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# Dorsal Onlay Buccal Mucosa Versus Penile Skin Flap Urethroplasty for Anterior Urethral Strictures: Results From a Randomized Prospective Trial

Deepak Dubey,\* Vivek Vijjan, Rakesh Kapoor, Aneesh Srivastava, Anil Mandhani, Anant Kumar and M. S. Ansari

From the Department of Urology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India

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**Purpose:** Reconstructive techniques for anterior urethral strictures have not been subjected to a randomized comparison. In a randomized controlled study we compared outcomes of buccal mucosa dorsal onlay vs skin flap dorsal onlay urethroplasty in patients with complex anterior urethral strictures.

**Materials and Methods:** In this prospective study 55 patients with anterior urethral strictures were randomized to undergo buccal mucosa dorsal onlay (27) or penile skin flap (28) urethroplasty. Operative time, hospital stay, short and long-term complications, recurrence rates, and patient satisfaction were compared between the 2 groups.

**Results:** The number of patients with pendulous, bulbar and bulbopendulous strictures as well as mean stricture length and median followup were comparable between the 2 groups. Mean operative time was significantly higher in the penile flap (224 minutes) vs the buccal mucosa group (162 minutes,  $p = 0.001$ ). In the penile flap group 6 patients had superficial penile skin necrosis, 1 had extensive skin loss and required skin grafting, and 2 had penile torsion. In the buccal mucosa group 25.6% of patients had minor morbidity which settled by 4 weeks after surgery. There were 9 (34.1%) patients in the penile flap group and 4 (14.8%) in the buccal mucosa group ( $p = 0.001$ ) who had troublesome post-void dribbling. In the buccal mucosa group 89% and in the penile flap group 65% said they would recommend this procedure to another patient ( $p = 0.001$ ). The success rate in the buccal mucosa (89.9%) and penile flap (85.6%) groups was similar ( $p > 0.05$ ).

**Conclusions:** On intermediate followup dorsal onlay penile skin flap and buccal mucosa urethroplasty provide similar success rates. Compared to buccal mucosa, penile flap procedures are technically complex, associated with higher morbidity and less preferred by patients.

*Key Words: mouth mucosa; surgical flaps; urethral stricture; penis; surgery, plastic*

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In recent years resurgence of the use of free grafts for anterior urethral stricture reconstruction has renewed the search for the ideal urethral substitute. Traditionally penile skin flaps, which have the advantage of a robust vascular pedicle, were considered the most reliable material for reconstruction of complex strictures.<sup>1,2</sup> Results from numerous centers dedicated to urethral reconstruction have highlighted the emerging role of buccal mucosa graft as the most versatile method of reconstructing the bulbar urethra.<sup>3-5</sup> Controversy still exists regarding the use of buccal mucosa on the less vascular pendulous urethra<sup>6,7</sup> despite good results being reported.<sup>3</sup>

In our experience<sup>4,8</sup> and that of others,<sup>9</sup> dorsal placement of penile skin flaps and free grafts has yielded superior outcomes compared to ventral placement. To our knowledge no prospective randomized comparison between the use of flaps and grafts for substitution urethroplasty has been performed. We present the results of a randomized prospective trial comparing dorsal onlay buccal mucosa grafting and penile skin flap urethroplasty.

## MATERIALS AND METHODS

Between February 2003 and February 2006 a total of 55 patients with anterior urethral strictures requiring substitution urethroplasty were randomized to receive either dorsal onlay buccal mucosa urethroplasty (27) or penile skin flap urethroplasty (28). Only patients in whom the stricture etiology was considered to be inflammatory or idiopathic were included in the study. Patients with balanitis xerotica obliterans, unhealthy penile skin, oral mucosal pathology or those who had undergone more than 1 urethral dilation/internal urethrotomy or urethroplasty were excluded from the study. The method of randomization was every alternate patient with bulbar, pendulous or bulbopendulous stricture being assigned to the BM and PF groups.

Preoperative assessment consisted of history, examination, uroflowmetry, and retrograde and voiding cystourethrography. After initial assessment patients were randomized to undergo substitution urethroplasty with either buccal mucosa or penile skin flap.

