Repeat Excision and Primary Anastomotic Urethroplasty for Salvage of Recurrent Bulbar Urethral Stricture

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Abbreviations and Acronyms

EPA = excision and primary anastomosis

VCUG = voiding cystourethrogram

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Purpose: We compared the results of initial excision and primary anastomosis urethroplasty to the excision and primary anastomosis outcomes of other challenging reoperative clinical settings, including secondary cases (prior urethroplasty of any technique other than excision and primary anastomosis) and repeat cases (prior excision and primary anastomosis).

Materials and Methods: We reviewed our database of patients who underwent excision and primary anastomosis urethroplasty for bulbar urethral stricture at our tertiary referral center from 2007 to 2014. Patients without available data and those with a history of lichen sclerosus, radiation, pelvic fracture urethral injuries, distal strictures and/or hypospadias were excluded from analysis. Patient characteristics and outcomes were compared between those undergoing initial, secondary, and repeat excision and primary anastomosis urethroplasty for bulbar urethral stricture.

Results: Among 898 urethroplasties performed during the study period we identified 305 men who underwent excision and primary anastomosis urethroplasty of the bulbar urethra, including an initial procedure in 268 of 305 (88%) and reoperation in 37 (12%). Of patients with reoperation 18 of 37 (49%) underwent secondary excision and primary anastomosis following a different type of prior urethroplasty and 19 (51%) underwent repeat excision and primary anastomosis. Repeat excision and primary anastomosis in the bulbar urethra was successful in 18 of 19 patients (95%), which was comparable to the success rate of initial bulbar excision and primary anastomosis (251 of 268 or 94%) as well as secondary bulbar excision and primary anastomosis (17 of 18 or 94%, $p = 0.975$) with a similar mean stricture length. Mean followup for all patients was 41.5 months (range 6 to 90) and mean followup in each group was greater than 30 months.

Conclusions: Repeat excision and primary anastomosis urethroplasty has excellent results for short bulbar strictures, comparable to those achieved in the initial and secondary setting.

Key Words: urethra; urethral stricture; reoperation; anastomosis, surgical; outcome and process assessment (health care)

Urethral stricture disease in the male has an estimated prevalence of 229 to 627/100,000 men and imparts a significant cost on the health care system.[1] Urethroplasty has been shown to be the most effective intervention for definitive long-term management.[2] While urethroplasty procedure selection depends on stricture length, location and etiology, the

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high success rate of EPA urethroplasty makes it the procedure of choice for most short strictures of the bulbar urethra.[3–6]

The management of recurrent urethral strictures is often challenging since failure of urethroplasty has been shown to be an adverse prognosticator.[7,8] The role of EPA in the setting of recurrent stricture is poorly established. Reconstruction in these patients is often difficult due to altered anatomy, poor vascularity, dense fibrosis and limited availability of donor tissue.[9] Stricture excision with tension-free anastomosis has been recommended even in the reoperative setting.[9,10] We sought to evaluate the efficacy of repeat EPA urethroplasty and compare these results to outcomes of initial and secondary EPA procedures.

MATERIALS AND METHODS

Study Population

To create this retrospective analysis of EPA urethroplasty cases we reviewed our prospectively maintained, institutional review board approved database of all urethroplasties performed by the senior author at our tertiary referral center between January 2007 and December 2014 (fig. 1). Patients without complete data available and those with a history of lichen sclerosus, radiation, pelvic fracture urethral injuries, distal strictures and/or hypospadias were excluded from analysis. Patients without followup greater than 6 months were also excluded. Followup was defined as the time from surgery to the date of last database extraction (February 2014).

Among 898 total urethroplasty cases performed during the 8-year study period we identified 305 patients who underwent EPA urethroplasty of the bulbar urethra.

