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SYSTEMATIC REVIEW

The efficacy and safety of prostatic urethral lift as a minimally invasive therapeutic modality to treat lower urinary tract symptoms while maintaining sexual function in patients with benign prostatic hyperplasia: A systematic review and meta-analysis of randomized controlled trials

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Summary

Background: *Benign Prostatic Hyperplasia (BPH) is prevalent among elderly men, necessitating focused attention. The Prostatic Urethral Lift (PUL) procedure, a minimally invasive intervention, has emerged as a promising option for BPH management. It has shown remarkable results in ameliorating Lower Urinary Tract Symptoms (LUTS), enhancing quality of life, and preserving sexual function. This study aims to evaluate the effectiveness and safety of PUL in BPH patients.*

Methods: *Key databases (MEDLINE, Cochrane CENTRAL, ScienceDirect, EBSCO, Google Scholar) were systematically searched using pertinent terms related to PUL and BPH. Following the PRISMA checklist, we considered only Randomized Controlled Trials studies (RCTs) from 2013 to 2023. The assessment focused on LUTS, Quality of Life, sexual function, and Adverse Events, within three months. Follow-up post-treatment mean values compared with controls (Sham) and the improvement from baseline to post-treatment follow-up duration were considered. Statistical analysis and risk of bias evaluation were conducted using Review Manager 5.4.1, presenting results as difference of mean values (MD) and Risk Ratios (RR).*

Results: *A meta-analysis with a Random Effects Model of 7 RCTs involving 378 confirmed BPH patients demonstrated significant improvements in the PUL arm including International Prostate Symptom Score (IPSS) (MD 5.51, $p < 0.0001$), maximum urinary flow rate (Q_{max}) (MD 2.13, $p = 0.0001$), BPH Impact Index (BPHII) (MD 2.14, $p = 0.0001$), and IPSS-QoL (MD 1.50, $p < 0.0001$), without significant increase of Adverse Events (RR 1.51; $p = 0.50$). Positive outcomes were observed in sexual function variables and post-void residual measurements when post-treatment values were compared to baseline.*

Conclusions: *PUL holds advantages over control interventions, providing encouraging prospects for BPH management. This study underscores the need for further exploration of PUL's efficacy and safety in BPH patients.*

KEY WORDS: *Benign prostatic hyperplasia; Lower urinary tract symptoms; Prostathic urethral lift; Quality of life; Sexual function.*

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INTRODUCTION

Benign prostatic hyperplasia (BPH), an affliction prevalent among aging men, is characterized by the proliferation of prostate cellular components. Its prevalence reaches up to 80% among those aged over 80 (1). BPH gives rise to *lower urinary tract symptoms* (LUTS), significantly impacting patients' lives. As a consequence of its considerable impact, increased research focus and awareness are imperative. The *American Urological Association* (AUA) defines BPH based on increased smooth muscle and epithelial cell growth in the prostate transition zone (2). Symptomatic BPH manifests as LUTS, including urgency, nocturia, and weak urine flow, occasionally associated with erectile dysfunction. Traditional treatments involve oral medication and surgeries like *Transurethral Resection of the Prostate* (TURP), which can lead to long-term complications (3). Recently, the PUL procedure has gained interest for its minimally invasive approach. PUL addresses LUTS by gently dilating the prostatic urethra using trans-prostatic UroLift implants (4). Encouragingly, PUL has demonstrated swift LUTS relief, improved urinary flow, and preserved sexual function. Although multiple trials have established its effectiveness, a systematic review and meta-analysis are essential to comprehensively assess PUL's efficacy and safety (5). This study aims to consolidate available data on PUL through system-

atic search strategies and meta-analysis of RCT, providing a comprehensive evaluation of PUL's potential as a viable BPH treatment.

Methods

Protocol registration

The Protocol of this review was registered in PROSPERO: International Prospective Register of Systematic Reviews under issued ID of CRD42023410982.

Elegibility criteria

In this review, we utilized the PICO (*Population, Intervention, Comparison, Outcome*) framework to evaluate the effectiveness and safety of PUL procedure in enhancing the condition of individuals diagnosed with BPH. Consequently, we formulated the PICO strategies for this meta-analysis, which are presented in Table 1. The data results were presented in numerical format, including means and *Standard Deviation* (SD). We specifically focused on RCT studies, preferably those conducted on a small to large scale with explicit protocols and published in English-based literature. During the literature identification process, studies were excluded if they had incompatible trial designs (e.g., trials involving oral therapy intervention, intervention versus standard surgical therapy such as TURP, or intervention versus any other surgical procedure for BPH or if they had incomplete data reporting.

Table 1.
PICO strategies.

Aspects	Criteria
Population	- All patients with Benign Prostatic Hyperplasia, regardless of their race or ethnicity - Men at least aged 50 years - Had no prior surgical treatment for BPH
Intervention	- Prostatic Urethral Lift (PUL)
Compatison	- Sham or placebo surgery as rigid cystoscopy
Outcome	LUTS Symptoms: 1. International Prostate Symptom Score (IPSS) 2. Q_{max} 3. Post Volume Residual (PVR) Quality of Life (QoL): 1. International Prostate Symptom Score-Quality of Life (IPSS-QoL) 2. Benign Prostatic Hyperplasia Index (BPHII) Sexual Function: 1. Male Sexual Health Qustionnaire-Ejaculatory Dysfunction Bother (MSHQ-EjD Bother) 2. Male Sexual Health Qustionnaire-Ejaculatory Dysfunction Function (MSHQ-EjD Function) 3. Sexual Health Inventory for Men (SHIM) Adverse Event

Database searching and systematic literature screening

Two authors, M.F.I and R.G.S, conducted a comprehensive literature search using three medical electronic databases: MEDLINE, *Cochrane Central Register of Controlled Trials* (CENTRAL), and *Cumulated Index to Nursing and Allied Health Literature* (CINAHL). Additionally, we utilized five search engines, namely PubMed, ScienceDirect, Google Scholar, EBSCO, and the Cochrane Library, for study screening. This search was performed from January to February 2023. To facilitate study tracing and identify suitable studies, we employed the PICO strategy. We identified relevant literature using strategic keywords specific to each search engine. We also manually screen the article references list the previous systematic-reviews and meta-analysis studies related to our objective to secure every possible litrerature and include them as "*studies from other source or review source*".

Study selection

Our systematic review is based on *Prefered Reporting Items for Sytematic Review and Meta-analysis* (PRISMA) statements as shown in Figure 1. The inclusion criteria for this study are RCT studies in accordance to PICO, full-text article, published in the last 10 years and written in English (6). The study excluded systematic reviews, meta-analyses, case reports, animal studies, guidelines, and more. Identified studies were gathered, duplicates removed, and those meeting format requirements were further assessed. Full-text articles were evaluated by both authors independently based on titles and abstracts. For selected articles, complete manuscripts were examined, and any differences in assessment were discussed and resolved.

Risk of bias and data extraction

This systematic review and meta-analysis study exclusively includes RCTs. The quality assessment of the RCTs was conducted using the revised Cochrane *Risk of Bias* for Randomized Controlled Trials (RoB) tool, which was performed using Microsoft Excel software. This tool consists of five domains, namely Randomization Process, Deviations from Intended Interventions, Missing Outcome Data, Measurement of Outcome Data, and Selection of the Reported Result. Each domain was interpreted as low, some concern, or high.

