

THE TYPE OF URETHROPLASTY FOR A PELVIC FRACTURE URETHRAL DISTRACTION DEFECT CANNOT BE PREDICTED PREOPERATIVELY

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ABSTRACT

Purpose: Pelvic fracture urethral distraction defects (PFUDDs) are generally treated surgically by a so-called progression approach consisting of 4 steps to achieve a tension-free bulboprostatic anastomosis. Implicitly the need for each step in turn is predictable according to the length of the defect on preoperative x-ray.

Materials and Methods: In 62 evaluable patients with PFUDD the length of the radiological defect was compared with the surgical steps that subsequently proved necessary to achieve a tension-free bulboprostatic anastomosis.

Results: Except at the extremes of length there was no association between defect length and the scale of the surgery performed.

Conclusions: Surgeons preparing to repair an apparently short PFUDD cannot assume that simple repair is all that is necessary.

KEY WORDS: urethral stricture; urethra; anastomosis, surgical; x-rays; fractures

Various groups have reported that when anastomotic repair of a urethral stricture is possible, it provides better results than substitution urethroplasty and the archetypal indication for anastomotic repair is a pelvic fracture urethral distraction defect (PFUDD).¹⁻⁵ The generally accepted procedure for PFUDD repair is a transperineal progression approach through 4 main technical steps. These steps are 1) to mobilize the bulbar urethra completely, 2) develop the intercrural space to allow separation of the crura, 3) perform wedge resection of the inferior pubic arch and 4) reroute the urethra around 1 penile crus, stopping at the stage that first provides a tension-free anastomosis. These steps were first clearly enumerated and described as a progression by Webster and Ramon² based on studies of others, notably Marion,⁶ Turner-Warwick¹ and Waterhouse et al.⁷ Although to our knowledge it has never been stated explicitly, it would seem intuitively that the need for successive steps from simple to complex repair could be determined by assessment of the length of the gap between the 2 ends of the urethra on combined ascending urethrogram and micturating cystogram. We performed this review to test that assumption.

PATIENTS AND METHODS

Between January 1997 and December 2000, 114 consecutive patients underwent bulboprostatic anastomosis (BPA) for a PFUDD. Of these 114 cases 14 involved revision after previous surgery elsewhere had failed. These cases were not considered further. The 100 patients undergoing BPA for the first time are the subject of this review.

Surgery was performed 3 months to 18 months after injury (mean interval 6 months). All had indwelling suprapubic catheters. Primary realignment had been attempted in 41 patients. The other 59 patients had been treated with primary suprapubic catheterization at the time of injury. All patients were continent and 58 had normal erectile function.

Details of the surgical procedure have been described previously.⁸ We present a brief outline. Step 1 of the operation was full mobilization of the bulbar urethra, which was then transected at the site of the obliteration/stricture, trimmed back to healthy tissue and spatulated. The proximal end of the urethra was also identified, trimmed back to healthy

tissue and spatulated. If there was no tension when approximating the 2 ends, end-to-end anastomosis was performed. If there was tension, step 2 was to identify the intercrural space and open it as far forward as possible. The bulbar urethra was then allowed to lie in the intercrural space and again the 2 ends were approximated to determine whether the tension was acceptable. If there was still tension, step 3 was to perform wedge resection of the inferior pubic arch. If it was still not possible to perform the end-to-end anastomosis without tension, step 4 was to reroute the urethra around the left penile crus and through a trench cut in the inferior pubic ramus to connect with the wedge pubectomy already performed (figs. 1 and 2). By this means a tension-free anastomosis was always possible. Table 1 shows the exact procedure used in these 100 patients.

All patients had undergone preoperative ascending urethrogram and micturating cystogram while in the right lateral oblique position with the right hip flexed and the left leg straight, as performed by 1 of 3 radiologists at our institution. In 38 cases there was no visualization of the posterior urethra below the bladder neck, and so defect length could not be measured. In the other 62 patients the 2 ends of the defect could be seen, and so defect length could be measured. In all patients a standard half plate x-ray was used to produce the film and there was a standard magnification factor of 0.8.

