

Original Research Article

Substitution urethroplasty: Buccal mucosal graft Vs local flaps - A prospective randomized study

G. Mallikarjuna^{1*}, N. Ramamurthy¹, G. Ravichander¹, Ravi Jahagirdar², Jagadeeshwar²

¹Assistant Professor, Department of Urology, Gandhi Hospital, Secundrabad, Telangana, India

²Associate Professor, Department of Urology, Gandhi Hospital, Secundrabad, Telangana, India

*Corresponding author email: drmallik@hotmail.com

	International Archives of Integrated Medicine, Vol. 3, Issue 10, October, 2016. Copy right © 2016, IAIM, All Rights Reserved. Available online at http://iaimjournal.com/ ISSN: 2394-0026 (P) ISSN: 2394-0034 (O)	
	Received on: 02-10-2016 Source of support: Nil	Accepted on: 09-10-2016 Conflict of interest: None declared.
How to cite this article: G. Mallikarjuna, N. Ramamurthy, G. Ravichander, Ravi Jahagirdar, Jagadeeshwar. Substitution urethroplasty: Buccal mucosal graft Vs local flaps - A prospective randomized study. IAIM, 2016; 3(10): 162-173.		

Abstract

Introduction: Urethral stricture is a common condition with varying etiology and management, determined by cause, site and length of stricture.

Materials and methods: We presented here a randomized prospective trial comparing dorsal onlay buccal mucosa graft and penile skin flap urethroplasty at our institute over 3 years period.

Results: Total 22 patients underwent substitution urethroplasty during this period. The mean age and follow up was 31.31 years and 9 months respectively. The most common cause of stricture urethra was post inflammatory (40.90%) followed by traumatic (36.36%) and balanitis xerotica obliterans (22.72%). Majority had combined penobulbar stricture (45.45%), followed by penile (31.81%) and bulbar (22.7%). The average size of the urethral stricture was 6.81 cm. The most common symptom of presentation of stricture urethra was thin stream (100%) followed by dysuria (80%), frequency (71.42%) and dribbling (30%). Most of the patients underwent surgical procedure prior to presentation; urethral dilatation done in 13 (59.05%) patients followed by visual internal urethrotomy 7 (31.81%) patients and suprapubic cystostomy in 4 (18.18%) patients. Of 22 patients, 10 (45.45%) underwent local flap and 12 (54.54%) patients buccal mucosal graft. Out of 10 local flap technique, 8 (36.36%) patients underwent ventral longitudinal flap and 2 (9.09%) underwent Quarter flap. Out of 12 buccal mucosal graft technique, 5 (22.72%) patients underwent ventral onlay graft, 5 (22.72%) dorsal onlay and 2 (9.09%) tube circumferential graft. Total success rate was 72.72%. Success rate was higher with buccal mucosal graft (83.33%) compared to local flap technique (60%). Among local

flap technique, ventral longitudinal flap (62.5%) had better results than quartey flap (50%). Among buccal mucosal graft dorsal onlay graft had best (100%) results followed by ventral onlay (80%) and then tube circumferencial graft (50%). Patients with smaller stricture length (2.5-7.5 cm) had better (75%) results. Patients with combined penobulbar (90%) and BXO as etiology (80%) also had better results.

Conclusion: The success rate of buccal mucosal free graft substitution urethroplasty is better than local penile skin flaps in patients with anterior urethral strictures.

Key words

Buccal mucosal graft, Local flap urethroplasty, Stricture urethra.

Introduction

Urethral stricture is a common condition with varying etiology and changing practices in management, grossly determined by cause, site and length of stricture and also by other factors like prior attempts at repair and local genital skin condition. Treatment options vary from blind dilatations to perineal urethrostomy. The surgical treatment of adult anterior urethral strictures is constantly evolving.

Skin grafts and flaps were used since a long time with satisfactory initial results but long term results were poor. Traditionally penile skin flaps, which have the advantage of a robust vascular pedicle, were considered the most reliable material for reconstruction of complex strictures. Over the past 10 – 15 years buccal mucosal grafts have been increasingly used in urethral reconstruction because of its advantages in harvesting, graft characteristics and minimal morbidity of donor site. 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. Buccal mucosa has the advantage of being thin with thicker epithelium and thinner sub mucosa, which has rich vascular plexus. It is easily available, easy to harvest and easy to handle during application at recipient site. In various studies dorsal placement of penile skin flaps and free grafts has yielded superior outcomes compared to ventral placement. We present the results of a randomized prospective trial

comparing dorsal onlay buccal mucosa grafting and penile skin flap urethroplasty.

