

Surgical Repair of Posterior Urethral Defects

Review of Literature and Presentation of Experiences

Jalil Hosseini, Kamyar Tavakkoli Tabassi

Introduction: The main objective of the present review article was to study the different aspects of reconstructive surgery for posterior urethral defects by reviewing the published articles and presentation of our experiences in the reconstructive urology division at Shohada-e-Tajrish hospital.

Materials and Methods: The Medline was searched with the keywords of *posterior urethroplasty, end-to-end anastomosis, excisional urethroplasty, anastomotic urethroplasty, pelvic fracture, bulboprostatic anastomosis, and urethral repair*. The search was limited to papers published from 1980 to September 2008. We selected the relevant published articles in this database and also presented our experience at our reconstructive urology division.

Results: Of over 5000 search results, we selected 38 relevant articles with substantial contribution to the subject. Pelvic fracture due to accidents was the most common etiology of pelvic fracture urethral distraction defect that usually involved the membranous urethra. Surgical treatment of this disorder with perineal anastomotic urethroplasty was accompanied by a success rate of 82% to 95% in different studies. The most important complications of this surgery include urinary incontinence and impotence; however, the incidence of these complications has been reduced by using new surgical techniques.

Conclusion: Complete preoperative assessment, the use of suitable reconstructive techniques, and in particular, the use of flexible cystoscopy can lead to acceptable outcomes of the surgical repair of pelvic fracture urethral distraction defects.

Keywords: reconstructive surgical procedures, urethral diseases, pelvic fracture, posterior urethral stricture

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INTRODUCTION

Strictures and defects of the posterior urethra in men is one of the challenging clinical problems for urologists. Because of the special anatomical structure of this region, especially in complicated cases, the stricture site is not easily accessible for surgeons. Also surgical repair can lead to several postoperative complications such as urinary incontinence and impotence (erectile dysfunction). When the urethral continuity is totally destructed, the term of *urethral*

distraction defect will be used.⁽¹⁾

The treatment of choice for this condition, that can frequently involve the membranous urethra, is perineal anastomotic urethroplasty.⁽²⁻⁵⁾ In the present article, we reviewed the outcome and complications of different treatment methods for this defect with the emphasis on perineal anastomotic urethroplasty on the basis of a comprehensive review of the published studies on the treatment methods of

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posterior urethral strictures in men. The Medline was searched with the keywords of *posterior urethroplasty, end-to-end anastomosis, excisional urethroplasty, anastomotic urethroplasty, pelvic fracture, bulboprostic anastomosis, and urethral repair*. The search was limited to papers published from 1980 to September 2008. Of over 5000 search results, we selected 38 relevant articles with substantial contribution to the subject. We also presented our 15-year experience at the reconstructive urology division of the urology department in Shohada-e-Tajrish Hospital as a referral center for the whole country. This division is the first reconstructive urology division accredited for the training of reconstructive urology fellowship program.

DEFINITION

Following a pelvic bone fracture with the destruction of posterior urethral continuity, a surrounding hematoma-fibrosis complex will be formed between the two urethral ends.⁽¹⁾ Therefore, instead of “stricture,” the term of “defect” is usually used for the posterior urethra.⁽¹⁾ The posterior urethra and then the liver and the spleen are the most commonly injured organs after a traumatic pelvic fracture.⁽⁶⁾ The prevalence of posterior urethral injuries in pelvic fractures had been estimated to be 5% to 10% in the earlier reports.⁽⁷⁾ In the latest studies, it has been estimated to be between 3% and 25%, and the concomitant injuries of abdominal organs have been also reported in 27% of them.⁽⁸⁾ The incidence of double injuries of the urethra and bladder in men has been reported between 10% to 20%.⁽⁹⁾ However, since a number of these injuries are incomplete, complete urethral defects are relatively uncommon.⁽¹⁾

