



REVIEW AND TREATMENT ALGORITHM OF OPEN SURGICAL TECHNIQUES FOR MANAGEMENT OF URETHRAL STRICTURES

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Treatment of urethral strictures can be challenging, but, with a thorough preoperative evaluation, appropriate surgical planning, and adherence to basic surgical principles, excellent results can be achieved. Minimally invasive treatment options, including direct vision internal urethrotomy (DVIU), urethral dilation, and urethral stents, can be used in selected patients, but are associated with high failure rates.^{1,2} DVIU and dilation are best used as the initial treatment for short (less than 1 cm) bulbar strictures.^{1,2} Open surgical repair should be the first choice with longer strictures or strictures that have failed more conservative treatment.

Dozens of procedures have been described in published studies for the repair of urethral strictures, but seldom has a unified approach to all types of stricture appeared in publication. This review is meant to provide a concise overview to all types of urethral stricture, both primary and recurrent. It is meant as a guide of how one referral center manages the diversity of urethral stricture cases, and although it reflects our experience, we recognize that other specialty centers might approach similar problems in their own unique way.

LOCATION, LOCATION, LOCATION

The urethral stricture location and length are the most important factors affecting the choice of the repair (Fig. 1). In general, we prefer one-stage repair over two-stage repair, although two-stage repairs remain useful for a wide range of strictures, including severe recurrent strictures, chronically infected tissue, very long strictures (especially when adequate penile skin is not available for re-

construction), and strictures secondary to balanitis xerotica obliterans (BXO).³

Fossa navicularis strictures are best treated with vascularized fasciocutaneous penile skin flaps (Fig. 1), because end-to-end anastomosis can lead to high failure rates, penile shortening, or chordee formation.⁴ The treatment of long pendulous urethral strictures is controversial. Although some authorities use dorsal onlay buccal mucosal grafts in these patients,⁵ other experts believe that the relatively poor blood supply of the distal urethra makes a penile skin fasciocutaneous flap a better option.⁶ Still others are content to use ventral onlay grafts in this area.^{7,8}

For short (less than 2.5 cm) bulbar urethral strictures, end-to-end anastomosis is preferred (Fig. 1).^{9,10} Bulbar strictures of moderate length, between 2.5 and 5 cm, can be treated with a buccal mucosal onlay graft. For longer strictures in the bulbous urethra or a failed prior buccal mucosal urethroplasty, a penile fasciocutaneous onlay flap is suggested (Fig. 1). An exception to the above rule is the use of an end-to-end anastomosis in impotent men with long strictures, who will not be affected by a bowed penis caused by overstretching the urethra.¹⁰ We recognize that several investigators have advocated the use of scrotal skin, with the claim that complications from hair formation in the urethra are not a problem.¹¹ However, this has not been our experience and we avoid them.

Treatment of urethral obliteration after posterior urethral distraction injuries after pelvic trauma is challenging. These strictures are best managed by end-to-end anastomosis in a delayed one-stage perineal repair (Fig. 1).¹² Rarely, an abdominoperineal transpubic approach may be needed in cases in which the stricture is very long or hidden directly underneath the pubic bone or complicated by rectal or cutaneous fistula.^{4,13} Recurrent strictures after primary perineal repair have classically been treated with an abdominoperineal transpubic approach, although newer data have indicated an