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\* Correspondence: Department of Urology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Rae Bareilly Rd., Lucknow 226014, India (e-mail: ddubey@sgpgi.ac.in).

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**Editor's Note:** This article is the fourth of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 2706 and 2707.

In terms of technique, the urethra was completely mobilized from the corpora cavernosa and rotated 180 degrees. The stricturous segment was opened along its dorsal aspect and a buccal mucosal graft or a penile skin flap was applied as a dorsal onlay. In the PF group a circumpenile or longitudinal penile skin flap was used depending on the stricture site. Buccal mucosa was harvested from 1 cheek or from both cheeks and lower lip depending on stricture length. A 2-team approach was used in patients undergoing BM urethroplasty whereas a single team performed PF urethroplasty.

Postoperatively patients underwent voiding cystourethrogram after 3 weeks. Any extravasation was managed by extending the period of catheterization to a maximum of 5 weeks. Followup consisted of uroflowmetry and urethral calibration with a 16Fr Foley catheter or flexible cystoscopy at 1 month, followed by 3-month intervals for the first year and 6-month intervals thereafter. Contrast studies were done when required depending on the uroflowmetry and calibration findings. Failure was defined as the need for any subsequent urethral procedure (internal urethrotomy, urethral dilatation or urethroplasty). A note of oral complications was made for the patients undergoing BM urethroplasty, and penile torsion, penile numbness and erectile function were noted for the patients undergoing PF urethroplasty. At 6 months after surgery patients in both groups were asked whether they would recommend the procedure to another patient.

**RESULTS**

A total of 55 patients with a mean age of 36.6 years (range 16 to 59) were included in the study. The numbers of patients with pendulous, bulbar and bulbopendulous strictures were similar in the 2 groups (table 1). Mean stricture length in the BM urethroplasty group was 5.6 cm (range 4 to 15) and in the PF urethroplasty group 6.0 cm (range 4 to 12, table 2). The techniques of substitution urethroplasty are outlined in table 3. Median followup in the 2 groups was 22.6 and 24.2 months, respectively (p >0.5, table 1). All patients completed at least 1 year of followup. The mean operative time was significantly longer in the PF urethroplasty group (224 minutes) vs the BM urethroplasty group (162 minutes, p = 0.001).

The postoperative complications are summarized in table 3. The rates of hematoma and minor wound infection were similar in the 2 groups. In the PF group 6 patients had superficial penile skin necrosis which healed within 6 weeks postoperatively. One patient had extensive skin loss and required split skin grafting. One patient in the BM urethroplasty group and 2 in the PF urethroplasty group had mild extravasation of dye on voiding cystourethrogram at 3 weeks after surgery, and required an additional week of catheterization. Two patients in the PF group had slight penile

TABLE 1. Preoperative parameters

	BM Urethroplasty	PF Urethroplasty
No. pts	27	28
Mean pt age (range)	37 (16-59)	36.2 (14-55)
No. site:		
Pendulous	4	5
Bulbar	8	8
Bulbopendulous	15	15

TABLE 2. Techniques used for substitution urethroplasty

	No.
Buccal mucosa:	
Single cheek	10
Both cheeks	11
Both cheeks + lower lip	6
Penile skin flap:	
Longitudinal penile skin flap	5
Circumpenile skin flap	23

torsion which did not interfere with sexual intercourse. In the BM group 6 patients (25.7%) had minor oral morbidity which settled by 4 weeks postoperatively. Four patients complained of perioral numbness and 2 had changes in salivation in the immediate postoperative period. One patient had a mucus retention cyst which resolved spontaneously.

All patients had some degree of post-void dribbling. This symptom was considered bothersome if patients needed manual urethral compression after voiding to empty residual urine. Bothersome post-void dribbling was significantly more common in the PF (9) compared to the BM urethroplasty group (4) (32.14.% vs 14.8%, p = 0.001, table 3).

