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ORIGINAL ARTICLE

Contemporary analysis of management of isolated pendulous urethral strictures using pedicled skin flap urethroplasty repair

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Abstract

Objectives To evaluate contemporary outcomes of urethroplasty employing a pedicled skin flap for isolated pendulous urethral strictures.

Subjects/patients Inclusion of males > 18 years of age with isolated pendulous urethral strictures treated between 1996 and 2012.

Results A total of 81 patients with isolated pendulous urethral stricture were identified. Twenty-eight patients underwent repair with a pedicled skin flap during the study period. The median age of the patients treated with a pedicled skin flap was 47 years old (range 21–74). The etiology of the strictures was considered to be idiopathic in 10 patients (35.7%), iatrogenic in 9 patients (32.1%), as a complication of prior hypospadias repair in 6 patients (21.4%), infectious in 2 patients (7.1%), and traumatic in 1 patient (3.6%). The median follow-up was 27 months (range 1–214). Urethroplasty success was noted in 19/21 patients (90.5%). Urethral stricture recurrence occurred in 2 of the 21 patients (9.5%).

Conclusions The pedicled skin flap repair for pendulous urethral strictures remains a durable and safe technique in patients without LS.

Keywords Urethroplasty · Urethral stricture · Pedicled skin flap · Orandi urethroplasty

Introduction

Determining the optimal urethroplasty technique for the management of pendulous urethral stricture disease is challenging due to the variability in presentation, severity, and underlying pathology. Factors when considering the most appropriate surgical approach include prior interventions, genital skin quality, and the patient's expectation of the repair. In bulbar urethral strictures, mobilization to perform an excision and primary anastomosis (EPA) urethroplasty can be accomplished in up to 5-cm stricture segments [1]. However, universally applying bulbar urethroplasty techniques to pendulous strictures is limited by the sequelae of possible chordee and penile shortening that can be seen in EPA repairs.

Historically, the two-stage urethroplasty [2] has been an option for pendulous strictures. However, the protracted time from initial intervention to tubularization makes this a less than desirable approach in the presence of an alternative technique. As such, a one-stage urethroplasty with a laterally based pedicled skin flap gained popularity in the 1990s [3, 4]. Most recently a growing interest in the use of autologous tissue to augment the diseased urethra has gained traction. Good outcomes have been observed with one-stage urethroplasty repairs employing free grafts [5–7] and a combination of flaps and grafts to create a composite repair [8, 9].

The Orandi urethroplasty, described in 1968, consists of a laterally based flap of penile skin, which is used as a ventral onlay for anterior urethral strictures [3, 10]. Although the use of this technique has been declining due to an alternative use of buccal mucosa graft for repair, it remains an important procedure in our armamentarium for pendulous urethral stricture management. In selecting this repair technique, patients with non-obliterative strictures with adequate

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penile skin integrity are appropriate candidates. This is also an alternative for patients with a diseased pendulous urethra in the presence of a short segment of severe narrowing amenable to excision and re-approximation. Herein, we report our experience using this technique in treating isolated pendulous urethral strictures.

Methods

We conducted an IRB-approved review of our institutional urethroplasty database from 1996 to 2012. Patients with isolated pendulous urethral strictures were identified and those who underwent a pedicled skin flap urethroplasty were included. Exclusion criteria included age < 18 years, lichen sclerosis, anastomotic urethroplasty, and augmentation urethroplasty with buccal mucosa. For evaluation of outcomes of urethroplasty, patients with no post-operative follow-up were excluded. Last follow-up was determined based on the patient's last visit in the urology clinic only. Data extracted included patient demographics, stricture etiology, stricture length based on RUG or measured intra-operatively at the time of urethrotomy, comorbid conditions, previous therapies, surgical complications, and follow-up data. Complications recorded included any need for readmission, VTE, cardiopulmonary events, infectious events, and wound issues.

