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Six-Month Urethral Outcomes After Intraoperative Accessory Access Maneuvers for a Narrow Urethra During Anatomical Endoscopic Enucleation of the Prostate: A Prospective Single-Arm Cohort Study

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Abstract

Purpose

Postoperative urethral stricture occurs in 1.4%–4.4% of patients after anatomical endoscopic enucleation of the prostate (AEEP), but the impact of the intraoperative maneuvers required to overcome a narrow urethra is unknown. We assessed whether urethral caliber deteriorates within 6 months after these maneuvers.

Methods

Single-center, prospective, single-arm cohort study (July–December 2025). Consecutive AEEP patients were staged intraoperatively with the Purohit-Blaivas scale; those with Stage 1–2 narrowing requiring an accessory maneuver (Béniqué dilation, resectoscope downsizing, meatotomy, or internal urethrotomy) were included. Flexible cystoscopy was repeated at 6 months. Paired changes were compared using the Wilcoxon signed-rank test.

Results

Of 518 patients screened, 36 (7.0%) were included, with 40 treated stricture sites. Dilation was the most frequent maneuver (31/40, 77.5%). At 6 months, 16 sites (40.0%) downstaged, 19 (47.5%) remained stable, and 5 (12.5%; 95% CI 4.2–26.8%) worsened ($p = 0.041$). Four worsened sites were asymptomatic (Stage 1→2); one patient (2.8%; 95% CI 0.1–14.5%) progressed to Stage 4 after meatotomy and required surgical reconstruction. IPSS improved from 23.0 to 8.0 ($n = 31$) and Qmax from 9.9 to 19.0 mL/s ($n = 30$) (both $p < 0.001$).

Conclusion

Most Stage 1–2 urethral narrowings downstaged or remained stable 6 months after accessory maneuvers during AEEP, and clinically significant stricture was uncommon. Comparative studies with longer follow-up are warranted.

1. INTRODUCTION

Anatomical endoscopic enucleation of the prostate (AEEP) is recommended by international guidelines as the size-independent reference standard for the surgical management of benign prostatic hyperplasia (BPH), with durable functional outcomes and low perioperative morbidity [1–3].

Postoperative urethral stricture is nevertheless a recognized complication of AEEP, with a reported incidence of 1.4%–4.4% [4, 5]. Proposed mechanisms include mucosal injury from repeated instrument

passage, pressure-related ischemia, and instrument caliber; larger sheaths and longer operative times have been identified as independent predictors of stricture [4, 6].

The average urethral caliber in adult men ranges from approximately 24 to 30 Fr [3]. Some patients have a narrower, asymptomatic urethra that precludes atraumatic passage of a standard 26 Fr resectoscope and require an intraoperative accessory maneuver, such as Béniqué dilation, meatotomy, internal urethrotomy, or downsizing of the resectoscope sheath. Because these maneuvers manipulate the urethra beyond standard instrumentation, they could themselves compromise the outcome of an otherwise successful procedure, a hypothesis that has not been specifically tested.

The Purohit-Blaivas system grades anterior urethral strictures on cystoscopy from Stage 0 (no stricture) to Stage 4 (no visible lumen). Low-stage strictures in non-instrumented patients frequently remain stable or regress [7], although external validation of the available staging tools in the perioperative endourological setting remains limited [8].

We therefore aimed to describe 6-month urethral outcomes in patients who required an intraoperative accessory maneuver for a narrow urethra during AEEP, and to determine whether urethral caliber deteriorates after these maneuvers.

2. MATERIALS AND METHODS

2.1 Study design and setting

This single-center, prospective, single-arm cohort study was conducted in the Department of Urology, Hospital Italiano de Buenos Aires, Argentina, between July and December 2025. The protocol was approved by the institutional ethics committee (CEPI, protocol number 19000) and conducted in accordance with the Declaration of Helsinki and applicable national regulations.

2.2 Study population

All consecutive patients undergoing AEEP for BPH were screened. Immediately before instrumentation, urethral caliber was staged using the Purohit-Blaivas scale: Stage 0, no stricture; Stage 1, easy passage of a 16 Fr flexible cystoscope; Stage 2, passage with difficulty; Stage 3, impassable stricture with a visible lumen; and Stage 4, no visible lumen. Patients were included if a Stage 1 or 2 narrowing precluded atraumatic passage of the standard 26 Fr resectoscope and required an accessory maneuver. Patients requiring a sheath smaller than 22 Fr and those with a Stage 3–4 stricture or an indwelling urethral catheter were excluded (Fig. 1).