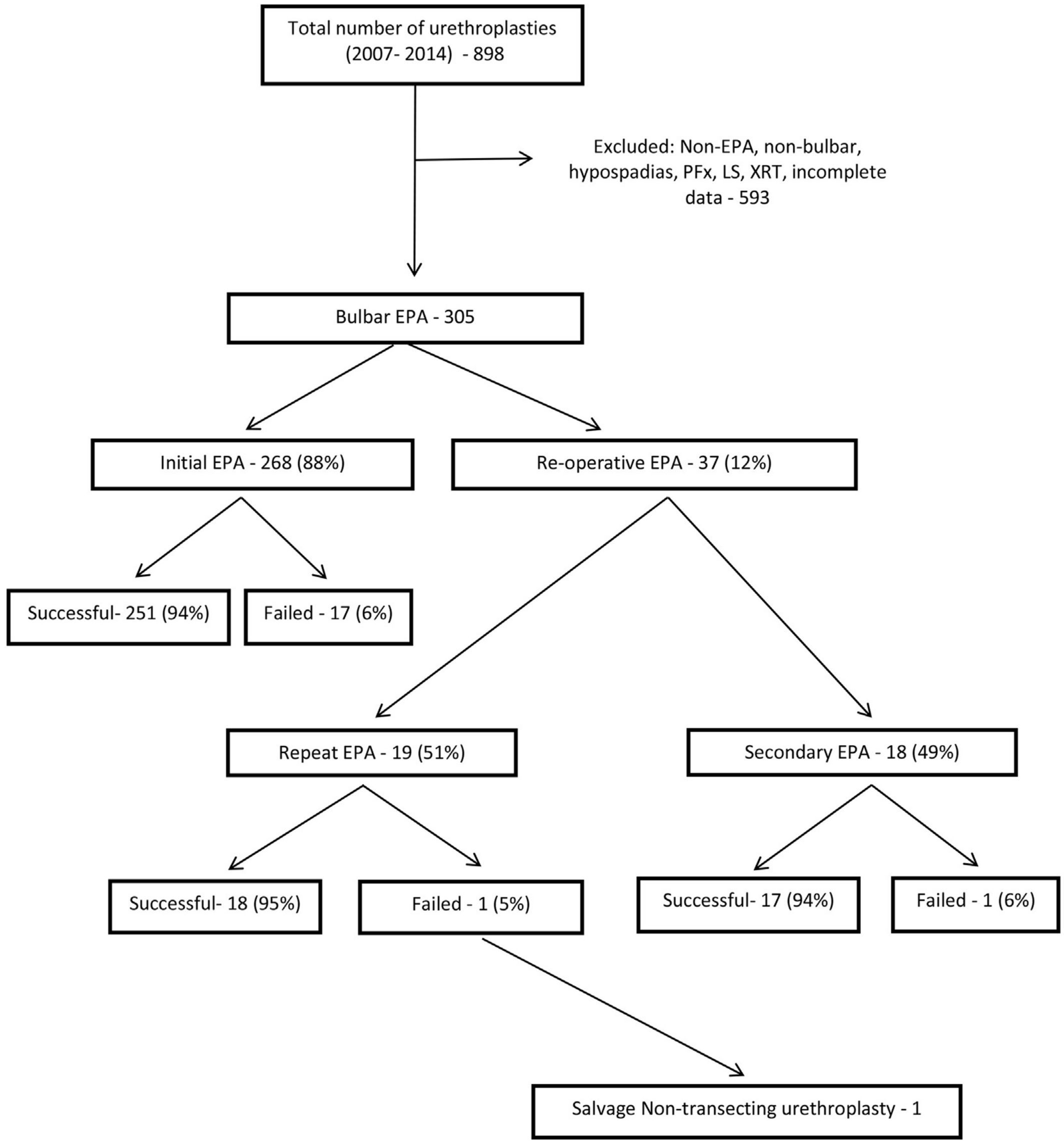

Figure 1. EPA urethroplasty results. *PFx*, pelvic fracture. *LS*, lichen sclerosus. *XRT*, radiation therapy.

Surgery was recorded as initial EPA (no prior urethroplasty) in 268 of 305 patients (88%). Reoperative EPA cases (37 of 305 or 12%) were stratified according to the previous type of urethroplasty performed. Of the 37 patients 18 (49%) underwent secondary EPA (prior urethroplasty of any technique other than EPA) and 19 (51%) underwent repeat EPA (prior EPA). Clinical characteristics and surgical outcomes were compared between patients who underwent initial, secondary and repeat EPA urethroplasty for bulbar urethral stricture, including etiology of urethral stricture, number of prior urethroplasties, prior endoscopic treatments and stricture length.

