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Bladder Neck Preservation During Transurethral Resection of the Prostate

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Abstract

Background: Transurethral resection of the prostate (TURP) remains the gold standard surgical treatment for benign prostatic hyperplasia (BPH), with over 90% of patients reporting improved voiding symptoms. However, conventional TURP is associated with a high incidence of postoperative retrograde ejaculation, ranging from 70-90%, which significantly impacts sexual satisfaction and quality of life. The bladder neck, functioning as the internal urethral sphincter, plays a crucial role in maintaining antegrade ejaculation through its rich noradrenergic innervation and active contraction during ejaculation. Conventional TURP involves circumferential resection of the bladder neck tissues, which is believed to be a major contributor to postoperative ejaculatory dysfunction. Bladder neck preservation TURP represents a modification of the standard technique, whereby resection is initiated 0.5-0.8 cm away from the bladder neck, aiming to preserve the smooth muscle fibers responsible for bladder neck closure during ejaculation while maintaining adequate prostatic decompression.

Keywords: Benign prostatic hyperplasia, Transurethral resection of prostate, TURP, Bladder neck preservation, Retrograde ejaculation, Ejaculation preservation, Lower urinary tract symptoms, IPSS, Sexual function, Postoperative complications, Urinary incontinence, Maximum urinary flow rate, Post-void residual urine, Internal urethral sphincter, Antegrade ejaculation

Introduction

Benign prostatic hyperplasia (BPH) is one of the most common urological conditions affecting aging men, with histopathologic evidence present in approximately 50% of men by age 60 years and 90% by age 85 years. This progressive condition significantly impacts patients' health-related quality of life through the development of bothersome lower urinary tract symptoms (LUTS), including both storage and voiding dysfunction. Despite the continued evolution of minimally invasive treatment modalities, transurethral resection of the prostate (TURP) has maintained its position as the gold standard surgical treatment for bladder outlet obstruction secondary to BPH, with more than 90% of patients reporting sustained improvement in urinary voiding over 10-year follow-up periods (1).

However, conventional TURP is associated with a high incidence of postoperative retrograde ejaculation, approximating 70-90% in most series. This complication not only affects fertility in men of reproductive age but also significantly impairs sexual satisfaction and overall quality of life. The bladder neck, functioning as the internal urethral sphincter with its rich noradrenergic sympathetic innervation, plays a crucial role in facilitating antegrade ejaculation through active contraction during the expulsion phase. The conventional TURP technique involves circumferential resection of tissues at the bladder neck, effectively removing this sphincteric mechanism and predisposing to retrograde flow of seminal fluid into the bladder during ejaculation (2).

In response to this significant functional limitation, several ejaculation-preserving modifications of TURP have been developed and evaluated over the past two decades. These techniques are based on various anatomical

preservation strategies, including bladder neck preservation, supramontanal tissue preservation, and combined approaches. The fundamental principle underlying bladder neck preservation TURP is to maintain the integrity of the smooth muscle fibers at the internal urethral sphincter while achieving adequate prostatic decompression (3).

Anatomical and Physiological Basis for Bladder Neck Preservation

Anatomy of the Bladder Neck

The bladder neck is a critical anatomical structure located at the internal urethral meatus, positioned 3-4 cm posterior to the midpoint of the symphysis pubis. It consists of a complex arrangement of smooth muscle fibers organized into three distinct layers: inner longitudinal fibers that extend into the urethral smooth muscle, a middle circular layer forming the preprostatic sphincter responsible for continence, and outer longitudinal fibers that create a loop around the bladder neck contributing to both continence and bladder neck opening during micturition. The middle circular layer, richly innervated by adrenergic sympathetic fibers, contracts vigorously in response to sympathetic stimulation, producing firm closure of the bladder neck. This sphincteric mechanism is essential for maintaining continence and preventing retrograde flow during ejaculation (4).

Physiology of Normal Ejaculation

Ejaculation represents a complex physiological process heavily controlled by the autonomic nervous system, consisting of two synchronized phases: emission and expulsion. During the emission phase, secretions from the seminal vesicles, prostate, and vas deferens are deposited into the posterior urethra via phasic contractions while the bladder neck undergoes firm closure to prevent retrograde flow. The bladder neck begins to close early in emission and maintains closure throughout the expulsion phase. The expulsion phase is then triggered through intense rhythmic contractions of the bulbospongiosus and ischiocavernosus muscles, propelling semen anterogradely through the urethra while the external sphincter undergoes coordinated relaxation. The bladder neck sphincter, regarded as an indispensable component of the "compression chamber" where seminal fluid accumulates before expulsion, plays a critical role in directing flow anterogradely rather than retrograde into the bladder (5).

