

# Urethral Reconstruction for Traumatic Posterior Urethral Disruption: Outcomes of a 25-Year Experience

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**Purpose:** Management of posterior urethral disruption due to pelvic trauma can be quite challenging and is the subject of ongoing controversy. This study presents an update of the University of California, San Francisco experience with delayed anastomotic posterior urethroplasty for management of these injuries.

**Materials and Methods:** Since 1979 all patients undergoing posterior urethroplasty by a single surgeon at University of California, San Francisco and its affiliated hospitals have been entered prospectively into a patient registry. For this cohort descriptive statistics were calculated and recurrence was analyzed with the Kaplan-Meier method. Success was defined as no recurrence (by symptoms and/or retrograde urethrogram) or a mild recurrence managed successfully with a single internal urethrotomy.

**Results:** A total of 134 male patients were analyzed with a mean of 32.9 and a median of 12 months followup. Mean patient age at surgery was 34.8 years. Of the patients 35% had undergone at least 1 prior procedure for stricture including prior urethroplasty in 16%. In addition, 22% required partial pubectomy and 4% a combined abdominal-perineal approach with total pubectomy. Of patients with a closed bladder neck on urethrography 34% vs 7% of those with an open bladder neck required pubectomy ( $p < 0.001$ ). Stricture length tended to be longer in pubectomy cases (mean 3.2 vs 2.1 cm by urethrography,  $p = 0.055$ ). Of the patients 14% experienced recurrent stricture at a mean of 12 months, 42% of whom were treated successfully with a single urethrotomy. The overall success rate allowing 1 direct vision internal urethrotomy was 93%.

**Conclusions:** Anastomotic urethroplasty offers excellent long-term results to patients with posterior urethral trauma and stricture disease even after multiple prior procedures.

*Key Words: urethra; urethral stricture; anastomosis, surgical; wounds and injuries*

Posterior urethral injury complicates up to 25% of pelvic fractures arising from blunt pelvic trauma.<sup>1</sup> These injuries pose a significant management challenge, aggravated by the frequently severe extent of associated organ injuries, initial medical instability of many patients, distortions of pelvic and lower urinary tract anatomy, and the potentially extensive fibrotic response to urinary extravasation. Multiple approaches to these patients have been used in past and recent series. Patients treated at or referred to UCSF undergo initial suprapubic cystostomy urinary diversion and some patients referred within the last 10 years have also had an unsuccessful attempt at primary realignment. In this article we present our experience with delayed perineal anastomotic urethroplasty for treatment of these patients in the last 25 years.

## METHODS

All operations were performed by a single surgeon (JWM). The technique for anastomotic posterior urethroplasty has been reported previously.<sup>2,3</sup> Key aspects of management

include accurate preoperative definition of the stricture, which is usually possible via retrograde and antegrade urethrography (RUG/VCUG). In cases in which the length of the stricture is in question (because the bladder neck does not open on RUG/VCUG, the posterior urethra does not fill with contrast or there is significant lateral distraction of the 2 urethral ends), pelvic MRI is performed to define the distraction defect. In selected patients with preoperative erectile dysfunction, penile Doppler ultrasound is used to help define the extent of baseline neurological and/or vascular compromise.

The critical surgical goals, which others have confirmed, are complete excision of existing fibrotic scar and achievement of a tension-free anastomosis apposing urethral epithelium to prostatic epithelium (fig. 1).<sup>4</sup> We perform a spatulated end-to-end anastomosis. Since 1990 we have used 12 radially placed 5-zero absorbable monofilament sutures (fig. 2). Identification of the proximal urethral end is facilitated by passage of van Buren sounds or a flexible cystoscope through the preexisting suprapubic cystostomy. The bulbar urethra is mobilized circumferentially to gain sufficient length for a tension-free anastomosis. If necessary to gain adequate mobility of the distal urethra, the corporal bodies may be split, and if still more length is needed a partial pubectomy is performed. In cases of extensive scarring, usually following multiple prior failed open repairs and/or extensive trauma, a combined abdomino-perineal approach

