treatment of BPH, total prostatic weight ≤ 30 g as measured with transrectal ultrasound, and the ability to give informed consent
Exclusion criteria	suspected prostate cancer (abnormal digital rectal examination, or elevated prostate specific antigen, bladder pathology (including mass, stones or chronic cystitis), prominent median lobe of the prostate or inability to comply with the follow-up schedule
Average age	TURP: 63.6 ± 4.2 years TUIP: 66.2 ± 6.1 years
INTERVENTIONS (technology 1)	Transurethral resection of the prostate (TURP)
INTERVENTIONS (technology 2)	Transurethral incision of the prostate (TUIP)
Number of patients in TURP	40
Number of patients in TUIP	40
OUTCOMES	IPSS, Qmed, Qmax, PVR, operative time, blood transfusion, duration of catheterization, length of hospital stay, retrograde ejaculationm, erectile dysfunction, bladder neck contracture , urethral stricture, reoperation

Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding source: not mentioned in the article. Conflicts of Interest: not mentioned in the article. Trial registration number: not mentioned in the article.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	No information reported.
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	uncertain risk of bias	Of the 86 patients enrolled, 80 completed the study: 40 patients in each group. Total loss to f-up: 7,0%. Difference in attrition between the two groups: no information, no flow chart; unknown the number of patients initially assigned to each of the two groups. For none of the outcomes, attrition varies for different follow-up times (in fact, there are no different follow-up times).
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	uncertain risk of bias	No information about possible conflicts of interest

Study ID	**Abt 2018**
Authors:	Abt D, Hechelhammer L, Müllhaupt G, Markart S, Güsewell S, Kessler TM, Schmid HP, Engeler DS, Mordasini L.
Title:	Comparison of prostatic artery embolisation (PAE) versus transurethral resection of the prostate (TURP) for benign prostatic hyperplasia: randomised, open label, non-inferiority trial
Journal/Book/Source:	BMJ
Date of Publication:	2018
Volume:	361
Issue:	k2338
Pages:	1-10
METHODS (study design; length of follow up)	investigator initiated, open label, single centre, randomised controlled trial; non-inferiority trial 12 weeks follow-up

PARTICIPANTS		
Total Number of Participants randomized	103	
Country of participants	Switzerland	
Data collection period	11 February 2014 - 24 May 2017	
Inclusion criteria	men aged at least 40 years, TURP indicated, refractory to medical treatment or not willing to undergo or continue medical treatment, with a prostate size 25-80 mL as measured by transabdominal ultrasound, with an international prostate symptoms score (IPSS) of at least 8, with an IPSS related quality of life of at least 3 points, with a maximum urinary flow rate of less than 12 mL/s or urinary retention, and who provided written informed consent	
Exclusion criteria	severe atherosclerosis, aneurysmatic changes or severe tortuosity in the aortic bifurcation or internal iliac arteries, acontractile detrusor, neurogenic lower urinary tract dysfunction, urethral stenosis, bladder diverticulum, bladder stone, allergy to intravenous contrast media, contraindication for magnetic resonance imaging, pre-interventionally proven carcinoma of the prostate, and renal failure (glomerular filtration rate <60 mL/min)	
Average age	PAE: 65.7 ± 9.3 years TURP: 66.1 ± 9.8 years	
INTERVENTIONS (technology 1)	Prostate artery embolization (PAE)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in PAE	48	
Number of patients in TURP	51	
OUTCOMES	IPSS, Qmax, PVR, haematoma, ejaculatory dysfunction, procedure time, bladder catheter indwelling time, duration of hospital stay, IIEF, persistent irritative symptoms (irritation, pain, discomfort), urinary retention, urinary incontinence, urinary tract infection, strictures (meatal)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding: The trial was supported by a grant from the research committee of St Gallen Cantonal Hospital (14/08). The funder had no role in the conduct or analysis of the trial. Competing interests: All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: support from St Gallen Cantonal Hospital for the submitted work; no financial relationship with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work. Trial registration number: Clinicaltrials.gov NCT02054013.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	We performed randomisation using the data management software SecuTrial, stratifying for patient age (<70 or ≥ 70 years) and prostate volume (<50 or≥ 50 mL) through minimisation. SecuTrial

		was programmed by the clinical trials unit's data manager.
Allocation concealment (selection bias)	low risk of bias	Automatic treatment allocation by SecuTrial was determined for individual patients without a predefined sequence after inclusion and entry of baseline characteristics by the investigators.
Blinding of participants and personnel (performance bias)	high risk of bias	Blinding of patients and physicians was not feasible in the framework of our trial. Therefore, both patients and physicians might have been biased in favour of or against a new treatment.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	Blinding of patients and physicians was not feasible. No information about blinding of assessors.
Incomplete outcome data (attrition bias)	low risk of bias	Total lost to f-up: 0%. Difference in attrition between the two groups: 0%. For none of the outcomes, attrition varies for different follow-up times (in fact, there are no different follow-up times).
Selective reporting (reporting bias)	low risk of bias	Trial registration: Clinicaltrials.gov NCT02054013 No difference between reported outcomes and protocol neither methods section.
Other bias	Low risk of bias	The trial was supported by a grant from the research committee of St Gallen Cantonal Hospital (14/08). The funder had no role in the conduct or analysis of the trial. Competing interests: authors declare no financial relationship with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work

Study ID	**Bai 2019**
Authors:	Bai F, Feng S, Xu C, Xu Z, Chen J, Zheng Y.
Title:	Transurethral resection versus holmium laser enucleation of the prostate: A prospective randomized trial comparing perioperative thrombin generation and fibrinolysis.
Journal/Book/Source	Medicine
Date of Publication:	2019
Volume:	98
Issue:	15
Pages:	1-5 (open access article)

METHODS (study design; length of follow up)	prospective RCT Follow up: just baseline and perioperative data.	
PARTICIPANTS		
Total Number of Participants randomized	70	
Country of participants	China	
Data collection period	June 2015 - March 2017	
Inclusion criteria	severe lower urinary tract symptoms (LUTS), refractory to medical therapy with alpha-blockers and/or 5-alpha reductase inhibitors, post void residual urine (PVR)>100ml, and acute urinary retention	
Exclusion criteria	neurogenic bladder, cardiovascular and/or cerebrovascular thromboembolic diseases, DVT, PE, malignancy, coagulopathy, and on antiplatelet or anticoagulant therapy	
Average age	TURP: 69.3 ± 4.3 years HoLEP: 71.2 ± 6.0 years	
INTERVENTIONS (technology 1)	Transurethral resection of the prostate (TURP)	
INTERVENTIONS (technology 2)	Holmium laser enucleation of the prostate (HoLEP)	
Number of patients in TURP	32	
Number of patients in HoLEP	33	
OUTCOMES	Qmax, PVR, IPSS, QoL, operative time, catheterization, hospitalization	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	This study was funded by Zhejiang Provincial Natural Science Foundation of China (LY16H160028). The authors have no conflicts of interest to disclose. Trial registration: ChiCTR1800019005	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	Patients were assigned into two groups by computer-generated randomization in 1:1 ratio.
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	uncertain risk of bias	Total lost to f-up: 7,1%. Difference in attrition between the two groups: 2,9%. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	low risk of bias	Registered trial. No difference between reported outcomes and protocol (in Chinese and in English) in the trial repository. No difference between reported outcomes and methods section.

		No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Low risk of bias	This study was funded by Zhejiang Provincial Natural Science Foundation of China. The authors had no conflicts of interest to disclose

Study ID	**Basic 2013**
Authors:	Basić D, Stanković J, Potić M, Ignjatović I, Stojković I.
Title:	Holmium laser enucleation versus transurethral resection of the prostate: a comparison of clinical results.
Journal/Book/Source:	Acta Chir Iugosl.
Date of Publication:	2013
Volume:	60
Issue:	1
Pages:	15-20
METHODS (study design; length of follow up)	RCT Follow up: 12 months.
PARTICIPANTS	
Total Number of Participants randomized	40
Country of participants	Serbia
Data collection period	October 2011 - December 2012
Inclusion criteria	postvoid residue > 50ml, prostate volume up to 50g, repeated episodes of acute urinary retention, indwelling urinary catheter, recurrent urinary tract infection, recurrent haematuria due to BPH and IPSS score >19
Exclusion criteria	voiding disorders out of BPH origin, previous urethral, bladder neck or prostatic surgery, and history of prostate cancer
Average age	HoLEP: 63.3 ± 7.4 years TURP: 65.1 ± 6.9 years
INTERVENTIONS (technology 1)	Holium laser enucleation of the prostate (HoLEP)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in HoLEP	20
Number of patients in TURP	20

OUTCOMES	IPSS, QoL, PVR, drop in serum sodium (addressed in Methods, but not reported in the results o in a table), operative time, transfusion, catheterization time, hospitalization time, bladder mucosal injury, urinary incontinence, acute urinary retention, persistent irritative symptoms (Urge incontinence + Dysuria), bladder neck stricture, reintervention	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	This work has been supported by the Serbian Ministry of Education and Science, grant No 175092. Conflicts of interest: no information. Trial registration number: no information	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	No information reported
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	low risk of bias	No lost to follow-up. (Pag. 16 b) All patients reached the 12-month follow-up. No difference in attrition between the two groups. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. Only one outcome is addressed in Methods, but not reported in the results in a table: drop in serum sodium etc. All data were collected in a database. Serum biochemistry (etc) were evaluated after the 1st month postoperatively, and reevaluated if it was indicated. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Low risk of bias	Supported by the Serbian Ministry of Education and Science

Study ID	**Bozzini 2017**

Authors:	Bozzini G, Seveso M, Melegari S, de Francesco O, Buffi NM, Guazzoni G, Provenzano M, Mandressi A, Taverna G.
Title:	Thulium laser enucleation (ThuLEP) versus transurethral resection of the prostate in saline (TURis): A randomized prospective trial to compare intra and early postoperative outcomes.
Journal/Book/Source:	Actas Urol Esp.
Date of Publication:	2017 Jun
Volume:	41
Issue:	5
Pages:	309-315
METHODS (study design; length of follow up)	RCT Follow up: 3 months after surgery.
PARTICIPANTS	
Total Number of Participants randomized	208
Country of participants	Italy
Data collection period	between September 2014 and September 2015
Inclusion criteria	All male patients with bothersome lower urinary tract symptoms due to BPH with indications for surgical intervention regardless of the patient age, International Prostate Symptom Score (IPSS), and prostatic size.
Exclusion criteria	Patients with mild symptoms (IPSS <8 and/or maximum urinary flow rate ≥15 ml/s and postvoid residual urine <50 ml), small adenomas <20 g measured by transrectal ultrasound, presence of urethral stricture, neurogenic bladder, vesicoureteric reflux, huge retentive bladder diverticulum, previous prostatic surgeries, previous or subsequent diagnosis of prostatic adenocarcinoma, patients receiving anticoagulant drugs due to the fact that holmium can be used safely in patients receiving anticoagulant drugs unlike TURis.
Average age	ThuLEP: 72.5 ± 17.5 years B-TURP: 70.7 ± 16.1 years
INTERVENTIONS (technology 1)	Thulium laser transurethral enucleation of the prostate (ThuLEP)
INTERVENTIONS (technology 2)	Bipolar transurethral resection of the prostate in saline (TURis) (B-TURP)
Number of patients in ThuLEP	102
Number of patients in B-TURP (TURiS)	106
OUTCOMES	IPSS, Qmax, PVR, operative time, catheterization time, hospital stay, blood transfusion, postvoid urinary retention (in our as-

	sessment: acute urinary retention), stress incontinence (in our assessment: urinary incontinence), urge incontinence (in our assessment: persistent irritative symptoms), urethral strictures, bladder injury, QoL	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding source: not mentioned in the article. Authors declare no conflicts of interest. Trial registration number: not mentioned in the article.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	No information reported
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	uncertain risk of bias	Authors do not address loss to follow-up. Not declared any difference in attrition between the two groups. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Low risk of bias	Authors declare no conflicts of interest.

Study ID	**Bozzini 2020**
Authors:	Bozzini G, Berti L, Aydoğan TB, Maltagliati M, Roche JB, Bove PL, Besana U, Calori A, Pastore AL, Müller A, Micali S, Sighinolfi MC, Rocco B, Buizza C
Title:	A prospective multicenter randomized comparison between Holmium Laser Enucleation of the Prostate (HoLEP) and Thulium Laser Enucleation of the Prostate (ThuLEP)
Journal/Book/Source:	World Journal of Urology
Date of Publication:	2020

Volume:	https://doi.org/10.1007/s00345-020-03468-6
Issue:	-
Pages:	-
METHODS (study design; length of follow up)	RCT Follow-up at 3 and 12 months
PARTICIPANTS	
Total Number of Participants randomized	236
Country of participants	Italy and France
Data collection period	2015-2018
Inclusion criteria	IPSS≥8; weak or no response to previous medical treatments; Qmax<15 ml/sec; acute urinary retention
Exclusion criteria	History of prostatic surgery; prostate or bladder cancer suspicion/history; documented/supspected neurogenic bladder; urethral stricture; anticoagulant/antiaggregant therapy; concurrent bladder stones; patients unft for surgery
Average age	HoLEP: 69.5 ± 15.54 ThuLEP: 67.1 ± 17.83
INTERVENTIONS (technology 1)	Thulium laser enucleation of the prostate (ThuLEP)
INTERVENTIONS (technology 2)	Holmium laser enucleation of the prostate (HoLEP)
Number of patients in ThuLEP	115
Number of patients in HoLEP	121
OUTCOMES	Hospital stay, operative time, catheterization time, IPSS, Qmax, PVR, QoL, urinary retention, blood transfusion, bladder injury, stress incontinence, urge incontinence, urethral stricture
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declared that they had no confict of interest or any known competing financial interests

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Used adaptive randomization software
Allocation concealment (selection bias)	Low risk	Allocation concealment facilitated by the adaptive randomization software
Blinding of participants and personnel (performance bias)	Low risk	Participants were blinded
Blinding of outcome assessment	Low risk	Assessors were blinded

OBJECTIVE OUTCOMES (detection bias)		
Blinding of outcome assessment SUBJECTIVE OUTCOMES (detection bias)	Low risk	Assessors were blinded
Incomplete outcome data (attrition bias)	High risk	50 patients excluded from the analysis either because lost to follow-up, or due to discontinued intervention, because of equipment malfunction
Selective reporting (reporting bias)	High risk	Among excluded patients, some are reported to have discontinued intervention because of equipment malfunction
Other bias	Low risk	The authors declare that they have no confict of interest or any known competing fnancial interests and that that no extra institutional funding was received

Study ID (surname first author and year – add a, b if same author same year)	**Carnevale2016**
Authors:	Francisco C. Carnevale, Alexandre Iscaife, Eduardo M. Yoshinaga, Airton Mota Moreira, Alberto A. Antunes, Miguel Srougi
Title:	Transurethral Resection of the Prostate (TURP) Versus Original and PErFecTED Prostate Artery Embolization (PAE) Due to Benign Prostatic Hyperplasia (BPH): Preliminary Results of a Single Center, Prospective, Urodynamic-Controlled Analysis
Journal/Book/Source:	Cardiovasc Intervent Radiol
Date of Publication:	27 October 2015
Volume:	2016
Issue:	39
Pages:	44-52
METHODS (study design; length of follow up)	Randomised controlled trial. Follow up: 1 year
PARTICIPANTS	
Total Number of Participants randomized	30
Country of participants	Brazil

Data collection period	November 2010 - December 2012	
Inclusion criteria	Age >45 years; International Prostate Symptom Score (IPSS) >19; symptoms refractory to medical treatment for at least 6 months; negative screening for prostate cancer; prostate volume between 30 and 90 cm^3 on magnetic resonance imaging (MRI); and bladder outlet obstruction (BOO) confirmed by urodynamic examination.	
Exclusion criteria	Patients with renal failure, bladder calculi or diverticula, suspected prostate cancer, urethral stenosis, or neurogenic bladder disorders.	
Average age	TURP: 66.4 ± 5.6 (range 55–78) PAE: 63.5 ± 8.7 (range 46–75)	
INTERVENTIONS (technology 1)	Transurethral resection of the prostate (TURP)	
INTERVENTIONS (technology 2)	Prostate artery embolization (PAE)	
Number of patients in TURP	15	
Number of patients in PAE	15	
Number of patients in technology 3		
OUTCOMES	IPSS, QoL, International Index of Erectile Function (IIEF-5), PVR, Qmax, procedure time, hospital stay, blood transfusion requirements, capsular perforation, retrograde ejaculation, urinary incontinence, postoperative LUTS, recatheterisation, radiodermatitis.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Uncertain risk	No information about random sequence generation
Allocation concealment (selection bias)	Uncertain risk	No information about allocation concealment
Blinding of participants and personnel (performance bias)	Uncertain risk	No information whether blinding was performed
Blinding of outcome assessment (detection bias)	Uncertain risk	No information whether bling was performed
Incomplete outcome data (attrition bias)	Uncertain risk	There is no number of patients at each follow up visit provided.
Selective reporting (reporting	Uncertain risk	There is no study protocol registered

bias)		in order to check selective reporting.
Other bias	Low risk	Authors declare they have no financial disclosure.

Study ID	**Cetinkaya 2015**
Authors:	Cetinkaya M, Onem K, Rifaioglu MM, Yalcin V.
Title:	980-Nm Diode Laser Vaporization versus Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia: Randomized Controlled Study
Journal/Book/Source:	Urol J.
Date of Publication:	2015
Volume:	12
Issue:	5
Pages:	2355-61
METHODS (study design; length of follow up)	two-arm, prospective, randomized controlled study Three months follow up
PARTICIPANTS	
Total Number of Participants randomized	72
Country of participants	Turkey
Data collection period	From June 2010 to July 2011
Inclusion criteria	The inclusion criteria were BPH refractory to medical treatment, recurrent urinary retention, prostate volume of < 80 mL , Qmax of ≤ 15 mL/s (under medical treatment), an IPSS of ≥ 15, and an IPSS-QoL of ≥ 3.
Exclusion criteria	Patients with prostate or bladder cancer histories, neurogenic bladder dysfunction, bladder stones, urethral structures, or previous bladder, urethral, or prostate surgery were excluded.
Average age	PVP: 63.1 ± 9.1 years TURP: 64.7 ± 10.2 years
INTERVENTIONS (technology 1)	Photoselective vaporization of the prostate (PVP)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in PVP	36
Number of patients in TURP	36
OUTCOMES	IPSS, Qmax, operative duration, catheterization time, hospital stay, urinary retention, re-treatment (reintervention), bleeding

	and need of blood transfusion, capsule perforation, TUR syndrome, urinary tract infection, urethral stricture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding source: not mentioned. Conflicts of interest: none declared. Trial registration: not mentioned.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	Patients were allocated randomly to the diode laser vaporization or TURP group with a schedule balanced in blocks of three. (Comment: they do not explain how they generated the randomization sequence)
Allocation concealment (selection bias)	uncertain risk of bias	The allocation was performed by a nurse and biostatistician. (Comment: they do not explain which methods they used to mask the allocation)
Blinding of participants and personnel (performance bias)	high risk of bias	Patients were informed about the operation and were not blinded for ethical reasons.
Blinding of outcome assessment SUBJECTIVE OUTCOMES (detection bias)	high risk of bias	Patients were not blinded. Three months after the surgical procedure, follow-up assessments were performed by research staff blinded to the patient's procedure.
Blinding of outcome assessment OBJECTIVE OUTCOMES (detection bias)	low risk of bias	Patients were not blinded. Three months after the surgical procedure, follow-up assessments were performed by research staff blinded to the patient's procedure.
Incomplete outcome data (attrition bias)	low risk of bias	Total lost to f-up: 1,4%. Difference in attrition between the two groups: 2,7%. In total, 36 patients underwent PVP with the diode laser and 36 patients underwent standard TURP. One patient in the laser group was excluded from the study because of bleeding and conversion to TURP. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND

		without statistical comparison between groups).
Other bias	uncertain risk of bias	No information available about possible conflicts of interest

Study ID	**Chang 2015**
Authors:	Chang CH, Lin TP, Chang YH, Huang WJ, Lin AT, Chen KK.
Title:	Vapoenucleation of the prostate using a high-power thulium laser: a one-year follow-up study
Journal/Book/Source:	BMC Urology
Date of Publication:	2015
Volume:	15
Issue:	40
Pages:	1-7
METHODS (study design; length of follow up)	Prospectively nonblind randomized trial 1 year follow up.
PARTICIPANTS	
Total Number of Participants randomized	59
Country of participants	Taiwan
Data collection period	August 2010 - May 2012
Inclusion criteria	The inclusion criteria were an international prostate symptom score (IPSS) >7, maximum urinary flow rate (Qmax) <15 mL/s, and normal level of age-specific prostate-specific antigen (PSA).
Exclusion criteria	Not mentioned in the article
Average age	76.1 ± 9.4 years in the ThuVEP group; 72.6 ± 7.4 years in the TURP group
INTERVENTIONS (technology 1)	Th:YAG laser vapoenucleation (ThuVEP)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in ThuVEP	29
Number of patients in TURP	30
OUTCOMES	Qmed, QoL, IIEF-5, IPSS, Qmax, PVR, decrease in serum sodium level, duration of catheterization, total duration of hospitalization, acute urinary retention, recatheterization, urinary tract infection, hemorrhage/hematuria requiring transfusion, TUR syndrome, death

Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding source. Not mentioned in the article. Conflicts of Interest. The authors declare that they have no competing interests. Trial registration number. ISRCTN registry with study ID ISRCTN52339705. Date assigned: 06/03/2015.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	No information reported.
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	high risk of bias	Non-blind randomized trial.
Blinding of outcome assessment (detection bias)	high risk of bias	Non-blind randomized trial.
Incomplete outcome data (attrition bias)	low risk of bias	Total lost to f-up: 5%. In all, 96.3% patients in the ThuVEP group and 93.3% in the TURP group completed the 1-year follow-up study. (Difference in attrition between the two groups: 3%). For none of the outcomes, attrition varies for different follow-up times (no information, but it does not seem so; the f-up is just 12 months and the lost to f-up in both groups is low)
Selective reporting (reporting bias)	low risk of bias	Retrospectively registered in the ISRCTN registry; (abstract) date assigned: 06/03/2015. No difference between reported outcomes and methods section. Two outcomes: QoL and IIEF -5 have incomplete data: their values at baseline and at follow-up are not in the text nor in figures, nor in tables. However, for all outcomes there is a statistical comparison between groups: (pag 3 b) All measurement data for the two groups were statistically analyzed using a two-tailed Student's t test. The scoring and questionnaire results were analyzed using analysis of variance (ANOVA).
Other bias	Low risk of bias	The authors declared that they had no competing interests

Study ID	**Chen 2013**
Authors:	Chen YB, Chen Q, Wang Z, Peng YB, Ma LM, Zheng DC, Cai ZK, Li WJ, Ma LH.
Title:	A prospective, randomized clinical trial comparing plasmakinetic resection of the prostate with holmium laser enucleation of the prostate based on a 2-year followup.
Journal/Book/Source:	J Urol.
Date of Publication:	2013
Volume:	189
Issue:	1
Pages:	217-22
METHODS (study design; length of follow up)	prospective randomized clinical trial 2-year follow up
PARTICIPANTS	
Total Number of Participants randomized	280
Country of participants	China
Data collection period	from August 2008 to February 2010
Inclusion criteria	Indications for the surgical treatment of BPH.
Exclusion criteria	Patients with severe pulmonary disease or heart disease, bladder calculus, neurogenic bladder dysfunction, bladder cancer, previous prostate surgery, prostate cancer, urethral stricture or coagulopathy were excluded from study
Average age	PKRP: 73.5 ± 8.8 years HoLEP: 72.1 ± 7.8 years
INTERVENTIONS (technology 1)	Plasmakinetic resection of the prostate (PKRP)
INTERVENTIONS (technology 2)	Holmium laser enucleation of the prostate (HoLEP)
Number of patients in PKRP	140
Number of patients in HoLEP	140
OUTCOMES	Operative duration, serum sodium decrease, catheter time, hospital stay, IPSS, QoL, Qmax, PVR, IIEF-5, TUR syndrome), recatheterization, blood transfusion due to postoperative blood loss, urinary incontinencem, reoperation, retrograde ejaculation, urethral stricture, bladder neck contracture
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Supported by grants from the Natural Science Foundation of China (No. 81070544 and No. 81172450). Conflicts of interest: not mentioned Trial registration: not mentioned.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	Each patient was assigned with an envelope through the computerized random number generator.
Allocation concealment (selection bias)	low risk of bias	Allocation concealment was done using sequentially numbered and sealed envelopes.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	The study was a single blinded trial in which only the patients were blinded to the treatments while the surgeons and supervisors were not.
Blinding of outcome assessment SUBJECTIVE OUTCOMES (detection bias)	low risk of bias	Patients were blinded. No information reported about blinding of assessors (Comment: probably they are not blinded)
Blinding of outcome assessment OBJECTIVE OUTCOMES (detection bias)	high risk of bias	Patients were blinded. No information reported about blinding of assessors (Comment: probably they are not blinded)
Incomplete outcome data (attrition bias)	uncertain risk of bias	Authors do not address loss to follow-up. Not declared any difference in attrition between the two groups. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Low risk of bias	Supported by grants from the Natural Science Foundation of China

Study ID	**Dahlstrandt 1995**
Authors:	DAHLSTRAND C, WALDEN M, GEIRSSON G, PETTERSSON S
Title:	Transurethral microwave thermotherapy versus transurethral resection for symptomatic benign prostatic obstruction: a prospective randomized study with a 2-year follow-up
Journal/Book/Source:	Br J Urol

Date of Publication:	1995	
Volume:	76	
Issue:		
Pages:	614-618	
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 3, 6, 12 and 24 months	
PARTICIPANTS		
Total Number of Participants randomized	72	
Country of participants	Sweden	
Data collection period		
Inclusion criteria	Prostate length of 35-50mm, symptom score of 28 according to the Madsen and Iversen system	
Exclusion criteria	Patients with an indwelling catheter or a residual urine volume of > 350 mL, with malignancy of the prostate or bladder, urethral stricture, a large median lobe, prior treatment for BPH, a neurogenic bladder disorder, a metallic hip implant, previous surgery for pelvic malignancy or regional arterial insufficiency,	
Average age	68	
INTERVENTIONS (technology 1)	TUMT	
INTERVENTIONS (technology 2)	TURP	
Number of patients in TUMT	37	
Number of patients in TURP	32	
OUTCOMES	Qmax, PVR, reintervention, urinary retention, urethral stricture, UTI, erectile dysfunction, blood loss, operation time, hospital stay	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs

Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	Incomplete follow-up mostly at 24 months (for 10 patients)
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**D'Ancona 1998**
Authors:	D'ANCONA FCH, FRANCISCA EAE, WITJES WPJ, WELLING L, DEBRUYNE FMJ, De La ROSETTE JJM
Title:	Transurethral resection of the prostate vs high-energy thermotherapy of the prostate in patients with benign prostatic hyperplasia: long-term results
Journal/Book/Source:	British Journal of Urology
Date of Publication:	1998
Volume:	81
Issue:	
Pages:	259–264
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 1, 3, 6, 12 and 30 months
PARTICIPANTS	
Total Number of Participants randomized	52
Country of participants	The Netherlands
Data collection period	January 1994 - August 1995
Inclusion criteria	Age $\geq$ 45, prostate length 25-50 mm, prostate volume 30-100 ml,

	symptoms since > 3 months, Madsen symptom score ≥ 8, Qmax ≤ 15 ml/s with a minimum voided volume of 100 ml, PVR ≤ 350 ml	
Exclusion criteria	Neurogenic disorders affecting bladder function, prostatic carcinoma, prior prostate surgery, microwave sensitive implants (pacemaker or hip prosthesis), diabetic neuropathy, urinary retention requiring indwelling catheter, renal impairment, obstructed bladder neck due to an enlarged median lobe of the prostate, drug therapies for BPH	
Average age	69	
INTERVENTIONS (technology 1)	TUMT	
INTERVENTIONS (technology 2)	TURP	
Number of patients in TUMT	31	
Number of patients in TURP	21	
OUTCOMES	IPSS, Qmax, PVR, catheterization time, UTI, hospitalization time, irritative symptoms, repeat treatment	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data	High risk	>20% of patients were lost to follow-up

(attrition bias)		after 2.5 years
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Dørflinger 1992**
Authors:	Dørflinger T, Svendsen Jensen F, Krarup T, Walter S.
Title:	Transurethral prostatectomy compared with incision of the prostate in the treatment of prostatism caused by small benign prostate glands.
Journal/Book/Source:	Scand J Urol Nephrol
Date of Publication:	1992
Volume:	26
Issue:	4
Pages:	333-338
METHODS (study design; length of follow up)	prospective randomized controlled study 12-months follow up
PARTICIPANTS	
Total Number of Participants randomized	60
Country of participants	Denmark
Data collection period	Not declared
Inclusion criteria	The study comprised unselected patients who had not had any prostatic surgery. This included patients with prostatism and urinary retention as a result of benign prostatic hypertrophy, estimated prostatic weight of less than 20 g and a bladder neck to seminal crest distance of less than 2 cm.
Exclusion criteria	Patients with prostatic cancer, urethral stricture , those who had had previous pelvic operations, and those with obvious neurological or psychiatric diseases, or who were at poor surgical risk were excluded.
Average age	**median values** TURP: 71 years TUIP: 69 years
INTERVENTIONS (technology 1)	Transurethral resection of the prostate (TURP)
INTERVENTIONS (technology 2)	transurethral incision of the prostate (TUIP)

Number of patients in TURP	31	
Number of patients in TUIP	29	
OUTCOMES	persistent irritative symptoms, obstructive symptoms (LUTS), maximum flow rate (ml/sec), length of operation, blood transfusion due to blood loss, urethral stricture, bladder neck contracture, catheterization time, reoperation, recatheterization, retrograde ejaculation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Fund: not mentioned. Conflicts of interest: not mentioned. Trial registration: not mentioned.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	no information about sequence generation
Allocation concealment (selection bias)	uncertain risk of bias	patients were randomly allocated (no other information)
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported about blinding of assessors.
Incomplete outcome data (attrition bias)	high risk	Overall lost to follow-up: 21.7%
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Uncertain risk of bias	No information about possible conflicts of interest

Study ID	**Dunsmuir 2003**
Authors:	Dunsmuir WD, McFarlane JP, Tan A, Dowling C, Downie J, Kourambas J, Donnellan S, Redgrave N, Fletcher R, Frydenberg M, Love C.
Title:	Gyrus bipolar electrovaporization vs transurethral resection of the prostate: a randomized prospective single-blind trial with 1 y follow-up.
Journal/Book/Source:	Prostate Cancer Prostatic Dis.
Date of Publication:	2003

Volume:	6	
Issue:	2	
Pages:	182-6	
METHODS (study design; length of follow up)	Randomized prospective single-blind trial Follow up: 1 year.	
PARTICIPANTS		
Total Number of Participants randomized	51	
Country of participants	Australia	
Data collection period	No information	
Inclusion criteria	men less than 80 y of age, presenting to the outpatient clinic with LUTS considered to be secondary to BPH and considered to be appropriate for TURP	
Exclusion criteria	men presenting with acute urinary retention, anticoagulant therapy, prostate volume greater than 80 cm^3, previous prostatic surgery, or suspicion of prostate cancer. The latter included men with a PSA 4 4 ng/ml (unless biopsies were negative for cancer)	
Average age	B-TUVP: 63 ± 7.1 years TURP: 60 ± 6.5 years	
INTERVENTIONS (technology 1)	Bipolar electrovaporization (B-TUVP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in B-TUVP	30	
Number of patients in TURP	21	
OUTCOMES	Qmax, PVR, AUA symptom score (analogue to IPSS or American Urological Association-Symptom Index (AUA-SI), operation time, catheter removal, time to discharge, recatheterization, serum sodium, procedural blood loss and transfusion requirements	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding source: not mentioned in the article. Conflicts of interest: not mentioned in the article. Trial registration number: not mentioned in the article.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	Randomization was made by drawing a chit from a previously sealed box containing an equal number of tickets for the two surgical modalities.
Allocation concealment	uncertain risk of bias	No information reported.

