Outcomes of a urethroplasty algorithm for fossa navicularis strictures

Mark Broadwin, MS,[1] Alex J. Vanni, MD[2]
[1]Tufts University School of Medicine, Boston, Massachusetts, USA
[2]Lahey Hospital and Medical Center, Burlington, Massachusetts, USA

BROADWIN M, VANNI AJ. Outcomes of a urethroplasty algorithm for fossa navicularis strictures. *Can J Urol* 2018;25(6):9591-9595.

Introduction: *There is no standardized treatment algorithm for isolated fossa navicularis strictures and treatment modality often falls to surgeon preference. We evaluated the outcomes of a standardized algorithm for fossa navicularis strictures based on stricture etiology, lumen size, and glans size to minimize the number of patients requiring a two-stage urethral reconstruction.*
Materials and methods: *We retrospectively reviewed a prospectively maintained urethral reconstruction database by a single surgeon from 2011-2018. A treatment algorithm was applied and patients underwent one of three treatment modalities: a two-stage buccal mucosa graft (BMG), a single-stage dorsal inlay BMG, or a single-stage dorsal inlay BMG and ventral fasciocutaneous flap repair. Stricture recurrence was measured by inability to pass 17 Fr flexible cystoscope. Patient sexual function and satisfaction were evaluated by the International Index of Erectile Function (IIEF) and a patient perception questionnaire.*
Results: *Forty-two patients met inclusion criteria with a mean follow up of 12.3 months. Urethroplasty success rate was 92%. There was no change in IIEF scores pre and postoperatively between single stage BMG, two-stage BMG, and combined BMG and flap repairs (+ 0.4; p = 0.88, 0.0; p = 1.00, and -0.3; p = 0.74). Ninety-four percent of patients reported being very satisfied or satisfied with their reconstruction.*
Conclusion: *An algorithmic approach to the treatment of fossa navicularis strictures is an appropriate method for reconstructive intervention with a high rate of success and patient satisfaction with no significant impact on erectile function.*

Key Words: urethroplasty, fossa navicularis, urethral stricture, algorithm

Introduction

Fossa navicularis (FN) strictures represent a challenging clinical problem for the urologist with no universally accepted treatment algorithm. The pathogenesis of meatal and FN strictures are most commonly due to iatrogenic process, lichen sclerosus, or failed hypospadias reconstruction.[1-3] As our understanding of this disease has progressed, traditional treatment paradigms, such as the reconstructive ladder, have fallen out of favor.[3] This is largely due to the high recurrence rate and possible iatrogenic harm associated with minimally invasive techniques.[4] Despite the consensus in the literature over the past decade to manage anterior urethra strictures surgically, a specific reconstruction strategy of the FN stricture is still variable from patient to patient. This treatment heterogeneity is due to the wide range and high efficacy of multiple surgical techniques, such as two-stage repairs, flap repairs, and single-stage repairs, as well as surgeon preference. Similarly, goals for outcomes in surgical management of FN strictures have evolved with a greater emphasis put on cosmesis than in the past.[1-3,5]

There is a void in the literature for how one should approach surgical repair of FN strictures. Furthermore there is lack of consensus as to the viability of single-stage repairs for many patients leading to underutilization of this technique.[5] We proposed to create and evaluate the outcomes of a standardized algorithm for FN strictures based on stricture etiology, lumen size, and glans size to minimize the number of patients requiring a two-stage repair.

Accepted for publication September 2018

Address correspondence to Dr. Alex J. Vanni, Lahey Hospital & Medical Center, 41 Mall Road, Burlington, MA 01805 USA

Materials and methods

Subjects

Institutional review board approval was obtained for this study. We retrospectively reviewed a prospectively maintained urethral reconstruction database by a single surgeon from 2011-2018. Inclusion criteria were patients at least 18 years of age who underwent urethral reconstruction of an isolated FN stricture. Patients were excluded if their stricture involved an isolated meatal stenosis, those undergoing a meatotomy or meatoplasty, and a penile stricture involving the FN urethra.