The data were extracted from baseline mean and SD values, as well as from follow-up reports, using Microsoft Excel software and the statistical software Review Manager (RevMan) 5.4.

Statistical design and analysis

In this study, we employed diverse methods for mathematical and structured analysis, focusing on comparing post-treatment values of variables in treated subjects versus controls and on changes of values of variables from baseline to follow-up evaluations. Results were presented as differences of mean values (MD) between groups. Notably, the comparison with controls was conducted at 3-month post-treatment follow-up, employing rigid cystoscopy as control procedure (sham surgery) (7). All analyses were carried out using *Review Manager* (RevMan) 5.4 software. Continuous data models were applied for most outcomes, while the dichotomous model was used for *Adverse Event* (AE) rates. Depending on heterogeneity levels, the fixed effect or random effects model was chosen for pooled effect size calculations. When I^2 is less than 25%, it indicates low heterogeneity. A value of 50% suggests moderate heterogeneity, and 75% suggests high heterogeneity. Depending on the level of heterogeneity, either the fixed effect model or the random effects model

was used to calculate the pooled effect size. The fixed effect model was used when there was low heterogeneity, while the random effects model was used when there was significant heterogeneity (8).

Characteristic of included study

ical therapy) and short-term follow-up. This screening yielded seven eligible studies aligning with our PICO criteria, all RCTs, published within the past decade, and available in full-text format. No additional studies meeting inclusion criteria were sourced from prior reviews. The review encompassed a total of 378 patients.

Table 2.
Characteristics of the studies.

Authors, Year	Study Design	Country	Follow-up (Months)	Mean Age (Years)		Total Participant (N)	Main Outcomes			
				PUL	Sham		Efficacy			Safety
							Symptoms	Quality of Life	Sexual Function	Adverse event
Cantwell, 2013 (12)	Prospective, Randomized Controlled Trial	USA, Canada, Australia	3 months	64 +- 8.0	64 +- 8.0	53	IPSS Q_{max}	IPSS-QoL BPHII	MSHQ-EjD Bother MSHQ-EjD Function SHIM	Adverse event
Gregg, 2023 (13)	Comparative Randomized Controlled Trial	USA, Columbia	1 month 3 months 6 months 12 months	64.55 +- 8.04	64.55 +- 8.04	66	IPSS PVR	IPSS-QoL	MSHQ-EjD SHIM	NR
Mcvary, 2014 (14)	Prospective, Randomized Controlled Trial	USA, Canada, Australia	1 month 3 months 6 months 12 months	67	65	206	IPSS Q_{max}	IPSS-QoL BPHII	MSHQ-EjD Bother MSHQ-EjD Function SHIM	NR
Rukstalis, 2016 (15)	Randomized Controlled Trial, Crossover study	USA, Canada, and Australia	1 month 3 months 6 months 12 months	64 +- 7.8	64 +- 8.0	53	IPSS Q_{max} PVR	IPSS-QoL BPHII	MSHQ-EjD Bother MSHQ-EjD Function SHIM	NR
Roehrborn, 2013 (16)	Prospective, Randomized Controlled Trial	USA, Canada, Australia	1 month 3 months 6 months 12 months	67 +- 8.6	65+- 8.0	206	IPSS PVR	IPSS-QoL BPHII	MSHQ-EjD Bother MSHQ-EjD Function SHIM	Adverse event
Roehrborn, 2015 (9)	Prospective, Randomized Controlled Trial	USA, Canada, Australia	3 months 12 months 24 Month 36 months	67 +- 8.5	64 +- 8.0	206	IPSS Q_{max}	IPSS-QoL BPHII	MSHQ-EjD Function SHIM	NR
Roehrborn, 2017 (17)	Prospective, Randomized Controlled Trial	USA, Canada, Australia	3 months 12 months 24 month 36 months 48 month 60 month	67 +- 8.6	65 +- 8.0	206	IPSS Q_{max}	IPSS-QoL BPHII	MSHQ-EjD Function SHIM	NR

International prostate symptom score (IPSS); *Post Volume Residual* (PVR); *International prostate symptom score - Quality of Life* (IPSS-QOL); *Benign Prostatic Hyperplasia Impact Index* (BPHII); *Male Sexual Health Questionnaire - Ejaculatory Dysfunction Bother* (MSHQ-EjD Bother); *Male Sexual Health Questionnaire - Ejaculatory Dysfunction Function* (MSHQ-EjD Function); *Sexual Health Inventory for Men* (SHIM).

RESULTS

Literature search

According to the standard PRISMA protocol as the foundation of this study, our initial search yielded 753 articles. After removing 80 duplicated articles, we were left with 672 articles for title and abstract screening. Out of these 672 articles, 649 did not meet the required form of the article and were subsequently excluded.

Consequently, we sought retrieval for the remaining 23 articles. Among them, we were able to access the full text of ten studies for further analysis. From an initial pool of ten studies, three were excluded for reasons such as unrelated comparator variables (e.g., vapor therapy, oral med-

Additionally, a thorough manual search of reference lists from various sources was conducted to ensure comprehensive coverage.

Risk of bias from included studies

All studies incorporated were prospective, randomized controlled trials. The Revised Cochrane Risk of Bias (RoB) tool, tailored for such trials, was used to evaluate risk of bias. One study had a moderate bias risk due to questionnaire measurement and outcome reporting issues. Similarly,

another study displayed suboptimal outcome reporting. The remaining studies showed uncertainties regarding questionnaire measurement.

