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Impact of Graft Position on Failure of Single-Stage Bulbar Urethroplasties with Buccal Mucosa Graft

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Abstract

OBJECTIVE—To determine whether patency rates after bulbar urethroplasty with buccal mucosa graft onlay differ based on whether the graft is placed ventrally or dorsally.

METHODS—This was a retrospective, single-center study of all single-stage bulbar urethroplasties performed from 2001–2011 by two surgeons in which buccal mucosa was used as an onlay graft. Failure was defined as the need for endoscopic or open revision of the reconstruction, or placement of a suprapubic catheter for urinary retention.

RESULTS—A total of 103 patients were reviewed; 41 underwent dorsal onlay, and 62 underwent ventral onlay. Mean age was 40.8 years. Most (84%) patients underwent a prior procedure, which consisted of DVIU in 69%, dilation in 53%, and urethroplasty in 14%. Mean stricture length was 3.9cm. At a mean follow-up of 36 months, failure occurred in 19 patients (12 ventral, 7 dorsal). The vast majority of these patients (79%) were successfully treated with a single dilation or DVIU. There was no difference in failure rate or time to failure according to whether graft position was ventral or dorsal. In multivariate analysis, diabetes was predictive of failure (OR 8.7, 95% CI 1.6–46.5, $p = 0.01$).

CONCLUSIONS—Single-stage bulbar urethroplasty with buccal mucosa graft is an effective procedure for patients with a bulbar urethral stricture that is not amenable to primary anastomosis. From our experience, we cannot conclude that dorsal or ventral graft position is inherently superior. Patients with diabetes may be more likely to require additional procedures following bulbar urethroplasty with buccal grafting.

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Keywords

Anterior Urethral Stricture; Urethral Stricture; Anterior; Urethral Stenosis; Buccal Mucosa; Grafting; Skin

Introduction

Buccal mucosa is widely accepted as a suitable free graft for repairing long or complex bulbar urethral strictures that are not amenable to primary anastomosis. The graft can be placed ventrally, supported by the corpus spongiosum, or dorsally on the corpora cavernosa. Ventral graft placement has the advantage of limited urethral mobilization, with preservation of cavernosal-spongiosal perforating arteries. However, potential drawbacks of this approach include greater blood loss, a higher incidence of diverticulum formation, and higher failure rate. Dorsal graft placement is advocated as providing a more stable and reliably well vascularized recipient bed for the graft, but requires more extensive urethral mobilization and potentially longer operative times.

These approaches have not been compared in a randomized controlled trial, but two retrospective single-institution series have compared the two techniques. In a review of 71 bulbar urethroplasties with dorsal or ventral graft placement, Andrich et al concluded that dorsal onlay is associated with a higher success rate. In contrast, Barbagli et al reported their experience in 44 patients, and concluded that there was no difference in terms of success rate^{1,2}.

To clarify these conflicting results, we reviewed our long-term experience with dorsal and ventral buccal mucosa grafts during single-stage bulbar urethroplasty. Our primary objective was to determine whether there is a difference between these groups in the rate of failure. Since urethroplasty success is likely to be multi-factorial and based in part on stricture characteristics and patient comorbidities, we also attempted to identify pre-operative risk factors for failure.

Methods

The study population comprised 103 consecutive patients age 14 to 88 who underwent single-stage bulbar urethroplasty with buccal mucosa graft at Harborview Medical Center from January 1, 2001 through July 31, 2011 by one of two surgeons (BV and HW). Patients with concomitant penile strictures were excluded. Urethroplasty techniques have been previously described^{3,4}. Stricture length, location and caliber were determined intra-operatively with ultrasound (HW) or sounds (BV). The decision to perform a dorsal or ventral onlay was at the discretion of the surgeons, who are experienced with both approaches. Follow-up protocol consisted of history, physical, flow analysis, and cystoscopy at 3 and 12 months. Typically, initial intervention in the form of dilation or direct vision internal urethrotomy (DVIU) is recommended when unable to pass a 16-French flexible cystoscope, and more invasive interventions are reserved for patients who fail endoscopic approaches.

