

THE IMPACT OF BENIGN PROSTATE HYPERPLASIA TREATMENT MODALITIES ON THE INCIDENCE AND PROGRESSION OF URETHRAL STRICTURE : A COMPREHENSIVE SYSTEMATIC REVIEW

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ABSTRACT

Background: Urinary tract symptoms in elderly men are frequently caused by BPH, which frequently results in urethral stricture. Perioperative morbidity might result from surgical methods such as simple open prostatectomy and transurethral resection. Several techniques, such as HoLEP, have surfaced as novel therapies.

Methods: Following PRISMA 2020 guidelines, this systematic review concentrated on full-text English literature published between 2014 and 2024. Editorials and review articles that appeared in the same journal as the submission were not accepted without a DOI. The literature was assembled using a variety of online databases, including ScienceDirect, PubMed, and SagePub.

Result: The study utilized reliable sources like Science Direct, SagePub, and PubMed for screening over 500 publications. Six papers were identified as relevant for systematic analysis, followed by further study and examination of the complete document.

Conclusion: The treatment of BPH patients using the TURis system and TUEP is effective in preventing postoperative complications like urethral strictures. However, further large-scale multicentre RCTs are needed to confirm these findings. BMA is suitable for short proximal bulbar urethral strictures, and the inverted omega En-bloc HoLEP technique is safe and effective for all prostate sizes.

Keyword: BPH, urethral stricture, treatment, complication.

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a common cause of lower urinary tract symptoms (LUTS) in older men. BPH is defined as the nonmalignant development or hyperplasia of prostate tissue. There is evidence that the prevalence of disease rises with age. According to Ng M, the histological prevalence of BPH at autopsy can reach 50% to 60% in guys in their 60s and 80% to 90% in those over 70.¹ Lower urinary tract symptoms (LUTS) that do not improve with medication therapy and complex situations such as acute urine retention, recurring or persistent UTIs, bladder stones, and refractory gross hematuria are currently criteria for BPH-related surgery.² The usual surgical procedures for BPH include invasive surgical therapy, such as simple open prostatectomy (OP) and transurethral resection of the prostate (TURP).^{3,4} On the other hand, significant perioperative morbidity, such as urethral stricture, TUR syndrome, and postoperative hemorrhage, is linked to these invasive procedures.⁴ TURP has additional drawbacks, such as bleeding during resection without enucleation and the need for hypotonic irrigation fluid, which increases the risk of hyponatremia.⁵

To address these issues, several surgical methods have been created. The first endoscopic enucleation technique was published in 1986 and was called transurethral enucleation (TUE). However, bleeding cannot be halted during enucleation due to the lack of electric cauterization. The use of a neodymium YAG laser for endoscopic vaporization of the prostate (EVP) was initially documented in 1990. Later, EVP using several kinds of lasers was unveiled. It was discovered that the laser's effectiveness and safety were comparable to those of TURP. To avoid sphincter damage, EVP techniques remove less apical prostate tissue because enucleation was not a part of the process.⁵ The first report of transurethral enucleation with bipolar energy (TUEB) dates back to 2007. According to Hirasawa, TUEB without morcellation offers efficacy comparable to TURIs, but with less bleeding and shorter hospital stays.⁶ It is uncertain, therefore, how safe and effective TUEB is for the occurrence and development of urethral stricture.⁵

As the first described anatomic endoscopic enucleation of prostate (AEEP),⁷ prostate enucleation with a holmium laser (HoLEP) has been around since 1995 and, independent of prostate size, has been shown to reduce morbidity, shorten hospital stays, and have good efficacy.⁵ Techniques for 3-lobe, 2-lobe, and En-bloc enucleation are among the conventional HoLEP surgical approaches.^{8,9} Two or three prostatic lobes are removed simultaneously as the fundamental idea behind the En-bloc procedure. Urinary incontinence following surgery is said to be less common using the En-bloc technique because it makes it simpler for the surgeon to identify the surgical plane and preserves the mucosa of the external sphincter.¹⁰ Furthermore, according to Rucker, the En-bloc approach produces similar results faster than the conventional method. Yet, learning and applying traditional En-bloc procedures to very small or big prostates might be challenging.¹¹ HoLEP has consequently emerged as the new accepted surgical treatment for BPH, despite the system's high cost and need for a morcellator.^{5,12} It is because of the advantage over traditional therapies, HoLEP is widely adopted by patients seeking surgical treatment for BPH/LUTS.¹³

