



Ventral Onlay Buccal Mucosal Graft Urethroplasty Based on Tunica Vaginalis Flap for Balanitis Xerotica Obliterans Related Urethral Strictures: The Outcome of Single- Stage Reconstruction

Authors

Shanky Singh¹, Vaibhav Vikas¹, Priyabarta Das¹, Jatin Soni¹

¹Department of Urology, Government Medical College, Trivandrum, India

Corresponding Author

Shanky Singh

RNRA-27, Rajiv Gandhi Nagar, Medical College PO, Trivandrum-695011

Abstract

Background: *Balanitis xerotica obliterans (BXO) related urethral strictures treatment demand particular attention to cosmesis and urethral patency. Usually a single or two- stage urethroplasty is needed in such cases. We assessed the feasibility and efficacy of single-stage ventral onlay buccal mucosal urethroplasty (VOBMGU) based on tunica vaginalis flap for such strictures.*

Materials and Methods: *In between January 2015 and April 2017, ten patients with BXO related anterior urethral strictures underwent VOBMGU based on tunica vaginalis flap in single stage. Three patients presented with a suprapubic catheter. Assessment of stricture was done using a retrograde urethrogram and micturating cystourethrogram. All patients had meatal stenosis with anterior urethral stricture. Treatment outcome was assessed in terms of cosmetic appearance, stricture recurrence and complications.*

Results: *At a mean follow-up of 20 months, 8 were free of stricture recurrence as assessed by uroflowmetry and cystoscopy. Two had recurrent stricture which was treated successfully with direct visual internal urethrotomy. All patients had a normal slit-like meatus; none had chordee or erectile dysfunction. Complications were self-limited.*

Conclusion: *In BXO related strictures with a viable urethral plate, ventral onlay buccal mucosal urethroplasty (VOBMGU) based on tunica vaginalis flap provides excellent results as a single-stage reconstruction procedure, with tunica vaginalis as a readily available tissue having several advantages, including close proximity to the penis, ease of use, high vascularity and providing good support to BMG graft.*

Keywords: *Balanitis xerotica obliterans, Buccal mucosa graft, Ventral onlay, Tunica vaginalis.*

Introduction

Balanitis xerotica obliterans (BXO), first described in 1928 by Stuhmer, is now considered to be the male genital variant of lichen sclerosus et atrophicus (LSA).¹ It is also known as kraurosis penis. This common penile disease can involve the prepuce, the glans or the urethra, either

individually or in any combination.² BXO was regarded as an exclusively adult disease until a case was documented in a 7-year-old boy in 1962.³ Now it is considered to be a common cause of acquired phimosis and meatal stenosis in prepubertal boys. The clinical presentation and severity of BXO can vary markedly. The onset

and progression of disease may be insidious and indolent or aggressive and florid. Urethral involvement is seen in about 25–30% of cases.⁴ It starts at the meatus, with a tendency to form superficial adhesions between the meatal lips in milder cases and then the typical dense ivory white fibrosis in more severe disease. In general BXO spread proximally from the meatus in a confluent manner. In long-standing cases, urethral mucosal involvement and spongiofibrosis can spread proximally as far back as the prostate but bladder mucosa has not been found involved so far. On examination penile urethra feels like a thickened cord. Occasionally mucosal skip lesions have been noted beyond the apparent posterior limit.

BXO involvement of the urethra poses a surgical challenge with the goals of restoring adequate urinary flow with minimal risk of recurrence and achieving good cosmesis with nearly normal-appearing meatus. Various surgical procedures have been described in the literature for urethral reconstruction in BXO with varying degrees of success.^{5,6,7} Excision of the involved urethra and substitution urethroplasty is the modality of choice.⁸ The currently most widely accepted recommendation is the use of non-genital mucosal grafts of which buccal mucosal graft is the most popular.^{8,9} Controversies exist in the literature about advantages and disadvantages of one stage versus two-stage repairs.¹⁰ However, many published studies have recently confirmed equally good results with one-stage mucosal graft substitution urethroplasty.^{11,12,13}

The quality of the graft bed is the most important determinant of successful free graft urethroplasty.¹⁴ Strategies to optimize graft take in the urethra include (1) limiting the use of grafts to the well-vascularized bulbar urethra, (2) using buccal mucosa grafts, and (3) placing the graft dorsally on the tunica albuginea of the penis.¹⁵ Barbagli et al and Iselin and Webster have advocated dorsal free grafts for the following theoretical reasons: less bleeding, better graft take, and reduced incidence of diverticulum formation.^{16,17} Ventral

onlay urethroplasty provides easy exposure of the stricture, an excellent graft bed, and long-term, stricture-free outcomes equal to dorsal onlay, however.