(selection bias)		
Blinding of participants and personnel (performance bias)	high risk of bias	Single-blind trial: Ward-nursing staff was blind to the surgical modality used. (Patients and clinicians are not blind)
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported about blinding of assessors. Patients are not blinded.
Incomplete outcome data (attrition bias)	high risk of bias	Missing overall: 22%
Selective reporting (reporting bias)	high risk of bias	Not registered trial. No difference between reported outcomes and methods section. These outcomes: AUA (analogue to IPSS), Qmax, PVR are reported at the baseline only; their values during follow-up are only in figures, not in tables nor in the text. For these outcomes, the statistical comparison between groups is only in Fig.3.
Other bias	Uncertain risk of bias	No information about possible conflicts of interest

Study ID	**Elsakka 2016**
Authors:	Elsakka AM, Eltatawy HH, Almekaty KH, Ramadan AR, Gameel TA, Farahat Y.
Title:	A prospective randomised controlled study comparing bipolar plasma vaporisation of the prostate to monopolar transurethral resection of the prostate.
Journal/Book/Source: (abbreviated name)	Arab J Urol.
Date of Publication:	2016
Volume:	14
Issue:	4
Pages:	280-286
METHODS (study design; length of follow up)	prospective RCT follow up: 3 and 6 months postoperatively
PARTICIPANTS	
Total Number of Participants randomized	84. However, two patients in group I were lost during follow-up and excluded from the study.
Country of participants	Egypt

Data collection period	1 April 2010 - 1 January 2012	
Inclusion criteria	patients with LUTS secondary to BOO with an IPSS of ≥8, low maximum urinary flow rate (Qmax) < 15 mL/s, not responding to medical treatment, and/or BPH complications such as refractory retention or recurrent haematuria, and prostate size <80 mL	
Exclusion criteria	Patients unfit for surgery and those suspected of prostatic carcinoma were excluded from the study	
Average age	B-TUVP: 56.9 years M-TURP: 55.6 years	
INTERVENTIONS (technology 1)	Bipolar transurethral plasma vaporisation (B-TUVP)	
INTERVENTIONS (technology 2)	Monopolar transurethral resection of the prostate (M-TURP)	
Number of patients in in B-TUVP	40	
Number of patients in M-TURP	42	
OUTCOMES	IPSS, Qmax, PVR, Na^+, perioperative mortality, operative time , catheterization time, bladder perforation, re-catheterisation, urinary tract infection, stress urinary incontinence, bladder neck obstruction, bleeding necessitating transfusion, TUR syndrome, stricture urethra, secondary intervention (reintervention)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Source of funding: none. Conflicts of interest. Trial registration number: not mentioned in the article.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	uncertain risk of bias	No information reported.
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	low risk of bias	-Total lost to f-up: 2,4%. -Difference in attrition between the two groups: 4,8%. -For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported

		outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Uncertain risk of bias	No information about possible conflicts of interest

Study ID	**Elshal 2015**
Authors:	Elshal AM, Elkoushy MA, El-Nahas AR, Shoma AM, Nabeeh A, Carrier S, Elhilali MM.
Title:	GreenLight™ laser (XPS) photoselective vapo-enucleation versus holmium laser enucleation of the prostate for the treatment of symptomatic benign prostatic hyperplasia: a randomized controlled study.
Journal/Book/Source:	J Urol
Date of Publication:	2015
Volume:	193
Issue:	3
Pages:	927-34
METHODS (study design; length of follow up)	randomized controlled noninferiority trial follow up: 1 year
PARTICIPANTS	
Total Number of Participants randomized	108 randomized, 103 included in the final analysis.
Country of participants	Canada
Data collection period	January 2012 - March 2013
Inclusion criteria	patient age greater than 50 years, refractory LUTS secondary to BPH, I-PSS greater than 15, QOL score 3 or greater, Qmax less than 15 ml per second or patients with acute urinary retention secondary to BPH in whom trial of voiding failed, and prostate size on preoperative TRUS of 40 to 150 ml
Exclusion criteria	Patients with neurological disorder, active urinary tract infection, active bladder or prostate cancer were excluded.
Average age	PVEP: 74,1 years HoLEP: 71 years
INTERVENTIONS (technology 1)	Photoselective vapo-enucleation of the prostate-XPS 180 W (PVEP)
INTERVENTIONS (technology 2)	Holmium laser enucleation of prostate (HoLEP)

Number of patients in PVEP	53	
Number of patients in HoLEP	50	
OUTCOMES	Reintervention, Qmax, PVR, IPSS, QOL, IIEF-15, operative time, blood sodium deficit, catheterization time, hospital stay, dysuria, urge urinary incontinence, prostate capsule violation, bladder injury, recatheterisation, anemia requiring transfusion, urinary tract infection, stress urinary incontinence, bladder neck contracture, urethral stricture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Financial interest and/or other relationship with Lumenis and AMS. Conflicts of interest: no information. Trial registration: ClinicalTrials.gov ID: NCT01494337	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	Computer generated random tables in a 1:1 ratio were used. Patients were randomly assigned to one of the treatment groups by stratified-blocked randomization.
Allocation concealment (selection bias)	uncertain risk of bias	No information reported.
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported.
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported.
Incomplete outcome data (attrition bias)	low risk of bias	Total lost to f-up: 4,6%. Difference in attrition between the two groups: 9,1%. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	Uncertain risk of bias	Trial registration: ClinicalTrials.gov ID: NCT01494337. No difference between reported outcomes and methods section. These outcomes: PVR, I-PSS, QOL, IIEF are reported at the baseline only; their values during follow- up are only in figures, not in tables nor in the text. IIEF is not even in figure. However, for these outcomes there is a statistical comparison between groups. Mean QOL at 1, 4 and 12 months were comparable in the HoLEP and PVEP groups. No significant changes were noted in

		IIEF-15 score or its subdomains in both groups. Noninferiority of I-PSS at 1 year was evaluated using a 1-sided test at 5% level of significance. The statistical significance of other comparators was assessed at the (2-sided) 5% level. There was significant, comparable improvement in I-PSS and post-void residual urine volume (PVR) at 1, 4 and 12 months.
Other bias	High risk of bias	Corresponding author had financial interest and/or other relationship with manufacturers

Study ID	**Elshal 2020**
Authors:	Elshal AM, Soltan M, El-Tabey NA, Laymon M, Nabeeh A
Title:	Randomised trial of bipolar resection vs holmium laser enucleation vs Greenlight laser vapo-enucleation of the prostate for treatment of large benign prostate obstruction: 3-years outcomes
Journal/Book/Source:	BJU Int
Date of Publication:	2020
Volume:	126
Issue:	
Pages:	731-8
METHODS (study design; length of follow up)	RCT Follow-up at 1, 2 and 3 years
PARTICIPANTS	
Total Number of Participants randomized	184
Country of participants	Egypt
Data collection period	2014-16
Inclusion criteria	Patients with estimated prostate volumes of 80–150 mL with refractory LUTS or with acute urine retention secondary to benign prostatic obstruction who failed medical treatment
Exclusion criteria	Neurological disorder, bleeding tendency, ongoing anticoagulants or antiplatelet medications, history of previous prostate surgery or diagnosis of prostate cancer
Average age	66
INTERVENTIONS (technology 1)	PVP (Greenlight)

INTERVENTIONS (technology 2)	HoLEP	
INTERVENTIONS (technology 3)	Bipolar transurethral resection (TURis system) (B-TURP)	
Number of patients in PVP	60	
Number of patients in HoLEP	60	
Number of patients in B-TURP	62	
OUTCOMES	Retreatment (primary); hospital stay, operative time, time to catheter removal, dysuria, IIEF, IPSS, Qmax, PVR, QoL, capsular perforation, blood transfusion, bladder wall injury, UTI	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Conflict of interest: none declared	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low	Computer generated random tables
Allocation concealment (selection bias)	Uncertain	No information available
Blinding of participants and personnel (performance bias)	Uncertain	No information about blinding of patients and post-surgery attending clinicians
Blinding of outcome assessment	Uncertain	No information about blinding of assessors
Incomplete outcome data (attrition bias)	Uncertain	No information available
Selective reporting (reporting bias)	Uncertain	10% were lost to follow-up at 3 years
Other bias	Low	No conflict of interest was declared

Study ID	**Eltabey 2010**
Authors:	Eltabey MA, Sherif H, Hussein AA.
Title:	Holmium laser enucleation versus transurethral resection of the prostate
Journal/Book/Source:	Can J Urol
Date of Publication:	2010
Volume:	17
Issue:	6
Pages:	5345-5350

METHODS (study design; length of follow up)	Prospective RCT follow up: 1 year	
PARTICIPANTS		
Total Number of Participants randomized	80	
Country of participants	Saudi Arabia	
Data collection period	April 2008 - December 2009	
Inclusion criteria	patients who presented to the Urology Department at King Fahd Specialist Hospital in Al Qassin, Saudi Arabia, with bladder outlet obstruction caused by BPH, with related voiding symptoms, and prostate volume greater than 30 g but less than 100 g (as determined by TRUS), who had not responded to pharmacologic therapy, and who were eligible for surgical treatment were enrolled in this randomized, prospective study. Other inclusion criteria were an AUA symptom score of 12 or higher and a peak urinary flow rate of 15 mL/sec or lower	
Exclusion criteria	neurogenic bladder; previous urethral, bladder neck, or prostate surgery; suspected prostatic cancer by abnormal digital rectal examination (DRE), total serum PSA > 4 ng/mL or abnormal TRUS; and TRUS-guided prostate biopsy	
Average age	HoLEP: 67.5 ± 8.1 years TURP: 68.3 ± 9.2 years	
INTERVENTIONS (technology 1)	holmium laser enucleation of the prostate (HoLEP)	
INTERVENTIONS (technology 2)	transurethral resection of the prostate (TURP)	
Number of patients in HoLEP	40	
Number of patients in TURP	40	
OUTCOMES	Qmax, PVR, AUA symptom score (analogue to IPSS or American Urological Association-Symptom Index (AUA-SI)), total operating time, blood transfusion, catheterization time, hospital stay, irritative voiding symptoms, urge urinary incontinence, mixed urinary incontinence, stress urinary incontinence, urethral stricture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Source of funding: no information reported. Conflicts of interest: no information reported Trial registration number: no information reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	The patients were randomized using a computer-generated table.
Allocation concealment	uncertain risk of bias	No information reported.

(selection bias)		
Blinding of participants and personnel (performance bias)	uncertain risk of bias	No information reported
Blinding of outcome assessment (detection bias)	uncertain risk of bias	No information reported
Incomplete outcome data (attrition bias)	uncertain risk of bias	Authors do not address loss to follow-up. Postoperative improvement in symptoms and micturition parameters were significantly better with HoLEP than with TURP; these occurred within the first month and lasted up to 12 months of follow up. For none of the outcomes, attrition varies for different follow-up times.
Selective reporting (reporting bias)	uncertain risk of bias	Not registered trial. No difference between reported outcomes and methods section. No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	Uncertain risk of bias	No information about possible conflicts of interest

Study ID	**Enikeev 2019**
Authors:	Enikeev D, Netsch C, Rapoport L, Gazimiev M, Laukhtina E, Snurnitsyna O, Alekseeva T, Becker B, Taratkin M, Glybochko P
Title:	Novel thulium fiber laser for endoscopic enucleation of the prostate: A prospective comparison with conventional transurethral resection of the prostate
Journal/Book/Source:	Int J Urol
Date of Publication:	2019
Volume:	26
Issue:	
Pages:	1138--1143
METHODS (study design; length of follow up)	RCT Follow-up of 3, 6 and 12 months
PARTICIPANTS	
Total Number of Participants randomized	119 (data on 103)
Country of participants	Russia

Data collection period	Not reported.	
Inclusion criteria	Prostate volume <80 cc, IPSS >20 and Qmax <10 mL/s	
Exclusion criteria	Prostate cancer, bladder stones, acute urinary retention (indwelling suprapubic or transurethral catheter), urethral strictures, neurogenic bladder and anticoagulant therapy	
Average age	67	
INTERVENTIONS (technology 1)	Thulium fiber laser enucleation (ThuLEP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in ThuLEP	51	
Number of patients in TURP	52	
OUTCOMES	PVR, IPSS, Qmax, QoL, surgery time, catheterization time, hospital stay, reduction of serum sodium, urinary incontinence, UTI, acute urinary retention, urethral stricture, bladder neck contracture, retrograde ejaculation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Conflict of interest: none declared	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Randomization list, not specified how it was generated. Judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs.
Allocation concealment (selection bias)	High risk	Non blind assignment.
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients.
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified.
Incomplete outcome data (attrition bias)	Unclear risk	8.5% of patients were lost to follow-up.
Selective reporting (reporting bias)	Unclear risk	Protocol not available.
Other bias	Unclear risk	No information available about possible conflicts of interest.

Study ID	**Fayad 2015**
Authors:	Fayad AS, Elsheikh MG, Zakaria T, Elfottoh HA, Alsergany R, Elshenoufy A, Elghamarawy H
Title:	Holmium Laser Enucleation of the Prostate Versus Bipolar Resection of the Prostate: A Prospective Randomized Study. "Pros and Cons"
Journal/Book/Source:	Urology
Date of Publication:	2015
Volume:	86
Issue:	
Pages:	1037-1041
METHODS (study design; length of follow up)	RCT Follow-up at 1 week, 1 month and 12 months
PARTICIPANTS	
Total Number of Participants randomized	120
Country of participants	Egypt
Data collection period	2008-2013
Inclusion criteria	Bothersome lower urinary tract symptoms due to BPH with indications for surgical intervention regardless of the patient age, International Prostate Symptom Score (IPSS), and prostatic size
Exclusion criteria	Patients with mild symptoms (IPSS <8 and/or maximum urinary flow rate 15 mL/s and minimal postvoiding residual urine), small adenomas <20 g measured by transrectal ultrasound, urethral stricture, neurogenic bladder, vesicoureteric reflux, huge retentive bladder diverticulum, previous prostatic surgeries, prostatic adenocarcinoma, patients receiving anticoagulant drugs (for the fact that holmium can be used safely in patients receiving anticoagulant drugs unlike bipolar TURP)
Average age	61
INTERVENTIONS (technology 1)	Holmium laser enucleation of the prostate (HoLEP)
INTERVENTIONS (technology 2)	Bipolar transurethral resection of the prostate (B-TURP)
Number of patients in HoLEP	60
Number of patients in B-TURP	60
OUTCOMES	IPSS, Qmax, PVR, prostate size, operative time, blood loss,

	intraoperative and postoperative complications, catheterization time, hospital stay, costs	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declared that they had no relevant financial interests. No trial registration available	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	A sequence of consecutive numbers
Allocation concealment (selection bias)	High risk	A secretary allocated consecutive patients (giving each of them a consecutive number) to each of the two groups according to timing of inclusion
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	Limited loss to follow-up (< 5%) up to one month. 12 months data suffer for a more pronounced loss to follow-up (>10%)
Selective reporting (reporting bias)	Unclear risk	No protocol or trial registration available
Other bias	Low risk	The authors declare that they have no relevant financial interests

Study ID	**Feng 2016**
Authors:	Feng L, Zhang D, Tian Y, Song J
Title:	Thulium Laser Enucleation Versus Plasmakinetic Enucleation of the Prostate: A Randomized Trial of a Single Center
Journal/Book/Source:	JOURNAL OF ENDOUROLOGY
Date of Publication:	2016
Volume:	30
Issue:	6
Pages:	665-670
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 3, 6 and 12 months
PARTICIPANTS	

Total Number of Participants randomized	127	
Country of participants	China	
Data collection period	2011-2013	
Inclusion criteria	Age ≥ 50 years but <85 years, IPSS ≥7, Qmax <15 mL/seconds, and medical therapy failure	
Exclusion criteria	Neurogenic bladder, documented or suspected prostate cancer, a history of prostatic or urethral surgery, and a poor tolerance for surgery	
Average age	69	
INTERVENTIONS (technology 1)	Thulium laser enucleation of the prostate (ThuLEP)	
INTERVENTIONS (technology 2)	Plasmakinetic enucleation of the prostate (PKEP)	
Number of patients in ThuLEP	61	
Number of patients in PKEP	66	
OUTCOMES	IPSS, QoL score, Qmax, PVR, catheterization time, operation time, changes in serum sodium and hemoglobin levels, hospital stay, complications	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declare that no competing financial interests exist	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs.
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs.
Blinding of participants and personnel (performance bias)	High risk	Open trial
Blinding of outcome assessment (detection bias)	High risk	Blinding of assessors was not mentioned.
Incomplete outcome data	Low risk	No patients lost to follow-up.

(attrition bias)		
Selective reporting (reporting bias)	Unclear risk	No rpotocol or trial registration available.
Other bias	Low risk	The authors declare that no competing financial interests exist.

Study ID	**Floratos 2001**
Authors:	FLORATOS DL, KIEMENEY LAL, ROSSI C, KORTMANN BBM, DEBRUYNE FMJ, DE LA ROSETTE JJM
Title:	Long-term follow-up of randomized transurethral microwave thermotherapy versus transurethral prostatic resection study
Journal/Book/Source:	The Journal of Urology
Date of Publication:	2001
Volume:	165
Issue:	
Pages:	1533-1538
METHODS (study design; length of follow up)	RCT Follow-up of 3, 6, 12, 18, 24 and 36 months
PARTICIPANTS	
Total Number of Participants randomized	155
Country of participants	The Netherlands
Data collection period	Jan 1996-Mar 1997
Inclusion criteria	Age $\geq$ 45 years, lower urinary tract symptoms persisting longer than 3 months, prostate volume $\geq$ 30 ml, prostatic urethral length $\geq$ 25 mm, a Madsen symptom score $\geq$ 8, Qmax $\geq$15 ml per second, PVR $\leq$ 350 ml
Exclusion criteria	Acute prostatitis or urinary tract infection, evidence of prostatic carcinoma, an isolated prostatic middle lobe protruding in the bladder, urethral stricture, neurological disorders affecting lower urinary tract function, previous prostatic surgery and severe co-morbidity not allowing surgery
Average age	67
INTERVENTIONS (technology 1)	Transurethral microwave thermotherapy (TUMT)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in TUMT	78

Number of patients in TURP	66	
OUTCOMES	PVR, IPSS, Qmax, QoL, re-treatment rate, urethral stricture, bladder neck contracture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	-	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	Less than 20% of loss to follow-up
Selective reporting (reporting bias)	High risk	For some critical outcomes: data only presented as figures and lack of statistical comparisons in parallel (only before-after comparisons for each group)
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID (surname first author and year – add a, b if same author same year)	**Gao2014**
Authors:	Yuan-an Gao, Yan Huang, Rui Zhang, Yu-dong Yang, Qing Zhang, Min Hou, Yi Wang

Title:	Prostatic Arterial Embolization versus Transurethral Resection of the Prostate—A Prospective, Randomized, and Controlled Clinical Trial
Journal/Book/Source:	Radiology
Date of Publication:	2014
Volume:	270
Issue:	3
Pages:	920-8
METHODS (study design; length of follow up)	Randomised controlled trial (RCT) Follow up: 1, 3, 6, 12, and 24 months
PARTICIPANTS	
Total Number of Participants randomized	114
Country of participants	China
Data collection period	January 2007 - January 2012
Inclusion criteria	International Prostate Symptom Score (IPSS) greater than 7 after failed medical therapy with a washout period of 2 or more weeks, prostate volume of 20–100 mL on transrectal ultrasonographic (US) or magnetic resonance (MR) images, peak urinary flow of less than 15 mL/sec, and patient understanding and written informed consent.
Exclusion criteria	Detrusor hyperactivity or hypocontractility at urodynamic study, urethral stricture, prostate cancer, diabetes mellitus, and previous prostate, bladder neck, or urethral surgery. Patients who had a prostate-specific antigen (PSA) value greater than 4 ng/mL or an abnormal finding at digital rectal examination and who had positive US guided prostate biopsy.
Average age	PAE: 67.7 ± 6 8.7 TURP: 66.4 ± 6 7.8
INTERVENTIONS (technology 1)	Prostatic arterial embolization (PAE)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in PAE	57
Number of patients in TURP	57
OUTCOMES	IPSS, QoL, PVR, Qmax, operative time, decrease in serum sodium levels within 24 hours after the procedure, transfusion requirements, hospital stay, catheter requirements, reintervention, TUR syndrome, acute urinary retention, UTI, urethral stricture, bladder neck contracture.

Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomization was performed by using computer-generated simple random tables in a 1:1 ratio.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information whether blinding was performed.
Blinding of outcome assessment (detection bias)	Unclear risk	No information whether blinding was performed.
Incomplete outcome data (attrition bias)	Unclear risk	loss to follow up in both arms between 5 and 20%
Selective reporting (reporting bias)	Unclear risk	There is no pre-registered protocol available.
Other bias	Unclear risk	There is no funding statement.

Study ID	**Geavlete 2010**
Authors:	Geavlete B, Multescu R, Dragutescu M, Jecu M, Georgescu D, Geavlete P
Title:	Transurethral resection (TUR) in saline plasma vaporization of the prostate vs standard TUR of the prostate: 'the better choice' in benign prostatic hyperplasia?
Journal/Book/Source:	BJU INTERNATIONAL
Date of Publication:	2010
Volume:	106
Issue:	
Pages:	1695–1699
METHODS (study design; length of follow up)	RCT Follow-up at 1, 3 and 6 months
PARTICIPANTS	
Total Number of Participants randomized	155

Country of participants	Romania	
Data collection period		
Inclusion criteria	Qmax <10 mL/ s, IPSS >19, prostate volume 30–80 mL	
Exclusion criteria	Severe comorbidities, previous prostate surgery, history of prostate cancer, abnormal DRE and/ or increased PSA level	
Average age	66	
INTERVENTIONS (technology 1)	Transurethral resection in saline plasma vaporization (TUVRP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in TUVRP	75	
Number of patients in TURP	80	
OUTCOMES	IPSS, HRQL, Qmax, PVR, catheterization time, operation time, capsular perforation, intraoperative bleeding, blood transfusion, haematuria, hemoglobin decrease, urinary tract infection, acute urinary retention, dysuria, urgency,	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	No conflict of interest was declared	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Consecutive numbers
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias)	Low risk	Blinding of patients and of urologists is declared. Surgeons could not be blinded, but we assume that their professional performance is as high as possible
Blinding of outcome assessment (detection bias)	Low risk	Blinding of urologists and patients was specified
Incomplete outcome data (attrition bias)	Unclear risk	No information provided
Selective reporting (reporting bias)	Unclear risk	No protocol or trial registration available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Geavlete 2011**

Authors:	Geavlete B, Georgescu D, Multescu R, Stanescu F, Jecu M, Geavlete P
Title:	Bipolar Plasma Vaporization vs Monopolar and Bipolar TURP–A Prospective, Randomized, Long-term Comparison
Journal/Book/Source:	Urology
Date of Publication:	2011
Volume:	78
Issue:	4
Pages:	930-935
METHODS (study design; length of follow up)	RCT Follow-up at 1, 3 and 6, 12 and 18 months
PARTICIPANTS	
Total Number of Participants randomized	510
Country of participants	Romania
Data collection period	
Inclusion criteria	BPH and severe LUTS
Exclusion criteria	Severe comorbidities, previous prostate surgery, history of prostate cancer, abnormal DRE, and/or increased PSA
Average age	67
INTERVENTIONS (technology 1)	Bipolar plasma vaporization (B-PVP)
INTERVENTIONS (technology 2)	Transurethral resection in saline (TURis) (B-TURP)
INTERVENTIONS (technology 3)	M-TURP
Number of patients in B-PVP	170
Number of patients in B-TURP	170
Number of patients in M-TURP	170
OUTCOMES	IPSS, QoL, Qmax, PVR, operation time, catheterization time, hospital stay, Intraoperative bleeding, blood transfusion, capsular perforation, TUR syndrome, re-catheterization, early irritative symptoms, dysuria, bladder neck sclerosis, urinary stricture, urinary incontinence, urinary tract infections, retreatment rate
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	No information provided

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias)	Low risk	Blinding of patients and of urologists is declared. Surgeons could not be blinded, but we assume that their professional performance is as high as possible
Blinding of outcome Assessment (detection bias)	Low risk	Blinding of urologists and patients was specified
Incomplete outcome data (attrition bias)	Unclear risk	No information provided
Selective reporting (reporting bias)	Unclear risk	No protocol or trial registration available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Geavlete 2014**
Authors:	Geavlete B, Stanescu F, Moldoveanu C, Geavlete P
Title:	Continuous vs conventional bipolar plasma vaporisation of the prostate and standard monopolar resection: a prospective, randomised comparison of a new technological advance
Journal/Book/Source:	BJU Int
Date of Publication:	2014
Volume:	113
Issue:	
Pages:	288-295
METHODS (study design; length of follow up)	Randomised controlled trial Follow-up at 1, 3, 6 months
PARTICIPANTS	
Total Number of Participants randomized	180
Country of participants	Romania
Data collection period	

Inclusion criteria	Qmax<10 mL/s and IPSS >19	
Exclusion criteria	Severe associated co-morbidities, previous prostate surgery or history of prostate cancer	
Average age	69	
INTERVENTIONS (technology 1)	Continuous bipolar plasma vaporisation of the prostate (C-BPVP)	
INTERVENTIONS (technology 2)	Standard bipolar plasma vaporisation of the prostate (S-BPVP)	
INTERVENTIONS (technology 3)	Transurethral resection oft he prostate (TURP)	
Number of patients in C-BPVP	60	
Number of patients in S-BPVP	60	
Number of patients in TURP	60	
OUTCOMES	IPSS, QoL, Qmax, PVR, operation time, capsular perforation, catheterization time, hospital stay, re-catheterization	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	One of the authors received honoraria from Olympus when he spoke at company sponsored symposia	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), postoperative team blinded, no information on patient blinding
Blinding of outcome assessment (detection bias) subjective outcomes	Unclear risk	Patient blinding is not mentioned
Blinding of outcome assessment (detection bias) objective outcomes	Low risk	Postoperative team blinded (we can assume assessors were blinded)
Incomplete outcome data (attrition bias)	Unclear risk	No information available
Selective reporting	Unclear risk	No protocol or tral registration available

(reporting bias)		
Other bias	High risk	The main author received honoraria from the manufacturer

Study ID	**Geavlete 2015**
Authors:	Geavlete B, Bulai C, Ene C, Checherita I, Geavlete P
Title:	Bipolar Vaporization, Resection, and Enucleation Versus Open Prostatectomy: Optimal Treatment Alternatives in Large Prostate Cases?
Journal/Book/Source:	JOURNAL OF ENDOUROLOGY
Date of Publication:	2015
Volume:	29
Issue:	3
Pages:	323-331
METHODS (study design; length of follow up)	Randomised controlled trial follow-up at 1, 3, 6, 12 months
PARTICIPANTS	
Total Number of Participants randomized	320
Country of participants	Romania
Data collection period	Between January 2009 and May 2013
Inclusion criteria	Prostate volume $\geq$ 80 mL, Qmax < 10 mL/second, IPSS > 19, or urinary retention imposing catheter indwelling
Exclusion criteria	Associated comorbidities preventing BPH surgery, previous prostate surgery, urethral strictures, and not BPH-related voiding disorders, prostate cancer
Average age	68
INTERVENTIONS (technology 1)	Transurethral enucleation with bipolar energy (B-TUEB)
INTERVENTIONS (technology 2)	Transurethral vaporization with bipolar energy (B-TUVP)
INTERVENTIONS (technology 3)	Transurethral resection of the prostate (TURP)
INTERVENTIONS (technology 4)	Open prostatectomy (OP)
Number of patients in B-TUEB	80
Number of patients in B-TUVP	80
Number of patients in TURP	80

Number of patients in OP	80	
OUTCOMES	IPSS, QoL, Qmax, PVR, operation time, catheterization time, hospital stay, change in haemoglobin level, blood transfusion, re-catheterization, urinary stricture, urinary incontinence, urinary tract infections	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	One author declared having been a lecturer for the manufacturer	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	The authors mention sealed envelopes but not how the sequence has been randomised
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome Assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	9% lost to follow-up
Selective reporting (reporting bias)	Unclear risk	No protocol or trial registration available
Other bias	High risk	The main author received honoraria from the manufacturer