Materials and methods

It was a randomized prospective study, involving patients with long stricture of the anterior urethra who underwent single stage substitution urethroplasty at Gandhi General Hospital between September 2006 and January 2009. Preoperatively, demographic data and clinical features were recorded. Retrograde urethrogram (RGU) and micturiting cysto-urethrogram (MCU) were obtained in all. After initial assessment, patients were then randomized to receive either local penile skin flap urethroplasty or buccal mucosal free graft urethroplasty.

Surgical technique

In terms of technique, a 2-team approach was used in patients undergoing buccal mucosal graft urethroplasty whereas a single team performed Penile flap urethroplasty. With the patient under general anesthesia and the diseased urethra was exposed by incision, depending on the site of stricture. For pendulous urethral strictures a circumcoronal incision was used, whereas for more proximal strictures a midline perineal incision was used. The spongiosum was detached dorsally from the corpora and a urethrotomy was made exactly at the 12 o'clock position. The urethra was completely mobilized from the corpora cavernosa and rotated 180 degrees. The stricturous segment was opened and a buccal mucosal graft or a penile skin flap was applied.

In the Penile skin flap group a circumpenile or longitudinal penile skin flap was used depending on the stricture site. Patients either underwent ventral longitudinal technique with the Orandi method or had undergone quarter flap. In both techniques, the hair-free skin of the ventral penis was harvested as a flap. First, an incision along the stricture was made and the skin flap, tailored to the stricture length, was harvested. The defect was covered by the penile skin flap. The anastomosis was made by a 4-0 or 5-0 suture. In buccal mucosal free graft urethroplasty buccal mucosa was harvested from 1 cheek or from both cheeks and lower lip. After measuring the length of the urethral defect, the buccal mucosa graft, with a width of 2 cm, was outlined on the lower lip with possible extension into the inner cheek when longer grafts were necessary, taking into account a possible shrinkage of 20%. A submucosal injection of saline with 1:200,000 epinephrine (hemostasis) and 1% Xylocaine (post-operative analgesia) was performed to elevate the mucosal graft. Great care was taken for strict submucosal harvesting without damaging the underlying oral musculature and stensen's duct. After hemostasis, the oral wound was left open in the lower lip and closed with a running 4-0 Vicryl rapid suture in the aspect of the inner cheek. After thinning the graft with removal of submucosal fat, the graft was sutured to the urethral plate with a 6-0 running suture (catgut and, more recently, Monocryl) over an 16F fenestrated urethral catheter reaching up to the membranous urethra. The mucosal graft was placed either dorsally or ventrally. Care was taken to cover the graft with two to three well-vascularized tissue layers (corpus spongiosum, bulbocavernosus muscle, subcutaneous tissue). A nonadhesive compressive dressing was used and left in place for 3 days.

Patients who underwent a urethroplasty that utilized a tubed buccal mucosal graft, the graft was defatted and tubed around an 16-F Silicon or foleys catheter using a series of interrupted 4-0 polyglactin sutures. These sutures also were used to anastomose the graft to both ends of the urethra after resection of fibrotic tissue through a

midline perineal incision. The dorsal onlay technique involved mobilisation of strictured urethra through perineal approach, dorsal splitting of the diseased urethra, placement of prepared graft on perineal cavernosal bed, fixing of graft by quilting sutures and suturing of graft edges to urethral edges with 4/0 vicryl over a 16 Fr silicone catheter. In ventral onlay technique, the stenotic urethral segment was incised longitudinally on the ventral part of the urethra, with the urethral opening reaching well into the healthy proximal and distal urethra.. After thinning the graft with removal of submucosal fat, the graft was sutured to the urethral plate with a 6-0 running suture.

Postoperative management

Intravenous antibiotic prophylaxis by ceftriaxone and amikacin was administered for 48 to 72 hours postoperatively and oral antibiotics were started thereafter. The patients were discharged on the 5th postoperative day, on average. The catheter was left in place for 2-3 weeks. Cystourethrography was performed through pricatheter, 3 weeks after the surgery. If contrast extravasation was present, a 16Fr Foley catheter was maintained for an additional 1-2 weeks.

Follow up

Follow up consisted of, physical examination, history with a special attention to voiding Pattern, uroflowmetry and urethral calibration with a 16 Fr 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. Appropriate diagnostic measures would be done in case of any obstructive or irritative symptoms, ejaculatory dysfunction, or recurrent urinary tract infections (UTI). The patients were followed up for an average of 9 (range, 3 to 24 months). Failure was defined as the recurrence of obstructive symptoms and/or failure to calibrate with a 16 F Foley catheter, the need for any subsequent urethral procedure (internal urethrotomy, urethral dilatation or urethroplasty).