In any reconstructive surgery, vascularity of the repaired site is a major concern.¹⁸ Hence, to obtain better outcome of urethroplasty, some vascularized flaps like dartos fascia and tunica vaginalis flap were introduced. These vascularized flaps are placed on the neourethra as the second layer. It seems that use of a vascularized tunica vaginalis flap as a second layer combined with ventral onlay buccal mucosal graft urethroplasty (VOBMGU) procedure results in better outcome.

Aim and objectives

To evaluate the feasibility and efficacy of single stage ventral onlay buccal mucosal graft urethroplasty (VOBMGU) in combination with vascularized tunica vaginalis flap in treatment of balanitis xerotica obliterans (BXO) related anterior urethral strictures.

Materials & Methods

Study design: A case series.

Study sample: Between January 2015 and April 2017, ten patients with a mean age of 47.5 years (range 25 to 60) underwent ventral onlay buccal mucosal urethroplasty (VOBMGU) based on tunica vaginalis flap for BXO related anterior urethral strictures in single stage at our institution.

Inclusion criteria

1. All cases of BXO with meatal stenosis and anterior urethral stricture.

Exclusion criteria

1. Strictures extending beyond anterior urethra
2. History of prior surgeries (including extended meatotomy, attempts of repair with either flap or graft-based techniques)
3. A follow-up of <12 months

Patients were evaluated with a medical history, subjective assessment of voiding symptoms with American Urological Association (AUA) symptom score and uroflowmetry test with

ultrasound assessment of post-void residual urine volume. Two patients presented with a suprapubic catheter that had been placed elsewhere. The extent of the stricture was assessed and coexisting proximal urethral strictures were ruled out by combined retrograde urethrography and voiding cystourethrography (VCUG) and urethrocystoscopy using a 6.5 Fr. ureteroscope pre-operatively.

Full written informed consent was obtained from each patient after explanation of all the available techniques for male distal urethral reconstruction.

Surgical technique

Under general anesthesia, the patient was positioned supine on the operating table. Pre-operative cystoscopy with ureteroscope was done to confirm that the stricture was limited exclusively to the anterior urethra. If the meatus was too tight to allow the ureteroscope, urethrocystoscopy was performed after splitting the meatus ventrally. At first, the meatus was slit ventrally up to the corona. Stay suture were placed on each of the glans flaps to aid in retraction. Glans wings were raised at the level of corona from the corporal bodies to get enough mobility for tension free apposition of the reconstructed glanular urethra. In all cases a dorsal strip of native urethral mucosa was preserved as far as available and remaining diseased mucosa resected. Patients who had the navicular fossa entirely obliterated, the entire unhealthy mucosa was resected. Ventral meatotomy was then extended to urethral stricture. The fibrotic segments were resected up to about 5 mm of the proximal healthy urethra and then patency of the proximal urethra was confirmed with a 24 Fr. sound. A rectangular BMG with an approximate length of 3.5 cm and width of 1.5-2.5 cm (depending upon the length of the defect) was harvested and defatted using standard technique with special care to avoid the oral commissure and the opening of Stensen's duct. The graft was longitudinally oriented and one long free edge was then anastomosed to the lateral margin of the native mucosal strip along with the underlying

