0022-5347/97/1571-0104$03.00/0
THE JOURNAL OF UROLOGY
Vol. 157, 104-108, January 1997
Printed in U.S.A.

TREATMENT OF COMPLEX ANTERIOR URETHRAL STRICTURE DISEASE WITH MESH GRAFT URETHROPLASTY

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ABSTRACT

Purpose: Treatment of complex anterior urethral strictures complicated by a lack of sufficient penile skin for primary flap repair has generally consisted of 2-stage scrotal inlay urethroplasty. Scrotal skin has shortcomings, most notably hair formation, diverticula and stricture recurrence from urine induced dermatitis. As an alternative, we present our results with staged mesh graft urethroplasty using split-thickness skin, which is nonhair-bearing, easier to size and seemingly less permeable to urine penetration.

Materials and Methods: Between 1990 and 1995, 20 men underwent mesh graft urethroplasty for complex strictures, most after failed urethroplasty. Meshed split-thickness skin graft from the thigh (17 men) or full-thickness foreskin (3) was used.

Results: Overall median time to closure was 5.5 months, and 6 men required revision before closure (revision of ostia in 3, chordee release in 2 and lysis of graft adhesions in 1). A successful outcome, as evidenced by retrograde urethrography and history, was achieved in 12 of 15 men (80%) with a median followup of 38 months. Five men have not undergone closure due to patient refusal (2) or because the graft is not ready to be closed (3). Of the failures 2 men had retrograde urethrographic evidence of stricture at the proximal anastomosis and 1 had recurrent stenosis of the entire neourethra by 2 years.

Conclusions: Mesh graft urethroplasty is not a panacea but it is a valuable adjunct in the treatment of complex urethral strictures, offering comparable results to and benefits over scrotal inlay procedures. In a significant percentage of cases it is a multistage rather than a 2-stage procedure.

KEY WORDS: urethral stricture, surgical flaps, surgical mesh

Most urethral stricture disease that recurs after failed urethral dilation or optical urethrotomy can be repaired successfully using 1-stage urethroplasty techniques.[1] However, 1-stage repairs are generally limited to cases when penile skin is available for graft or flap construction, the stricture is of appropriate length to allow anastomosis and there are no adverse local features that may jeopardize graft or flap survival. When these criteria are not met the stricture has been termed complex and a multistage repair may be appropriate.

Historically, complex lengthy urethral strictures were treated by 2-stage scrotal inlay urethroplasty, with the procedures performed differing only in the flap design and inlay technique.[2-6] At stage 1 the strictured portion of the urethra was marsupialized to the scrotal skin margin. At stage 2 the neourethra was then tubularized from the remaining strictured urethral roof strip and adjacent inlaid scrotal skin. Unfortunately, the results of such scrotal inlay urethroplasties have been less than optimal. Several series have suggested a long-term repeat stenosis rate of approximately 25%.[2,7,8] In a review of reported series of Johanson urethroplasty, Olsson and Krane found overall combined rates of 14% for recurrent stricture, 14% for diverticulum formation and 6% for urethrocutaneous fistula.[9] Brendler and Jacobson reported a 10% failure rate with short-term followup for strictures treated with the Turner-Warwick urethroplasty, and 50% of patients required at least 1 revision between stage 1 and closure.[10] Scrotal skin has poor waterproofing qualities with resultant urinary dermatitis and later cicatrization. The skin is also hair-bearing, and intraurethral hair growth may lead to infection and be a nidus for stone formation, further predisposing to recurrent stricture. Mundy clearly demonstrated that scrotal skin is inferior to penile or preputial skin for onlay or tubed urethroplasty, showing recurrent stricture rates at 5 years of 31 and 67%, respectively, for scrotal skin compared to 14 and 19%, respectively for penile skin.

Schreiter and Noll have been proponents of staged meshed graft urethroplasty, generally using full-thickness preputial skin.[12] The inlay of meshed preputial or split-thickness extragenital skin graft around the marsupialized urethra at stage 1 in place of scrotal skin is seemingly a successful way to circumvent problems, since the graft is hairless, appears to have better waterproofing qualities and is easier to form into a uniformly sized urethra, decreasing the risk of diverticulum formation. We report our experience with mesh graft urethroplasty for complex urethral stricture disease using mainly split-thickness skin graft from the thigh.