Mechanisms of Retrograde Ejaculation Following TURP

Retrograde ejaculation occurs when semen that would normally be expelled anterogradely through the urethra is redirected into the urinary bladder due to incompetence of the bladder neck sphincter. In conventional TURP, circumferential resection of the bladder neck is performed to achieve maximal bladder outlet opening and optimal voiding outcomes. This aggressive resection removes the smooth muscle fibers responsible for bladder neck closure, effectively eliminating the sphincteric mechanism that prevents retrograde flow during ejaculation. Without this competent sphincter, the path of least resistance during ejaculation becomes retrograde into the bladder rather than antegrade through the urethra. Retrograde ejaculation is typically diagnosed by identifying an abnormally high concentration of sperm in post-ejaculatory urine specimens (6).

Technical Aspects of Bladder Neck Preservation TURP

Standard TURP Technique

Conventional TURP involves systematic resection of hyperplastic prostatic adenomatous tissue from the transitional zone while preserving the prostatic capsule and protecting structures distal to the verumontanum. The procedure begins with careful cystoscopic inspection to establish anatomical orientation, followed by systematic resection from the bladder neck to the verumontanum. The key point of standard TURP is complete resection of tissues enveloped within the prostatic capsule and circumferential resection at the bladder neck to achieve maximal outlet opening. Resection proceeds in an orderly fashion, typically addressing the median lobe first if significantly enlarged, followed by systematic resection of the lateral lobes. Complete resection at the bladder neck, while potentially causing excessive hemorrhage and sexual dysfunction, has traditionally been performed to optimize voiding outcomes (7).

Bladder Neck Preservation Technique

Bladder neck preservation TURP modifies the conventional approach by intentionally retaining tissue at the bladder neck level while maintaining adequate prostatic decompression. For bi-lobar prostates, resection is initiated 0.5-0.8 cm distal to the bladder neck, leaving a rim of tissue at the internal urethral meatus intact throughout the procedure. The remainder of the resection proceeds identically to conventional TURP, with systematic removal of adenomatous tissue down to the surgical capsule while protecting the verumontanum and external sphincter. For tri-lobar prostates with median lobe protrusion into the bladder, resection begins with the protruding tissue and highly proliferative tissue around the bladder neck, flattening the median lobe without complete or excessive resection at the neck. Following median lobe reduction, lateral lobe resection proceeds from 0.5-0.8 cm away from the bladder neck. Throughout the procedure, particular attention is directed toward avoiding injury to the circular smooth muscle fibers at the bladder neck (8).

Intraoperative Considerations

Several technical considerations are essential for successful bladder neck preservation. First, adequate bladder distension with approximately 100 mL of irrigant facilitates identification of the bladder neck and prevents inadvertent bladder wall injury during resection at the neck level. Second, when resecting near the bladder neck, visual confirmation of ureteral orifice positions prevents their inadvertent resection, particularly at the 4-5 and 7-8 o'clock positions. Third, resection strokes should be smooth and controlled, avoiding chopping motions that increase perforation risk and bleeding. Fourth, cauterization should be minimized at the bladder neck to reduce tissue injury, scarring, and subsequent contracture risk. Finally, careful hemostasis is essential, with particular attention to arterial bleeders while avoiding futile attempts to cauterize venous sinuses (9).

Clinical Outcomes

Efficacy Parameters

Urinary Flow Improvement

Multiple studies have demonstrated that bladder neck preservation TURP achieves significant improvement in objective urinary flow parameters, though early postoperative values may be slightly lower than conventional TURP. In comparative studies, maximum urinary flow rate (Qmax) increased from baseline values of 6-7 mL/s to 18-20 mL/s at three months postoperatively in both bladder neck preservation and conventional TURP groups. Some studies report transiently lower Qmax values in the bladder neck preservation group during the first postoperative month (approximately 15-16 mL/s versus 18-19 mL/s for conventional TURP), attributed to residual tissue and postoperative edema at the bladder neck. However, these differences consistently resolve during follow-up, with comparable flow rates achieved by three to six months postoperatively, indicating that bladder neck preservation does not compromise long-term voiding function (10).