Procedures and techniques

FN stricture location is determined by preoperative retrograde urethrogram, voiding cystourethrogram, and intraoperative measurements with a 5 Fr fogarty balloon. The balloon is inserted into the urethra, inflated to ~26 Fr, and pulled back towards the meatus. The balloon indicates the proximal extent of the stricture. Patients with confirmed FN strictures were then treated by one of three modalities, a two-stage buccal mucosa graft (BMG), a single-stage dorsal inlay BMG, or a single-stage dorsal inlay BMG and ventral fasciocutaneous flap repair, as determined prospectively by the algorithm in Figure 1. Patients with a stricture etiology of prior hypospadias repair underwent a two-stage BMG. Those with stricture etiology not including lichen sclerosus (LS) and with glans lumen too small to allow for 20 Fr tubularization underwent a dorsal inlay and fasciocutaneous flap repair. Patients with stricture etiology of LS by either clinical or pathologic diagnosis were excluded from flap repair due to the high rate of stricture recurrence in LS repairs with skin grafts or flaps.[6] Therefore, patients with LS etiology underwent a single-stage dorsal inlay BMG if they met the following criteria: the urethral plate and glans size allowed for 20 Fr calibration. Otherwise, LS patients underwent a two-stage BMG repair. A voiding cystourethrogram was performed 2-3 weeks postoperatively.

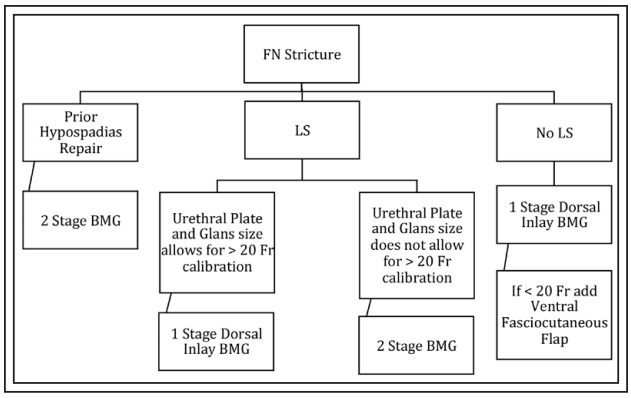

Figure 1. Algorithm for surgical intervention of FN stricture based on stricture etiology and functional anatomy.

Definitions and criteria

Patients were followed at 3-6 months, 12 months, and yearly with a uroflow, cystoscopy and questionnaires. Our primary outcome was stricture recurrence. Stricture recurrence was defined anatomically as a urethra < 17 Fr demonstrated by cystoscopy. Secondary outcomes included evaluation of sexual function, and patient's self-reported satisfaction. Sexual function was measured both pre and postoperatively via the validated International Index of Erectile Function (IIEF) questionnaire.[7] Patient satisfaction was measured by administration of satisfaction questionnaires, Table 1, postoperatively.

TABLE 1. **Satisfaction questionnaires**

Patient satisfaction					
Are you satisfied with the outcome your operation?	Yes, very satisfied ☐	Yes, satisfied ☐	Neither satisfied nor unsatisfied ☐	No, unsatisfied ☐	No, very unsatisfied ☐
Would you recommend urethroplasty (open surgery) to others with urethral stricture disease?		Yes ☐	No ☐	Maybe ☐	
Sexual function					
Did you have a change in penile sensitivity after surgery?	Increased sensitivity ☐		Decreased sensitivity ☐		No change ☐

Results

Subject characteristics

A total of 512 men underwent anterior urethroplasty from 2011-2018. Forty-two patients were identified that met inclusion criteria for isolated FN strictures. Patient stricture etiology and demographics are listed by repair type in Table 2. All patients with strictures of LS etiology (n = 11) underwent either single-stage BMG reconstruction (n = 4) or two-stage BMG repair (n = 7).