2.3 Accessory access maneuvers

The maneuver was selected by the operating surgeon according to the site and severity of the narrowing on flexible cystoscopy (15.7 Fr) and consisted of progressive Béniqué dilation, cold-knife meatotomy,

internal urethrotomy, or downsizing to a 22 Fr Slim resectoscope (RZ Medizintechnik, Tuttlingen, Germany).

2.4 Surgical technique

All procedures were performed by the same two surgeons, experienced in AEEP and urethral reconstruction, using an en-bloc technique with early apical release, a 26 Fr resectoscope (Karl Storz, Tuttlingen, Germany), a 120 W holmium:YAG laser (Lumenis Pulse™ P120H, Yokneam, Israel) with a 550 µm fiber, and mechanical morcellation (DrillCut-X® II, Karl Storz, or MultiCut® Solo, Jena Surgical, Jena, Germany).

2.5 Follow-up and outcome assessment

Flexible cystoscopy was repeated at 6 months by the same surgical team to re-stage urethral caliber; the change in stage was the primary outcome. Secondary outcomes were the maximum flow rate (Qmax) and the International Prostate Symptom Score (IPSS) at 6 months. No patient was lost to follow-up.

2.6 Statistical analysis

Continuous variables are presented as mean (SD) or median (IQR) according to the Shapiro-Wilk test, and categorical variables as frequencies; proportions are reported with exact (Clopper-Pearson) 95% confidence intervals (CI). Paired changes in stage, IPSS, and Qmax were compared using the Wilcoxon signed-rank test, chosen because the Purohit-Blaivas scale is ordinal. The stricture site was the unit of analysis; four patients contributed two sites, and analyses were not adjusted for clustering. Outcomes by site and maneuver are presented descriptively. A two-sided $p < 0.05$ was considered significant. Sample size was determined by consecutive recruitment. Analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA).

3. RESULTS

3.1 Study population, stricture location and accessory maneuvers performed

Of the 518 patients screened, 36 (7.0%) were included (Fig. 1). Four patients required maneuvers at two sites, for a total of 40 stricture sites. The bulbar urethra was the most common site (20/40, 50.0%), followed by the fossa navicularis (9/40, 22.5%), meatus (8/40, 20.0%), and penile urethra (3/40, 7.5%). Béniqué dilation was the most frequent maneuver (31/40, 77.5%), followed by resectoscope downsizing (5/40, 12.5%), internal urethrotomy (3/40, 7.5%), and meatotomy (1/40, 2.5%). Patient and site characteristics are shown in Table 1.

Table 1
Patient and stricture-site characteristics, overall and by baseline Purohit-Blaivas stage

Patients	**Total (N = 36)**	**Stage 1 (n = 30)**	**Stage 2 (n = 6)**
Preoperative variables			
Age, years, mean (SD)	68.9 (8.9)	68.7 (8.3)	69.8 (12.3)
Body mass index, kg/m², mean (SD)	28.2 (4.3)	28.2 (4.5)	28.1 (4.0)
Diabetes mellitus, n (%)	8 (22.2)	8 (26.7)	0 (0.0)
Prior urethroplasty, n (%)	2 (5.6)	2 (6.7)	0 (0.0)
Prostate volume, cc, median (IQR)	79.0 (56.0–104.5)	73.5 (55.2–94.8)	134.0 (115.0–163.2)
Perioperative variables			
Operative time, min, median (IQR)	56.0 (50.0–66.8)	56.0 (50.0–66.8)	57.0 (53.0–65.8)
Re-catheterization, n (%)	3 (8.3)	3 (10.0)	0 (0.0)
Stricture sites	**Total (N = 40)**	**Stage 1 (n = 34)**	**Stage 2 (n = 6)**
Stricture location, n (%)			
Bulbar urethra	20 (50.0)	18 (52.9)	2 (33.3)
Fossa navicularis	9 (22.5)	8 (23.5)	1 (16.7)
Meatus	8 (20.0)	7 (20.6)	1 (16.7)
Penile urethra	3 (7.5)	1 (2.9)	2 (33.3)
Accessory maneuver, n (%)			
Béniqué dilation	31 (77.5)	29 (85.3)	2 (33.3)
Resectoscope downsizing (26→22 Fr)	5 (12.5)	5 (14.7)	0 (0.0)
Internal urethrotomy	3 (7.5)	0 (0.0)	3 (50.0)
Meatotomy	1 (2.5)	0 (0.0)	1 (16.7)