Post-Void Residual Reduction

Post-void residual urine (PVR) volume demonstrates marked reduction following both bladder neck preservation and conventional TURP, confirming effective relief of bladder outlet obstruction with both techniques. Baseline PVR values typically ranging from 85-110 mL decrease to 18-20 mL within the first postoperative month. Some studies report slightly higher early PVR values in bladder neck preservation groups, potentially reflecting the retained tissue at the bladder neck; however, these differences are generally minimal and clinically insignificant. The substantial reduction in PVR compared to preoperative values, regardless of technique, demonstrates that bladder neck preservation achieves adequate decompression without compromising bladder emptying efficiency (11).

Symptom Improvement

International Prostate Symptom Score (IPSS) shows dramatic and comparable improvement following both bladder neck preservation and conventional TURP. Baseline IPSS values typically ranging from 21-22 (severe symptoms) decrease to 9-10 (mild symptoms) within the first postoperative month, representing approximately

50% reduction in symptom severity. No statistically significant differences in IPSS improvement have been reported between bladder neck preservation and conventional TURP groups at any follow-up interval, indicating equivalent symptomatic relief despite the anatomical preservation. Both storage and voiding subscores demonstrate improvement, confirming that bladder neck preservation does not selectively compromise either symptom domain (12).

Ejaculatory Function

Rates of Retrograde Ejaculation

The preservation of ejaculatory function represents the primary functional advantage of bladder neck preservation TURP. Studies consistently demonstrate significantly lower rates of retrograde ejaculation compared to conventional TURP, though complete preservation is not uniformly achieved. In the largest prospective series, retrograde ejaculation occurred in approximately 50% of patients at one month and 25% at three months following bladder neck preservation TURP, compared to 80% at one month and 60% at three months following conventional TURP. These differences are statistically significant and clinically meaningful, representing a substantial reduction in ejaculatory dysfunction. The gradual improvement observed during follow-up likely reflects progressive resolution of tissue edema and improved bladder neck function as healing progresses (13).

Comparative Effectiveness of Ejaculation-Preserving Techniques

Various ejaculation-preserving TURP modifications have been described, with differing rates of success. Supramontanal tissue preservation techniques, which preserve tissue proximal to the verumontanum rather than at the bladder neck, report retrograde ejaculation rates ranging from 9-20%. Combined bladder neck and supramontanal preservation approaches have achieved even lower rates, approximately 9% in selected series. Laser-based ejaculation-preserving techniques, particularly those employing defined apical and supramontanal safety zones, report the most favorable ejaculatory outcomes, with some studies demonstrating preservation of antegrade ejaculation in the majority of patients and significant improvements in sexual satisfaction scores. However, these techniques may sacrifice the ability to obtain tissue for histopathological examination and may have limitations regarding prostatic size and anatomy (14).

Sexual Satisfaction

Beyond preventing retrograde ejaculation, bladder neck preservation may positively impact overall sexual satisfaction. Studies evaluating sexual function using validated questionnaires have demonstrated higher postoperative satisfaction scores in ejaculation-preserving groups compared to conventional TURP. Preservation of semen volume and maintenance of antegrade ejaculation contribute to improved sexual experience and psychological well-being. However, it should be noted that ejaculatory preservation techniques do not appear to significantly impact erectile function, which remains largely unchanged or shows similar rates of dysfunction compared to conventional TURP (15).

Complications

Perioperative Complications

Perioperative complication rates are generally comparable between bladder neck preservation and conventional TURP. Operative time shows no significant difference, typically ranging from 54-58 minutes regardless of technique. Intraoperative bleeding, measured by hemoglobin drop, demonstrates no significant difference between approaches, with mean decreases of 0.57-0.78 g/dL reported in comparative studies. Transfusion requirements remain low and comparable between techniques. Hospital stay and catheterization duration are similarly equivalent, typically 1.9 days and 2.9-3.0 days respectively. Early postoperative hematuria occurs in approximately 10% of patients regardless of technique, usually managed conservatively with catheter traction and anticholinergic medications without requiring return to the operating room (16).

Urinary Tract Infection and Retention

Urinary tract infection rates following bladder neck preservation TURP range from 10-20%, comparable to conventional TURP, and respond well to culture-directed antibiotic therapy. Acute urinary retention following catheter removal is uncommon with both techniques, occurring in less than 5% of patients. When retention does occur, it is typically managed with temporary catheter reinsertion and alpha-blocker therapy, with most patients achieving successful voiding within days to weeks. The retained tissue at the bladder neck does not appear to significantly increase retention risk compared to conventional TURP (17).