MATERIALS AND METHODS

Between 1990 and 1995, 20 men 16 to 60 years old (median age 40) with complex strictures underwent mesh graft urethroplasty. The primary indications for this technique were lengthy or multiple strictures, complicating adverse local factors, such as inflammation or fistula, and lack of sufficient penile skin for a 1-stage repair. All patients had a long history of extensive stricture disease treated by repeated urethral dilations and/or optical urethrotomy, and prior urethroplasty had failed in 11. The etiology of the strictures was balanitis xerotica obliterans in 6 patients, trauma in 3, urethritis in 2, hypospadias in 1 and unknown causes in 8. All

Accepted for publication July 26, 1996.
Read at annual meeting of American Urological Association, Orlando, Florida, May 4-9, 1996.

strictures were at least 5 cm. long and in 5 patients the disease involved the entire urethra distal to the verumontanum. Stricture disease in 2 patients was complicated by prior periurethral abscess and fistula.

All patients were evaluated preoperatively by retrograde urethrography, with cystourethroscopy generally reserved for the operation. Surgery was performed with the patient under general anesthesia in the lithotomy position and with broad-spectrum antibiotic coverage. The operative field was prepared to include the full circumference of the right thigh as well as the genitalia and perineum. Depending on stricture location, the skin was either ventrally incised in the midline along the penile shaft or in the perineum bifurcating posteriorly towards the ischial tuberosities. When necessary, the scrotum was bivalved to allow access to the distal bulbar and proximal pendulous urethra. The urethra was ventrally marsupialized, extending the urethrotomy 2 cm. proximally and distally into healthy nonstrictured urethral tissue. If required, hemostasis was obtained by over sewing the spongy tissue edges with running 4-zero chromic suture.

A pneumatic dermatome set at 0.022 inch was used to harvest sufficient split-thickness skin from the anteromedial thigh, and the graft was meshed to a ratio of 1.5:1. Alternatively, full-thickness foreskin was used in 3 uncircumcised patients. Foreskin was not used as a graft for any man with balanitis xerotica obliterans. The penile and scrotal skin edges were retracted laterally from the incised urethra to ensure that a large enough area was grafted to allow for graft shrinkage. The graft was then sutured into the defect using 4-zero polyglactin around the marsupialized urethra between the urethral edge and penile or scrotal/perineal skin edge (fig. 1). The graft was bolstered in place with a surgical dressing as layer 1 followed by cotton balls soaked in Bunnell's solution (acetic acid, glycerine and normal saline) as layer 2 and gauze as layer 3. The bolster dressing was held in place with 3-zero polyglactin ties to achieve gentle but secure approximation of the graft to the bed (fig. 2). Urinary diversion was accomplished with a urethral Foley catheter and a suprapubic catheter in some cases. The donor site was covered intraoperatively with epinephrine soaked sponges to promote hemostasis and then with an occlusive adhesive dressing left in place until it spontaneously peeled off several days postoperatively.

Early postoperatively, the graft dressing was kept moist with Bunnell's solution and patient activities were restricted to prevent graft shearing. The bolster dressing was maintained for 5 days until preliminary graft take was assured. Erections were prevented with amyl nitrate and diazepam at bedtime for week 1 but then encouraged, particularly if the penis was also grafted, to avoid graft contracture and penile chordee. Once the initial dressings were removed, twice daily dressings and sitz baths were begun. The Foley catheter was removed at approximately 14 days, allowing the patient to void through the perineal urethrostomy. Followup visits were initially every 2 weeks and then monthly until stage 2 was completed in approximately 3 to 6 months. At each visit the ostia were calibrated with a bougie-à-boule and skin bridging was lysed by digital separation or incision.

At stage 2 tubularization of a uniform caliber neourethra of approximately 28 to 30F was done (fig. 3). The old strictured urethra, if not previously excised, formed the roof strip of the neourethra and the main portion of the urethra comprised the tubularized graft. The neourethra was outlined as a 30 to 35 mm. wide strip straddling the urethral roof strip and, once incised, the isolated segment was tubularized around a 28F forming catheter using a watertight running 4-zero polyglactin suture. The surrounding scrotal and penile skin was then judiciously mobilized, allowing for a multilayer closure over the neourethra. The 28F forming catheter was replaced with a 14F silicone stent, and a small Jackson-Pratt drain was inserted periurethrally when appropriate.