Stricture recurrence

At a mean follow up of 12.3 months (range 2.8-43.9 months) the anatomic success rate was 92% (24/26) with two stricture recurrences identified; one single-stage dorsal inlay and one two-stage repair.

One patient developed an UTI. No patients developed an urethrocutaneous fistula or complication of glans breakdown.

Sexual function

Mean baseline IIEF scores were 17.8, 21.0, and 21.3 in the single-stage BMG, two-stage repair, and flap repair arms respectively (p = 0.26). Post reconstruction IIEF scores were 18.2, 21.0, and 21.0 in the single-stage BMG, two-stage repair, and flap repair arms respectively (p = 0.63). There was no difference between the groups with respect to their pre and postoperative IIEF scores, with the change in mean IIEF being +0.4 (p = 0.88), 0.0 (p = 1.00), and -0.3 (p = 0.74) in the single-stage BMG, two-stage repair, and flap repair arms respectively.

Subject perception/satisfaction

Patient satisfaction was measured via patient satisfaction questionnaires seen in Table 1. Patients reported as being very satisfied (63%), satisfied (31%), or neither satisfied nor unsatisfied (6%) with the outcome of the repair. Increased penile sensitivity was reported in two patients who underwent single-stage dorsal inlay BMG and one patient with BMG and flap repair. Decreased penile sensitivity was noted in three patients with single-stage dorsal inlay BMG, one patient with a two-stage repair, and one patient with a BMG and flap repair. Eighty-six percent of patients stated they would recommend urethroplasty to others with urethral stricture disease (single-stage dorsal inlay BMG and flap repair: both stated maybe).

Discussion

To our knowledge, this is the first study evaluating the outcomes of an algorithmic approach to FN urethral strictures. Since first described by Orandi, flap repairs have been an attractive surgical approach to FN strictures as they limit scarring and preserve glans anatomy.[3,8,9] A two-stage approach is still favored by many due to its high rate of functional success.[3,10] More recently single-stage repairs have been proposed as they offer a single operation with a result that may be more esthetically pleasing to the patient.[5] The end result of the increased range of approaches has led to surgeon comfort and preference being the deciding factor in treatment choice as stated in almost all literature

TABLE 2. **Baseline study population characteristics and stricture etiology by repair type.**

	Dorsal inlay (n = 23)	**Two stage repair (n = 12)**	**Dorsal inlay and fasciocutaneous flap repair (n = 7)**
Mean age (range)	58 (42-72)	49 (27-69)	62 (54-68)
Mean body mass index (range)	32.0 (23.0-40.4)	31.8 (24.3-51.2)	29.4 (24.0-33.5)
Previous urethroplasty	3	2	0
Etiology of stricture			
Idiopathic	4	1	2
Iatrogenic	15	1	6
External urethral trauma	1	0	0
Failed hypospadias	0	2	0
Infectious	0	1	0
Lichen sclerosus	4	7	0
Radiation	0	0	0

regarding FN stricture repair. This is in contrast to other more proximal strictures involving the bulbar urethra, which have defined algorithmic approaches proposed in the literature and published by professional societies.[11]

We have demonstrated that the application of an algorithmic approach is an appropriate aid for the urologist when determining which surgical treatment option to use for the isolated FN stricture. Recurrence rates of FN strictures treated by flap repair vary by the specific flap technique used, with success rates ranging from 79%-100%.[7,12-15] Using a multistage buccal mucosa repair Meeks et al and Barbagli et al were able to demonstrate stricture free rates of 86% and 82% respectively.[2,12,16,17] Using a single-stage dorsal onlay Kulkarni et al demonstrated a 92% stricture free rate, although these are in more complex panurethral strictures.[2,18] With regard to stricture recurrence our data demonstrates a success rate well above the 35%-70% success rate reported with endoscopic techniques[11,19-21] and comparable to typical stricture recurrence rates when urethroplasty technique is decided upon by surgeon preference alone. It is worth noting that the ventral buccal graft inlay has recently been advocated by Nikolovsky as a minimally invasive approach to FN urethral strictures. The dorsal buccal graft inlay urethroplasty we describe is similarly trans-urethral and minimally invasive. However, we prefer a dorsal approach as the glans provides a robust a reliable graft bed to ensure graft take, and after the dorsal urethrotomy is made, can easily be converted into a two-stage repair if the lumen size is inadequate for a 1 stage repair.[22]