It is generally believed that the posterior urethral injuries can be caused by disruption

of the membranous urethra after pelvic fracture.⁽¹⁰⁾ However, Mundy showed that the disorder is accompanied by avulsion of the bulbomembranous junction in two-thirds of the cases and avulsion of the proximal bulbar urethra in one-third.⁽¹⁾ Urethral injuries in these patients are often accompanied by butterfly fracture of symphysis pubis with or without diastasis of one sacroiliac joint.⁽¹¹⁾ After puberty, this defect rarely involves the prostatic urethra; however, before puberty, this disorder can involve both the prostatic urethra and the bladder neck.⁽¹²⁾ Previously, Colapinto and McCallum classified posterior urethral injuries into 3 categories on the basis of radiological appearance.⁽¹³⁾ Recently, a new classification of posterior urethral injury in patients with fractured pelvis was proposed. The new classification scheme allows us to compare different therapeutic strategies and their outcomes (Table).⁽¹⁴⁾

ETIOLOGY

The most common etiologies of strictures or defects of the posterior urethra are motor vehicle accidents.⁽¹⁵⁻¹⁹⁾ In a study on 82 patients undergoing posterior urethroplasty, the main causes of pelvic fracture were car to pedestrian in 40%, car to motorcycle in 26%, and falling down and crash injuries in 26% of the cases.⁽¹⁹⁾ In another study on 21 patients with complex posterior urethral disruption, the most common reported etiology was explosive blast in 12 men.⁽¹⁵⁾ Another common cause of posterior urethral defects in men is gunshot independent of pelvic fracture.^(16,17) In one study, gunshot was the main cause of defect in 2 of 60 cases, and in another survey, this etiology was the cause of defect in 1 of 155 patients. Furthermore, in a large study in Shohada-e-Tajrish hospital on 320 patients with posterior urethral defects (unpublished data),

Classification of Urethral Defects by Goldman and Colleagues⁽¹⁴⁾

Class	Definition
I	The posterior urethra stretched but intact
II	Tear of the prostatomembranous urethra above the urogenital diaphragm
III	Partial or complete tear of both anterior urethra and posterior urethra with disruption of the urogenital diaphragm
IV	Bladder injury extending into the urethra
IVA	Injury of the bladder base with periurethral extravasation simulating posterior urethral injury
V	Partial or complete pure anterior urethral injury

the most common etiologies of these defects were motor vehicle crashes (63%), falling (10%), getting trapped under the debris (12%), kicking (2.2%), iatrogenic (2.5%), infection (0.6%), and penetrating trauma (3.8%).

PREOPERATIVE EVALUATION

Before each interventional procedure, the exact determination of the anatomy of the injured organ is necessary.^(1,15-17,20-26) In almost all previous studies, it has been recommended to perform retrograde urethrography and antegrade cystourethrography for the determination of stricture severity and other anatomical information. A combination of the two above techniques guided by fluoroscopy not only can determine the length of posterior urethral defect, but also describes coronal displacement of the prostatic urethra. If the posterior urethra is not filled by contrast medium on cystourethrography, it is imperative to repeat cystourethrography before and during anesthesia.⁽¹⁶⁾ However, some researchers concluded to perform static cystography and then concomitant retrograde urethrography and cystourethrography.⁽¹⁸⁾ If the neck of the bladder is opened, it may lead to postoperative urinary incontinence more often.^(27,28) A combination of retrograde urethrography and cystourethrography can determine not only the length of the posterior urethral defect, but also the opening of the bladder neck during urination.⁽¹⁸⁾ Furthermore, some experts consider it useful to perform secretory retrograde urethrography and/or complete abdominal and pelvic ultrasonography.^(16,26) The role of magnetic resonance imaging in this condition is controversial. Some investigators believe that the information provided by magnetic resonance imaging is not particularly useful.⁽¹²⁾ Others, however, believe magnetic resonance imaging can provide additional information on the lateral displacement of the prostate and the severity of the posterior urethral defect.^(19,29) In addition, this technique can detect bone fragments between the two ends of the urethra after pelvic fracture.^(12,29)

Some researchers have used the flexible suprapubic cystoscopy and urethroscopy for the assessment of the bladder neck condition

and its anatomical details. In addition, flexible suprapubic endoscopy can guide anatomic reconstructive urethroplasty by showing the true proximal urethral end to prevent false passage or malalignment.^(20,23,30) In a previous study on 111 patients suffering from posterior urethral rupture, we recommended flexible suprapubic cystoscopy as a useful technique for the assessment of the bladder, bladder neck, and posterior urethra.⁽³⁰⁾ This modality can reveal the exact anatomy after the trauma with any suggestion for urethral end deviation and also the complications related to previous managements.

