# Urethral Pull-through Operation for the Management of Pelvic Fracture Urethral Distraction Defects

**Lei Yin, Zhenhua Li, Chuize Kong, Xiuyue Yu, Yuyan Zhu, Yuxi Zhang, and Yuanjun Jiang**

**OBJECTIVE** To present our institutional experience in the management of pelvic fracture urethral distraction defects with urethral pull-through operation.

**METHODS** Seventy-six patients (average age 34.5 years) with posterior urethral strictures caused by pelvic fracture urethral distraction defects underwent urethral pull-through operation at our department from July 1995 to September 2009. The estimated urethral stricture length was 2.0–3.5 cm (mean 2.5). Of these patients, 31 (41%) had undergone failed urethroplasty or urethrotomy after the initial management, and 5 (7%) had urethrorectal fistula. Urethral pull-through operation was performed 4–7 months (mean 4.9) after initial treatment or failed urethral reconstruction. The clinical outcome was considered a failure when any postoperative intervention was needed.

**RESULTS** Follow-up was 14–74 months (mean 42.5). The overall success rate was 89% (68/76). All treatment failures occurred within the first 6 months postoperatively. Failed repairs were successfully managed with internal urethrotomy in 1 patient, by urethral dilation in 6, and by another urethroplasty in 1. All patients were urinary-continent postoperatively. Of the potent patients, 2 (5%) became impotent after urethroplasty. There was no chordee, penile shortening, or urethral fistula recurrence.

**CONCLUSION** Urethral pull-through operation might be a less demanding and less time-consuming procedure. It does not increase the rate of impotence or incontinence and, with a high success rate, might serve as an alternative method for the management of pelvic fracture urethral distraction defects. UROLOGY 78: 946–951, 2011. © 2011 Elsevier Inc.

Traumatic disruption of the posterior urethra occurs in approximately 10% of men with pelvic fractures, and in 10% of them some factors make them complex strictures, including stricture length >3 cm, perineal or rectourethral fistulas, periurethral cavities, false passages, incompetent bladder neck, or previously failed repair.[1,2] The management of pelvic fracture urethral distraction defect (PFUDD) remains one of the most challenging problems in urology, and the associated complicating factors make urethral reconstruction more difficult. It is generally agreed that optimal procedure for the management of PFUDD is urethral anastomosis after excision of the intervening scarred segment through the perineum. If a simple anastomosis is impossible, stepwise ancillary procedures are necessary for a tension-free anastomosis, including corporeal body separation, inferior pubectomy, and rerouting of the urethra around the corpora cavernosa.[3-5] The success rates of these operations were 63–95%.[5-10]

A tension-free anastomosis is essential for a successful repair, but in some cases after the excision of the stricture segment, it is difficult to distinctly expose the proximal urethral stump because of its deep location.[3,11] As a result, tensionless anastomosis would be difficult, particularly in patients with recurrent stricture or a long stricture segment. With urethral anastomosis, the bulbar urethra mobilization generally achieves 4–5 cm of elastic lengthening, which is only sufficient to bridge a urethral gap of 2.0–2.5 cm, and even shorter in some populations. When the urethral gap is longer, ancillary procedures have to be adapted, which are surgically more complex and time-consuming and associated with more complications.[5,9,11] The urethral pull-through operation is an alternative procedure to urethral anastomosis in the management of PFUDD.[12] Recently, a primary success rate of 96.5% was reported in 113 patients with PFUDD undergoing urethral pull-through operation, and satisfactory outcome was obtained in the patient with a 4.7-cm urethral stricture.[12]

*Lei Yin and Zhenhua Li contributed equally to this work.*

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*From the Department of Urology, the First Affiliated Hospital of China Medical University, Shenyang, China; and Institute of Urology, China Medical University, Shenyang, China*

*Reprint requests: Chuize-Kong, M.D., Department of Urology, The First Affiliated Hospital of China Medical University, 155 Nanjingbei Street, Shenyang 110001, China. E-mail: yinlei_cmu@hotmail.com*

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In the urethral pull-through operation, proximal urethra mobilization is not required, and the ancillary procedures and associated untoward effects could be avoided in some patients. Thus, it is simple and surgically less demanding and might serve as an alternative method for the management of PFUDD. Herein, we retrospectively reviewed the long-term outcomes of 76 patients with PFUDD undergoing urethral pull-through operation.