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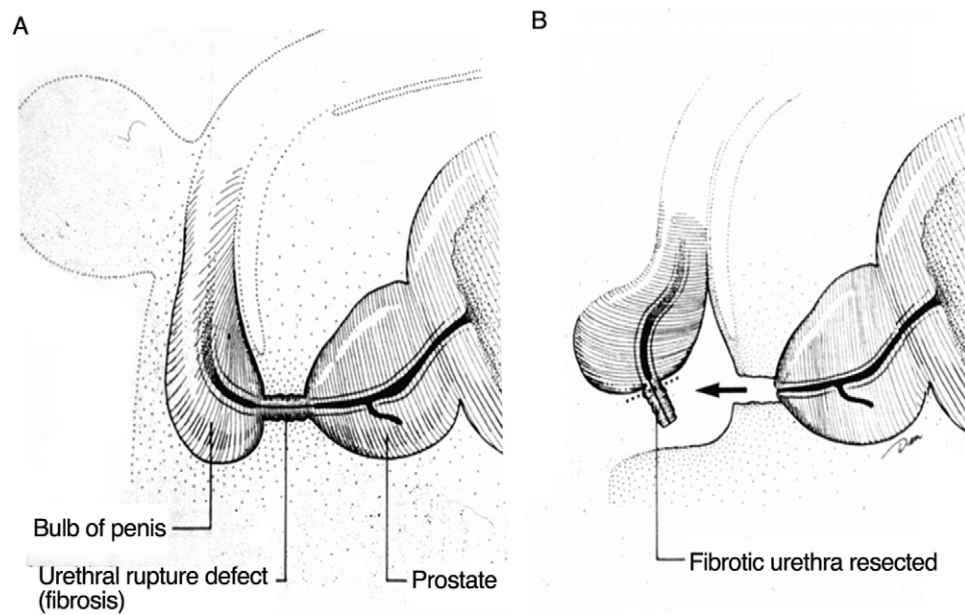


FIG. 1. Diagram of typical posttraumatic urethral distraction defect with fibrosis (A). Fibrotic scar must be completely excised to facilitate tension-free anastomosis (B).

with complete pubectomy may be performed. We do not typically use supracrural rerouting. A urethral catheter is typically left in place for 4 weeks postoperatively.

Aside from relatively minor issues such as scrotal hematoma, the greatest risk of complications relates to prolonged patient positioning in high lithotomy, and careful attention must be given to this aspect of the procedure. Two patients had compartment syndrome early in our experience when Allen stirrups were used for positioning, and a decubitus ulcer developed in 1 due to a long procedure with inadequate padding. We now use candy cane stirrups and a gel pad overlying a beanbag to elevate the hips, and have had no similar problems since. No patient has had symptomatic deep vein thrombotic disease. Minor lower extremity neuropathic complaints occur occasionally but are self-limiting as a rule.

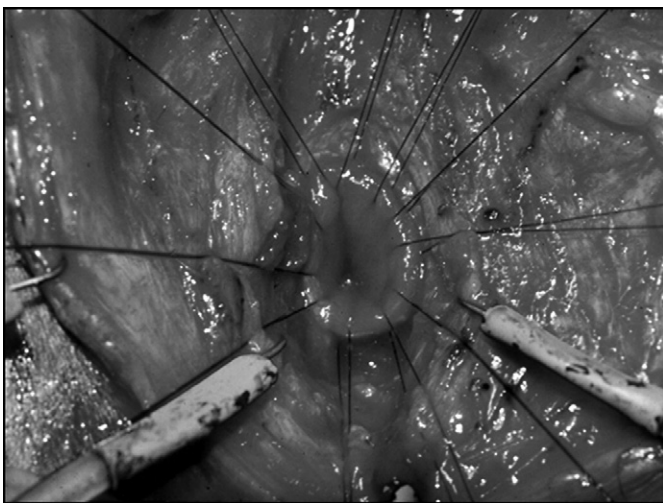


FIG. 2. Intraoperative photograph of proximal urethral end following complete excision of scar and proximal placement of anastomotic sutures.