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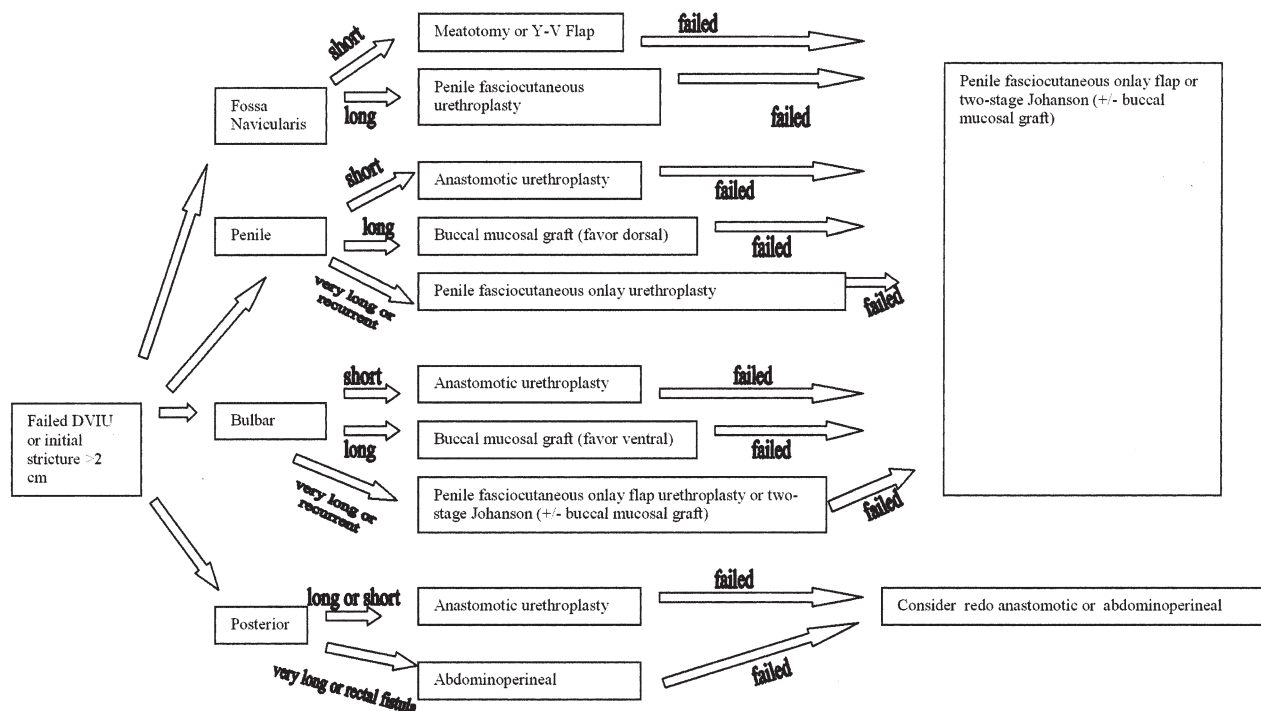


FIGURE 1. Algorithm for the management of urethral stricture. After any failed open urethroplasty, DVIU should be attempted before contemplating redo urethroplasty.

acceptably high success rate when repeat perineal anastomosis is attempted (Fig. 1).¹⁴

Panurethral strictures are the most challenging. Consider using a combination of the above techniques, such as buccal mucosal onlay graft for the proximal portion and penile fasciocutaneous onlay flap for the distal portion, or a two-stage Johanson repair. As a last resort, for patients with multiple failed prior urethroplasties, or if the patient has multiple comorbidities (or is of advanced age), consider a perineal urethrostomy. This assumes the patient has an adequate length of bulbar urethral stump to anastomose to the skin. In the rarest of cases, a completely hopeless urethra (perhaps complicated by previous radiotherapy, rectal fistula, concomitant incontinence, or other lower genitourinary problems [eg, recurrent prostate cancer, neurogenic bladder, ureteral obstruction]) could be treated with suprapubic urinary diversion. This could include a continent catheterizable stoma (Mitrofanoff principle), ileovesicostomy, ileal loop, or any other described suprapubic diversion. We consider one of the goals of urethral reconstruction surgery to avoid this outcome when possible, but some patients may not be salvageable any other way.

GENERAL GUIDELINES

INSTRUMENTS

Urethroplasty is an operation that can be done with any standard set of open surgical instruments,

but it is facilitated by the use of specialized instruments that navigate the small spaces better. We use a specialty instrument “kit” for all urethroplasty procedures, as well as other standard surgical equipment (Table I).

