

Roles & Complications of Substitution Urethroplasty: Systematic review

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Abstract: Background: Urethroplasty is the 'gold standard' for treatment of urethral stricture infection; substitution urethroplasty is utilized as a part of long, perplexing, intermittent urethral strictures.

Objectives: aim of this study is to discuss the roles and different surgical approaches that are used in substitution urethroplasty and also to demonstrate the most complications of this procedure according to evidence based trails.

Methodology: A systematic review study of the literature was performed using Medline, Embase, the Web of Science, and the Cochrane Library were conducted databases through July 2016 using the search terms, 'substitutional urethroplasty', 'urethral obstruction', 'urethral stricture', 'sexual function', 'erection'.

Conclusion: the results of the ventral and dorsal onlay of BM for bulbar urethroplasty are equivalent. Two-stage procedures are preferable in the penile urethra, except under certain circumstances when a one-stage dorsal onlay is feasible.

Keywords: Urethroplasty.

1. INTRODUCTION

Deformities of the male urethra can be repaired utilizing genital or extragenital skin, bladder mucosa, oral mucosa and colonic mucosa ^(1,2,3). Urethroplasty is the 'gold standard' for treatment of urethral stricture infection; substitution urethroplasty is utilized as a part of long, perplexing, intermittent urethral strictures. Urethral remaking utilizing a union to substitute the urethral mucosa is an established treatment for strictures at the penile urethra and for bulbar strictures not amenable with anastomotic repair ^(12,13,14). Local skin flaps might also be used to substitute the urethra. Although the results seem to be equal to those of grafts, flaps are associated with more complications and less preferred by the patient ⁽¹⁵⁾.

In the course of recent years, oral mucosal grafts (OMGs) which is a technique of substitution urethroplasty have been a reliable and popular substitute for use in urethroplasty ^(1,2,3). Oral mucosa obviates most of the problems associated with other graft harvesting, providing easy accessibility and a concealed donor site scar ^(3,4). OMGs are easy to harvest, resistant to infection, compatible with a wet environment and have a thick epithelium, thin lamina propria and a high capillary density ^(3,4). However, in other studies, the OMG harvest was associated with oral complications such as numbness, tightness of the mouth and motor deficits ⁽⁵⁻⁹⁾.

These different techniques for urethroplasty may involve aggressive urethral dissection extending from high in the bulbomembranous urethra to sometimes beyond the suspensory ligament. This may theoretically adversely affect the erectile function as the dissection of the urethra in the intercrural space is potentially more likely to expose erectile nerves to risk since these nerves must leave the safety of the dorsal surface of the corporeal bodies to enter the pelvis lateral to the membranous urethra behind the symphysis ^(6,7).

Substitution urethroplasty which involve bulbar urethral strictures require comprehensive and careful urological management. Generally speaking, urethroplasty is the preferred treatment method, conferring far superior and more durable urethral patency rates compared with urethral incision or dilatation ^(10,11).

2. OBJECTIVES

In this systematic review of the literature, a search of the PubMed database was conducted to identify articles dealing with augmentation/ substitution urethroplasty of the urethral stricture. And the aim of this study is to discuss the roles and different surgical approaches that are used in substitution urethroplasty and also to demonstrate the most complications of this procedure according to evidence based trails. The choice of technique and the surgical approach are discussed along with the potential of the use of a graft. There is research potential for tissue engineering. The efficacy of the surgical approach to the urethra is reviewed.

3. METHODOLOGY

A systematic review study of the literature was performed using Medline, Embase, the Web of Science, and the Cochrane Library were conducted databases through July 2016 using the search terms, 'substitutional urethroplasty', 'urethral obstruction', 'urethral stricture', 'sexual function', 'erection'. The search strategy and search terms were constructed with the assistance of an experienced medical librarian. The search was limited to human studies. A manual search of reference lists from the articles selected for inclusion in this study was also performed. Abstracts presented at national urology meetings appropriate for inclusion in the present study were identified through EMBASE and Google Scholar searches to identify additional studies ('grey material') and studies that may have a negative result. These abstracts were matched with the corresponding articles written later by the same groups when a complete article was available for inclusion, and only the completed article was included for review.