All patients undergoing reconstructive urethral surgery at the UCSF, San Francisco General Hospital, or San Francisco Veterans Administration medical center since 1979 have been prospectively entered into a disease registry, maintained under institutional review board supervision. A variety of preoperative, intraoperative and postoperative data points are captured on each patient via review of clinical records. Between January 1979 and June 2005 there were 163 patients who underwent posterior urethroplasty. All posterior urethral procedures were anastomotic and none involved grafts or other substitution urethroplasty techniques. Those whose etiology for urethral stricture was not traumatic disruption (ie radical prostatectomy, urethral surgery and/or pelvic radiation therapy) were excluded from analysis, leaving 134 patients.

Data were analyzed with descriptive statistics. Potential predictors of the need for partial pubectomy were assessed with the t test or chi-square test, as appropriate. Surgical success was measured with Kaplan-Meier analysis of time to stricture recurrence. For this analysis 2 definitions of recurrence were used: 1) a strict definition under which any secondary procedure was considered to define failure at the date of the secondary procedure, and 2) a permissive definition under which a mild recurrence managed successfully with a single DVIU, with subsequent radiographic and symptomatic success and no further procedures, was not considered a failure (under this definition for those patients requiring additional procedures the date of failure was still defined as the date of the first DVIU). Incidences of prior urethroplasty, use of pubectomy and resticture outcomes were compared between patients treated through 1995, the point up to which our experience was previously reported,<sup>2</sup> and those treated since 1996 (chi-square test for prior urethroplasty and use of pubectomy, log rank for resticture outcomes). All analyses were performed with commercially available software.

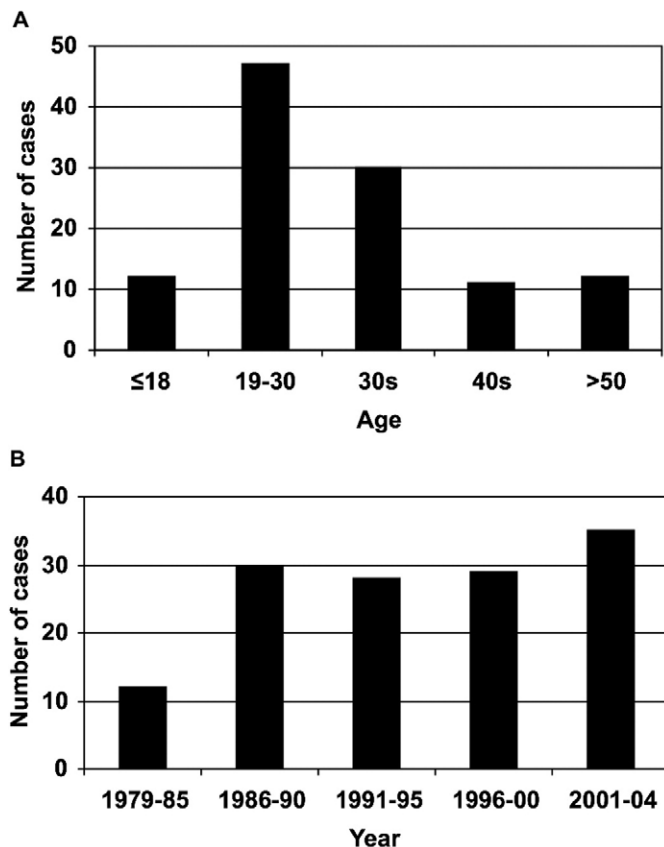


FIG. 3. Distribution of posterior urethroplasty cases by age (A) and over time (B).

## RESULTS

A total of 134 men were included in the analysis, including 109 treated at UCSF, 23 at San Francisco General Hospital and 2 at San Francisco Veterans Administration medical center. Mean patient age was 34.8 years (range 4 to 75). The age distribution is illustrated in figure 3, A. As would be expected given the traumatic etiology of the urethral injuries, the majority were younger than 40 years. Figure 3, B demonstrates the relatively consistent number of annual cases during the last 2 decades. Most had associated trauma involving pelvic viscera (63.4% of patients), abdominal viscera (10.4%), other urological organs (55.2%), the extremities (8.2%), the head (4.5%) and/or the thorax (2.2%). Most patients were in good health before the injury, with 7.5% reporting comorbid illness including hypertension, coronary artery disease, diabetes mellitus, liver disease and/or vascular disease.