glans tissue. The graft extends from the proximal healthy urethra to the site of the intended neomeatus. Then, the graft was rolled over a 18 Fr. silicone catheter with its mucosal surface facing inward. Its short edge was sutured circumferentially to the healthy proximal urethral mucosa using fine polyglactin sutures. Once the proximal anastomosis of the BMG was completed, the free long edge of the graft was sutured to the free edge of the native mucosal strip dorsally in a proximal to distal fashion on the other side. Thereafter, the testis was delivered via a separate scrotal incision and a vascularized tunica vaginalis flap was harvested and transferred to the site of surgery through a subcutaneous tunnel. Care was taken to make a wide tunnel to avoid compression of flap pedicle. Scrotal dissection was done gently with paying attention to complete hemostasis. Ventral side of the buccal mucosal graft was covered by serosal layer of tunica vaginalis flap thus providing high vascularity and good support to BMG graft. Glans apposition was started proximally. During the first (innermost) layer of glans apposition, anchoring bites were taken on the graft in the midline, ventrally. This ensured a three point fixation of the graft thereby providing stability to the same. Then the glans wings were apposed ventrally in two more layers with horizontal mattress sutures. Neomeatus was reconstructed by suturing the distal edge of the BMG to the margins of the initial ventral slit made on the meatus, allowing the passage of the 18 Fr. catheter freely. Gauze soaked in antibiotic ointment was placed around the meatus and the Foley catheter was taped and fixed to the abdomen for 1 week to immobilize the VOBMG during graft take.

The Foley catheter was generally kept in place for 10 days. The urinary pattern was assessed after its removal by uroflowmetry. Post-operative data were prospectively recorded during an initial visit at 7 days after urethral catheter removal, at 1, 3 and 6 months and then annually thereafter. During each visit, patients underwent subjective assessment of voiding symptoms with AUA

symptom score and objective calibration of the distal urethra with an 18 Fr. catheter as well as uroflowmetric studies with post-void residual determination.

All patients were followed for urinary pattern changes, lower urinary tract symptoms and reassessed with VCUG and urethroscopy in the case of recurrent symptoms. A successful outcome was defined as the subjective and objective improvement in urinary flow with maintenance of glanular shape and the absence of any need for further urethral instrumentation during follow-up. Post-operative splaying of urine and cosmetic acceptance were assessed by simple individual questionnaires. The mean of pre-operative AUA symptom score and Q-max measurements were compared with post-operative values obtained at the last follow-up. All variables were categorical and percentage and proportions were calculated manually.

Results

A total of 10 cases of BXO were operated in this study period. Median age was 47.5 years. In a median follow-up of 20 months (range 12-28 months), success was achieved in 8 (80%) patients. Two patients with BXO developed stricture at the site of the proximal anastomosis and was managed with urethrotomy followed by intermittent urethral self-calibration. A cosmetic and functional distal urethra was obtained in all the remaining cases. The mean substituted urethral stricture length measured was 2.4 cm (range 2-3.5 cm). At the last follow-up, the mean Qmax (ml/s) increased from 5.3 pre-operatively to 26 post-operatively and the mean AUA score decreased from 26.2 ± 3.4 pre-operatively to 9 ± 4 post-operatively. Eight patients had no splaying of the urinary stream and out of the remaining, one had mild and only one had moderate splaying. Splaying subsided in all cases within 6 months. Seven patients were very pleased, one was pleased and two were unhappy with the final cosmetic appearance.

Characteristic	Median	Range
Age (yr)	47.5	25-60
Stricture length (cm)	2.4	2-3.5
Breath of dosal urethral strip preserved (cm)	3	1-4
BMG Length (cm)	3.5	2.5-4.5
Preoperative Qmax (ml/sec)	5.3	4-10
Postoperative Qmax (ml/sec)	26	15-35
Preoperative AUA score	26	22-31
Postoperative AUA score	9	7-18
Follow up (months)	20	12-28

Qmax-Peak urinary flow rate; AUA-American urological association ; BMG-Buccal mucosal graft.

