Substitution urethroplasty is as successful as anastomotic urethroplasty for short bulbar strictures

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Introduction: *To evaluate the efficacy of transecting anastomotic urethroplasty (AU) and buccal mucosa graft (BMG) ventral onlay substitution urethroplasty (SU) in treating short bulbar urethral strictures.*

Materials and methods: *Sixty patients underwent either AU or SU for bulbar strictures of similar length with follow up of at least 12 months. Follow up included clinical history, uroflowmetry, and ultrasound post-void residuals (PVR) performed every 4 months for the first year and yearly thereafter.*

Results: *Out of 131 patients with short bulbar strictures, 40 were treated with BMG onlay SU and 20 had AU. Median follow up in the SU group was 57 months (IQR 27-76) and 120 months (IQR 109-130) in the AU group. The median stricture length was 3 cm (IQR 2.5-3.0) in the SU group and 1.3 cm (IQR 1-2) in the AU group ($p < 0.001$). The 3 year freedom from intervention was 93% in the SU group, and 85% in the AU group ($p = 0.72$).*

Conclusions: *BMG onlay ventral urethroplasty has similar success rates to anastomotic urethroplasty for short bulbar urethral strictures. Due to the relatively fewer complications reported after substitution urethroplasty with BMG, it should be considered the treatment of choice for short bulbar urethral strictures.*

Key Words: bulbar urethral stricture, buccal mucosa graft, anastomotic, urethroplasty

Introduction

There is growing controversy over which urethroplasty to perform for the most common of all urethral strictures: the "short" (less than 4 cm) bulbar urethral stricture. The two preferred surgeries include anastomotic urethroplasty (AU) and buccal mucosal graft (BMG) onlay substitution urethroplasty (SU). Many authors report long term success rates greater than 90% for AU.[1-3] However, despite its popularity, anastomotic urethroplasty has a major disadvantage in that it requires more urethral mobilization than ventral onlay urethroplasty, and may cause sexually related complications,[4] including chordee, impotence and penile shortening.[5] Current opinion is moving away from the once dominant AU and towards less invasive techniques like non-transecting AUs[6] or substitution urethroplasties for short bulbar urethral strictures.[4] In our series, we evaluate our results on the use of AU and BMG urethroplasty for short, comparable bulbar strictures. We hypothesize that substitution urethroplasty will at least match the success rates of AU and should avoid AU-associated erectile dysfunction, chordee and penile shortening.

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Materials and methods

Institutional review board approval was obtained for chart review of patients who underwent bulbar urethroplasty for strictures less than 4 cm from 2001 to 2012. Patients were selected from a database of patients who had undergone urethroplasty at our institution and had been followed for at least 12 months after surgery. Patients were excluded from the study if they

underwent urethroplasty for strictures ≥ 4 cm, if they had prior radiation, high intensity focused ultrasound, pelvic fracture urethral injuries, or were treated with double graft or augmented roof strip techniques. After urethroplasty, clinical history, uroflowmetry, and ultrasound post-void residuals were performed every 4 months for the first year, and then yearly thereafter.

We compared patients who had undergone AU to those with buccal urethroplasty by evaluating patient age, stricture length, and stricture etiology. Other data collected include number of previous interventions, stricture recurrence, time to failure, and subsequent procedures performed. Failure was defined as recurrent stricture disease requiring urologic intervention. Subsequent procedures performed included urethral dilation, direct visual internal urethrotomy (DVIU), and repeat urethroplasty, and all were performed at the Detroit Medical Center in Detroit, Michigan by a full-time reconstructive urologist. Urethroplasty type was determined intraoperatively: transecting AU was reserved for spongiofibrotic and obliterative strictures; ventral BMG onlay SU was performed for less obliterative strictures. BMG SU techniques used were described and published previously.[7] Sexual function and graft donor site morbidity were not evaluated. Time-to-event analyses were conducted using Kaplan-Meier analysis with log-rank significance test. Comparisons between groups for continuous and categorical variables were performed using the independent samples Student's T-test and chi-square test, respectively. All of these analyses were performed using SAS 9.2. The level of statistical significance was set at $p < 0.05$.

Results

Of 131 patients (72 AU and 59 SU) undergoing an anastomotic urethroplasty or BMG ventral onlay urethroplasty for strictures less than 4 cm, only 60 (20 AU and 40 SU) met the criteria. Median follow up was 120 months (IQR 109-130) in the AU group and 57 months (IQR 27-76) in the SU group ($p < 0.001$). The median age for the AU group was 49 years (IQR 40-65) and 42 years (IQR 29-58) in the SU group ($p = 0.09$). The median stricture length was 1.3 cm (IQR 1-2) in AU patients and 3 cm (IQR 2-3) in SU patients ($p < 0.001$). Median interventions prior to urethroplasty was 1 (IQR 0-2.3) in the AU group and 1 (IQR 1-3) in the SU group ($p = 0.11$).