Patients were discharged from the hospital within 2 to 3

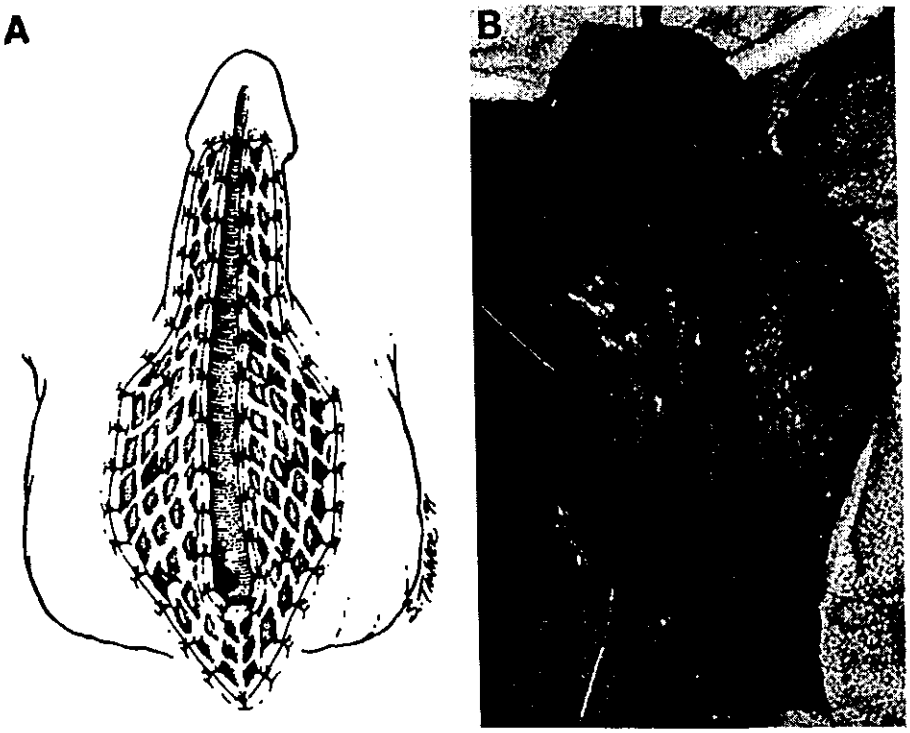

FIG. 1. Stage 1 of mesh graft urethroplasty using split-thickness skin graft from thigh. *A*, reprinted with permission from Webster, G. D. and Khoury, J. M.: Urethral stricture disease. In: Clinical Urology. Edited by R. Krane and M. Siroky. Philadelphia: J. B. Lippincott Co., p. 914, 1994. *B*, surgical repair.

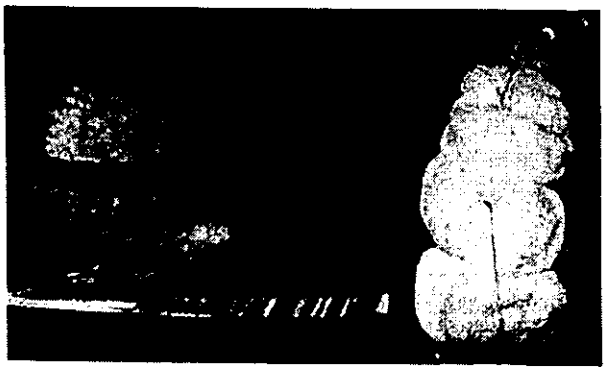

FIG. 2. Bolster dressing for grafted site. Note also donor site on medial thigh.

FIG. 3. Soft pliable, hairless split-thickness skin graft ready to be tubularized for neourethra reconstruction. Note that urethral roof strip was excised at stage 1.

days with oral antibiotics to return in 14 days for removal of the stent. A pericatheter retrograde urethrography was always performed before stent removal. The patient was seen at 3 months and then annually, with followup retrograde urethrography (fig. 4).