A retrospective chart review was performed to extract relevant patient and surgical characteristics as well as follow-up data related to efficacy or complications of the surgery. The primary outcome measure was urethroplasty failure, which was defined as the need for endoscopic or open revision of the reconstruction or placement of a suprapubic catheter for urinary retention. Secondary outcomes were occurrence of complications related to the urethroplasty. Statistical analysis was performed in Stata/SE 11.2. Comparison of means was performed with a two-sided t-test, allowing for unequal variance. Chi-square test and logistic regression were utilized for categorical variables. Multivariate analyses were performed using stepwise backward elimination. The study was approved by the Human Subjects Division of the University of Washington.

Results

Demographic data is presented in Table 1. Of 103 patients who underwent single-stage bulbar urethroplasty with buccal mucosa graft, 41 underwent dorsal onlay and 62 underwent ventral onlay. The cohort is relatively young (mean age 40.8 years) and healthy, with 10% of patients having diabetes and 15% being current smokers. Stricture etiology was predominantly trauma/instrumentation (43%) or unknown (45%). Most (84%) patients underwent a prior procedure, which most commonly consisted of DVIU (69%) or dilation (53%). Only 14% of patients underwent a prior urethroplasty.

Mean stricture length was 3.9cm, as would be expected for strictures not amenable to primary anastomosis. Augmented anastomosis was performed in 25% of patients, and no patient underwent a concomitant penile skin flap repair. Minor surgical complications included incisional bleeding, hematuria, and diverticulum formation, occurring in less than 5% of patients.

At a mean follow-up of 36 months, failure occurred in 18% of patients (17% after dorsal onlay, 19% after ventral onlay; $p=0.77$). Mean time to failure was 52 months. As demonstrated in Figure 1, the most common initial treatment for failures was dilation DVIU, and most of these patients (11/14, 79%) required no further intervention. A total of 7 patients in our series underwent a second urethroplasty, and at a mean follow-up of 446 days after urethroplasty none of these patients have experienced recurrence.

Compared to the dorsal onlay group, patients who underwent a ventral onlay were less likely to have undergone a previous urethroplasty (8% vs 22%, $p = 0.04$) and less likely to undergo an augmented anastomosis (15% vs 42%, $p < 0.01$). There was no difference in failure rate or time to failure according to whether graft position was ventral or dorsal. Since the need for an augmented anastomosis may reflect a more severe stricture, a comparison was made between patients undergoing augmented vs non-augmented anastomosis. There was no difference in terms of demographic and stricture characteristics, or in terms of outcomes. However, patients with augmented anastomosis were less likely to undergo a ventral onlay (35% vs 69%, $p = 0.002$) and required a smaller graft size (8.6 vs 9.7cm², $p = 0.04$).

There were no significant differences among patients who experienced failure (Table 2), though diabetes, which was present in 7% of patients with a successful urethroplasty and

21% of those who failed urethroplasty, approached statistical significance (OR 3.5, $p = 0.08$). On multivariate analysis (accounting for graft position, etiology, prior procedures, and graft size), diabetes was predictive of failure (OR 8.7, 95% CI 1.6 – 46.5; $p = 0.01$).

Discussion

We reviewed our 11-year experience with buccal mucosal grafts for single-stage bulbar urethroplasties in order to determine if dorsal or ventral graft position is associated with recurrent urethral stricture. We conclude that graft position alone is not a powerful predictor of recurrence in this population. We also found that among potential pre-operative factors, diabetes is the only factor associated with increased risk of failure.

Buccal mucosa has emerged as a reliable free graft for repairing bulbar urethral strictures that are not amenable to primary anastomosis, with reported stricture-free rates ranging from 89-100%⁵⁻⁹. Despite theoretical advantages of dorsal (compared to ventral) grafts, such as a more stable and reliably well vascularized recipient bed, attempts at identifying optimal position of the graft have been inconclusive.

