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Mechanism of Penile Prosthesis Induced Urethral Stricture: Treatment and Prevention

Jong Kwan Park and Chen Zhao
Chonbuk National University
South Korea

1. Introduction

The advent of phosphodiesterase type 5 inhibitor has revolutionized the management of erectile dysfunction (ED). Since the introduction of sildenafil citrate in 1998, oral systemic therapy has become the first line therapy for men with ED. However, oral pharmacotherapy often fails in patients with severe diabetes, radical prostatectomy, Peyronie's disease, and severe penile fibrosis. These patients may select other therapies such as penile injection therapy or a vacuum erection device. When oral and injectable therapies fail to produce satisfactory results, implantation of a penile prosthesis is the last strategy which has demonstrated the highest level of satisfaction among treatments for ED [1,2].

Penile implants include malleable (semi-rigid) and inflatable (two- or three-piece) types. Most patients prefer the three-piece inflatable devices because it most closely approaches the functioning penis with respect to flaccidity and erection. Three-piece prostheses consist of paired corporal cylinders, a scrotal pump, and a large volume reservoir implanted into the prevesical or retropubic space (Fig. 1). Currently available three-piece devices include the Coloplast Titan, Coloplast Titan Narrow Base, the AMS Ultrex, the AMS 700 CX, AMS 700 CXM and the AMS 700 CXR. A major difference is whether connecting tubing between cylinders and pump has been made on production line or not.

The inflatable prostheses are usually inserted via a penoscrotal or an infrapubic approach. The advantage of the infrapubic approach is the placement of the reservoir under direct vision. However, this approach limits to expose the corpora cavernosa and may damage the dorsal nerve, especially during revision procedures. The penoscrotal or transverse scrotal approach allows to securely placing the pump in the scrotum and the skin in the prepubic area is not violated, but the reservoir has to be placed blindly through the inguinal canal which may injury the iliac vessels [3].

In the past, the implantation of a penile prosthesis was often associated with high complication rate such as infection, persistent pain, cavernous perforation, mechanical failure, malposition, erosion into the bladder, urethra and bowel, and gangrene [4,5]. In recent years, the use of antibiotic impregnated or hydrophilic-coated prosthesis and proper antibiotic prophylaxis against Gram-positive and Gram-negative bacteria has significantly reduced the complication rates. The two main complications of penile prosthesis implantation are mechanical failures and infection. The technical improvements result in mechanical failure rates of less than 5% at 5-year follow-up [6,7], and infection rates range from 1 to 4% [8,9].



Fig. 1. Coloplast Titan inflatable penile prosthesis

Urethral stricture after implantation of a three-piece inflatable penile prosthesis is very rare but has been reported in 2007 [10]. Urethral stricture was induced by compression of twisted tubing in three-piece inflatable penile prosthesis and it would be aggravated with the lapse of time [11]. We developed a more reliable surgical technique to place the three-piece inflatable penile prosthesis. Also, we would like to share the unusual experience which may be helpful to prevent urethral stricture in penile prosthesis implantation.

2. Urethral stricture

The normal urethral spongiosum was comprised of 75.1% type I collagen and 24.9% type III collagen. A functional nerve supply to the urethral spongiosum seems to be crucial in the maintenance of the unique ultrastructure of the urethral spongiosum [12]. The term urethral stricture refers to urethral disease and is a scarring process of the subepithelial tissue of the corpus spongiosum that constricts the urethral lumen [13]. Recent studies on molecular mechanism of urethral stricture have shown that the fibrosis in strictures is different from other organ in the wound healing process. In the process of the urethral stricture, the type I collagen in urethral stricture tissue was significantly increased (83.9%), with a corresponding decrease in type III collagen (16.1%) [14]. The fibrotic process may also be associated with significant changes in nitric oxide synthase metabolism. The connective tissue growth factor was significantly up-regulated in urethral tissues of urethral stricture patients, which has been identified as a cause of other fibrotic diseases [15].

The etiology includes idiopathic, iatrogenic, inflammatory, and traumatic. In an evaluation of 175 patients, it showed that most urethral strictures are idiopathic (34%) or iatrogenic (32%), being less frequently inflammatory (20%) or traumatic (14%) [16]. Patients who have urethral strictures most often present with obstructive voiding symptoms or urinary tract infections such as prostatitis and epididymitis. Some patients also present with urinary retention [13].