Surgical Technique

All patients underwent 1-stage EPA of bulbar strictures via a perineal approach. The location of the diseased urethra was precisely identified intraoperatively by flexible cystoscopy and marked with electrocautery on the spongiosum just prior to transection. Two angled DeBakey vascular clamps were applied above and below the obstruction for hemostasis and control. The urethra was amputated through the stricture sharply with a No. 20 scalpel blade. Additional sharp excision of scar tissue at the proximal and distal urethral stumps was done until healthy urethral tissue was found on both sides, allowing bougie calibration of the proximal and distal urethral lumen to 28Fr to confirm adequate urethral diameter. The urethra was aggressively mobilized distal and proximal until tension-free overlap was achieved.

A wide caliber, spatulated, tension-free anastomosis was performed using interrupted 5-zero polydioxanone (10 to 14 sutures). The technique used for anastomosis was a hybrid combination of single and double layer suturing by following 5 distinct steps, including 1) excision of scar tissue to expose healthy urethral edges with preservation of the vascularized ventral spongiosum, 2) spatulation to achieve adequate urethral caliber (28Fr), 3) reapproximation of the dorsal urethral margins (9 o'clock to 3 o'clock positions) in a single layer with interrupted sutures, 4) ventral urethral reapproximation of mucosa to mucosa in interrupted fashion, preserving the outer spongiosum layer, and 5) a running closure of the ventral spongiosum (fig. 2).

In all patients efforts were made to bring together the ends of the urethra without tension using only aggressive distal and proximal spongiosal mobilization. We did not use ancillary procedures such as corporeal splitting, inferior pubectomy or supracrural rerouting for additional lengthening in any case. Meticulous attention was paid to hemostasis while postoperative wound drainage was not performed. Repair was protected with an indwelling 16Fr silicone Foley catheter for 3 weeks. Prophylactic antibiotics were continued during the perioperative period.

Postoperatively patients had catheters removed at 3 weeks and were evaluated thereafter according to our cost-effective, risk stratified followup protocol.[11] Chordee was assessed at postoperative visits based on patient report. Further studies, including VCUG, retrograde urethrogram and cystoscopy, were performed based on patient symptoms, uroflowmetry and/or when urinary tract infection suggested stricture recurrence.

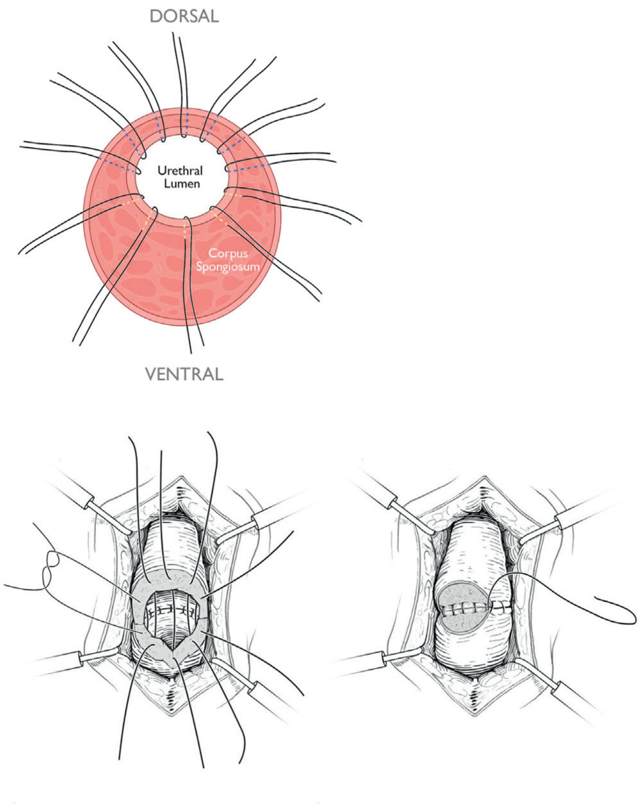

Figure 2. Hybrid anastomotic technique

Statistical Analysis

Demographic and perioperative data on all men undergoing urethroplasty were tabulated in Excel® and analyzed using SPSS®, version 19.0. The primary outcome was operative success, defined as the absence of a need for any additional surgical procedures after urethroplasty. Failure after urethroplasty was defined as the need for any secondary urethral procedure except diagnostic cystoscopy. Statistical data were analyzed among initial, secondary and repeat EPA using the chi-square test (categorical data) and ANOVA (continuous data). Statistical significance was defined at $p < 0.05$.