## MATERIAL AND METHODS

From July 1995 to September 2009, 76 patients with PFUDD underwent surgical intervention at the Department of Urology, The First Affiliated Hospital of China Medical University. All patients were male with a mean age at operation of 34.5 years (range 18–55). All patients had a history of posterior urethral disruption after pelvic fracture. Eighteen patients had bladder rupture, and concomitant bladder neck laceration was present in 5. The initial surgical intervention was primary realignment of the urethral distraction with suprapubic cystostomy, and the bladder injuries were repaired simultaneously. Of these patients, 31 (41%) had undergone surgical repairs, including urethral anastomosis in 20, urethral pull-through operation in 8, and urethrotomy in 3 after the initial management. Five patients had anal urinary leakage. The interval between our urethral repair and initial treatment or failed urethral reconstruction was 4–7 months (mean 4.9).

Preoperative evaluation included clinical history, physical examination, urinalysis, urine culture, retrograde urethrography, and antegrade cystourethrography via a suprapubic catheter. Flexible suprapubic cystoscopy and urethroscopy were performed when further anatomical detail was necessary. PFUDD was diagnosed and the estimated urethral stricture length was 2.0–3.5 cm (mean 2.5) according to the results of retrograde urethrography and antegrade cystourethrography. The 5 patients (7%) with anal urinary leakage were diagnosed with PFUDD associated with urethrorectal fistula; the location of the fistula together with the site and extent of the posterior urethral strictures were revealed by the voiding and retrograde cystourethrography, and the fistula was found to be near the anus.

Urethral pull-through surgery was performed in these patients. The patients with urethrorectal fistula had been managed with suprapubic cystostomy and diverting colostomy 3–6 months before our operations. Intravenous antibiotics were administered to sterilize urine according to the urine cultures. Povidone-iodine saline irrigation of bladder and urethra was performed twice daily for 3 days before surgery.

### Operative Procedure

Patients were placed in the lithotomy position. Broad-spectrum antibiotics were given before anesthesia induction. Through a midline perineal incision, the bulbospongiosus muscles were incised in the midline. The strictured portion was exposed, and the bulbar urethra was circumferentially mobilized proximally up to the strictured segment. This segment was dissected in continuity with the mobilized urethra to the proximal end. The urethra was transected at the point just distal to the stricture or obliteration. The bulbar urethra was then trimmed back into healthy-appearing tissue. The bulbar urethra was mobilized distally to allow the distal urethral end to be pulled to the level of the urogenital diaphragm, but not beyond the penoscrotal junction. The stricture segment and the surrounding fibrous tissue were excised under the guidance of a sound in the proximal urethra passed through the suprapubic cystostomy tract (Fig. 1). Then, meticulous retrograde piecemeal resection of the proximal urethra was done until a healthy pliable mucosa was reached and 24-Fr sound could be passed without resistance. In the patients with urethrorectal fistulas, the fistula was dissected circumferentially and excised completely, and the margins of the fistulous opening in the rectum were freshened. The rectum was repaired in 2 layers using 3-0 polyglactin running sutures.

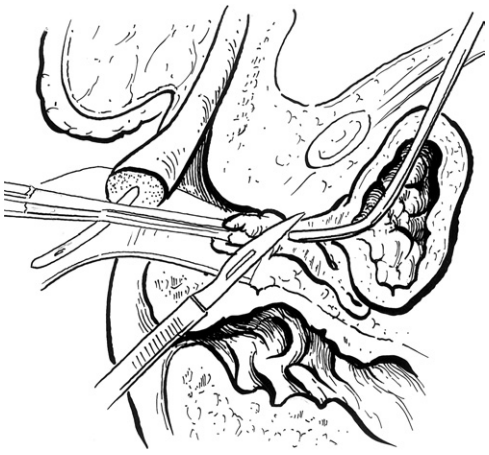

**Figure 1.** The stricture segment with the surrounding fibrous tissue is excised under the guidance of sound in the proximal urethra.

An 18-Fr catheter was inserted through the urethral meatus, and the distal urethral end was fixed on the catheter using 4 sutures of 3-0 polyglactin placed through the catheter wall and the urethral spongiosum, and 0.5 cm away from the border of urethral end (Fig. 2). The catheter was pulled through the proximal urethra and bladder to allow the approximation of the 2 urethral ends without tension and interposition of periurethral tissue and was then fixed in place on the abdominal wall with a stitch through a small abdominal incision (Fig. 3). Finally, the bulbar urethra was fixed to the perineal fascia with several 3-0 polyglactin sutures. A perineal drain and a retropubic drain were placed and closure was done anatomically. The operation was completed by inserting a suprapubic catheter.

### Postoperative Management

Suprapubic catheterization was used for bladder drainage. The drains were removed 2 or 3 days after surgery. Urethral catheters were removed 3 weeks after surgery. The suprapubic catheter was removed if the patients could void as previously for 3 days. If the repair was considered failed, the suprapubic catheter would be left in place. All patients were evaluated with uroflowmetry and retrograde and voiding urethrography 1 week after removal of the catheter.