RESULTS

Graft take was uniformly excellent with no more than 5% loss observed in any patient. During the observation period after stage 1 and before closure 6 men required surgical revision. Proximal ostial stenosis mandated Y-V plasty in 3 patients, 1 of whom had full length recurrent stricture disease and had previously undergone 2 scrotal-urethral inlay urethroplasties. He was known preoperatively to have a cavitated and fibrotic prostatomembranous urethra from previous injury, surgery and infection. The ostium has since been revised twice but he continues to void per perineal urethrostomy, awaiting confirmation of stability of the prostatomembranous urethra. One patient had extensive balanitis xerotica obliterans and ostial stenosis developed approximately 10 weeks postoperatively. He required further proximal urethral marsupialization into normal urethra with more graft inlay.

During the observation period 2 men with pendulous urethral strictures and split-thickness skin graft from the thigh had penile chordee, which was treated by simple flap rotation with no recurrence. One patient required surgical incision and lysis of cross adhesions of the graft over the urethral roof strip. Median time from stage 1 to closure was 5.5 months (range 3 to 24). Five men have not undergone closure because they prefer to continue voiding per perineal urethrostomy (2) or are still within the observation period (3).

A successful outcome with no recurrent stricture, as evidenced by normal retrograde urethrography and voiding history, was achieved in 12 of 15 men (80%). Median followup from closure in this group was 38 months (range 3 to 56). Failures were due to recurrent stricture at the proximal anastomotic line (2 cases) or along the entire length of the neourethra (1), and all occurred in the group treated with split-thickness skin graft from the thigh, with no failures identified in the group in which foreskin was used. These failures showed stable graft and ostia before closure, and had not required revision during the observation period. One man with recurrent proximal stricture is asymptomatic and continues under observation without intervention while 1 is performing self-calibration. The recurrent strictures became evident at 26 and 36 months of followup. The patient with recurrent full length stricture underwent creation of a second neourethra from the remaining local graft skin at 2 years and continues to do well with a further 2 years of followup. The only other post-closure complication was a urethrocutaneous fistula that required subsequent closure in a man with hypospadias and multiple failed repairs. No urethral diverticula were documented by retrograde urethrography.

DISCUSSION

The majority of patients treated with split-thickness mesh graft urethroplasty have lengthy strictures that require large grafts for reconstruction, particularly when graft shrinkage is considered. Shrinkage is maximal by 3 months postoperatively, and approaches 50% for split-thickness and 20% for full-thickness grafts. In select patients with strictures of the pendulous urethra full-thickness skin may have a theoretical advantage, since excessive graft shrinkage along the penile shaft may result in chordee. In our experience both patients with penile chordee during the observation period had split-thickness thigh skin as the source of the graft. While use of full-thickness grafts is preferable, this is not always possible since the availability of thin, hairless skin is limited by previous circumcision. Extragenital full-thickness skin may also yield suboptimal results compared to skin from genital sources for substitution urethroplasty.[13] Extrapenile split-thickness grafts are superior to extra penile full-thickness grafts because they are more pliable and graft take is superior. Harvesting the graft to 0.022 inch excludes all hair follicles and ensures a hairless graft. The graft is

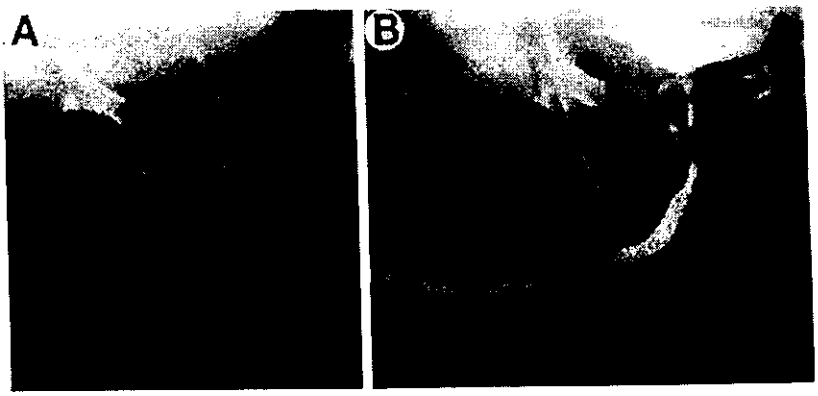

FIG. 4. Retrograde urethrogram preoperatively (*A*) and after mesh graft urethroplasty (*B*). Two previous urethroplasties were unsuccessful.

meshed to improve wound drainage of secretions and blood, which can deter graft take, and to increase the area of cover. The thigh is an ideal donor site, since there is no limitation of skin availability and it is readily accessible with the patient in the lithotomy position. Although initially the donor site is unsightly, the area fades with time and becomes cosmetically acceptable.