Study ID	**Ghobrial 2020**
Authors:	Ghobrial FK, Shoma A, Elshal AM, Laymon M, El-Tabey N, Nabeeh A, Shokeir AA
Title:	A randomized trial comparing bipolar transurethral vaporization of the prostate with GreenLight laser (xps-180watt) photoselectiven vaporization of the prostate for treatment of small to moderate benign prostatic obstruction: outcomes after 2 years
Journal/Book/Source:	BJU International
Date of Publication:	2020
Volume:	125
Issue:	
Pages:	144–152
METHODS (study design;	RCT

length of follow up)	Follow-up at 1, 4, 12, 24 months	
PARTICIPANTS		
Total Number of Participants randomized	120	
Country of participants	Egypt	
Data collection period	October 2014 - November 2015 (surgery)	
Inclusion criteria	Age >50 years; LUTSsecondary to BOO attributable to BPH for which medical treatment has failed; IPSS >15; maximum urinary flow rate (Qmax) <15 mL/s with at least 125 mL voided volume or acute urinary retention secondary to BPH with failed trial of voiding after medical treatment; and TRUS-estimated prostate size 30–80 mL	
Exclusion criteria	Patients with neurological disorders or diagnosed prostate cancer	
Average age	64	
INTERVENTIONS (technology 1)	PVP (GreenLight laser xps-180watt)	
INTERVENTIONS (technology 2)	Bipolar transurethral vaporization (B-TUVP)	
Number of patients in PVP	58	
Number of patients in B-TUVP	59	
OUTCOMES	Qmax, PVR, IPSS, QoL, IIEF-15, operating time, catheterization time, hospital stay, blood sodium change, UTI, postoperative LUTS, bladder neck contracture, urethral stricture, urinary incontinence, urinary retention, anaemia necessitating blood transfusion, retention/re-catheterization, bladder wall injury, capsular violation, retrograde ejaculation-anejaculation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	All authors declared they had nothing to disclose. Trial registration number: NCT02283684	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer-generated random tables
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and	Unclear risk	Open trial (surgeons cannot be blind), but

personnel (performance bias)		no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	18% of patients were lost to follow-up
Selective reporting (reporting bias)	Low risk	No substantial differences emerge from (limited) information available in the trial register (NCT02283684)
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**WATER Study: Gilling2018**
Authors:	Peter Gilling, Neil Barber, Mohamed Bidair, Paul Anderson, Mark Sutton, Tev Aho, Eugene Kramolowsky, Andrew Thomas, Barrett Cowan, Ronald P. Kaufman, Jr., Andrew Trainer, Andrew Arther, Gopal Badlani, Mark Plante, Mihir Desai, Leo Doumanian, Alexis E. Te, Mark DeGuenther and Claus Roehrborn
Title:	WATER: A Double-Blind, Randomized, Controlled Trial of Aquablation vs Transurethral Resection of the Prostate in Benign Prostatic Hyperplasia
Journal/Book/Source	The journal of urology
Date of Publication	May 2018
Volume:	199
Issue:	-
Pages:	1252-1261
METHODS (study design; length of follow up)	Double-blind, multicentre, prospective RCT
PARTICIPANTS	
Total Number of Participants randomized	184
Country of participants	United States, United Kingdom, Australia, New Zeland
Data collection period	October 2015 – December 2016
Inclusion criteria	Age between 45-80 years old, prostate size between 30 amd 80 gm, IPSS of 12 or grater, maximum urinary flow rate less than 15 ml per second.
Exclusion criteria	History of prostate or bladder cancer, neurogenic bladder, bladder calculus or clinically significant bladder diverticulum, active infection, treatment for chronic prostatitis, diagnosis of urethral stricture, meatal stenosis or bladder neck contracture, a damaged external urinary sphincter, stress urinary incontinence, post-void residual urine greater than 300 ml or urinary retention, selfcatheterization se or prior prostate surgery, men receiving anticoagulants or bladder anticholinergics, men with severe cardiovascular disease
Average age	Aquablation: 66.0±7.3

	TURP: 65.8 ±7.2	
INTERVENTIONS (technology 1)	Aquablation	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients Aquablation	116	
Number of patients in TURP	65	
OUTCOMES	Primary outcomes: IPSS, adverse events classified as Clavien-Dindo Secondary outcomes: resection time and total operative time, hospital stay, reoperation or repeat intervention rate, proportion of sexually active subjects who reported worsening sexual function through 6 months on IIEF-5 (6-point decrease) or MSHQ-EjD (2-point decrease) and proportion of subjects with a serious device or procedure related adverse event. (The reoperation or repeat intervention rate was defined as any invasive procedure, eg cystoscopy, of the lower urinary tract to treat problems potentially related to BPH. The definition excluded required study evaluations and bladder catheterization only without a surgical intervention).	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	ClinicalTrials.gov Identifier NCT02505919 No direct or indirect commercial incentive associated with publishing this article. Supported by PROCEPT BioRobotics (manuscript preparation). Gilling, Anderson, Desai, Te, DeGuenther: Financial interest and/or other relationship with PROCEPT BioRobotics.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Subjects were assigned at random in a 2:1 ratio to Aquablation or TURP. Randomization was done through a web based system and stratified by study site and baseline I-PSS score category with random block sizes."
Allocation concealment (selection bias)	Unclear risk	No mention to allocation mode
Blinding of participants and personnel (performance bias)	Unclear risk	Patients are blinded
Blinding of outcome assessment (detection bias)	Low risk	Patients are blinded and a separate blinded team (coordinator and physician) performed the follow up visits and will do so out to the completion of the trial
Incomplete outcome data (attrition bias)	Low risk	Compliance with study visits was high. Of the patients 178 (98%) completed the 3-month follow up and 175 (97%) completed the 6-month follow up.

Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's pre-specified outcomes that are of interest in the review have been reported in the pre-specified way
Other bias	High risk	Financial interest, manufacturer financed the study.

Study ID	**WATER Study: Gilling2019a**	
Authors:	Peter J. Gilling, Neil Barber, Mohamed Bidair, Paul Anderson, Mark Sutton, Tev Aho, Eugene Kramolowsky, Andrew Thomas, Barrett Cowan and Claus Roehrborn	
Title:	Randomized Controlled Trial of Aquablation versus Transurethral Resection of the Prostate in Benign Prostatic Hyperplasia: One-year Outcomes	
Journal/Book/Source (abbreviation):	Urology	
Date of Publication (year):	2019	
Volume:	125	
Issue:		
Pages:	169-173	
PARTICIPANTS	Same as Gilling 2018	
OUTCOMES	IPSS, quality of life, Qmax, PVR Complications	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	ClinicalTrials.gov Identifier NCT02505919 Conflict of Interest: Mohamed Bidair and Eugene Kramolowsky are consultants for PROCEPT BioRobotics. No other author has a conflict of interest with PROCEPT BioRobotics. Financial Disclosure: The study was funded by PROCEPT BioRobotics.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Subjects were assigned at random (2:1 ratio) to Aquablation or TURP. Assignments, stratified by study site and baseline IPSS score category with random block sizes, were obtained prior to treatment using a web-based system."
Allocation concealment (selection bias)	Unclear risk	No mention to allocation mode
Blinding of participants and personnel (performance bias)	Unclear risk	Patients are blinded
Blinding of outcome assessment (detection bias)	Low risk	All follow-up assessments were administered by a blinded research team (physician and coordinator). Visits included IPSS, uroflow meas-

		urements, quality of life, adverse events, and blinding assessment.
Incomplete outcome data (attrition bias)	Low risk	Overall lost to follow-up lower than 5% (2.8%)
Selective reporting (reporting bias)	Low risk	The protocol is available. 4 main outcomes are reported in figures but are appropriately commented in the results section. Not clear the complications report.
Other bias	High risk	Financial interest, manufacturer financed the study.

Study ID	**WATER Study: Gilling2019b**	
Authors:	Peter J. Gilling, Neil Barber, Mohamed Bidair, Paul Anderson, Mark Sutton, Tev Aho, Eugene Kramolowsky, Andrew Thomas, Barrett Cowan, Ronald P. Kaufman Jr., Andrew Trainer, Andrew Arther, Gopal Badlani, Mark Plante, Mihir Desai, Leo Doumanian, Alexis E. Te , Mark DeGuenther, Claus Roehrborn	
Title:	Two-Year Outcomes After Aquablation Compared to TURP: Efficacy and Ejaculatory Improvements Sustained	
Journal/Book/Source:	Adv Ther	
Date of Publication:	April 2019	
Volume:	36	
Issue:		
Pages:	1326-1336	
PARTICIPANTS	Same as Gilling 2018	
OUTCOMES	2-year efficacy outcomes Procedure-related complications occurring between months 12 and 24	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	ClinicalTrials.gov Identifier NCT02505919 Funding: PROCEPT BioRobotic Funding. WATER, the article processing fees and the Open Access fee were funded by PROCEPT BioRobotics. All authors had full access to all of the data in this study and take complete responsibility for the integrity of the data and accuracy of the data analysis. Disclosures. Mihir Desai is a consultant for PROCEPT BioRobotics and Auris Surgical. Mo Bidair is a consultant for PROCEPT BioRobotics and has performed commercial Aquablation procedures. Eugene Kramalowsky is a consultant for PROCEPT BioRobotics. Peter Gilling has performed commercial Aquablation procedures. Neil Barber has performed commercial Aquablation procedures. Paul Anderson has performed commercial Aquablation procedures.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Subjects were assigned at random (2:1 ratio) to Aquablation or TURP. Assignments, stratified by study site and baseline IPSS score category with random block sizes, were ob-

		tained prior to treatment using a web-based system."
Allocation concealment (selection bias)	Unclear risk	No mention to allocation mode
Blinding of participants and personnel (performance bias)	Unclear risk	Patients are blinded
Blinding of outcome assessment (detection bias)	Low risk	A blinded research team performed al follow-up assessments
Incomplete outcome data (attrition bias)	Low risk	Overall lost to follow-up lower than 5% (4.4%)
Selective reporting (reporting bias)	Low risk	The protocol is available. The efficacy outcomes are reported in graphs but results are commented in the text and a supplementary material with precise numbers concerning IPSS, IPSS QOL, Qmax and complications is provided
Other bias	High risk	Financial interest, manufacturer financed the study

Study ID	**WATER Study: Gilling2020**
Authors:	Peter Gilling, Neil Barber, Mohamed Bidair, Paul Anderson, Mark Sutton, Tev Aho, Eugene Kramolowsky, Andrew Thomas, Barrett Cowan, Ronald P Kaufman Jr, Andrew Trainer, Andrew Arther, Gopal Badlani, Mark Plante, Mihir Desai, Leo Doumanian, Alexis E Te, Mark DeGuenther, Claus Roehrborn
Title:	Three-year outcomes after Aquablation therapy compared to TURP: results from a blinded randomized trial
Journal/Book/Source:	Can J Urol.
Date of Publication:	2020
Volume:	27
Issue:	1
Pages:	10072-10079
METHODS (study design; length of follow up)	Prospective double-blinded multicenter international randomized controlled trial (RCT). Follow up: 3 years.
PARTICIPANTS	Same as Gilling 2018.
OUTCOMES	International Prostate Symptom Score (IPSS), International Index of Erectile Function (IIEF), PVR, QoL, bladder neck contracture, dysuria, retrograde ejaculation, urethral stricture, urinary retention, urinary tract infection, urinary urgency/frequency/difficulty/leakage, dysuria, erectile dysfunction, reintervention.

Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The study was funded by PROCEPT BioRobotics.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Subjects were assigned at random (2:1 ratio) to Aquablation or TURP. Assignments, stratified by study site and baseline IPSS score category with random block sizes, were obtained prior to treatment using a web-based system.
Allocation concealment (selection bias)	Unclear risk	No information available about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	Personnel was not blinded.
Blinding of outcome assessment (detection bias)	Low risk	Assessors and participants were blinded for treatment.
Incomplete outcome data (attrition bias)	Unclear risk	Slightly higher percent of lost to follow up in TURP group (16.4%) than in Aquablation group (15.4%).
Selective reporting (reporting bias)	Low risk	This is a three year follow up and postoperative complications were not reported. Other outcomes (functional and safety) are reported in line with research protocol.
Other bias	High	Financial interest, the manufacturer financed the study.

Note: the three articles Bachmann 2014, Bachmann 2015 and Thomas 2016 are part of the GOLIATH Study, analysed in the EUnetHTA Report OTCA17 [163].

Study ID	**GOLIATH study: Thomas 2016, Bachmann 2014, Bachmann 2015**

6 Authors:		Thomas JA, Tubaro A, Barber N, d'Ancona F, Muir G, Witzsch U, Grimm MO, Benejam J, Stolzenburg JU, Riddick A, Pahernik S, Roelink H, Ameye F, Saussine C, Bruyère F, Loidl W, Larner T, Gogoi NK, Hindley R, Muschter R, Thorpe A, Shrotri N, Graham S, Hamann M, Miller K, Schostak M, Capitán C, Knispel H, Bachmann A.

7	Title:	A Multicenter Randomized Noninferiority Trial Comparing GreenLight-XPS Laser Vaporization of the Prostate and Transurethral Resection of the Prostate for the Treatment of Benign Prostatic Obstruction: Two-yr Outcomes of the GOLIATH Study
	Journal/Book/Source:	8 Eur Urol.
	Date of Publication:	9 2016
	Volume:	10 69
	Issue:	11 1
	Pages:	12 94-102
METHODS (study design; length of follow up)		open-label, multicenter, prospective, randomized, and controlled noninferiority trial (29 centres in nine European countries); 24 months follow up.

13 PARTICIPANTS	
Total Number of Participants randomized	281
Country of participants	nine European countries
Data collection period	Between April 2011 and September 2012
Inclusion criteria	The complete list of inclusion/exclusion criteria was previously published (Bachmann 2014, Table 1): Subject has provided informed consent and agrees to attend all study visits, has diagnosis of lower urinary tract symptoms due to benign prostatic enlargement causing bladder outlet obstruction, is willing to be randomised, is able to complete self-administered questionnaires, is a surgical candidate for either the XPS or the TURP procedure and may be randomised into either arm, is 40–80 yr of age, has an IPSS score ≥ 12 measured at the baseline visit, has medical record documentation of Qmax <15 ml/s, has medical record documentation of a prostate volume ≤100 ml by TRUS, is classified ASA I, II, or III, has a serum creatinine within the normal range for the study centre.
Exclusion criteria	The complete list of inclusion/exclusion criteria was previously published (Bachmann 2014, Table 1) Subject has a life expectancy <2 yrs, is currently enrolled in or plans to enrol in any concurrent drug or device study, has an active infection (eg, urinary tract infection or prostatitis), has a diagnosis of or has received treatment for chronic prostatitis or chronic pelvic pain syndrome (eg, nonbacterial chronic prostatitis), has been diagnosed with a urethral stricture or bladder neck contracture within the last 180 d, has been diagnosed with two or more urethral strictures nd/or bladder neck contractures within 5 yrs, has a diagnosis of lichen sclerosus, has a neurogenic bladder or other neurologic disorder that affects bladder function, has a diagnosis of polyneuropathy (eg, diabetic), has history of lower urinary tract surgery, has diagnosis of stress urinary incontinence that requires treatment or daily pad or device use. Subject has a history of intermittent self-catheterisation, has been catheterised or has a PVR >400 ml in the 14 d prior to the surgical procedure, has current diagnosis of bladder stones., has diagnosis of prostate cancer, has a history of CIS, TaG2, TaG3, or any T1 stage bladder cancer, has damage to external urinary sphincter, has a medical contraindication for undergoing either TURP or XPS surgery, has a disorder of the coagulation cascade (eg, haemophilia) or disorders that affect platelet count or function (eg, von Willebrand disease) that would put the subject at risk for intraoperative or postoperative bleeding. Subject is unable to discontinue anticoagulant and antiplatelet therapy preoperatively (3–5 d) except for low-dose aspirin (eg, ≤100 mg). Subject has had an acute myocardial infarction, open heart sur-

	gery, or cardiac arrest <180 d prior to the date of informed consent. Subject is immunocompromised (eg, organ transplant, leukaemia).	
Average age	Bachmann 2014: PVP: 65.9 ± 6.8 years TURP: 65.4 ± 6.6 years	
INTERVENTIONS (technology 1)	Greenlight photo-vaporization of the prostate (PVP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in PVP	136	
Number of patients in TURP	133	
OUTCOMES	IPSS, Qmax, PVR, Erectile dysfunction (measured by the IIEF-5), Urinary tract infection, Irritative symptoms, Stricture (meatal, urethral, bladder neck), Urinary incontinence, Urinary retention, Reoperation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Funding/Support and role of the sponsor: American Medical Systems (AMS) helped designed and conduct the study, collect, manage, and analyze the data, and prepare, review, and approve the manuscript. This study was sponsored by an AMS clinical grant (NCT01218672). Financial disclosures: James A. Thomas certifies that all conflicts of interest, including specific financial interests and relationships and affiliations relevant to the subject matter or materials discussed in the manuscript (eg, employment/affiliation, grants or funding, consultancies, honoraria, stock ownership or options, expert testimony, royalties, or patents filed, received, orpending), are the following: James A.Thomas and Alexander Bachmann and are the European Joint principal investigators of the Goliath study; both are advisers for AMS and received honoraria for presentations. The other authors have nothing to disclose. Trial registration: The trial was registered at www.clinicaltrials.gov (NCT01218672).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	low risk of bias	Patients were assigned to treatments following a computer generated 1:1 randomization schedule with varying block sizes of two and four, stratified by center.
Allocation concealment (selection bias)	low risk of bias	The treatment assignments were prepared centrally by the study sponsor, sealed in opaque, sequentially numbered envelopes, and opened by trained center staff at the time of randomization.

Blinding of participants and personnel (performance bias)	high risk of bias	patients and treating physicians were not blinded to the therapy
Blinding of outcome assessment SUBJECTIVE OUTCOMES (detection bias)	high risk of bias	See the articles Bachmann 2014 and Bachmann 2015 that are part of the GOLIATH Study with Thomas 2016.
Blinding of outcome assessment OBJECTIVE OUTCOMES (detection bias)	low risk of bias	See the articles Bachmann 2014 and Bachmann 2015 that are part of the GOLIATH Study with Thomas 2016.
Incomplete outcome data (attrition bias)	uncertain risk of bias	Total lost to f-up: 7,4%. Difference in attrition between the two groups =3,1% (lost in PVP group 5,9%; lost in TURP group 9,0%). (Bachmann 2015) For some of the outcomes, attrition varies for different follow-up times; at 12 months lost in TURP group, for IPSS, 5,3%; at 12 months lost in TURP group, for Qmax, 10,4%. In Thomas 2016, few outcomes are reported with their attrition, and it is no more than 7%.
Selective reporting (reporting bias)	uncertain risk of bias	Registered trial. No difference between reported outcomes and protocol in the trial repository. No difference between reported outcomes and methods section, with the following exception: Secondary outcomes included assessments of BPH Impact Index (assessed up to Mo 3). Note that subsequently this outcome is not treated. It's not even in the other two articles of the Goliath Study. (Comment: Unclear risk can be assigned; it is a compromise solution because "only" one outcome is mentioned in the methods and is not reported in the results. This is a single, non-main outcome, so it can be assigned not high risk, but unclear risk.) No outcomes have incomplete data (e.g. data shown as a figure AND without statistical comparison between groups).
Other bias	High risk of bias	Funded by the manufacturer

Study ID	**BPH6 Study: Gratzke 2017**

Authors:	Gratzke et al
Title:	Prostatic urethral lift vs transurethral resection of the prostate: 2-year results of the BPH6 prospective, multicentre, randomised study
Journal/Book/Source:	BJUI
Date of Publication:	2017
Volume:	119
Issue:	-
Pages:	767-775
METHODS (study design; length of follow up)	Prospective RCT, 2 years FU (BPH6 study)
PARTICIPANTS	
Total Number of Participants randomized	80
Country of participants	10 centres in Germany, Denmark and UK
Data collection period	February 2012 – October 2013
Inclusion criteria	Men >50 years old and candidate for TURP, IPSS>12, Qmax≤15 mL/s, and prostate volume ≤60 cc on ultrasonography
Exclusion criteria	Other medical condition or co-morbidity contraindicative for TURP or UroLift
Average age yrs (SD)	PUL: 63 (6.8) TURP: 65 (6.4)
INTERVENTIONS PUL	UroLift System. Investigator experience ranged from 0 to 20 PUL procedures
INTERVENTIONS TURP	Each investigator had xtensive previous experience with TURP and conducted TURP procedures in accordance with their own standards and practices.
Number of patients in PUL	44 (1 patient was excluded due to violation of protocol)
Number of patients in TURP	35
OUTCOMES	IPSS, Sexual Health Inventory for Men (SHIM), Male Sexual Health Questionnaire for Ejaculatory Dysfunction (MSHQ-EjD), Incontinence Severity Index (ISI), Quality of Recovery visual analogue score (QoR VAS), Clavien–Dindo classification of adverse events, QoL, patient satisfaction
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Sponsor NeoTract, Inc. Study authors reported grants from NeoTract, Inc., Astellas, Lilly, Janssen, Amgen, Olympus, Boston Scientific, Intuitive Surgical, Medtronic, Pfizer, Recordati, Allergan. This is a follow-up study of Sonksen 2015.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomisation using permuted blocks of various sizes chosen randomly.
Allocation concealment (selection bias)	Low risk	Consealed through password protected computer.
Blinding of participants and personnel (performance bias)	High risk	Nonblinded study.
Blinding of outcome assessment (detection bias)	Unclear risk	No information available
Incomplete outcome data (attrition bias)	High risk	Over 20% of patients were lost to follow-up in the TURP arm and less than 5% in the PUL arm.
Selective reporting (reporting bias)	Low risk	Outcomes reported in the study protocol are reported in the study.
Other bias	High risk	Funding of the study from the manufacturer of PUL and majority of the study investigators received grants from the the PUL manufacturer, as well as other manufacturers of other products.

Study ID	**Gupta 2006**
Authors:	GUPTA N, KRISHNA S, KUMAR R, DOGRA PN, SETH A
Title:	Comparison of standard transurethral resection, transurethral vapour resection and holmium laser enucleation of the prostate for managing benign prostatic hyperplasia of >40 g
Journal/Book/Source:	BJU International
Date of Publication:	2006
Volume:	97
Issue:	
Pages:	85-89
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 6 and 12 months
PARTICIPANTS	
Total Number of Participants randomized	150
Country of participants	India
Data collection period	2002-2003
Inclusion criteria	Patients with BPH who were candidates for TURP and with glands of >40 g

Exclusion criteria	Patients with a previous history of prostatic and urethral surgery, neurovesical dysfunction, and carcinoma of the prostate	
Average age	66	
INTERVENTIONS (technology 1)	HoLEP	
INTERVENTIONS (technology 2)	Transurethral vapour resection (TUVRP)	
INTERVENTIONS (technology 3)	Transurethral resection oft he prostate (TURP)	
Number of patients in HoLEP	50	
Number of patients in TUVRP	50	
Number of patients in TURP	50	
OUTCOMES	IPSS, Qmax, PVR, operative duration, catheterization time, reduction of serum sodium, recatheterization, fever (UTI), blood transfusion, capsular perforation, bladder mucosal injury, transient dysuria, urethral stricture, incontinence	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Conflict of interest: none declared	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	Just the n. of randomised patients is stated, there is no mention of n. of patients followed up to 1 year

Selective reporting (reporting bias)	Unclear risk	No protocol is available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Habib 2020**
Authors:	Habib E, Ayman LM, ElSheemy MS, El-Feel AS, Elkhouly A, Nour HH, Badawy MH, Elbaz AG, Roshdy MA
Title:	Holmium Laser Enucleation vs Bipolar Plasmakinetic Enucleation of a Large Volume Benign Prostatic Hyperplasia: A Randomized Controlled Trial
Journal/Book/Source:	Journal of endourology
Date of Publication:	2020
Volume:	34
Issue:	3
Pages:	330-338
METHODS (study design; length of follow up)	RCT Follow-up of 12 months
PARTICIPANTS	
Total Number of Participants randomized	64
Country of participants	Egypt
Data collection period	November 2016 to February 2018
Inclusion criteria	IPSS >13, Qmax <15 mL/s, prostate size $\geq$80 g
Exclusion criteria	Presence of a urethral stricture, neurological disorder affecting bladder function, bladder cancer, prostate cancer, or a previous history of TURP or bladder neck surgery
Average age	67
INTERVENTIONS (technology 1)	Holmium laser enucleation of the prostate (HoLEP)
INTERVENTIONS (technology 2)	Bipolar plasmakinetic enucleation of prostate (B-PEP)
Number of patients in HoLEP	33
Number of patients in B-PEP	31
OUTCOMES	PVR, IPSS, Qmax, QoL, IIEF, operative time, catheterization time, hospital stay, pre-post serum sodium, capsule perforation, urinary retention, transient urinary incontinence, irritative symptoms, UTI, blood transfusion, bladder neck contracture
Notes (e.g. funding source;	ClinicalTrials.gov Identifier: NCT03998150. The authors declare

conflicts of Interest; trial registration number, etc)	that no competing financial interests exist and that no funding have been received	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information provided. Judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Low risk	Opaque and sealed envelopes
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias) subjective outcomes	Unclear risk	Not clear if patients were blinded
Blinding of outcome assessment (detection bias) objective outcomes	Low risk	Blinded evaluation
Incomplete outcome data (attrition bias)	Low risk	No loss to follow-up
Selective reporting (reporting bias)	Low risk	No discrepancies with information registered in clinicaltrials.gov
Other bias	Low risk	The authors declared that no competing financial interests exist

Study ID	**Hamouda 2014**
Authors:	Hamouda A, Morsi G, Habib E, Hamouda H, Emam AB, Etafy M
Title:	A comparative study between holmium laser enucleation of the prostate and transurethral resection of the prostate: 12-month follow-up
Journal/Book/Source:	J Clin Urol
Date of Publication:	2014
Volume:	7
Issue:	2
Pages:	99-104
METHODS (study design; length of follow up)	RCT Follow-up at 1, 3, 6, 12 months
PARTICIPANTS	

Total Number of Participants randomized	60	
Country of participants	Egypt	
Data collection period	2009-2010	
Inclusion criteria	Prostate weight 20-80 g; AUA symptom score $\geq$ 12; peak urinary flow rate $\leq$ 15/ml/sec	
Exclusion criteria	Neurogenic bladder, previous urethral, bladder neck or prostate surgery, suspected prostatic cancer by abnormal digital rectal examination (DRE), total serum prostate-specific antigen (SPSA) > 4 ng/ml	
Average age	67	
INTERVENTIONS (technology 1)	Holmium laser enucleation of the prostate (HoLEP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in HoLEP	30	
Number of patients in TURP	30	
OUTCOMES	AUA symptom score (corresponding 7/8 to IPSS); Qmax, PVR, urinary tract infection, blood transfusion, urethral stricture, irritative voiding symptom, incontinence, operative time, catheterization time, hospital stay	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients

Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Low risk	The authors stated that the 60 randomised patients were followed up to 12 months
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Hashim2020**
Authors:	Hashim Hashim, Jo Worthington, Paul Abrams, Grace Young, Hilary Taylor, Sian M Noble, Sara T Brookes, Nikki Cotterill, Tobias Page, K Satchi Swami, J Athene Lane, on behalf of the UNBLOCS Trial Group
Title:	Thulium laser transurethral vaporesection of the prostate versus transurethral resection of the prostate for men with lower urinary tract symptoms or urinary retention (UNBLOCS): a randomised controlled trial
Journal/Book/Source:	Lancet
Date of Publication:	July, 2020
Volume:	359
Issue:	
Pages:	50-61
METHODS (study design; length of follow up)	Randomized, blinded, parallel-group, pragmatic equivalence trial. 12 months follow up
PARTICIPANTS	
Total Number of Participants randomized	410
Country of participants	UK
Data collection period	July 23, 2014 - December 30,2016
Inclusion criteria	Men presenting in secondary care with either bothersome lower urinary tract symptoms or urinary retention, secondary to benign prostatic obstruction, and suitable for TURP surgery (having failed conservative and medical therapy)
Exclusion criteria	Men were excluded if they had neurogenic lower urinary tract symptoms, prostate cancer, previous prostate or urethral surgery, a prostate specific antigen level outside the normal age-related range without prostate cancer excluded, or were unable to give informed consent or complete trial documentation.
Average age	ThuVERP: 70.85 (7.85) TURP: 69.22 (7.91)
INTERVENTIONS (technology 1)	Thalium laser transurethral vaporesection (ThuVERP)
INTERVENTIONS	Transurethral resection (TURP)

(technology 2)		
Number of patients in Thu-VERP	203 (allocated)	
Number of patients in TURP	204 (allocated)	
OUTCOMES	Co-primary outcome: Qmax, IPSS Surgical secondary outcome: complications occurring after leaving recovery until completation of 12-month follow up, length of hospital stay, perioperative complications, postoperative catheterisation time, urinary podt-void residual, blood loss during surgery (change in haemoglobin and blood transfusion rate), absorption of irrigation fluid. Low urinary tract symptoms (IPSS, ICIQ-MLUTS) Sexual function (ICIQ-MLUTSsex, IIEF) Quality of life (IPSS QoL subscore, ICIQ-LUTSqol) Patient satisfaction (ICIQ Satisfaction questionnaire)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	PA reports grants and personal fees from Astellas Pharma and personal fees from Pfizer, Ipsen, Pierre Fabre, Coloplast UK, and Sun Pharmaceuticals Industries, outside the submitted work. All other authors declare no competing interests. The trial is registered with the ISRCTN Registry, ISRCTN00788389. Role of the funding source: The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Patients were randomly assigned (1:1) to TURP or ThuVARP through an automated, computer-generated web or telephone randomisation system.
Allocation concealment (selection bias)	Unclear risk	No mention in the text
Blinding of participants and personnel (performance bias)	Unclear risk	Patients remained masked to their allocation while surgeons clearly were not masked
Blinding of outcome assessment (detection bias) SUBJECTIVE OUTCOMES	Low risk	Outcome assessors were not masked
Blinding of outcome assessment (detection bias) OBJECTIVE OUTCOMES	High risk	Outcome assessors were not masked
Incomplete outcome data (attrition bias)	Low risk	
Selective reporting (reporting bias)	Low risk	
Other bias	Low risk	One author reports grants and personal fees from pharmaceutical industry,

		but not from other companies producing technologies for BPH. Other authors have nothing to declare.