Discussion

Balanitis xerotica obliterans (BXO) related strictures are complex and involving anterior urethra are particularly challenging because successful reconstruction requires the creation of a functional urethral conduit as well as maintaining a cosmetically appealing glans penis. Ventral meatotomy, onlay urethroplasty using transverse island ventral penile skin flap, two stage repair using BMG etc., are the commonly used reconstructive options for the management of distal strictures.^{5,10,19,20,21,22,23,24,25,26,27} An ideal urethral substitute should have a dependable blood supply, absence of hair follicles, excellent applicability and immunity from progression of the disease process.^{24,27} Urethral substitution for an obliterative process, mandates a more complex reconstructive procedure. Management of these strictures requires a customized approach, taking into account the length and etiology of the stricture, patient expectations and surgeon's experience. Strictures associated with BXO may require excision of the diseased urethra and substitution with a multistage approach,^{5,10-28,29} which would not appeal to most adult men. The psychological distress of multiple procedures, loss of work and the inability to stand during voiding until the repair may outweigh the benefits of 2-stage repairs. Even the distorted hypospadiac meatal appearance following a ventral meatotomy³⁰ or Blandy's urethroplasty³¹ may not be acceptable to most adult males.

Our results suggest that VOBMGU with tunica vaginalis flap is a viable single-stage

reconstructive alternative in the management of BXO related stricture. BXO involvement of the urethra ranges from isolated meatal stenosis to panurethral disease. In most instances, the most severe inflammatory reaction in BXO is seen at the meatus and distal urethra, which compromises a successful stricture repair because of the recalcitrant nature of this disease.^{10,19,28} Therefore, excision of the diseased urethra and one or two stage urethroplasty using extragenital tissue grafts has been advocated in patients with BXO.^{10,28,29} In our present cohort, a narrow 2-3 mm of native mucosal strip was preserved on the dorsal side. When the urethral plate is severely stenosed complete replacement of the diseased, fibrotic mucosa with BMG in a circular form still renders a 1-stage reconstruction possible. The outcome is also cosmetically appealing. In the VOBMGU procedure, the anastomosis with the healthy dorsal urethra mucosal strip and proximal mucosa can be done under vision by the wide ventral meatotomy incision. The suture lines of the BMG with the native mucosal strip do not overlie the apposing ventral suture line of the glans wings. The robust buccal mucosa with its panlamellar plexus provides a continuous tissue layer, over which the glans wings are apposed ventrally. This may be hypothesized to be responsible for the excellent functional outcome without any post-operative fistula.

Traditionally, the use of BMG as a circumferential graft has been approached with caution in the literature because of its high overall failure rates compared with onlay or 2-stage techniques.^{32,33,34} However in recent times, reports have revealed an improved success rates with circular BMG for urethral substitution.^{11,24} The data presented by Barbagli et al. is encouraging and it suggests that circular BMG may be a feasible option in the management of bulbar urethral strictures because of good vascularity in this area.¹¹ They treated five patients with bulbar strictures (2-4.5 cm in length) with circular BMG and reported no complications with a mean follow-up of 38 months. Likewise, we have successfully used

VOBMGU with tunica vaginalis flap for one-stage reconstruction of anterior urethral strictures because the tunica vaginalis and glans penis has a good blood supply, providing an efficient circumferential graft take.³⁵ The long-term result of graft take in glans penis is encouraging, as an evident from their frequent use in Hypospadias surgery.^{36,37,38,39} In a recent study, Gelman and Sohn presented their experience with 1-stage reconstruction of obliterative distal urethral strictures with combined BMG urethral plate reconstruction and onlay penile skin flap.²⁶ They reported no urinary obstructions in 12 patients treated with this technique with a mean follow-up of 39 months. Despite presenting an attractive 1-stage alternative to tube flaps and grafts, these authors did not report on the incidence of BXO in their series. There is a quantum of evidence that BXO is prone to recur if local tissues are used for reconstruction.^{6,40,41} BMG is a robust graft which is most resistant to BXO.^{6,10,28,29,40,41} Onol et al. in their series of circular BMG for distal urethral strictures have reported impressive results in the short term follow-up.³⁵ However, this technique employs a tubular BMG, which is only fixed at the proximal and distal anastomotic line without any fixation along its length. In our technique, the BMG is not only fixed proximally and distally, but also along the lateral margins on both sides with an anchoring midline suture ventrally. This provides stability to the graft and obliterates any free space between the graft and the bed, preventing any hematoma formation underneath, which would have made the graft take precarious. The 5-0 vicryl sutures apposing the superficial layer of ventral meatotomy leaves almost no appreciable scar at 1 year follow-up. Thus, a highly acceptable cosmetic outcome may be achieved without compromising on the graft uptake as the entire graft placement and fixation is done under vision.⁴²

Nevertheless, VOBMGU reconstruction may not be suitable in longer strictures extending beyond corona, because of lack of ventral support proximally, leading to various complications.

