
Simplified Reconstruction of Posterior Urethral Disruption Defects: Limited Role of Supracrural Rerouting

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Purpose: We present our combined experience with a simplified posterior urethroplasty technique to determine the necessity and usefulness of ancillary reconstructive maneuvers.

Materials and Methods: We reviewed the records of 135 men and 7 boys who underwent reconstruction of traumatic posterior urethral defects with greater than 1 year of followup from 5 tertiary teaching hospitals. Prior treatments, surgical approach and ancillary techniques required during reconstruction were compiled.

Results: Direct anastomosis following scar excision and urethral mobilization alone was performed in 95 of the 142 males (67%). Formal corporal splitting was performed in 24 patients (17%) and inferior pubectomy in was done in 14 (10%). Supracrural urethral rerouting was performed in only 4 patients (3%), of whom 3 (75%) experienced recurrent stenosis. Abdominoperineal reconstruction, which was reserved mainly for salvage and pediatric cases, was required to reconstruct complex defects in 5 of the 142 cases (4%) and it was successful in 4 (80%). Early urethral realignment was associated with successful subsequent reconstruction in all patients in whom this maneuver was achieved (17 of 17 or 100%). This maneuver tended to be straightforward. Overall successful posterior urethral reconstruction was achieved in 130 of 142 cases (92%). Eight failures were successfully salvaged by internal urethrotomy (3) or repeat urethroplasty (5).

Conclusions: Ancillary maneuvers such as corporal splitting or inferior pubectomy are seldom required for successful posterior urethral reconstruction. Urethral rerouting appears to be inferior to the abdominoperineal approach as a salvage maneuver for complex cases. Primary realignment appears to promote more simplified and successful surgical repair.

Key Words: urethra; urethral stricture; fractures, bone; pelvis; wounds and injuries

In 1983 Webster and Ramon popularized an elaborated perineal approach for the reconstruction of pelvic fracture related urethral distraction injuries, in which urethral mobilization is augmented by progressing through additional steps of corporal splitting, inferior pubectomy and supracrural urethral rerouting as needed to bridge long or complex urethral defects.¹ Since its inception, this approach has been a well accepted template for posterior urethral reconstruction. In a 2003 update of the experience of Webster and Ramon, Flynn et al noted a chronological progression during 2 decades toward more elaborate repairs with urethral mobilization (8%) only rarely completed without the addition of corporal splitting (34%), inferior pubectomy (12%) or supracrural urethral rerouting (38%).²

In contrast, groups at other reconstructive centers noted that urethral rerouting is almost wholly unnecessary.³ Instead, they found that liberal urethral mobilization and corporal splitting alone are sufficient, when needed, to en-

able successful posterior urethral reconstruction in most patients. We present our combined experience using a simplified posterior urethroplasty technique to determine the necessity and usefulness of ancillary reconstructive maneuvers.

PATIENTS AND METHODS

During 1998 to 2004, 142 consecutive male patients treated with anastomotic urethroplasty for traumatic posterior urethral strictures were prospectively and retrospectively reviewed at our 5 tertiary teaching hospitals. Blunt or crush injuries, almost all in conjunction with pelvic fracture, were the cause in 135 cases (95%). Gunshot wounds of the posterior urethra accounted for another 7 patients (5%). Seven of our patients (5%) were younger than 18 years. All patients in this study had greater than 1 year followup postoperatively.

Early Urethral Realignment

In the acute setting early realignment with a urethral catheter was attempted when deemed clinically appropriate. However, emergent treatment with open or percutaneous suprapubic drainage was more commonly done because many of these patients were referred for delayed reconstruction from elsewhere. Realignment techniques varied but the

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predominant technique used was antegrade manual passage of an 18Fr Coudé catheter during transvesical exploration with retrograde retrieval of a 16Fr or 18Fr catheter into the bladder. Once realignment was completed the urethral catheter was removed after 4 to 6 weeks. Suprapubic cystostomy was maintained subsequently if a voiding trial failed. Open repair was usually performed 2.5 to 4 months after injury.

Preoperative Evaluation

Combined antegrade and retrograde cystourethrography was performed under fluoroscopic guidance to evaluate urethral distraction length and coronal displacement of the prostatic urethra. Flexible suprapubic cystoscopy and urethroscopy were liberally used to augment imaging when further anatomical detail was deemed necessary.