Outcomes

Urethroplasty was considered successful if there was no need for further instrumentation including urethral dilation, self-calibration, repeat urethroplasty, or if symptomatic urethral narrowing was noted despite the absence of subsequent treatment. Follow-up included patient-reported outcomes measures (IPSS) to establish symptom recurrence, uroflow, and PVR. It has been our practice to obtain imaging or cystoscopy only if symptoms return or if evidence of obstruction on non-invasive urodynamics such as urine flow rates becomes demonstrable. Descriptive statistics were used to report outcomes.

Surgical technique

Two surgeons performed all operations (ACP, GDW). Methylene blue (2 ml) was injected retrograde to stain the urethral mucosa. A 20 French catheter was inserted into the urethra to the level of the urethral stricture to identify the exact distal level of the defect. A midline ventral midline incision was made on the penile shaft. The dartos layer was dissected and the urethra encountered. With the pendulous urethra completely exposed, a urethrotomy was made at the level of the stricture and opened proximally until normal urethra was encountered (Fig. 1). Flexible cystoscopy was then performed to ensure no strictures presented proximal to the urethrotomy. Next, the penile skin lateral to the stricture was marked out to a width of 1.5–2 cm and a length corresponding to length of the stricture. Penile skin, distal to the hair-bearing aspect of the penile shaft specifically, was utilized (Fig. 2). The ends of the skin flap were tapered to facilitate closure and prevent vascular compromise of the proximal and distal limits of the flap. The skin lateral to the flap was elevated and dissected to preserve vascular supply to the skin flap (Fig. 2). A 4-0 vicryl suture was then used to approximate the skin edge to the urethral mucosa (Fig. 2). The flap was then anastomosed to the contralateral mucosal edge over a 14 French catheter. Mobilization of a dartos flap for additional suture line coverage to prevent fistula formation was accomplished by elevation of the contralateral skin and coverage of the underlying suture line. The penile skin was then closed in a running horizontal mattress fashion with 4-0 vicryl suture. The urethral catheter was removed 3 weeks after a pericatheter retrograde urethrogram (RUG) demonstrating no extravasation.

Results

In total, 677 urethroplasties from 1996 to 2012, in all areas of the urethra, were reviewed. Of these, 81 had isolated pendulous urethral strictures. Twenty-eight urethral strictures were repaired with a pedicled skin flap. Of the remaining 53 patients, 14 underwent a perineal urethrostomy, 9 underwent excision and primary anastomosis, 5 underwent extended meatotomy, 10 underwent a first-stage repair only, 10 underwent a two-stage repair with buccal graft, 2 underwent a buccal onlay, and 3 were excluded due to LS. The median age of the patients treated with a pedicled skin flap was 47 years old (range 21–74). The etiology of the strictures was considered idiopathic in 10 patients (35.7%), iatrogenic in 9 (32.1%), as a complication of prior hypospadias repair in 6 (21.4%), infectious in 2 (7.1%), and traumatic in 1 patient (3.6%; Table 1). The majority of the patients (26/28) were treated with a laterally based pedicled skin flap. The remaining 2 patients were treated with a circumferential pedicled skin flap. The median stricture length for all cases was 4.2 cm (range 0.5–10 cm).

In the whole cohort, there were 5 (5/28, 17.8%) postoperative complications. A DVT was recorded in 2 patients, breakdown of the wound secondary to ventral traction on the catheter required revision in 1 patient, scrotal abscess in 1 patient requiring incision and drainage, and penile cellulitis treated with oral antibiotics in 1 patient.

The median follow-up was 27 months (range 1–240). Urethroplasty success was noted in 19/21 patients (90.5%).