Study ID	**He 2019**
Authors:	Gaofei He, Yuanyuan Shu, Bohan Wang, Chuanjun Du, Jimin Chen, Jiaming Wen
Title:	Comparison of Diode Laser (980 nm) Enucleation vs Holmium Laser Enucleation of the Prostate for the Treatment of Benign Prostatic Hyperplasia: A Randomized Controlled Trial with 12-Month Follow-Up
Journal/Book/Source:	J Endurol.
Date of Publication:	2019
Volume:	33
Issue:	10
Pages:	843-849
METHODS (study design; length of follow up)	RCT Follow up: 3, 6, and 12 months.
PARTICIPANTS	
Total Number of Participants randomized	126
Country of participants	China
Data collection period	December 2016 - December 2017
Inclusion criteria	The BPH patients who required surgical treatment. Additional criteria were: (1) maximum flow rate (Qmax) ≤15 mL/s, (2) quality of life (QoL) score ≥3, and (3) international prostate symptom score (IPSS) ≥8.
Exclusion criteria	(1) confirmed prostate cancer or history of prostate surgery, (2) acute prostatitis or urethritis, and (3) neurogenic bladder and urethral injury.
Average age	DiLEP: 71.7 ± 8.7 years HoLEP: 71.6 ± 9.8 years
INTERVENTIONS (technology 1)	DiLEP
INTERVENTIONS (technology 2)	HoLEP
Number of patients in DiLEP	63
Number of patients in HoLEP	63
OUTCOMES	Qmax, postvoid residual (PVR), IPSS, QoL, decrease in serum sodium, bladder injury, blood transfusion, capsule perforation,

	TUR syndrome, urinary retention, re-catheterization, retrograde ejaculation, urinary incontinence, UTI, urethral stricture, bladder neck contracture, operative time, catheter duration, hospital stay.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	This randomized controlled trial (RCT) was registered in the Chinese Clinical Trials Register (ChiCTR 190002207). This work was supported by grants from Zhejiang Provincial Natural Science Foundation of China (No. LY18H040007 to J.W.) and the National Natural Science Foundation of China (No. 81871153 to J.W. and 81500532 to B.W.).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	The computer-generated allocation sequence was used for randomization of the patients.
Allocation concealment (selection bias)	Unclear risk	No information about concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information about blinding.
Blinding of outcome assessment (detection bias)	Unclear risk	No information whether outcome assessment was blinded.
Incomplete outcome data (attrition bias)	Low risk	No lost to follow up occurred in neither of two groups.
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the pre-specified functional outcomes are reported in the study.
Other bias	Low risk	No funding was received for this article and authors have no conflict of interest to declare.

Study ID	**Higazy 2020**
Authors:	Higazy A, Tawfeek AM, Abdalla HM, Shorbagy AA, Mousa W, Radwan AI
Title:	Holmium laser enucleation of the prostate versus bipolartransurethral enucleation of the prostate in management of benignprostatic hyperplasia: A randomized controlled trial
Journal/Book/Source:	International Journal of Urology
Date of Publication:	2020
Volume:	-
Issue:	online before inclusion in an issue
Pages:	-

METHODS (study design; length of follow up)	RCT Follow-up: 12 months
PARTICIPANTS	
Total Number of Participants randomized	120
Country of participants	Egypt
Data collection period	April – December 2018
Inclusion criteria	LUTS secondary to BPH with prostatic volume>80 mL, failed medical treatment, refractory hematuria, recurrent attacks of urine retention, upper urinary tract affected or high IPSS≥20 that affects QoL.
Exclusion criteria	Patients using anticoagulant or antiplatelet medications, or those with neurogenic bladder, urethral stricture, bladder stones, prostate cancer, previous prostate or urethral surgery were excluded.
Average age	HoLEP: 66.1 (7.22) B-PEP: 67.7 (6.48)
INTERVENTIONS (technology 1)	HoLEP
INTERVENTIONS (technology 2)	B-PEP
Number of patients in HoLEP	54
Number of patients in B-PEP	53
OUTCOMES	mean operative time (from the initiation of the endoscopic procedure to catheter insertion), enucleation and morcellation time, the volume of resected tissue, perioperative complications according to the Clavien–Dindo classification, catheter removal time, hospital stay, PSA, Qmax, PVR, IPSS, QoL (1, 3 and 12-month follow-up). For patients who started to develop a recurrence of symptoms with a drop in their Qmax, the incidence of urethral stricture or bladder neck contracture was evaluated.
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	NCT04275076 Conflicts of interest: none declared.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Uncertain risk	It is not described in the publication.
Allocation concealment (selection bias)	Low risk	Patients were randomized into two groups with a 1:1 ratio using sealed envelopes thatwere prepared by the department's ethics committee.
Blinding of participants and personnel (performance bias)	Low risk	Patients were blinded to the type of intervention, as were the data collector

		and the statistician.
Blinding of outcome assessment (detection bias)	Low risk	Patients were blinded to the type of intervention, as were the data collector and the statistician.
Incomplete outcome data (attrition bias)	Low risk	In one treatment arm 10% loss-to follow-up, in the other treatment arm even less than 10%.
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's pre-specified outcomes that are of interest in the review have been reported in the pre-specified way.
Other bias	Low risk	Authors declared no conflicts of interest.

Study ID	**Hon 2006**
Authors	Hon NHY, Brathwaite D, Hussain Z, Ghiblawi S, Brace H, Hayne D, Coppinger SWV
Title:	A Prospective, Randomized Trial Comparing Conventional Transurethral Prostate Resection With PlasmaKinetic® Vaporization of the Prostate: Physiological Changes, Early Complications and Long-Term Followup
Journal/Book/Source:	THE JOURNAL OF UROLOGY
Date of Publication:	2006
Volume:	176
Issue:	
Pages:	205-209
METHODS (study design; length of follow up)	RCT Mean follow-up: 247-265 days
PARTICIPANTS	
Total Number of Participants randomized	160
Country of participants	United Kingdom
Data collection period	Not stated
Inclusion criteria	Bladder outflow obstruction undergoing elective transurethral prostatectomy
Exclusion criteria	Previous myocardial infarction within the 6 months preceding surgery, previous TURP, confirmed or suspected prostate cancer, serum creatinine more than 200 mmol/l and prostate volume greater than 80 cc
Average age	67

INTERVENTIONS (technology 1)	Plasmakinetic prostate vaporization (PKVP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in PKVP	81	
Number of patients in TURP	79	
OUTCOMES	Resection time, intraoperative blood loss, serum sodium change, postoperative stay, transfusion, urethral stricture, reintervention, IPSS, Qmax, Qmed, PVR, QoL	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer generated numbers
Allocation concealment (selection bias)	Low risk	Opaque envelopes
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	6 to 7,5% of patients were lost to follow-up (similar numbers between the two groups).
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Insausti 2020**
Authors:	Insausti I, Ocariz AS, Galbete A, Capdevila F, Solchaga S, Giral P, Bilhim T, Isaacson A, Urtasun F, Napal S
Title:	Randomized Comparison of Prostatic Artery Embolization versus Transurethral Resection of the Prostate for Treatment of Benign Prostatic Hyperplasia
Journal/Book/Source:	J Vasc Interv Radiol
Date of Publication:	2020

Volume:	31
Issue:	-
Pages:	882-890
METHODS (study design; length of follow up)	RCT Follow-up: 12 months
PARTICIPANTS	
Total Number of Participants randomized	61
Country of participants	Spain
Data collection period	November 2014 - January 2017
Inclusion criteria	age>60 years; BPH-related LUTS refractory to medical treatment for at least 6 months or the patient could not tolerate medical treatment; IPSS ≥ 8; QoL related to LUTS ≥ 3; Qmax ≤ 10 mL/s or urinary retention
Exclusion criteria	advanced atherosclerosis and tortuosity of the iliacarteries, non-visualization of the prostatic artery or other accessory arteries supplying the prostate on computed tomography angiography, urethral stenosis, detrusorfailure or neurogenic bladder, glomerularfiltration rate of less than 30 mL/min, and the presence of prostate cancer
Average age	PAE: 72.4 (6.2) TURP: 71.8 (5.5)
INTERVENTIONS (technology 1)	PAE
INTERVENTIONS (technology 2)	TURP
Number of patients in PAE	31
Number of patients in TURP	30
OUTCOMES	Qmax, IPSS, QoL, prostate volume, PVR, IIEF-6, PSA, adverse events according to Clavien-Dindo classification, patient satisfaction, pain
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	NCT01963312 Manufacturer funded study.

	Authors' judgement	**Support for judgement**
Random sequence generation (selection bias)	Low risk	A simple, unreplaced 1:1 randomization was performed in balanced blocks of 6. The principal investigator randomly selected a number from a table of random numbers determining the

		sequence of 10 blocks.
Allocation concealment (selection bias)	Unclear risk	It is described in the study that the random sequence was known only by the study data manager, and the individual enrolling participants were unaware of the allocation of the next participants. This is unclear if the participants were aware of their own allocation.
Blinding of participants and personnel (performance bias)	High risk	There was no blinding of clinicians or patients due to the nature of the trial.
Blinding of outcome assessment (detection bias)	Unclear risk	It was not described in the study.
Incomplete outcome data (attrition bias)	High risk	74 resp. 73% of randomised patients were analysed and this number was below the pre-specified 80% of power required for the non-inferiority hypothesis.
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's pre-specified outcomes that are of interest in the review have been reported in the pre-specified way.
Other bias	High risk	Manufacturer sponsored study. The authors did not include a statement on conflicts of interest.

Study ID	**Jahnson 1998**
Authors:	JAHNSON S, DALEN M, GUSTAVSSON G, PEDERSEN J
Title:	Transurethral incision versus resection of the prostate for small to medium benign prostatic hyperplasia
Journal/Book/Source:	Br J Urol
Date of Publication:	1998
Volume:	81
Issue:	
Pages:	276–281
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 2–3, 6, 12, 24, 60 months
PARTICIPANTS	
Total Number of Participants randomized	85

Country of participants	Sweden	
Data collection period	1991	
Inclusion criteria	No previous treatment for BPH; estimated prostate weight 20–40 g; distance from verumontanum to bladder neck <4.0 cm	
Exclusion criteria	Bladder stone; bladder cancer; prostatitis; prostatic cancer; prominent median lobe	
Average age	71	
INTERVENTIONS (technology 1)	Transurethral incision of the prostate (TUIP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in TUIP	43	
Number of patients in TURP	42	
OUTCOMES	Qmax, PVR, blood loss, transfusion, catheterisation time, operative duration, reinterventions	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	High risk	Up to 25% patients with missing data at 24 months
Selective reporting (reporting bias)	High risk	For some critical outcomes: data only presented as figures and lack of statistical

		comparisons in parallel (only before-after comparisons for each group)
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Jahnwar 2017**
Authors:	Jhanwar A, Sinha RJ, Bansal A, Prakash G, Singh K, Singh V
Title:	Outcomes of transurethral resection and holmium laser enucleation in more than 60 g of prostate: A prospective randomized study
Journal/Book/Source:	Urology Annals
Date of Publication:	2017
Volume:	9
Issue:	
Pages:	45-50
METHODS (study design; length of follow up)	Randomised controlled trial. Follow up at 1, 3, 6, 12, 24 months
PARTICIPANTS	
Total Number of Participants randomized	164
Country of participants	India
Data collection period	2012-2015
Inclusion criteria	Age < 75, Qmax <15 ml/s, prostate size >60 g, gross hematuria secondary to BPH, recurrent urinary tract infection (UTI), acute urinary retention, PVR > 150 ml, Schafer Grade II or more in pressure flow study
Exclusion criteria	BPH with associated neurogenic bladder, stricture urethra, prostatic carcinoma, or previous history of intervention
Average age	67
INTERVENTIONS (technology 1)	Holmium laser enucleation of the prostate (HoLEP)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in HoLEP	72
Number of patients in TURP	72
OUTCOMES	IPSS, PVR, Qmax, blood transfusion, TUR syndrome, reduction of serum sodium, urinary tract infection, urinary incontinence, urethral stricture, recatheterization, IIEF, hospital stay, catheterization time

Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declared the absence of any financial support and of conflicts of interest	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	6% of randomised patients were lost to follow-up. 11 patients were excluded before randomization for lack of consent
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	Low risk	The authors declared that there were no conflicts of interest.

Study ID	**Jovanovic 2014**
Authors:	Jovanović M, Džamić Z, Aćimović M, Kajmaković B, Pejčić T
Title:	Usage of GreenLight HPS 180-W laser vaporisation for treatment of benign prostatic hyperplasia
Journal/Book/Source:	Acta Chir Iugosl
Date of Publication:	2014
Volume:	61
Issue:	1
Pages:	57-61
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 1, 3, 6, 12 months

PARTICIPANTS		
Total Number of Participants randomized	62	
Country of participants	Serbia	
Data collection period	2011-2013	
Inclusion criteria	Patients with moderate or severe LUTS (IPSS >16), failure of previous medical treatment with a washout period of at least 2 weeks, Qmax <15 ml/s, PVR urine >100 ml, prostate volume (TRUS) <100 ml	
Exclusion criteria	Patients on anticoagulants, those with urethral strictures, bladder stone or neurogenic bladder or diagnosed or suspected of having prostate cancer	
Average age	67	
INTERVENTIONS (technology 1)	Photovaporization of the prostate (PVP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in PVP	31	
Number of patients in TURP	31	
OUTCOMES	IPSS, Qmax (ml/s) , PVR, operative time, catheterisation time, hospital stay, blood transfusion, capsule perforation, TURP syndrome, dysuria/urge, bladder neck contracture, urethral stricture, urinary incontinence	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs

Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	No information on loss to follow-up was reported
Selective reporting (reporting bias)	High risk	Point estimates at different time follow-up were not reported
Other bias	Unclear risk	No information available about possible conflicts of interest

Study ID	**Karadag 2014**
Authors:	Karadag MA, Cecen K, Demir A, Kocaaslan R, Altunrende F
Title:	Plasmakinetic vaporization versus plasmakinetic resection to treat benign prostatic hyperplasia: A prospective randomized trial with 1 year follow-up
Journal/Book/Source:	Can Urol Assoc J
Date of Publication:	2014
Volume:	8
Issue:	
Pages:	e595-9
METHODS (study design; length of follow up)	RCT Follow-up at 1 and 12 months
PARTICIPANTS	
Total Number of Participants randomized	183
Country of participants	Turkey
Data collection period	2008-2012
Inclusion criteria	Moderate to severe LUTS, based on IPSS, requiring surgery, recurrent urinary retention, failed medical therapy (at least 21 days) and obstructive pressure flow study or Qmax less than 10 mL/s
Exclusion criteria	Suspicion of prostatic adenocarcinoma, abnormal DRE or elevated PSA, known urethral stricture or neurogenic bladder and a history of prostate surgery
Average age	67
INTERVENTIONS	Plasmakinetic vaporization of the prstate (PKVP)

(technology 1)		
INTERVENTIONS (technology 2)	Plasmakinetic resection of the prstate (PKRP)	
Number of patients in PKVP	96	
Number of patients in PKRP	87	
OUTCOMES	Qmax, PVR, IPSS, blood loss, catheterization time, operation time, infravesical obstruction, incontinence, recatheterization, UTI	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Authors declared no competing financial or personal interests.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Allocation concealment (selection bias)	Unclear risk	Not mentioned by the authors and judged according to rating criteria indicated in the Cochrane handbook, although we strongly believe that information on randomization procedures should not be missing in RCTs
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Unclear risk	No indication of any type is available on n. of patients at follow-up
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	All authors declared no competing financial interests

Study ID	**Kaya 2007**
Authors:	Kaya, Ilktac, Gokmen, Ozturk, Kraman
Title:	The long-term results of transurethral vaporization of the

	prostate using plasmakinetic energy	
Journal/Book/Source:	BJU International	
Date of Publication:	2006	
Volume:	99	
Issue:	-	
Pages:	845-848	
METHODS (study design; length of follow up)	RCT	
PARTICIPANTS		
Total Number of Participants randomized	40	
Country of participants	Turkey	
Data collection period	2001-2003	
Inclusion criteria	Qmax < 10 mL/s or obstructive pressure-flow study, severe LUTS requiring surgical treatment, based on the IPSS and a prostate volumen of <60 mL	
Exclusion criteria	Neurogenic bladder, prostate cancer, urethral strcxiture and previous prostate surgery	
Average age	PKVP: 67.2 (58-78) TURP: 66 (53-74)	
INTERVENTIONS (technology 1)	PKVP: with plasmakinetic 27 F resectoscope with a plasmakinetic loop electrode of the Plasma Kinetic Management System (Gyrus Medical Ltd), including a bipolar electrosurgical device used endoscopically to instantly remove the obstrcting prostate tissue by vaporisation.	
INTERVENTIONS (technology 2)	TURP: with 26 F continuous flow resectoscope	
Number of patients in PKVP	25	
Number of patients in TURP	15	
OUTCOMES	IPSS, Qmax, urethral stricture, erectile dysfunction, retrograde ejaculation, overall satisfaction	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Non declared.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	It is reported that from 75 admitted patients 40 were randomised. It is not clear why the rest were not randomised

		and how the 40 were selected for randomisation.
Allocation concealment (selection bias)	High risk	It is reported that those were included in the study who returned for follow-up.
Blinding of participants and personnel (performance bias)	Unclear risk	Not reported.
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported.
Incomplete outcome data (attrition bias)	Low risk	No loss to follow-up.
Selective reporting (reporting bias)	Low risk	Outcomes specified in the methods are reported on in the results.
Other bias	Unclear risk	Trial registration number and funding source were not reported.

Study ID	**Kini 2020**
Authors:	Kini et al.
Title:	Ejaculatory hood-sparing photoselective vaporization of the prostate vs bipolar button plasma vaporization of the prostate in the surgical management of benign prostatic hyperplasia
Journal/Book/Source:	Journal of Endourology
Date of Publication:	2020
Volume:	34
Issue:	-
Pages:	322-329
METHODS (study design; length of follow up)	RCT 6 month follow-up
PARTICIPANTS	
Total Number of Participants randomized	27
Country of participants	USA
Data collection period	August 2016 – March 2018
Inclusion criteria	Sexually active, antegrade ejaculation before the intervention, LUTS secondary to BPH, IPSS >12, Qmax <15 mL/s, prostate volume <80 mL
Exclusion criteria	Chronic prostatitis, chronic pelvic pain syndrome, urethral stricture, bladder neck contracture within 5 years, pre-existing erectile or ejaculatory dysfunction
Average age	PVP: 66.1 (7.5) BPVP: 65.1 (9.5)
INTERVENTIONS (technology 1)	Photovaporisation of the prostate with Greenlight Laser 180 W (PVP)
INTERVENTIONS (technology 2)	Plasma vaporization with bipolar energy (B-PVP)

Number of patients in PVP	13	
Number of patients in B-PVP	14	
OUTCOMES	Ejaculation preservation (measured by Male Sexual Health Questionnaire), IPSS, QoL (measured by SF-12 and overactive bladder questionnaire form), PVR, PSA	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Boston Scientific supported the study with a grant. One of the study authors who was one of the two surgeons performing the interventions was a consultant for Boston Scientific, Olympus, Meditate. The other authors did not report finacial interests.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Fix block size of 2, order of treatment within the block was randomly permuted, random number sequence was used to choose a particular block
Allocation concealment (selection bias)	Low risk	After enrollment the patients were randomly allocated with a fixed block size of 2.
Blinding of participants and personnel (performance bias)	Unclear risk	No information provided.
Blinding of outcome assessment (detection bias)	Low risk	Objective outcomes: Analysis was performed by an independent statistician and the specific study results were not shared with the study authors, site personnel and patients.
	High risk	Subjective outcomes: these are self-assessed by patients, therefore blinding of assessors will not influence the risk of bias.
Incomplete outcome data (attrition bias)	High risk	Based on the interim analysis the study was termintated.
Selective reporting (reporting bias)	High risk	The authors state that the study was not intended as a regsitration trial.
Other bias	High risk	Financial interest, manufacturer financed the study.

Study ID	**Kuntz 2004**
Authors:	Kuntz, Ahyai, Lehrich, Fayad
Title:	Transurethral Holmium Laser enucleation of the prostate versus transurethral electrocautery resection of the prostate: a randomised prospective trial in 200 patients
Journal/Book/Source:	The Journal of Urology
Date of Publication:	2004

Volume:	172	
Issue:	-	
Pages:	1012-1016	
METHODS (study design; length of follow up)	RCT 12 month follow-up	
PARTICIPANTS		
Total Number of Participants randomized	200	
Country of participants		
Data collection period	June 1999 - December 2001	
Inclusion criteria	AUA symptom score ≥ 12, Qmax ≤ 12 ml/s (voided volume ≥ 150 ml), PVR > 50 ml, urodynamic obstruction in pressure flow (Schäfer grade) ≥ 2, prostate volume < 100 cc	
Exclusion criteria	Carcinoma of the prostate (evaluated by TRUS guided biopsies in patients with abnormal digital rectal examination, elevated serum prostate specific antigen and/or suspicious lesions on TRUS). Patients who had undergone previous urethral or prostatic surgery were also excluded.	
Average age	HoLEP: 68.0 ± 7.3 TURP: 68.7 ± 8.2	
INTERVENTIONS (technology 1)	HoLEP was performed with a maximum average power of 80 W (2.0 J at 40 Hz) or 100 W (2.0 J at 50 Hz). The prostatic lobes were enucleated subtotally.	
INTERVENTIONS (technology 2)	A standard tungsten wire loop with a cutting current of 80 W and a coagulating current of 160 was used.	
Number of patients in HoLEP	100	
Number of patients in TURP	100	
OUTCOMES	AUA symptom score, Qmax, postoperative catheter time, total postoperative hospital stay, haemoglobin loss, resected tissue weight, total operative time (time that the resectoscope sheath was within the urethra), decrease in serum sodium, total laser energy (in the holmium group), PVR, sexual function, continence, intraoperative and postoperative complications	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Financial interest and/or other relationship with Lumenis, Inc. and Karl Storz, Inc.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomised with a schedule balanced in blocks of 4
Allocation concealment	Unclear risk	Not described

(selection bias)		
Blinding of participants and personnel (performance bias)	Unclear risk	Not described
Blinding of outcome assessment (detection bias)	Unclear risk	Not described
Incomplete outcome data (attrition bias)	Low risk	Loss-to-follow-up is explained by the exclusion of patients with prostate cancer at 1 month. At 6 and 12 months, loss-to-follow-up was under 5%.
Selective reporting (reporting bias)	Low risk	
Other bias	High risk	Financial interest from manufacturer of product under assessment

Study ID	**Li 2013**
Authors:	Li, Pan, Liu, He, Song, Jlang, Zhou
Title:	Selective Transurethral Resection of the Prostate Combined with Transurethral Incision of the Bladder Neck for Bladder Outlet Obstruction in Patients with Small Volume Benign Prostate Hyperplasia (BPH): a Prospective Randomized Study
Journal/Book/Source:	Plos One
Date of Publication:	2013
Volume:	8
Issue:	5
Pages:	e63227
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	124
Country of participants	China
Data collection period	July 2009 – June 2010
Inclusion criteria	≥ 50 years; diagnosis of BPH; capable of reading, understanding and completing a symptom and Quality of Life questionnaire; prostate grand volume 20 to 40 cm3; IPSS≥ 20, failed conservative medical therapy; BOO on urodynamic study; normal urinary bladder function
Exclusion criteria	History or evidence of prostate cancer or bladder cancer; PSA level > 4.0 ng/mL; previous prostate surgery or other invasive procedures to treat BPH; diabetes mellitus, cerebrovascular events, and/or neurogenic diseases; was expected to move out

	of the are during study period; currently participating in a clinical trial or other research study	
Average age	TURP: 68.66 (7.52) STURP+TUIP: 66.83 (4.91)	
INTERVENTIONS (technology 1)	TURP	
INTERVENTIONS (technology 2)	Selective transurethral resection combined with transurethral incision of the bladder neck performed using Olympus resectoscope (STURP+TUIP)	
Number of patients in TURP	61	
Number of patients in STURP+TUIP	63	
OUTCOMES	Operation time, intraoperative blood loss, hospital stay, changes in hemoglobin and serum sodium, catheterization time, TURP syndrome, perioperative complications, IPSS, Qmax, PVR, major adverse events (acute urinary retention, need for prostate biopsy, gross hematuria, acute urinary tract infection, urinary stricture, bladder contracture, prostate cancer), QoL, PSA level	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	It is not reoprted how the patients were randomized, only that they were randomized.
Allocation concealment (selection bias)	Unclear risk	It is not reported if and how allocation concealment happenned.
Blinding of participants and personnel (performance bias)	Unclear risk	Not reported.
Blinding of outcome assessment (detection bias)	High risk	Same personnel designed the study, analyzed data and collected the data.
Incomplete outcome data (attrition bias)	Low risk	Study outcomes specified in the methods are reported in the results section.
Selective reporting (reporting bias)	High risk	Ther methods section states that 1,3,6 and 12 month follow-up data for the primary endpoints (QoL and IPSS) are recorded, however, the baseline QoL score, the 1,3 and 12 months follow-up data for QoL and IPSS are not reported.
Other bias	Unclear risk	Funding source, conflicts of interest and trial numbers are not reported.

Study ID	**Li 2017**
Authors:	K.Li, Wang, Hu, Mao, M.Li, Si-Tu, Huang, W.Qiu, J.Qiu
Title:	A Novel Modification of Transurethral Enucleation and Resection of the Prostate in Patients With Prostate Glands Larger than 80 mL: Surgical Procedures and Clinical Outcomes
Journal/Book/Source:	Urology
Date of Publication:	2018
Volume:	113
Issue:	-
Pages:	153-159
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	86
Country of participants	China
Data collection period	April 2012 – May 2014
Inclusion criteria	Prostate volume > 80 mL; IPSS> 13, Qmax < 10 mL/s, recurrent or persistent gross hematuria caused by an enlargement of the prostate or the bladder calculi. 5α-reductase inhibitors or α-blockers had to be stopped before surgery.
Exclusion criteria	Prostate or bladder cancer, neurogenic bladder, permanent anticoagulation therapy, previous urethral or prostate surgery
Average age	B-TURP: 69.89 (8.1) M-TUERP: 73.33 (5.9)
INTERVENTIONS (technology 1)	Bipolar transurethral resection of the prostate (B-TURP) (Olympus plasmakinetic bipolar system with 140 W cutting and 60 W coagulating power)
INTERVENTIONS (technology 2)	Modified transurethral enucleation and resection (M-TUERP) (Olympus plasmakinetic bipolar system)
Number of patients in B-TURP	44
Number of patients in M-TUERP	42
OUTCOMES	PVR, QoL, IPSS, Qmax, PSA level, prostate volume, change in serum sodium level and hemoglobin, duration of surgery, weight of resected tissue, intraoperative IP, bladder irrigation fluid drainage, catheterization time, immediate or late postoperative complications, TUR syndrome, micturition parameters
Notes (e.g. funding source;	Authors reported that they had no relevant financial interestst.

conflicts of Interest; trial registration number, etc)	The study was supported by the National Natural Science Foundation of China, National Natural Science Foundation of Guangdong Province, Science and Technology Program of Guangzhou, Basic Service Charge Young Teachers Cultivation Project of Sun Yat-sen University, Medical Scientifc Research Foundation of Guangdong Province.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	It is reported that a sealed envelope sequence was used and that patients were randomized. It is not detailed how the randomization took place.
Allocation concealment (selection bias)	Low risk	Sealed envelope sequence was used.
Blinding of participants and personnel (performance bias)	High risk	Neither patients, nor surgeons were blinded.
Blinding of outcome assessment (detection bias)	High risk	Subjective outcomes: As patients and surgeons were not blinded, for the subjective outcomes, the blinding of outcome assessment has no influence on potential bias.
	Low risk	Objective outcomes: 2 independen investigators carried out the follow-up management.
Incomplete outcome data (attrition bias)	Unclear risk	Loss-to follow-up is not reported.
Selective reporting (reporting bias)	Unclear risk	IPSS, QoL, Qmax and PVR follow-up date are reported only in figures/graphs and not tabular view (exact numbers are not known), but the authors presented a between group statistical analysis as well.
Other bias	Unclear risk	Study registration number was not reported. There are no financial interests though.

Study ID	**Luo 2014**
Authors:	Luo, Shen, Guan, Li, Wang
Title:	Plasmakinetic Enucleation of the Prostate vs Plasmakinetic Resection of the Prostate for Benign Prostatic Hyperplasia: Comparison of Outcomes According to Prostate Size in 310 Patients
Journal/Book/Source:	Urology

Date of Publication:	2014	
Volume:	84	
Issue:	-	
Pages:	904-910	
METHODS (study design; length of follow up)	RCT	
PARTICIPANTS		
Total Number of Participants randomized	310	
Country of participants	China	
Data collection period	October 2009 – October 2011	
Inclusion criteria	Qmax<15 mL/s, IPSS> 12, medical therapy failure, TRUS volume >20 ml with no upper limit	
Exclusion criteria	Abnormal digital rectal examination, increased serum PSA level, known neurogenic bladder, history of prostatic or urethral surgery	
Average age	PKEP: 70 (5.7) PKRP: 69.8 (5.9)	
INTERVENTIONS (technology 1)	Plasmakinetic enucleation (PKEP): 27F Storz resectoscope (Karl Storz) with Gyrus Plasmakinetic SuperPulse System with a cutting power of 160 W and coagulating power of 80 W	
INTERVENTIONS (technology 2)	Plasmakinetic resection (PKRP): 27F Storz resectoscope (Karl Storz) with Gyrus Plasmakinetic SuperPulse System with a cutting power of 160 W and coagulating power of 80 W	
Number of patients in PKEP	155	
Number of patients in PKRP	155	
OUTCOMES	IPSS, Qmax, QoL, PVR, TURS, UTI, incontinence, recatheterizatoin, bladder neck contracture, urethral stricture, blood transfusion, hospital stay, catheter time, blood loss, operation time, resected tissue weight	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	It is not reported how the randomization happenned but randomization to 1:1 is mentioned only.
Allocation concealment (selection bias)	Unclear risk	Not reported.

Blinding of participants and personnel (performance bias)	Unclear risk	Not reported.
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported.
Incomplete outcome data (attrition bias)	Unclear risk	10% loss to follow-up at the 24 month follow-up visit.
Selective reporting (reporting bias)	Low risk	In the methods section listed outcomes were reported on.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Lusuardi 2011**
Authors:	Lusuardi, Myatt, Sieberer, Jeschke, Zimmermann, Janetschek
Title:	Safety and Efficacy of Eraser Laser Enucleation of the Prostate: Preliminary Report
Journal/Book/Source:	The Journal of Urology
Date of Publication:	2011
Volume:	186
Issue:	-
Pages:	1967-1971
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	60
Country of participants	Austria
Data collection period	Febr 2010 – Sept 2010
Inclusion criteria	Symptomatic bladder outflow obstruction
Exclusion criteria	Suspicion of prostate cancer, patients on oral anticoagulation and 5α-reductase inhibitor
Average age	ELEP: 66.5 (5.96) B-TURP: 65.7 (6.2)
INTERVENTIONS (technology 1)	Eraser laser enucleation (ELEP) with Storz laser resectoscope, 120 W output power, tissue morcellation with the Piranha Laser Enuckleations-System
INTERVENTIONS (technology 2)	Bipolar TURP using Plasmakinetic^{TM} system (B-TURP)
Number of patients in ELEP	30

Number of patients in B-TURP	30	
OUTCOMES	Blood loss, operative time, catheter time, hospital time, intraop irrigation, morcellation time, resected wt, retrieval rate, bleeding velocity, Hb loss, postop Hb, Qmax, IPSS, QoL, PVR	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Balanced, blocked randomization with a block size of 6 patients.
Allocation concealment (selection bias)	Unclear risk	Not reported.
Blinding of participants and personnel (performance bias)	Unclear risk	Not reported if patients were blinded or not. Surgeon was not blinded.
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported.
Incomplete outcome data (attrition bias)	Unclear risk	The number of participants in the follow-up visits is not reported.
Selective reporting (reporting bias)	Low risk	Study regsitration number is not reported, outcomes litsed in the methods section are reported on.
Other bias	Unclear risk	Funding source, conflicts of interests are not reported.