In our center, the patient is first visited in the clinic, his clinical information is collected, and undergoes physical examination. Then, concurrent retrograde urethrography and cystography is performed. In another visit, the patient undergoes anterior urethra cystoscopy and flexible suprapubic cystoscopy. By this protocol, the anterior urethra, bladder, bladder neck, ureteral orifices, and prostatic urethra are assessed, and the length of defects is determined. Based on the results of these studies, the procedure of choice and time of operation are determined.

SURGICAL OPERATION METHODS

Grafts and flaps, used commonly for the repair of anterior urethral stricture, are less useful for the defects of the posterior urethra. Therefore, end-to-end anastomosis should be usually performed.⁽³¹⁾ After injection of antibiotics, the patient is placed in the lithotomy or the exaggerated lithotomy position.⁽²⁰⁾ Through an inverted Y-shaped perineal incision or a straight midline perineal incision,⁽²³⁾ the bulbar urethra is mobilized and transected at the point just distal to the stricture or obliteration (Figure 1). We have a 15-year experience in Shohada-e-Tajrish Hospital as a referral center and as the first reconstructive urology fellowship training center for the whole country. Our selected method is operation in the lithotomy position and setting of small cotton or gelatinize pillow under the thigh and then straight perineal incision on the median raphe. Other centers explain their experiences in this stage by guidance of a sound.^(16,20) The proximal end of the stricture or obliteration is determined

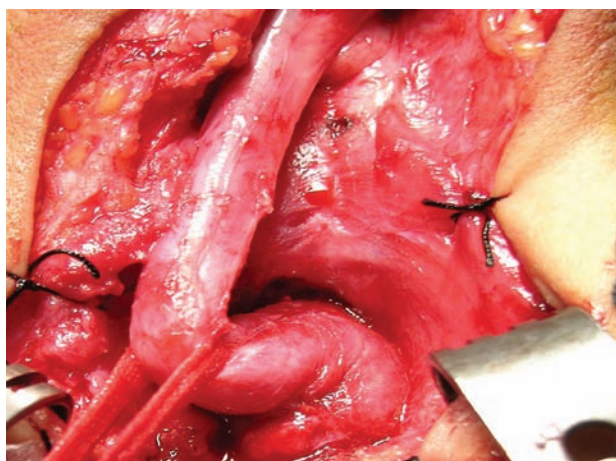


Figure 1. The bulbar urethra is mobilized.

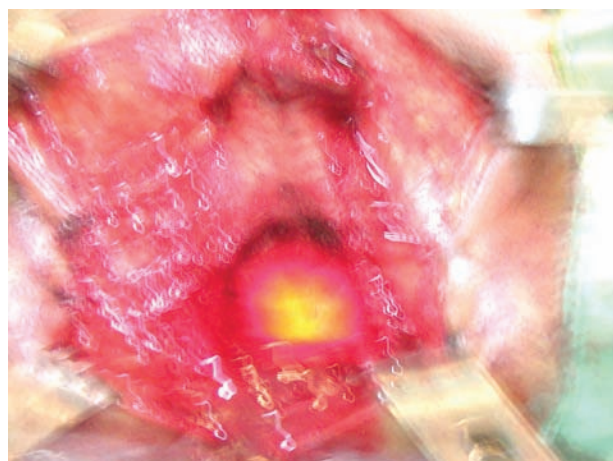


Figure 2. Light of the flexible cystoscope. be performed.⁽²³⁾

via passing of a 20-F van Buren sound through the suprapubic cystostomy tract.⁽²⁰⁾ If the tip of the sound is not palpable in the perineal point, the use of flexible cystoscopy is recommended to locate the proximal end of the stricture.^(5,20)