Results

A total of 22 patients underwent substitution urethroplasty from December 2006 to January 2009. The mean age was 31.31 years (range 25 to 65). The mean follow up was 9 months (ranging 3-24). Majority (50%) of the patients had 6 months follow-up. The most common cause of stricture urethra was post inflammatory 9 (40.90%) followed by traumatic (36.36%) and balanitis xerotica obliterance (22.72%). Most of the patients had combined penobulbar stricture (45.45%). Among combined Penobulbar stricture 3 (30%) patients had complete stricture. Penile and bulbar strictures were seen in 7(31.81%) and 5 (22.72%) patients respectively (**Table - 1**). The most common cause of bulbar and penile stricture urethra was post-inflammatory and traumatic seen in 3 (60%) and 4 (57.14%) patients respectively (**Table - 1**).

The most common symptom of presentation of stricture urethra in our study was thin stream, present in all the patients (100%) followed by, dysuria (80%) in bulbar stricture, frequency (71.42%) in penile stricture and dysuria (30%) and dribbling (30%) in bulbopenile (**Table - 2**).

The average size of the urethral stricture was 6.81 centimeters (range 4 to 12 centimeters). Majority of patients with combined bulbopenile urethral stricture (40%) had stricture size of more than 10 cm. Most of the patients with penile (57.14%) and bulbar (60%) stricture had stricture size of 5.1-7.5 cm and 2.6-5 cm respectively (**Table - 3**). The most common cause of stricture urethra of size more than 10cms was BXO and Most of the patients with post-inflammatory stricture urethra (55.55%) had stricture size of 2.5- 5 cm (**Table - 3**).

Table - 1: Etiology and site of stricture urethra.

Etiology	Bulbar n (%)	Penile n (%)	Penobulbar n (%)	Total number of patients(%)
BXO	0(0%)	1(14.28%)	4(40%)	5(22.72%)
Traumatic	2(40%)	4(57.14%)	2(20%)	8(36.36%)
Inflammatory	3(60%)	2(28.57%)	4(40%)	9(40.9%)
Total (%)	5(22.7%)	7(31.81%)	10(45.45%)	22(100%)

Table - 2: Presenting symptoms of stricture urethra.

Symptoms	Penobulbar n (%)	Bulbar n (%)	Penile n (%)	Total number of patients (%)
Thin stream	10(100%)	5(100%)	7(100%)	22(100%)
Interrupted stream	2(20%)	1(20%)	3(42.85%)	6(27.27%)
Dysuria	3(30%)	4(80%)	0(0%)	7(31.81%)
Frequency	1(10%)	2(40%)	5(71.42%)	8(36.36%)
Postvoid Dribbling	3(30%)	3(60%)	1(14.28%)	7(31.31%)

Most of the patients underwent surgical procedure prior to presentation. Most common procedure was urethral dilatation done in 13 (59.05%) patients followed by visual internal urethrotomy (VIU) in 7 (31.81%) patients and suprapubic cystostomy (SPC) in 4 (18.18%) patients. None of our patients underwent meototomy or urethroplasty. Patients with

combined penobulbar stricture underwent maximum number of surgical procedures; urethral dilatation in 7 (53.84%) patients and VIU in 4 (66.66%) patients (**Table - 4**). Of 22 patients, 10 (45.45%) underwent local flap surgery and 12 (54.54%) patients buccal mucosal graft. Among local flap technique, 8 (36.36%) patients underwent ventral longitudinal flap and

2 (9.09%) patients underwent Quartey flap. Among buccal mucosal graft technique 5 (22.72%) patients underwent ventral onlay graft, 5 (22.72%) patients dorsal onlay and 2 (9.09%) patients tube circumferential graft.

Total success rate was 72.72%. Success rate was higher with buccal mucosal graft (83.33%) compared to local flap technique (60%), however it was not statistically significant (P Value-0.3). Among local flap technique ventral longitudinal flap (62.5%) had better results than quartey flap (50%), which was not statistically significant (P Value-1.0). Among buccal mucosal graft dorsal

onlay graft had best (100%) results followed by ventral onlay (80%) and then tube circumferential graft (50%), which was also not statistically significant (**Table - 5**).

Other predictors of outcome were the length, site and the etiology of the stricture. Patients with smaller of stricture length had better results; stricture length of 2.5-7.5 cm had 75% success rates and >7.5cm had 50% success rates. Patients with combined penobulbar (90%) and BXO (80%) as a cause if stricture had better results (**Table - 6**).

Table - 3: Etiology, Length and site of stricture urethra.

Stricture length (cm)	Site of Stricture				Etiology of stricture			Total No. of patients (%)
	Bulbar n (%)	Penile n (%)	Penobulbar n (%)	Panurethral n (%)	BXO n (%)	Traumatic n (%)	Inflammatory n (%)	
2.6-5	3(60%)	3(42.85%)	2(20%)	0(0%)	1(20%)	2(25%)	5(55%)	8(36.36%)
5.1-7.5	2(40%)	4(57.14%)	2(20%)	0(0%)	0(0%)	4(50%)	4(44.44%)	8(36.36%)
7.6-10	0(0%)	0(0%)	2(20%)	0(0%)	0(0%)	2(25%)	0(0%)	2(9.09%)
>10	0(0%)	0(0%)	4(40%)	3(30%)	4(80%)	0(0%)	0(0%)	4(18.18%)

Table - 4: Surgical procedure prior to presentation and site of the stricture urethra.