PATIENT POSITIONING

The specifics of high-lithotomy positioning are often individualized at different centers, but the patient’s position must expose the entire perineum (Table II). Injuries from positioning at our center have been rare and have been limited to temporary upper extremity neuropathy, usually in an ulnar nerve distribution. Other potential complications include compartment syndrome, rhabdomyolysis, neuropathy (sciatic, femoral, and/or peroneal nerve), pulmonary embolism, deep venous thrombosis, severe lower back pain, and trochanteric bursitis.¹⁵

PREOPERATIVE PREPARATION

Preoperative imaging with retrograde urethrography (RUG) often combined with voiding cystourethrography (VCUG) is used to establish the exact location and length of the stricture.⁹ The adequacy of penile skin or buccal mucosa should be established preoperatively when necessary. Patients should have had a negative urine culture before the repair. Patients with chronic indwelling catheters or poor bladder emptying should be treated with 3 days of anti-

TABLE I. Speciality and general equipment list for urethroplasty

Item	Comment
Specialty item kit	
8-in. Debaquey needle driver	Fine tip allows easier manipulation of small needles, textured tip holds needles better, tapered end navigates small spaces
7-in. Serrated curved fine Metzenbaum scissors (Sontec Maxi-cut, Englewood, Colo)	Surgical dissector, serrated blades hold tissue to be cut more efficiently
Andrews suction tip	Small tipped suction allows easier maneuvering in tight spaces
Bougies a boule	Allows measurement of the urethra distal and proximal to the repair
7.75-in. Fine-tipped Debaquey forceps × 2	
3.5-in. Bishop-Harmon pickups	For fine tissue manipulation, as with fasciocutaneous onlay urethroplasty
6.75-in. Serrated straight Mayo scissors (Sontec Maxi-cut, Englewood, Colo)	Useful for dividing the urethra during anastomotic urethroplasty—serrated edges hold tissue efficiently
40-mm calipers	Allows measuring of grafts, and other
Standard items	
19F Rigid cystoscope	To view urethra proximal to stricture to ensure a second stricture is not present and rule out bladder stones
22F Red Robinson catheter	To sound out stricture at beginning of case and delineate urethral anatomy for the initial dissection
Bipolar and monopolar cautery	Bipolar decreases potential for nerve and flap injury
16F Silicone 5-mL balloon catheter	Silicone catheter theoretically decreases urethral inflammation during healing
0.5% Bupivacaine (Marcaine/Sensorcaine) (± epinephrine)	Local block provides excellent perioperative pain control
5-0 and 6-0 PDS or Maxon (glycolic acid or polydioxanone),	Specialty suture for urethral work
General sutures 2-0, 3-0, 4-0 Vicryl (polyglycolic acid) and 2-0 chromic gut on a taper needle	3-0 Vicryl to close bulbospongiosus muscle, 2-0 Vicryl to close dartos layer, 2-0 chromic to close perineal wounds
Jordan retractor system (C&S Surgical, Slidell, La) for Bookwalter retractor system (Codman, Raynam, Mass)	Provides excellent surgical exposure, especially in posterior urethroplasty

TABLE II. High-lithotomy position precautions

Item	Comment
Candy cane stirrups	Readily available, small profile does not block access to the perineum
Foam heel cup	Foot protection
Padded heel straps	Foot protection
Pad dorsum foot	Foot protection
Bean bag	Allows elevation of the buttocks
Gel pad	Avoids rhabdomyolosis from exposure to hardened bean bag
Armboards pointed downwards toward the feet	Decrease shoulder stress
Sequential compression devices	Potentially decrease lower extremity injury (unproven)
Compression stockings (TED) hose	Potentially decrease lower extremity injury (unproven)

biotics, usually fluoroquinolones, such as ciprofloxacin or levofloxacin, before surgery. Intravenous antibiotics, usually ampicillin (1 g intravenous) and gentamicin (5 mg/kg body

weight, daily, in those without renal impairment¹⁶) should be given 1 hour before surgery to allow some excretion into the urine before the start of the procedure.

GENERAL TECHNICAL CONSIDERATIONS

We use magnifying loupes during all cases. Generally, we try to achieve the following: (a) tension-free anastomosis with adequate tissue mobilization; (b) watertight closure with small monofilament dissolvable suture; (c) nonoverlapping suture lines; and (d) multiple layer closures when possible (to avoid fistula formation). We use fine forceps, traction sutures, skin hooks, and bipolar electrocautery to limit tissue damage.

POSTOPERATIVE CARE

Most patients are discharged home the day of surgery. Exceptions include those undergoing an especially long or complicated operation, those with multiple comorbidities or advanced age, and those with social issues that preclude safe discharge from the hospital (eg, lack of transportation or lack of home support to assist with postoperative care). Admitted patients are usually discharged after 24 hours, except for those who underwent very complicated surgery such as abdominoperineal anastomotic urethroplasty with pubectomy.