However, the tunica vaginalis flap as used in our cases with BMG graft has several advantages including close proximity to the penis, ease of use, high vascularity, readily available tissue and providing good support to BMG graft. Hence preventing complications like diverticula formation, recurrence of stricture, fistula formation, etc.

Conclusion

In BXO with a viable urethral plate, ventral onlay buccal mucosal urethroplasty (VOBMGU) remains an effective and versatile part of the armamentarium for anterior urethral stricture and can be based on tunica vaginalis flap as a single stage reconstruction procedure with tunica vaginalis as a readily available tissue and having several advantages.

References

1. Stühmer A: Balanitis xerotica obiterans und ihre Beziehungen zur 'Kraurosis glandi et praeputii penis'. Arch Dermatol Syph 1928; 156:613.
2. Barbagli G, Lazzeri M, Palminteri A, Turini D: Lichen sclerosus of male genitalia involving anterior urethra. Lancet 1999;354:429.
3. Campus GV, Ena P, Scuderi N: Surgical treatment of balanitis xerotica obliterans. Plast Reconstr Surg 1984;73:652–657.
4. Alsifaki NF, Arrendono SA, McAninch JW: The efficacy of penile fasciocutaneous flaps in the treatment of urethral strictures caused by BXO. J Urol 2004;171(S 18):70.
5. Venn SN, Mundy AR: Urethroplasty for balanitis xerotica obliterans. BJU Int 1998;81: 735–737.
6. Depasquale I, Park AJ, Bracka A: The treatment of balanitis xerotica obliterans. BJU Int 2000;86:459–465.
7. Secrest CL: Staged urethroplasty: indications and techniques. Urol Clin North Am 2002;29:467–475.
8. Andrich DE, Greenwell TJ, Mundy AR: The problems of penile urethroplasty with particular reference to two-stage reconstructions. J Urol 2003;170:87–91.
9. Bhargava S, Chapple CR: Buccal mucosal urethroplasty: is it the new gold standard? BJU Int 2004;93:1191–1193.
10. Dubey D, Kumar A, Kapoor R, et al: Buccal mucosal urethroplasty for balanitis xerotica obliterans related strictures: the outcome of one- and two-stage techniques. J Urol 2005; 173:463–466.
11. Barbagli G, Palminteri E, Lazzeri M, Guazzoni G: One-stage circumferential buccal mucosa graft urethroplasty for bulbous stricture repair. Urology 2003;61:452–455.
12. Menneghini A, Cacciola A, Cavarretta L, Abatangelo G, Ferrarrie P, Tasca A: Bulbar urethral stricture repair with buccal mucosa graft urethroplasty. Eur Urol 2006;39:264–267.
13. Beyer AP, Deibl M, Bartsch G, Steiner H, Varkarakis J, Goazzi E: Comparison of onestage procedures for post-traumatic urethral stricture repair. BJU Int 2005; 95: 1299–1302.
14. Wessells H, McAninch JW. Controversies in urethral stricture repair: free graft versus pedicled skin flap reconstruction of the anterior urethra. World J Urol 1998;16:175–80.
15. Barbagli G, Selli C, Tosto A, Palminteri E. Dorsal free graft urethroplasty. J Urol 1996;155:123–6.
16. Barbagli G, Selli C, di Cello V, Mottola A. A onestage dorsal free-graft urethroplasty for bulbar urethral strictures. Br J Urol 1996;78:929–32.
17. Iselin CE, Webster GD. Dorsal onlay graft urethroplasty for repair of bulbar urethral stricture. J Urol 1999;161:815–8.
18. Yang SS, Chen SC, Hsieh CH, Chen YT. Reoperative Snodgrass procedure. J Urol. 2001;166:2342-5.