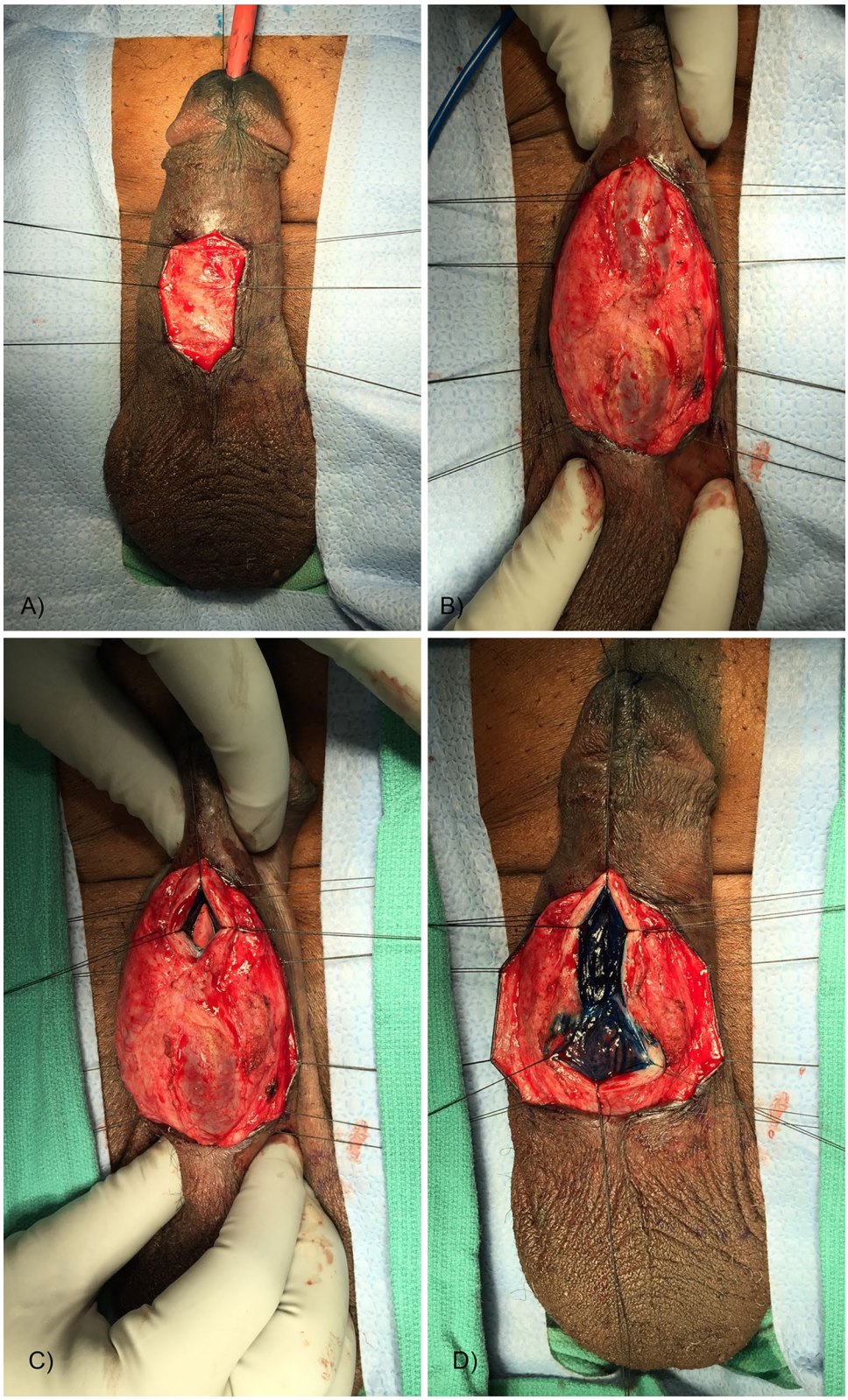

Fig. 1 **a** Ventral incision on the skin. Stay sutures allow retraction. **b** Urethra is identified and the distal segment of narrowing demarcated by the 20 Fr. catheter. **c** Ventral urethrotomy over catheter. Methylene blue dye stains the urethral mucosa for ease of identification. **d** The urethrotomy is carried proximally until healthy mucosa is noted

Due to lack of follow-up, 7 patients were not included in the outcomes reporting. Urethral stricture recurrence occurred in 2 of the 21 patients (9.5%; Table 2). One patient was managed with a perineal urethrostomy and one with staged urethroplasty utilizing buccal mucosa with tubularization 12 months later. Of these patients, one recurred 1 month