Because many of the patients were referred to UCSF for urethral reconstruction, limited data were available on acute urethral management (eg catheterization attempts, cystoscopy and/or suprapubic tube placement). Many patients had undergone urological procedures subsequent to the initial injury including primary realignment in 7.5% (all since 1996), cut-to-the-light in 1.5%, urethral dilation in 7.5%, DVIU in 10.4% and open urethroplasty in 15.7%. Among patients undergoing preoperative MRI we noted a relatively weak correlation between stricture length as assessed by RUG/VCUG and length as assessed by MRI ( $r = 0.42$ ,  $p = 0.09$ ). In general, stricture length was longer

by MRI than by RUG/VCUG (2.3 vs 1.7 cm,  $p = 0.04$ ). There was no difference in mean stricture length from 1979 to 1995 vs 1996 to 2005 with a mean of 2.09 vs 2.14 cm ( $p = 0.82$ ). Mean stricture length was 2.50 cm in those who underwent prior realignment and 2.08 in those who did not ( $p = 0.26$ ).

In terms of surgical approach the corporal bodies were split in approximately 30% of patients. There were 30 patients (22%) who required a partial pubectomy and 6 (4%) who required a combined abdomino-perineal approach with complete pubectomy. Stricture length tended to be longer in those requiring partial pubectomy than in those who did not require pubectomy (mean 3.2 vs 2.1 cm,  $p = 0.055$ ). Of the cases with a closed bladder neck on RUG/VCUG 34% required partial pubectomy, compared to 7% of those with an open bladder neck ( $p < 0.001$ ). No specific pattern of pelvic bony fracture was statistically significantly associated with need for pubectomy.

Mean ( $\pm$  standard deviation) and median followup were 32.9 ( $\pm 49.5$ ) and 12 months (range 1 to 248). There were 19 patients (16%) who experienced a recurrent stricture at a median of 11.3 months after urethroplasty, and of these 9 were treated successfully with a single DVIU, 3 required 2 DVIUs, 1 required more extensive transurethral resection of fibrotic tissue, 1 underwent DVIU and simultaneous transurethral resection of hyperplastic prostatic tissue, and 5 required repeat urethroplasty. Of note, 3 of the latter 5 had undergone at least 1 urethroplasty before referral to UCSF, and 1 of the remaining 2 disrupted his anastomosis in an imprudent attempt to self-replace a Foley catheter which fell out in the postoperative period. Postoperative voiding function was recorded qualitatively based on clinic records and telephone followup for 103 of the men. Of these men 90 (87%) reported no symptoms and 13 (13%) had some degree of incontinence (3 urge, 1 stress and 9 unspecified). Only 1 patient in the series required subsequent placement of an artificial urinary sphincter. Data on outcomes in terms of sexual function were not consistent enough in the database to allow a meaningful analysis.

The overall success rate was 84% requiring no additional procedures after urethroplasty, and 93% allowing for a single DVIU. Among patients with a history of urethroplasty prior to referral to UCSF, the success rate was 86%. All patients were ultimately successfully treated to the extent that none required permanent urinary diversion. Figure 4 illustrates recurrence-

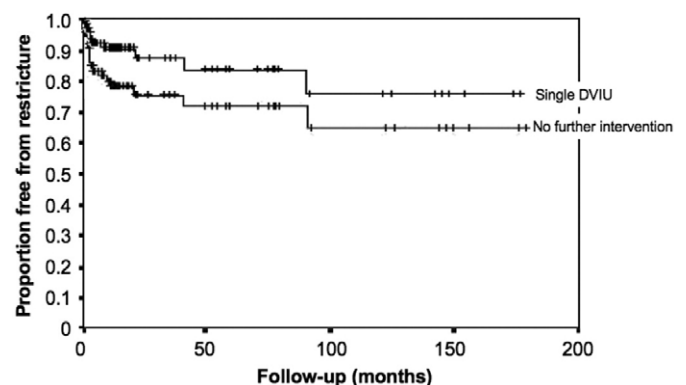


FIG. 4. Kaplan-Meier plot of time to recurrence using strict (no further intervention) and permissive (allowing single DVIU) definition. Each vertical hash mark represents maximum followup for patient with no recurrence.