The constriction of the urethra that results in obstructive symptoms is called a urethral stricture. There are four main categories of urethral strictures' etiology: idiopathic, iatrogenic, inflammatory, and traumatic. Of these, idiopathic and iatrogenic strictures are the most prevalent, accounting for 33% of cases. Of all iatrogenic strictures, 41% are transurethral resections (TUR). The comparatively large devices used in these procedures are repeatedly moved in and out of the urethra, causing urethral dilatation and stretching to cause variable degrees of epithelial damage. Stricture development is the ultimate result of this urethral mucosal damage.¹⁴

This research attempts to present a thorough summary of the literature published in the last ten years about the impact of benign prostate hyperplasia treatment modalities on the incidence and progression of urethral stricture.

METHODS

Protocol

The study's author carefully followed the guidelines set forth by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020. This was done to make sure the study complied with all rules. The selected methodology was meticulously crafted to guarantee the precision and coherence of the research outcomes.

Criteria for Eligibility

This article offers a thorough analysis of research conducted over the previous ten years on the effects of treatment strategies for benign prostatic hyperplasia on the occurrence and development of urethral stricture. Through in-depth data

analysis, this study seeks to enhance and elucidate patient care procedures. This thesis' main goal is to highlight the significance of important topics that may be found in a range of literary works.

Specific inclusion and exclusion standards were put in place to ensure that the data utilized in this study was accurate. Items must have been published in English between 2014 and 2024 in order to be considered for inclusion. Among the exclusion criteria are editorials, submissions without a DOI, published reviews, and duplicate journal entries.

Search Strategy

The study's keywords include "the impact of benign prostate hyperplasia treatment modalities on the incidence and progression of urethral stricture". For this research, the following Boolean MeSH keywords were entered into the databases: (((("benign prostate hyperplasia"[MeSH Terms] OR ("benign prostate hyperplasia "[All Fields] AND "treatment"[All Fields]) OR ("BPH"[MeSH Terms] OR "bph"[All Fields] AND "modalities"[All Fields]) AND ("urethral stricture"[MeSH Terms] OR "urethral stricture"[All Fields] OR "impact"[All Fields] OR "incidence"[MeSH Subheading] OR "progression"[All Fields] OR "prognosis"[All Fields])))).

Data retrieval

The authors carefully read the abstract and title of each publication to determine its significance before starting this meticulous study. More weight was only assigned to the studies that met the inclusion criteria and bolstered the goals of the article. Finally, a pattern that kept coming up across several searches produced a definitive answer. Only full-text entries in the English language were accepted. Content that satisfied all predetermined inclusion criteria and had a direct connection to the study's topic matter was produced using the strictest screening methodology. Research that deviated from these patterns was typically disregarded, and their conclusions were overlooked. Numerous items, including titles, authors, publication dates, locations, study techniques, and factors, were discovered and reviewed during the assessment.

Quality Assessment and Data Synthesis

The research referenced in each article's title and abstract was independently assessed by the writers in order to determine which publications require additional investigation. Examining every document that satisfied the requirements in advance for review inclusion was the next step. The selection of the papers for the review was guided by the evaluation findings. This criterion expedited the selection of papers for additional study, enabling a comprehensive evaluation of prior research and the requirements that qualified it for assessment.