4. RESULTS

The development of substitution urethroplasty techniques highlights the efforts to restore urethral anatomy and function to as near normal as possible. Over the years the preference has changed between flaps and grafts as a urethral substitute. Penile skin flaps and buccal mucosal free grafts have emerged as reliable urethral substitutes with comparable long-term results⁽¹⁶⁾. In the 1990s there was a radical change in the anatomical positioning of the flap/graft. Previously flaps and grafts were applied ventrally on the urethra, which resulted in complications like pseudo-diverticulum, postvoid dribbling and ejaculatory dysfunction⁽¹⁷⁾. Barbagli *et al.*⁽¹⁸⁾, and subsequently others⁽¹⁹⁾, reported that placing the free graft dorsally on the corpora resulted in better support and neovascularization. Both penile skin flaps and buccal mucosal grafts have emerged as reliable urethral substitutes with comparable long-term results^(20,21). Some have recommended buccal mucosal grafts over flaps for patch urethroplasty⁽²²⁾, whereas others find flaps more reliable⁽¹⁶⁾. In recent years dorsal placement of flaps (Bhandari *et al.*, unpublished) and grafts⁽²³⁾ has been shown to be more advantageous than the traditional ventral onlay (VO). With the availability of numerous tissues and approaches for reconstruction, the challenge lies in choosing the appropriate technique for a particular stricture. We reviewed our experience with dorsal and VO substitution urethroplasty using free grafts and skin flaps, to determine the outcome and particular problems associated with each technique.

Various approaches to buccal mucosa graft urethroplasty (BMGU)

(Substitution urethroplasty (SU)):

BMGU (SU) offers a wide array of surgical approaches, thereby offering many options for stricture management to be tailored to surgeon preference. Since the initial dorsal and ventral reports in 1996 (24, 25), several modifications of BMGU have been described. It should be noted that comparative reports have described similar outcomes with the dorsal vs ventral onlay approach (26). Given the robust nature of the ventral spongiosum in the proximal bulbar urethra, a ventral approach offers more simplicity and does not necessitate the dissection of the lateral circumflex vessels. Fig. 1 depicts a ventral onlay buccal mucosal urethroplasty. In the distal bulb and the penile urethra, the ventral spongiosum is not robust enough to support the ventral onlay approach, and therefore a dorsal approach should be used if the stricture extends beyond the proximal bulb. Fig. 2 depicts the dorsal onlay approach for a pan-urethral stricture. Some surgeons use the distal edge of the bulbospongiosus muscle as the extent to which a ventral graft should be used. Wessells⁽²⁷⁾ reported the advantages of the ventral approach including: preservation of the lateral blood supply between the spongiosum and corpora, as there is no need to fully mobilise the urethra circumferentially, the lumen of the stricture is easily visualised

allowing the water-tight anastomosis to be easily made, and a portion of the stricture can be excised if needed and a dorsal re-anastomosis can be performed.