Prior surgical procedure	Bulbar n (%)	Penile n (%)	Penobulbar n (%)	Total number of patients (%)
Dilatation	3(23.07%)	3(23.07%)	7(53.84%)	13(59.05)
VIU	0(0%)	2(33.33%)	4(66.66%)	6(31.81%)
SPC	1(50%)	2(50%)	1(25%)	4(18.18%)

Table - 5: Outcome according to surgical technique.

Local flap	Success N (%)	Failure N (%)	Total number of patients	p Value	P Value
Ventral longitudinal	5(62.5%)	3(37.5%)	8	1.0	0.3
Quartey	1(50%)	1(50%)	2		
Total no of patients (%)	6(60%)	4(40%)	10		
Buccal mucosa graft					
ventral onlay graft	4(80%)	1(20%)	5	0.2	
Dorsal onlay graft	5(100%)	0(0%)	5		
Tube circumferencial graft	1(50%)	1(50%)	2		
Total no of patients(%)	10(83.33%)	2(16.66%)	12		

Table - 6: Outcome according to stricture site, etiology and stricture length.

	Variables	Success n (%)	Failure n (%)	Total number of patients
Site of the stricture	Bulbar	4(80%)	1(20%)	5
	Penile	3(42.85%)	4(57.14%)	7
	Combined penobulbar	9(90%)	1(10%)	10
	Total (%)	16(72.72%)	6(27.27%)	22
Etiology of stricture	BXO	4(80%)	1(20%)	5
	Inflammatory	6(66.66%)	3(33.33%)	9
	Traumatic	6(75%)	2(25%)	8
	Total (%)	16(72.72%)	6(27.27%)	22
Stricture length (cm)	2.5-5	6(75%)	2(25%)	8
	5.1-7.5	6(75%)	2(25%)	8
	7.6-10	1(50%)	1(50%)	2
	>10	2(50%)	2(50%)	4
	Total	15(68.18%)	7(31.18%)	22

Discussion

Urethral stricture is a relatively common condition, with an estimated prevalence of 40 per 100 000 men at risk [1]. In adult male patients, the urethral stricture of the anterior urethra may be inflammatory, traumatic, ischemic, iatrogenic or idiopathic in origin. In our study the most common cause of stricture urethra was post inflammatory (40.90%). Affected men generally present with a deteriorating urinary stream, confirmed by a reduced maximum urinary flow rate (Q max) and flattened flow curve on uroflowmetry. All of our patients presented with thin stream. A long segment stricture of the anterior urethra continues to be a challenge for the reconstructive urologist. Visual internal urethrotomy (VIU) may be useful for short annular strictures, but this procedure is associated to a very high recurrence rate [2]. Urethral reconstruction with excision of the strictured segment and end-to-end anastomosis is successful in more than 95% of patients with a stricture of up to 2 cm in length [3]. Patients with long strictures (> 2 cm in length) are not suitable for end-to-end urethroplasty due to the risk of postoperative chordee formation [4]. Substitution urethroplasty is ideal for the management of long anterior urethral strictures. The ideal material for

substitution urethroplasty remains controversial [5]. Substitution urethroplasty can be performed using either vascularised genital skin or free graft. Historically, genital skin flaps have been widely used for urethroplasty, with the theoretical advantage of a better local blood supply. The comprehensive description of penile microcirculation by Quartey led to the dominance of flap in 1980's and early 1990's [6-8]. This seemed theoretical since current studies could not establish superiority of flaps over grafts in terms of re-stricture rate [9]. Flap reconstruction is time consuming, the dissection extensive and redeployment of dartos tend to cause penile deforming and scarring. However, recent studies have suggested that grafts and flaps have equal success rates, with grafts having the advantage of easier and quicker harvesting, as well as better availability. Flaps are still favored in some revision surgeries and in any condition that may interfere with the ability of graft take such as radiotherapy, peripheral vascular disease or persistent local infection [10].

In our study of 22 patients, 10 (45.45%) underwent local flap surgery; of which 8 (36.36%) patients underwent ventral longitudinal flap and 2 (9.09%) patients underwent quartey

flap. Ventral longitudinal flap (62.5%) had better results than quartey flap (50%), which was not statistically significant (P Value-1.0).