free survival curves using the strict (no procedures) and permissive (allowing a single DVIU) definitions of failure. Differences between patients treated until 1995, the last time the series was analyzed,<sup>1</sup> and those treated after 1995 are presented in the table. In the last 10 years fewer patients have required partial or total pubectomy. There is a trend toward a greater likelihood of prior urethroplasty at time of referral. Rates of resticture are much lower among the more recent patients but these are not statistically significant on log rank analysis due to shorter followup.

## DISCUSSION

Posterior urethral disruption is one of the more challenging injuries to manage following urological trauma. Early intervention may be complicated by bleeding and/or hematoma, concurrent injuries and potential instability, and edema and friability of traumatized tissues. After a more prolonged delay these issues settle, but at the expense of more extensive fibrosis. Therefore significant controversy continues regarding the best approach to these cases.

Some authors advocate primary realignment after urethral disruption.<sup>5</sup> For example, Mouraviev et al recently reported realignment in 57 men of 96 surviving pelvic injuries with urethral disruption, and noted urethral patency in 51% at 2-year followup.<sup>6</sup> They claimed better quality of life end points (urinary and erectile function) among those undergoing primary realignment. However, these were selected patients with presumably milder injuries, and only 19% had prostatic or membranous urethral disruptions while the remainder had bulbular urethral injuries.<sup>6</sup> Asci et al reported that among 20 patients undergoing primary realignment, stricture developed in only 45%, and 10% underwent urethroplasty with a mean of 39 months of followup.<sup>7</sup> Again, these patients were carefully selected from the patients presenting with trauma. This group found that sexual and urinary function did not vary significantly with management approach.<sup>7</sup> Conversely, Koraitim found significantly higher rates of impotence among those undergoing primary realignment using interlocking sounds compared to delayed urethroplasty.<sup>8</sup> To date, no study has prospectively assigned let alone randomized patients to primary vs delayed treatment.

Delayed endoscopic approaches, variations on core-through, cut-to-the-light and stenting procedures, typically are not successful in the long run because they do not adequately address the fibrotic reaction. A case of successful buccal mucosal grafting for posterior urethral disruption has been reported recently.<sup>9</sup> We have found that delayed anastomotic urethroplasty offers excellent long-term patency results, with 84% requiring no further procedures and 93% requiring at most a single DVIU. The success rate even among patients referred to us following failed urethroplasty was 86%. The mean time to recurrence was 1 year, but as

figure 4 illustrates occasionally there are late recurrences, highlighting the need for long-term followup of patients following complex reconstruction.<sup>10</sup>

The UCSF experience with posterior urethral reconstruction was last reported in 1998, including cases presenting up to 1995.<sup>2</sup> At that time the rates of prior procedures were lower (9% DVIU or dilation and 11% urethroplasty) and intraoperative use of pubectomy was higher. As our experience has expanded an increasing proportion of patients seen at our institution has been previously treated with endoscopic and open procedures. However, with increasing experience these patients are treated successfully and with excellent outcomes. Recurrence rates since 1996 are only 4.8% by the strict definition, 1.6% allowing for a single DVIU. These results are comparable to other large series recently reported.<sup>11</sup>

Anastomotic urethroplasty has also been demonstrated as effective in children, with similar primary and ultimate success rates.<sup>12,13</sup> With increasing experience, pubectomy is less frequently required, although it is still an important component of the surgical approach in patients with longer strictures. Innovations which have limited the need for pubectomy are related at least in part to improved visualization by use of high lithotomy positioning in candy-cane stirrups and use of a self-retaining ring retractor with flexible hooks. Rare cases of complex strictures (2 post-trauma cases since 1996) still require a combined abdomino-perineal approach.<sup>14</sup> In our series 10 patients had undergone primary realignment before urethroplasty, all treated since 1996, representing 16% of the patients since 1996. These patients did not have a significant difference in stricture length from those who did not undergo primary realignment, and we do not have the impression that primary realignment facilitates subsequent urethroplasty among those in whom realignment fails.