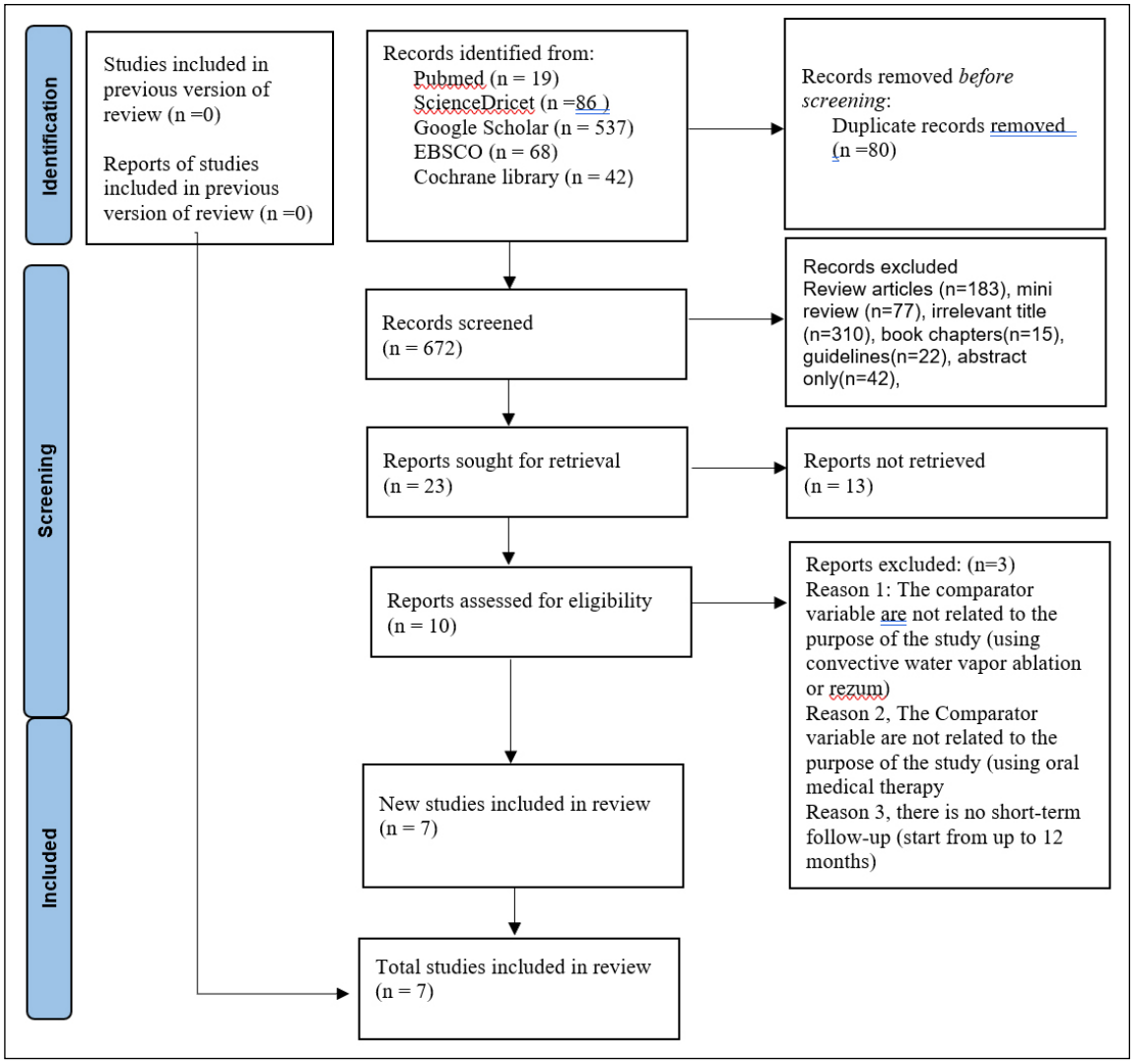


Figure 1. *PRISMA 2020 flow diagram used to identify the analyzed study in this review.*

LUTS

Based on the analysis of three studies, the average IPSS score after 3 months of PUL action was significantly lower by 5.51 (95% CI 1.01-10.02) compared to the Sham group. In other words, the Sham group had an average post-treatment IPSS score 5.51 points higher than the PUL group. A higher IPSS score indicates a greater severity of symptoms (p = 0.02). Based on the results of Egger's test of IPSS findings an asymmetrical funnel plot was found indicating publication bias (p = 0.0382). Based on the analysis involving three studies, it was found that Q_{max} value after 3 months of PUL action was significantly higher by 2.13 (CI 95% 1.04-3.22) compared to Sham (p-value = 0.0001). Based on the Egger's test of Q_{max} results, there was no funnel plot asymmetry which indicates that there is no publication bias (p = 0.1003). Based on the forest plot results, there was no significant difference between the PUL and Sham groups for the PVR value (P = 0.93) (Figure 2).

Quality of Life

Based on the analysis of three studies, the average BPHII score after 3 months of PUL action was significantly lower by 2.14 (95% CI 1.52-2.77) compared to the Sham group (p < 0.0001). In other words, the Sham group had an average BPHII score 2.14 points higher than the PUL group, indicating a significantly worse severity of symptoms. Based on the results of Egger's test for BPHII, it was found an asymmetrical funnel plot indicating publication bias (p = 0.0371).

Based on the analysis of three studies, the average *quality of life* (QoL) score after 3 months of PUL action was significantly lower by 1.50 (95% CI 1.14-1.86) compared to the Sham group (p < 0.00001).

This indicates that the PUL group had a significantly better QoL score compared to the Sham group.

Based on the results of Egger's test of IPSS-Qo, t was found an asymmetrical funnel plot indicating publication bias (p = 0.0108) (Figure 3).

Sexual function

Based on the forest plot results, there was no significant difference between the PUL and Sham groups for SHIM scores (p = 0.64), MSHQ- EjD Function (p = 0.09), and MSHQ- EjD Bother (p = 0.07). Based on the egger's test results for SHIM, MSHQ-Ejd Function, and MSHQ-EjD Bothers, there is no funnel plot asymmetry which indicates that there was no publication bias (p = 0.8806; p = 0.5414; p = 0.9147) (Figure 4).

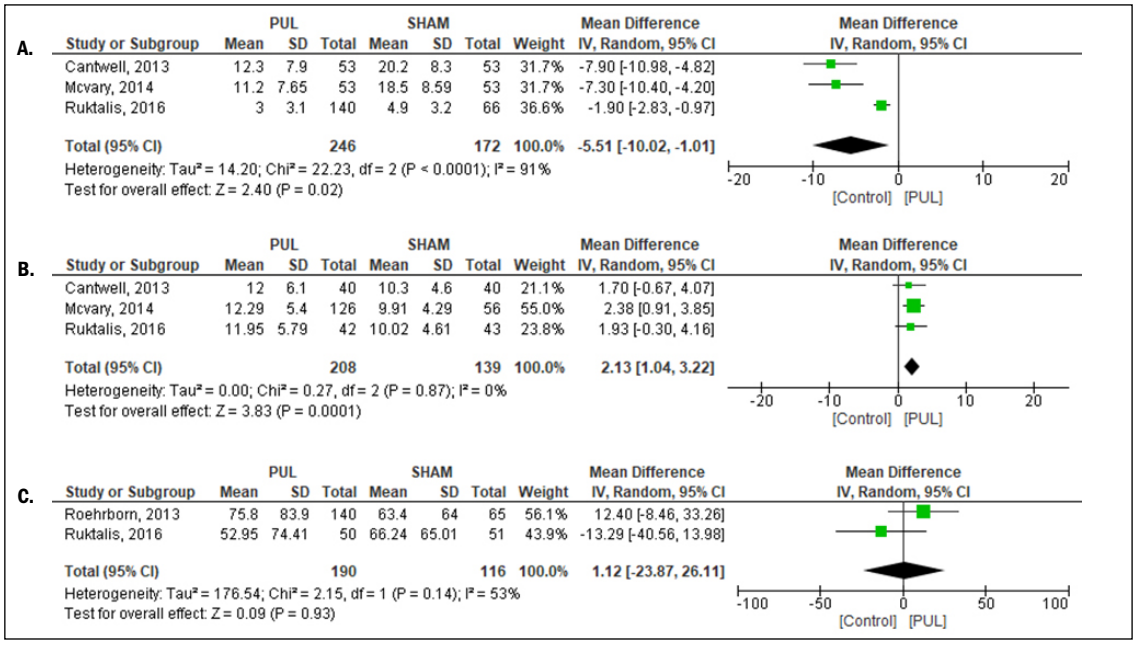


Figure 2.
(A) Meta-analysis of comparison of IPSS between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.
(B) Q_{max} value between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.
(C) PVR value between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.