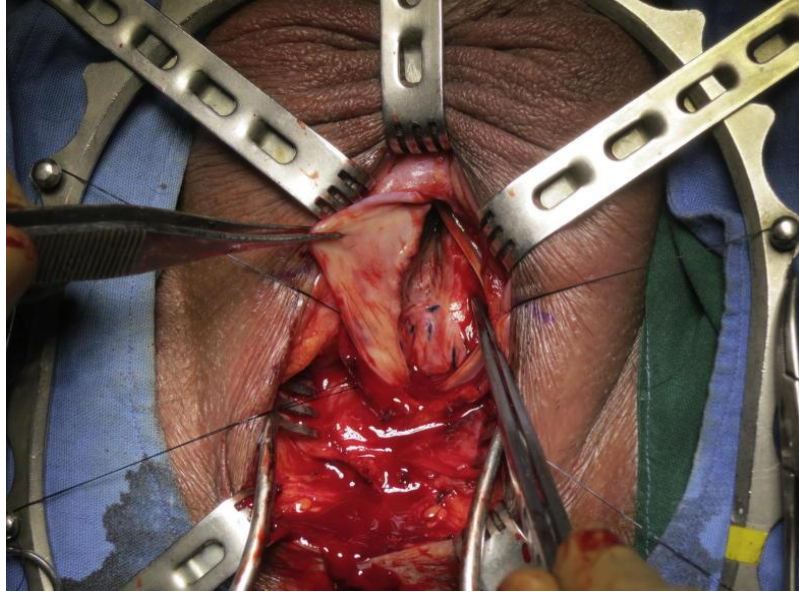


Fig. 1, Ventral onlay BMGU

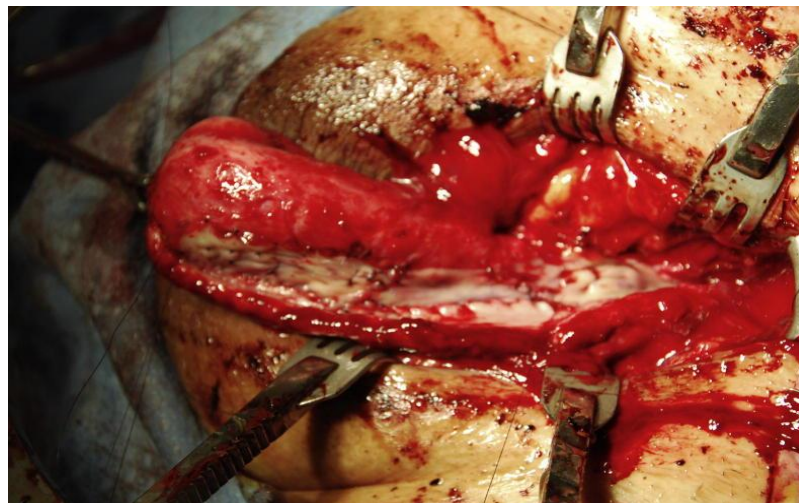


Fig. 2, Dorsal onlay BMGU for a pan-urethral stricture

Despite the surgical ease and the above advantages of the ventral approach, some surgeons prefer the dorsal approach for several reasons. This approach allows better control and visualisation because blood loss is minimised given the shallow nature of the spongiosum dorsally. It also is not dependent on a healthy spongiosum and so should be resistant to spongiofibrosis. Additionally, it allows for spread-fixation of the graft to a firm graft bed of corpora, which may in theory prevent it from contracting or folding as it heals and provide a wider long-term urethral patency. As mentioned previously, if the stricture involves the distal bulb or the penile urethra, then most agree that a dorsal approach should be used. In the dorsal approach, it is necessary to mobilise the urethra off of the corpora, thereby dividing the corporal and spongiosal attachments and vasculature. Mangera et al. ⁽²⁸⁾ performed a large systematic review of various approaches, which revealed similar outcomes between dorsal and ventral onlay urethroplasties.

Surgical technique of lingual mucosal grafts (LMGs) for substitution urethroplasty and its complications:

The surgical technique for harvesting LMGs is similar to that reported for OMGs ⁽²⁹⁾. There is more bleeding associated with the lingual graft because the tongue is more vascular than the cheek ⁽²⁹⁾. However, the tongue can be pulled out of the mouth with a traction suture, which makes harvesting from the tongue technically easier than from the inner cheek. General anaesthesia with naso-tracheal intubation is preferred but not mandatory. A traction suture is placed at the border of the tongue tip to keep the lingual mucosa stretched. Most authors do not infiltrate the graft site with lidocaine,