2.1 Mechanism of urethral stricture by penile prosthesis

The paired corporal cylinders and scrotal pump of the three-piece prosthesis are connected by tubeings. If a cylinder were abnormally rotated 360 degree from neutral position during

the implantation, the tubeing connected the cylinder would be rotated as well. The rotated tubeing compresses the urethra and induces inflammation in the corpus spongiosum which results in urethral stricture.

2.2 Diagnosis of urethral stricture

Urethral stricture could be diagnosed by urine analysis, voiding symptoms aggravated just after implantation, uroflowmetry and retrograde urethrography. Before or during surgery, endoscopy (Fig. 2) or bougienage (urethral sound) could be used to evaluate the stricture and ensure completely, all the involved urethra is included in the reconstruction.

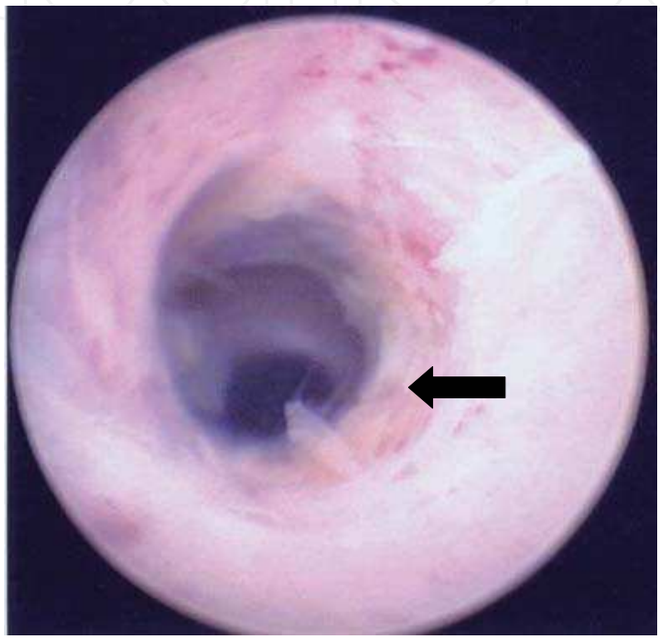


Fig. 2. Cystoscopy reveals penile urethral stricture (arrow) after three-piece penile prosthesis (Mentor alpha I) implantation 6 months later

2.3 Prevention and treatment

During the implantation, cylinder, tubing, and pump must be placed without abnormal rotation. If you find the rotated tubing or pump induced by the abnormal rotation of the cylinder, you have to relocate the cylinder after re-rotation of the abnormal rotated cylinder (Fig. 3).

3. Unusual experience of long urethral stricture by rotated tubeing

A 36-year-old man was presented with severe voiding difficulty after implantation of the three-piece inflatable penile prosthesis. The symptom occurred after removal of a Foley catheter at day 1 of implantation postoperatively and voiding difficulty continued. Previously, he had received an inflatable penile prosthesis Mentor Alpha I implantation (Mentor Corp., Santa Barbara, CA, USA) via infrapubic approach 4.5 years ago. We performed uroflowmetry and retrograde urethrography. The peak uroflowrate was 4 mL/second, and retrograde urethrogram showed severe penile urethral stricture (Fig. 4).