Prostate volume and operative time were unavailable in 2 patients each (all Stage 2; n = 34 overall and n = 4 in Stage 2 for these variables). Values are mean (SD), median (IQR), or n (%). SD standard deviation, IQR interquartile range

3.2 Six-month urethral staging and functional outcomes

At baseline, 34 sites (85.0%) were Stage 1 and 6 (15.0%) were Stage 2. At 6 months, 16 sites (40.0%; 95% CI 24.9–56.7%) had downstaged, 19 (47.5%) remained stable, and 5 (12.5%; 95% CI 4.2–26.8%) had upstaged (Table 2; p = 0.041). Downstaging occurred in 12/34 Stage 1 sites (35.3%) and in 4/6 Stage 2

sites (66.7%). Four upstaged sites (Stage 1→2) were asymptomatic and managed conservatively, and one (Stage 2→4) required surgical reconstruction (1/36 patients, 2.8%; 95% CI 0.1–14.5%).

Table 2
Change in urethral stricture stage (Purohit-Blaivas) from intraoperative baseline to 6-month cystoscopy (N = 40 sites)

Baseline stage	**n (%)**	**→ Stage 0 (%)**	**→ Stage 1 (%)**	**→ Stage 2 (%)**	**→ Stage 4 (%)**
Stage 1	34 (85.0)	12 (35.3)	18 (52.9)	4 (11.8)	0 (0.0)
Stage 2	6 (15.0)	0 (0.0)	4 (66.7)	1 (16.7)	1 (16.7)
Overall	**40 (100.0)**	**12 (30.0)**	**22 (55.0)**	**5 (12.5)**	**1 (2.5)**

All three sites treated with internal urethrotomy downstaged, whereas the single meatotomy site upstaged to Stage 4 (Table 3).

Table 3
Six-month cystoscopic outcome by site of urethral narrowing and by accessory maneuver (N = 40 sites)

Site of urethral narrowing	**n (%)**	**Downstaged (%)**	**Stable (%)**	**Worsened (%)**
Bulbar urethra	20	5 (25.0)	13 (65.0)	2 (10.0)
Fossa navicularis	9	4 (44.4)	4 (44.4)	1 (11.1)
Meatus	8	5 (62.5)	1 (12.5)	2 (25.0)
Penile urethra	3	2 (66.7)	1 (33.3)	0 (0.0)
Accessory maneuver	**n (%)**	**Downstaged (%)**	**Stable (%)**	**Worsened (%)**
Béniqué dilation	31	11 (35.5)	17 (54.8)	3 (9.7)
Resectoscope downsizing (26→22 Fr)	5	2 (40.0)	2 (40.0)	1 (20.0)
Internal urethrotomy	3	3 (100.0)	0 (0.0)	0 (0.0)
Meatotomy	1	0 (0.0)	0 (0.0)	1 (100.0)
Overall	**40 (100.0)**	**16 (40.0)**	**19 (47.5)**	**5 (12.5)**

Values are n (%), with row percentages. Outcome is defined relative to the intraoperative baseline Purohit-Blaivas stage. Given the small subgroups, outcomes are presented descriptively, without formal statistical comparison

Paired Qmax data were available in 31 of 36 patients (86.1%) and improved from a median of 9.9 mL/s (IQR 6.0–11.5) to 19.0 mL/s (IQR 13.2–25.0) ($p < 0.001$). Paired IPSS data were available in 30 of 36 patients (83.3%) and improved from 23.0 (IQR 20.5–29.5) to 8.0 (IQR 6.0–10.0) ($p < 0.001$).

4. DISCUSSION

In this prospective cohort of patients who required an intraoperative accessory maneuver for a narrow urethra during AEEP, most stricture sites downstaged or remained stable at 6 months, and only one patient (2.8%) developed a clinically significant stricture. The net change in stage favored downstaging ($p = 0.041$), which likely reflects, at least in part, the therapeutic effect of dilation and internal urethrotomy. When matched to the site and severity of subclinical narrowing, these maneuvers do not appear to cause meaningful short-term deterioration of urethral caliber.