We use flexible cystoscopy routinely for all patients. In this technique, a cystoscope is passed through the bladder neck from the prostatic urethra and the tip of the cystoscope is placed on the end of the stricture (Figure 2). Fibrotic tissue is removed under the guidance of cystoscope light. Then, a needle is passed through the perineum into the proximal urethral end under the guidance of the flexible cystoscope light (Figure 3). Using the light of the flexible cystoscope versus a 20-F van Buren sound for the determination of the true end of the urethra has 2 benefits: first, it does not allow creation of false passage. Second, the true end point of the urethra is opened, and opening of the urethra proximal to the point of obstruction is avoided. Furthermore, by using a flexible cystoscope, it is possible to determine abnormal and nonanatomical placement of the proximal end of the urethra and its deviation to the rectum, laterals, and behind the pubis.⁽³⁰⁾ After the incising of the two ends of the urethra, fibrotic tissues should be completely removed. Tractional sutures on these fibrotic tissues are useful.⁽²⁰⁾ For prevention of intensive tension on the point of the anastomosis, creation of spaces between the two corpora, inferior pubectomy by using a bone nibbling forceps, or rerouting of the corpus spongiosum around the corpus cavernosum can

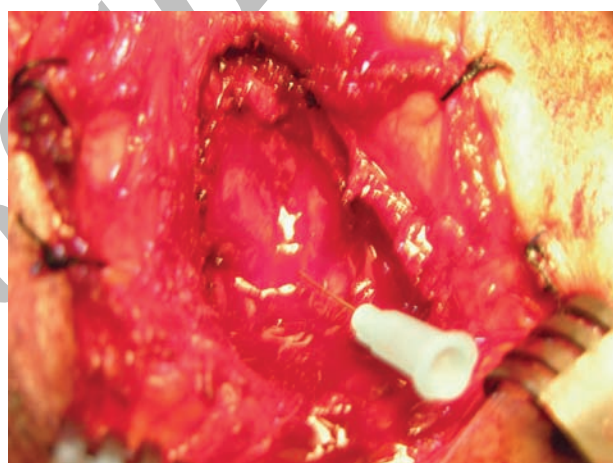


Figure 3. A needle is passed through the perineum into the proximal urethral end under the guidance of cystoscope light.

According to one study and the anatomical feature of the vessels and nerves, for preservation of erection and potency, it was recommended that during the repair of the distal end of the urethra, dissection be performed only inside the bulb and without disturbing the area outside the bulb (cutting within the bulb).⁽²²⁾ Also, during the exposure of the prostatic urethra, dissection in the lateral surface of the prostate is not recommended and it is preferred only in the anterior surface of the prostate.⁽²²⁾

After the removal of the scar and fibrotic tissue, the proximal end of urethra is spatulated in the position of 12 o'clock (Figure 4), so that a 24-F to 32-F metallic sound can pass through the urethra. The Distal end of urethra is also spatulated in the opposite direction (Figure 5).^(12,20)

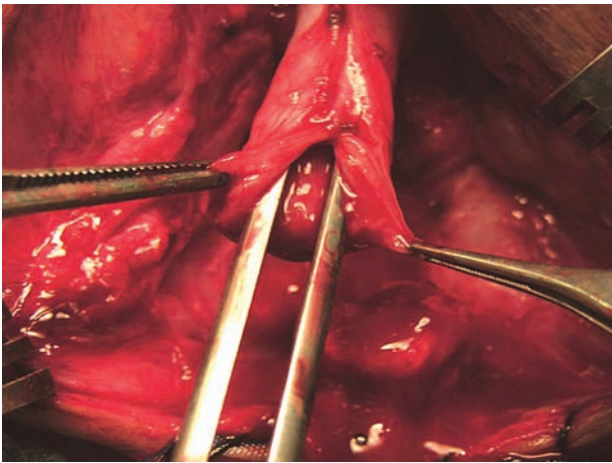


Figure 4. Spatulation of the distal end of the urethra.