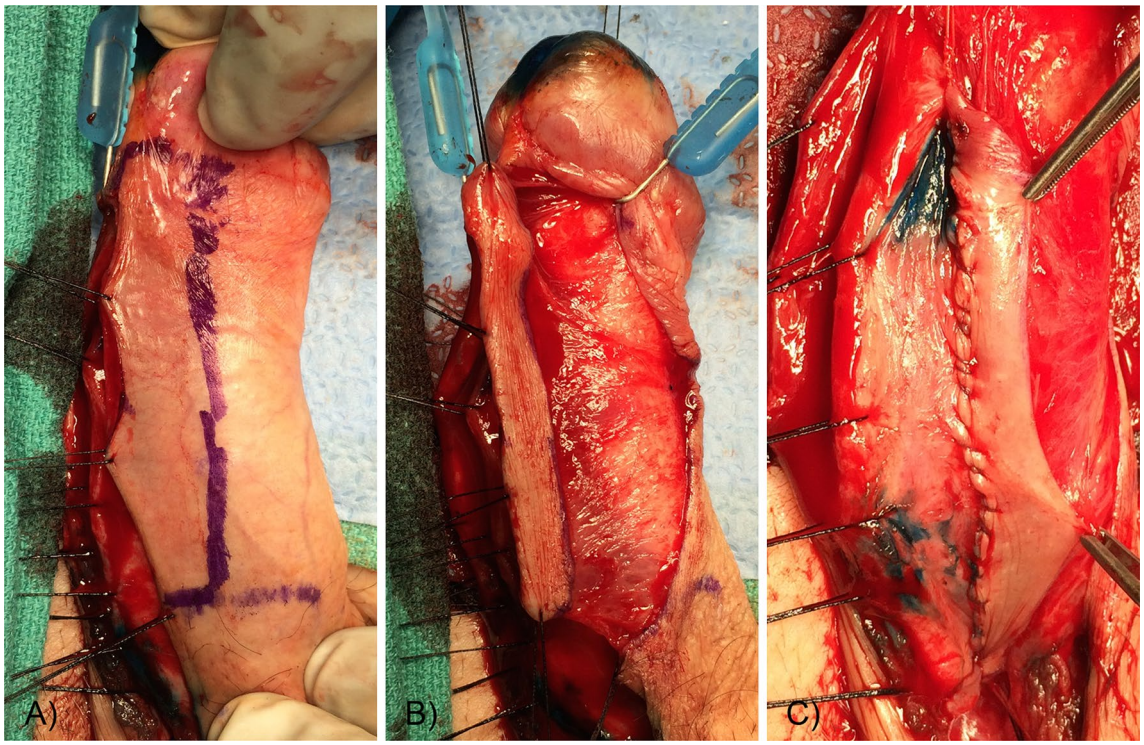

Fig. 2 **a** The flap is demarcated. Note the horizontal marking extending beyond the flap. This was marked prior to shaving and delineates the edge of the non-hair bearing skin. **b** Flap is developed ensuring preservation of the dartos layer which provides the blood supply. **c** Running anastomosis of the flap onto the mucosa

Table 1 Demographics

Total patients	28	
Age (years)	47	21–74
BMI		
Median stricture length (cm)	4.2	0.5–10
Stricture etiology		
Idiopathic	10	35.7%
Iatrogenic	9	32.1%
Hypospadia	6	21.4%
Infectious	2	7.1%
Traumatic	1	3.6%
Prior urethroplasty (*n*)	3	10.7%
Prior urethrotomy (*n*)	14	50.0%
Prior dilation (*n*)	22	78.6%
Tobacco use (*n*)	8	28.6%
Diabetes (*n*)	2	7.1%
Hypertension (*n*)	5	17.9%
Hyperlipidemia (*n*)	5	17.9%
Coronary artery disease (*n*)	1	3.6%

post-operatively and presented with urinary straining and a weak stream, and one recurred 14 months post-operatively.