In the majority of cases the urethral roof strip is left intact and is excised only if it is excessively scarred and obliterated. Graft inadvertently placed over urethral mucosa is not a problem, since it does not survive. Placing graft directly on the corpora cavernosa without intervening soft tissue is suboptimal because the resultant lack of graft mobility will make future retubularization difficult, and graft shrinkage could cause penile chordee.

Although our dressing may appear rather elaborate, the importance of a secure bolster and patient immobilization to prevent graft shearing during the period of early graft take cannot be overemphasized. With these provisions graft take universally approaches 95 to 100%.

As with all 2-stage urethroplasties, an eventual successful outcome relies on careful interim management. Careful calibration (and not dilation) of the ostia with a bougie-à-boule to ensure a 30F caliber proximally and 26F distally is of utmost importance. The risk of ostial stenosis should be minimized by generous incision of the urethra proximally and distally into healthy tissue. Stenosis, if it occurs, should be treated with Y-V plasty rather than dilation, and the stage 2 closure should then be deferred for a further 3 to 6 months until the ostia are stable. Skin bridging is common and all adhesions require digital separation. Urinary diversion is required until the graft is epithelialized. Although the Foley catheter initially acts as an ostial splint, it should be removed within 1 to 2 weeks postoperatively to prevent pressure necrosis of the graft. The goal of this proper interim care is to achieve adequate sized stable ostia, along with a supple well epithelialized hairless skin graft ideal for retubularization.

The grafted area is hypopigmented and easily identified for retubularization. Excision of any excessive skin graft at the final skin closure is optional. Although excision tends to be more cosmetically pleasing, leaving the grafted hairless skin in the perineum has obvious advantages if future urethroplasty is required.

Mesh graft urethroplasty is an excellent technique in select difficult cases of complex urethral stricture disease but it should be used for highly selected stricture disease. Of our approximately 200 urethroplasties performed during the last 5 years only 10% were mesh graft procedures. As illustrated by 6 of our 19 patients, surgical intervention during the surveillance period is frequently required to ensure an ultimate desirable result. For this reason we believe that mesh graft urethroplasty should be considered a multistage rather than a 2-stage procedure. The conclusion that this is a multistage repair markedly contrasts with the experience of Schrieter and Noll with mesh graft urethroplasty in 96 patients, of whom none underwent interim revision before closure.[12] The surgical success rate was 98%, with 4 men requiring curative visual urethrotomy for recurrent stricture considered cured. Their patient selection criteria may have been different from ours, accounting partly for the contrasting results. Of 169 urethroplasties performed by Lindell et al between 1977 and 1990, 60% were done with mesh graft,[14] in contrast to our 10% case selection. Our results better parallel those of Lipsky, who found a recurrent stenosis rate of 19% (4 of 21 cases) within 2 years of mesh graft urethroplasty.[15] His interim revision rate was 13%, with the majority of patients undergoing successive reconstruction in 2 stages.

CONCLUSIONS

Mesh graft urethroplasty, although not a panacea, is an excellent alternative for repair of complex urethral stricture disease, and durable successes at 3 years may be expected in approximately 80% of patients. The technique has many advantages over other 2-stage urethroplasties that tubularize the neourethra from scrotal skin. Mesh grafting generates a smooth, supple hairless skin graft ideal for urethral tubularization, and with this technique there is no limitation on the amount of tissue that can be obtained enabling reconstruction of the entire urethra, if necessary. One cannot overemphasize that in many patients this becomes a multistage, rather than a 2-stage repair but we believe that this is appropriate considering the complex nature of this type of stricture disease. Although mesh graft urethroplasty offers good outcome and is potentially versatile, it should be used only in circumstances inappropriate for 1-stage anastomotic or penile flap repairs.

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