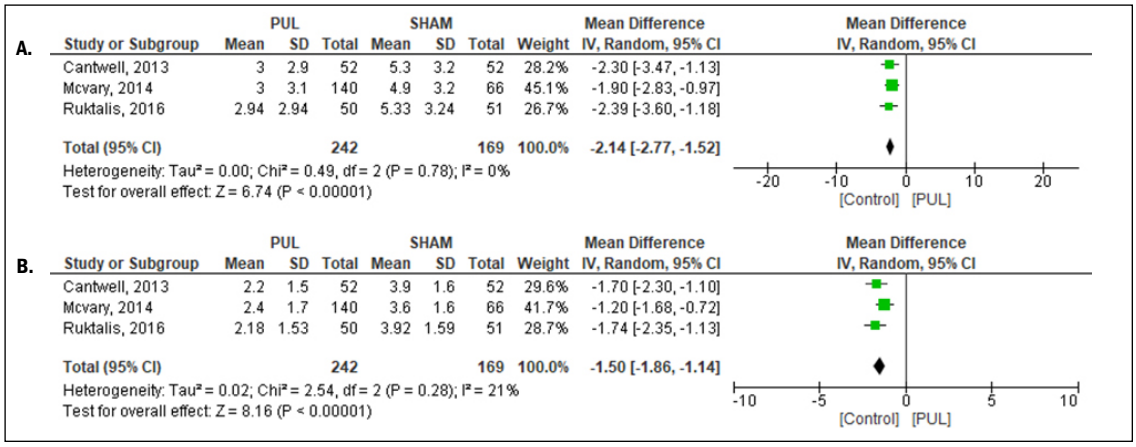


Figure 3.
(A) Meta-analysis of comparison of BPHII between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.
(B) IPSS-QoL score between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.

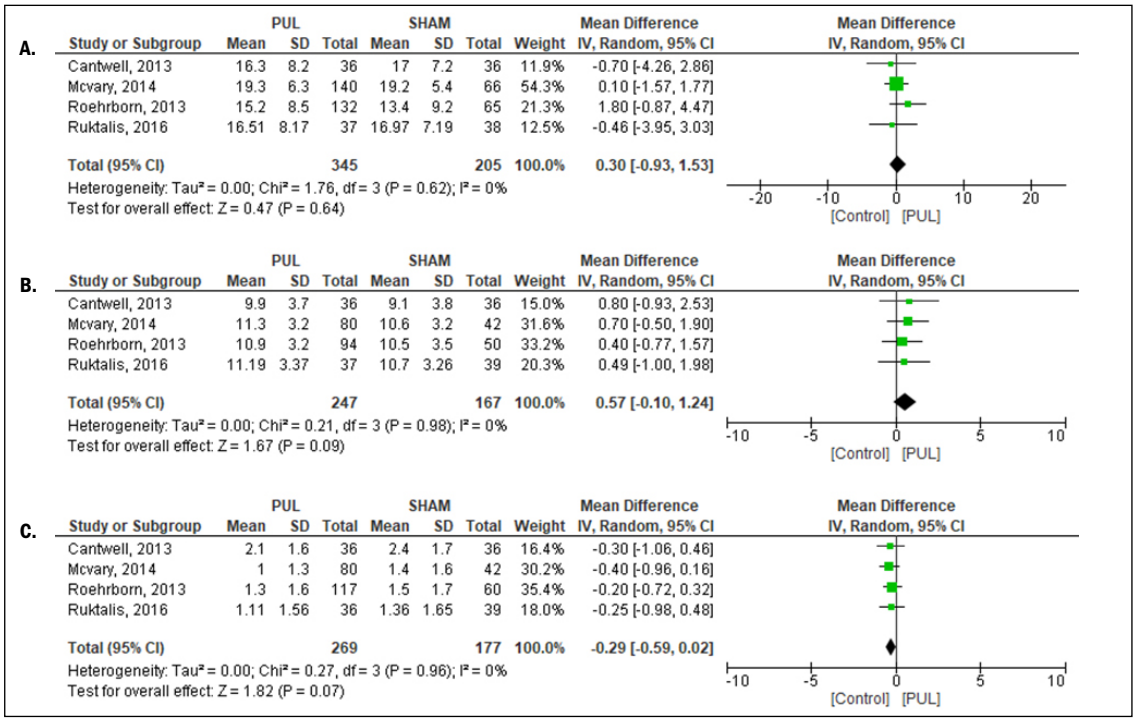


Figure 4.
(A) Meta-analysis of comparison of SHIM score between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.
(B) MSHQ-EjD Function score between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.
(C) MSHQ-EjD Bother score between PUL and control group (Rigid Cystoscopy) after 3 months follow-up.

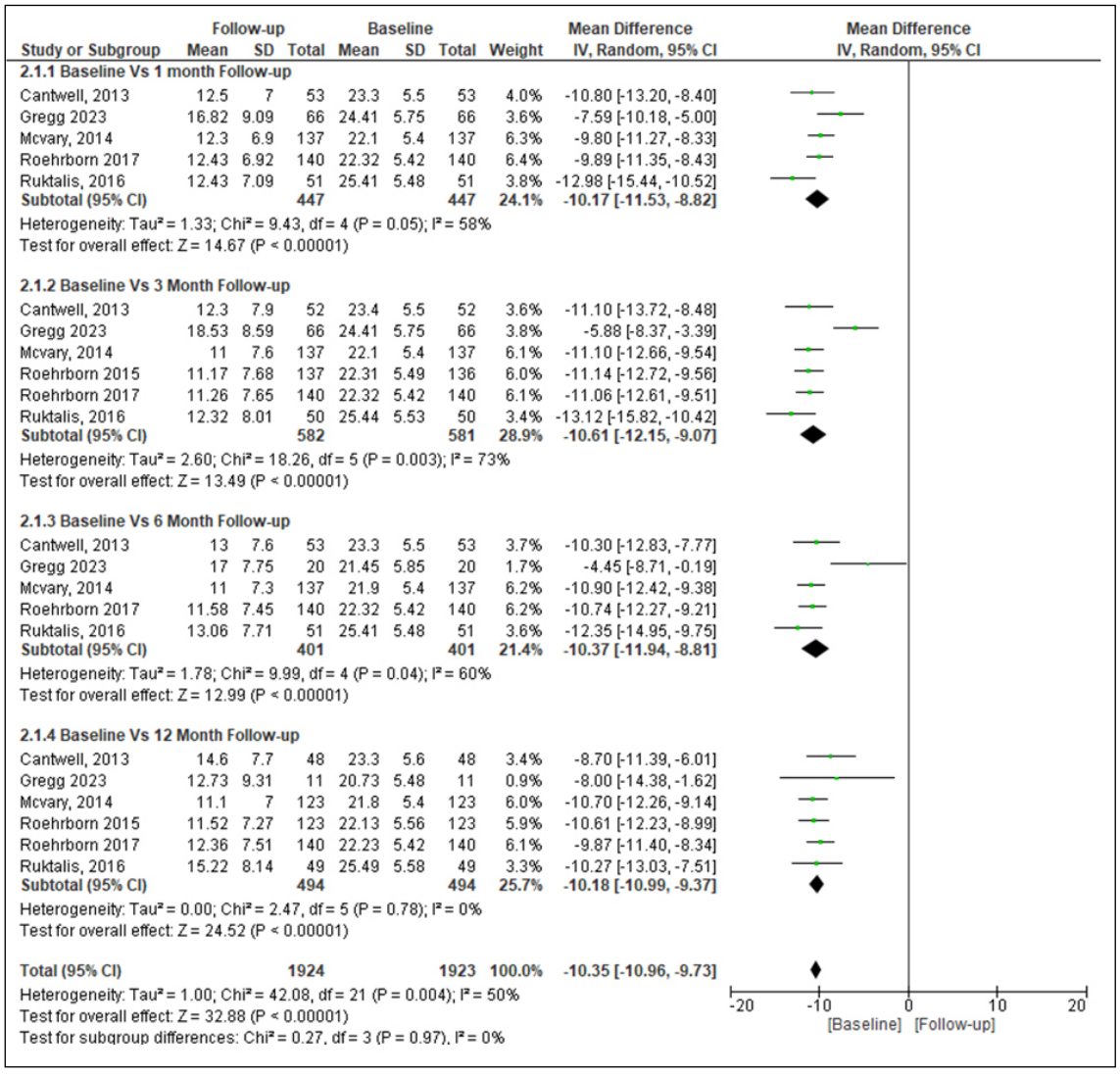


Figure 5. *Subgroup Meta-analysis of comparison of IPSS between baseline and 1, 3, 6, and 12 months follow-up after PUL treatment.*