Study ID	**Mavuduru 2009**
Authors:	Mavuduru, Mandal, Singh, Acharya, Agarwal, Garg, Kumar
Title:	Comparison of HoLEP and TURP in Terms of Efficacy in the Early Postoperative Period and Perioperative Morbidity
Journal/Book/Source:	Urol Int
Date of Publication:	2009
Volume:	82
Issue:	-
Pages:	130-135
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	30

Country of participants	India	
Data collection period	Not reported	
Inclusion criteria	Patiens who underwent BPH surgery.	
Exclusion criteria	History of previous prostatic or urethral surgery, and documented cases of prostate carcinoma	
Average age	TURP: 66.46 (5.79) HoLEP: 69.86 (9.6)	
INTERVENTIONS (technology 1)	TURP with 26-Fr resectoscope (Karl Storz) with 100-120 W cutting current, 50-60 W coagulating current	
INTERVENTIONS (technology 2)	HoLEP (550 nm end-firing flexible quartz, 27-Fr resectoscope, Versapulse Holmium laser)	
Number of patients in TURP	15	
Number of patients in HoLEP	15	
OUTCOMES	Total operative time, total amount of prostate excised, any intraoperative adverse events, blood transfusions, incidence of TUR syndrome, total volume of irrigation fluidn required, total traction time, irrigation time, catheter time, post-catheter removal stream and complications, median time of discharge, histopathology, IPSS, uroflowmetry, PVR, adverse events, urethral stricture, urine culture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Patients who underwent surgery were randomized into the TURP or HoLEP group. 30 operated patients to 15 group each. This does not mean randomization if the patients were allocated to a group after surgery.
Allocation concealment (selection bias)	High risk	Patients were allocated to a group after the surgery, based on which surgery they had.
Blinding of participants and personnel (performance bias)	Unclear risk	Not reported.
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported.
Incomplete outcome data (attrition bias)	Unclear risk	For the 9 month follow-up, 10% of the patients were lost to follow-up
Selective reporting (reporting	High risk	A total of 2 intraoperative complications

bias)		are reported but in the HoLEP group only one is detailed and it is unknown what was the other complication.
Other bias	Unclear risk	No funding, conflict of interest or study regsitration number was reported.

Study ID	**Montorsi 2004**
Authors:	Montorsi, Naspro, Salonia, Suardi, Briganti, Zanoni, Valenti, Vavassori, Rigatti
Title:	Holmium laser enucleation versus transurethral resection of the prostate: results from a 2-center, prospective randomized trial in patients with obstructive benign prostatic hyperplasia
Journal/Book/Source:	The Journal of Urology
Date of Publication:	2004
Volume:	172
Issue:	-
Pages:	1926-1929
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	100
Country of participants	Italy
Data collection period	January 2002 – October 2002
Inclusion criteria	<75 years, Qmax < 15 ml/s, PVR < 100 cc, madical therapy failure, transrectal ultrasound adenoma volume < 100 gm, urodynamic obstruction
Exclusion criteria	Neurogenic bladder, diagnosis of prostate cancer, any previous prostatic, bladder neck or urethral surgery
Average age	HoLEP: 65.14 TURP: 64.5
INTERVENTIONS (technology 1)	Holmium laser enucleation of the prostate (HoLEP): 360 µ fiber delivered the holmium laser energy, placed in a 24Fr resectoscope. Enucleation was performed at 2.0 J and 35 Hz.
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP): Standard tungsten wire loop with a cutting current of 80 W and a coagulating current of 160 W
Number of patients in HoLEP	52
Number of patients in TURP	48

OUTCOMES	Operative time, resected tissue weight, retrieval rate per minute, hemoglobin level, blood loss, catheterization time, hospital stay, Qmax, Qmed, IPSS, QoL, urodynamic findings, IIEF, early and late adverse events (1, 6, 12 months)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Not reported.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	100 consecutive patients were considered and included in the study. The method of randomization is not described.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding of participants and personnel (performance bias)	Unclear risk	No information provided.
Blinding of outcome assessment (detection bias)	Unclear risk	No information provided.
Incomplete outcome data (attrition bias)	Low risk	No patient lost to follow-up.
Selective reporting (reporting bias)	Low risk	No difference between reported outcomes and methods section.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Neill 2006**
Authors:	Mischel g. Neill, Peter j. Gilling, Katie m. Kennett, Christopher m. Frampton, Andre m. Westenberg, Mark r. Fraundorfer, and Liam c. Wilson
Title:	Randomized trial comparing holmium laser enucleation of prostate with plasmakinetic enucleation of prostate for treatment of benign prostatic hyperplasia.
Journal/Book/Source:	Urology
Date of Publication:	2006
Volume:	68
Issue:	5
Pages:	1020-1024
METHODS (study design; length of follow up)	Prospective randomized controlled trial, 12 months follow-up
PARTICIPANTS	
Total Number of Participants randomized	40
Country of participants	New Zeland
Data collection period	May 2001-November 2003

Inclusion criteria	clinical diagnosis of BPH, desired and agreed to surgical treatment, older than 45 years of age, prostate volume on TRUS measurement was required to be 20 to 200 cm3, the Qmax to be less than 15 mL/s, the IPSS to be greater than 12, urodynamically proven obstruction (Schäfer linearized passive urethral resistance relation grade 2 or greater) had to be present.
Exclusion criteria	previous prostatic or urethral surgery, patients with prostate cancer, neurogenic bladder dysfunction, urinary retention (or postvoid residual urine volume greater than 399 mL), coagulopathy, anticoagulant medication, or urinary tract infection at enrollment
Average age	HoLEP: 68.9 ± 2.0 (52–83) PkEP: 67.0 ± 1.7 (56–83)
INTERVENTIONS (technology 1)	Holmium laser enucleation (HoLEP)
INTERVENTIONS (technology 2)	Plasmakinetic enucleation (with Gyrus) (PKEP)
Number of patients in HoLEP	20
Number of patients in PKEP	20
OUTCOMES	Perioperative outcome**:** operation time (assessed as the time the resectoscope sheath was in place), pathologic specimen weight, energy requirement (in kilojoules), amount of intraoperative and postoperative irrigant used, duration of indwelling catheter, time spent in the postoperative recovery room, time spent in the hospital, adverse events. Preoperative outcome measures were reassessed at 1, 3, 6, and 12 month**:** IPSS, Sexual function questionnaire, continence and dysuria questionnaire, adverse events (*only 12 months: bladder irrigation required - %, urinary tract infection, urethral stricture, urinary incontinence, reoperation, transfusion)* , Qmax at the 6-month assessment, urodynamic pressure flow studies, digital rectal examination, TRUS measurement of prostate volume
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	P. J. Gilling is a study investigator funded by Gyrus Limited.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information in the text
Allocation concealment (selection bias)	Unclear risk	A sealed envelope sequence was used but it is not clear whether envelopes are opaque.
Blinding of participants and personnel (performance bias)	High risk	No blinding was used
Blinding of outcome	High risk	No blinding was used

assessment (detection bias)		
Incomplete outcome data (attrition bias)	Unclear risk	No information in the text, no mention to lost at FU
Selective reporting (reporting bias)	Unclear risk	A protocol is not available, adverse events are not pre-specified. Data on some outcome are not reported (e.g.: sexual function questionnaire)
Other bias	High risk	Financial interest, principal investigator funded by the manufacturer

Study ID	**Netsch 2017**
Authors:	Christopher Netsch, B. Becker, C. Tiburtius, C. Moritz, A. Venneri Becci, T. R. W. Herrmann, A. J. Gross
Title:	A prospective, randomized trial comparing thulium vapoenucleation with holmium laser enucleation of the prostate for the treatment of symptomatic benign prostatic obstruction: perioperative safety and efficacy
Journal/Book/Source:	World J Urol (2017) 35:1913–1921
Date of Publication:	11 July 2017
Volume:	35
Issue:	
Pages:	1913-1921
METHODS (study design; length of follow up)	Prospective randomized trial, 4 weeks follow up
PARTICIPANTS	
Total Number of Participants randomized	107
Country of participants	Germany
Data collection period	January 2015 – February 2016
Inclusion criteria	Qmax) ≤15 ml/s, IPSS) ≥12, male patients ≥18 years, and/or failed medical therapy of BPO, recurrent urinary tract infections (UTI), and/or recurrent episodes of urinary retention
Exclusion criteria	previous urethral/prostatic surgery, known prostate cancer (PCa) or urethral strictures, urodynamically diagnosed neurogenic bladder
Average age	ThuVEP: median age: 74 (68-76.75) HoLEP: median age: 71.5 (67-75)
INTERVENTIONS (technology 1)	Thulium vapoenucleation (ThuVEP)
INTERVENTIONS (technology 2)	Holmium laser enucleation (HoLEP)
Number of patients in ThuVEP	48
Number of patients in HoLEP	46
OUTCOMES	IPSS, QoL, Q_{max}, PVR, Operation time, Catheterization time, Hospitalization time, Complication Rate (CR)
Notes (e.g. funding source; conflicts of Interest; trial regis-	None This RCT was registered in the German Clinical Trials Regis-

tration number, etc)	ter (DRKS-ID: DRKS00008206)	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer generated block randomization
Allocation concealment (selection bias)	Unclear risk	No information in the article
Blinding of participants and personnel (performance bias)	Unclear risk	No information in the article
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the article
Incomplete outcome data (attrition bias)	Unclear risk	Overall lost to follow-up=13%
Selective reporting (reporting bias)	Unclear risk	This RCT was registered in the German Clinical Trials Register (DRKS-ID: DRKS00008206). https://www.drks.de/drks_web/navigate.do?navigationId=trial.HTML&TRIAL_ID=DRKS00008206 But outcome are not reported in detail
Other bias		The authors have nothing to disclose.

Study ID	**Nuhoglu 2011**
Authors:	Bariş Nuhoğlu, Mustafa Bahadir, Can Balci Memduh, Aydin Ismet Hazar, Özkan Onuk, Tuncay Taş, Onur Fikri
Title:	The Role of Bipolar Transurethral Vaporization in the Management of Benign Prostatic Hyperplasia
Journal/Book/Source:	Urologia Internationalis
Date of Publication:	November 11,2011
Volume:	87
Issue:	
Pages:	400-404
METHODS (study design; length of follow up)	Prospective randomized trial, 1 year follow-up
PARTICIPANTS	
Total Number of Participants randomized	90
Country of participants	Turkey
Data collection period	February 2009-February 2010
Inclusion criteria	Patients with established surgical indications with lower urinary tract symptoms secondary to BPH, BPH patients with a Qmax of <15 ml/s and a total IPSS scores of >=8 points were included in the study.
Exclusion criteria	Patients with prostate carcinoma or neurogenic urinary dysfunction, and those with a history of prostatic and/or urethral surgery

Average age	TURP: 64.7 ±7.3 TUVP: 65.4±8.9
INTERVENTIONS (technology 1)	Transurethral resection (TURP)
INTERVENTIONS (technology 2)	Transurethral vaporization (TUVP)
Number of patients in TURP	47
Number of patients in TUVP	43
OUTCOMES	IPSS, PVRU, Qmax, Prostate volume, Operative time, Amount of bleeding, Post-operative hyponatremia, Catheter tetention time, Blood transfusion, Urethral stricture, Recatjeterization, Urinary retention, Re-TURP, Bladder neck incision, Urethral stricture, Reoperation , TUR syndrome, Urinary incontinence
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	None

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information in the article
Allocation concealment (selection bias)	Unclear risk	No information in the article
Blinding of participants and personnel (performance bias)	Unclear risk	No information in the article
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the article
Incomplete outcome data (attrition bias)	Unclear risk	5 patients are lost to follow-up but it is not clear if they are excluded or not. If they are excluded the initial numbers of patients was 95 not 90
Selective reporting (reporting bias)	Unclear risk	No protocol and outcome not pre-specified
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Peng 2016**
Authors:	Mou Peng, Lu Yi, and Yinhuai Wang
Title:	Photoselective Vaporization of the Prostate vs Plasmakinetic Resection of the Prostate: A Randomized Prospective Trial With 12-Month Follow-up in Mainland China
Journal/Book/Source (abbreviation):	Urology
Date of Publication (year):	2016
Volume:	87
Issue:	
Pages:	161-165

METHODS (study design; length of follow up)	Randomized prospective trial, 12 months follow-up	
PARTICIPANTS		
Total Number of Participants randomized	120	
Country of participants	China	
Data collection period	January 2011-June 2012	
Inclusion criteria	patients with BPH-related LUTS, exclusive age range from 50 to 80 years, IPSS >7, Qmax <15 mL/s, transrectal ultrasound volume >30 and <150 cc	
Exclusion criteria	diagnosis of or suspected prostate cancer, neurogenic bladder, urethral stricture, bladder stone, postvoid residual (PVR) urine volume of >300 mL	
Average age	PVP: 69.3 ± 6.4 PKRP: 68.7 ± 5.8	
INTERVENTIONS (technology 1)	Photoselective vaporization of the prostate (PVP)	
INTERVENTIONS (technology 2)	Plasmakinetic Resection of Prostate (PKRP)	
Number of patients in PVP	61	
Number of patients in PKRP	59	
OUTCOMES	**Perioperative outcome:** Prostate volume, Total PSA level, IPSS, Qmax, QoL score, PVR volume, Operation time, Length of catheterization, Hospital stay Postoperative outcomes evaluated at 1,3,6,12 months: IPSS, Qmax, QoL Complications evaluated at 12 months: Clot retention, Incontinence, Retrograde ejaculation, Urethral stricture, Transfusion, Reoperation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	None	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomization was performed using a computer-generated list
Allocation concealment (selection bias)	Unclear risk	No information
Blinding of participants and personnel (performance bias)	Unclear risk	No information
Blinding of outcome assessment (detection bias)	Unclear risk	No information
Incomplete outcome data (attrition bias)	Low risk	No missing outcome data
Selective reporting (reporting bias)	Unclear risk	No protocol. All pre-specified outcome (in the method section) are evaluated but

		not all expected outcomes have been reported.
Other bias	Low risk	The authors declare that they have no relevant financial interest.

Study ID	**Radwan 2020**
Authors:	Ahmed Radwan, Ahmed Farouk, Ahmed Higazy, Younan R. Samir, Ahmed M. Tawfeek, Mohamed A. Gamal
Title:	Prostatic artery embolization versus transurethral resection of the prostate in management of benign prostatic hyperplasia
Journal/Book/Source:	Prostate International
Date of Publication:	2020
Volume:	8
Issue:	3
Pages:	130-133
METHODS (study design; length of follow up)	Randomized trial. Follow up: 1 and 6 months postoperatively.
PARTICIPANTS	
Total Number of Participants randomized	60
Country of participants	Egypt
Data collection period	January 2016 to January 2018
Inclusion criteria	Patients complained of LUTSs with an IPSS score of 8e35 (8 being moderate and 35 being severe), uroflowmetry with an average flow of ≤10 ml/sec, and a prostate volume less than 100 ml by transrectal ultrasound.
Exclusion criteria	Patients with elevated kidney functions (≥1.5 mg/dl), with allergy to intravenous (IV) contrast media, unfit for surgery, with prostatic adenocarcinoma, with previous history of prostatic or urethral operations, with signs of the decompensated bladder (e.g., bladder diverticulum), with signs of upper urinary tract infection revealed by pelvic abdominal ultrasound.
Average age	The demographic data for patients in the 3 groups were nearly the same, with a mean age of 63 years.
INTERVENTIONS (technology 1)	Prostatic artery embolization (PAE)
INTERVENTIONS (technology 2)	Monopolar transurethral resection of prostate (M-TURP)
INTERVENTIONS (technology 3)	Bipolar transurethral resection of prostate (B-TURP)
Number of patients in PAE	20
Number of patients in	20

M-TURP		
Number of patients in B-TURP	B-TURP n = 20	
OUTCOMES	International prostate symptom score (IPSS) score, postvoid residual urine, Qmed, AUR, catheter time, operative time, TUR syndrome	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Participants were randomly allocated into 3 equal groups using the sealed envelope method.
Allocation concealment (selection bias)	Low risk	Sealed envelopes were used.
Blinding of participants and personnel (performance bias)	Unclear	No information whether they were blinded.
Blinding of outcome assessment (detection bias)	Unclear	No information whether they were blinded.
Incomplete outcome data (attrition bias)	Unclear	Numbers of patients at follow up not presented
Selective reporting (reporting bias)	Unclear	Study protocol not registered.
Other bias	Low risk	The authors have no conflict of interest to declare.

Study ID	**Ran 2013**
Authors:	Longfei Ran, Weiyang He, Xin Zhu, Qingsong Zhou, Xin Gou
Title:	Comparison of Fluid Absorption between Transurethral Enucleation and Transurethral Resection for Benign Prostate Hyperplasia
Journal/Book/Source	Urol Int
Date of Publication	April 2013
Volume:	91
Issue:	
Pages:	26-30
METHODS (study design; length of follow up)	Prospective RCT, no follow up
PARTICIPANTS	
Total Number of Participants randomized	60
Country of participants	China
Data collection period	From April 2011 to December 2011
Inclusion criteria	Postvoid residual urine between 60 and 250 ml, acute urinary retention, Q max less than 15 ml/s

Exclusion criteria	prostate cancer, urethrostenosis, neurogenic bladder, significantly reduced lung function, suspected bladder tumor, being addicted or allergic to alcohol.	
Average age	PKRP: 72.3±8.3 PKEP: 70.9±5.7	
INTERVENTIONS (technology 1)	Transurethral plasma kinetic resection (PKRP)	
INTERVENTIONS (technology 2)	Transurethral plasma kinetic enucleation (PKEP)	
Number of patients in PKRP	30	
Number of patients in PKEP	30	
OUTCOMES	Weight of prostate tissued removed Absorption of irrigation fluid Operation time Hospital stay Catheterization time Intra-operative complications (capsular perforation, obturator nerve reflection, transfusion, NO OTHER COMPLICATIONS SPECIFIED) Reduction in Hb Reduction in Sodium Reduction in Hematocrit Severe complication (TUR syndrome, myocardial arrhythmia NO OTHER COMPLICATIONS SPECIFIED)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	None	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No mention in the text
Allocation concealment (selection bias)	Unclear risk	No mention in the text
Blinding of participants and personnel (performance bias)	Unclear risk	No mention in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No mention in the text
Incomplete outcome data (attrition bias)	Unclear risk	No mention of missing data
Selective reporting (reporting bias)	Unclear risk	No protocol available. No clear outcome reporting, especially for complications.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Razzaghi 2014**
Authors:	Mohammad Reza Razzaghi, Mohammad Mohsen Mazloom-

	fard, Hooman Mokhtarpour and Aida Moeini
Title:	Diode Laser (980 nm) Vaporization in Comparison With Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia: Randomized Clinical Trial With 2-year Follow-up
Journal/Book/Source	UROLOGY
Date of Publication	May 2014
Volume:	84
Issue:	3
Pages:	526-532
METHODS (study design; length of follow up)	RCT with 2 years follow up
PARTICIPANTS	
Total Number of Participants randomized	115
Country of participants	Iran
Data collection period	October 2010 – February 2012
Inclusion criteria	Surgical treatment was indicated according to the international BPH guidelines of the European Association of Urology including: lower urinary tract symptoms despite maximal medical therapy, frequent urinary tract infections, hematuria unresponsive to medical therapy, high serum creatinine that decreased with urethral catheter placement, urinary retention despite medical therapy.
Exclusion criteria	history of neurogenic bladder, previous prostate surgery, anticoagulant medication, urethral stricture, bladder stone, diagnosis of prostate cancer, prostate volume >100 mL on transrectal ultrasonography (TRUS) disability, refusal to give a fully informed consent
Average age	TURP: 68.2±7.8 Diode Laser: 68.5±8.8
INTERVENTIONS (technology 1)	Transurethral resection of the prostate (TURP)
INTERVENTIONS (technology 2)	Diode laser vaporisation (980 nm) (DioLVP)
Number of patients in TURP	58
Number of patients in DioLVP	57
OUTCOMES	IPSS, PVR, Qmax assessed at baseline, 1,6,12, 24 months. Prostate volume, PSA level assessed at baseline, 6, 12 months. Duration of operation, changes in haemoglobin, serum sodium, perioperative and postoperative complications, hospitalization period, duration of indwelling catheter
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declare that they have no relevant financial interests. The trial is registered at Iranian Registry of Clinical Trials, number: IRCT201202138146N3

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomization was carried out using computerized random numbers
Allocation concealment (selection bias)	Unclear risk	No mention in the text
Blinding of participants and personnel (performance bias)	Unclear risk	No mention in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No mention in the text
Incomplete outcome data (attrition bias)	Unclear risk	Missing data declared and balanced between the two groups. However, overall lost to follow-up are 11%.
Selective reporting (reporting bias)	High risk	Not clear which complications have been considered. Trial registered in the Iranian Registry but outcome not clearly pre-specified.
Other bias	Low risk	The authors declare that they have no relevant financial interest.

Study ID	**Rezum II study: McVary2016a, McVary2016b, Roehrbohrn2017, McVary2018, McVary2019**
Authors:	Roehrborn, Gange, Gittelman, Goldberg, Patel, Shore, Levin, Rousseau, Beahrs, Kaminetsky, Cowan, Cantrill, Mynderse, Ulchaker, Larson, Dixon, McVary
Title:	McVary2016a: Erectile and ejaculatory function preserved with convective water vapor energy treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia: randomized controlled study McVary2016b: Minimally Invasive Prostate Convective Water Vapor Energy Ablation: A Multicenter, Randomized, Controlled Study for the Treatment of Lower Urinary Tract Symptoms Secondary to Benign Prostatic Hyperplasia Roehrnborn2017: Convenctive thermal therapy: durable 2-year results of randomized controlled and prospective crossover studies for treatment of lower urinary tract symptoms due to benign prostatic hyperplasia McVary2018: Three-Year Outcomes of the Prospective, Randomized Controlled Rezum System Study: Convective Radiofrequency Theraml Therapy for Treatment of Lower Urinary Tract Symptoms Due to Benign Prostatic Hyperplasia McVary2019: McVary2019: Rezum Water Vapor Thermal Therapy for Lower Urinary Tract Symptoms Associated With Benign Prostatic Hyperplasia: 4-Year Results From Randomized Controlled Study
Journal/Book/Source:	McVary2016a: J Sex Med McVary2016b: The Journal of Urology

	Roehrborn2017: The Journal of Urology McVary2018: Urology McVary2019: Urology
Date of Publication:	McVary2016a: 2016 June McVary2016b: 2016 May Roehrbohr2017: 2017 June McVary2018: 2017 November McVary2019: 2019 January
Volume:	McVary2016a: 13 McVary2016b: 195 Roehrbohr2017: 197 McVary2018: 111 McVary2019: 126
Issue:	-
Pages:	McVary2016a: 924-933 McVary2016b: 1529-1538 Roehrbohr2017: 1507-1516 McVary2018: 1-9 McVary2019: 171-179
METHODS (study design; length of follow up)	RCT with crossover option after 3 months
PARTICIPANTS	
Total Number of Participants randomized	197
Country of participants	U.S.
Data collection period	September 2013 – August 2014
Inclusion criteria	≥ 50 yrs old, no prior invasive prostate procedures, 30 – 80 cm3 prostate size, IPSS ≥ 13, ≥5 Qmax ≤ 15 mL/s with a voided volume of at least 125 mL
Exclusion criteria	Postvoid residual volume > 250 mL, PSA > 2.5 ng/mL with free PSA < 25%, active urinary infections, 2 separate infections within 6 months
Average age	WAVE: 63.0 ± 7.1 Sham: 62.9 ± 7.0
INTERVENTION 1 (technology 1)	Water vapor thermal therapy with the Rezum System
INTERVENTION 2 (technology 2)	Sham procedure using a rigid cystoscopy with simulated active treatment sounds
Number of patients in WAVE	136
Number of patients in sham	61
OUTCOMES	IPSS, QoL, Qmax, BPHII, IIEF-15 (erectile function), MSHQ-EjD

	(ejaculatory function)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	NCT01912339 Study was funded by the manufacturer of the Rezum System (NxThera Inc.). Two authors consulted NxThera for trial design, Roehrborn, McVary and Rogers have a financial interest with the manufacturer and competitor devices, the other authors reported no financial interests.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Electronic programming using permuted blocks of random sizes stratified by investigational site
Allocation concealment (selection bias)	Unclear risk	Not reported.
Blinding of participants and personnel (performance bias)	Low risk	Double blind was mainained for personnel administering and patients until 3 months FU.
Blinding of outcome assessment (detection bias)	Low risk	Independent data monitoring and clinical events committees reviewed adverse events and safety.
Incomplete outcome data (attrition bias)	Low risk	Considering the first 3 months, until the possibility for the cross-over, across the various outcomes, assessments were missing for at most three subjects in the active treatment arm (2.2%) and none in the sham arm.
	High risk	For cross over and the follow-up of the WAVE arm, (12 month, 2, 3 and 4 years) attrition rate was higher, and PP analysis was performed. At 4 years only 66% of patients (90/136) could be followed-up.
Selective reporting (reporting bias)	Low risk	The endpoints pre-specified in the trial registration were reported, along with the maximum urinary flow rate, post-void residual urine volume, and BPHII.
Other bias	Unclear risk	Study sponsored by the manufacturer.

Study ID	**Riehmann 1995**	
Authors:	Morten Riehmann, Jane M. Knes, Dennis Heisey, Paul 0. Madsen, Reginald C. Bruskewitz	
Title:	Transurethral resection versus incision of the prostate: a randomized, prospective study	
Journal/Book/Source	UROLOGY	
Date of Publication	1995	
Volume:	45	
Issue:	5	
Pages:	768-775	
METHODS (study design; length of follow up)	Randomized Prospective study 82 months follow up	
PARTICIPANTS		
Total Number of Participants randomized	120	
Country of participants	Winsconsin, USA	
Data collection period	January 31, 1985 / August 28, 1990	
Inclusion criteria	Patients with symptoms of bladder outlet obstruction caused by smaller benign prostates (estimated resectable weight less than 20g)	
Exclusion criteria	Patients were excluded if estimated resectable weight of the prostate by simultaneous cystoscopy and rectal examination exceeded 20 g, the prostatic urethra was longer than 3 cm, the median lobe exceeded 2 g, or cancer of the prostate was suspected. Patients with previous prostatic or major pelvic surgery, high operative risk, or overt neurologic or psychiatric disease were also excluded. Written consent for participation was obtained from all the patients in the project.	
Average age	TURP: 64 (42-78) TUIP: 65 (51-77)	
INTERVENTIONS (technology 1)	Transurethral Resection (TURP)	
INTERVENTIONS (technology 2)	Transurethral Incision (TUIP)	
Number of patients in TURP	56	
Number of patients in TUIP	61	
OUTCOMES	Preoperative, postoperative and at follow up visits: URINARY SYMPTOMS (total, obstructive and irritative symptom scores) SEXUAL FUNCTION UROFLOWMETRY (peak flow rate)	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	None	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No mention in the text

Allocation concealment (selection bias)	Unclear risk	No mention in the text
Blinding of participants and personnel (performance bias)	Unclear risk	No mention in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No mention in the text
Incomplete outcome data (attrition bias)	High risk	Overall lost to follow up <5% (4.3%) but the flow chart of the study is not clear. Among lost to follow-up or excluded: 1 bladder perforation and 1 TURP after TUIP!!!
Selective reporting (reporting bias)	High risk	No protocol or trial registration available. Some complications are mentioned but it is not specified in which group accured.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Samir 2019**
Authors:	Mohamed Samir, Ahmed Tawfick, Mahmoud a Mahmoud, Hossam Elawady, Mohamed Abuelnaga, Mohamed Shabayek, Abd el hamed Youssef, and Ahmed M. Tawfeek
Title:	Two-year Follow-up in Bipolar Transurethral Enucleation and Resection of the Prostate in Comparison with Bipolar Transurethral Resection of the Prostate in Treatment of Large Prostates. Randomized Controlled Trial
Journal/Book/Source	UROLOGY
Date of Publication	209
Volume:	133
Issue:	
Pages:	192-198
METHODS (study design; length of follow up)	RCT with 2 year follow up
PARTICIPANTS	
Total Number of Participants randomized	240
Country of participants	Egypt
Data collection period	June 2015 – March 2019
Inclusion criteria	patients aged between 50 and 80 years old prostate sizes of more than 80 gm by transrectal ultrasound severe lower urinary tract symptoms (LUTS) (International Prostate Symptom Score [IPSS] >20 and maximal flow rate [Qmax] < 10 mL/sec) refractory to medical treatment with alpha blockers
Exclusion criteria	Patients known to have neurogenic bladder, prostate cancer,

	urethral stricture, or who have had previous prostate surgery	
Average age	B-TUERP: 66.41±6.38 B-TURP: 64.81±5.73	
INTERVENTIONS (technology 1)	Bipolar Transurethral Enucleation and Resection of the Prostate (B-TUERP)	
INTERVENTIONS (technology 2)	Bipolar Transurethral Resection of the Prostate (B-TURP)	
Number of patients in B-TUERP	120	
Number of patients in B-TURP	120	
OUTCOMES	**Efficacy**: Operative time, resected prostatic tissue weight, catheterization time and hospital stay, IPSS, Qol assessment, residual prostate volume, uroflowmetry (Qmax), and post-voiding residual urine volume (PVRU). **Safety**: TUR syndrome, haemoglobin decrease, and transfusion rate, urethral stricture and urinary incontinence.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declare no conflict of interest	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information in the text
Allocation concealment (selection bias)	Low risk	"patients were randomly divided using the closed envelope method"
Blinding of participants and personnel (performance bias)	Unclear risk	No information in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Unclear risk	Numbers of subjects analysed are not clear for each follow-up. I consider n=106 (B-TUERP) and n=113 (B_TURP) in each follow-up visit. I consider n=120 pre and post operation. Overall lost to follow-up=8.7%
Selective reporting (reporting bias)	Unclear risk	A protocol is not available but all the pre-specified outcomes are presented. However for complications it is not clear the time of follow-up.
Other bias	Low risk	The authors declare that they have no relevant financial interest.