Andrich et al¹⁰ reported their results with 29 ventral and 42 dorsal single-stage urethroplasties with buccal mucosa grafts from 1990-1995. They define failure as the development of symptoms suggesting recurrent obstruction with radiographic evidence of a stricture, and follow-up is not clearly described. They report a 14% failure rate for ventral urethroplasties and a 5% failure rate for dorsal urethroplasties, though statistical significance was not assessed.

Barbagli et al² report their results with 17 ventral, 27 dorsal, and 6 lateral single-stage bulbar urethroplasties from 1997 to 2002. They define failure as the occurrence of any post-operative procedure, including urethral dilation. At a mean follow-up of 42 months, they report 3 failures in the ventral group (18%), 4 failures in the dorsal group (15%), and 1 failure in the lateral group (17%). They conclude that failure rate is not affected by ventral, dorsal or lateral graft position.

While surgical technique is clearly a major determinant of success following urethroplasty, patient comorbidities are likely to significantly affect outcomes as well. In one of the few studies to assess the impact of comorbidities on success following urethral surgery, Breyer et al found obesity and smoking history to be associated with failure after various types of anterior and posterior urethroplasties^{11,12}. In our series, which is more homogenous, obesity and smoking status were not associated with failure, but diabetes was.

An association between diabetes and graft failure has been reported in the plastic surgery literature for skin grafts^{13,14}, but to the best of our knowledge this relationship has not been reported in the urologic literature. The details of this relationship are not known, but it has been proposed that hyperglycemia leads to local tissue edema, limiting diffusion of wound-healing factors at the graft site¹⁵. Preliminary results suggest that this effect may be overcome by the use of fibrin skin glue, which may restore graft adherence to near-normal levels in diabetic patients¹⁴. Given the reported utility of fibrin glue in buccal mucosa graft urethroplasty^{16,17}, this may merit further analysis.

While this study tends to support the findings of Barbagli et al, there are limitations. One limitation of the study is the retrospective nature, which tends to result in over-reliance on the medical record. Though the surgeons have attempted over the study period to include accurate and consistent information in the medical record, it is reasonable to expect that information collected from a chart review will be less reliable than similar information collected prospectively. Furthermore, selection bias was a factor in determining which patients underwent dorsal or ventral onlay. While we were able to control for some of the variation between these groups, such as the performance of multiple prior procedures, our data suggest that there is a bias at our institution toward dorsal onlay for patients with more complicated strictures, and it is unlikely that we were able to control for all the factors involved in the decision to perform a dorsal or ventral urethroplasty.

Another limitation of this study is the limited sample size, which is especially important given our negative finding (i.e., no difference in failure rates between patients undergoing a dorsal vs ventral onlay). Using aggregated data from a review Bhargava et al¹⁸, in which the reported success rates for ventral and dorsal onlay were 85% and 96%, approximately 140 patients for each group would be necessary to achieve 80% power (assuming $\alpha = 0.05$). Since it would be difficult to achieve this sample size in a single-institution study, collaborative efforts may be necessary to definitively address this issue.

Conclusions

Single-stage bulbar urethroplasty with buccal mucosa graft is a highly effective procedure for patients with a bulbar urethral stricture that is not amenable to primary anastomosis. From our experience, we cannot conclude that dorsal or ventral graft position is inherently superior. Patients with diabetes may be more likely to require additional procedures following bulbar urethroplasty with buccal grafting.

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References

1. Andrich DE, Leach CJ, Mundy A. The Barbagli procedure gives the best results for patch urethroplasty of the bulbar urethra. *BJU international*. 2001; 88(4):385–389. [PubMed: 11564027]
2. Barbagli G, Palminteri E, Guazzoni G, et al. Bulbar urethroplasty using buccal mucosa grafts placed on the ventral, dorsal or lateral surface of the urethra: are results affected by the surgical technique? *The Journal of urology*. 2005; 174(3):955–958. [PubMed: 16094007]
3. Wessells H, Morey AF, McAninch JW. Single stage reconstruction of complex anterior urethral strictures: combined tissue transfer techniques. *The Journal of urology*. 1997; 157(4):1271–1274. [PubMed: 9120918]
4. Wessells H. Ventral onlay graft techniques for urethroplasty. *The Urologic clinics of North America*. 2002; 29(2):381–387. [PubMed: 12371229]
5. El-Kasaby A, Fath-Alla M, Noweir A, et al. The use of buccal mucosa patch graft in the management of anterior urethral strictures. *The Journal of urology*. 1993; 149(2):276–278. [PubMed: 8426400]