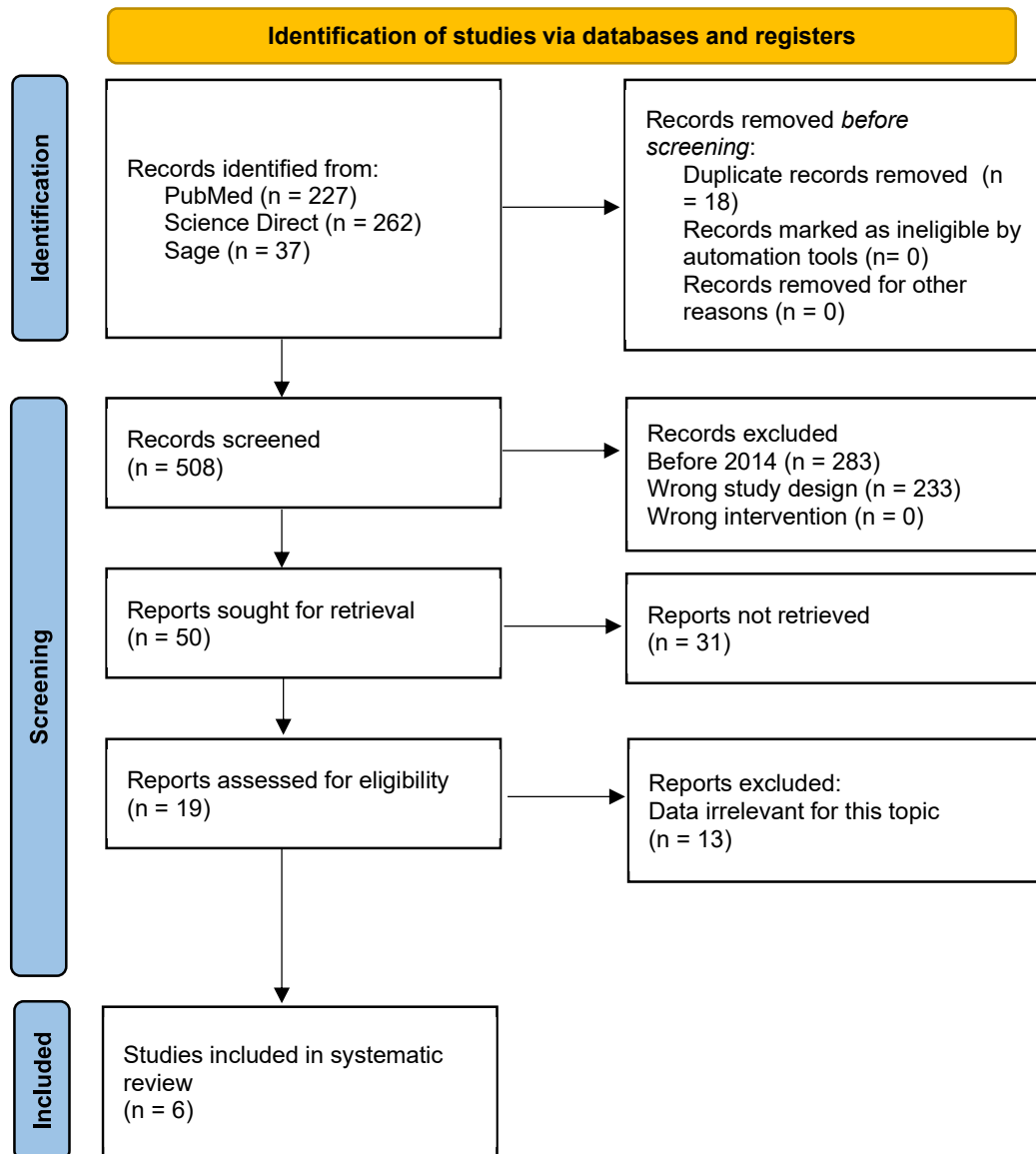


Figure 1. Article search flow chart

RESULT

First, our study team collected more than 500 publications from reliable sources like PubMed, Science Direct, and SagePub. Following an extensive three-tier screening process, only six papers were found to be directly pertinent to our ongoing systematic analysis. After that, some passages were chosen for more study and a careful examination of the complete document. For convenience of viewing, the content that was evaluated for this analysis is compiled in Table 1.