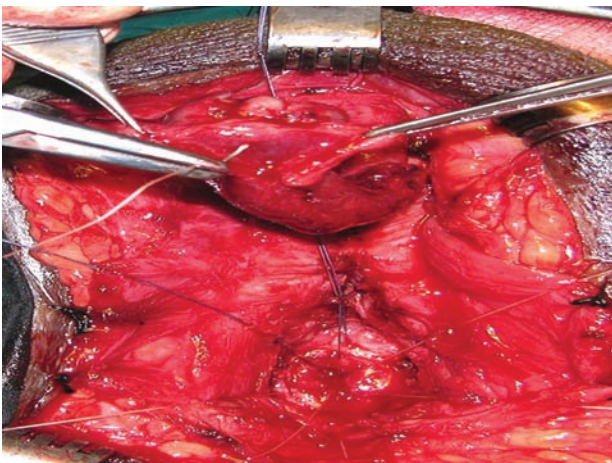


Figure 5. Proximal end of the urethra after spatulation.

To achieve better mucus-to-mucus anastomosis, some surgeons fix the proximal end of the urethra to the lateral section of the urethra with 4 to 6 sutures after spatulation.^(16,25) Anastomosis of the two ends of the urethra is performed mucus to mucus around the urethra on a urethral catheter, with 6 to 12 sutures (Figure 6). For this purpose, absorbable single-filament threads with the diameters of 6-0 to 3-0 are used.^(15,16,20,21) After the anastomosis of the urethra, to reduce tension on the suture line, bulbar urethra is fixed to the perineal fascia with 3 chromic sutures with the diameters of 3-0.⁽²⁶⁾ During anastomosis, a loupe can be used for magnification.⁽²⁴⁾ The operation can be finished after setting the cystostomy sound, washing the wound, setting the drain, and closing the layers. In our experience, there is no need for a drain and we rarely use rerouting.

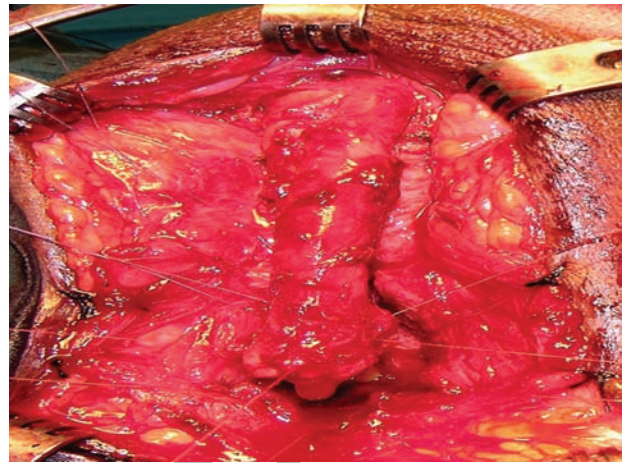


Figure 6. Anastomosis over a urethral stent.

In complex disruption of the posterior urethra (stricture gap exceeding 3 cm) or the presence of a previous history of perineal urethroplasty, some surgeons recommend abdominal transpubic perineal urethroplasty.⁽¹⁵⁾ In this surgery, patients are placed in the standard lithotomy position. Through a midline perineal incision, the anterior urethra is dissected and the fibrotic tissue of the stricture is completely excised. A midline subumbilical incision is made that extends over the symphysis. The attachments of the rectus abdominis muscles are cleared off of the outer surface of the pubis using a periosteal elevator approximately 2 cm from each side of the symphysis pubis. A wedge of bone is removed from the superior surface of the pubis using an osteotome. The depth of osteotomy varies according to the required exposure. The prostate is freed from the retropubic callus. The prostatic apex and distal urethra are spatulated anteriorly. A tension-free end-to-end anastomosis is performed using 6 to 8 sutures of 4-0 polyglactin over an 18-F catheter. Furthermore, in children, anastomosis of the two ends of posterior urethra after symphysiotomy has been described in place of transpubic method.⁽³⁴⁾ Turner-Warwick proposed the concept of *engaged bladder neck by fibrotic tissue* during traumatic pelvic fracture healing that make the bladder neck open and increase the risk of incontinence.⁽³⁵⁾ Then, in suspicious cases for open bladder neck and the risk of incontinence after urethroplasty, he proposed perineoabdominal approach to release the bladder neck from fibrotic tissue during

urethroplasty. We use this concept in complicated cases of pelvic fracture urethral distraction defect to decrease the incontinence.