RESULTS

Three patients had a gap between the 2 ends of less than 1 cm on preoperative x-ray. In 54 patients the gap was 1.0 to 4.0 cm. In the remaining 5 patients the gap was greater than 4 cm.

In the 3 patients with a PFUDD of 1 cm or less step 1 was all that was necessary to allow a tension-free anastomosis. At the other end of the spectrum all 5 patients with a gap greater than 4 cm on preoperative x-rays required step 4. In the 54 intermediate patients with a radiological defect of 1 to 4 cm there was no association between the surgical procedure performed and the radiological defect on preoperative evaluation (table 2). All patients with normal erectile function preoperatively remain normal postoperatively.

At the short followup of only 3½ years 5 patients had

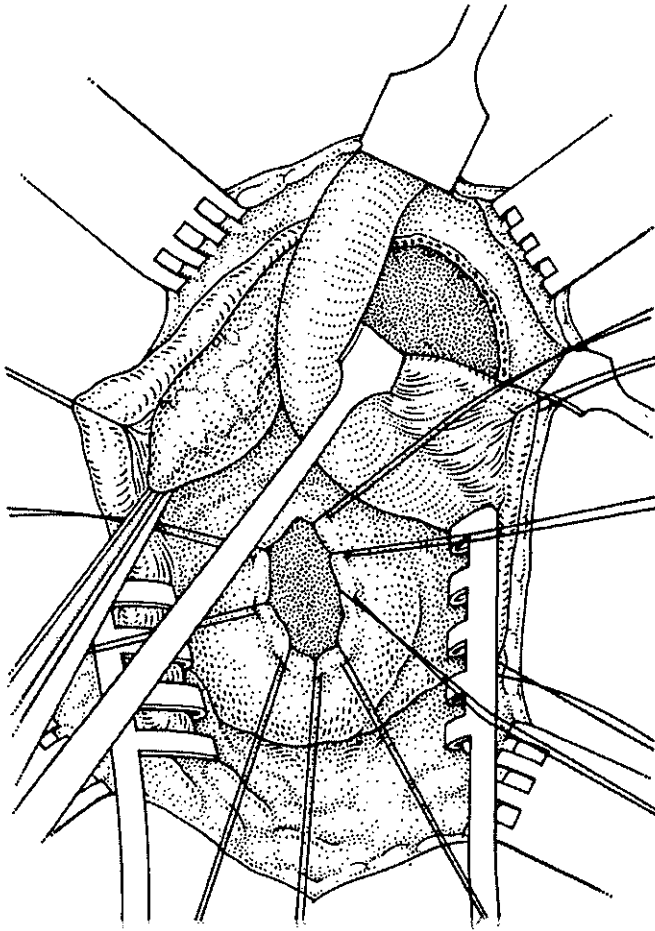


FIG. 1. Pubic symphysis is exposed from above beside left penile crus, which is retracted with Langenbeck retractor. Urethra is held with forceps. Trench is cut from this point to join inferior pubectomy already cut. Reprinted with permission.⁸