Table 1. The literature included in this study

Author	Origin	Method	Sample	Result
Komura et al. ¹⁵ (2015)	Japan	Randomized Controlled Trial	136 patients	When the two groups urethral stricture treatments were compared, there was no discernible change in the occurrence rates. However, TURis therapy resulted in a statistically greater incidence of Urethral Stricture compared to M-TURP in

				patients with a prostate volume (PV) of 70 ml. Patients with PV > 70 ml had a significantly longer mean operation time with TURIs, however, this difference did not hold for the PV < 70 ml group. Over 36 months, the treatment's overall efficacy was equivalent.
Lin et al.¹⁶ (2015)	China	Systematic Review	9 studies	A meta-analysis of nine RCTs involving 758 patients found no significant differences between TUEP and OP groups in urinary flow rate, postvoiding residual urine volume, prostate-specific antigen, quality of life score, urethral stricture, and international index of erectile function. TUEP benefited from perioperative outcomes, while OP had a lower blood transfusion rate.
Favre et al.¹⁷ (2020)	Argentina	Retrospective Study	77 patients	The study comprised 77 participants with a mean age of 70 years. The length of the bulbomembranous urethral stricture (BMS) was 1.5 cm on average. A 53-month follow-up was the median. Of the patients, 3/77 (3.9%) were categorized as failures and 74/77 (96.1%) as successes. Five of the 6/77 (7.8%) patients with postoperative urine incontinence had undergone Open Simple Prostatectomy (OSP) as a treatment for their benign prostatic hyperplasia (BPH).
Endo et al.⁵ (2022)	Japan	Retrospective Study	180 patients	The SG group had 132 patients (73%), while the LG group had 48 (27%). Preoperative characteristics like age, IPSS, and QOLS did not differ. LG had higher serum PSA levels and PV. Postoperative changes were similar, but longer. No differences were found in early complications or late problems like urethral stricture.
Zhou et al.¹³ (2022)	China	Cohort	188 patients	Perioperative complications were minimal and did not exhibit statistically significant variation. A minimum of 12 months were spent on the

				follow-up. Following surgery, both groups experienced improvements in IPSS, Qmax, QoL, and PVR. The parameters did not differ statistically between the two groups. Long-term problems, such as urethral stricture and bladder neck contracture, were similar and uncommon in both groups ($p < 0.05$).
Kim et al.¹¹ (2023)	Korea	Retrospective Study	716 patients	The postoperative rate of complications in patients with prostate cancer was 1.5%, with urethral stricture being the most common. The rate of complications increased to 1.7% in patients with bladder neck contractures. Postoperative management included urethral sounding, endoscopic internal urethrotomy, and re-HoLEP.

Study by Komura et al. found that the treatment of benign prostate hyperplasia patients was divided into two groups: conventional monopolar transurethral resection of the prostate (M-TURP) and TURP with TURis system (TURis). The TURis group experienced longer operation times and a higher rate of urethral stricture compared to the M-TURP group. The TURis group was more likely to experience urethral stricture compared to the M-TURP group.¹⁵

Lin's study compared urinary flow rate and perioperative outcomes between TUEP and OP groups, finding no significant differences in urinary flow rate, quality of life, or complications such as urethral stricture.¹⁶

The study by Favre et al. analyzed 77 patients with prostatic enlargement, focusing on the TURP group. The stricture treatment was most frequent in the TURP group, with a success rate of 96.1%. The UI rate was 7.8%, with open simple prostatectomy (OSP) used in five cases and HoLEP in one. Postoperative complications occurred in 16 patients.¹⁷

The study by Endo et al. compared 180 patients with urinary retention and urethral catheter placement before surgery. The LG group experienced longer operation times and a significant postoperative decrease in IPSS and QOLS, with no significant differences between the SG and LG groups. Ten patients developed urethral stricture, all cured within 6 months.⁵

The study by Zhou et al. compared outcomes of HoLEP procedures in 188 patients, revealing no major life-threatening complications, and infrequent long-term complications like bladder neck contracture and urethral stricture in both groups.¹³

According to a study by Kim et al. found that significant differences were observed in postoperative complications, including urethral strictures, despite no significant differences in BMI, comorbid diseases, or uroflowmetry scores among patients with larger prostate sizes.¹¹