Subgroup analysis

LUTS

Subgroup analysis was performed based on IPSS score along follow-up. The analysis demonstrated that IPSS scores at 1, 3, 6, and 12 months post-PUL were significantly lower by 10.17, 10.61, 10.37, and 10.18, respectively, compared to baseline ($p < 0.0001$ for all). Lower IPSS scores indicate higher symptom improvement. No significant difference in average IPSS value across different follow-up durations was observed ($p = 0.97$). Egger's test results for IPSS indicated no funnel plot asymmetry, suggesting no publication bias for each follow-up duration ($p = 0.7614$; $p = 0.6467$; $p = 0.2887$; $p = 0.1703$) (Figure 5).

Quality of Life

The analysis revealed that QoL scores at 1, 3, 6, and 12 months post-PUL were significantly lower by 1.97, 2.07, 2.05, and 2.20, respectively, compared to baseline ($p < 0.0001$ for all). Lower QoL scores indicate higher symptom improvement. No significant difference in average QoL value across different follow-up durations was observed ($p = 0.67$). However, Egger's test for IPSS-QoL indicated asymmetrical funnel plots at 6 and 12 months follow-up, suggesting publication bias, although not at 1 and 3 months follow-up ($p = 0.9806$; $p = 0.838$; $p = 0.0483$; $p = 0.0002$) (Figure 6).

Sexual function

Subgroup analysis based on SHIM score during follow-up was conducted. The analysis showed no significant SHIM score difference between baseline and follow-up at 1 month ($p = 0.28$), 3 months ($p = 0.04$), 6 months ($p = 0.08$), and 12 months ($p = 0.34$). Likewise, there was no significant difference in average SHIM values across different follow-up durations ($p = 0.90$). Egger's test for SHIM indicated asymmetrical funnel plots at 3 months follow-up, suggesting publication bias, but not at other follow-up durations ($p = 0.5326$; $p = 0.0487$; $p = 0.1436$; $p = 0.1360$) (Figure 7).

The analysis revealed that MSHQ-EjD Function scores at 1, 3, 6, and 12 months post-PUL were significantly higher by 2.09, 1.88, 1.64, and 1.40, respectively, compared to baseline ($p < 0.00001$ for all). Higher MSHQ-EjD Function scores indicate greater symptom improvement.

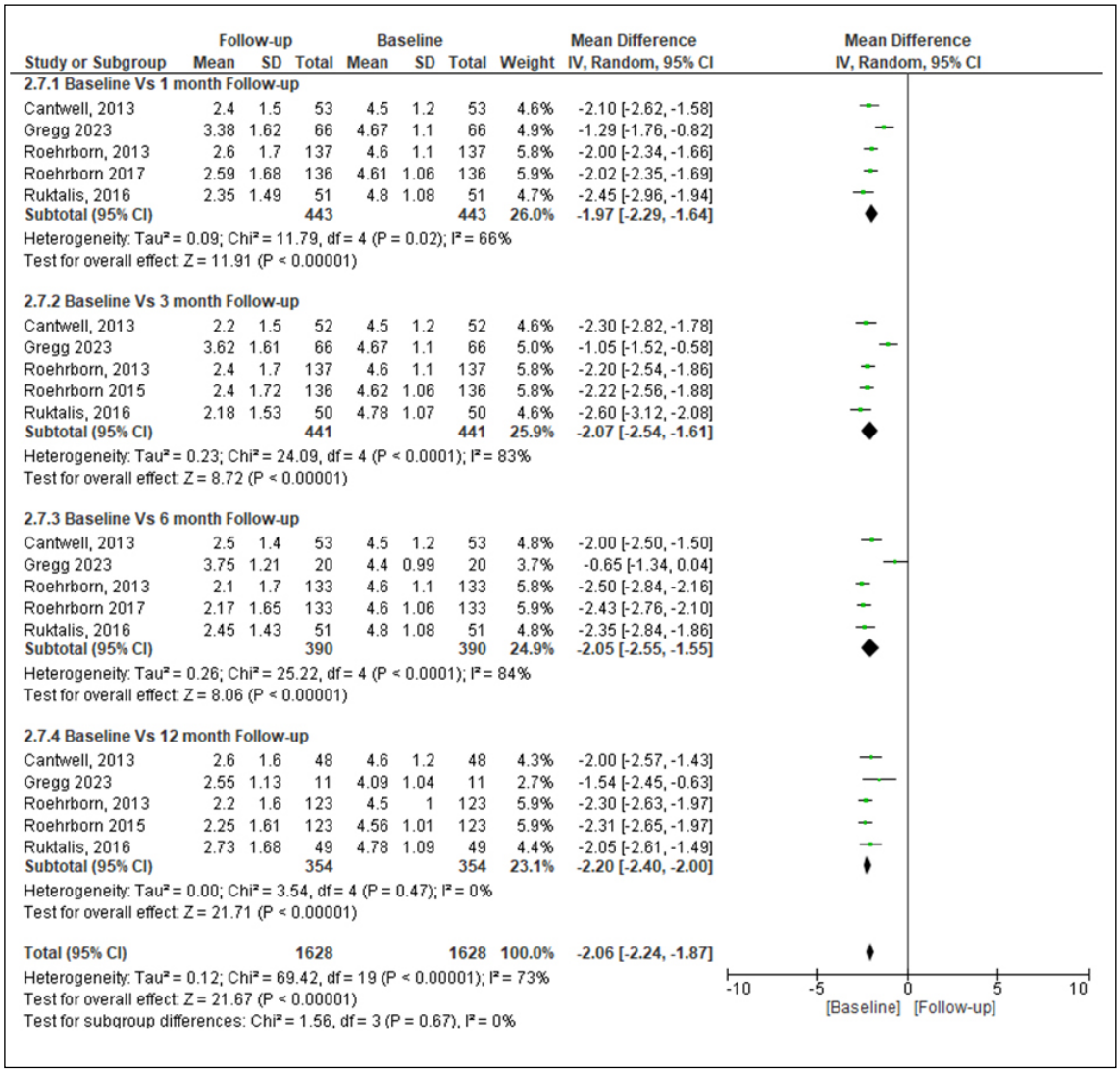


Figure 6. *Subgroup Meta-analysis of comparison of QoL score between baseline and 1,3,6 and 12 months follow-up after PUL treatment.*

No significant difference in average MSHQ-EjD value across different follow-up durations was observed (p = 0.33). Egger's test for MSHQ-EjD Function showed no funnel plot asymmetry, suggesting no publication bias for each follow-up duration (p = 0.8395; p = 0.2660; p = 0.8406; p = 0.9254) (Figure 8).