Table 2 Outcomes

Total patients (*n*)	28
Lost to follow-up (*n*)	7
Median follow-up (mo)	27
Success (19/21)	90.5%
Recurrence (2/21)	9.5%
Management of recurrence	
Perineal urethrostomy (*n*)	1
Two-stage urethroplasty (*n*)	1
Complications	
Deep venous thrombosis (*n*)	2
Wound breakdown (*n*)	1
Abscess (*n*)	1
Cellulitis (*n*)	1

Discussion

The management of pendulous urethral strictures is complex due to the variability in presentation and extent of disease. A number of techniques over the years have been proposed including single-stage pedicled skin flap repairs, buccal onlay and inlay repairs, composite repairs, and

two-stage repairs employing buccal and full thickness skin grafting with subsequent tubularization. In the most severe cases, abandonment of the pendulous urethra and creation of a perineal urethrostomy may be necessary. The appeal of a local flap such as a pedicled skin flap stems from its proximity to the diseased urethra and reliable blood supply. However, with the advent of buccal repairs, the pedicled skin flap repair is often considered inferior. In this vein, we executed a diverse array of repairs for pendulous urethral strictures of which pedicled skin flaps were few. A review of our outcomes with pedicled skin flaps shows this approach to have acceptable results leading to this report. We are now utilizing this approach with more frequency at our institution.

Orandi described the technique of a laterally based pedicle island skin flap for treatment of pendulous urethral strictures in 1968, updating it in 1972 [3, 10]. In his series, 21 patients were treated with the Orandi technique with recurrence seen in one patient and hair/stones in the neourethra in another 2 (86% success rate). In our series of 28 patients with isolated strictures of the pendulous urethra, the overall success was 90.5% with a median follow-up of 27 months.

In a series of 202 patients undergoing pedicled skin flap urethroplasty for anterior urethral strictures, Schulte-Baukloh et al. describe a 63.4% success rate in all patients, which improved to 84.7% after a single DVIU post-urethroplasty. In a sub-group analysis of 39 pendulous strictures, the success rate of a single pedicled skin flap urethroplasty was 72% [11].

Since Orandi, multiple variations of his technique have been described including the circular fasciocutaneous flap described by McAninch [4] and the one-stage distal preputial island flap described by Quartey [12–16]. Success rates of the circular fasciocutaneous flap as described by McAninch as well as other preputial skin flaps have been reported at 79–95% [17–21]. In his most recent update, Whitson et al. described their series of 124 patients undergoing circular fasciocutaneous flap urethroplasty. At 1, 3, 5, and 10 years, the recurrence-free survival rates were 95, 89, 84, and 79%, respectively [18]. In a series of 36 patients treated with circular fasciocutaneous flap, Schwentner et al. described a 90% success rate over 96.7-month follow-up [17].

In recent years, the ventral or dorsal onlay buccal mucosa graft urethroplasty has seemingly overtaken the flap-based urethroplasty as the most commonly used technique for the repair of long bulbar strictures or strictures of the pendulous urethra. Increased success of buccal grafting over penile skin flaps in bulbar urethroplasty has been reported [22]; limited reports for isolated pendulous strictures exist. In a recent series by Barbagli et al., 54 patients underwent reconstruction of the penile urethra. Success of penile skin flap was found to be 77% ($n=13$) versus 85% in those receiving buccal mucosa grafting ($n=20$). A direct comparison between the outcomes of pendulous urethral stricture repair with pedicled skin flaps and buccal grafts is difficult given the intrinsic variability in the patients who undergo one repair versus the other.

It has been well established at this point that patients with lichen sclerosus should not have augmentation urethroplasty using genital skin due to the very high recurrence rate seen with these repairs [23–25]. Only three patients in this series had lichen sclerosus and were excluded from the analysis. Pedicled skin flap repair in these patients was considered a temporizing measure, given that they refused a staged procedure secondary to its morbidity. In our more recent experience, intraurethral steroid therapy is preferable to flap-based or staged repairs for these patients given their high risk of failure [26]. Although not reported in our results, two of these patients had a patent repair on follow-up.