This study does have limitations. The most important is that the recording of urinary and sexual function in the reconstruction database to date has been based on qualitative or semiquantitative comments in followup clinic notes. This is similar to assessment and reporting of quality of life outcomes in other reported large urethroplasty series.<sup>6,11,15</sup> Aydos et al reported successful use of the International Prostate Symptom Score as a measure of urinary outcomes following urethroplasty.<sup>16</sup> However, this instrument was designed to capture obstructive voiding symptoms and is not sensitive to continence or potency outcomes.

Continence and potency are important outcomes following urethral reconstruction, which should be measured with validated, patient reported instruments. The questions comprising the urinary and sexual domains of the Expanded Prostate Cancer Index Composite for example, may be quite applicable in the setting of urethroplasty.<sup>17</sup> We plan in the future to administer such surveys at baseline and at followup after surgery. Thus, we will be able to assess survey validity in this population, and to quantify with greater precision the impact of the trauma (vascular and neurogenic) and the surgery on these important quality of life domains.<sup>18</sup>

Furthermore, although the UCSF database is populated with urethroplasty case data prospectively and consecutively, it is possible that variables not included in the database may be important determinants of urethroplasty outcomes. Because most of the patients included were referred from other institutions, the details of the original trauma severity and treatment in particular are often limited. For

	1995 or Earlier	1996 or Later	p Value
No. pts	70	64	
History of urethroplasty (%)	11.4	20.3	0.158
Use of pubectomy (%)	30.0	10.9	0.007
Rate of resticture-strict definition (%)	22.9	4.8	0.133
Rate of resticture-allowing single DVIU (%)	14.3	1.6	0.130

example, trauma severity scores cannot be calculated. Although this series represents a long experience, the number of patients with extended followup is relatively small due in large part to the inherent difficulties in following patients with trauma over the long term. However, we believe the followup is sufficient to support the generation of the survival curves presented in figure 4, demonstrating that late recurrences are uncommon after urethroplasty.

## CONCLUSIONS

Anastomotic posterior urethroplasty is an effective and durable approach to the treatment of men with traumatic posterior urethral disruption. Recurrent strictures are uncommon and most can be effectively managed with a single DVIU. Over time we have noted a decreasing need for intraoperative pubectomy, even as an increasing proportion of patients are referred to our center with a history of prior failed urethroplasty. Future research will be directed at more formal assessment of patient reported urinary and sexual quality of life before and after urethroplasty.

### Abbreviations and Acronyms

DVIU	=	direct vision internal urethrotomy
MRI	=	magnetic resonance imaging
RUG/VCUG	=	retrograde urethrogram and voiding cystourethrogram
UCSF	=	University of California, San Francisco

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## EDITORIAL COMMENT

The authors present their 25-year experience performing delayed anastomotic urethroplasty after traumatic posterior urethral disruption. Primary realignment was not used routinely because the authors believe it does not significantly improve upon the outcomes achieved with the delayed approach in their experience. Stricture recurrence was seen in 19 patients (16%) with 9 of these men responding to a subsequent single DVIU. These results are similar to previously reported single surgeon data and represent the success of delayed anastomotic urethroplasty following posterior urethral disruption.<sup>1</sup> Mean and median followup were relatively short in this 25-year experience. However, the constraints of long-term patient contact at a tertiary care referral center are understood.

Erectile dysfunction after pelvic trauma induced posterior urethral disruption is common (reference 18 in article). While data were not consistent enough for analysis of sexual function within this cohort, the authors do discuss the importance of and need to assess these men. The use of patient reported questionnaires represents a promising, noninvasive way to longitudinally assess the various aspects of sexual function. Prospective data are needed to confirm their validity.

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