Adverse events

Two studies, *Roehrborn* (16) and *Cantwell* (12), reported adverse events in the analysis. In the study of *Roehrborn et al.*, the PUL group had 113 events out of 140, while the Sham group had 20 events out of 66. In the study of *Cantwell et al.*, the PUL group had 12 events out of 53, and the Sham group had 15 events out of 53.

The PUL group showed a nonsignificant 1.51 higher risk for adverse events (OR 1.51; 95% CI 0.46-4.89; p = < 0.50), with high heterogeneity in the analysis (I^2 = 90%) (Figure 9).

Publication bias

The funnel plots based on the outcomes are shown in Figure 10. Because all studies laid inside the 95% CI limits, no evidence of publication bias was noted. Egger test was performed to provide statistical evidence regarding funnel plot symmetry. Results still did not reveal any evidence of publication bias for Q_{max} (p = 0.1003), MSHQ-EjD Function (p = 0.5414), SHIM (p = 0.8806), and MSHQ-Ejd Bother (p = 0.9147) of *PUL vs Sham* in 3 months follow-up duration (Figure 10).

Discussion

Benign Prostatic Hyperplasia (BPH) is a common condition in aging men, with a significant global rise. In 2019, 612.7 million men were affected, up by 41% since 1990. Incidence can be high, reaching 80% to 90% in men aged 70 and above.

This worries urologists due to BPH's impact on quality of life. Enlarged prostate disrupts urinary function, causing LUTS that affect bladder, urethra, and sexual health. Tools like IPSS, PVR, and Q_{max} quantify symptoms. TURP is the standard treatment, but lasers are emerging as alternatives (9). A new minimally invasive method, PUL, is promising for managing BPH-related LUTS. PUL involves repositioning the prostate with small implants, swiftly relieving symptoms and causing minimal side effects.

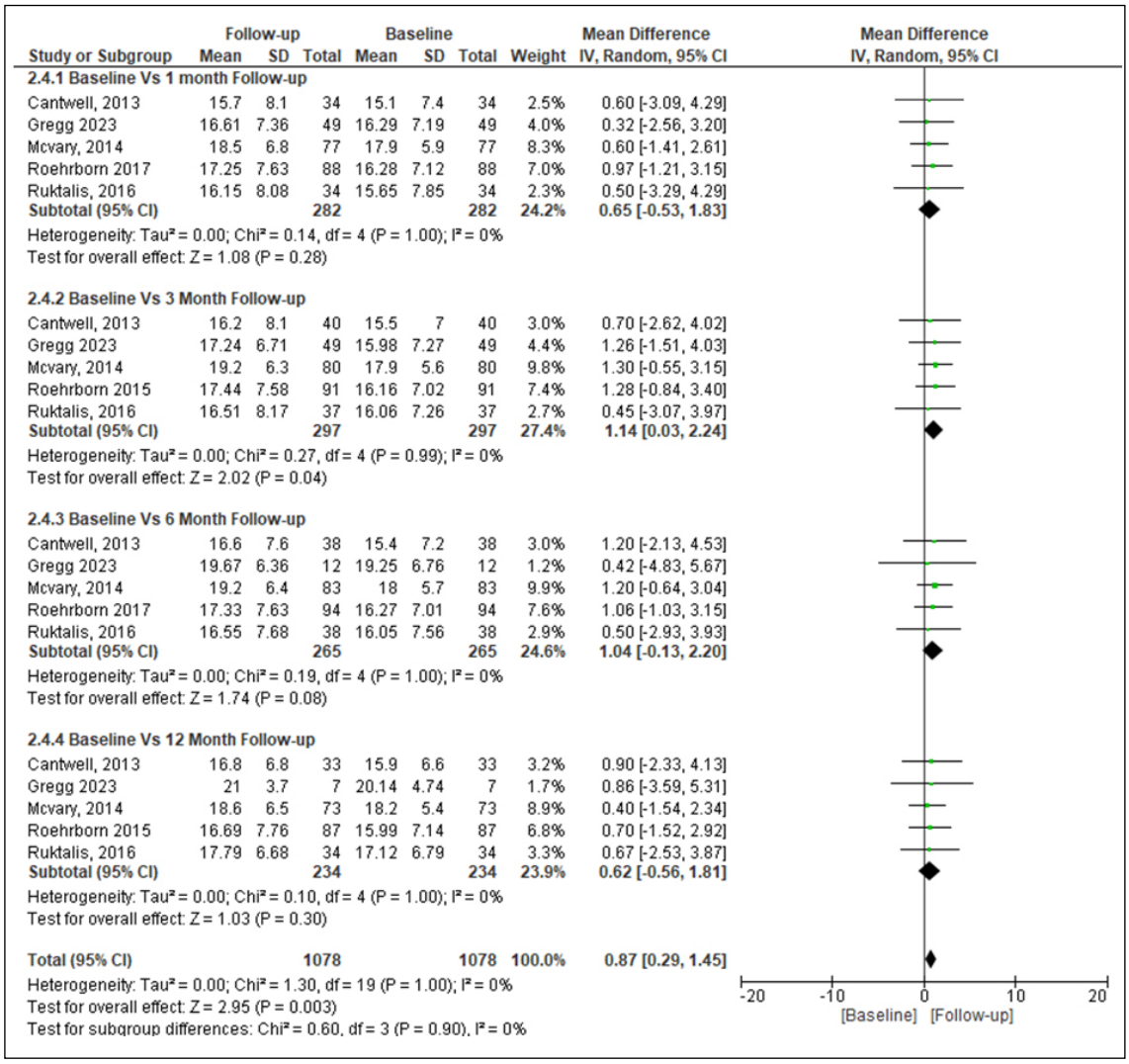


Figure 7. *Subgroup Meta-analysis of comparison of SHIM score between baseline and 1, 3, 6 and 12 months follow-up after PUL treatment.*

This approach aims to balance symptom relief, better quality of life, and maintained sexual function, offering a valuable alternative to existing treatments. This review focused on assessing PUL's effectiveness in improving LUTS symptoms, quality of life, and sexual function in BPH patients, using internationally validated scores and comparing them with control variables and baseline measurements post-PUL therapy (10). In this review, the Sham procedure served as a control, mimicking a placebo surgery for comparison. This could be done under various forms of anesthesia. It involves placing implants to gently retract obstructive prostate lobes, distinguishing it from other BPH treatments (11). In contrast to TURP, the PUL procedure provides measurable functional improvements and quality of life enhancements without major adverse events. It preserves erectile and ejaculatory function, albeit with mild to moderate, short-term side effects (12).

As per the *European Association of Urology* (EAU), PUL effectively treats BPH with fewer side effects than TURP, especially regarding recovery time and sexual function. However, more research is needed to confirm these findings (13). Short- and medium-term studies highlight PUL's significant improvement in urination ability and overall quality of life after the procedure (14). An advantage of PUL is its lack of negative effects on erectile and ejaculatory function. No instances of worsened function have been reported following PUL, thanks to its tissue-sparing approach that maintains bladder neck integrity and avoids thermal damage, minimizing the risk of ED (15). In relation to enhancing LUTS in BPH patients with PUL, this review observed a significant 3-month reduction in mean IPSS score, 5.51 times lower than Sham. Similar results were found in Cantwell's study, where PUL showed a 122% greater mean IPSS improvement, with a change of 11.1 points (7.2) versus 5 points (7.5) in 53 patients (16). Subgroup analysis revealed the most notable mean IPSS improvement at 3 months, decreasing significantly by 10.61 times from baseline, followed by 10.37 times at 6 months. Improvement persisted at 12 months, albeit with a slight reduction. However, no significant differences in IPSS score change were noted between follow-up periods.