Technique of Urethral Reconstruction

Broad-spectrum antibiotics were given before anesthesia induction. All patients were placed in a high lithotomy position with candy cane or Allen lithotomy stirrups. The distal extent of the stricture was localized by retrograde passage of an 18Fr urethral catheter. The bulbous urethra was exposed through a midline perineal incision and the urethra was transected at the distal extent of obliteration. The amputated urethra was then aggressively mobilized into the scrotum to the suspensory ligament of the penis and placed on the lower abdomen out of the operative field.

A 20Fr Van Buren sound was passed antegrade through the suprapubic site to precisely identify the proximal urethra by palpating its impulse at the distal extent of injury. Incision of scar tissue enveloping the tip of the sound was performed until the sound was visually identified. Intraoperative flexible cystoscopy was used when the Van Buren sound could not be palpated via the perineal incision. Systematic excision of the surrounding periurethral collar of scar tissue was aided by traction sutures placed in the fibrotic areas obscuring the normal proximal urethra. Multiple fresh scalpel blades were used for complete proximal scar incision and resection. The prostate was spatulated on its thinner, anterior aspect and the opposing bulbous urethra was spatulated posterior to allow passage of a 28Fr bougie without resistance. A tension-free mucosa-to-mucosa anastomosis was then performed with 12 full-thickness sutures of 5-zero or 6-zero absorbable monofilament.

Complete proximal scar excision was performed until normal urethral mucosa was identified circumferentially. Only when this maneuver proved to be difficult were accessory procedures such as corporal separation, inferior pubectomy or abdominal exposure performed. Of note, a 2 team abdominoperineal approach was performed a priori in select complex cases, such as salvage (reoperative) reconstruction, complex injuries and pediatric cases.

Outcome Analysis

Charts were reviewed for etiology, prior treatments and ancillary techniques used during reconstruction. Urethroplasty success was quantified by urethrography, direct patient questioning and cystoscopy with retrograde urethrography when necessary. The necessity of clean intermittent catheterization or dilation was considered treatment failure. Early urethral realignment outcomes were compared to

those of delayed reconstruction cases using Fisher's exact test.

RESULTS

Outcomes and Ancillary Maneuvers

Overall success due to posterior urethral reconstruction alone was achieved in 130 of the 142 cases (92%) (see table). Eight of the 12 failures were successfully salvaged by internal urethrotomy (3) or repeat urethroplasty (5) for a final success rate of 97% (138 of 142 cases). Another 4 failures awaited further treatment. A perineal approach alone was used in 137 of 142 patients (97%) and it was successful in 126 of 137 (92%).

Direct anastomosis with scar excision and urethral mobilization alone was performed in 95 of 142 patients (67%). Corporal splitting was performed in 24 cases (17%) and inferior pubectomy was done in 14 (10%). Supracrural urethral rerouting was performed in only 4 patients (3%), of whom 3 sustained recurrent stenosis requiring intervention. In another 2 cases a previously rerouted urethra (performed at referring facilities) was mobilized distal and replaced in its normal anatomical position between the corporal bodies during successful repeat urethroplasty. In 1 case direct anastomosis was achieved with no further maneuvers and in the other a circular penile fasciocutaneous skin flap was required for proximal urethral substitution. A combined abdominoperineal procedure was performed to reconstruct complex defects in 5 of the 142 cases (4%) and it was successful in 4 of 5 (80%).

Early Realignment

Early urethral realignment during the acute treatment phase after pelvic fracture was associated with subsequent successful delayed reconstruction in all patients (17 of 17 or 100%). Of these 17 patients 13 successfully underwent reconstruction with only urethral mobilization and the remaining 4 underwent it with urethral mobilization and corporal splitting alone. Although reconstruction after early realignment tended to be simplified (no patient required inferior pubectomy or an abdominoperineal approach), no significant difference was noted compared to reconstruction in those without early urethral realignment ($p = 0.361$).