We demonstrated that sexual dysfunction is rare with any type of FN reconstruction with IIEF scores remaining stable across all three repair arms. Additionally, subjective patient satisfaction was also high using this algorithmic approach with almost all patients being satisfied or very satisfied and almost all patients stating they would recommend urethroplasty to others suffering from urethral stricture disease.

We showed that a single-stage repair is an appropriate choice for most patients seeking reconstruction for isolated FN strictures with similar successes rates, sexual function scores, and patient satisfaction metrics as two-stage repairs. Due to the superior outcomes with regards to cosmesis, and the fact that it burdens the patient with one less operation, we advocate for this algorithmic approach to minimize the number of two-stage repairs. Two-stage repairs however, should still be used in patients with hypospadias repair failures and obliterative LS strictures.

We believe this work addresses a void in the current literature regarding decision making for treatment of FN urethral strictures. While stricture free rates have been demonstrated across a wide modality of repair options in the literature, (such as those of flap repairs, multistage approaches, and single-stage repairs reported above) there currently lacks a decision-making tool for when each intervention is best utilized, in contrast to the approach used in the bulbar urethra. Furthermore our results demonstrate similar efficacy between single-stage and two-stage repairs which is consistent with much of the literature over the past decade advocating for a single-stage repair as a viable approach to anterior urethral strictures.[1,3,5] While stricture recurrence was rare regardless of repair choice and sexual function remained constant in all three arms, the cosmetic superiority and relived burden to the patient make single-stage dorsal inlay BMG our preferred approach when possible.

Urethral strictures are exceedingly challenging surgeries for even the most experienced reconstructive surgeon. However, strictures remain a common malady with a 0.6% overall incidence representing 5000 inpatient stays and almost 1.5 million office visits annually.[2,4,6] Establishing an algorithmic approach to this problem allows for decision making to move from that of individual surgeon preference to a more systematic methodology. While these complex repairs are best managed by high volume reconstructive surgeons, even the busiest surgeons see relatively few isolated FN strictures. We believe that many reconstructive surgeons whose practice sees fewer FN urethral strictures may benefit from a decision-making tool in order to avoid the pit falls and biases when treatment is left up to surgeon preference alone. Additionally, this work lays the foundation for a more systematic approach to outcomes research of FN urethral strictures.

This study is limited by its retrospective nature, small cohort size, and mean follow up of 1 year. Despite these limitations, we believe this manuscript is significant in that it demonstrates a way for the reconstructive urologist to systematically evaluate and treat FN strictures in a way to minimize the number of two-stage procedures without compromising outcomes. Additionally, we were able to evaluate and compare the impact of reconstruction on sexual function and patient satisfaction for each repair. Further research will be needed at other centers to validate this algorithm and determine whether it is reproducible.

Conclusion

An algorithmic approach to the treatment of FN strictures is an appropriate method for reconstructive intervention. Most patients can be successfully treated with a one-stage approach, and two-stage approach should be reserved for hypospadias repair failures and obliterative LS strictures. With this approach sexual function complaints are rare with a high degree of patient satisfaction. □