Elsaqa et al. identified an intraoperatively diagnosed stricture and the need for meatotomy as the strongest independent predictors of urethral stricture after HoLEP (odds ratios 15.5 and 7.69, respectively) [4]. Our findings are directionally consistent: the single meatotomy site upstaged to Stage 4, whereas Béniqué dilation, which involves no incision or thermal energy, was followed by downstaging or stability in 28/31 sites (90.3%). Although subgroups were too small for formal comparison, this pattern supports less invasive strategies whenever anatomically feasible.

Larger series have reported stricture rates of 3.9%–5.0% after HoLEP, with most strictures located in the bulbar urethra; in the largest cohort, smaller prostate volume and lower PSA, rather than instrumentation itself, emerged as risk factors [9–11].

In non-instrumented patients with incidentally identified low-stage strictures, Purohit et al. reported regression to Stage 0 in 36%, stability in 52%, and progression in 12% over a median of 23 months [7]. Our proportions of downstaging and stability (40.0% and 47.5%) are broadly similar, although the settings are not directly comparable: dilation and urethrotomy are themselves treatments for narrowing, and our follow-up was shorter. With these caveats, transurethral manipulation to permit resectoscope passage does not appear to markedly alter the short-term course of low-grade narrowing, which is the period these strictures are mainly developed [3].

Preventive strategies, such as preoperative catheterization or dilation and the use of smaller instruments, are under investigation. Preoperative catheterization may promote urethral compliance [5], and preoperative dilation from 18 to 28 Fr reduced postoperative stricture after HoLEP in a randomized trial [12]. Primary use of a 22 Fr resectoscope reduced transient urinary leakage but not stricture compared with a 26 Fr sheath [13]. In our small subgroup, downsizing performed comparably to dilation (4/5 sites downstaged or stable), suggesting that a smaller sheath could be used primarily in patients with a known narrow urethra; however, slim resectoscopes require dedicated morcellation instruments and sometimes a suprapubic puncture [14]. Because patients with an indwelling catheter were excluded, our data cannot address the catheterization hypothesis, but they provide a baseline for future preventive studies.

This study has limitations. It was a single-center, single-arm study without a comparator group of patients with a normal-caliber urethra, which precludes attributing outcomes to the maneuver rather than to the underlying narrowing. Maneuver selection was not randomized, introducing confounding by indication, and the small sample precluded multivariable analysis. Four patients contributed two sites, so observations were not fully independent. Follow-up cystoscopy was performed by the same operating

surgeons, who were not blinded, which may have introduced detection bias. Finally, 6 months may not capture late strictures, which can be diagnosed up to two years after HoLEP [7, 9].

Nonetheless, the prospective design with complete follow up, using a systematic intraoperative and 6-month cystoscopic staging with a validated classification and standardized by the same team of experiences surgeons, and to our knowledge, the first dedicated characterization of urethral outcomes after accessory access maneuvers during AEEP. Multicenter studies with a control cohort and longer follow-up are warranted.

5. CONCLUSIONS

Among patients with intraoperative Stage 1–2 urethral narrowing who required an accessory access maneuver during AEEP, most stricture sites downstaged or remained stable at 6-month cystoscopic follow-up, and clinically significant stricture was uncommon (1/36 patients). These data support the feasibility of AEEP in appropriately staged patients with a narrow urethra, pending comparative studies with longer follow-up.

DECLARATIONS

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Competing interests The authors have no relevant financial or non-financial interests to disclose.

Ethics approval This prospective study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Comité de Ética de Protocolos de Investigación (CEPI) of Hospital Italiano de Buenos Aires (protocol number 19000).

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent to publish Not applicable; this article contains no identifying information.

Data availability The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Artificial intelligence disclosure ProWritingAid, which incorporates artificial intelligence capabilities, was used for line editing to improve spelling, grammar, sentence flow, and overall readability. The authors reviewed and approved all suggested changes and remain fully responsible for the content of the article.