Operative steps vs urethral realignment and outcome

| Operative Steps | Not Realigned | Primarily Realigned | No. Success/ Total No. (%) |
|-----------------------------|---------------|---------------------|-------------------------------|
| Urethral mobilization alone | 82 | 13 | 91/95 (96) |
| Corporal splitting | 20 | 4 | 22/24 (92) |
| Inferior pubectomy | 14 | — | 12/14 (86) |
| Urethral rerouting | 4 | — | 1/4 (25) |
| Abdominoperineal (salvage) | 5 | — | 4/5 (80) |
| | — | — | — |
| No. success/ total No. | 113/125 (90%) | 17/17 (100%) | 130/142 (92) |

DISCUSSION

Simplified Perineal Reconstruction

Most posterior urethral distraction injuries produce short defects, as in the majority of patients in this series. Flynn and Webster noted in 120 men with urethral disruptions that in 78% the defect was less than 3 cm long.² Similarly Ennemoser et al reported in another large, single center series that 76% of patients had defects less than 2.5 cm long.⁴ A limitation of the current study is that stenosis length was not prospectively recorded at each center. We believe that our patient population was balanced and not dissimilar to patients reported in the other large series,⁴ given the wide geographic variability in our unique multi-center study. We estimate that a similar percent (approximately 75%) of our patients had short defects (less than 3 cm).

Because distal mobilization of the bulbous urethra from external sphincter to penoscrotal junction is known to provide 4 to 5 cm of urethral length,^{5,6} this step alone should be sufficient to allow tension-free reconstruction in the majority of posterior urethral injuries. Although in our hands 66% of patients underwent reconstruction via urethral mobilization alone compared with only 8% in the experience of Flynn et al,² the high degree of success (91 of 95 or 96%) that we achieved in these patients indicates that further steps would have been unlikely to improve outcomes.

We believe that the least possible number of surgical steps should be used during posterior urethroplasty in an effort to minimize high lithotomy time and potential morbidity. Additional ancillary techniques such as corporal splitting and inferior pubectomy, as performed in about a fourth of our patients, were used in this series but only when deemed absolutely necessary to facilitate adequate proximal urethral exposure. Our combined success rate in cases requiring corporal splitting and/or inferior pubectomy was high (34 of 38 or 89%), thus, illustrating the effectiveness of these maneuvers during challenging procedures. We believe that the value of these maneuvers stems not from their ability to provide additional urethral length, but rather from their propensity to promote direct sharp dissection into the obliterated distal retropubic space, thus, enabling complete fibrosis excision.

In our hands supracrural urethral rerouting was almost never required (4 of 142 cases or 2.8%). When it was used, it did not appear to enhance effectiveness (25% success rate). Our routine use of the high lithotomy position for posterior urethroplasty may have partially accounted for the limited

need for urethral rerouting in this series. Perhaps the high lithotomy position allows better access for distal urethral mobilization. Others previously described its limited role, including a report of 82 patients in which none required urethral rerouting.³ Jordan similarly emphasized the rare need for urethral rerouting in his experience with posterior urethroplasty.⁷ We advise caution for urologists considering supracrural rerouting during posterior urethroplasty and we consider it to be indicated only as a measure of last resort. We have seen penile torsion and ischemic strictures of the rerouted bulbar urethra produced by compression beneath the corporal body. We underscore the requirement to create a capacious channel in the underlying ischiopubic ramus to prevent ischemia of the rerouted spongiosum.

Abdominoperineal Reconstruction

The abdominal perineal approach is best reserved for complex cases when adjunctive reconstructive steps beyond perineal urethral mobilization are needed for reconstruction.⁸ Complicating features, such as defect length more than 3 cm, abscess, fistula or prior rectal injuries, were suggested as indications for a concomitant abdominal incision for repair.^{7,9,10} An abdominoperineal approach was also suggested in pediatric patients due to their small habitus, which often makes a perineal approach suboptimal for adequate exposure.¹¹ We have found that this approach is extremely helpful in these challenging cases.

We believe that initial failure of posterior urethroplasty is almost always due to inadequate exposure of the normal urethral segment proximal to the injury site.⁹ We have found that the additional exposure provided by a combined abdominoperineal approach helpful during reoperative urethroplasty. The addition of the abdominal approach in these cases facilitates complete mobilization of the incarcerated prostate from above, thus, allowing tension-free reapproximation of the urethral ends via a perineal anastomosis (see figure). We have found that a 2 team approach helps decrease surgical time dramatically, such that virtually all procedures can be successfully completed in less than 4 hours.