Similarly, Whitson et al. found patients with a history of hypospadias to be 4.4 times more likely than those without hypospadias to have stricture recurrence after pedicled skin flap urethroplasty on multivariate analysis [18]. In our cohort, 6 patients had a history of hypospadias. One of these patients had a recurrence on follow-up. Flap-based repairs in this cohort are challenging given the aberrant vascular supply of penile tissue. Preoperative evaluation is focused on assessing the quality of the potential tissue for repair. Intraoperatively, careful mobilization to minimize trauma to the blood supply of the flap is imperative.

A notable limitation of most studies reporting on pendulous urethral strictures is the small number of cases in their series. Herein, we evaluated isolated pendulous strictures. Given that the combination of pendulous and bulbar stricture in a single patient may herald worse disease, inclusion of those patients in this study may have led to a lower success rate. The true success rate of all patients treated with a pedicled skin flap repair may vary from the reported rate within this manuscript, given that seven patients were excluded due to the lack of follow-up—neither failure nor success was assumed in these patients. Notably, as a tertiary referral center, many patients elect to follow post-operatively with their local urologists thus limiting our ability to collect these data. The low number of events of recurrence limits our ability to analyze multiple variables and their role in outcomes. Thus, the role of prior interventions and comorbid conditions cannot be reliably assessed.

Conclusions

In our experience, urethroplasty with a pedicled skin flap is a successful technique for repair of isolated pendulous urethral strictures and an integral tool in management of these strictures. A success rate of 90.5% can be achieved in properly selected patients.

Author contributions RJMF: project development, data collection and analysis, and manuscript writing. MJB: data collection and analysis, and manuscript writing. MAG: project development, data analysis. AC: project development, data analysis, and manuscript writing. Authors whose names appear on the submission have contributed sufficiently to the scientific work and therefore share collective responsibility and accountability for the results.

Compliance with ethical standards

Conflict of interest The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. This protocol was carried out after review from the Institutional Review Board.

Studies involving human participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study was deemed excluded from informed consent by the IRB.