adrenaline or other medication^(29,30,31). Xu *et al.*⁽²⁾ suggest using submucosal infiltration with a mixed solution of 0.01% adrenaline which can elevate the lingual mucosa and facilitate a submucosal dissection without damaging the underlying musculature or lingual nerve. Additionally, haemorrhage tends to be less with the use of adrenaline⁽²⁾. The opening of Wharton's duct and the site of the underlying lingual nerve should be carefully identified before graft removal⁽²⁹⁾. During graft harvesting, care should be taken not to excise the mucosa from the floor of the mouth, to preserve tongue mobility⁽²⁹⁾. The graft edges are incised using a scalpel and the graft is removed using sharp scissors. It is crucial to dissect precisely in the plane between the mucosa and submucosal fat, which ensures harvesting of a LMG that is as thin as possible. The donor site is closed with 4-0 polyglactin sutures. The graft is de-fatted to remove the underlying fibrovascular tissue. The mucosa covering the lateral and ventral surface of the tongue is identical to the lining of the rest of the oral cavity and has no particular functional features⁽³²⁾. Previous reports describe three different sites of the tongue where the graft could be removed, with different lengths and widths (Table 1). Simonato *et al.*⁽³²⁾ reported the lateral mucosal lining of the tongue Fig. 3 as the harvest graft site.



Fig. 3, Graft harvesting along the lateral mucosal lining of the tongue.

5. COMPARISON OF DIFFERENT DONOR SITES

In urology, the sites of tissue grafting in the oral cavity are the cheek and lower lip⁽³⁾. The advantages and disadvantages of cheek or lower lip harvesting are summarized in (Table 1). The incidence of postoperative oral complications after graft harvesting from these sites is still an open issue^(5,6,7,8,9). The difference in morbidities can most likely be explained by the anatomical location of each harvest site⁽⁸⁾. Because of the location of the harvest site over the buccinator muscle, harvest from the cheek is more commonly associated with scarring and contracture⁽⁸⁾, while harvest from the lip can be associated with peri-oral numbness due to the proximity of the harvest site to the mental nerve⁽⁸⁾. Moreover, eversion of the lip vermilion by primary closure or postoperative contracture with secondary healing, especially if larger grafts are harvested from the lip, can occur. Wood *et al.*⁽⁵⁾ suggested that the morbidity of harvesting the graft from the cheek is related to closure of the donor site. These authors conducted a prospective study comparing 20 unselected men whose donor site in the cheek was closed, with a group of 20 men in whom it was left open, using a 5-point analogue pain score that was completed twice daily for the first 5 days after surgery⁽⁵⁾. The authors concluded that closure of the harvest donor site appears to worsen postoperative pain and that it might be best to leave the harvest site open⁽⁵⁾. The main long-term complications were peri-oral numbness (26% of cases), persistent difficulty with mouth opening (9%), and change in salivary function (11%)⁽⁵⁾. Dublin and Stewart⁽⁶⁾ reported oral numbness (16%) and tightness (32%) which persisted even after 13.2 months of follow-up in patients who had graft harvesting; the mean graft dimension was 2.5 × 5–7 cm from the cheek, with closure of the donor site. Barbagli *et al.*⁽³³⁾ reported the largest series (300 cases) of patients who had oral graft harvesting from a single cheek using a standard technique (the graft was ovoid and the mean graft length and width was 4 and 2.5 cm in all patients), with closure of the donor site. The incidence of early and late complications and the evaluation of patient satisfaction after surgery were assessed using a questionnaire which included six questions to investigate early (first 10 days) complications, 14 to investigate late (3 months after surgery) complications, and final patient satisfaction⁽³³⁾.

Table 1. Comparison of the techniques using different intra-oral donor sites

Graft characteristics	Cheek	Lower lip	Tongue
Harvesting technique	deep in the mouth	easy access	easy access
Number of grafts	two	one	two
Maximum graft length, cm	5–6	3–4	7–16
Donor site scar	concealed	visible	concealed
Maximum graft width, cm	2–2.5	1–1.5	1–2.5
Histological features	robust – thick	delicate – thin	delicate – thin
Anatomical landmark	Stensen's duct	mental nerve	Wharton's duct lingual nerve
Harvesting site	closed – left open	left open	close

6. Conclusion

Dorsal free graft/flap onlay urethroplasty gives better results than ventrally placed free grafts/flaps. Dorsal onlay buccal mucosal urethroplasty is a versatile procedure and associated with fewer complications than other substitution methods. Moreover the results of the ventral and dorsal onlay of BM for bulbar urethroplasty are equivalent. Two-stage procedures are preferable in the penile urethra, except under certain circumstances when a one-stage dorsal onlay is feasible.

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