RESULTS

As summarized in the table, the 3 groups analyzed were similar in patient characteristics such as comorbidities, age ($p = 0.623$) and body mass index ($p = 0.757$). The average stricture length in the patients with repeat EPA was 2.1 cm (range 1.0 to 3.5), similar to that seen in the patients with initial (2.0 cm, range 1.0 to 5.0) and secondary (2.3 cm, range 1.0 to 3.5, $p = 0.559$) EPA.

Repeat EPA of the anterior urethra after prior failed EPA was successful in 18 of 19 patients (95%) (fig. 1). This success rate is comparable to that of patients with initial (251 of 268 or 94%) and secondary (17 of 18 or 94%, $p = 0.975$) EPA urethroplasty. Mean followup was greater than

Patient demographics

	EPA						
	Initial		Secondary		Repeat		p Value
No. pts	268		18		19		
Mean age	49		47		53		0.623
Mean body mass index (kg/m^2)	29.5		30.0		29.3		0.757
Mean cm stricture length (range)	2.0 (1.0–5.0)		2.3 (1.0–3.5)		2.1 (1.0–3.5)		0.559
No. prior endoscopy (%)	182	(68)	17	(94)	14	(74)	0.056
No. coronary artery disease (%)	27	(10)	2	(11)	1	(5)	0.780
No. hypertension (%)	83	(31)	4	(22)	6	(32)	0.733
No. diabetes (%)	33	(12)	3	(17)	1	(5)	0.550
No. smoking history (%)	86	(32)	3	(17)	7	(37)	0.345
No. chronic obstructive pulmonary disease (%)	6	(2)	0		0		0.655

30 months for all groups, including 41.6 months (range 6 to 90) in initial, 50.8 months (range 6 to 88) in secondary and 30.5 months (range 6 to 55) in repeat EPA cases.

Endoscopic treatments were attempted prior to open surgical reconstruction in the majority of repeat EPA patients (14 of 19 or 74%) with many having undergone more than 2 endoscopic procedures (9 of 19 or 47%). All 19 patients had undergone previous EPA urethroplasty, of whom 3 were treated with more than 1 prior urethroplasty. Only 1 of the 19 patients with repeat EPA required an additional procedure for the treatment of recurrent stricture disease (a nontransecting anastomotic urethroplasty). No patient reported chordee on followup examination.

Most prior EPA failures (13 of 19 or 68%) had been performed elsewhere and only 6 of the 19 EPA failures (32%) were from our hospital. All of our 6 patients in whom EPA failed had proximal bulbar strictures and only 1 had antegrade access to the stricture available via a suprapubic tube during our initial operation. Median time to recurrence after initial EPA was 13 months (range 6 to 80). Among our 6 patients with EPA failure the combined length of urethral stricture excised from the initial and repeat EPA averaged 3.75 cm (range 2.5 to 6.0). In the patients with secondary EPA the initial procedures were 1-stage grafts in 10 (5 penile skin and 5 buccal mucosa), 2-stage buccal mucosa grafts in 2, skin flaps in 3 and unknown in 3.

DISCUSSION

Reoperative EPA Urethroplasty

Although dozens of articles during several decades underscore the high success rates of various methods of urethroplasty in the initial setting, the literature is far less robust regarding the outcomes of reoperative urethroplasty. Failure rates in early reoperative urethroplasty series have been reported to be as high as 31%, while recent series highlight a better outcome of anastomotic technique in the reoperative setting.[10,12–15] A 1997 report of patients with reoperative EPA demonstrated a uniformly successful outcome in 11 at UCSF (University of California-San Francisco), including repeat EPA repairs in 6 (supplementary table, http://jurology.com/).[10] Barbagli et al reported similar excellent results in 2 reoperative EPA cases, of which 1 was a repeat EPA.[12] Combining the data from these 2 small studies with our experience shows that repeat EPA in experienced hands has a profoundly high rate of success (25 of 26 cases or 96%) for short strictures (mean 2.0 cm) of the bulbar urethra.

The largest reported series of reoperative urethroplasties included 130 patients during a 33-year period at UCSF.[13] The group reported that EPA in the reoperative setting demonstrated higher success rates than other techniques (88% vs 71%). Similarly Joseph[14] and Levine[15] et al found high success rates (13 of 13 cases or 100% and 7 of 8 or 88%, respectively) for reoperative EPA urethroplasty. However, these reports did not specify how many patients with repeat EPA were included in the reoperative EPA cases.