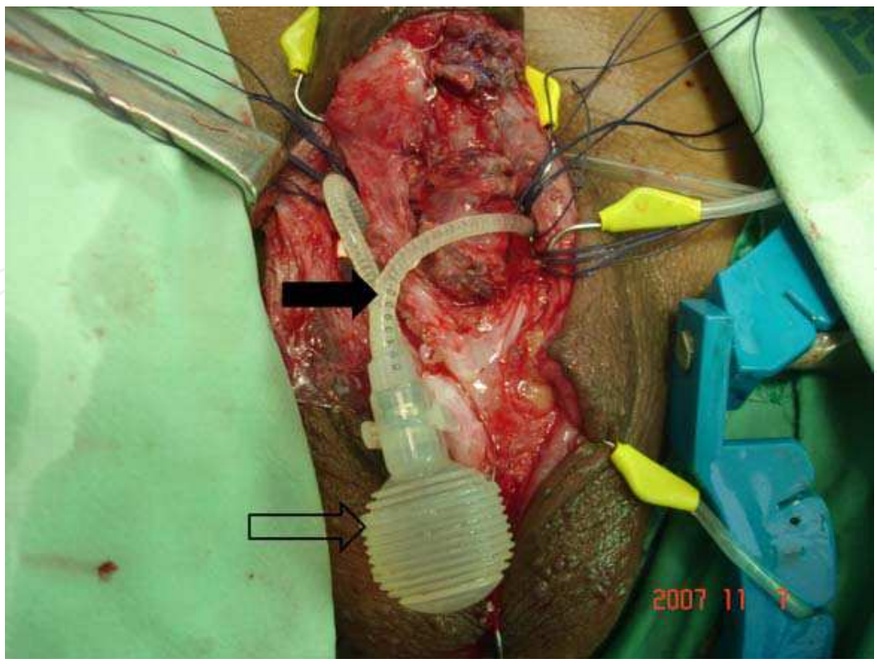


Fig. 3. Rotated tubeings (solid arrow) and pump (open arrow)



Fig. 4. Retrograde urethrogram shows severe urethral stricture (solid arrow)

During the revision surgery, we made a neourethra with pedicle island of penile skin and anastomosed after removal of the strictured portion (Fig. 5). After urethroplasty, new cylinders and pump were placed in cavernosal spaces and intra-scrotum in a routine manner, respectively (Fig. 6).

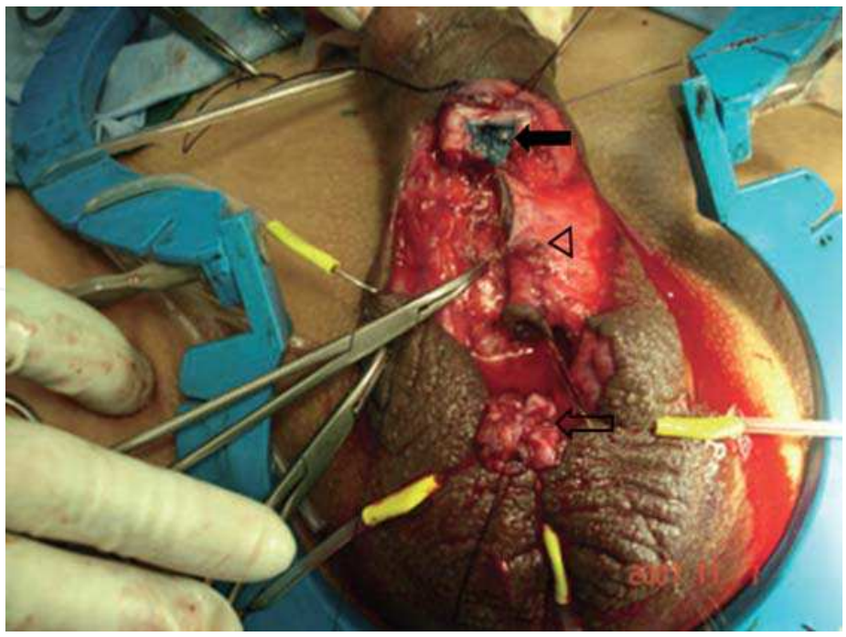


Fig. 5. Operative view shows long urethral defect between distal (solid arrow) and proximal (open arrow) urethral opening and neourethra with pedicle island of penile skin (open arrow head)