Both full-thickness grafts of genital or extragenital skin [11] as well as bladder mucosa [12], have been associated with specific problems and complications, particularly during long-term follow-up. A number of techniques using various candidate tissues have evolved to deal with this problem. These include split skin and full thickness grafts, bladder mucosa, buccal mucosa and now tissue engineered substitutes available over the shelf [13]. These complications have led to the current enthusiasm for buccal mucosa grafting in reconstructive surgery of both hypospadias and stricture repair.

Humby was the first to use buccal mucosa for urethral reconstruction in a series of single stage hypospadias repair. Buccal mucosa is receiving increased attention in the urological literature for penile and bulbar urethroplasty [14]. The advantages of buccal mucosa include ease of harvesting, superior donor site cosmesis, resilience to infections and better long-term stability [15]. Much debate has been generated recently as to whether to place the graft ventrally or dorsally [16]. Substitution urethroplasty by ventral onlay of a full thickness penile skin graft has been a mainstay in the repertoire of urethroplasty since it was first reported by Presman and Greenfield in 1953 [17]. Applied ventrally over the incised urethra, the graft often lacked the mechanical support of a fixed bed, which allowed it to fold on itself. Long-term follow-up revealed that ventrally placed grafts are prone to shrinkage and a reason for late failure [18, 19]. Less commonly urethral sacculation at the graft site would occur with its attendant problem of sequestration of urine and semen [20]. Ventral onlay graft is more prone to fistula formation, sacculation and diverticula formation leading to urinary stasis and ejaculatory dysfunction [21]. Jan fichtner, et al. [22] evaluated patients who were treated with ventral buccal mucosa onlay grafts for open urethral stricture repair with a follow-up

exceeding 5 year, 67 patients who underwent ventral buccal mucosa onlay graft surgery for urethral stricture repair. Of these, 32 were followed up for longer than 5 years (mean 6.9 years). The overall complication rate was 25% (8 of 32). In different series, ventral onlay urethroplasty has revealed a success rate of 57.1 % to 100% with a follow-up ranging from 20 to 64 months [23-26]. The outcome of our study in comparison to the other major series with ventral onlay graft placement in the literature (**Table - 7**). Based on the dorsal approach to stricture disease described by Monseur (1980), [36], Barbagli, et al. [37] proposed dorsal rather than ventral application of graft. This technique allows the graft to be spread and anchored onto the under surface of the corporeal bodies overlying the dorsally incised stricture offering a more secure bed and improving the chances of neovascularization and less incidence of sacculation, urethral diverticula and fistula formation [38, 39]. In another study, dorsal onlay BMG urethroplasty has shown a success rate from 87.5% to 100% with a follow-up ranging from 22 to 41 months [40, 32]. Recently, Barbagli, et al. [35] published a retrospective study of 50 cases with bulbar urethral stricture where buccal mucosal graft urethroplasty were done. In their study, grafts were placed as ventral, dorsal and lateral onlay in 17, 27 and 6 patients respectively. After a mean follow-up of 42 months, placement of graft into ventral, dorsal or lateral surface of the bulbar urethra showed the similar success rate. Recently Asopa Hari S, et al. [41] reported dorsal free graft urethroplasty for urethral strictures by ventral sagittal urethrotomy approach. He described a technique of laying open the stricture ventrally and then incising the urethra dorsally without mobilizing it to expose the tunica albuginea for the free skin or buccal mucosa graft followed by retubularization of the urethra in 1 stage. Oral complications after buccal mucosal graft harvest for urethroplasty are infrequent and mild in nature [42]. However, few investigators, have shown that ventral onlay grafts have similar successful outcomes [5, 22, 26, 30, 32, 43] with the advantage of easier placement. In a series of

70 patients who underwent anterior urethroplasty, Greenwell, et al. [44] concluded that for a circumferential repair of the urethra, particularly the penile urethra, a 2-stage repair using a free graft gives better result than a 1-stage repair using a flap or tube graft. But the 1 and 3-year re-stricture rates of the 2-stage reconstructions were the same as for patch grafts in their series.

In our series 12 (54.54%) of 22 undervent patients buccal mucosal graft, of which 5 (22.72%) patients underwent ventral onlay graft, 5 (22.72%) patients dorsal onlay and 2 (9.09%) patients tube circumferential graft. The outcome of our study in comparison to the other major series with dorsal onlay graft placement in the literature (**Table - 7**).

Table - 7: Studies of ventral and Dorsal onlay graft placement.