The overall success rate in the BM urethroplasty group was 89.9% and in the PF urethroplasty group it was 85.8% (p >0.5, table 4). Three patients in the BM group and 4 in the PF group had stricture recurrence and required internal urethrotomy. All of them settled after a period of clean intermittent catheterization except 1 patient in the BM group with a bulbopendulous stricture who required subsequent penile skin flap urethroplasty. At 6 months after surgery 10 (35.7%) patients in the PF group said that they would not recommend this procedure to another patient as opposed to only 3 (11.1%) patients in BM group (table 4).

**DISCUSSION**

Penile skin flaps and buccal mucosal grafts have proven to be reliable urethral substitutes for the management of complex anterior urethral strictures. Wessells and McAninch compared outcomes of studies using free graft and penile skin flap urethroplasty with comparable success rates for both techniques (free grafts 84.3%, penile skin flaps 85.9%).<sup>7</sup> However, the previously mentioned report only included retrospective studies in which stricture characteristics and patient variables were not controlled. To our knowledge

TABLE 3. Comparison of complications

	No. BM Urethroplasty	No. PF Urethroplasty
Hematoma	2	2
Wound infection	1	0
Troublesome post-void dribbling	4	9
Penile skin problems:		
Superficial necrosis	0	6
Extensive skin loss (requiring skin grafting)	0	1
Penile torsion	0	2
Penile hypoesthesia	0	3
Oral complications:		
Perioral numbness	4	0
Increased salivation	3	
Mucus retention cyst	1	

TABLE 4. Comparison of outcomes

	BM Urethroplasty	PF Urethroplasty	p Value
Mean cm stricture length (range)	5.6 (4–15)	6 (4–12)	Not significant
Mean operative mins (range)	162 (120–210)	224 (180–410)	0.001
Median mos followup	22.6	24.2	Not significant
No. stricture recurrence	3	4	Not significant
% Overall success	89.9	85.8	Not significant
% Degree of satisfaction	89	64.3	0.001

before our study there was no prospective controlled trial for patients undergoing different techniques of substitution urethroplasty. It is difficult to conduct a randomized trial on urethroplasty techniques because numerous variables like stricture length, etiology, site, previous intervention and degree of spongiofibrosis might influence treatment outcomes. We excluded from analysis patients with an etiology of trauma and balanitis xerotica obliterans, and those who had undergone more than 1 dilation or urethrotomy or previous urethroplasty. In addition, the proportions of patients with pendulous, bulbar and bulbopendulous strictures were well balanced in both groups due to randomization. The only uncontrolled variable was the degree of spongiofibrosis. Although sonourethrography certainly identifies periurethral tissue, it is unreliable in predicting the depth of spongiofibrosis compared with histopathological correlation.<sup>10</sup>

In our hands PF urethroplasty was associated with a longer operative time and hospital stay, and more troublesome minor complications compared to buccal mucosa graft urethroplasty. The mean operative time in the BM group was significantly less than in the PF group (162 vs 224 minutes,  $p = 0.001$ ). This reduction in operative time was achieved by using a 2-team approach. Prolonged operative times when using the high lithotomy position can result in complications like the compartment syndrome, especially when the procedure lasts up to 5 hours.<sup>11</sup> In our study none of the patients had this complication, which may have been because we used the standard lithotomy position.

Significantly fewer patients in the BM urethroplasty group complained of bothersome post-void dribbling (14.8% vs 32.14%,  $p = 0.001$ ). We acknowledge that some degree of post-void dribbling invariably occurs after substitution urethroplasty. However, we presume that the decreased incidence of this complication in the BM group may be related to the technicalities of the procedure. Dorsal placement of the graft on the undersurface of corpora cavernosa provides fixation and excellent mechanical support preventing sacculation of the graft. Moreover, unlike a flap the graft can be tailored precisely without bothering with the vascularity.

The number of troublesome short-term complications was higher in the PF group. Six patients (27.2%) in the PF group had superficial penile skin necrosis which healed with conservative measures within 6 weeks after surgery. One patient in this group had extensive skin loss and was treated successfully with skin grafting. Mild penile torsion developed in 2 patients, and 3 patients reported penile hypoaesthesia but it did not interfere with erection and intercourse. The reported incidence of superficial penile necrosis in various studies varies between 4% and 27%.<sup>12,13</sup> Kessler et al reported a higher incidence of re-interventions for complications (hematoma evacuation, débridement of necrotic tissue, fistula excision and diverticulum resection) following skin flap procedures compared to free grafts.<sup>14</sup> In our study oral

complications in the BM urethroplasty group were short-term and few. Most of these settled within 30 days postoperatively.