References

1. Terlecki RP, Steele MC, Valadez C, Morey AF (2010) Grafts are unnecessary for proximal bulbar reconstruction. J Urol 184(6):2395–2399. https://doi.org/10.1016/j.juro.2010.08.034
2. Johanson B (1954) Reconstruction of the male urethra in strictures—application of the buried intact epithelium technic. Acta Chir Scand 106(6):483
3. Orandi A (1968) One-stage urethroplasty. Br J Urol 40(6):717–719
4. McAninch JW (1993) Reconstruction of extensive urethral strictures: circular fasciocutaneous penile flap. J Urol 149(3):488–491
5. Barbagli G, Selli C, Tosto A, Palminteri E (1996) Dorsal free graft urethroplasty. J Urol 155(1):123–126. https://doi.org/10.1016/S0022-5347(01)66566-2
6. Morey AF, McAninch JW (1996) When and how to use buccal mucosal grafts in adult bulbar urethroplasty. Urology 48(2):194–198. https://doi.org/10.1016/S0090-4295(96)00154-9
7. Iselin CE, Webster GD (1999) Dorsal onlay graft urethroplasty for repair of bulbar urethral stricture. J Urol 161(3):815–818
8. Wessells H, Morey AF, McAninch JW (1997) Single stage reconstruction of complex anterior urethral strictures: combined tissue transfer techniques. J Urol 157(4):1271–1274
9. Erickson BA, Breyer BN, McAninch JW (2012) Single-stage segmental urethral replacement using combined ventral onlay fasciocutaneous flap with dorsal onlay buccal grafting for long segment strictures. BJU Int 109(9):1392–1396. https://doi.org/10.1111/j.1464-410X.2011.10483.x
10. Orandi A (1972) One-stage urethroplasty: 4-year followup. J Urol 107(6):977–980
11. Schulte-Baukloh H, Sturzebecher B, Blomers F, Fleck H, Knispel HH (2004) Orandi one-stage urethroplasty using the subcutaneous pedicle graft modification of Raatzsch—long-term results. Scand J Urol Nephrol 38(4):321–325
12. Quartey JK (1983) One-stage penile/preputial cutaneous island flap urethroplasty for urethral stricture: a preliminary report. J Urology 129(2):284–287
13. Quartey JK (1985) One-stage penile/preputial island flap urethroplasty for urethral stricture. J Urology 134(3):474–475
14. Quartey JK (1993) One-stage transverse distal penile/preputial island flap urethroplasty for urethral stricture. Ann Urol 27(4):228–232
15. Tijani KH, Adesanya AA, Ogo CN, Osegbe DN (2009) Penile fasciocutaneous flap urethroplasty: recent experience and challenges in a sub-Saharan African teaching hospital. Urology 74(4):920–923. https://doi.org/10.1016/j.urology.2009.05.041
16. Duckett JW Jr (1980) Transverse preputial island flap technique for repair of severe hypospadias. Urol Clin N Am 7(2):423–430
17. Schwentner C, Seibold J, Colleselli D, Alloussi SH, Gakis G, Schilling D, Sievert KD, Stenzl A, Radmayr C (2011) Anterior urethral reconstruction using the circular fasciocutaneous flap technique: long-term follow-up. World J Urol 29(1):115–120. https://doi.org/10.1007/s00345-010-0548-0
18. Whitson JM, McAninch JW, Elliott SP, Alsikafi NF (2008) Long-term efficacy of distal penile circular fasciocutaneous flaps for single stage reconstruction of complex anterior urethral stricture disease. J Urology 179(6):2259–2264. https://doi.org/10.1016/j.juro.2008.01.087
19. Berger AP, Deibl M, Bartsch G, Steiner H, Varkarakis J, Gozzi C (2005) A comparison of one-stage procedures for post-traumatic urethral stricture repair. BJU Int 95(9):1299–1302. https://doi.org/10.1111/j.1464-410X.2005.05523.x
20. Mathur RK, Nagar M, Mathur R, Khan F, Deshmukh C, Guru N (2014) Single-stage preputial skin flap urethroplasty for long-segment urethral strictures: evaluation and determinants of success. BJU Int 113(1):120–126. https://doi.org/10.1111/bju.12361
21. Abdel-Kader MS, Gadelmoula M, Elderwy A, Elgammal M, Abuzeid AM (2013) Long anterior urethral stricture: reconstruction by dorsally quilted penile skin flap. Urol Ann 5(3):163–166. https://doi.org/10.4103/0974-7796.115735
22. Barbagli G, Kulkarni SB, Fossati N, Larcher A, Sansalone S, Guazzoni G, Romano G, Pankaj JM, Dell'Acqua V, Lazzeri M (2014) Long-term followup and deterioration rate of anterior substitution urethroplasty. J Urol 192(3):808–813. https://doi.org/10.1016/j.juro.2014.02.038
23. Venn SN, Mundy AR (1998) Urethroplasty for balanitis xerotica obliterans. Br J Urol 81(5):735–737
24. Virasoro R, Eltahawy EA, Jordan GH (2007) Long-term follow-up for reconstruction of strictures of the fossa navicularis with a single technique. BJU Int 100(5):1143–1145. https://doi.org/10.1111/j.1464-410X.2007.07078.x
25. Stewart L, McCammon K, Metro M, Virasoro R (2014) SIU/ICUD consultation on urethral strictures: anterior urethra-lichen sclerosus. Urology 83(3 Suppl):S27–S30. https://doi.org/10.1016/j.urology.2013.09.013
26. Potts BA, Belsante MJ, Peterson AC (2016) Intraurethral steroids are a safe and effective treatment for stricture disease in patients with biopsy proven lichen sclerosus. J Urol 195(6):1790–1796. https://doi.org/10.1016/j.juro.2015.12.067