Series	No. of patients	Mean age	Stricture site	Stricture length, cm	Follow up months	Success rate Number (%)
Ventral onlay graft placement						
Duck, et al. [27]	2	-	Penobulbar	-	6-84	2(100)
Morey, et al. [28]	13	-	Bulbar	-	2-33	13(100)
Venn S, et al. [29]	28	-	Bulbar-23 Penile-5	-	24-60	27(92)
Pansodoro [30]	9	41	-	-	41	80 (88.9)
Andrich [31]	29	-	Bulbar	-	60	86%
Kane, et al. [32]	53	-	-	-	25	94
Elliot, et al. [33]	60	-	-	-	47	90
Kellner, et al. [34]	18	-	-	-	50	88
Barbagli [35]	17	-	-	-	42	83
Our series	10	31	Penile 7, Penobulbar 3	-	9	60
Dorsal onlay graft placement						
Kasaby AW, et al. [45]	13	-	Bulbar	1-2	-	12(90)
Barbagli [37]	6	-	Bulbar	-	18-56	6(100)
Gupta, et al. [4]	12	-	Panurethral,4 Penobulbar,8	3-16	10-16	11(72)
Meneghini, et al. [46]	20	52	-	-	12	16(80)
Anna O’Riordan, et al. [47]	52	39	-	-	34	44(86)
Col DK Jain, et al. [48]	12	38.9	Bulbar,2 Penile,6 Penobular, 4	10.1	2-26	11(91.7)
Pansodoro, et al. [30]	56	41	-	-	41	55 (98.2)
Barbagli, et al. [39]	6	-	14	-	-	06 (100)
Andrich, et al. [31]	42	-	Bulbar	-	60	95%
Iselin CE, et al. [38]		-	-	-	19	97%
Barbagli, et al. [35]	27	-	-	-	42	85
Our series	12	-	Bulbar-5 Penobular-7	-	9	83.33%

There are few studies which compared penile skin graft with free graft urethroplasty. Wessells and McAninch [9] 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%). However, this study only included retrospective studies in which stricture characteristics and patient variables were not controlled in a prospective study [49] 55 patients

with anterior urethral strictures were randomized to undergo buccal mucosa dorsal onlay [27] or penile skin flap [28] urethroplasty. Only 14 patients in this study [49] had purely bulbar strictures, whereas the rest had strictures involving or extending into the penile urethra. The success rate in the buccal mucosa (89.9%)

and penile flap (85.6%) groups was similar (p value-0.05) [49]. 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 (**Table – 8**).

Table - 8: Comparative outcome studies of Penile flap Vs Buccal mucosal graft.

Series	Penile flap		Buccal mucosal graft		Overall success rate
	Number of patients	Success rates	No of patients	Success rates	
Our series	10	6(60%)	12	10(83.33%)	72.72%
Wessells McAninch, et al. [9]	-	85.6%	-	84.3%,	-
Deepak Dubey, et al. [49]	28	(85.6%)	27	(89.9%)	-
Marco Raber, et al. [51]	-	76%	-	85%	80%

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?” [9]. Traditionally, penile flaps are preferred compared to free grafts for pendulous urethral reconstruction [43, 50]. 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 [50]. Moreover, in strictures associated with significant spongiosal scarring, skin flaps are recommended compared to grafts due to a poor quality graft bed [7]. 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. Marco Raber, et al. [51] compare the outcomes of dorsal onlay graft urethroplasty using penile skin or buccal mucosa free grafts in the repair of adult bulbourethral strictures. Mean follow-up was 51 months (range 20–74 months). The overall success rate was

80% (85% in the Buccal Mucosa and 76% in the Penile Skin group).

To our knowledge ours is one of the few such studies, where the outcomes of the buccal mucosal graft has been compared with the penile skin flap. Dorsal onlay graft urethroplasty using buccal mucosa had best success rate of 100%. Ventral onlay buccal mucosa graft had success rate of 80% and the penile graft had a success rate of 60%. The overall success rate was 72.72%.

Conclusion

The most common cause of stricture urethra was post inflammatory but BXO was the common cause of stricture urethra of size more than 10 cm. Buccal mucosa is receiving increased attention in the urological literature for penile and bulbar urethroplasty. The success rate of buccal mucosal free graft substitution urethroplasty is better than local penile skin flaps in patients with anterior urethral strictures. The advantages of buccal mucosa include ease of harvesting, superior donor site cosmesis, resilience to infections and better long-term stability. The question of placing the BMG dorsally, ventrally or laterally is still unresolved. Our study showed that the dorsal onlay technique

has better success rate than ventral onlay technique in patients with anterior urethral stricture. However a randomized controlled trial with careful patient selection and long-term evaluation of results is required to confirm the durability of the results.