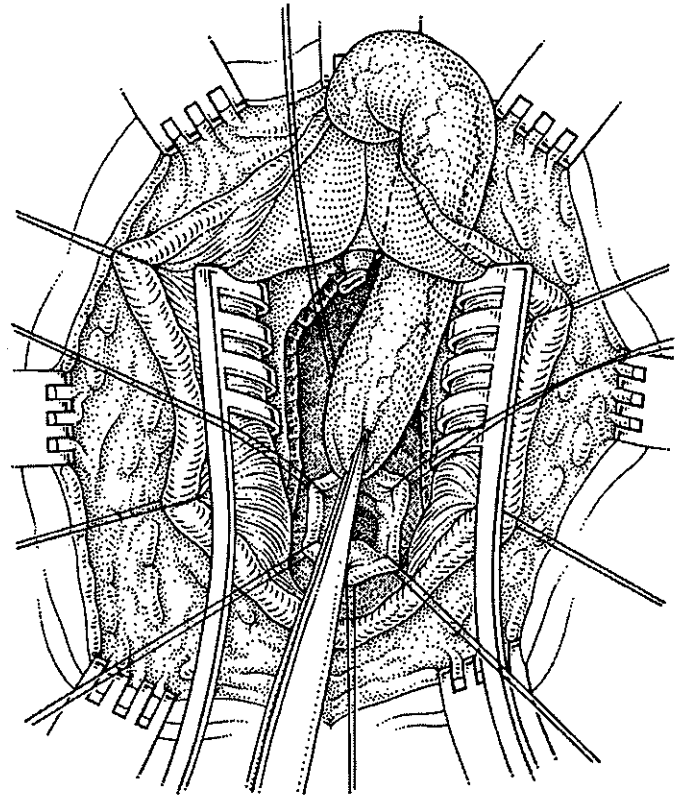


FIG. 2. Bulbar urethra is rerouted through channel created for anastomosis to prostate apex. Reprinted with permission.⁸

recurrent strictures, including 2 and 3 treated with steps 1 and 3, respectively. In 2 cases a fine membrane endoscopically was treated endoscopically. These 2 patients were potent and they remained so. The other 3 patients had a fibrotic stricture, which was resected, and step 4 was then performed. All 3 men were impotent and they remained so. All 5 patients had re-stricture within 6 months of surgery and they were stricture-free at the time of this report.

DISCUSSION

The conclusions from these observations are that in 38% of patients with a PFUDD the length of the radiological defect could not be calculated because the posterior urethra could not be demonstrated radiologically and in the remaining 62% there was no association between measured defect length and the scale of subsequent surgery. Therefore, it is not possible to predict in advance what exactly must be done to achieve a tension-free anastomosis and surgeons preparing to repair an apparently short PFUDD cannot assume that simple repair is all that may be necessary. Indeed, any surgeon performing PFUDD repair must be willing and able to perform comfortably all 4 steps described.

Failure to demonstrate the posterior urethra radiologically is common in this group of patients if a voiding contraction cannot be generated to open the bladder neck and fill the posterior urethra. If it is the case and it seems necessary to assess the health of the posterior urethra and exact defect length, a flexible cystoscope or bougie can be passed down through the inevitable suprapubic cystostomy. We do not

TABLE 1. Surgical maneuvers performed

Step No.	Maneuver	No. Pts
1	Urethral mobilization	7
2	Step 1 + crural separation	35
3	Step 2 + inferior pubectomy	7
4	Step 3 + urethral rerouting	51
Total No.		100

TABLE 2. Surgical steps in 54 patients with 1 to 4 cm PFUDD

Step No.	No. Pts	Mean Cm Defect (range)
1	1	2.4 (1.1-4.0)
2	22	2.4 (1.1-4.0)
3	3	2.6 (1.5-4.0)
4	28	2.6 (1.5-4.0)

believe that it is necessary in patients with an uncomplicated PFUDD undergoing first time treatment if the bladder base and bulbar urethra are in their normal location since this finding suggests a typically short defect, which we would approach in the usual way.

There are 2 general principles underlying the surgical approach to the repair of PFUDD. The bulbar urethra is elastic and can be stretched 2 to 4 cm to make up a defect in length and also allow for a spatulated anastomosis. 2) In its natural position the bulbar urethra describes half or five-eighths of a circle and by straightening this natural curve the gap between the 2 defect ends can be reduced by the difference between the semicircumference of that circle and its diameter (figs. 3 and 4). The structures that produce this natural curvature of the bulbar urethra are the fused crura of the penis and the inferior aspect of the pubic symphysis underneath (fig. 5).