The IPSS score, a globally standardized tool with 8 questions, quantitatively evaluates LUTS symptoms post-diagnosis or in treated patients, categorizing scores of 0, 8-19,

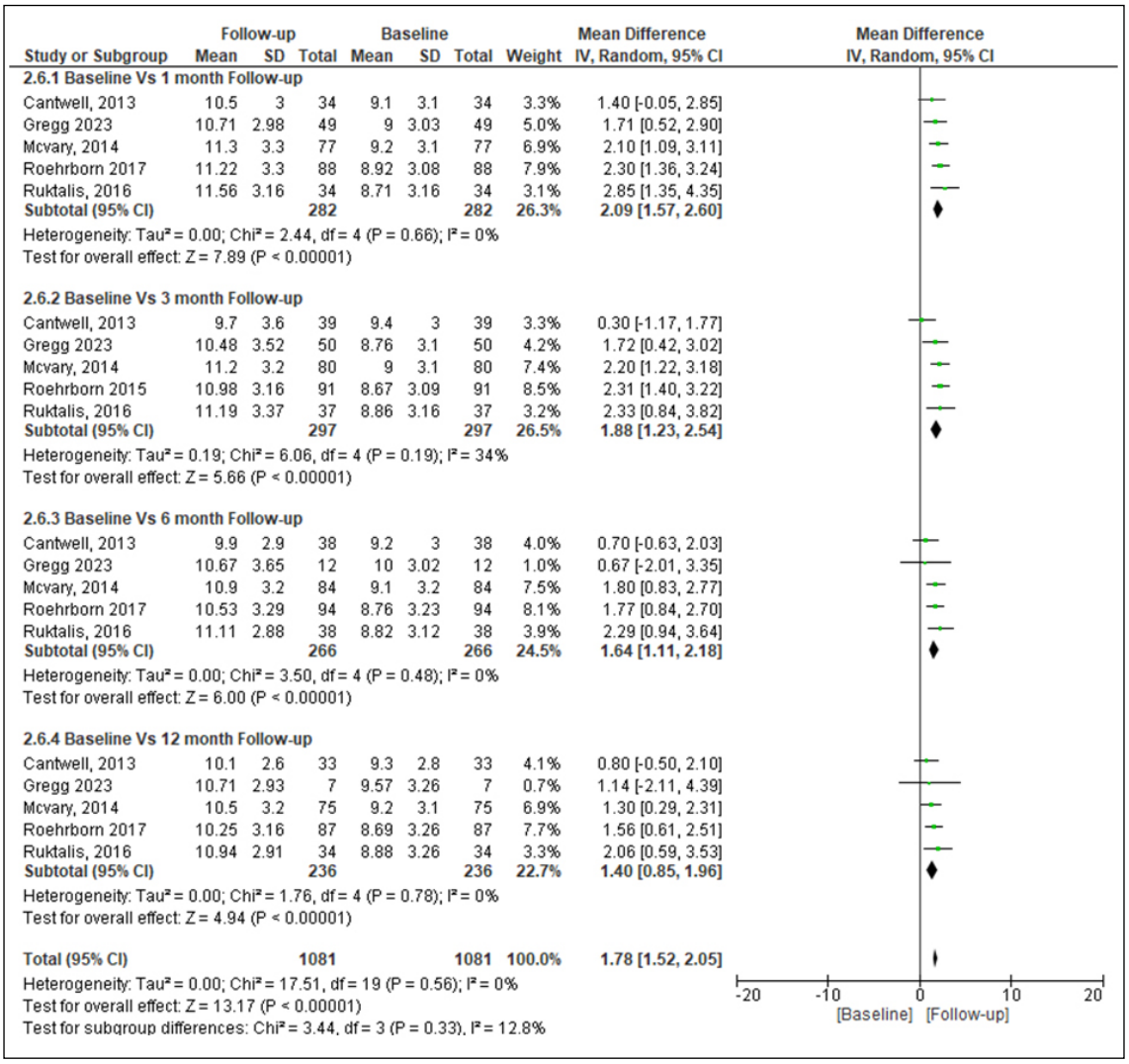


Figure 8. *Subgroup Meta-analysis of comparison of MSHQ-EjD Function score between baseline and 1, 3, 6 and 12 months follow-up after PUL treatment.*