All patients underwent retrograde and voiding urethrography and uroflowmetry 3 months after the removal of the suprapubic catheter. In the patients with urethrorectal fistulas, if the urethral reconstruction was successful, the colostomy would be reversed at that time or later. Subsequently, patients were followed-up annually with uroflowmetry and symptomatic assessment with regard to urine stream, incontinence, and erection. Whenever obstructive symptoms de-

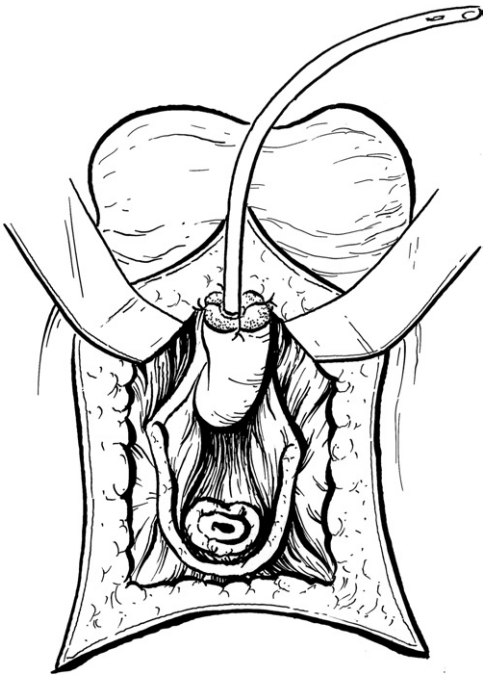

**Figure 2.** The distal urethral end is fixed on a catheter, with sutures placed through the catheter wall and the urethral spongiosum, and 0.5 cm away from the border of urethral end.

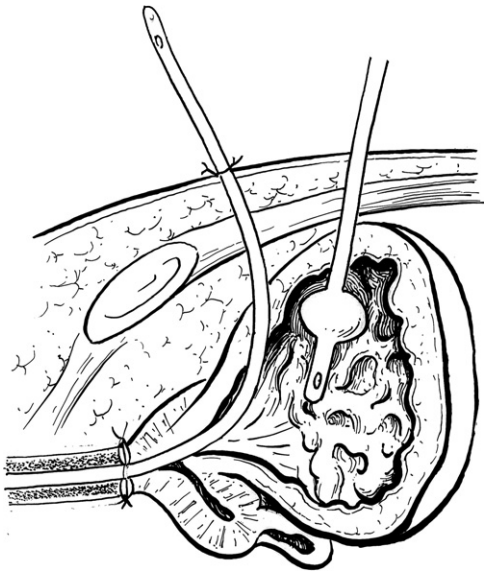

**Figure 3.** The catheter is fixed in place on the abdominal wall with a stitch to allow the approximation of the 2 urethral ends without tension and interposition of periurethral tissue.

veloped or maximum urinary flow rate was <15 mL/s, urethrography and urethroscopy were indicated. Whenever urethral stricture recurrence was determined, further interventions would be performed.

Successful reconstruction was defined as normal voiding without requirement of further interventions, urinary continence, maximum urinary flow rate >15 mL/s, and a wide urethral caliber on urethrography.

## RESULTS

Follow-up was 14–74 months (mean 42.5). The median operative time was 130 minutes (range 100–160). Wound infection developed in 3 patients. The urethral catheter was removed 3 weeks after surgery, and all patients reported satisfactory voiding with minimal urinary tract symptoms. No urinary incontinence and fistula formation occurred. All patients were evaluated with uroflowmetry and urethrography 1 week after removal of the catheter. The urethrography showed a wide and patent urethra, and the maximum urinary flow rate was >15 mL/s in all patients. In patients with urethrorectal fistulas, the diverting colostomy was closed 3–6 months after our operation when extravasation was absent on urethrography.

The success rate was 89% (68/76), and this result was sustained during follow-up. Mild dysuria developed at 3–6 months in 8 patients (11%) after urethroplasty. Among them, 3 had surgical wound infection, 3 had previous failed urethroplasty, and 1 had failed urethrotomy. The maximum urinary flow rate was 10–13 mL/s. The urethroscopy showed that the urethral lumen was narrower than normal but smooth. The patients were treated with urethral dilation. Normal voiding with a maximum urinary flow rate >15 mL/s was achieved in 6 patients after 1–2 months of regular urethral dilations. One patient was cured with internal urethrotomy after 6 months of urethral dilation. One patient was cured by another urethroplasty.