Author contributions C Pedergnana: Protocol/project development, Data collection, Data analysis, Manuscript writing. E Pedroni: Data management, Data analysis.GA Favre: Protocol/project development, Manuscript editing. FI Tirapegui: Protocol/project development, Surgical procedures, Manuscript editing.G Montelli Yanzi: Surgical procedures, Manuscript editing. D Santillán: Surgical procedures,

Manuscript editing. C Cristallo: Surgical procedures, Manuscript editing. MS González: Protocol/project development, Manuscript editing.

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Figures

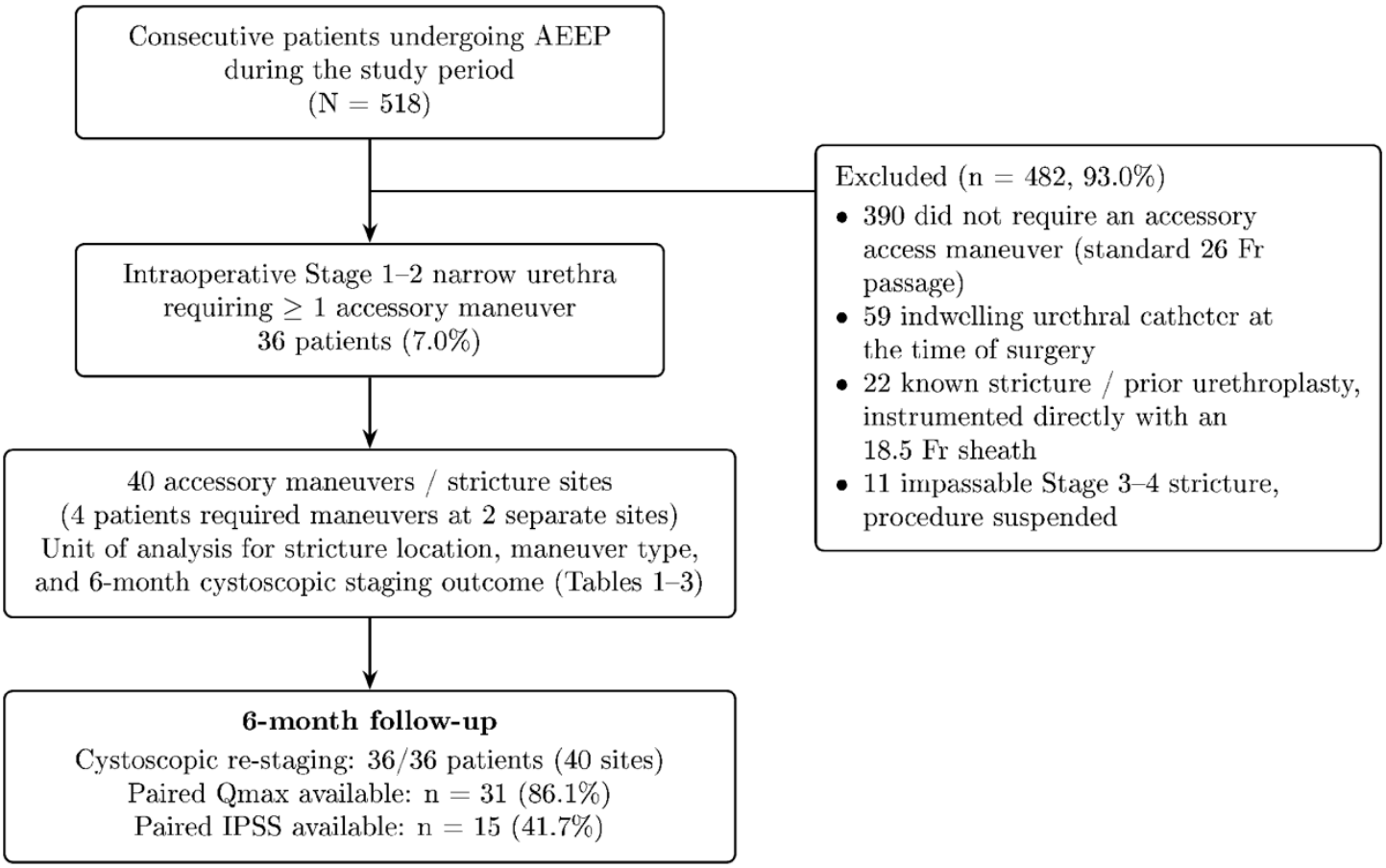


Figure 1

STROBE flow diagram of patient screening, inclusion, and outcome ascertainment