Study ID	**Shoji 2020**
Authors:	Sunao Shoji, Izumi Hanada, Tatsuya Otaki, Takahiro Ogawa,

	Koichiro Yamada, Takato Uchida, Taro Higure, Masayoshi Kawakami, Hakushi Kim, Masahiro Nitta, Masanori Hasegawa, Yoshiaki Kawamura and Akira Miyajima	
Title:	Functional outcomes of transurethral thulium laser enucleation versus bipolar transurethral resection for benign prostatic hyperplasia over a period of 12 months: A prospective randomized study	
Journal/Book/Source:	Int J Urol	
Date of Publication:	2020	
Volume:	27	
Issue:	11	
Pages:	974--980	
METHODS (study design; length of follow up)	Randomized trial. Follow up: 1, 3, 6, 9 and 12 months after treatment	
PARTICIPANTS		
Total Number of Participants randomized	140	
Country of participants	Japan	
Data collection period	April 2017 to February 2019	
Inclusion criteria	(i) aged 50–90 years; (ii) diagnosis of mild or severe BPH based on the IPSS, IPSS QOL, maximum flow rate, residual urine and prostate volume; (iii) symptoms were not improved by medication; and (iv) patients provided informed consent.	
Exclusion criteria	(i) patients who had other diseases that affected urinary function; and (ii) patients who had preoperative treatment.	
Average age	ThuLEP: median (range) = 72 (57–83) B-TURP: median (range) = 73 (55–86)	
INTERVENTIONS (technology 1)	Thulium laser enucleation of the prostate (ThuLEP)	
INTERVENTIONS (technology 2)	Bipolar transurethral resection of the prostate (B-TURP)	
Number of patients in ThuLEP	70	
Number of patients in B-TURP	70	
OUTCOMES	The International Prostate Symptom Score, International Prostate Symptom Score quality of life, Qmax, PVR, International Index of Erectile Function-5, urinary incontinence, operation time, hospitalisation time, catheterisation time, UTI, capsule perforation, blood transfusion, recatheterisation, urethral stricture, bladder neck contracture, erectile dysfunction.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**

Random sequence generation (selection bias)	Low risk	A randomization list was used for non-blind assignment to treatment groups.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear	No information provided about blinding of participants and personnel.
Blinding of outcome assessment (detection bias)	Unclear	No information provided about blinding of outcome assessors.
Incomplete outcome data (attrition bias)	Unclear	Number of patients at follow up measurements not provided.
Selective reporting (reporting bias)	Unclear	There is no study protocol registered.
Other bias	Low risk	Authors declared none competing interest.

Study ID	**Skinner 2017**
Authors:	Thomas A.A. Skinner; Robert J. Leslie; Stephen S. Steele; J. Curtis Nickel
Title:	Randomized, controlled trial of laser vs. bipolar plasma vaporization treatment of benign prostatic hyperplasia
Journal/Book/Source	CUAJ
Date of Publication	2017
Volume:	11
Issue:	6
Pages:	194-8
METHODS (study design; length of follow up)	RCT, 12 weeks follow up
PARTICIPANTS	
Total Number of Participants randomized	55
Country of participants	Canada
Data collection period	June 2014 - June 2016
Inclusion criteria	Age over 45, IPSS ≥12, estimated prostate volume on digital rectal exam (DRE) ≥ 30 cc (as this is a real-life clinical practice study, prostate size and post-void residual were not mandatory).
Exclusion criteria	prior invasive intervention for BPH, prostate-specific antigen (PSA) level >10 ng/ml, urinary retention, medical condition unfit for surgery, history of prostate cancer, documented prostatitis within the past three months, known bleeding disorder, inability to follow directions or sign informed consent due to organic brain or psychiatric disease, history of substance abuse, which would affect compliance
Average age	DioVAP: 69.4 B-TUVP: 71.8

INTERVENTIONS (technology 1)	Diode laser vaporization (DioLVP)	
INTERVENTIONS (technology 2)	Bipolar plasma vaporization with the Olympus plasma button (B-TUVP)	
Number of patients in DioLVP	25	
Number of patients in B-TUVP	30	
OUTCOMES	IPSS, QoL, Surgical team satisfaction, Side effect and complications, Cost analysis	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Dr. Steele has been an advisor for Allergan and Astellas; a speaker for Abbott and Astellas; has received grants from Astellas and Pfizer; and has participated in clinical trials supported by Astellas and Pfizer. The remaining authors report no competing personal or financial interests. This study was supported by the Ontario Academic Health Centres – Alternate Funding Plan Innovation Fund. The equipment was provided by Olympus and Biolitec. We thank Dr. Amir Rumman, who assisted the research team in developing the analytical models.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Patients were randomized into two groups using GraphPad QuickCalcs, random number generator software
Allocation concealment (selection bias)	Unclear risk	No information in the article
Blinding of participants and personnel (performance bias)	Unclear risk	The study is declared as "single-blinded" but it is not clear who is blinded.
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the article
Incomplete outcome data (attrition bias)	Unclear risk	No mention to missing data!?!?
Selective reporting (reporting bias)	High risk	It is not clear to me which complications has been taken into account, standard deviation are missing
Other bias	High risk	The equipment was provided by the manufacturer

Study ID	**BPH6 Study: Sonksen 2015**
Authors:	Sonksen et al
Title:	Prospective, randomized, multinational study of prostatic urethral lift versus transurethral resection of the prostate: 12-month results from the BPH6 study
Journal/Book/Source:	European Urology
Date of Publication:	2015

Volume:	68
Issue:	-
Pages:	643-652
METHODS (study design; length of follow up)	Prospective RCT, 1 year FU
PARTICIPANTS	
Total Number of Participants randomized	91
Country of participants	10 centres in Germany, Denmark and UK
Data collection period	February 2012 – October 2013
Inclusion criteria	Men >50 years old and candidate for TURP, IPSS>12, Qmax≤15 mL/s, PVR < 350 ml, prostate volume ≤60 cc on ultrasonography, sexually active within 6 mo before the index procedure, SHIM score >6, positive reponse to MSHQ-EjD, ISI score ≤4
Exclusion criteria	active urinary tract infection at the time of treatmet, bacterial prostatitis within 1 year of idex procedure, obstructive median lobe, urinary retention, urethral conditions that may prevent insertion of a rigid 20F cystoscope, previous TURP, unwilling to report sexual function, anticoagulants within 3 d of the index procedure, severe cadiac comorbidities, PSA ⩾10ng/l, history of prostate or bladder cancer, other medical condition or co-morbidity contraindicative for TURP or UroLift
Average age yrs (SD)	PUL: 63 (6.8) TURP: 65 (6.4)
INTERVENTIONS (technology 1)	Prostatic urethral lift (PUL) with the UroLift System
INTERVENTIONS (technology 2)	TURP
Number of patients in PUL	44 (1 patient was excluded due to violation of protocol)
Number of patients in TURP	35
OUTCOMES	IPSS, Sexual Health Inventory for Men (SHIM), Male Sexual Health Questionnaire for Ejaculatory Dysfunction (MSHQ-EjD), Incontinence Severity Index (ISI), Quality of Recovery visual analogue score (QoR VAS), Clavien–Dindo classification of adverse events, QoL, patient satisfaction, BPH II, Qmax, PVR, Quality of Recovery visual analogue score (QoR VAS), reinter-vention at ≤30 d and >30 – 365 d (due to bleeding, urethral strci-ture, return of LUTS)
Notes (e.g. funding source; conflicts of Interest; trial regis-	Sponsor NeoTract, Inc. Study authors reported grants from NeoTract, Inc.

tration number, etc)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomisation using permuted blocks of various sizes chosen randomly.
Allocation concealment (selection bias)	Low risk	Consealed through password protected computer.
Blinding of participants and personnel (performance bias)	High risk	Nonblinded trial.
Blinding of outcome assessment (detection bias)	High risk	Same study authors aquired and analysed the data.
Incomplete outcome data (attrition bias)	High risk	Over 20% of patients were lost to follow-up in the TURP arm and less than 5% in the PUL arm.
Selective reporting (reporting bias)	Low risk	Outcomes reported in the study protocol are reported in the study.
Other bias	High risk	Funding of the study from the manufacturer of PUL. It is reported that the sponsor played a role in the study design and conduct of the study, data mangement and analysis, manuscript preparation and review.

Study ID	**Sun 2014**
Authors:	Nao Sun, Yaowen Fu, Tengzheng Tian, Jialin Gao, Yuantao Wang, Song Wang, Wei An
Title:	Holmium laser enucleation of the prostate versus transurethral resection of the prostate: a randomized clinical trial
Journal/Book/Source:	Int Urol Nephrol
Date of Publication:	February 2014
Volume:	46
Issue:	
Pages:	1277-1282
METHODS (study design; length of follow up)	RCT 12 months FU
PARTICIPANTS	
Total Number of Participants randomized	164
Country of participants	Jilin, China
Data collection period	January 2010-December 2011
Inclusion criteria	age of less than 90 years old with no contraindication to surgery; Qmax B 10 ml/s; PVR C 50 ml; IPSS C 8; prostate weight\100 g as determined by transrectal ultrasonography.
Exclusion criteria	treatment with transurethral prostate surgery previously; neurogenic bladder; suspected prostate cancer.

Average age	HoLEP: 72.16 ± 7.53 TURP: 71.91 ± 7.53	
INTERVENTIONS (technology 1)	Holmium laser enucleation (HoLEP)	
INTERVENTIONS (technology 2)	Transurethral resection (TURP)	
Number of patients in HoLEP	82	
Number of patients in TURP	82	
OUTCOMES	In the method section outcomes are not indicated. From results: Qmax, PVR, IPSS, QOL, (1 month and 12 months after survey) operative time, bladder irrigation time, time of indwelling catheter, hospitalization time, weight of resected prostate, haemoglobin level 1 day after surgery, blood sodium level 1 day after surgery, hyponatremia, blood transfusion, urethral stricture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	The authors declare they have no outside financial interests that would affect the design or outcomes of this study.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information on the generation process of the unique identification numbers used in the group assignment
Allocation concealment (selection bias)	Unclear risk	"The information of enrollment for all patients was done by another doctor"
Blinding of participants and personnel (performance bias)	Unclear risk	"Patients were blinded to their method of treatment…and the surgeon didn't know whether the patient who under surgery included in the group"
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Unclear risk	A flow chart is not present and there is no mention of missing data in the text
Selective reporting (reporting bias)	Unclear risk	It is not present a protocol and outcomes are not pre-specified
Other bias	Low risk	The authors declare that they have no conflict of interest.

Study ID	**Swiniarski 2012**
Authors:	Piotr Paweł Świniarski, Stanisław Stępień, Waldemar Dudzic, Stanisław Kęsy, Mariusz Blewniewski, W aldemar Różański
Title:	Thulium laser enucleation of the prostate (TmLEP) vs. transurethral resection of the prostate (TURP): evaluation of early results

Journal/Book/Source:	Central European Journal of urology	
Date of Publication:	2012	
Volume:	65	
Issue:	3	
Pages:	130-134	
METHODS (study design; length of follow up)	Prospective, non-consecutive randomized controlled trial, 3 months fu	
PARTICIPANTS		
Total Number of Participants randomized	106	
Country of participants	Poland	
Data collection period	February 2007-September 2009	
Inclusion criteria	IPPS >7, Qmax <5 ml/s, and the clinically confirmed BPH.	
Exclusion criteria	previous surgical treatment for BPH, prostate cancer, and LUTS resulting from conditions other than BPH	
Average age	TmLEP: 68.3±6.8 TURP: 69.3±7.2	
INTERVENTIONS (technology 1)	Thulium laser enucleation (TmLEP)	
INTERVENTIONS (technology 2)	Transurethral resection (TURP)	
Number of patients in TmLEP	54	
Number of patients in TURP	52	
OUTCOMES	Time of surgery, use of laser, morcellation, catheterization, hospitalization, used energy, Hgb loss, removed tissue weight. IPSS, QoL, Qmax and PVR (one and three months after surgery), Perioperative and postoperative complications	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	Financial disclosure: The research was funded from science funds of the Research Department of the Ministry of Science and Higher Education in years 2007-2010 as a research project.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomization consisted in preparing a computer-generated list of patients that was well balanced
Allocation concealment (selection bias)	Unclear risk	No information in the text
Blinding of participants and personnel (performance bias)	Unclear risk	No information in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Unclear risk	No mention of missing data in the text and no flow chart
Selective reporting (reporting bias)	Unclear risk	No protocol available but all pre-specified outcomes are presented, however a primary outcome is not pre-specified

Other bias	Unclear	There is no information about conflict of interest.

Study ID	**Tan 2003**
Authors:	A. H. H. Tan, P. J. Gilling, K. M. Kennett, C. Frampton, A. M. Westenberg and M. R. Fraundorfer
Title:	A randomized trial comparing holmium laser enucleation of the prostate with transurethral resection of the prostate for the treatment of bladder outlet obstruction secondary to benign prostatic hyperplasia in large glands (40 to 200 grams)
Journal/Book/Source:	The Journal of urology
Date of Publication	2003
Volume:	170
Issue:	
Pages:	1270-1274
METHODS (study design; length of follow up)	RCT 12 months follow up
PARTICIPANTS	
Total Number of Participants randomized	61
Country of participants	New Zeland
Data collection period	June 1997 – December 2000
Inclusion criteria	prostate volume, as calculated by a TRUS volume of 40 to 200 ml, Qmax 15 ml per second or less, AUA symptom score 8 or greater, post-void residual less than 400 ml and Scha¨fer grade (linearized passive urethral resistance relation) 2 or greater
Exclusion criteria	Cases of carcinoma, Catheterized patients. Patients with a history of urethral or prostatic surgery
Average age	HoLEP: 71.7±1.1 (54-84) TURP: 70.3±1.0 (59-83)
INTERVENTIONS (technology 1)	Holmium Laser Enucelation (HoLEP)
INTERVENTIONS (technology 2)	Transurethral Resection (TURP)
Number of patients in HoLEP	31
Number of patients in TURP	30
OUTCOMES	Perioperatively the primary outcomes measured included duration of catheterization and hospital stay, and blood transfusion rate. Postoperatively the primary outcome measures were single question quality of life scores, International Prostate Symptom Score and peak flow rate at 1, 3, 6 and 12 months. Perioperatively the secondary outcomes measured included the time that the resectoscope sheath was in place, the time that the laser or electrocautery unit was in action, morcellation time in the HoLEP group, the amount of tissue resected and total irrigation volume (intraoperative and postoperative). Postoperatively the secondary outcomes measured included

	continence and sexual function. A pressure flow urodynamic assessment was performed at the 6-month followup interval, consisting of the measurement of detrusor pressure at Qmax (PdetQmax), Scha¨ fer grade and post-void residual volume. Transrectal ultrasound volume measurements were made preoperatively and again at 6 months of followup. All adverse events, such as reoperation, re-catheterization and urinary tract infection, were also recorded.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	PJG and MRF has financial interest/otr other relationship with Lumenis, Inc., Tel Aviv, Israel	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Blanced blocked randomization schedule"
Allocation concealment (selection bias)	Unclear risk	"sequence of sealed envelope"
Blinding of participants and personnel (performance bias)	High risk	"Participant were not blinded"
Blinding of outcome assessment (detection bias) SUBJECTIVE OUTCOMES	High risk	"outcome assessments were performed of staff blinded to patient treatment"
Blinding of outcome assessment (detection bias) OBJECTIVE OUTCOMES	Low risk	"outcome assessments were performed of staff blinded to patient treatment"
Incomplete outcome data (attrition bias)	Unclear risk	Overall lost to follow-up is 15%
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	High risk	Financial interest, manufacturer financed the study.

Study ID	**Tefekli 2005**
Authors:	Ahmet Tefekli, Ahmet Yaser Muslumanoglu, Murat Baykal, Murat Binbay, Aytul Tas and Fatih Altunrende
Title:	A hybrid technique using bipolar energy in transurethral prostate surgery: a prospective, randomized comparison
Journal/Book/Source:	The journal of Urology
Date of Publication	2005
Volume:	174
Issue:	
Pages:	1339-1343
METHODS (study design; length of follow up)	RCT, 12 months follow up
PARTICIPANTS	
Total Number of Participants randomized	101
Country of participants	Turkey

Data collection period	2001 and 2002	
Inclusion criteria	failed medical therapy in 72 men (71.3%) recurrent urinary retention in 29 (28.7%).	
Exclusion criteria	abnormal DRE, increased serum PSA, evidence of neurogenic bladder (ie history of diabetes, cerebrovascular accident, etc), urethral stricture disease, bladder stone, tumor, a history of prostate surgery	
Average age	PlamaKinetic 68.7±6.3 (N=49) TURP 69.4±5.9 (N=47)	
INTERVENTIONS (technology 1)	Transurethral vaporesection (TUVRP) with bipolar PlasmaKinetic technique	
INTERVENTIONS (technology 2)	Transurethral prostate surgery using monopolar energy (M-TURP)	
Number of patients in TUVRP	51	
Number of patients in M-TURP	50	
OUTCOMES	IPSS, Uroflowmetry scores, Operative time, Catheterization duration, Hospital stay, Complication rates	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc)	None	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information in the text
Allocation concealment (selection bias)	Unclear risk	No information in the text
Blinding of participants and personnel (performance bias)	High risk	In the discussion: "… the fact that randomization in this study was not double-blind…"
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Low risk	Overall lost to follow-up is 5%
Selective reporting (reporting bias)	Unclear risk	A protocol is not present and outcomes are not clearly pre-specified
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Tkocz 2002**
Authors:	Michal Tkocz, Andrzej Prajsner
Title:	Comparison of long-term results of transurethral incision of the prostate with transurethral resection of the prostate, in patients with benign prostatic hypertrophy
Journal/Book/Source	Neurourology and urodynamics
Date of Publication	2002
Volume:	21

Issue:		
Pages:	112-116	
METHODS (study design; length of follow up)	Randomized study, with 24 months follow up	
PARTICIPANTS		
Total Number of Participants randomized	100	
Country of participants	Poland	
Data collection period	n.a.	
Inclusion criteria	Moderate symptoms of bladder outlet obstruction caused by smaller benign prostate. Average prostate weight before operation no more than 30g	
Exclusion criteria	Patients with third lobe	
Average age	63 ± 6.7	
INTERVENTIONS (technology 1)	Transurethral incision (TUIP)	
INTERVENTIONS (technology 2)	Transurethral resection (TURP)	
Number of patients in TUIP	50	
Number of patients in TURP	50	
OUTCOMES	mean weight of the resection adenoma, mean weight of the incised adenoma, IPSS, QoL, daily and nocturnal micturition frequency, mean volume of a single urine portion, maximum flow rate during free flowmetry and during pressure-flow study, Voiding volume, urine retention, maximal cystometric capacity, detrusor pressure and detrusor pressure maximal flow rate, compliance of the bladder, opening detrusor pressure, linearized passive urethral resistance relation, detrusor instability, transfusion, retrograde ejaculation, urine incontinence	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	None	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information in the text
Allocation concealment (selection bias)	Unclear risk	No information in the text
Blinding of participants and personnel (performance bias)	Unclear risk	No information in the text
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Unclear risk	Missing data are not mentioned in the text.
Selective reporting (reporting bias)	Unclear risk	No protocol available. Outcomes are not clearly pre-specified.
Other bias	Unclear	Funding source, conflicts of interest

		and trial registration number are not reported.

Study ID	**Wagrell 2002**
Authors:	Wagrell, Schelin, Nordling, Richthoff, Masgnusson, Schain, Larson, Boyle, Duelund, Kroyer, Ageheim, Mattiasson
Title:	Feedback microwave thermotherapy versus TURP for clinical BPH – a randomized controlled multicenter study
Journal/Book/Source:	Adult Urology
Date of Publication:	2002
Volume:	-
Issue:	2
Pages:	292-299
METHODS (study design; length of follow up)	RCT
PARTICIPANTS	
Total Number of Participants randomized	154
Country of participants	United States, Scandinavia (Sweden and Denmark)
Data collection period	October 1998 to November 1999
Inclusion criteria	symptomatic BPH, IPSS of 13 or greater, prostate volume of 30 to 100 mL, Qmax less than 13 mL/s
Exclusion criteria	Not reported.
Average age	TUMT: 67 (8) TURP: 69 (8)
INTERVENTIONS (technology 1)	Transurethral microwave thermotherapy (TUMT)
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)
Number of patients in TUMT	100
Number of patients in TURP	46
OUTCOMES	IPSS, Qmax, PVR, QoL, detrusor pressure, prostate volume, all adverse events (serious adverse events defined separately), catheter time
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	Study was sponsored by the manufacturer of the TIMT device (ProstaLund). Wagrell, Schelin, Larson and Matthiasson are paid consultants of the manufacturer. Trial registration number was not provided.

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not reported.
Allocation concealment (selection bias)	Unclear risk	Not reported.
Blinding of participants and personnel (performance bias)	Unclear risk	Not reported.
Blinding of outcome assessment (detection bias)	Unclear risk	Not reported.
Incomplete outcome data (attrition bias)	Unclear risk	Loss-to-follow-up was higher than 5% but lower than 15% within groups and it had the same proportion between groups.
Selective reporting (reporting bias)	Low risk	Outcomes were reported as a priori described in the methods (study protocol).
Other bias	High risk	Study sponsored by the manufacturer and 4 authors were paid consultants of the manufacturer.

Study ID	**Wang 2019**
Authors:	Wang Z, Zhang J, Zhang H, Liu S, Sun D, Hu L, Fu Q, Zhang K
Title:	Impact on sexual function of plasma button transurethral vapour enucleation versus plasmakinetic resection of the large prostate >90 ml: Results of a prospective, randomized trial
Journal/Book/Source:	Andrologia
Date of Publication:	2019
Volume:	
Issue:	
Pages:	
METHODS (study design; length of follow up)	Randomised controlled trial. Follow-up at 3 and 6 months
PARTICIPANTS	
Total Number of Participants randomized	101
Country of participants	China
Data collection period	2017-2018
Inclusion criteria	Symptomatic BPH
Exclusion criteria	Prostate ≤90 ml, prostatic cancer, severe respiratory or circulatory diseases, coagulopathy, uncontrolled diabetes with HbA1c levels ≥7 mg/dl, neurogenic bladder disease, major

	psychiatric disorder, receiving a 5α-reductase inhibitor or phosphodiesterase-5 (PDE5) inhibitor, history of prostatic or urethral surgery	
Average age	67	
INTERVENTIONS (technology 1)	Plasma button transurethral vapour enucleation (B-VEP)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in B-VEP	50	
Number of patients in TURP	51	
OUTCOMES	Qmax, IPSS, PVR, QoL, IIEF-5, erectile dysfunction, anejaculation	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information available
Allocation concealment (selection bias)	Unclear risk	No information available
Blinding of participants and personnel (performance bias)	Unclear risk	Open trial (surgeons cannot be blind), but no information on other clinicians/health personnel in charge and patients
Blinding of outcome assessment (detection bias)	Unclear risk	Blinding of assessors and of patients was not specified
Incomplete outcome data (attrition bias)	Low risk	No patients lost to follow-up
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias		

Study ID	**Wu 2016**
Authors:	Gang Wu & Zhe Hong & Chao Li & Cuidong Bian & Shengsong Huang & Denglong Wu
Title:	A comparative study of diode laser and plasmakinetic in transurethral enucleation of the prostate for treating large volume benign prostatic hyperplasia: a randomized clinical trial with 12-month follow-up
Journal/Book/Source (abbre-	Lasers Med Sci

viation):		
Date of Publication (year):	January 2016	
Volume:	31	
Issue:		
Pages:	599-604	
METHODS (study design; length of follow up)	RCT with 12-months follow-up	
PARTICIPANTS		
Total Number of Participants randomized	80	
Country of participants	Shanghai, China	
Data collection period	January 2013 – June 2014	
Inclusion criteria	Patients with indications for the surgical treatment of BPH and a prostate volume >=80 ml	
Exclusion criteria	Patients with severe pulmonary disease or heart disease, bladder calculus, neurogenic bladder dysfunction, bladder cancer, prostate cancer, urethral stricture, or coagulopathy	
Average age	PKEP: 73.6±6.2 (54-81) DioLEP: 75.4±8.4 (56-85)	
INTERVENTIONS (technology 1)	Plasmakinetic enucleation (PKEP)	
INTERVENTIONS (technology 2)	Diode laser enucleation (DioLEP)	
Number of patients in PKEP	40	
Number of patients in DioLEP	40	
OUTCOMES	Perioperative parameters Perioperative or postoperative complications Clinical outcomes assess at 3,6 and 12 months	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This work was supported by Grants from the National Natural Science Foundation of China (81172426) and Shanghai Education Commission Research and Innovation projects (12ZZ034). The authors declare that they have no competing interests.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Grouping strategy was performed by using sequentially numbered and sealed envelopes. Each patient was handed out with an envelope through the computerized random number generator
Allocation concealment (selection bias)	Low risk	Grouping strategy was performed by using sequentially numbered and sealed envelopes. Each patient was handed out with an envelope through the computerized random

		number generator
Blinding of participants and personnel (performance bias)	Unclear risk	Only the patients were blinded to the treatments
Blinding of outcome assessment (detection bias)	Unclear risk	No information in the text
Incomplete outcome data (attrition bias)	Unclear risk	In the results: “All 80 patients completed the 12-month assessment.” But perioperative data are collected for 35 patients but missing data are not justified
Selective reporting (reporting bias)	Unclear risk	No protocol available and outcomes not clearly pre-specified
Other bias	Low risk	The authors declare that they have no conflict of interest.

Study ID	**Xia 2008**
Authors:	Shu-Jie Xia, Jian Zhuo, Xiao-Wen Sun, Bang-Min Han, Yi Shao, Yi-Nan Zhang
Title:	Thulium Laser versus Standard Transurethral Resection of the Prostate: A Randomized Prospective Trial
Journal/Book/Source:	Eur Urol.
Date of Publication:	2008
Volume:	53
Issue:	2
Pages:	382-389
METHODS (study design; length of follow up)	Randomised controlled trial (RCT) Follow up: 1, 6, and 12 months
PARTICIPANTS	
Total Number of Participants randomized	100
Country of participants	China
Data collection period	November 2004 to December 2005
Inclusion criteria	Age younger than 85 yr, maximum urinary flow rate (Qmax) less than 15 ml/s, postvoid residual (PVR) urine volume less than 150 ml, medical therapy failure, transrectal ultrasound (TRUS) adenoma volume less than 100g, and urodynamic obstruction (Schäfer grade 2 or greater).
Exclusion criteria	Neurogenic bladder; a diagnosis of prostate cancer and any previous prostatic, bladder-neck, or urethral surgery; and the presence of an indwelling catheter.
Average age	TmLRP-TT: 68.9 ± 7.7 (range 57–85)

	TURP: 69.3 ± 7.3 (range 52–82)	
INTERVENTIONS (technology 1)	Thulium laser resection of the prostate-tangerine technique (TmLRP-TT)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in TmLRP	TmLRP-TT n = 52	
Number of patients in TURP	TURP n = 48	
OUTCOMES	International Prostate Symptom Score (IPSS), quality of life score (QoLs), 5-item version of the International Index of Erectile Function (IIEF-5) questionnaires, PVR volume, Qmax, operative time, serum sodium decrease, catheterization time, hospital day, blood transfusion, TUR syndrome, UTI, re-catheterization, acute urinary incontinence, retrograde ejaculation, urethral stricture.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	/	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information about randomization.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information whether patients or personnel were blinded.
Blinding of outcome assessment (detection bias)	Unclear risk	No information whether outcomes assessors were blinded of the procedure.
Incomplete outcome data (attrition bias)	Low risk	All patients completed the 12-mo assessment.
Selective reporting (reporting bias)	Unclear risk	There is no study protocol available to judge this bias.
Other bias	Low risk	The authors have nothing to disclose.

Study ID	**Xu 2013**
Authors:	Abai Xu, Yong Zou, Bingkun Li, Chunxiao Liu, Shaobo Zheng, Hulin Li, Yawen Xu, Binshen Chen, Kai Xu, Haiyan Shen
Title:	A Randomized Trial Comparing Diode Laser Enucleation of the Prostate with Plasmakinetic Enucleation and Resection of the Prostate for the Treatment of Benign Prostatic Hyperplasia
Journal/Book/Source:	J Endurol.
Date of Publication:	2013

Volume:	27	
Issue:	October	
Pages:	1254-1260	
METHODS (study design; length of follow up)	Randomized trial. Follow up at 3, 6, and 12 months.	
PARTICIPANTS		
Total Number of Participants randomized	80	
Country of participants	China	
Data collection period	July 2011 to November 2011	
Inclusion criteria	Age ≥ 50 years, IPSS ≥ 7, and Qmax ≤ 15 mL/s.	
Exclusion criteria	Neurogenic bladder, history of prostatic or urethral surgery and prostate cancer.	
Average age		
INTERVENTIONS (technology 1)	Transurethral plasma kinetic enucleation and resection of prostate (PKERP)	
INTERVENTIONS (technology 2)	Diode Laser Enucleation of the Prostate (DioLEP)	
Number of patients in PKERP	40	
Number of patients in DioLEP	40	
OUTCOMES	Postvoid residual (PVR) urine volume, Qmax, IPSS, and quality of life (QoL) score, operative time, changes in serum sodium levels, the need for blood transfusion, catheterization time, hospital stay, death, TUR syndrome, bladder injury, transient incontinence, urethral stricture, irritative symptoms.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This work was supported by China Postdoctoral Science Foundation funded project (No. 2012M511830 for Bingkun Li).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Patients were randomly assigned to either DiLEP or PKERP but no information on sequence generation method.
Allocation concealment (selection bias)	Unclear risk	Information about concealment not provided.
Blinding of participants and personnel (performance bias)	Unclear risk	Information about blinding not provided.
Blinding of outcome	Unclear risk	No information whether outcome

assessment (detection bias)		assessment was blinded.
Incomplete outcome data (attrition bias)	Low concern	All patients in the two groups completed the follow-up at 3, 6, and 12 months after operation.
Selective reporting (reporting bias)	Unclear risk	There is no study protocol registered in order to judge this bias.
Other bias	Low risk	Authors declare that they have no competing financial interest.