There was no postoperative chordee, penile shortening, or curvature. Erectile function was normal in 69 patients before injury, 40 (58%) remained potent, and 29 (42%) became impotent after injury. Of the potent patients, 38 (95%) were still potent after urethroplasty and 2 (5%) became impotent. In the posttraumatic impotent patients, 17 regained (59%) potency after urethroplasty and 12 (41%) remained impotent.

## COMMENT

Posterior urethra disruption occurs in about 10% of patients with pelvic fracture, and trauma from agricultural activities, occupational injuries, or motor vehicle accidents accounts for 90% of cases, which are still frequent in developing countries. There is much controversy regarding the initial management of such injuries and options for delayed surgical repair of urethral stricture.[1,4] The management of PFUDD generally includes internal urethrotomy and open surgical repairs. Procedure selection is usually dictated by the nature and length of the urethral defect, complicating factors, and the treatment philosophy and experience of the surgeon.[1]

Open surgical urethral reconstruction includes 3 categories of procedures, anastomotic urethroplasty, urethral pull-through urethroplasty, and substitution urethroplasty.[3] Our results indicated that success rates of urethral pull-through operation is 89%; it is simple and surgically less demanding and it might serve as an alternative

method for the management of PFUDD. The length of gap between the 2 urethral ends to be bridged is determined primarily by the proximal dislocation of the prostate rather than the distal retraction of the bulbar urethra. The dislocated prostate cannot be mobilized downward, and the only way to restore urethral continuity is to mobilize the bulbar urethra from its attachment to the perineal membrane and bring it up to the prostate.[13] The elasticity of the mobilized bulbar urethra can provide an extra length of 4–5 cm, which is sufficient to achieve a tension-free 2-cm spatulated overlap urethral anastomosis after bridging a 2–2.5 cm gap.[3] When the urethral gap is longer, ancillary procedures would be required for a tension-free anastomosis.[14] For extremely complex PFUDDs, an abdominoperineal approach or substitution urethroplasty will be indicated.[1,3]

The ancillary procedures are more complex and time-consuming and might be associated with significant blood loss and untoward effects.[7,11] In some patients with prior urethroplasties, after removal of the unhealthy urethral tissue and excessive surrounding scar, the length and elasticity of the bulbar urethra are not sufficient to cover the stricture gap. In addition, the penile length is shorter in the Asian patient population.[5] Therefore, ancillary procedures will be necessary for a tension-free anastomosis in such patients. In a Chinese study, 66% of the patients with 1–3-cm urethral stricture required ancillary procedures for anastomosis.[5] Is it likely that because of the aforementioned factors, urethral pull-through surgery is still commonly used in China; it is less time-consuming and is associated with less bleeding and other complications because of the avoidance of ancillary procedures.[9,12]

In recent years, the success rates of perineal anastomotic urethroplasty were 63–95%.[1,5-10] In a Chinese series involving 113 patients with PFUDD, 46.0% having had previous surgical repairs, a primary success rate of 96.5% and a final success rate of 100% were accomplished with a modified urethral pull-through operation.[12] In our study, 41% of the patients had undergone failed urethroplasty or urethrotomy, and 7% had urethrorectal fistula, whereas a success rate of 89% was acquired. The success rates of urethral pull-through surgeries were comparable with those of anastomotic urethroplasties; therefore, it could be successfully applied to those with PFUDD, including some complex PFUDD.[5-10,12]

For the success of posterior urethral anastomosis, complete excision of fibrous tissue and a tension-free anastomosis are particularly important.[5,9] Similar principles are also crucial in urethral pull-through surgery. In urethral pull-through, it is unnecessary to mobilize the proximal urethral stump. The mobilization of a sufficient length of bulbar urethra is very important; otherwise the subsequent pulling tension will lead to the narrowing of the urethral lumen and stricture recurrence. In our opinion, a 0.5-cm overlapping area might be suitable for a successful operation. Inadequate overlapping of the urethral ends will cause recurrent stricture, whereas excessive overlapping will lead to the formation of a urethral valve and consequent stricture recurrence.[12] The interposition of periurethral tissue between the urethral ends may also lead to recurrent stricture, which must be avoided. The mobilized bulbar urethra could provide 4–5 cm of urethral length, so it might be sufficient to bridge a gap of, at most, 4.5 cm in urethral pull-through surgery considering another 0.5 cm dispensed for urethral ends overlapping. It has been reported that a 4.7-cm PFUDD was successfully repaired with urethral pull-through surgery.[12] Therefore, for a 2.0–3.5-cm stricture length in our series, it was unnecessary to dissect the bulbar urethra extensively. Overextended mobilization of the bulbar urethra carries the risk of ischemia and chordee.[3] In our study, there was no postoperative chordee, penile shortening, or curvature. In our opinion, this procedure is simple and less demanding than anamostic urethroplasty for a stricture length <4.5 cm because of the avoidance of proximal urethral stump mobilization and the ancillary procedures, as well as the extended mobilization of the bulbar urethra.