References

1. Armenakas NA, McAninch JW. Management of fossa navicularis strictures. *Urol Clin North Am* 2002;29(2):477-484.
2. Dielubanza EJ, Han JS, Gonzalez CM. Distal urethroplasty for fossa navicularis and meatal strictures. *Transl Androl Urol* 2014;3(2):163-169.
3. Singh SK, Agrawal SK, Mavuduru RS. Management of the stricture of fossa navicularis and pendulous urethral strictures. *Indian J Urol* 2011;27(3):371-377.
4. Tonkin JB, Jordan GH. Management of distal anterior urethral strictures. *Nat Rev Urol* 2009;6(10):533-538.
5. Chowdhury PS, Nayak P, Mallick S, Gurumurthy S, David D, Mossadeq A. Single stage ventral onlay buccal mucosal graft urethroplasty for navicular fossa strictures. *Indian J Urol* 2014; 30(1):17-22.
6. Santucci RA, Joyce GF, Wise M. Male urethral stricture disease. *J Urol* 2007;177(5):1667-1674.
7. Rosen RC, Cappelleri JC, Smith MD, Lipsky J, Pena BM. Development and evaluation of an abridged, 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res* 1999;11(6):319-326.
8. Jordan GH. Reconstruction of the fossa navicularis. *J Urol* 1987;138(1):102-104.
9. Jordan GH. Reconstruction of meatus/fossa navicularis using skin flap technique. *Urologe A* 1998;37(2):175-179.
10. Andrich DE, Greenwell TJ, Mundy AR. The problems of penile urethroplasty with particular reference to 2-stage reconstructions. *J Urol* 2003;170(1):87-89.
11. Wessells H, Angemeler KW, Elliott S et al. (2016). Male urethral stricture guidelines: American Urological Association guideline. *J Urol* 2017;197(1):182-190.
12. Armenakas NA, Morey AF, McAninch JW. Reconstruction of resistant strictures of the fossa navicularis and meatus. *J Urol* 1998;160(2):359-363.
13. Virasoro R, Eltahawy EA, Jordan GH. Long-term follow-up for reconstruction of strictures of the fossa navicularis with a single technique. *BJU Int* 2007;100(5):1143-1145.
14. Fiala R, Vrtal R, Zenisek J, Grimes S. Ventral prepucial flap meatoplasty in the treatment of distal urethral male strictures. *Eur Urol* 2003;43(6):686-688.
15. Whitson JM, McAninch JW, Elliott SP, Alsikafi NF. Long-term efficacy of distal penile circular fasciocutaneous flaps for single stage reconstruction of complex anterior urethral stricture disease. *J Urol* 2008;179(6):2259-2264.
16. Meeks JJ, Barbagli G, Mehdiratta N, Granieri MA, Gonzalez CM. Distal urethroplasty for isolated fossa navicularis and meatal strictures. *BJU Int* 2012;109(4):616-619.
17. Barbagli G, De Angelis M, Palminteri E, Lazzeri M. Failed hypospadias repair presenting in adults. *Eur Urol* 2006;49(5):887-894; discussion 95.
18. Kulkarni S, Barbagli G, Sansalone S, Lazzeri M. One-sided anterior urethroplasty: a new dorsal onlay graft technique. *BJU Int* 2009;104(8):1150-1155.
19. Heyns CF, Steenkamp JW, De Kock ML, Whitaker P. Treatment of male urethral strictures: is repeated dilation or internal urethrotomy useful? *J Urol* 1998;160(2):356-358.
20. Launonen E, Sairanen J, Ruutu M, Taskinen S. Role of visual internal urethrotomy in pediatric urethral strictures. *J Pediatr Urol* 2014;10(3):545-549.
21. Steenkamp JW, Heyns CF, de Kock ML. Internal urethrotomy versus dilation as treatment for male urethral strictures: a prospective, randomized comparison. *J Urol* 1997;157(1):98-101.
22. Nikolavsky D, Abouelleil M, Daneshvar M. Transurethral ventral buccal mucosa graft inlay urethroplasty for reconstruction of fossa navicularis and distal urethral strictures: surgical technique and preliminary results. *Int Urol Nephrol* 2016;48(11):1823-1829.