We recommend several maneuvers to improve postoperative pain control. We infiltrate the surgical wound with 0.5% bupivacaine (Marcaine/Sensorcaine) with or without epinephrine (epinephrine is not used in penile repairs or after flaps) just before closure. We also place ice packs on the perineum, penis, and/or cheek as necessary for 24 hours. Oral cyclooxygenase-2 inhibitors, such as celecoxib (Celebrex), valdecoxib (Bextra), or rofecoxib (Vioxx) are given in the recovery room as soon as the patient can swallow pills. Finally, patients are discharged with a supply of narcotic pain medications to use on an as needed basis.

Postoperatively, patients are sent home with a supply of antibiotics such as nitrofurantoin monohydrate macrocrystals (Macrobid; dosage 100 mg twice daily) to take until 3 days after the catheter has been removed, although we are aware of no published data that absolutely support the use of postoperative antimicrobial agents after urethroplasty. Prescriptions for "as needed" medications are filled by the patient only when necessary and include anticholinergic/antispasmodic agents such as oxybutynin and a stool softener. Patients who have undergone buccal mucosal grafting are asked to swish and spit an antimicrobial rinse after each meal for 4 days using chlorhexidine (Peridex).

Patients are instructed to resume a regular diet, avoid strenuous activity or lifting more than 10 lb for 3 to 4 weeks, and avoid sitting directly on the perineum while the urethral catheter is in place. Patients with buccal mucosal grafts are additionally advised to consume only clear liquids for 24 hours and then a soft diet for an additional 24

hours before starting a regular diet. Urinary catheter instructions are given by the recovery room nursing staff before discharge.

The duration of catheterization varies depending on the type of repair and its difficulty. In general, catheterization after end-to-end anastomosis is scheduled for 4 to 5 days and most other procedures for 7 to 10 days. VCUG is performed before catheter removal, and if extravasation is noted, the catheter is replaced. VCUG is repeated at weekly intervals until the extravasation resolves. Alternatively, the urethra can be imaged before catheter removal with pericatheter RUG, although formal VCUG should still be completed at the same sitting if RUG is normal.

We follow-up our patients using ultrasonography to determine the postvoid residual urine volume, uroflow studies, and a symptom survey (decreased force of urinary stream, urgency, frequency, urinary tract infection, nocturia, poor emptying, double voiding) every 4 months for 1 year and then yearly for life.¹⁰ Any abnormalities are investigated with repeat RUG. Other experts have different follow-up schemes that may involve routine cystoscopy or other studies.⁹

SUCCESS RATES DEPEND ON LENGTH AND LOCATION OF STRICTURE

Stricture recurrence generally increases with the complexity and length of the stricture. Stricture recurrence rates from a University of California, San Francisco, series highlighted the different rates of recurrence: anastomotic 6%, posterior anastomotic 17%, and buccal mucosal 4% (despite in general being used for longer strictures).¹⁷ Most repairs fail in the first 6 months, but they can also fail decades after surgery.¹⁸

Recurrent strictures should be imaged with RUG. If short, DVIU should be performed. Although repeat DVIU has been shown to have a very high failure rate in unoperated strictures, recurrent strictures (especially when new tissue is brought in to the area such as with buccal mucosal or fasciocutaneous onlay urethroplasty) are often cured with one postoperative DVIU.⁷

SPECIFIC SURGICAL TECHNIQUES

FOSSA NAVICULARIS STRICTURES

Fossa navicularis strictures can be difficult to treat. In general, we choose simple meatotomy or Y-V advancement flap only for very short strictures (Fig. 1). Y-V flaps may not be possible in cases of BXO. Recurrent or long strictures are treated with fasciocutaneous onlay flaps when adequate penile skin is present, but Johanson urethroplasty (with or without buccal grafting in the first stage) may be

required when adequate penile skin is not present (Fig. 1). The *Atlas of Urologic Surgery*⁴ provides details of how to perform a Y-V advancement flap or meatotomy.