Of the 20 patients in the AU group, 3 (15%) failed; 4 (10%) of the 40 patients in the SU group failed ($p = 0.68$). Two (67%) of the three AU failures required DVIU and one (33%) required redo buccal urethroplasty. All four SU failures required endoscopic intervention. One of the four (25%) failed DVIU and required redo BMG urethroplasty. Median stricture free interval was 120 months (IQR 98-130) in the AU group and 54 months (IQR 20-73) in the BMG ($p < 0.001$). The 3 year freedom from intervention in the AU group and SU group was 85% and 93%, respectively ($p = 0.72$), Figure 1.

Discussion

Anastomotic urethroplasty for short bulbar urethral strictures has published long term success rates greater than 90%.[1-5] BMG ventral onlay urethroplasty also has a published success rate of around 90%,[8] even though this number includes bulbar urethroplasty for strictures 4 cm and longer. We were eager to determine the performance characteristics of both AU and BMG SU for short bulbar strictures given the brewing controversy over which should be recommended. The limited literature on direct comparisons between transecting anastomotic urethroplasties and BMG ventral onlay urethroplasties prompted our investigation into which procedure would maintain high success rates and minimize morbidity.

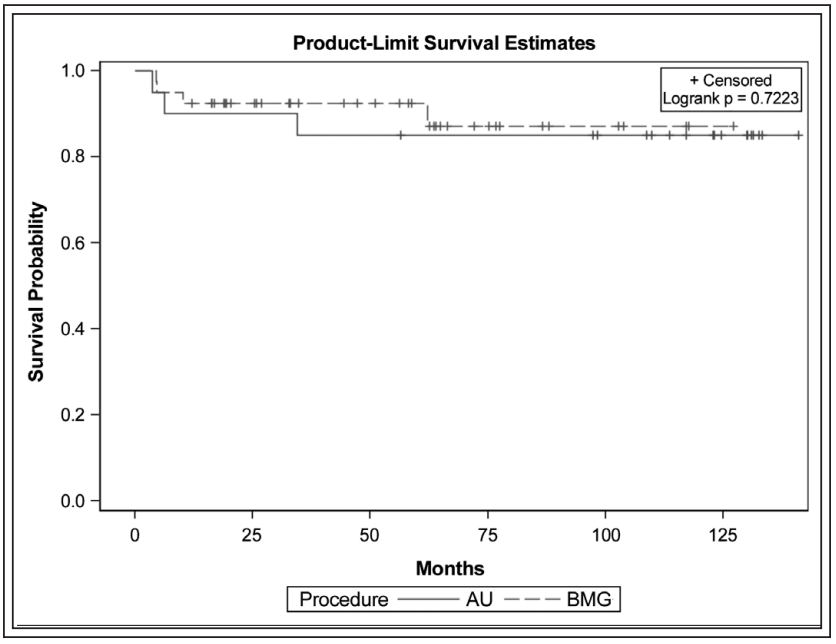

Figure 1. Kaplan-Meier curves for anastomotic urethroplasty and BMG ventral onlay urethroplasty.

Anastomotic urethroplasty or bust?

There are many reconstructive urologists who favor anastomotic urethroplasty over substitution urethroplasty due to perceived high success rates. In addition, no graft is required so there is no donor site morbidity. Santucci and colleagues evaluated their single institution experience with 168 patients who underwent an anastomotic urethroplasty for an average stricture length of 1.7 cm.[3] The stricture free rate was 95% with a mean follow up of 70 months. Eltahawy et al described their experience with 260 patients with bulbar urethral strictures who underwent anastomotic urethroplasty.[1] Mean stricture length was 1.9 cm and their success rate after a follow up of 50 months was 98.8%; however, it is crucial to point out that 77% of their patients were never successfully contacted to determine if they had failed or not. Andrich et al looked at the long term results of anastomotic urethroplasty for all etiologies including pelvic fracture related urethral injuries. They found that the 5, 10 and 15 year re-stricture rates were 12%, 13%, and 14%, respectively,[9] connoting a sustained response to treatment. The Andrich study also looked at substitution urethroplasty in 84 patients of whom both grafts and flaps were used. Lichen sclerosus and post-hypospadias surgery patients (11/84 or 13%) were included in this study, and length was not evaluated. They found that the 5, 10, and 15 year re-stricture rates were 21%, 31%, and 58% respectively, indicating that substitution urethroplasty produces inferior results in this specialized population. Furthermore, there was a 33% complication rate for substitution urethroplasty, which includes post-void dribbling, diverticulum, urinary tract infections, urethrocutaneous fistula, chordee, and erectile dysfunction. The authors therefore highly recommended performing anastomotic urethroplasty over substitution urethroplasty whenever possible, although it must be emphasized that the Andrich dataset differed from ours in significant ways: many of these patients were not bulbar urethral stricture patients, and some were treated with skin flaps instead of BMG.