Clearly a reason for the unpredictability of the scale of



FIG. 3. Ascending urethrogram shows natural, approximately semicircular curve of bulbar urethra.

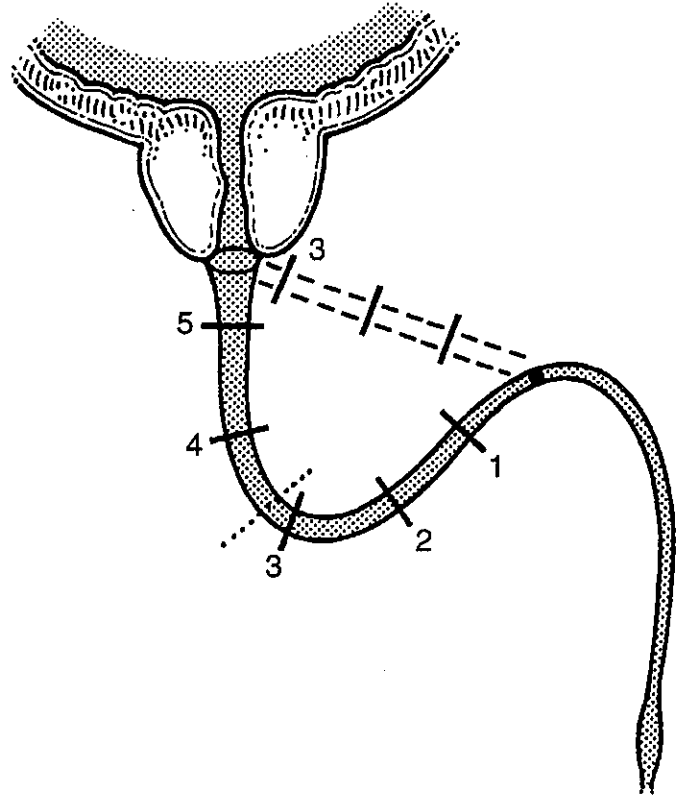


FIG. 4. In straightening curve between bulbopendulous junction and prostate apex bulbar urethra follows diameter rather than circumference of curve and, therefore, helps bridge PFUDD. Numbers indicate distances in cm. Reprinted with permission.⁸

surgery is the effect of trauma in relation to the pelvic fracture and subsequent fibrosis. By the time the 2 ends of the urethra have been trimmed back to healthy tissue and spatulated the gap between them has inevitably increased. In addition, there is usually upward displacement of the bladder and prostate by the injury, and associated retro pubic hematoma and variable displacement in the coronal and/or sagittal planes that cannot be readily evaluated on 2-dimensional x-ray. In addition, the elasticity of the bulbar urethra lies primarily in its thicker ventral aspect. The dorsal aspect, which is the side on which it is usually spatulated and which, therefore, forms the point of highest tension during the anastomosis, is relatively much less elastic. All of these factors contribute to the lack of predictability of surgery to some degree.

Mobilization of the bulbar urethra is a necessary step before performing any of the other steps described. However, it is surprising that the majority of the patients were in 2 groups, namely those who needed just crural separation and those who needed rerouting of the urethra. It is also surprising that inferior pubectomy alone contributed so infrequently to the procedure, although inferior pubectomy is, of course, a necessary component of urethral rerouting. There are 2 possible explanations. 1) Particularly with the patient in the lithotomy position the fused crura overlap the inferior pubic arch posteriorly and, therefore, they are the principle reason for the natural curve of the bulbar urethra (fig. 5). 2) The prostate is normally displaced posterior and upward by a pelvic fracture relative to the bulbar urethra and logically one would expect the inferior pubic arch to be a significant obstruction in its own right only when the prostate is displaced anterior and upward, so that having separated the crura the urethra must then curve around the inferior pubic arch to reach up to the apex of the prostate.

Thus, in practice, the principle maneuver in PFUDD repair is to separate the crura to allow the bulbar urethra to lie between them. However, because the intercrural plane only extends distal for 5 to 7 cm, any more distal mobilization means that the bulbar urethra must be rerouted around the crura rather than between them and inferior pubectomy is really no more than a necessary part of that rerouting.