Study ID	**Yan 2013**
Authors:	Hao Yan, Tong-Wen Ou, Liang Chen, Qi Wang, Fei Lan, Peng Shen, Jin Li, Jian-Jun Xu.
Title:	Thulium laser vaporesection versus standard transurethral resection of the prostate: A randomized trial with transpulmonary thermodilution hemodynamic monitoring
Journal/Book/Source:	Int J Urol.
Date of Publication:	2013
Volume:	20
Issue:	/
Pages:	507-512
METHODS (study design; length of follow up)	Randomised controlled trial (RCT). Follow up: 3 months.
PARTICIPANTS	
Total Number of Participants randomized	80
Country of participants	China
Data collection period	August 2010 and October 2011
Inclusion criteria	Indication for the surgical treatment of BPH
Exclusion criteria	Patients with prostate cancer, bladder calculus, neurogenic bladder dysfunction, previous prostate surgery, urethral stricture or coagulopathy and any other diseases that interfere with the PiCCO monitoring system, such as severe heart or pulmonary diseases.
Average age	Mean value (SD, min-max) TmLRP: 72.5 (7.9, 57–91) Mean value (SD, min-max) TURP: 74.5 (6.5, 58–87)
INTERVENTIONS (technology 1)	Thulium laser vaporesection of the prostate (TmLRP)
INTERVENTIONS (technology 2)	Transurethral resection of prostate (TURP)
Number of patients in	40

TmLRP		
Number of patients in TURP	40	
OUTCOMES	IPSS, Qmax, TUR syndrome, blood transfusion, recatheterisation, urinary incontinence, urethral stricture, retrograde ejaculation, re-operation, decreases in serum sodium, catheter duration, operation duration, mortality.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This study was supported by a grant-in-aid from Beijing Municipal Science &Technology Project and Clinical Characteristics and Application Research of Capital (Surgery for high-risk patients with benign prostatic hyperplasia, No.D101100050010060).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information about generation sequence method.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information about blinding.
Blinding of outcome assessment (detection bias)	Unclear risk	No information about blinding.
Incomplete outcome data (attrition bias)	Low risk	There was no lost to follow up.
Selective reporting (reporting bias)	Unclear risk	There is no protocol available in order to judge this bias.
Other bias	Low risk	Authors have no conflict of interest to declare.

Study ID	**Yang 2013**
Authors:	Zhonghua Yang, Xinghuan Wang, and Tongzu Liu
Title:	Thulium Laser Enucleation Versus Plasmakinetic Resection of the Prostate: A Randomized Prospective Trial With 18-Month Follow-up
Journal/Book/Source:	Urology
Date of Publication:	2013
Volume:	81
Issue:	2
Pages:	396-401
METHODS (study design; length of follow up)	Randomized controlled trial (RCT) Follow up: 1, 3, 6, 12, and 18 months from surgery.

PARTICIPANTS		
Total Number of Participants randomized	158	
Country of participants	China	
Data collection period	From May 2009 to June 2010.	
Inclusion criteria	Age <85 years, maximum urinary flow rate (Qmax) of <15 mL/s, postvoid residual (PVR) urine volume of <150 mL, failure of medical therapy, and transrectal ultrasound (TRUS) volume of <100 g.	
Exclusion criteria	Prostate volume <30 mL, documented or suspected prostate cancer, neurogenic bladder, bladder stone or diverticula, urethral stricture, and maximal bladder capacity >500 mL.	
Average age	ThuLEP: 62.4 ± 7.2 (range: 51-85) PKRP: 61.4 ± 6.9 (range 52-85)	
INTERVENTIONS (technology 1)	Thulium laser transurethral enucleation of the prostate (ThuLEP)	
INTERVENTIONS (technology 2)	Plasmakinetic bipolar resection of the prostate (PKRP) (Gyrus)	
Number of patients in ThuLEP	79	
Number of patients in PKRP	79	
OUTCOMES	International Prostate Symptom Score (IPSS), quality of life score (QOLS), maximum flow rate (Qmax), and postvoid residual urine volume (PVR), blood transfusion, operation time, acute urinary retention, postoperative catheterization time, hospital length of stay.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This study was supported by the National Natural Science Foundation of China (No. 81172734) and Independent Research Projects of Wuhan University (No. 111086).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information about randomisation method.
Allocation concealment (selection bias)	Unclear risk	No information about concealment method.
Blinding of participants and personnel (performance bias)	Unclear risk	No information about blinding.
Blinding of outcome assessment (detection bias)	Unclear risk	No information about blinding.
Incomplete outcome data (attrition bias)	Low risk	No patient was lost during the follow-up.

Selective reporting (reporting bias)	Unclear risk	Study protocol not available in order to judge this bias.
Other bias	Low risk	Authors declare that they have no financial interest to declare.

Study ID	**Yee 2015**
Authors:	Chi-hang Yee, Joseph Hon-ming Wong, Peter Ka-fung Chiu, Chi-kwok Chan, Wai-man Lee, James Hok-leung Tsu, Jeremy Yuen-chun Teoh, Chi-fai Ng.
Title:	Short-stay transurethral prostate surgery: A randomized controlled trial comparing transurethral resection in saline bipolar transurethral vaporization of the prostate with monopolar transurethral resection
Journal/Book/Source:	Asian J Endosc Surg.
Date of Publication:	2015
Volume:	8
Issue:	3
Pages:	316-322
METHODS (study design; length of follow up)	Multicenter, double-blinded, prospective RCT. Follow up: 3 and 6 months.
PARTICIPANTS	
Total Number of Participants randomized	168
Country of participants	China
Data collection period	January and December 2013
Inclusion criteria	Men with BPE, 50–75 years old, American Society of Anesthesiologists Class ≤ 2, Compliant patients, Activities of daily living independent or largely independent, Agreeable to principle of short-stay surgery, Have access to hospital care within 15 min of travel and either of the following conditions: failed medical therapy with alpha-blockers or 5-alpha reductase inhibitors, with IPSS ≥ 18 and/or Qmax ≤ 15 mL/s, urinary retention status.
Exclusion criteria	Previous TURP or other forms of surgical intervention for BPE, patient confirmed to have carcinoma of prostate, patients with known neurogenic bladder, bladder stone, or urethral stricture.
Average age	TURis-PVP: 64.3 ± 5.7 TURP: 65.7 ± 5.5
INTERVENTIONS (technology 1)	Transurethral resection in saline bipolar vaporization of the prostate (TURis-PVP)
INTERVENTIONS	Monopolar transurethral resection of prostate (TURP)

(technology 2)		
Number of patients in TURis-PVP	84	
Number of patients in TURP	84	
OUTCOMES	IPSS, QoL, Qmax, PVR, operative time, catheter time, dysuria score, hospital length of stay, TUR syndrome, blood transfusion.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This research project was funded by the Health and Medical Research Fund, Hong Kong Special Administrative Region Government.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Permuted block design with random block size of two, four, and six was used for subject randomization.
Allocation concealment (selection bias)	Unclear risk	No information about concealment allocation methods.
Blinding of participants and personnel (performance bias)	Unclear risk	Personnel was blinded, but patients were not.
Blinding of outcome assessment (detection bias)	Low risk	Both the patients and the assessors (including doctors and nurses) were blinded to the mode of surgery performed throughout the postoperative period until the completion of the 6-month follow-up.
Incomplete outcome data (attrition bias)	High risk	Overall attrition rate more than 20% due to high attrition rate in TURis group (23.8%). More people were lost to follow up in TURP (23.8%) group than in TURis bipolar vaporisation group (16.7%).
Selective reporting (reporting bias)	Unclear risk	There is no study protocol to judge this bias.
Other bias	Low risk	The authors have no conflict of interest or financial ties to disclose.

Study ID	**Yeni 2002**
Authors:	Ercan Yeni, Doğan Unal, Ayhan Verit, Mehmet Gulum
Title:	Minimal Transurethral Prostatectomy plus Bladder Neck Incision versus Standard Transurethral Prostatectomy in Patients with Benign Prostatic Hyperplasia: A Randomised Prospective Study
Journal/Book/Source:	Urol. Int.
Date of Publication:	2002
Volume:	69

Issue:	4	
Pages:	283-286	
METHODS (study design; length of follow up)	RCT Follow up: 6 months.	
PARTICIPANTS		
Total Number of Participants randomized	40	
Country of participants	Turkey	
Data collection period		
Inclusion criteria	Prostates ≤25 ml, maximal flow rates <10 ml/s, International Prostate Symptom Score (IPSS) values >7, prostate-specific antigen <4 ng/ml, and if they had failed treatment or refused medical treatment.	
Exclusion criteria	Patients with strictures of the bladder neck and/or the urethra, suspicious prostate or bladder malignancy, bladder stone, severe urinary infection, and additional pathologies such as diabetes mellitus and neurologic disorders.	
Average age	TURP+I: 53.2±6.0 TURP: 54.8±5.7	
INTERVENTIONS (technology 1)	TURP and bladder neck incision (TURP+I)	
INTERVENTIONS (technology 2)	TURP	
Number of patients in TURP + I	20	
Number of patients in TURP	20	
OUTCOMES	IPSS, Qmax, operating time, length of hospital stay, bladder neck contracture, procedural blood loss and transfusion requirements, retrograde ejaculation, erectile dysfunction, TUR syndrome.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Randomization method not described.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information whether patients were blinded.

Blinding of outcome assessment (detection bias)	Unclear risk	No information whether outcome assessment was blinded.
Incomplete outcome data (attrition bias)	Unclear risk	Number of patients analysed after 6 months not stated.
Selective reporting (reporting bias)	Unclear risk	No information whether study protocol was registered.
Other bias	Unclear	Funding source and conflicts of interest not reported.

Study ID	**Yip 2011**
Authors:	Sidney K. Yip, Ning Hong Chan, Peter Chiu, Kim W. Lee, Chi Fai Ng
Title:	A Randomized Controlled Trial Comparing the Efficacy of Hybrid Bipolar Transurethral Vaporization and Resection of the Prostate with Bipolar Transurethral Resection of the Prostate
Journal/Book/Source:	J Endurol.
Date of Publication:	2011
Volume:	25
Issue:	12
Pages:	1889–1894
METHODS (study design; length of follow up)	Double-blinded phase III RCT Follow up: 12 months.
PARTICIPANTS	
Total Number of Participants randomized	86
Country of participants	China
Data collection period	
Inclusion criteria	The patients recruited for this study had BPH, were aged 50 or above, and were fit for anesthesia, had undertaken a failed course of medical therapy with alpha-blockers/5-alpha reductase inhibitors, had an IPSS of ≥18, and a Qmax of ≤15 mL/s, or had urinary retention.
Exclusion criteria	Patients who had a history of TURP or other forms of BPH intervention, were confirmed to have carcinoma of the prostate, or had neurogenic bladder, bladder stones, diverticula, or urethral stricture were excluded from the study.
Average age	Mean=69.27 years, standard deviation (SD) = 7.67 years.
INTERVENTIONS (technology 1)	Bipolar transurethral vaporization and resection of prostate (TUVRP)
INTERVENTIONS	Bipolar transurethral resection of prostate (B-TURP)

(technology 2)		
Number of patients in TUVRP	46	
Number of patients in B-TURP	40	
OUTCOMES	IPSS, Qmax, catheter time, length of hospital stay, dysuria score, reintervention, blood transfusion	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	It is an interim analysis. The surgical consumables are supported by Olympus Surgical Technologies Europe. The research is partially funded by the Direct Grant, Medicine Panel, the Chinese University of Hong Kong.	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	A computer-generated permuted block design with random block sizes of 2, 4, and 6 was used for subject randomization.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	Patients and assessors were blinded to the type of surgery performed, but operating surgeon and the individual involved in randomization were aware of the type of surgery to be performed.
Blinding of outcome assessment (detection bias)	Low risk	Both patients and assessors were blinded to the type of surgery performed. Only the operating surgeon and the individual involved in randomization were aware of the type of surgery to be performed, and they did not participate in subsequent postoperative clinical decisions or in collecting data from the patient.
Incomplete outcome data (attrition bias)	Low risk	There was no lost to follow up.
Selective reporting (reporting bias)	Low risk	Same outcomes stated in the study protocol were assessed in the article.
Other bias	High risk	Financial interest, manufacturer financed the study.

Study ID	**Zhang 2015**
Authors:	Keqin Zhang, Dingqi Sun, Hui Zhang, Qingwei Cao, Qiang Fu
Title:	Plasmakinetic Vapor Enucleation of the Prostate with Button

	Electrode versus Plasmakinetic Resection of the Prostate for Benign Prostatic Enlargement >90 ml: Perioperative and 3-Month Follow-Up Results of a Prospective, Randomized Clinical Trial
Journal/Book/Source:	Urol Int.
Date of Publication:	2015
Volume:	95
Issue:	3
Pages:	260-264
METHODS (study design; length of follow up)	Randomized controlled trial Follow up: 3 months
PARTICIPANTS	
Total Number of Participants randomized	112
Country of participants	China
Data collection period	August 2012 to May 2014
Inclusion criteria	Patients with urinary symptoms due to benign prostatic enlargement (BPE) >90 ml.
Exclusion criteria	Prostate volume <90 ml (transrectal ultrasound measured), severe pulmonary disease or heart disease, coagulopathy, bladder cancer, prostate cancer, neurogenic bladder, and a history of prostatic or urethral surgery.
Average age	PVEP: 68.25 ± 4.60 PKRP: 67.48 ± 4.87
INTERVENTIONS (technology 1)	Plasmakinetic vapor enucleation of the prostate (PVEP)
INTERVENTIONS (technology 2)	Button electrode and plasmakinetic resection of the prostate (PKRP)
Number of patients in PVEP	56
Number of patients in PKRP	56
OUTCOMES	International Prostate Symptom Score (IPSS), quality-of-life score (QoL), maximum urinary flow rate (Q max), the postvoid residual urine volume (PVR), operation time, the serum sodium decrease, transfusion, the duration of catheterization, the duration of hospital stay, urinary incontinence and urethral stricture.
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	

Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Patients were randomized in a 1: 1 ratio to undergo either PVEP or PKRP by means of a random number table.
Allocation concealment (selection bias)	Unclear risk	No information about allocation concealment.
Blinding of participants and personnel (performance bias)	Unclear risk	No information whether patients were blinded.
Blinding of outcome assessment (detection bias)	Unclear risk	No information whether outcome assessment was blinded.
Incomplete outcome data (attrition bias)	Low risk	There was no loss to follow up.
Selective reporting (reporting bias)	Unclear risk	No information whether study protocol was registered.
Other bias	Low risk	The authors have nothing to declare

Study ID	**Zhang 2019**
Authors:	Jun Zhang, Xilong Wang, Yanbin Zhang, Chaoliang Shi, Minqi Tu, and Guowei Shi
Title:	1470nm Diode Laser Enucleation vs Plasmakinetic Resection of the Prostate for Benign Prostatic Hyperplasia: A Randomized Study
Journal/Book/Source:	J Endurol.
Date of Publication:	2019
Volume:	33
Issue:	3
Pages:	211-217
METHODS (study design; length of follow up)	Design: A single-blinded RCT. Follow up: 3, 6, and 12 months postsurgery.
PARTICIPANTS	
Total Number of Participants randomized	152
Country of participants	China
Data collection period	January 2016 to March 2017
Inclusion criteria	Prostate volume less than or equal to 80 mL.
Exclusion criteria	Neurogenic bladder, urethral stricture, prostate carcinoma, and a history of urethral or prostate surgery.
Average age	DioLEP: 73.7 ± 8.4 (range 56–92) PKRP 71.5 ± 8.9 (range 55–93)

INTERVENTIONS (technology 1)	Diode laser enucleation of the prostate (DioLEP)	
INTERVENTIONS (technology 2)	Plasmakinetic resection of the prostate (PKRP)	
Number of patients in DioLEP	76	
Number of patients in PKRP	76	
OUTCOMES	Qmax, PVR, IPSS, QoL, serum sodium decrease, operative time, catheterization time, hospitalization duration, blood transfusion requirement, TURS, urinary incontinence, capsular perforation, and urethral stricture	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	The authors acknowledge financial support from the Guiding Medical Project of Shanghai Science and Technology Committee (Grant No. 16411972000) and the Shanghai Key Medical Specialty Program (Grant No. ZK2015B04).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	The patients were assigned envelopes by a computerized random number generator.
Allocation concealment (selection bias)	Low risk	Grouping strategy was performed with sequential numbering and sealed envelopes.
Blinding of participants and personnel (performance bias)	Unclear risk	It is a single-blinded RCT but it is not stated who was blinded.
Blinding of outcome assessment (detection bias)	Unclear risk	It is a single-blinded RCT but it is not stated who was blinded.
Incomplete outcome data (attrition bias)	Low risk	All cases underwent follow-up assessment at 3, 6, and 12 months postoperation.
Selective reporting (reporting bias)	Unclear risk	There is no study protocol to judge this bias.
Other bias	Low risk	The authors declare that they have no competing interest.

Study ID	**Zhang+F 2012**
Authors:	Fengbo Zhang, Qiang Shao, Thomas R. W. Herrmann, Ye Tian, Yuhai Zhang
Title:	Thulium Laser Versus Holmium Laser Transurethral Enucleation of the Prostate: 18-Month Follow-up Data of a Single Center
Journal/Book/Source:	J Urology

Date of Publication:	2012	
Volume:	79	
Issue:	4	
Pages:	869-874	
METHODS (study design; length of follow up)	Prospective randomized trial Follow up: 1, 6, 12 and 18 months.	
PARTICIPANTS		
Total Number of Participants randomized	133	
Country of participants	China	
Data collection period	December 2007 to April 2009	
Inclusion criteria	Age <85 years, a maximal urinary flow rate (Qmax) <15 mL/s, medical therapy failure, transrectal ultrasound-measured adenoma volume <80 g, and urodynamic obstruction without detrusor dysfunction	
Exclusion criteria	Neurogenic bladder, findings suspicious for prostate cancer, and a poor tolerance for surgery.	
Average age	ThuLEP: 76.2 ± 9.7 (range 63-85) HoLEP: 73.4 ± 10.3 (range 66-84)	
INTERVENTIONS (technology 1)	Thulium laser transurethral enucleation of the prostate (ThuLEP) (70W)	
INTERVENTIONS (technology 2)	Holmium laser transurethral enucleation of the prostate (HoLEP) (90W)	
Number of patients in ThuLEP	71	
Number of patients in HoLEP	62	
OUTCOMES	International Prostate Symptom Score (IPSS), Qmax, postvoid residual urine (PVR), bleeding, reoperation, and urethral/bladder neck stricture, operation time, serum sodium decrease, postoperative catheterization time.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	The randomization numbers obtained from table of randomized numbers were allocated to patients by the sequence of hospitalization.
Allocation concealment (selection bias)	Unclear risk	No information about concealment method.

Blinding of participants and personnel (performance bias)	Unclear risk	No information about blinding.
Blinding of outcome assessment (detection bias)	Unclear risk	No information about blinding.
Incomplete outcome data (attrition bias)	Low risk	No patient was lost to follow up.
Selective reporting (reporting bias)	Unclear risk	There is no study protocol available to judge this bias.
Other bias	Unclear	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Zhang+S 2012**
Authors:	Zhang Shi-ying, Hu Hao, Zhang Xiao-peng, Wang Dong, Xu Ke-xin, Na Yan-qun, Huang Xiao-bo, Wang Xiao-feng
Title:	Efficacy and safety of bipolar plasma vaporization of the prostate with “button-type” electrode compared with transurethral resection of prostate for benign prostatic hyperplasia
Journal/Book/Source:	Chin Med J.
Date of Publication:	2012
Volume:	125
Issue:	21
Pages:	3811-3814
METHODS (study design; length of follow up)	Randomized controlled trial Follow up: 1, 3, and 6 months
PARTICIPANTS	
Total Number of Participants randomized	30
Country of participants	China
Data collection period	January 2009 to January 2012
Inclusion criteria	Bladder outlet obstruction secondary to BPH with maximum flow rate <10 ml/s, prostate volume 25–125 ml.
Exclusion criteria	Serious comorbidity, previous history of prostate surgery, history of prostate cancer, abnormal digital rectal examination and prostate-specific antigen (PSA) level >4 ng/ml.
Average age	B-PVP: 70.9±7.1 TURP: 71.9±6.1
INTERVENTIONS (technology 1)	Bipolar plasma vaporization of the prostate with “button-type” electrode (B-PVP)
INTERVENTIONS	Transurethral resection of prostate (TURP)

(technology 2)		
Number of patients in B-PVP	15	
Number of patients in TURP	15	
OUTCOMES	International Prostate Symptom Score (IPSS), quality of life (QOL), Qmax, catheter time, blood loss, hospital stays.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Sealed envelopes which contain the consecutive digits were used for randomization.
Allocation concealment (selection bias)	High risk	Sealed envelopes which contain the consecutive digits were used for randomization.
Blinding of participants and personnel (performance bias)	Unclear risk	No information about blinding.
Blinding of outcome assessment (detection bias)	Unclear risk	No information about blinding.
Incomplete outcome data (attrition bias)	High risk	There is no number of patients at each follow up visit provided and results on changes at follow up are only described in writing without providing numbers.
Selective reporting (reporting bias)	Uncertain risk	There is no study protocol registered in order to check selective reporting.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Zhao 2010**
Authors:	Zhigang Zhao, Guohua Zeng , Wen Zhong, Zanlin Mai, Shaohua Zeng, Xueting Tao
Title:	A Prospective, Randomised Trial Comparing Plasmakinetic Enucleation to Standard Transurethral Resection of the Prostate for Symptomatic Benign Prostatic Hyperplasia: Three-year Follow-up Results
Journal/Book/Source:	Eur Urol.
Date of Publication:	2010

Volume:	58	
Issue:	5	
Pages:	752-758	
METHODS (study design; length of follow up)	Randomised controlled trial. Follow up: 1, 3, 6, 12, 18, 24, and 36 months.	
PARTICIPANTS		
Total Number of Participants randomized	204	
Country of participants	China	
Data collection period	January 2004 to December 2006	
Inclusion criteria	Age >45 yr, maximal urinary flow rate (Qmax) <15 ml/s, International Prostate Symptom Score (IPSS) >12, medication failure, prostate volume on TRUS >20 g with no upper limit, and urodynamically proven obstruction (Schäfer grade ≥2).	
Exclusion criteria	Patients with neurovesical dysfunction, a diagnosis of prostate carcinoma, and a previous history of prostatic or urethral surgery.	
Average age	PKEP: 67.3 ± 6.6 (range 49–86) TURP: 67.8 ± 6.4 (range 51–84)	
INTERVENTIONS (technology 1)	Plasmakinetic enucleation of the prostate (PKEP) (Gyrus)	
INTERVENTIONS (technology 2)	Transurethral resection of the prostate (TURP)	
Number of patients in PKEP	102	
Number of patients in TURP	102	
OUTCOMES	IPSS, quality of life (QoL) score, the International Index of Erectile Function (IIEF)-5 questionnaire, Qmax, postvoid residual urine (PVR) volume, sexual function, operation time, changes in serum sodium, the need for blood transfusion, transurethral resection (TUR) syndrome, urinary tract infections, transient incontinence, retrograde ejaculation, urethral stricture, bladder neck contracture, dysuria, the duration of catheterisation and hospitalization, reintervention.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	This work was supported by a grant from the Science & Technology Planning Project of Guangdong Province, China (No. 2008B080701035).	
Risk of bias	**Authors' judgement**	**Support for judgement**

Random sequence generation (selection bias)	High risk	Patients were randomised in a 1:1 ratio to undergo either PKEP or TURP by using a sealed envelope sequence.
Allocation concealment (selection bias)	High risk	Patients were randomised in a 1:1 ratio to undergo either PKEP or TURP by using a sealed envelope sequence.
Blinding of participants and personnel (performance bias)	High risk	Neither the patient nor the surgeon was blinded as to the type of the procedure performed.
Blinding of outcome assessment (detection bias) SUBJECTIVE OUTCOMES	High risk	Patients were not blinded.
Blinding of outcome assessment (detection bias) OBJECTIVE OUTCOMES	Low risk	Two independent investigators, who did not know which treatment the patients had undergone, performed the 1-, 3-, 6-, 12-, 18-, 24-, and 36-mo follow-up assessment.
Incomplete outcome data (attrition bias)	Low risk	There was no statistically significant difference in the number of dropouts at any of the follow-up assessments between the two groups.
Selective reporting (reporting bias)	Low risk	Numerous outcomes are assessed in the study, it is unlikely that study protocol envisioned more outcomes than reported.
Other bias	Low risk	The authors declare that they have no financial or competing interest.

Study ID	**Zhu 2013**
Authors:	Lingfeng Zhu, Shushang Chen, Shunliang Yang, Meijing Wu, Rong Ge,Weizhen Wu, Lianming Liao, Jianming Tan
Title:	Electrosurgical Enucleation Versus Bipolar Transurethral Resection for Prostates Larger than 70 ml: A Prospective, Randomized Trial with 5-Year Followup
Journal/Book/Source:	J Urol.
Date of Publication:	2013
Volume:	189
Issue:	4
Pages:	1427-1431
METHODS (study design; length of follow up)	Prospective, open label, randomized trial Follow up: 1, 6, 12, 24, 36, 48 and 60 months.
PARTICIPANTS	
Total Number of Participants	80

randomized		
Country of participants	China	
Data collection period	June 2004 to December 2006	
Inclusion criteria	Urodynamically proven obstruction, Qmax less than 10 ml per second, I-PSS greater than 19, age between 50 and 70 years, prostate volume between 70 and 200 ml on transrectal ultrasound, PSA less than 4 ng/ml and failure of medical therapy (combined -adrenoreceptor blocker and 5-reductase inhibitor for at least 6 months).	
Exclusion criteria	Patients with neurogenic bladder, urethral stricture, bladder tumor, prostate cancer or previous prostate, bladder neck or urethral surgery, PSA 4 ng/ml or greater, or prostate biopsy within 3 months.	
Average age	PKEP: 64.1 ± 4.8 B-TURP: 64.8 ± 3.9	
INTERVENTIONS (technology 1)	PlasmaKinetic™ Electrosurgical enucleation (PKEP)	
INTERVENTIONS (technology 2)	Bipolar transurethral resection (B-TURP)	
Number of patients in PKEP	40	
Number of patients in B-TURP	40	
OUTCOMES	IPSS, Qmax, QOL, PVR, IIEF-5, operative time, catheterization time, postoperative hospital stay, urinary retention, transient incontinence, urinary tract infections.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)		
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Patients were randomly assigned in 1:1 fashion using computer generated block randomization.
Allocation concealment (selection bias)	High risk	Open label RCT.
Blinding of participants and personnel (performance bias)	High risk	Open label RCT.
Blinding of outcome assessment (detection bias)	High risk	Two experienced urologists were blinded only to the surgical modality determined bladder irrigation, catheter removal and hospital discharge in all cases, for other safety outcomes as well as functional

		outcomes they were not blinded.
Incomplete outcome data (attrition bias)	Low risk	7.5% and 10% patients were lost to follow up only at 3 years of follow up in PkEP and B-TURP, respectively.
Selective reporting (reporting bias)	Uncertain risk	There is no study protocol registered in order to judge selective reporting.
Other bias	Unclear risk	Funding source, conflicts of interest and trial registration number are not reported.

Study ID	**Zou 2018**
Authors:	Zhihui Zou, Abai Xu, Shaobo Zheng, Binshen Chen, Yawen Xu, Hulin Li, Chongyang Duan, Junhong Zheng, Jiasheng Chen, Chaoming Li, Yiming Wang, Yubo Gao, Chaozhao Liang, Chunxiao Liu
Title:	Dual‐centre randomized‐controlled trial comparing transurethral endoscopic enucleation of the prostate using diode laser vs. bipolar plasmakinetic for the treatment of LUTS secondary of benign prostate obstruction: 1‐year follow‐up results
Journal/Book/Source:	World J Urol.
Date of Publication:	2018
Volume:	36
Issue:	7
Pages:	1117–1126
METHODS (study design; length of follow up)	Dual-centre, open-label, parallel-design non-inferiority RCT Follow up: 1 week, 1, 3, 6, and 12 months.
PARTICIPANTS	
Total Number of Participants randomized	114
Country of participants	China
Data collection period	May 2015 to October 2015
Inclusion criteria	IPSS > 12 and the QoL > 4, maximum urinary flow rate (Qmax) < 15 mL/s, and/or The Schafer grade > 2, and/or failed medical therapy of BPO, and/or recurrent urinary retention.
Exclusion criteria	Previous urethral/prostatic surgery, known prostate cancer or urethral strictures, and neurogenic bladder or other neurologic disorder that may affect micturition.
Average age	DioLEP: 67.3 ± 7.7 B-EEP: 69.4 ± 7.5
INTERVENTIONS (technology 1)	Modified diode laser enucleation of the prostate (DioLEP)

INTERVENTIONS (technology 2)	Bipolar endoscopic enucleation of the prostate (B-EEP)	
Number of patients in DioLEP	57	
Number of patients in B-EEP	57	
OUTCOMES	Post-void residual urine (PVR), International Prostate Symptom Score (IPSS), quality of life (QoL), International Index of Erectile Function (IIEF-5), operative time, the time of enucleation, blood loss during surgery, decrease in serum sodium, catheterization time, hospital stay days, persistent irritative symptoms, transient incontinence, retrograde ejaculation, recatheterization, UTI, bladder-neck contracture.	
Notes (e.g. funding source; conflicts of Interest; trial registration number, etc.)	Funded by Guangzhou Science Technology Key Program (201504301009390).	
Risk of bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	The randomization sequence (1:1 ratio) was developed using the proc plan process of SAS 9.2.
Allocation concealment (selection bias)	Low risk	Allocation concealment was conducted using sealed opaque envelopes.
Blinding of participants and personnel (performance bias)	High risk	Open label RCT.
Blinding of outcome assessment (detection bias) SUBJECTIVE OUTCOMES	High risk	Patients were not blinded to the type of procedure.
Blinding of outcome assessment (detection bias) OBJECTIVE OUTCOMES	Low risk	The assessment of outcomes was made by researchers blinded to treatment allocation.
Incomplete outcome data (attrition bias)	Unclear risk	5.2% loss to follow up in DiLEP and 0% in BEEP.
Selective reporting (reporting bias)	Low risk	The study protocol is available and all of the study's pre-specified outcomes have been reported.
Other bias	Low risk	The authors have nothing to disclose.