After the operation, the patient is kept completely bed rest for 24 to 48 hours. We recommend even longer bed rest. Three to 4 weeks after the operation, the urethral catheter is removed and a voiding cystourethrography is done through the suprapubic tract. If extravasation is absent, the suprapubic catheter is clamped and removed 5 to 7 days later.⁽¹²⁾ Some surgeons perform urethrography before bringing out the urethral sound.⁽¹⁵⁾ We recommend the same method.

OUTCOME AND COMPLICATIONS OF SURGERY

In different studies, different results of posterior urethra repair have been obtained due to various definitions of surgical success, follow-up duration, age of the patients, and the previous history of surgery. In some of these studies, successful operation has been defined as the absence of relapse of stricture or defect. The need for re-operation, urethrotomy, or dilation has been defined as failure. Thus, in different studies, the success rate of this surgery ranged between 82% and 95%.^(15,16,19,20,22,25,26,28,36) Our unpublished results are also in this range. In some other studies, the absence of relapse of the defect after one urethrotomy was also defined as successful surgery. Based on this definition, a success rate of 93% to 97% was achieved.^(19,32) In a study by Culty and Boccon-Gibod, it was found that the success rate of the operation during 1-, 5-, and 10-year follow-up was 63%, 55%, and 43%, respectively, while half of their patients had a history of open or endoscopic surgery. Including 1 or 2 internal urethrotomies in the treatment, these rates reached to 84%, 80%, and 76%, respectively.⁽²¹⁾ The authors noticed that a history of previous operation notably reduced the success rate. In Mundy's study, the rate of relapse one year after the operation was 7% and this rate was estimated as 12% after 5-year follow-up. In that study, the relapse rate was constant during 10 years after the operation.⁽³⁾

In 2 studies on children with posterior urethral defect, aged 11.9 years and 9.8 years on average,

complete success rate was 70% and 89%, respectively.^(17,23) In the fist survey, 6 of 10 patients were operated with the technique of abdominal transpubic perineal urethroplasty. In contrast, in one study on the elderly patients (older than 65 years old), complete success rate of posterior urethroplasty was 84% that confirmed the safety of this procedure in the elderly.⁽²⁴⁾ Koraitim determined factors that contribute to an unsuccessful results and proposed guidelines to reduce failures. The essential operative details of posterior urethroplasty included complete excision of scar tissue involving the membranoprostic region, lateral fixation of pliable prostatic mucosa, and creation of a tension-free anastomosis.⁽²⁵⁾ In his study, previous repair, a long distraction defect, and urinary infection did not preclude successful posterior urethroplasty.⁽²⁵⁾

The most common complications of posterior urethroplasty include urinary incontinence and erectile dysfunction. The incidence of urinary incontinence is about 10% in some reports, the majority of which are reversible^(15,23); however, in some other studies, the incidence of this complication was much lower.^(12,19) In some reports, opening of the bladder neck in static cystostography before operation resulted in a higher incidence of urinary incontinence.^(27,28) Furthermore, in Mundy's study, the incidence of persistent erectile dysfunction was about 7%.⁽³⁾ However, in recent studies, the incidence of impotence has been lower. For example in one study, only 2 of 155 patients suffered from impotence. In another study, among 22 studied patients only 3 cases of impotence was found, one of which was persistent impotence.^(16,22) In Koraitim's study on 155 patients undergoing posterior urethroplasty, 110 patients had normal sexual activity before trauma. This normal activity was preserved only in 66 patients after the trauma. Twenty-nine patients of this group regained their sexual ability postoperatively, while 2 suffered from impotence.⁽¹⁶⁾

Other less common complications of posterior urethroplasty include rectal injury, fistula formation, wound infection, perineal nerve injury, and recurrent urinary infection.^(16-18,22,26)

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CONFLICT OF INTEREST

None declared.

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