DISCUSSION

Advancements in BPH treatment have shifted from traditional open prostatectomies to the introduction of TURP, a laser-based alternative. However, TURP poses a notable risk of postoperative bleeding and is not suitable for larger prostate masses.¹¹ A recent meta-analysis study by Komura et al. compared bipolar TURP and monopolar systems, with a focus on the TURis system.¹⁵ The study found that the TURis group required longer operation times compared to the M-TURP group, contradicting previous studies. The TURis system also required different sheath widths and procedures, and a higher rate of urinary retention in patients treated with TURis was associated with longer operation times and larger preoperative prostate volume.¹⁵ These findings align with the EAU Guidelines on the Treatment for BPO, which recommend open prostatectomy or holmium laser enucleation (HoLEP) as the preferred surgical treatment for men with prostate sizes exceeding 80 ml.¹⁸ Postoperative results showed no significant differences in hemoglobin and hematocrit levels between groups, but the M-TURP group had a significantly higher perioperative clot retention rate.¹⁵

According to Kim, the HoLEP procedure is a great option that offers advantages such as shorter enucleation times and lower total laser energy.¹¹ The 2-lobe technique is better suited for larger prostates, while the 'Inverted omega En-bloc' HoLEP technique combines the benefits of both 2-lobe and En-bloc techniques.⁸ This allows for accurate bladder identification during En-bloc enucleation, making it particularly effective for prostates weighing less than 30 gm and reducing post-surgery complications like urinary incontinence. Lerner's study found that the incidence of urinary incontinence after the procedure was only 2.0%.¹⁹ Despite its safety and efficacy, many urologists are still unaware of HoLEP, which Kampantais et al. attribute to the learning curve required to achieve acceptable outcomes.²⁰

Research indicates that transurethral enucleation of prostate (TUEP), as opposed to open prostatectomy (OP), is a safer and more effective treatment option for benign prostatic hyperplasia with a better perioperative outcome.¹⁶ Although there are no appreciable variations in post-operative problems, TUEP is linked to longer operating times and shorter hospital stays. However, none of the individuals experienced blockage from a recurrence.²¹ Studies on the safety of OP and TUEP in the treatment of big prostates have revealed notable variations in the rates of reoperation. No statistically significant variations were seen in the postoperative complications (UTI, transitory incontinence, bladder neck contracture, urethral stricture, re-catheterization, pneumonia, and infarction) reported by Lin et al. Subsequent research endeavors will methodically assess the clinical effectiveness and safety of TUEP in contrast to TURP for individuals with BPH.¹⁶

Patients with benign prostate hyperplasia after BPH surgical treatment face challenges in treating stenosis while preserving sphincter function and urethral stricture. Conservative treatment methods, such as dilation and bulbo-prostatic anastomosis, have been unsuccessful.¹⁷ However, urethroplasty is more effective than internal urethrotomy and dilations.²² The modified ventral onlay OG technique, which avoids circumferential dissection of the urethral sphincter, has been shown to prevent postoperative urinary incontinence in 95.6% of patients. In addition, they reported a 79.6% stricture-free rate, with 52 monthly median follow-up.¹⁷ Patients with proximal bulbar strictures after TURP using dorsal onlay OG urethroplasty had a 92.9% success rate, while only one stricture recurrence occurred in 16 patients with BMS.²³ Gomez et al.'s ISBPA technique, which involved the circumferential mobilization of the membranous urethra and dissection of the urethra of the external sphincter, achieved a 100% free stricture recurrence rate.²⁴ Patients with de novo incontinence are advised to use bulbomembranous anastomosis (BMA) for short and proximal bulbar urethral strictures, with a success rate of 96.1% and a mean follow-up of 53 months. The estimated five-year free stricture survival rate is 95.2%.¹⁷ The results suggest that the method employed for BPH surgery can affect urethral pattern and UI. BMA offers better results than onlay techniques in long-term follow-up and urethral-free stricture rate. Circumferential dissection of the bulbomembranous urethra in patients with previous BPH surgery does not increase UI risk.¹⁷ The best surgical method depends on individual preference, prostate size, learning curve, and laser power.²⁵

CONCLUSION

The treatment of BPH patients using the TURis system has shown no significant differences in short- and intermediate-term functional outcomes. TUEP, which uses en bloc and urethral mucosal flap sparing technique, is a safe and effective option for preventing postoperative complications such as urethral strictures. However, further large-scale multicentre RCTs are needed to confirm these findings. BMA is a suitable reconstructive option for short proximal bulbar urethral strictures after BPH surgical treatment. The inverted omega En-bloc HoLEP technique is also safe and effective for all prostate sizes.

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