6. Morey AF, Duckett CP, McAninch JW. Failed anterior urethroplasty: guidelines for reconstruction. *The Journal of urology*. 1997; 158(4):1383–1387. [PubMed: 9302126]
7. Barbagli G, Palminteri E, Rizzo M. Dorsal onlay graft urethroplasty using penile skin or buccal mucosa in adult bulbourethral strictures. *The Journal of urology*. 1998; 160(4):1307–1309. [PubMed: 9751341]
8. Pansadoro V, Emiliozzi P, Gaffi M, et al. Buccal mucosa urethroplasty for the treatment of bulbar urethral strictures. *The Journal of urology*. 1999; 161(5):1501–1503. [PubMed: 10210382]
9. Kane CJ, Tarman GJ, Summerton DJ, et al. Multi-institutional experience with buccal mucosa onlay urethroplasty for bulbar urethral reconstruction. *The Journal of urology*. 2002; 167(3):1314–1317. [PubMed: 11832721]
10. Andrich D, Mundy A. Substitution urethroplasty with buccal mucosal-free grafts. *The Journal of urology*. 2001; 165(4):1131–1134. [PubMed: 11257653]
11. Breyer BN, McAninch JW, Whitson JM, et al. Multivariate analysis of risk factors for long-term urethroplasty outcome. *The Journal of urology*. 2010; 183(2):613–617. [PubMed: 20018318]
12. Breyer BN, McAninch JW, Whitson JM, et al. Effect of obesity on urethroplasty outcome. *Urology*. 2009; 73(6):1352–1355. [PubMed: 19371937]
13. Thourani VH, Ingram WL, Feliciano DV. Factors affecting success of split-thickness skin grafts in the modern burn unit. *The Journal of trauma*. 2003; 54(3):562–568. [PubMed: 12634539]
14. Cabrera-Sanchez E, Fidalgo-Rodriguez FT, Rioja LF, et al. Smoking and diabetes mellitus type 2 reduce skin graft take; the use of fibrin glue might restore graft take to optimal levels. *European Journal of Dermatology*. 2011; 21(6):895–898. [PubMed: 21926042]
15. Mowlavi A, Andrews K, Milner S, et al. The effects of hyperglycemia on skin graft survival in the burn patient. *Annals of plastic surgery*. 2000; 45(6):629–632. [PubMed: 11128762]
16. Hick EJ, Morey AF. Initial experience with fibrin sealant in pendulous urethral reconstruction. Is early catheter removal possible? *The Journal of urology*. 2004; 171(4):1547–1549. [PubMed: 15017217]
17. Barbagli G, De Stefani S, Sighinolfi MC, et al. Bulbar urethroplasty with dorsal onlay buccal mucosal graft and fibrin glue. *European urology*. 2006; 50(3):467–474. [PubMed: 16806665]
18. Bhargava S, Chapple C. Buccal mucosal urethroplasty: is it the new gold standard? *BJU international*. 2004; 93(9):1191–1193. [PubMed: 15180603]

Figure 1.

Surgical outcomes. DVIU = Direct vision internal urethrotomy. *Number of patients following dilation or DVIU does not add up to the number of patients who had dilation or DVIU because one patient was scheduled for DVIU multiple times but lost to follow-up. For analysis purposes, he was considered to have undergone DVIU.

Table 1

Demographic, stricture, and surgical data among patients undergoing dorsal and ventral onlay.