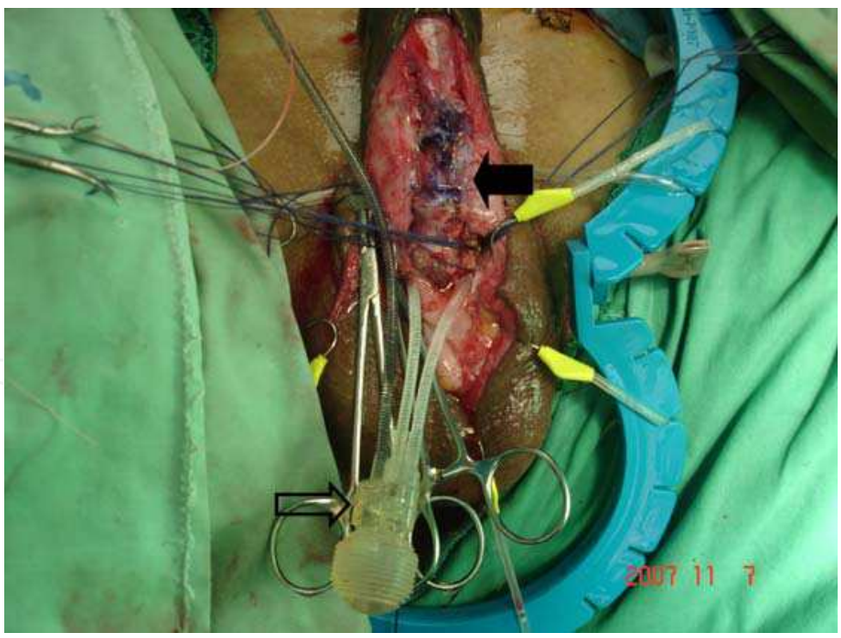


Fig. 6. Anastomosis of neourethra (solid arrow) and revised penile prosthesis (open arrow). Pump is located at the neutral position (open arrow)

We have drawn two longitudinal lines on the cylinder and tubings leading from cylinder to prevent the abnormal rotation of the cylinder during the preparation of the prosthesis (Fig. 7). If the cylinder would be rotated, a marked line at the related tubeing also is twisted.



Fig. 7. Two longitudinal lines marked at the cylinder and tubeings

We removed a Foley catheter and took an retrograde urethrography on postoperative day 21. However, there was dye extravasation from the anastomosed portion to the pump (Fig. 8).

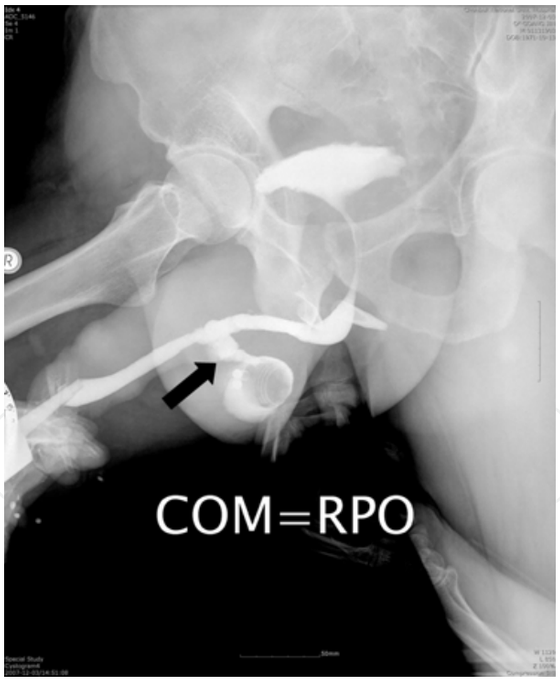


Fig. 8. Retrograde urethrogram shows the extravastion of dye from the anastomotic portion to the pump (solid arrow)

A 16 Fr Foley catheter was inserted again, and prescribed oral antibiotics for additional 21 days. We performed voiding cystourethrography at day 21 after the second insertion of a Foley catheter. There was no extravasation in the urethra (Fig. 9).



Fig. 9. Voiding cystogram do not shows extravasation of dye

4. Conclusions

During the implantation of a three piece inflatable penile prosthesis, abnormal rotation of the cylinder rotates the connecting tubeing between cylinder and pump. If the operator ignores the abnormal rotated cylinder, the rotated tubeing compress the urethra resulting in urethral stricture. The stricture induced by compression by the rotated tubeing will be aggravated with the duration of the time. We suggest the following surgical tips to prevent urethral stricture in penile implantation of a three-piece of penile prosthesis, which was produced company of Coloplast. (i) An incision of the tunica albuginea may be made as laterally as possible to prevent tubing crossing the anterior urethra. (ii) The producer or operator should mark two longitudinal lines parallel to the long axis of the cylinder at the surface of the cylinders and tubings leading from the cylinders during the preparation of penile prosthesis. (iii) Stitches are to be made on the scrotal soft tissue to prevent rotation of the pump. (iv) The pump should be placed at the lowest dependent portion.

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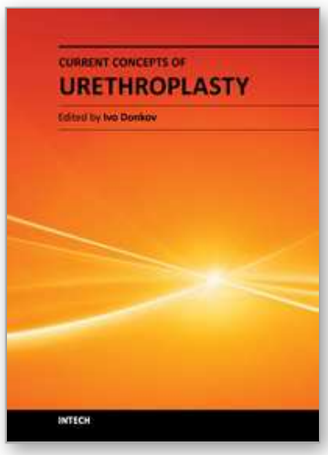
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University Campus STeP Ri
Slavka Krautzeka 83/A
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