References

1. McMillan A, Pakianathan M, Mao JH, Mac Urethral stricture and urethritis in men in Scotland. *Genitourin Med.*, 1994; 70: 403-5.
2. 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: 356-8.
3. Webster GD, Robertson CN. The vascularized skin island urethroplasty: its role and results in urethral stricture management. *J Urol.*, 1985; 133: 31-3.
4. Gupta NP, Ansari MS, Dogra PN, Tandon S. Dorsal buccal mucosal graft urethroplasty by a ventral sagittal urethrotomy and minimal-access perineal approach for anterior urethral stricture. *BJU Int.*, 2004; 93: 1287-90.
5. Bhargava S, Chapple CR. Buccal mucosal urethroplasty: is it the new gold standard? *BJU Int.*, 2004; 93: 1191-3.
6. Quartey JKM. One-stage penile/prepuccial cutaneous island flap urethroplasty for urethral stricture. A preliminary report. *J Urol.*, 1983; 129: 284-287.
7. Quartey JKM. One-stage penile/prepuccial island flap urethroplasty for urethral stricture. *J Urol.*, 1985; 134: 474 - 487.
8. Quartey JKM. Microcirculation of the penis and scrotal skin. In Resnick MI, Jordan GH (eds). *Atlas of Urol Clin N Am.*, 1997; 5: 3 - 4.
9. Wessells H, McAninch JW. Current controversies in anterior urethral stricture repair: free graft versus pedicle skin flap reconstruction. *World J Urol.*, 1998; 16: 175 - 180.
10. Andrich DE, Mundy AR. Use of free grafts for urethroplasty. In: Schreiter F, Jordan GH (eds). *Reconstructive Urethral Surgery*. Springer, Heidelberg, 2006; p. 176 - 179.
11. Mundy AR. The longterm results of skin inlay urethroplasty. *Br J Urol.*, 1995; 75: 59-64.
12. Wessells H, Morey AF, McAninch JW. Single stage reconstruction of complex anterior urethral strictures: combined tissue transfer techniques. *J Urol.*, 1997; 157: 1271-1274.
13. Bhargava S. Tissue-engineered buccal mucosa for substitution urethroplasty. *BJU Int.*, 2004; 93: 807-11.
14. Barbagli G. When and how to use buccal mucosa grafts in penile and bulbar urethroplasty. *Minerva Urol Nefrol.*, 2004; 56: 189-203.
15. Andrich DE, Mundy AR. Urethral strictures and their surgical management. *Br J Urol.*, 2000; 86: 571-80.
16. Andrich DE, Leach CJ, and Mundy AR: The Barbagli procedure gives the best results for patch urethroplasty of the bulbar urethra. *BJU Int.*, 2001; 88: 385-389.
17. Pressman D. Greenfield DL. Reconstruction of the perineal urethra with a free full-thickness skin graft from the prepuce. *J Urol.*, 1953; 69: 677.
18. Devine PC, Sakati LA, Poutasse FF, Devine CJ Jr. One stage urethroplasty: repair of urethral strictures with a free full thickness patch of skin. *J Urol.*, 1968; 99: 191.
19. Blum JA, Feeney MJ. Howe GE, Steel JF. Skin patch urethroplasty: 5-year follow-up. *J Urol.*, 1982; 127: 909.
20. Brigman JA, Deture FA. Giant urethral diverticulum after free fullthickness skin graft urethroplasty. *J d'Urol.*, 1979; 121: 523.