Fasciocutaneous Onlay Flap. The fasciocutaneous onlay flap may be used when splitting the glans (Jordan flap)¹⁹ or without splitting the glans (McAninch flap).²⁰ We acknowledge that other surgical options are available, such as the skin graft technique (Devine),⁴ buccal mucosal graft technique, or skin flap technique (Blandy-Tresidder),²¹ but we have not needed to use these procedures and favor fasciocutaneous onlay flap for most cases.⁶

We prefer to dress these wounds with a sterile 11 × 6-in. (or similar large size) Op-Site semipermeable transparent dressing (Smith and Nephew, Largo, Fla). This allows an adherent, nonexpanding dressing over the penis, decreasing postoperative pain from movement and the risk of hematoma expansion. The catheter should be fixed dorsally with the dressing to decrease pressure on the suture lines. The catheter is left in place for 1 week.

PENDULOUS (PENILE) STRICTURES

Possible surgical techniques include excision and end-to-end anastomosis (if this does not shorten the penis or cause chordee), penile fasciocutaneous onlay flaps (if preputial and/or penile skin is available), the buccal mucosal onlay graft, or two-stage Johanson repair (for very long, complicated or multiple strictures). Some experts believe that anastomotic urethroplasty should be used sparingly in the penile urethra and that ventral buccal mucosal grafts should be avoided in favor of dorsal buccal mucosal grafts.⁵

We acknowledge that augmented roof strip grafts can be used (in which the dorsum of the urethra is sewn primarily in an anastomotic technique, and the ventrum is grafted with buccal mucosa), but poor results in our hands¹⁷ have prompted us to avoid this approach despite other favorable published reports.²² For strictures in the penile urethra, repairs can be performed with the patient in supine position.

Buccal Mucosal Graft Harvest Technique. Buccal mucosa is an ideal graft because it has a thick mucosa and thin strong lamina propria, is elastic, and is well vascularized.²³ Buccal grafts may allow for better results when treating strictures secondary to BXO^{3,9} and are ideal when sufficient preputial skin is not available. Postoperatively, the catheter is left in place for 1 week.

The anesthesiologist should tape the endotracheal tube to the side opposite that from which the graft will be harvested. A lip-cheek retractor such as the Steinhauser buccal retractor or the more readily available Denhardt mouth gag should be inserted to open the mouth, together with a “baby

sweetheart” retractor to retract the tongue. Three to four traction sutures should be placed through-and-through the entire lip using 3-0 silk suture.

A marking pen is used to mark the length and width (2.5 cm) of the strip of buccal mucosa using calipers. Stenson’s duct should be identified and avoided. A mixture of 1:100,000 1% lidocaine with epinephrine is infiltrated beneath the mucosa to lift it off the buccinator muscle, facilitate dissection, and reduce bleeding.

We use a No. 15 blade knife to incise the borders of the strip of buccal mucosa. With the combination of the knife and scissors, the mucosa is dissected off the buccinator muscle. Because the buccal mucosal neurovascular bundle lies in the buccinator muscle and the facial nerve runs beneath it, it is imperative not to enter the muscle.

Hemostasis is obtained with direct pressure and electrocautery. The defect is closed using a running 3-0 chromic suture on a small taper needle. The mouth is packed with two 4 × 4 gauze during the rest of the procedure and removed at the end. An external ice pack should be placed on the cheek in the recovery room.

The graft is pinned onto a board and thinned out by removing the fat and subcutaneous tissue with iris scissors. This will foster imbibition. Magnifying loupes should be worn.

Dorsal Onlay Buccal Graft Urethroplasty. Dorsal onlay buccal grafts are advisable when adequate penile skin is not present for fasciocutaneous urethroplasty. The graft should be quilted to the corpora using multiple 5-0 monofilament absorbable suture such as PDS or Maxon.

Fasciocutaneous Penile Onlay Flap. Fasciocutaneous penile onlay flaps may be aided by placing an 8F feeding tube or 0.035-in. guidewire through the strictured portion and into the bladder as a guide to identify the proximal urethra. The urethra should be incised proximally over the feeding tube or wire until healthy urethra is appreciated. Then, 4-0 Vicryl traction sutures are placed through the urethral mucosa and spongiosum every 1 to 2 cm to hold the urethral plate open. Bougies are used to sound out the urethra proximally and distally to ensure an adequate size lumen (at least 28F).