Our experience shows that EPA urethroplasty can be safely repeated in appropriate cases with identical, reliable results, comparable to other series of initial[3,4,6] and reoperative[10,12–15] EPA urethroplasty. When combining all available published data with the current study, reoperative EPA has been highly successful (115 of 124 cases or 93%) for short (mean 2.1 cm) bulbar strictures. While other groups have reported high success rates for reoperative anastomotic urethroplasty of the posterior urethra,[16,17] to our knowledge our study is the largest to specifically evaluate the use of anastomotic urethroplasty in the anterior urethra after prior EPA failure.

Elements of Reoperative and Repeat EPA

Reoperative urethroplasty presents special anatomical and technical challenges for the reconstructive urologist. At our tertiary referral center the majority of our patients received initial treatment elsewhere (13 of 19 or 68%), similar to prior studies.[13,14] Most of them (14 of 19 or 74%) had undergone attempted endoscopic procedures before reoperative urethroplasty,[14,15] confirming the futility of endoscopic procedures in this setting.[15,18]

It is our belief that almost all of the initial EPA failures were caused by inadequate proximal urethral dissection, of which delineation was obvious during reoperation, where the strictured urethral segment almost invariably extended proximal beyond the failed initial repair into a virgin operative plain. Accurate control of the proximal urethral lumen during deep bulbar dissection is critical and best facilitated by 1) antegrade instrumentation through a suprapubic tube tract when that exists, or 2) via initial retrograde guidewire placement when no suprapubic tract exists. Without these the visibility may be compromised proximal due to tissue retraction and venous pooling. Identification of the distal extent of the stricture is easily accomplished via urethroscopy with transillumination or palpation of the scope at the stricture. We prefer to amputate the urethra within the stricture, resecting scar systematically until the lumina are open in either direction. This prevents excessive resection of additional healthy neighboring urethra, thus, minimizing tension on the anastomosis.

Once localized and transected, adequate resection of fibrotic urethra is paramount, often requiring scalpel dissection when scissors cannot cut through the dense periurethral cicatrix. Conversely this is a noteworthy disadvantage of nontransecting techniques, especially in the reoperative setting, where scar is more prominent. These technical points have been emphasized in previous literature and are essential to optimizing success.[9,10,13,19]

Adequate urethral length after transection is essential for EPA in initial and reoperative settings. While longer strictures (greater than 2.5 cm) have traditionally required substitution techniques, contemporary literature has shown that these limits may be extended.[20] Classically EPA articles recommend that the technique be limited to strictures 2 cm or less[21] but our experience suggests that this underestimates the potential urethral length that can be mobilized via perineal dissection. The male urethra has been shown to be exceptionally extensible with a possible additional 65% of length obtained after mobilization, allowing for a tension-free anastomosis even of longer strictures in virgin or reoperative cases.[22] Perhaps prior urethroplasty results in tissue remodeling that reestablishes urethral elasticity and length, allowing for repeat excision of segments similar to initial EPA repairs. Although our longest repeat EPA stricture in this series was 3.5 cm, we have found that up to 5 cm resection is possible in the proximal bulb (lower half of perineal incision) in select favorable cases. A 2 cm limit is more customary in the distal bulb (upper half of the perineal incision).

Preservation of Urethral Vascularity

One criticism of transecting techniques is the risk of vascular compromise in the corpus spongiosum, leading some to advocate recently for vessel sparing and nontransecting approaches[19,23–25] especially in the reoperative setting.[26–29] The proposed advantage of such techniques is that preservation of spongiosal continuity preserves periurethral blood flow. Our experience with these approaches has been positive and a nontransecting technique was successfully used to salvage our 1 repeat EPA failure at the third urethroplasty. However, we advocate caution for strictures with extensive spongiofibrosis as excision of diseased tissue is essential for a successful repair and may be best accomplished by complete spongiosal transection. We have encountered failed vessel sparing and nontransecting urethroplasty cases referred to our facility, which were successfully salvaged with transection based procedures (fig. 3).