In the largest reported single series to date of 155 patients Koraitim advised repair of defects less than 2.5 cm via a perineal approach with urethral mobilization alone and he used corporal splitting and inferior pubectomy in only 2.⁸ When longer or complex strictures required further reconstructive maneuvers (40 patients or 25%), an abdominoperineal rather than an elaborated perineal approach was



A, preoperative cystogram after pelvic fracture reveals superiorly displaced bladder outlet. B, preoperative staging via combined cystogram/retrograde urethrogram reveals more than 3 cm urethral defect. C, postoperative voiding cystourethrogram demonstrates successful reconstruction after abdominoperineal urethroplasty.

used.⁸ A similar 2006 report from Nepal echoed this trend toward combined abdominoperineal reconstruction in complex cases.¹⁰

Early Urethral Realignment

Our experience suggests that early urethral catheter realignment may simplify, if not prevent, delayed urethroplasty. Previous studies associated early realignment with less pronounced strictures that were often amenable to endoscopic treatment.¹²⁻¹⁴ Although early urethral realignment for posterior urethral disruption has been associated with decreased rates of impotence and incontinence,¹² we believe that these complications are linked more to injury severity than to the method of management. Our experience is that most men treated with urethral realignment for complete urethral distraction injuries eventually require delayed open reconstruction. While endoscopic evaluation and treatment in patients with acute urethral disruption appear to be relatively safe and effective,¹⁵ a note of caution is advised since aggressive endoscopic interventions in the acute setting are occasionally associated with hematoma disruption and/or infectious complications.

In our study urethroplasty was 100% successful when early realignment with urethral catheterization was achieved and more than three-fourths of these cases were treated with urethral mobilization alone. The remaining fourth of patients required only the addition of corporal splitting for successful reconstruction and none required pubectomy or additional procedures. Although all men in this series with early urethral realignment at presentation were successfully treated via delayed perineal urethroplasty requiring fewer ancillary reconstructive steps compared to those not realigned at presentation, this difference did not attain statistical significance in this small study. To our knowledge this is the first time that realignment has been associated with the simplification and facilitation of subsequent urethroplasty. However, it is possible that those who were realigned acutely comprised a less severely injured group than the general population and they might have been more amenable to reconstruction even without realignment. Larger series are needed to further delineate the potential benefits of acute urethral realignment.

CONCLUSIONS

Supracrural urethral rerouting is almost never necessary for success during posterior urethroplasty and it appears to be inferior to an abdominoperineal approach as a salvage maneuver for complex cases. Early realignment appears to promote more simplified and successful reconstruction. Although ancillary maneuvers such as corporal splitting or inferior pubectomy are seldom necessary, they are useful when required for successful posterior urethral reconstruction.

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EDITORIAL COMMENT

Reconstruction of posterior urethral rupture following pelvic fracture can be one of the most complex procedures performed by a urological surgeon. Most of these injuries are managed by initial suprapubic urinary diversion and urethral reconstruction in 3 to 6 months, as these authors have done. One of the problems in the reconstruction of posterior urethral rupture is gaining adequate length of the bulbar urethra to obtain a tension-free anastomosis to the distal prostatic urethra. The authors clearly show that bulbar urethral mobilization with the patient in the high lithotomy position can successfully accomplish this goal in a high percent of patients. Interestingly in patients who underwent initial primary alignment procedures the rate of successful reconstruction was 100%, suggesting that the rupture defect had shortened and reconstruction was less complex and without complications. When initial primary alignment procedures are to be attempted, it should be done with minimal added trauma using the most careful techniques to avoid additional injury and maximize the ability to perform later reconstruction when necessary.

Corporal splitting and inferior partial pubectomy were other successful techniques used in this series to gain additional urethral length to maintain a tension-free anastomosis. These 2 techniques can be done through the perineal incision and they can add significant urethral length (1 to 2 cm) alone or in combination.

Urethral rerouting was used in only 4 cases in an effort to gain additional length with recurrent stenosis in 3. The technique of urethral rerouting can be difficult and in my

hands it has not been a beneficial maneuver. This is confirmed by this current report.

The authors used a multicenter study to gain additional insight into the beneficial techniques needed to achieve success in these complex reconstructions.

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