With such robust results reported after AU, Morey and colleagues tested the limits of anastomotic urethroplasty. They found that bulbar strictures up to 5 cm may be excised and anastomosed with a success rate of 91% (20/22)(5). The average stricture length was 2.7 cm and the mean follow up was 22 months. However, excising the stricture and bridging the gap without graft tissue lead to sexual dysfunction in a significant proportion of patients. These authors found that 83% of men who had undergone AU for strictures greater than 2.5 cm were overall satisfied with their erections and none had chordee, but 33% had decreased length. Curiously, men with shorter strictures less than 2.5 cm in this same study had worse outcomes with a 56% overall satisfaction rate, 44% chordee, and 22% decreased length. Nevertheless, many authors are encouraged with the high success rates and low complication rates associated with anastomotic urethroplasty for short bulbar strictures. We, however, remain skeptical of the potentially high sexual dysfunction rates of anastomotic urethroplasty and endeavored to avoid the complications of AU by performing BMG ventral onlay urethroplasty in those with even short strictures, with good results.

Avoiding transection: the new gold standard?

Excision of stricture and primary anastomosis of the bulbar urethra involves extensive dissection and urethral mobilization to create a tension-free suture line. With the refinement and low morbidity of BMG harvest, and with the new knowledge of associated sexual dysfunction from transection and circumferential dissection, some experts avoid the trauma of anastomotic urethroplasty and perform BMG ventral onlay urethroplasty instead. A non-transecting technique is sometimes used in the shortest of strictures.[10] Barbagli and colleagues reported their long term results from 153 bulbar anastomotic urethroplasties with a mean follow up of 68 months and found a 22% overall complication rate: 14 patients experienced ejaculatory dysfunction, 1 had a cold glans during erection, 7 had soft glans during erections, and 11 had decreased glans sensitivity.[4] Interestingly, no one complained of chordee or impotence.[4] They reported a 91% (139/153) stricture free rate. A study by Palminteri et al looked specifically at sexual complications from bulbar urethroplasty and found that graft augmentation techniques were superior to excision anastomotic techniques.[11] These authors now favor BMG usage over excision and primary anastomosis for bulbar urethroplasty.

For very short bulbar strictures, Mundy and Andrich recommended avoiding urethral transection altogether, and introduced a new non-transecting anastomotic technique where a dorsal longitudinal stricturotomy is performed followed by transverse closure.[10] This has the flexibility to convert to a BMG dorsal onlay urethroplasty if the stricturotomy proves too long to be closed primarily. Circumferential urethral dissection is still required for this procedure, but dissection is more limited than standard AU, and precluding urethral transection preserves antegrade blood flow to the urethra.

BMG ventral onlay urethroplasty minimizes surgical trauma because it avoids both urethral transection and circumferential dissection, which damages arterial perforators from the corpora cavernosa to the urethra. We found 14 studies looking at the success rates and complications of BMG urethroplasty, Table 1. In total, 343 patients have been described. The mean stricture length was 4.4 cm. Patients had an average follow up of 37 months with an overall success rate of 88%. Stricture free rates for BMG ventral onlay urethroplasty are therefore universally greater than 80% for strictures that are generally longer than those treated with anastomotic urethroplasty. The overall complication rate was 16% with the predominant complaint being post void dribbling from sacculations. Of note, our bulbar urethral stricture patients do not have sacculations after BMG. We hypothesize that this is due to judicious sizing of the BMG, coverage of the BMG with the overlying tunica of the spongiosum, and bolstering the spongiosal coverage with bulbospongiosus muscle closure. We expected success rates to reach 90% or higher with the BMG onlay technique for shorter strictures: our success rate for strictures < 4 cm was 93%.