We advocate performing a 2-layer ventral anastomosis after urethral transection to preserve urethral vascularity. We avoid additional maneuvers such as corporeal splitting when possible, as they may further compromise antegrade and retrograde corporeal blood flow to the urethra. Instead we facilitate urethral lengthening by aggressively mobilizing the urethra from its ventral scrotal attachments while preserving the dorsal perforating vasculature as much as possible. Finally we preserve the ventral spongiosum of the proximal urethral stump when possible, which maintains its bulbar arterial blood supply. Our results underscore the effectiveness of incorporating these various alternative strategies to avoid urethral ischemia during transection based urethroplasty.

Limitations

This is to our knowledge the largest reported series to focus on repeat anastomotic urethroplasties. It represents a select group of patients from an ongoing, prospectively recorded data set but is limited by the inherent shortcomings of a retrospective analysis and possible selection bias. Similar to most urethroplasty series, all operations were performed by a single experienced surgeon, which limits the generalizability of our results. In those patients in whom the initial operation was performed elsewhere, there is inevitable heterogeneity regarding the technique and expertise of that procedure. However, this heterogeneous population is reflective of a typical tertiary reconstructive urology practice. Although sexual function was not an objective of this study, we remain confident that EPA urethroplasty has negligible long-term adverse effect on erectile function.[30]

With regard to followup patients were treated according to a risk stratified protocol.[11] Initially they

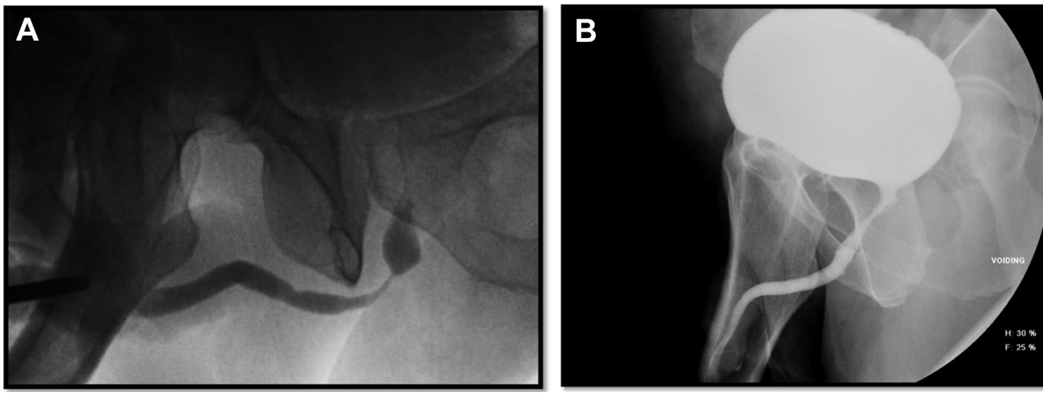

Figure 3. *A*, retrograde urethrogram after vessel sparing urethroplasty was performed elsewhere demonstrates dense recurrent stricture. *B*, VCUG 3 weeks after repeat EPA using complete transection and scar excision reveals stable open lumen.

were treated as at standard risk in the algorithm with 3-week postoperative VCUG and annual followup with uroflowmetry and symptom score reporting at our center. However, having observed that these secondary and repeat EPAs behave similarly to initial EPA, a low risk, symptom based followup protocol was adopted for all EPAs regardless of prior surgery. Although the short followup may limit our ability to capture late recurrences, recurrences beyond 2 years are rare in the reoperative urethroplasty data.[13] As in other urethroplasty series from tertiary referral centers[4] many of our patients travel great distances for treatment and, therefore, their followup is often managed by their local referring urologist. While this may theoretically limit our ability to capture all recurrences, we are vigilant about maintaining ongoing communication with referring urologists and patients when problems arise, thus, allowing patients with recurrence to return to our institution even up to 10 years after the original operation. Therefore, we are confident that patients with recurrent disease are appropriately captured in our numbers and we are not aware of any patient in this series who underwent repeat urethroplasty elsewhere.

Briefly, EPA bulbar urethroplasty is the predominant reconstructive technique used at our tertiary center practice to treat a high volume of men with urethral strictures. This is a large, diverse series of transection based urethroplasties that serves as a favorable frame of reference to which various contemporary nontransecting techniques can be compared. In conclusion, repeat anastomotic urethroplasty after failed prior EPA has excellent results for short bulbar strictures, comparable to those achieved in the initial and secondary settings.

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