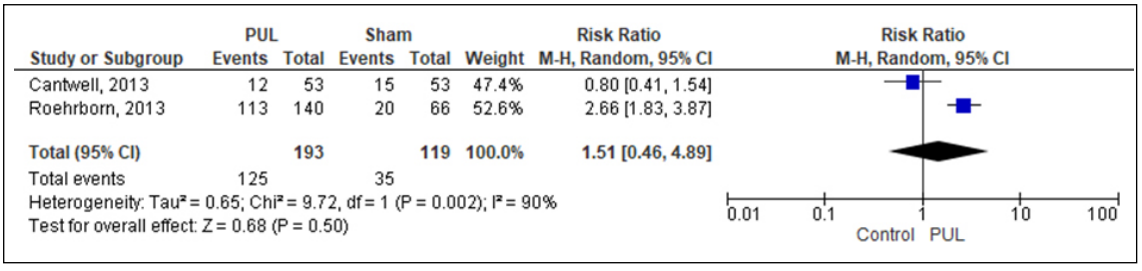


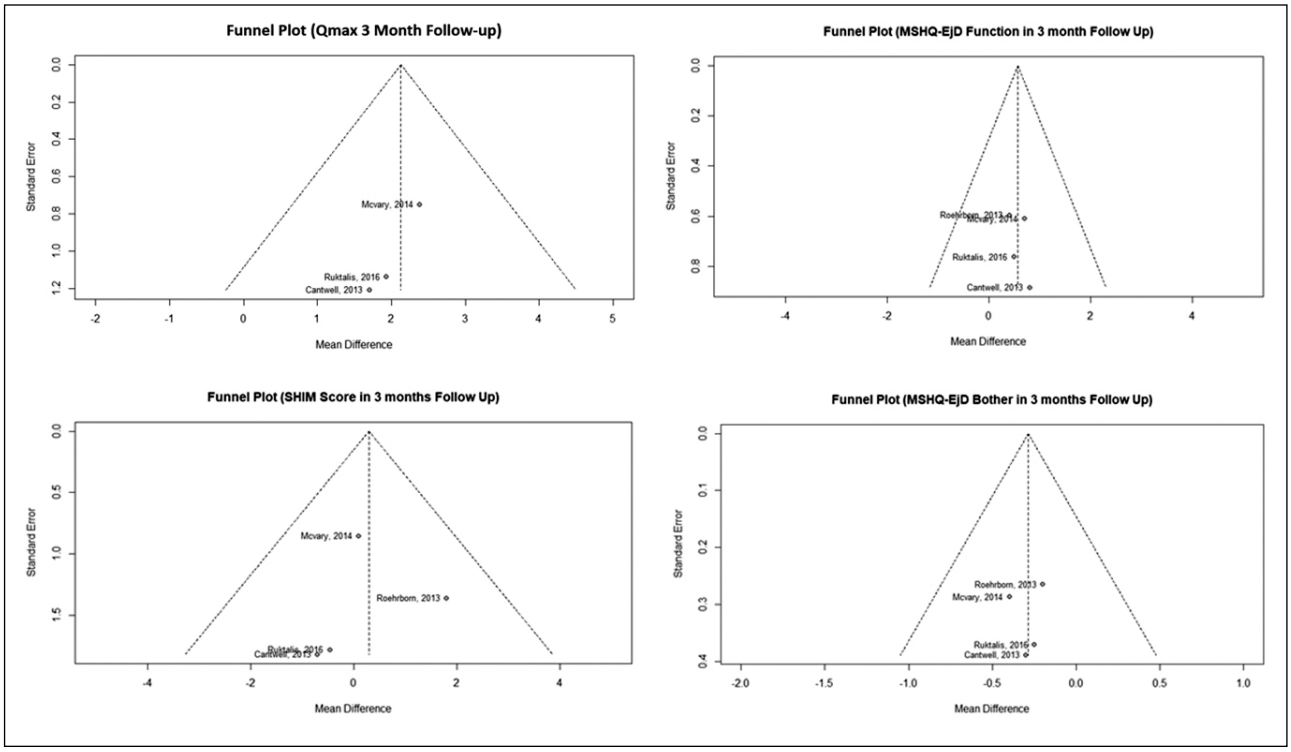
Figure 9. *Meta-analysis of all related adverse events of PUL treatment.*

and 20-35 as no/mild, moderate, and severe symptoms, respectively (17).

Other findings highlighted PUL's efficacy in addressing LUTS symptoms through uro-flowmeter-assessed $_{max}$i-mum flow rate (Q_{max}), a non-invasive urodynamic test for BPH-related bladder detrusor muscle function (18). From this review's analysis of 3 studies, PUL significantly outperformed Sham in mean Q_{max} improvement at 3 months post-procedure. Notably, the greatest Q_{max} enhancement was at 3 months post-PUL, a 4.03 times increase from baseline.

This aligns with *Rukstalis et al.'s* study, reporting a substantial Q_{max} increase from 7.95 mL/sec to 11.95 mL/sec at 3 months post-PUL (19). While the 12-month post-PUL Q_{max} change showed a decrease, significant improvement remained evident. Results showed no significant Q_{max} change between follow-ups. Normal Q_{max} in men is > 15 mL/second, potentially declining with age (20). Post residual volume (PVR) assessment reveals leftover urine after urination, often using a catheter. Elderly normal PVR values range from 50-100 mL; > 200 mL or < 50 mL suggests bladder or prostate issues (20-22). Compared to baseline, PVR significantly improved, especially at 3 months post-PUL. At 12 months, improvement remained. PUL exhibit-

Figure 10.
Based on the Egger's test results for Q_{max}, SHIM, MSHQ-Ejd Function, and MSHQ-EjD Bothers, there is no funnel plot asymmetry which indicates that there is no publication bias (p = 0.1003; p = 0.8806; p = 0.5414; p = 0.9147).



ed swift, significant LUTS symptom improvement within 3 months, supporting its potential for treating BPH patients' symptoms. Its minimally invasive nature makes widespread use likely (22).

The analysis of 3 studies in this review found that BPHII scores at 3-month after PUL were less worse compared to Sham (22). Another subgroup analysis comparing change in mean BPHII scores between baseline and post-PUL follow-up showed significant improvement across different intervals, with the best enhancement at 6 months (4.11 times lower) (22). The BPHII questionnaire includes 4 domains assessing micturition problems' impact on physical discomfort, health concerns, symptom bother, and interference with activities. Scores range from 0 (no symptoms) to 13 (severe symptoms) (22, 23).

Similarly, the IPSS-QoL score assesses a patient's outlook on his current micturition condition, with scores ranging from 0 (happy) to 6 (very bad) (23). This review revealed that IPSS-QoL scores at 3 months after PUL were significantly better when compared to Sham. Another subgroup analysis found the best IPSS-QoL score improvement at 12 months post-PUL (24). However, IPSS score change showed no significant difference between follow-up durations. Given PUL's significant impact on improving the quality of life by rapidly addressing LUTS complaints linked to BPH and its high effectiveness, its steady use in various health centers is anticipated to reduce morbidity and mortality rates in BPH patients.

Impaired sexual function is common in BPH patients due to the impact of LUTS symptoms and prostate enlargement. This review indicated that PUL therapy's effectiveness in improving sexual function wasn't significantly better than Sham at the 3-month follow-up for such patients (24). However, *McArvy et al.'s* study intriguingly found that mean SHIM scores increased at each follow-up interval without worsening. Similar findings were supported by *Rukstalis et al.*, showing stable improvement in SHIM scores at 1, 3, 6, and 12 months post-PUL from baseline (25). Conversely, the mean MSHQ-EjD Function score significantly improved, with scores increasing at each follow-up interval compared to baseline, notably at 1-month post-PUL. These results suggest that PUL doesn't negatively impact urogenital anatomy, allowing sexual function to naturally progress while also improving LUTS symptoms. Notably, PUL's positive effect on sexual function contrasts with other therapies like TURP, often causing significant sexual function disorders such as erectile dysfunction and ejaculation issues (25). The adverse effects of PUL therapy vary. A review of two studies revealed that the common adverse events after PUL were dysuria, hematuria, pelvic pain, and urgency, all resolving within two weeks. No severe events leading to mortality occurred. Hematuria improved within 3 days without needing blood transfusion. Pelvic pain was measured using VAS during follow-up (26). Notably, there were no reports of adverse events impacting sexual function, like impaired ejaculation or erectile function, highlighting a clear advantage of the PUL procedure. Its bladder neck integrity preservation and absence of thermal tissue damage allow for controlled antegrade ejaculation and reduced risk of erectile dysfunction (27).

This review has limitations due to the limited number of

studies, resulting in some analyses having high heterogeneity. However, subgroup analysis and random effects models helped minimize this issue. Most studies didn't categorize score results according to international guidelines, preventing risk analysis using RR or OR. Additional studies are needed for a comprehensive analysis. More studies comparing PUL with common BPH therapies like TURP are expected. PUL is recommended for high BPH risk populations like the elderly in densely populated areas where qualified therapy modalities are advised.

Conclusions

PUL plays a vital role in rapidly and significantly improving BPH-related LUTS and urinary flow, making it a viable operative option for BPH patients. Beyond swift symptom relief, PUL preserves sexual function, enhancing it as symptoms resolve. Additionally, its minimally invasive nature results in minimal side effects and low morbidity compared to other therapies. With these significant outcomes, PUL holds promise to replace established procedures like TURP or enucleation in BPH management. However, broader clinical studies are recommended to comprehensively assess its efficacy, especially given its current limited use.

Author's contributions

Syah Mirsya Warli contributed to the conception, editing, and supervision for this work.
Zaimah Zulkarnaini Tala contributed to the design, supervision, and providing resources and funding for this work.
Muhammad Fahmi Ikram, Raja Gerald Sarumpaet, and Ignatius Ivan Putrantyo contributed equally to drafting, data curation and analysis, data interpretation and writing original draft for this work.

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