There is also the potential for oral complications from BMG urethroplasty. These generally include oral pain, numbness, and tightness. Dublin and Stewart analyzed these complications, which occur in 50%-75% of patients during their first recovery week.[12] This improves to 16% persistent oral numbness and 32% mouth tightness during a follow up of 2 years. More telling is that most (74%) patients would have their

TABLE 1. **BMG ventral onlay bulbar urethroplasty. Stricture length denotes intraoperative measured lengths; BMG graft lengths listed serve as surrogates for stricture length**

Study	Number treated	Stricture length (cm)	Follow up (months)	Complications (N) – non-stricture	Complication rate (%)	Stricture (N)	Stricture free rate (%)
Morey et al[15]	13	6.2	18	0	0	0	100
Wessels et al[16]	7	--	23	--	--	0	100
Pansadoro et al[17]	7	4	20	--	--	1	86
Andrich et al[18]	29	--	48	Bothersome postmicturition dribbling (6)	21	4	86
Meneghini et al[19]	20	3.6 (BMG length)	13	--	--	4	80
Kane et al[20]	53	3.6	25	Buccal hematoma (1) Rhabdomyolysis (1) Febrile UTI (1) Sacculations (4)	13	3	94
Heinke et al[21]	30	--	23	Diverticulum (1) Oral paresthesia (1)	6	6	80
Pansadoro et al[22]	9	--	41	--	--	1	89
Elliott et al[8]	60	4.8 (BMG length)	47	0	0	6	90
Fichtner et al[23]	15	--	83	Fistula (1)	7	2	87
Kellner et al[24]	23	4.9	50	0	0	3	87
Barbagli et al[25]	17	4.2 (BMG length)	42	Sacculations (6)	35	3	82
McLaughlin et al[26]	48	3.9	30	--	--	3	94
Levine et al[27]	12	--	58	--	--	2	83
Totals/ Average	**343**	**4.4**	**37**	**22**	**16**	**38**	**88**

cheek harvested again if required, 3% would not, and 23% had mixed feelings, indicating that it is overall a well-tolerated procedure. Stricture length was not addressed in this study. This is an important omission since longer strictures require more BMG and hence expectedly higher harvest site morbidity. The minimal and temporary morbidity of BMG harvest was reviewed and confirmed by oral surgeons from the University of Buffalo.[13] Their metanalysis revealed that 9 of 225 patients (4%) had complications at the donor site, the most common of which was scarring and contracture. Hematoma and harvest site bleeding occurred in less than 1% of patients. In our study, a small graft (less than 4 cm x 2.5 cm) is harvested and the donor site is closed. Patients do have some pain, numbness, and tightness that rapidly improve over the course of 1-4 weeks; few complain of any lasting difficulties.[14]

Our results

To our knowledge, this is the first head-to-head evaluation of anastomotic urethroplasty and BMG ventral onlay urethroplasty for the treatment of the most common of all urethral strictures: the short bulbar stricture. Anastomotic urethroplasty has excellent stricture free rates but less desirable complications. Our AU outcomes were worse than our colleagues; however, we selectively reserved transecting AU for spongiofibrotic and obliterative strictures and perhaps this worsened our outcomes. Our stricture free rates for BMG urethroplasty were slightly better than those of AU and rivaled the results of BMG urethroplasty performed by other reconstructive urologists. BMG for short strictures is a durable and robust technique with few sexual side effects at the cost of additional but limited morbidity from BMG harvest.

To more definitively determine which technique is better, a prospective randomized control trial should be performed for patients with short bulbar strictures treated with AU or BMG ventral onlay urethroplasty. Paying specific attention to urethral patency rates, urinary symptoms, uroflowmetry changes, donor site morbidity, and sexual outcomes will help determine which technique is truly the better option.

Limitations

We recognize that there are several limitations to our study. These include its retrospective nature, longer follow up times in the AU cohort, emphasis on urethral patency, as well as its lack of evaluation of sexual function and donor site morbidity (although we have evaluated our donor site morbidity previously and found it to be negligible).[14] Nevertheless, this study brings to light the growing trend of avoiding transecting anastomotic urethroplasty and the excellent success rates of BMG ventral onlay urethroplasty for short bulbar strictures. It remains our treatment of choice for even short strictures.

Conclusions

BMG ventral onlay urethroplasty for bulbar strictures < 4 cm has a 93% success rate with a median follow up time of 57 months. The patency rates rival those of anastomotic urethroplasties for bulbar strictures yet avoids the sexual dysfunction associated with urethral transection and extensive dissection. Given the choice of BMG urethroplasty with its minor donor site morbidity versus anastomotic urethroplasty with its higher sexual dysfunction risks, and given equivalent stricture free rates of both techniques, we advocate BMG onlay urethroplasty over anastomotic urethroplasty. □

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