21. Bhargava S, Chapple CR. Buccal mucosal urethroplasty: is it the new gold standard? *BJU Int.*, 2004; 93: 1191-3.
22. Jan Fichtner, Dragana Filipas, Margit Fisch, Rudolf Hohenfellner, Joachim W. Thüroff .Long-term outcome of ventral buccal mucosa onlay graft urethroplasty for urethral stricture repair. *Urology*, 2004; 64(4): 648–650.
23. Wessells H, McAninch JW. Use of free grafts in urethral stricture reconstruction. *J Urol.*, 1996; 155: 1912-5.
24. Caldamone AA, Edstrom LE, Koyle MA, Rabinowitz R, Hulbert WC. Buccal mucosal grafts for urethral reconstruction. *Urology*, 1998; 51: 15-9.
25. Metro MJ, Wu HY, Snyder HM 3rd, Zderic SA, Canning DA. Buccal mucosal grafts: lessons learned from an 8-year experience. *J Urol.*, 2001; 166: 1459-61.
26. Heinke T, Gerharz EW, Bonfig R, Riedmiller H. Ventral onlay urethroplasty using buccal mucosa for complex stricture repair. *Urology*, 2003; 61: 1004-7.
27. Duckett JW, Coplen D, Ewalt D, Baskin LS. Buccal mucosal urethral replacement. *J Urol.*, 1995; 153: 1660–3.
28. Morey AF, McAninch JW. Technique of harvesting buccal mucosa for urethral reconstruction. *J Urol.*, 1996; 155: 1696–7.
29. Venn SN, Mundy AR. Early experience with the use of buccal mucosa for substitution urethroplasty. *Br J Urol.*, 1998; 81: 738–40.
30. Pansodoro V, Emiliozzi P, Gaffi M, et.al. Buccal mucosa urethroplasty in the treatment of bulbar urethral strictures. *Urology*, 2003; 61: 1008-10.
31. Andrich DE, Leach CJ, Mundy AR. The Barbagli procedure gives the best results for patch urethroplasty of the bulbarurethra. *Br J Urol.*, 2001; 88: 185-9.
32. Kane CJ, Tarman GJ, Summerton DJ, et al. Multi-institutional experience with buccal mucosa onlay urethroplasty for bulbar urethral reconstruction. *J Urol.*, 2002; 167: 1314–1317.
33. Elliott SP, Metro MJ and McAninch JW. Long-term follow up of the ventrally placed buccal mucosa onlay graft in bulbarurethral reconstruction. *J Urol.*, 2003; 169: 1754.
34. Kellner DS, Fracchia JA, Armenakas NA, et al. Ventral onlay buccal mucosal grafts for anterior urethral strictures: long-term follow up. *J Urol.*, 2004; 171(2 Pt 1): 726-9.
35. Barbagli G, Palminteri E, Guazzoni G, Montorsi F, Turini D, Lazzeri M. Bulbar urethroplasty using buccal mucosa grafts placed on the ventral, dorsal or lateral surface of the urethra: are results affected by the surgical technique? *J Urol.*, 2005; 174: 955-8.
36. Monsieur JL. Elargissement de P'uretre au moyen due plan susuretral, Bilan apres 13 ans sur 219 cas. *J d'Urol.*, 1980; 86: 439.
37. Barbagli G, Selli C, Tosto A, Palminteri F. Dorsal free graft urethroplasty. *J Urol.*, 1996; 155: 123.
38. Iselin CE, Webster GD. Dorsal onlay graft urethroplasty for repair of bulbar urethral stricture. *J Urol.*, 1999; 161: 815-8.
39. Barbagli G, Palminteri E, Rizzo M. Dorsal onlay graft urethroplasty using penile skin or buccal mucosa in adult bulbourethral strictures. *J Urol.*, 1998; 160: 1307-9.
40. Dubey D, Kumar A, Bansal P, Srivastava A, Kapoor R, Mandhani A, et al. Substitution urethroplasty for anterior urethral strictures: a critical appraisal of various techniques. *BJU Int.*, 2003; 91: 215-8.
41. Asopa Hari S. Dorsal free graft urethroplasty for urethral stricture by ventral sagittal urethrotomy approach. *Urology*, 2001; 58: 657-659.
42. Dublin N, Stewart LH. Oral complications after buccal mucosal graft

- harvest for urethroplasty. *BJU Int.*, 2004; 94: 867-9.
43. Morey AF, McAninch JW. When and how to use buccal mucosal grafts in adult bulbar urethroplasty. *Urology*, 1996; 48: 194-198.
 44. Greenwell J, Venn SN, Mundy AR. Changing practice in anterior urethroplasty. *Br J Urol.*, 1999; 83: 631-635.
 45. Kasaby AW, Fath-Alla M, Noweir AM, el-Halaby MR, Zakaria W, el-Beialy MH. The use of buccal mucosa patch graft in the management of anterior urethral strictures. *J Urol.*, 1993; 149: 276-8.
 46. Meneghini A, Cacciola A, Cavarretta L, Abatangelo G, Ferrarrese P, Tasca A. Bulbar urethral stricture repair with buccal graft urethroplasty. *Eur Urol.*, 2001; 39: 264-7.
 47. Anna O'Riordan, Radnakrishna Narahari, Vinod Kumar, Robert Pickard. Outcome of dorsal buccal graft urethroplasty for recurrent bulbar urethral strictures. *BJU Int.*, 2008; 102: 1148-51.
 48. Col DK Jain, Wg Cdr R Talwar. Outcome of Dorsal Onlay Buccal Mucosa Substitution Urethroplasty in Long Strictures of Anterior Urethra. *MJAFI*, 2007; 63(1).
 49. Deepak Dubey, Vivek Vijjan, Rakesh Kapoor, Aneesh Srivastava, Anil Mandhani, Anant Kumar, M. S. Ansari. Dorsal Onlay Buccal Mucosa Versus Penile Skin Flap Urethroplasty for Anterior Urethral Strictures: Results From a Randomized Prospective Trial. *J Urology*, 2007; 178: 2466-2469.
 50. Wessells H, McAninch JW. Use of free grafts in urethral stricture reconstruction. *J Urol.*, 1996; 155: 1912.
 51. Marco Raber, Richard Naspro, Emanuele Scapaticci, et al. Dorsal Onlay Graft Urethroplasty Using Penile Skin or Buccal Mucosa for Repair of Bulbar Urethral Stricture: Results of a Prospective Single Center Study. *Eur Urol.*, 2005; 48: 1013-7.