Two-Stage Johanson Technique. The Johanson technique is used for very long, dense strictures or failed previous repairs when adequate penile skin is not present to complete fasciocutaneous onlay flap repair (Fig. 1). Some experts also advise using a Johanson technique for BXO stricture, with inlay of buccal mucosal graft in the first stage.³

Stage 1 Johanson urethroplasty may be aided by incising the urethral plate as described by Snodgrass *et al.*²⁴ An Op-Site dressing should be placed over the penis for 72 hours and the urethral catheter left in place for 1 week. Stage 2 should be

completed 3 to 6 months later, when all signs of inflammation are gone and the surgical area is soft and fully healed. The urethral catheter should be left in place for 2 weeks.

Other Techniques. Longitudinal pedicle flap urethroplasty (Orandi)²⁵ and transverse penile/preputial cutaneous pedicle flaps (Quartey)²⁶ can also be used in the penis, but we usually tend toward using circumferential penile skin fasciocutaneous urethroplasty.

BULBAR STRICTURE

Bulbar stricture repairs are performed with the patient in an exaggerated high dorsal lithotomy position. We make a longitudinal perineal incision without the Y. The bulbospongiosus muscle may be incised with the electrocautery (set to “cut”) or sharp dissection.

Anastomotic Urethroplasty. We advocate single-layer closure of the corpus spongiosum together with the urethra dorsally, but two-layer closure ventrally (the urethral mucosa should be closed with multiple interrupted 6-0 PDS sutures, and the corpus spongiosum and adventitia should be closed separately with multiple interrupted 5-0 PDS sutures). We believe this allows free blood flow from the reconstructed corpora spongiosum over the anastomosed urethral mucosa, but we acknowledge that others close the urethra in one layer with good results. We dress the incision in sterile fluffs held in place with an athletic supporter and leave the catheter in place for only 4 to 5 days.

Buccal Mucosal Ventral Onlay Graft Urethroplasty. When performing a ventral onlay buccal mucosal graft, it is neither necessary nor desirable to dissect out the entire urethra (as is done for anastomotic urethroplasty). Only the ventral urethra should be isolated. As is the case for other urethroplasty procedures, an 8F feeding tube or guidewire placed through the stricture will allow controlled incision of the urethra before sewing on the buccal graft onlay.

POSTERIOR STRICTURES

Posterior strictures may be approached through the perineum, abdomen (rarely required), through a combined abdominoperineal approach (rarely required) (Fig. 1). These strictures are typically seen after distraction injuries from pelvic trauma, anastomotic strictures after radical prostatectomy, or strictures after external beam radiotherapy for prostate cancer.

We advocate the use of the Jordan system for the Bookwalter retractor in these operations, because we believe it greatly improves exposure. However, many experts have used the LoneStar Retractor System (Stafford, Tex) with good results. Using 5-0 PDS, we place 12 sutures circumferentially like the numbers

on a clock into the proximal urethra (tagged with shodded “mosquito” hemostats). After all 12 are placed, each corresponding suture is placed into its proper spot in the distal urethra (mucosa-to-mucosa). This tends to pull the urethral stump out into the surgical field, also facilitating tensionless watertight closure.

Certain techniques can be used to improve exposure, identify the strictured area, increase the length of urethra, or decrease the distance between the urethral ends for a tension-free anastomosis. These include mobilizing the urethra proximally and distally with sharp and blunt dissection to free the natural elasticity of the urethra; incising between the corpora cavernosal bodies using electrocautery (being careful to avoid the dorsal vein)⁹; partial “inferior” pubectomy⁹; and conversion to an abdominoperineal approach plus pubectomy if necessary.²⁷ Some investigators have described rerouting the urethra underneath the proximal corpora cavernosa, but we have never needed this technique.²⁸

The abdominal approach is used with the patient in the supine position. Additional required instruments include the abdominal Bookwalter retractor, bone wax, mallet, and osteotomes. We leave the urethral catheter in place for 1 month after these difficult repairs.