19. Singh SK, Agrawal SK, Mavuduru RS. Management of the stricture of fossa navicularis and pendulous urethral strictures. *Indian J Urol* 2011;27:371-7.
20. Tonkin JB, Jordan GH. Management of distal anterior urethral strictures. *Nat Rev Urol* 2009;6:533-8.
21. Meeks JJ, Barbagli G, Mehdiratta N, Granieri MA, Gonzalez CM. Distal urethroplasty for isolated fossa navicularis and meatal strictures. *BJU Int* 2012;109:616-9.
22. Jordan GH. Reconstruction of the fossa navicularis. *J Urol* 1987;138:102-4.
23. Armenakas NA, Morey AF, McAninch JW. Reconstruction of resistant strictures of the fossa navicularis and meatus. *J Urol* 1998;160:359-63.
24. Armenakas NA, McAninch JW. Management of fossa navicularis strictures. *Urol Clin North Am* 2002;29:477-84.
25. Goel A, Goel A, Dalela D, Sankhwar SN. Meatoplasty using double buccal mucosal graft technique. *Int Urol Nephrol* 2009;41:885-7.
26. Gelman J, Sohn W. 1-stage repair of obliterative distal urethral strictures with buccal graft urethral plate reconstruction and simultaneous onlay penile skin flap. *J Urol* 2011;186:935-8.
27. Onol SY, Onol FF, Onur S, Inal H, Akba° A, Köse O. Reconstruction of strictures of the fossa navicularis and meatus with transverse island fasciocutaneous penile flap. *J Urol* 2008;179:1437-40.
28. Levine LA, Strom KH, Lux MM. Buccal mucosa graft urethroplasty for anterior urethral stricture repair: Evaluation of the impact of stricture location and lichen sclerosus on surgical outcome. *J Urol* 2007;178:2011-5.
29. Kulkarni S, Barbagli G, Kirpekar D, Mirri F, Lazzeri M. Lichen sclerosus of the male genitalia and urethra: Surgical options and results in a multicenter international experience with 215 patients. *Eur Urol* 2009;55:945-54.
30. Morey AF, Lin HC, DeRosa CA, Griffith BC. Fossa navicularis reconstruction: Impact of stricture length on outcomes and assessment of extended meatotomy (first stage Johanson) maneuver. *J Urol* 2007;177:184-7.
31. Blandy JP, Tresidder GC. Meatoplasty. *Br J Urol* 1967;39:633.
32. Patterson JM, Chapple CR. Surgical techniques in substitution urethroplasty using buccal mucosa for the treatment of anterior urethral strictures. *Eur Urol* 2008;53:1162-71.
33. Andrich DE, Mundy AR. Substitution urethroplasty with buccal mucosal-free grafts. *J Urol* 2001;165:1131-3.
34. Caldamone AA, Edstrom LE, Koyle MA, Rabinowitz R, Hulbert WC. Buccal mucosal grafts for urethral reconstruction. *Urology* 1998;51:15-9.
35. Onol SY, Onol FF, Gümü° E, Topakta° R, Erdem MR. Reconstruction of distal urethral strictures confined to the glans with circular buccal mucosa graft. *Urology* 2012;79:1158-62.
36. Leslie B, Lorenzo AJ, Figueroa V, Moore K, Farhat WA, Bägli DJ, *et al*. Critical outcome analysis of staged buccal mucosa graft urethroplasty for prior failed hypospadias repair in children. *J Urol* 2011;185:1077-82.
37. Fichtner J, Filipas D, Fisch M, Hohenfellner R, Thüroff JW. Long-term followup of buccal mucosa onlay graft for hypospadias repair: Analysis of complications. *J Urol* 2004;172:1970-2.
38. Dessanti A, Iannuccelli M, Ginesu G, Feo C. Reconstruction of hypospadias and epispadias with buccal mucosa free graft as primary surgery: More than 10 years of experience. *J Urol* 2003;170:1600-2.

39. Snodgrass W, Elmore J. Initial experience with staged buccal graft (Bracka) hypospadias reoperations. J Urol 2004;172:1720-4.
40. Bracka A. Re: Reconstruction of resistant strictures of the fossa navicularis and meatus. J Urol 1999;162:1389-90.
41. Pugliese JM, Morey AF, Peterson AC. Lichen sclerosus: Review of the literature and current recommendations for management. J Urol 2007;178:2268-76.
42. 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 Jan;30(1):17-22.