At present, it is agreed that magnitude of the injury rather than the initial management is responsible for impotence and incontinence.[1]

Injuries of the membranous urethra and subsequent repair generally destroy the distal intrinsic sphincter mechanism, making subsequent continence dependent on an intact bladder neck mechanism. In our patients, the bladder neck laceration had been repaired, and no postoperative urinary incontinence was observed. Impotence is usually related to the original pelvic fracture urethral injury; simple realignment does not increase the incidence of impotence.[1,3] In our patients, erectile function was normal in 91% of patients before the urethral injury; among them, 42% became impotent after injury. Of the potent patients, 2 became impotent. These 2 patients had undergone urethral anastomosis after primary realignment, which might be related to impotence. In addition, impotence can occur in the absence of urinary tract injury.

In patients with posttraumatic impotence, 59% of patients regained potency after urethral reconstruction. These findings were similar to other reports.[5,8,9,12] The erectile function can ultimately recover in many patients, but it can sometimes take up to 2 years. Permanent impotence after a pelvic fracture injury is usually secondary to neurogenic or vasculogenic insults caused by the injury, but this might be compounded by the surgical procedures.[1,3] The cavernous nerves course in neurovascular bundles along the posterolateral aspect of the prostate, taking a more lateral position at the membranous urethra before reaching their eventual position ventral to the corporal bodies. A median incision and avoidance of mobilization of the proximal urethral stump are important in the preservation of the cavernous nerves.[15] In our patients, the operations were performed through a perineal incision and the proximal urethra was not dissected;

these factors might be the reason that only 2 patients had postoperative impotence. In addition, the recovery of erectile function may be related to the delayed recovery of potency and the improvement of patient morale because of the regaining of urethral voiding after their being dependent on a suprapubic catheter for several months.[9]

Complex PFUDD associated with urethrorectal fistulas is not common.[1,3] Identification and excision of the fistulous tract and closure of all fistulous openings are essential for the management of this condition. A well-vascularized tissue flap is usually required to be interposed between the repaired rectum and the urethra, and between the suture lines, to support urethral anastomosis to promote healing and prevent recurrence.[15,16] In our patients, there was no placement of vascularized tissue flap, and no fistula recurrence, demonstrating that 2.0–3.5-cm urethral defect associated with low urethrorectal fistula might be successfully repaired with urethral pull-through surgery without the need of vascularized tissue interposition.

## CONCLUSION

Our results suggest that urethral pull-through urethroplasty might be a less demanding and less time-consuming procedure, and could be successfully applied to patients with PFUDD. This procedure does not increase the rate of impotence or incontinence and, with a high success rate, it might serve as an alternative method for the management of PFUDD.

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## EDITORIAL COMMENT

In 1950, Badenoch[1] described his pull-through operation for "impassable traumatic stricture of the urethra." The Badenoch operation is not an operation that I have any experience with, nor have I ever felt the need to become facile with that technique. However, with that said, I am constantly amazed at the number of places that I have been, where surgeons do practice the Badenoch procedure and find it to be most useful for the reconstruction of pelvic fracture urethral distraction defects. The authors describe a series of 76 patients. They discuss excellent results and have good follow-up criteria. Using the operation for patients with complex conditions, as well as those with failed urethroplasty and those with failed urethrotomy, they report an overall success rate of 89%. Although this is slightly less than that from contemporary series using primary anastomotic techniques, it is not far below those success rates. They have a very acceptable rate of erectile dysfunction after urethral reconstruction, and they do not report any patients who complained of penile shortening or new onset of curvature. Although I have not seen the need to learn how to do this operation, it certainly would appear that it could represent an alternative method of dealing with pelvic fracture urethral injury.


**Gerald H. Jordan, M.D.,** Department of Urology, Eastern Virginia Medical School, Norfolk Virginia


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## REPLY

The management of pelvic fracture urethral distraction defect (PFUDD) is a difficult problem in urology. At present, it is widely accepted that the optimal procedure for the management of PFUDD is urethral anastomosis after excision of the intervening scarred segment through the perineum.[1] A tension-free anastomosis is essential for a successful repair; however, in some cases, it is difficult to distinctly expose the proximal