REFERENCES

1. Pansadoro V, and Emiliozzi P: Internal urethrotomy in the management of anterior urethral strictures: long-term followup. *J Urol* 156: 73–75, 1996.
2. Heyns CF, Steenkamp JW, De Kock ML, *et al*: Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? *J Urol* 160: 356–358, 1998.
3. Venn SN, and Mundy AR: Urethroplasty for balanitis xerotica obliterans. *Br J Urol* 81: 735–737, 1998.
4. Hinman F Jr: Urethral reconstruction, in *Atlas of Urological Surgery*, 2nd ed. Philadelphia, WB Saunders, 1998, pp 261–302.
5. Andrich DE, Leach CJ, and Mundy AR: The Barbagli procedure gives the best results for patch urethroplasty of the bulbar urethra. *BJU Int* 88: 385–389, 2001.
6. Armenakas NA, and McAninch JW: Management of fossa navicularis strictures. *Urol Clin North Am* 29: 477–484, 2002.
7. Elliott SP, Metro MJ, and McAninch JW: Long-term followup of the ventrally placed buccal mucosa onlay graft in bulbar urethral reconstruction. *J Urol* 169: 1754–1757, 2003.
8. Kellner DS, Fracchia JA, and Armenakas NA: Ventral onlay buccal mucosal grafts for anterior urethral strictures: long-term followup. *J Urol* 171: 726–729, 2004.
9. Jordan GH, and Schlossberg SM: Surgery of the penis and urethra, in Walsh PC, Retik AB, Vaughan ED Jr, *et al* (Eds): *Campbell's Urology*, 8th ed. Philadelphia, WB Saunders, 2002, vol 4, pp 3886–3952.
10. Santucci RA, Mario LA, and McAninch JW: Anastomotic urethroplasty for bulbar urethral stricture: analysis of 168 patients. *J Urol* 167: 1715–1719, 2002.
11. Provet JA, Surya BV, Grunberger I, *et al*: Scrotal island flap urethroplasty in the management of bulbar urethral strictures. *J Urol* 142: 1455–1458, 1989.

12. Jordan GH: Management of membranous urethral distraction injuries via the perineal approach, in McAninch JW (Ed): *Traumatic and Reconstructive Urology*. Philadelphia, WB Saunders, 1996, pp 393–409.
13. Turner-Warwick R: Complex traumatic posterior urethral strictures. *J Urol* 118: 564–574, 1977.
14. Koraitim MM: Failed posterior urethroplasty: lessons learned. *Urology* 62: 719–722, 2003.
15. Anema JG, Morey AF, McAninch JW, *et al*: Complications related to the high lithotomy position during urethral reconstruction. *J Urol* 164: 360–363, 2000.
16. Santucci RA, and Krieger JN: Gentamicin for the practicing urologist: review of efficacy, single daily dosing and “switch” therapy. *J Urol* 163: 1076–1084, 2000.
17. Santucci RA, and McAninch JW: Actuarial success rates of open urethral stricture repair in 369 patients (abstract). *J Urol* 165: 13, 2001.
18. Andrich DE, Dungleison N, Greenwell TJ, *et al*: The long-term results of urethroplasty. *J Urol* 170: 90–92, 2003.
19. Jordan GH: Reconstruction of the fossa navicularis. *J Urol* 138: 102–104, 1987.
20. Armenakas NA, Morey AF, and McAninch JW: Reconstruction of resistant strictures of the fossa navicularis and meatus. *J Urol* 160: 359–363, 1998.
21. Blandy JP, and Tresidder GC: Meatoplasty. *Br J Urol* 39: 633–664, 1967.
22. Guralnick ML, and Webster GD: The augmented anastomotic urethroplasty: indications and outcome in 29 patients. *J Urol* 165: 1496–1501, 2001.
23. Morey AF, and McAninch JW: When and how to use buccal mucosal grafts in adult bulbar urethroplasty. *Urology* 48: 194–198, 1996.
24. Snodgrass W, Koyle M, Manzoni G, *et al*: Tubularized incised plate hypospadias repair for proximal hypospadias. *J Urol* 159: 2129–2131, 1998.
25. Orandi A: One-stage urethroplasty: 4-year followup. *J Urol* 107: 977–980, 1972.
26. Quartey JK: One-stage penile/preputial island flap urethroplasty for urethral stricture. *J Urol* 134: 474–475, 1985.
27. McAninch JW: Pubectomy in repair of membranous urethral strictures, in McAninch JW (Ed): *Traumatic and Reconstructive Urology*. Philadelphia, WB Saunders, 1996, pp 411–415.
28. Mundy AR: Urethroplasty for posterior urethral strictures. *Br J Urol* 78: 243–247, 1996.