APPENDIX 5

REGULATORY AND REIMBURSEMENT STATUS

Table A4: Regulatory status

Technology	Proprietary name	Manufacturer	Class	Intended use	CE mark approval	FDA approval
PUL	UroLift® System	NeoTract Inc.	Class 2	To treat symptoms due to urinary outflow obstruction secondary to BPH in men ≥ 50 years.	2013 [164]	2013 [165]
WAVE	Rezūm System	Boston Scientific	Class 2	To relieve symptoms, obstructions, and reduce prostate tissue associated with BPH. It is indicated for men ≥ 50 years of age with a prostate volume ≥ 30cm3 and ≤ 80cm3. It is indicated for treatment of prostate with hyperplasia of the central zone and/or a median lobe.	2013	2015 [166, 167]
TIND	iTIND®	Medi-Tate Ltd.	Class 2	To treat male patients who suffer from lower urinary tract symptoms secondary to BPH.	2011 [168]	2020 [169]
Aquablation	AquaBeam Robotic System	Procept Biorobotics	Class 2	To resect and remove prostate tissue in males suffering from lower urinary tract symptoms due to BPH. Contraindications: active UTI, known allergy to device materials, inability to safely stop anticoagulants or antiplatelet agents perioperatively, diagnosed or suspected prostate cancer.	2014 [170]	2017 [171]
PAE	Embozene™ Microspheres	Boston Scientific	Class 2	To embolize arteriovenous malformations and hypervascular tumors, including uterine fibroids and hepatoma, and to embolize prostatic arteries for symptomatic BPH. This device is not intended for neurovascular use.	2005, renewed in 2015 [172]	2018 [173]
PAE	Bead Block®	Boston Scientific (formerly BioCompatibl	Class 2	To embolize arteriovenous malformations and hypervascular tumours including uterine fibroids, and benign prostatic hyperplasia.	2003, renewed in 2014 [172]	No

		es UK)				
PAE	Embos-phere®Microsp heres	Merit (formerly BioSphere Medical S.A.)	Class 2	To embolize arteriovenous malformations, hypervascular tumors, including symptomatic uterine fibroids, and prostatic arteries for symptomatic BPH.	2013 [172]	2016 [174]
PAE	PVA Foam Embolisation Particles	Cook Medical	Class 2	To treat symptomatic BPH.	2013 [172]	No
PVP	GreenLight XPS™ Laser Therapy Sys-tem	Boston Scien-tific	Class 2 GreenLight XPS con-sole: class 2b, MoXy disposable laser fibre: class 2a	To incise, vaporize, ablate, and coagulation soft tissue, including photoselec-tive vaporization of the prostate for BPH. The laser system is contraindicated for patients who: are contraindicated for surgery, contraindicated where appro-priate anesthesia is contraindicated by patient history, have calcified tissue, require hemostasis in >2mm vessels, have uncontrolled bleeding disorders, have prostate cancer, have acute UTI, or severe urethral stricture. Possible risks and complications include, but are not limited to, irritative symptoms (dys-uria, urgency, frequency), retrograde ejaculation, urinary incontinence, erectile dysfunction, hematuria - gross, UTI, bladder neck contracture/outlet obstruct, urinary retention, perforation - prostate, urethral stricture.	2010 for the XPS System. The predecessor re-ceived CE mark in 2005.	2009 [175]
HoLEP, HoLRP, HoLAP, TUIP, open surgery	Lumenis® VersaPulse™ 20, 60, 80, 100 W Lasers (including the laser genera-tor, fiber and morcellator)	Lumenis	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.	Yes [176]	2001 [177]
HoLEP, HoLRP,	Lumenis® Pulse™ 120H	Lumenis	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this	Yes [178]	2014 [179]

HoLAP, TUIP, open surgery				includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.		
HoLEP	MOSES™ Pulse 120H	Lumenis	Class 2	Laser enucleation of the prostate.	Yes [180]	No
HoLEP, HoLRP, HoLAP, TUIP, open surgery	Sphinx Laser	LISA Laser USA	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.	Yes [181]	2004 [182]
HoLEP	Dornier Medilas ® H100 and H140 with integrated morcellator	Dornier MedTech	Class 2b	Combination of laser and auxiliary morcellation module for BPH treatment.	Yes [183]	n.a.
HoLEP, HoLRP, HoLAP, TUIP, open surgery	Cyber Ho 100	Quanta System	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.	n.a.	2019 [184]
HoLEP, HoLRP, HoLAP, TUIP, open surgery	MultiPulse HoPLUS with integrated morcellator	Jena Surgical/ Asclepion Laser Technologies GmbH	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.	n.a.	2014 [185]

HoLEP, HoLRP, HoLAP, TUIP, open surgery	Auriga® XL	Boston Scientific	Class 2	For surgical procedures involving open, laparoscopic and endoscopic ablation, vaporization, excision, incision, and coagulation of soft tissue. In urology this includes: TUIP, bladder neck incision, HoLAP, HoLEP, holmium laser resection of the prostate, open and endoscopic urological surgery.	Yes [186]	2011 [187]
TUMT	TMX-2000 THERMATRX Thermo Therapy System	Boston Scientific (formerly AMS)	n.a.	To treat BPH in men who have a minimum prostatic urethra length of 30 mm and a total prostate volume between 30 and 100 cc.	n.a.	2001 [188]
TUMT	CoolWave® control unit Targis system	Urologix	Class 2	To relieve symptoms and obstruction associated with BPH and is indicated for men with prostatic urethra lengths of 3 to 5 cm or 2.5 to 3.5 cm.	Yes [189]	2006 [190]
TUMT	CoreTherm™	Prostalund	Class 3	To treat BPH in men who have a minimum prostatic urethra length of 35 mm and a total prostate volume between 30 and 100 g.	Yes [191]	2002 [192]
TURP, TUVP, TUVRP, TUViS, TURiS, TUIP	PLASMA (TURiS) System (ESG 400 generator, working elements, telescopes, resectoscopes, HF resection electrodes or HF resection electrodes for plasma vapor-	Olympus Medical	Class 2	HR resection electrode: to resect, ablate or remove soft tissue where hemostatis is required. The specific urological indications include use in the prostate, bladder and bladder neck. The procedures for which the devices can be used are TURis, transurethral prostatectomy, TURP for benign prostatic hyperplasia, TUIP or bladder neck, transurethral resection of bladder tumors and cystodiathermy. These devices are intended to be used in an irrigated environment. These devices are not intended to be used to treating cancer of the prostate. HF resection electrode for plasma vaporisation: intended for use in urological surgical procedures involving the vaporization, ablation, coagulation, cutting, removal of soft tissue and coagulation where hemostatis is required. The specific soft tissue indications include use in the prostate, bladder and bladder neck. The specific treatment indications include BPH, bladder cancer, tumors,	The components of the TURis system are covered by individual CE marks. The most recent issued in 2013 for the TURis working element. [193]	2011 [194]

	isation)			lesions and neoplasms. The specific urological indications include transurethral electrovaporization, also known as transurethral vapor resection of the prostate or transurethral vaporization in saline.		
ThuLEP, ThuVEP, ThuVARP, ThuVAP	Revolix 200 Watt Continuous Wave Laser	LISA Laser USA (formerly Quanta System)		RevoLix is a multi-disciplinary surgical laser for the application in urology for the treatment of BPH: ThuVAP, vaporesection, ThuLEP and vapoenucleation. RevoLix 200 is only approved for the treatment of BPH when used at power levels greater than 120W.	Yes [195]	2005 [196]
ThuLEP, ThuVEP, ThuVARP, ThuVAP	Cyber TM Family (Cyber TM 150, 180, 200)	Quanta System	Class 2	Intended for use in surgical procedures using open, laparoscopic and endoscopic incision, excision, resection, ablation, vaporization, coagulation and hemostasis of soft tissue in medical specialties including urology. Cyber Tm 180 and Cyber Tm 200 are only approved for the treatment of BPH when used at power levels greater than 150W.	n.a.	2013 [197]
ThuLEP, ThuVEP, ThuVARP, ThuVAP	MultiPulse Tm+1470	Jena Surgical/ Asclepion Laser Technologies GmbH	Class 2	Intended for use in surgical procedures using open, laparoscopic and endoscopic incision, excision, resection, ablation, vaporization, coagulation and hemostasis of soft tissue in medical specialties including urology.	Yes [198]	2015 [199]
ThuLEP, ThuVEP, ThuVARP, ThuVAP	Vela® XL	Boston Scientific	Class 2	Intended for use in surgical procedures using open, laparoscopic and endoscopic incision, excision, resection, ablation, vaporization, coagulation and hemostasis of soft tissue in medical specialties including urology.	n.a.	2011 [200]
DioLEP, DioVAP	Multidiode™ SST 200	InterMedic	Class 2	For surgical applications requiring the vaporization, incision, excision, ablation, cutting and hemostasis, or coagulation of soft tissue in conjunction with endoscopic equipment for medical specialties including urology.	Yes 2008 (information from manufacturer)	2009 [201]

DioLEP, DioVAP	LEONARDO® (with the Leonardo fiber) and XCAVATOR® (with the Twister fiber)	BioLitec	Class 2	For incision, excision, ablation, cutting, vaporization, hemostasis, and coagulation of soft tissue contact or non-contact, open or closed endoscopic applications where incision, tissue dissection, excision of external tumors and lesions, complete or partial resection of internal organs, tumors and lesions, tissue vaporization, hemostasis and/or coagulation may be indicated.	Yes for both LEONARDO and XCAVATOR [202, 203]	n.a.
B-TURP	Gyrus Plasmakinetic SuperPulse System (generator, resectoscope, electrode)	Gyrus Medical	Class 2	Intended for use with bipolar instruments used in open, endoscopic and laparoscopic surgical procedures involving the coagulation and cutting of soft tissue. The device is intended for use by qualified medical personnel trained in the use of electrosurgical equipment.	Yes [204]	2003 [205]
B-TURP, B-TUEP, B-TUVP	Bipolar high frequency surgery unit AUTOCON® III (separately working elements, electrodes, morcellator)	Karl Storz	Class 2b	Intended for use by qualified surgeons to provide a high frequency electrical current for monopolar and bipolar cutting and coagulation of tissue structures during surgical operations.	Yes [206]	2017 [207]

Abbreviations: BPH benign prostatic hyperplasia, B-TUEP bipolar transurethral enucleation of the prostate, B-TURP bipolar transurethral resection of the prostate, B-TUVP bipolar transurethral vaporisation of the prostate,DioLEP diode laser enucleation of the prostate, DioVAP diode laser vaporisation, HF high frequency, HoLEP holmium laser enucleation of the prostate, HoLRP holmium laser resection of the prostate, LUTS lower urinary tract symptoms, n.a. not available, PAE prostate artery embolization, PUL prostatic urethral lift, PVP photoselective vaporization of the prostate, ThuLEP thulium laser enucleation of the prostate, ThuVARP thulium vaporesection of the prostate, ThuVEP thulium vapoenucleation of the prostate, TIND temporary implantable nitinol device, TUIP transurethral incision of the prostate, TUMT transurethral microwave therapy, TURis transurethral resection in saline, TURP transurethral resection of the prostate, TUVRP transurethral vapor resection of the prostate, TUVis transurethral vaporization in saline, TUVP/TUEVP transurethral electrovaporization, UTI urinary tract infection, WAVE water vapour thermal therapy

Table A5: Summary of (reimbursement) recommendations in European countries for the assessed technologies

issuing organisation (document number)	Summary of (reimbursement) recommendations and restrictions	Summary of reasons for recommendations, rejections and restrictions
NICE (MTG49)	Evidence supports the case for adopting **Rezum** for treating LUTS caused by BPH. Rezum relieves LUTS and improves quality of life. Rezum should be considered as a treatment option for people with: moderate to severe LUTS (IPSS typically 13 or over) and a moderately enlarged prostate (typically between 30 cm^3 and 80 cm^3). Cost modelling estimates that Rezum is cost saving compared with standard treatments such as TURP and HoLEP. Savings compared with UroLift are uncertain.	Clinical evidence shows that using the Rezum procedure relieves LUTS caused by BPH in men with moderate to severe symptoms who have a moderately enlarged prostate. Evidence also shows that using Rezum is associated with improved quality of life and a low risk of sexual dysfunction. Cost analyses suggest that when Rezum is used as an alternative to standard treatment, such as TURP or HoLEP, it is likely to lead to cost savings because it is done as day surgery with reduced operating and recovery costs.
NICE (MTG26)	The clinical case for adopting the **UroLift** system for treating LUTS attributed to BPH is supported by the evidence. The UroLift system relieves LUTS while avoiding the risk to sexual function associated with TURP and HoLEP. Using the system reduces the length of a person's stay in hospital. It can also be used in a day-surgery unit. The UroLift system should be considered as an alternative to current surgical procedures for use in a day-case setting in men with LUTS attributed to BPH who are aged 50 years and older and who have a prostate of less than 100 ml without an obstructing middle lobe.	The Committee concluded that the UroLift system is effective in relieving symptoms of BPH. It noted that the degree of symptom relief outcomes is slightly less than that after TURP or HoLEP, but it is sufficient and clinically important. The duration of symptom relief after using the UroLift system is uncertain. It concluded that it is similar in the medium term (up to 3 years) to the comparators but that further evidence on durability and the need for subsequent procedures would be useful. The Committee considered the evidence that the UroLift system does not damage sexual function to be convincing. This contrasts with a substantial risk to erectile and ejaculatory function after TURP or HoLEP and represents a significant advantage for men who wish to preserve their sexual function. The evidence for avoiding catheterisation after the UroLift system was sparse, but based on expert advice the catheterisation time would be reduced and in many cases catheterisation would be avoided, especially as surgeons gain experience with the procedure. It also concluded that it was reasonable and likely that the UroLift system would be used as a day-surgery procedure, often under local anaesthetic.

issuing organisation (document number)	Summary of (reimbursement) recommendations and restrictions	Summary of reasons for recommendations, rejections and restrictions
NICE (MTG29)	The case for adopting **GreenLight XPS** for treating BPH is supported in non-high-risk patients. GreenLight XPS is at least as effective in these patients as TURP, but can more often be done as a day-case procedure, following appropriate service redesign. There is currently insufficient high-quality, comparative evidence to support the routine adoption of GreenLight XPS in high-risk patients, that is those who: have an increased risk of bleeding or have prostates larger than 100 ml or have urinary retention. NICE recommends that specialists collaborate in collecting and publishing data on the comparative effectiveness of GreenLight XPS for high-risk patients to supplement the currently limited published evidence. NICE recommends that hospitals adopting GreenLight XPS plan for service redesign to ensure that day-case treatment can be delivered appropriately. Cost modelling indicates that in non-high-risk patients, cost savings with GreenLight XPS compared with TURP are determined by the proportion of procedures done as day cases.	The committee concluded that GreenLight XPS is as effective as TURP for treating BPH in non-high-risk patients. The committee considered that the evidence for the use of GreenLight XPS in high-risk patients is limited, but accepted expert advice that the clinical benefits of its use in this population are plausible. It concluded that further comparative clinical evidence of the benefits of GreenLight XPS in high-risk patients is needed before recommending the procedure for routine adoption in this population. The committee considered that the evidence for GreenLight XPS allowing more procedures to be done on a day-case basis than current practice was both convincing and compelling. The committee concluded that adopting the GreenLight XPS system is likely to drive an increase in rates of day-case surgery and that planning for the redesign of urological services would be required to accommodate this. The committee concluded that, in non-high-risk patients, adopting the GreenLight XPS system is likely to be cost saving compared with TURP, only if the current arrangement where consoles are provided at no cost to the hospital based on a contracted commitment to fibre usage is continued, and that high rates of day-case treatment are achieved.

issuing organisation (document number)	Summary of (reimbursement) recommendations and restrictions	Summary of reasons for recommendations, rejections and restrictions
G-BA (BAnz Nr. 107 (S. 2555) vom 20.07.2011) https://www.g-ba.de/beschluesse/1254/	**Holmium laser resection** (HoLRP) and **HoLEP** are considered alternative treatments to TURP for BPH. The indications for the use of HoLRP and HoLEP are based on the indications for TURP. HoLRP and HoLEP can only be provided and billed by specialists in urology at the expense of the statutory health insurance, who have proven knowledge, experience and skills of the methods. As part of the treatment, the doctor must ensure that the patient is informed in particular about the risk of a necessary re-intervention, about undesirable effects, about the therapeutic significance of TURP and about the natural course of the BPH syndromes.	The G-BA sees the benefits, medical necessity and economic viability for the following procedures proven: HoLRP and HoLEP, so that these procedures can be included in the service catalog of statutory health care. For procedures TmLRP and TUMT, the G-BA, after considering the available evidence, the specific characteristics of the procedures and the existing treatment alternatives, determined that these procedures cannot be conclusively assessed. Studies that are suitable to clarify the open questions, in particular on the re-intervention rate and suitability for defined patient groups, can in principle be carried out and can therefore be expected from the G-BA in a reasonable time. The decision on these procedures should therefore be suspended. The evidence on PVP is also not yet sufficient, but results are expected from ongoing studies that are suitable to answer the question about the benefit. The decision on these procedures should therefore also be suspended. For the following procedures, neither a benefit, a necessity nor an efficacy in comparison to non-treatment could be demonstrated: HoLAP, holmium laser incision, water induced thermotherapy, TUNA, transurethral ethanolablation, high-intensity focused ultrasound, interstitial laser coagulation, hybrid laser technology (KTP and Nd:YAG lasers), so these procedures cannot be applied to the treatment of benign prostate syndrome at the expense of the statutory health insurance.
G-BA (BAnz AT 29.08.2017 B5), 2017 https://www.g-ba.de/beschluesse/2985/	**TmLRP** is another method for the treatment of BPH and, like TURP, adenomectomy, holmium laser resection (HoLRP) and HoLEP is among the specified treatments for BPH. The indications are based on the indications for TURP. The services according to can only be provided and billed by specialists in urology at the expense of the statutory health insurance who have proven knowledge, experience and skills with TmLRP. The provision of services at the expense of the statutory health insurance is tied to the approval of the responsi-	In comparison with the standard treatment, there was no hint of a greater benefit of TmLRP for the outcomes “symptoms”, “health-related quality of life” and “sexual function”. The TmLRP proved to be non-inferior to the standard treatment with regard to irritative and obstructive symptoms. The perioperative endpoints showed an indication of a shorter length of stay in hospital and a shorter catheterization time compared to standard treatment (indication of a greater

issuing organisation (document number)	Summary of (reimbursement) recommendations and restrictions	Summary of reasons for recommendations, rejections and restrictions
	ble Association of Statutory Health Insurance Physicians. As part of the treatment, the doctor must ensure: that the patient is informed in particular about the risk of a necessary re-intervention, about undesirable effects, about the therapeutic significance of TURP and about the natural course of the BPH syndromes. The provision of TmLRP for the treatment of BPH is introduced into statutory health care.	benefit of TmLRP compared to standard treatment). In addition, the adverse events indicated that blood transfusions are required less frequently with TmLRP and that severe bleeding occurs less frequently with treatment than with standard treatment (indication of lesser harm to TmLRP). Furthermore, for the endpoint irritative postoperative micturition symptoms, there was a hint of lesser harm from TmLRP compared to standard treatment. G-BA therefore comes to the conclusion that the benefit of TmLRP for the treatment of BPH has been sufficiently proven.
G-BA (BAnz AT 11.05.2018 B6), 2018 https://www.g-ba.de/beschluesse/3237/	Provision of **ThuLEP** for the treatment of BPH is introduced into statutory health care. The indications for ThuLEP and the key points for quality assurance are similar to the already introduced laser methods HoLRP, HoLEP and TmLRP.	It was found that the benefits of the TmLEP have been adequately proven and the medical necessity is given. The G-BA comes to the conclusion that the ThuLEP for the treatment of BPH provides sufficient, appropriate and economic care, and thus the statutory health insurance benefits remain within the scope of hospital treatment.
G-BA, 2017 https://www.g-ba.de/beschluesse/3066/	**TUMT** can be used in the context of inpatient care, service providers can provide it if it is approved by the health insurance companies.	The trend in the number of cases and the lack of study activity indicate a significantly decreasing relevance of the method. In addition, according to the available findings, the method does not show any frequency of serious adverse events relevant to patient safety.
G-BA (BAnz AT 11.05.2018 B7), 2018 https://www.g-ba.de/beschluesse/3235/	**PVP** is considered alternative treatments to TURP for BPH. The indications for the use of PVP are based on the indication for TURP. PVP can only be provided and billed by specialists in urology at the expense of the statutory health insurance, who have proven knowledge, experience and skills of the methods. As part of the treatment, the doctor must ensure that the patient is informed in particular about the risk of a necessary re-intervention, about undesirable effects, about the therapeutic significance of TURP and about the natural course of the BPH syndromes. The provision of PVP for the treatment of BPH is introduced into statutory health care.	G-BA came to the conclusion that the benefit of PVP for the treatment of BPH is adequately proven. The medical need is given. The G-BA defines the prerequisites for the indication for PVP and the cornerstones for quality assurance analogous to the already introduced laser procedures HoLRP, HoLEP and TmLRP.

issuing organisation (document number)	Summary of (reimbursement) recommendations and restrictions	Summary of reasons for recommendations, rejections and restrictions
Abbreviations: G-BA Gemeinsamer Bundesausschuss, HoLEP holmium laser enucleation of the prostate, HoLRP holmium laser resection of the prostate, IPSS International Prostate Symptom Score, LUTS lower urinary tract symptoms, NICE National Institute for Health and Care Excellence, PVP photoselective vaporization of the prostate, TmLRP thulium laser resection of the prostate, BPH benign prostatic hyperplasia, ThuLEP thulium laser enucleation of the prostate, TUMT transurethral microwave therapy, TURP transurethral resection of the prostate		

APPENDIX 6

Table A6: List of planned, ongoing, withdrawn and completed studies without results on the assessed technologies

Study ID	Estimated completion date	Study type	Number of patients	Intervention	Comparator	Patient population	Endpoints
ChiCTR2000032522	Not recruiting, registered in May 2020	Multi-Center, Single-Blind, Non-Inferiority Design RCT	n.a.	DioVAP (450 nm diode laser)	PVP (Greenlight laser 532 nm)	Male, aged 50-85 years, BPH patients who plan to have surgery, IPSS score of 8-35, prostate volume of 30-100ml, Qmax<= 15ml/s, patients who are able to complete the relevant scale scores under the guidance of doctors, voluntarily participate and sign informed consent.	PRIMARY OUTCOMES: IPSS, Qmax, decrease in hemoglobin SECONDARY OUTCOMES: operative time, serum electrolyte changes, time of bladder irrigation, catheterization time, hospital stay, QoL, IIEF-5, prostate volume; PSA
ChiCTR2000036273	Not recruiting, registered in August 2020	Prospective single-center RCT	n.a.	transurethral high-power green laser vaporization enucleation PVEP	TURP	Signed informed consent, Chinese males aged 50-100, repeated urinary retention, repeated hematuria, 5a-reductase inhibitor treatment is ineffective, repeated urinary tract infection with bladder stones, secondary upper urinary tract hydrops (with or without renal impairment), combined with large diverticulum of bladder, inguinal hernia, severe hemorrhoids or prolapse.	PRIMARY OUTCOMES: IPSS 1 month after surgery, Qmax SECONDARY OUTCOMES: PVR, QoL
ChiCTR2000032510	Recruiting	RCT	n.a.	HoLEP	TURP	Signed informed consent, Chinese male aged 50-100, meet the western medical diagnostic criteria for BPH: IPSS >= 12 points, prostate volume> 25 cm3, Qmax <15 ml/s, PSA <= 4ng/ml.	PRIMARY OUTCOMES: Qmax, IPSS, QoL SECONDARY OUTCOMES: Volume of postoperative flushing fluid, complications

Study ID	Estimated completion date	Study type	Number of patients	Intervention	Comparator	Patient population	Endpoints
						Alpha receptor blocker and 5a reductase inhibition after at least 6 months before surgery. Preoperative examination results completed within 30 days before enrolment.	
NCT04560907	2027 Nov	Prospective, open-label, non-inferiority RCT	120	HoLEP	Aqaublation	Men ≥45 years of age and candi-date for HoLEP: refractory to medical therapy or not willing to consider (further) medical treat-ment, prostate size ≥ 50 ml and ≤ 150ml, IPSS ≥12, QoL≥3, Qmax ≤ 15 ml/s with a minimum voided volume ≥ 125 ml or patient in urinary retention, written informed consent.	IPSS at 6 months
NCT04338776 (C.L.E.A.R study)	2023 Jan	RCT	120	PUL (UroLift)	WAVE (Rezum)	Male, aged ≥ 50 years, diagnosis of symptomatic BPH, prostate volume 30cm3 ≤ 80cm3, willing to sign informed consent.	Number of subjects who are catheter independent post-operative day 4 and remain catheter independent through 1-week
NCT04471155	2020 Apr (no study results posted at the time of our search, Jan 2021)	RCT	110	HoLEP	Open prostatectomy	AUA Symptom Score 8 or higher, Qmax 10ml/s or less, Post void residual urine volume of 50 ml or more, total prostate volume of 80 ml or more in TRUS	Primary Outcomes: Qmax at 1 year, AUA symptom score at 1 year, post-voiding residual urine volume at 1 year Secondary Outcomes: hemoglobin drop
NCT04386941	2022 July	RCT	92	PVP	HoVARP holmium vaporesection	Males over 50 years of age re-ferred to urology for refractory LUTS secondary to BPH, pros-tate size on preoperative TRUS	Primary outcomes: IPSS (baseline, 1 month, 3 months, 6 months, 12 months), QoL (baseline, 1

Study ID	Estimated completion date	Study type	Number of patients	Intervention	Comparator	Patient population	Endpoints
						of 40-80 ml, IPSS >15, QOL score ≥3 and Qmax <15 ml/sec, written informed consent to participate in the study, ability to comply with the requirements of the study procedures	month, 3 months, 6 months, 12 months), Qmax (baseline, post-catheter removal, 1 month, 3 months, 6 months, 12 months), PVR (baseline, post-catheter removal, 1 month, 3 months, 6 months, 12 months), PSA (baseline, 3 months, 12 months) Secondary outcomes: intraoperative adverse events, prostate size change, IIEF-5 (baseline, 3 months, 12 months)
NCT04561505	2020 Febr (no study results posted at the time of our search, Jan 2021)	RCT	60	HoLEP	M-TURP	Prostate volume less than 80 ml, IPSS more than 19 affecting quality of life, recurrent urinary retention with failure of medical treatment, recurrent urinary tract infection, refractory hematuria, bladder stones, bladder diverticula	Primary outcomes: IPSS and Qmax at 1 year Secondary outcomes: operative time, hemoglobin drop, resected prostate volume, serum sodium drop, catheterization time, hospital stay, PVR at 1 year, intraoperative, early postoperative and late postoperative complications, costs
NCT04342533 (PRISSA)	2021 May	RCT	140	HoLEP	ThuLEP	LUTS presence, proven by: IPSS >20; OR Qmax <10 ml/s)	Urinary incontinence (change from 1 week after 6 month after surgery), intra- and perioperative adverse events (until 6 months after surgery), surgery duration, haemoglobin drop,

Study ID	Estimated completion date	Study type	Number of patients	Intervention	Comparator	Patient population	Endpoints
							catheterization time, hospitalization time, IPSS, QoL, IIEF-5 (at 3 months, 6 months)
NCT04236687	2022 Febr	RCT	100	HoLEP	PAE	Age > 45 years, IPSS ≥ 10, Qmax< 12 mL/s), PVR< 300m, prostatic volume between 20mL and 250mL, signed informed consent	Primary outcomes: IPSS improvement from baseline to 6 months Secondary outcomes: Qmax, PVR, PSA, IIEF, adverse events, urinary incontinence (from baseline to 6 months)
NCT04398420	2024 June	Open label RCT	180	B-TURP (TURiS), Vapor Enucleation and resection	HoLEP	Male, age older than 22 and younger than 75 years of age, candidate for surgical treatment of bladder outlet obstruction, BPH, surgical indication (refractory to medical treatment, refractory or recurrent urinary retention, recurrent haematuria, bladder stones, recurrent infections, hydronephrosis), prostate volume >30 and ≤80 ml, PSA <4 ng/ml in patients above 55 years old and a prostate cancer risk less than 35%. IPSS ≥8 (moderate to severe), indications for TURIS, Qmax <10ml/second, written informed consent signed.	Change of hemoglobin and hematocrit levels at 6 hours and 24 hours after surgery
CTRI/2020/05/025100	Not recruiting, registered in May 2020	RCT	n.a.	B-TUEP	TURP	Age greater than 50 years. Refractory LUTS secondary to BPH. IPSS greater than 7. QOL score 3 or greater. Qmax less	PRIMARY OUTCOME: IPSS; Qmax at 2 weeks, 4 weeks, 12 weeks SECONDARY OUTCOME:

Study ID	Estimated completion date	Study type	Number of patients	Intervention	Comparator	Patient population	Endpoints
						than 15 ml per second or patients with acute urinary retention secondary to BPH in whom trial of voiding after medical therapy failed. Prostate size 40 gms or more.	Duration of Surgery, Weight of Tissue resected, Necessity for transfusion, Post-operative pain score, IIEF-5 score, Post op SUI
CTRI/2020/08/027056	Not recruiting, registered in August 2020	RCT	n.a.	TUIP	TURP	Patients having bothersome LUTS with IPSS > 15 after medical treatment or patients who are not willing for medical management. Qmax less than or equal to 8ml/sec. PSA < 4 ng/ml Prostatic urethra length < 2.5cms, Size of prostate gland less than 25cc	PRIMARY OUTCOMES: improvement in IPSS score and flow rates, rate of complications, need of readmission or re-surgery at 3 months SECONDARY OUTCOMES: improvement in IPSS score and flow rates, rate of complications in, the need of readmission or re-surgery at 3 months

Abbreviations: BPH benign prostatic hyperplasia, B-TUEP bipolar transurethral enucleation of the prostate, B-TURP bipolar transurethral resection of the prostate, DioVAP diode laser vaporisation, HoLEP holmium laser enucleation of the prostate, HoVARP holmium vaporesection, IIEF International Index of Erectile Function, IPSS International prostate syndrome score, LUTS lower urinary tract syndrome, PSA prostate specific antigen, PVR postvoid residual, PVP photoselective vaporization of the prostate, RCT randomized controlled trial, TUIP transurethral incision of the prostate, TURP transurethral resection of the prostate, TURiS transurethral resection in saline, TRUS transrectal ultrasonography, Qmax maximum flow rate