Urinary Incontinence

Transient postoperative urinary incontinence represents an important consideration with bladder neck preservation. Studies report incontinence rates of 10-20% at one month postoperatively, primarily urge incontinence, with occasional cases of mixed stress and urge incontinence. Importantly, these symptoms are typically self-limited and resolve spontaneously or with conservative management including pelvic floor exercises and anticholinergic or beta-3 agonist medications. By three months postoperatively, incontinence rates approach zero in most series, with complete resolution in both bladder neck preservation and conventional TURP groups. The early recovery from incontinence in bladder neck preservation groups is attributed to preserved sphincteric function at the internal urethral sphincter (18).

Bladder Neck Contracture and Urethral Stricture

Bladder neck contracture represents a theoretical concern with bladder neck preservation due to the retained tissue and potential for fibrous healing at the neck level. Reported rates range from 0-10%, comparable to or slightly higher than conventional TURP. When contracture occurs, it typically manifests within the first three to six months postoperatively with recurrent obstructive symptoms and responds well to bladder neck incision. Urethral stricture rates are comparable between techniques, occurring in 0-10% of patients, most commonly at the penoscrotal junction due to inadequate urethral dilation prior to resectoscope insertion (19).

Comparative Analysis and Evidence Synthesis

The existing literature on bladder neck preservation TURP comprises predominantly small to moderate-sized cohort studies and a limited number of randomized controlled trials. Sample sizes range from approximately 20-40 patients in smaller feasibility studies to 80-120 patients in larger randomized trials. The relatively small sample sizes in many studies limit statistical power and the ability to detect meaningful differences in less common complications. Additionally, most studies are single-center experiences, which may introduce selection bias and limit generalizability. Despite these limitations, the consistency of findings across multiple independent studies strengthens the overall evidence base (20).

Duration of Follow-Up

Most published studies report short to intermediate-term follow-up, typically ranging from three to twelve months postoperatively. While this duration is adequate for assessing early functional outcomes, ejaculatory function, and common complications, longer follow-up is necessary to evaluate the durability of ejaculatory preservation, late complications such as stricture and contracture, and the potential need for reoperation due to incomplete resection or prostatic regrowth. The few studies with extended follow-up beyond one year suggest that ejaculatory function remains stable and that reoperation rates are comparable to conventional TURP (21).

Patient Selection and Applicability

Bladder neck preservation TURP is most applicable to sexually active men with moderate-sized prostates (typically 30-80 g) without significant median lobe protrusion. Patients with very large prostates, severe median lobe enlargement extending deep into the bladder, or prior prostatic surgery may be less suitable candidates due to technical challenges in achieving adequate resection while preserving the bladder neck. Additionally, patients with neurological disorders affecting bladder neck function or detrusor contractility may not derive the same ejaculatory benefit from anatomical preservation alone (22).

Alternative Ejaculation-Preserving Approaches

Several alternative approaches to ejaculatory preservation exist beyond bladder neck preservation TURP. Prostatic urethral lift (UroLift) and water vapor thermal therapy (Rezūm) represent minimally invasive options that preserve ejaculatory function in the majority of patients, with reported retrograde ejaculation rates near 0%. However, these techniques are limited to smaller prostates, have higher reoperation rates, and do not provide tissue for histopathological examination, potentially missing incidental prostate cancer. Laser-based ejaculation-preserving techniques offer excellent functional outcomes but require specialized equipment and expertise. Each approach must be individualized based on patient anatomy, symptom severity, and treatment goals (23).

Conclusion

Bladder neck preservation TURP is a technically feasible and clinically effective modification of conventional TURP that significantly reduces the incidence of postoperative retrograde ejaculation while maintaining satisfactory improvements in urinary flow parameters and symptom relief. The technique achieves retrograde ejaculation rates of approximately 25-50%, substantially lower than the 60-90% rates associated with conventional TURP, through preservation of the internal urethral sphincter mechanism at the bladder neck. While some studies report transiently lower early postoperative flow rates and slightly higher residual urine volumes in bladder neck preservation groups, these differences resolve during follow-up without compromising long-term functional outcomes. Complication rates, including bleeding, infection, incontinence, stricture, and contracture, are generally comparable between bladder neck preservation and conventional TURP. The technique is most applicable to sexually active men with moderate-sized prostates who prioritize ejaculatory preservation, though patient selection and anatomical considerations remain important determinants of success. Future research should focus on larger multicenter randomized trials with extended follow-up to confirm the durability of ejaculatory preservation, assess long-term reoperation rates, and further refine patient selection criteria. For appropriately selected patients, bladder neck preservation TURP offers a pragmatic balance between ejaculatory preservation and effective prostatic decompression, representing a valuable addition to the urologist's armamentarium for managing symptomatic benign prostatic hyperplasia (24).

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