Tension at the anastomosis is obviously a subjective impression except at extremes and it may sometimes be difficult to judge whether a degree of tension is acceptable or whether one should progress to the next tension relieving step. Also, clearly familiarity with the next step makes one more inclined to proceed with it, perhaps more inclined than might actually be necessary. It is clearly important when separating the crura and incising the pubic periosteum to perform wedge resection of the inferior pubic arch because it is during these maneuvers that the penile neurovascular structures are most at risk. It may be that many surgeons who perform this type of surgery avoid these maneuvers if at all possible for precisely this reason. Therefore, it is reassuring that none of our patients with normal erectile function preoperatively were rendered impotent by these steps. It is also perhaps relevant that the only recurrent strictures that we have noted were in patients treated with the least extensive surgery and they were corrected by more extensive surgery. This observation suggests that our approach to steps 3 and 4 is probably not surgical overkill.

However, the point is that one should be able to take those steps if necessary, to minimize tension and not be limited by training or experience to the ability to do mobilization and anastomosis alone, as for example with a bulbobulbar anastomosis for a fall astride or straddle injury. Radiologically the gap between the 2 ends may look similar, just a couple of cm difference along the length of the urethra in location. Of

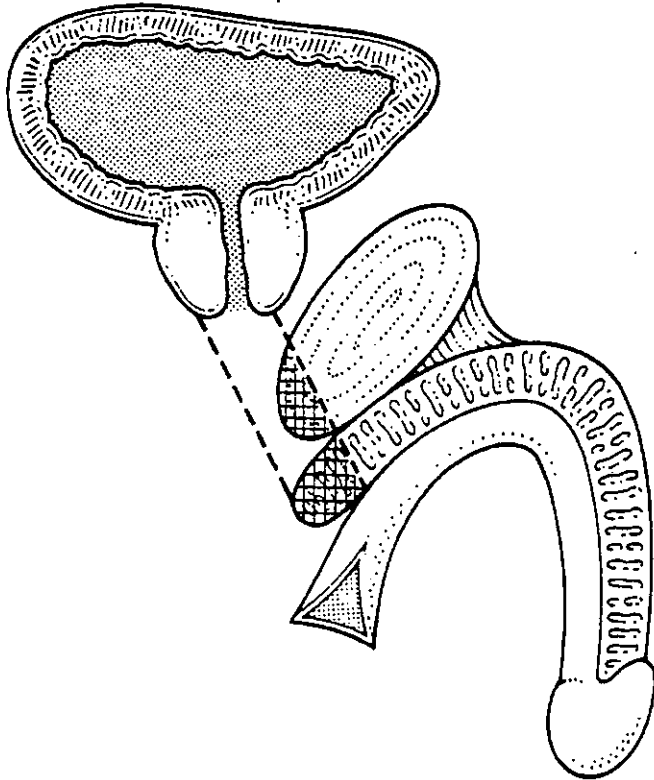


FIG. 5. Natural curve of bulbar urethra is produced by fused corpora cavernosa and underlying pubic symphysis, and corpora overhangs symphysis inferior. Dotted lines and hatching indicate how these strictures must be dealt with to bring bulbar urethra to prostate apex with minimal tension. Reprinted with permission.⁸

course, the difference is that after a straddle injury the 2 urethral ends remain fixed in position by their attachment via the dorsal midline raphe to the corpora cavernosa, whereas after pelvic fracture there may be distraction and deformity. Thus, the surgeon who may be well able to deal with a BPA may have difficulties with a BPA if there is no familiarity with crural separation, inferior pubectomy and urethral rerouting in addition to bulbar urethral mobilization, which alone is rarely sufficient to treat a PFUDD. One wonders how many PFUDDs a surgeon must treat per year to be able to be competent to perform the surgery that may be necessary.

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