Our results demonstrate similar recurrence rates for anterior urethral strictures managed by dorsal onlay substitution urethroplasty using penile skin flaps (85.8%) or buccal mucosa (89.9%). Only 14 patients in the current study had purely bulbar strictures, whereas the rest had strictures involving or extending into the penile urethra. In 1998 Wessells and McAninch posed a relevant question: "The real controversy in modern stricture reconstruction is the following: should one choose a free graft or a distal penile skin flap to reconstruct long strictures in the face of a compromised graft bed?"<sup>7</sup> Traditionally penile flaps are preferred compared to free grafts for pendulous urethral reconstruction.<sup>6,15</sup> It is believed that a deficient corpus spongiosum and poor vascularity of this segment would not support graft take. Wessells and McAninch reported a high failure rate for graft placement in the penile urethra.<sup>6</sup> Moreover, in strictures associated with significant spongiosal scarring, skin flaps are recommended compared to grafts due to a poor quality graft bed.<sup>7</sup>

These concerns may have been pertinent in an era when grafts were exclusively applied on the ventral aspect. In the dorsal position grafts have the advantage of a secure scaffold in the corpora cavernosa which also forms a substantial portion of the graft bed. Logically the take of dorsally applied grafts should not depend on the degree of spongiosal scarring. We previously demonstrated that buccal mucosa urethroplasty can be applied successfully on any segment of the anterior urethra in the presence of a viable urethral plate.<sup>3</sup> In this study BM and PF urethroplasty provided comparable outcomes for strictures involving the pendulous urethra. Others have also reported good outcomes of single stage buccal mucosa urethroplasty for pendulous urethral strictures.<sup>16,17</sup>

In substitution urethroplasty viability of the engrafted tissue depends on the degree of neovascularization. Kamhouri et al conducted an experimental study of penile or buccal grafts and pedicle skin flaps to compare angiogenic activity.<sup>18</sup> Substitution urethroplasty was performed using the previously mentioned substitutes in 28 white New Zealand rabbits. On postoperative day 21 the animals were sacrificed and the retrieved substitutes were subjected to microscopic analysis. Angiogenic activity, expressed by the number of newly formed vessels per optical field, was reported to be the highest in buccal mucosa grafts compared to penile skin grafts or flaps. In another experimental study El-Sherbiny et al demonstrated excellent outcomes with buccal grafts compared to penile skin and bladder mucosa.<sup>19</sup> These studies highlight the inherent advantages of the buccal graft compared to other urethral substitutes, which in

turn correlate with the clinical results reported by various studies.

The degree of satisfaction assessed at 6 months was significantly higher in patients undergoing BM urethroplasty. This finding could have been influenced by the slightly increased incidence of superficial penile necrosis and delayed wound healing experienced by patients in the PF group. However, it seems obvious that patients would prefer not to have violation of the penile skin if an alternative is available.

In our experience buccal mucosa urethroplasty is technically easier and requires significantly less operative time. The short-term complications are temporary and not bothersome. Even long strictures involving the whole anterior urethra can be managed successfully using multiple strips of buccal mucosa. Thus, whenever available we prefer buccal mucosa as the tissue of choice for substitution of all segments of the anterior urethra. Long-term results with skin flap urethroplasty show a decreasing success rate with time.<sup>20</sup> Five-year results with BM urethroplasty show promising success rates.<sup>8</sup> Further followup will determine whether initial success with BM grafting stands the test of time.

## CONCLUSIONS

At intermediate followup dorsal onlay penile skin flap and buccal mucosa urethroplasty provide similar success rates. Compared to buccal mucosa urethroplasty penile skin flap urethroplasty procedures are technically complex, associated with higher morbidity and less preferred by patients.

### Abbreviations and Acronyms

BM = buccal mucosa  
PF = penile flap

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