	Dorsal Onlay (N=41)	Ventral Onlay (N=62)	All Patients (N=103)	P Value
Demographic Characteristics				
Mean age, years (SD)	41.9 (16.6)	40.1 (13.3)	40.8 (14.6)	0.56
Mean BMI, kg/m ² (SD)	30.3 (6.73)	30.2 (7.3)	30.2 (7.0)	0.91
Diabetes, N (%)	5 (12%)	5 (8%)	10 (10%)	0.49
Current smoker, N (%)	9 (22%)	7 (11%)	16 (15%)	0.14
Stricture Characteristics				
Etiology, N (%)				0.38
Trauma/Instrumentation	19 (46%)	25 (40%)	44 (43%)	
Lichen sclerosis/infection	1 (2%)	5 (8%)	6 (6%)	
Hypospadias	1 (2%)	2 (3%)	3 (3%)	
Radiation	1 (2%)	3 (5%)	4 (4%)	
Unknown	19 (46%)	27 (43%)	46 (45%)	
Prior Procedure, N (%)	33 (80.5%)	54 (87%)	87 (84%)	0.37
Prior DVIU, N (%)	27 (66%)	44 (71%)	71 (69%)	0.58
Prior dilation, N (%)	22 (53.7)	33 (53%)	55 (53%)	0.86
Prior urethroplasty, N (%)	9 (22%)	5 (8%)	14 (14%)	0.04
Prior stent, N (%)	2 (4.9%)	4 (6%)	6 (6%)	0.74
Surgical Characteristics				
Mean stricture length, cm (SD)	3.8 (1.66)	3.9 (1.17)	3.9 (1.38)	0.81
Mean graft size, cm ² (SD)	9.4 (2.84)	9.5 (1.91)	9.4 (2.32)	0.88
Augmented anastomosis, N (%)	17 (42%)	9 (15%)	26 (25%)	<0.01
Surgical Outcomes				
Mean follow-up, months	31.9 (33.5)	38.2 (34.6)	35.7 (34.1)	0.36
Incisional bleeding, N (%)	2 (5%)	1 (1.6%)	3 (3%)	0.34
Hematuria, N (%)	1 (2%)	1 (1.6%)	2 (2%)	0.77
Diverticulum, N (%)	1 (2%)	3 (5%)	4 (4%)	0.54
Failure, N (%)	7 (17%)	12 (19%)	19 (18%)	0.77
Mean time to failure, months (SD)	25.6 (31.9)	67.6 (72.2)	52.1 (62.9)	0.17
Failure – Initial Management, N (%)				0.68
Dilation/DVIU	5 (12%)	8 (13%)	13 (13%)	
Urethroplasty	1 (2%)	3 (5%)	4 (4%)	
SP Tube	0	1 (2%)	1 (1%)	

Table 2

Demographic, stricture and surgical characteristics according to urethroplasty success.

	Success (N=84)	Failure (N=19)	OR (95% CI)	P Value
Mean age, years (SD)	40.6 (14.6)	41.7 (14.9)	-	0.77
Mean BMI, kg/m ² (SD)	29.9 (7.3)	31.5 (5.7)	-	0.32
Diabetes, N (%)	6 (7%)	4 (21%)	3.5 (0.9 – 13.8)	0.08
Current smoker, N (%)	13 (15%)	3 (16%)	1.0 (0.3 – 4.0)	0.97
Etiology – trauma/instrumentation, N (%)	34 (40%)	10 (53%)	1.6 (0.6 – 4.4)	0.34
Prior Procedure, N (%)	72 (86%)	15 (79%)	0.6 (0.2 – 2.2)	0.47
Prior DVIU	59 (70%)	12 (63%)	0.7 (0.3 – 2.1)	0.55
Prior Dilation	47 (56%)	8 (42%)	0.6 (0.2 – 1.5)	0.26
Prior Urethroplasty	12 (14%)	2 (11%)	1.2 (0.3 – 5.0)	0.76
Prior Stent	5 (6%)	1 (5%)	0.9 (0.1 – 8.0)	0.91
Mean stricture length, cm (SD)	3.8 (1.4)	4.2 (1.4)	-	0.23
Mean graft size, cm ² (SD)	9.4 (2.4)	9.7 (2.1)	-	0.57
Augmented anastomosis, N (%)	22 (26%)	4 (21%)	0.8 (0.2 – 2.5)	0.64
Ventral graft position, N (%)	50 (60%)	12 (63%)	1.2 (0.4 – 3.3)	0.78