INTERNATIONAL JOURNAL OF UROLOGY
International Journal of Urology (2014) **21**, 185–188 doi: 10.1111/iju.12235

Original Article: Clinical Investigation

Dorsal onlay (Barbagli technique) versus dorsal inlay (Asopa technique) buccal mucosal graft urethroplasty for anterior urethral stricture: A prospective randomized study

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Abbreviations & Acronyms
AUA = American Urological Association
BMG = buccal mucosal graft
Qmax = maximum flow rate

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Received 12 March 2013; accepted 27 June 2013.
Online publication 12 August 2013

Objective: To compare both the dorsal onlay technique of Barbagli and the dorsal inlay technique of Asopa for the management of long anterior urethral stricture.
Methods: From January 2010 to May 2012, a total of 47 patients with long anterior urethral strictures were randomized into two groups. The first group included 25 patients who were managed by dorsal onlay buccal mucosal graft urethroplasty. The second group included 22 patients who were managed by dorsal inlay buccal mucosal graft urethroplasty. Different clinical parameters, postoperative complications and success rates were compared between both groups.
Results: The overall success rate in the dorsal onlay group was 88%, whereas in the dorsal inlay group the success rate was 86.4% during the follow-up period. The mean operative time was significantly longer in the dorsal onlay urethroplasty group (205 ± 19.63 min) than in the dorsal inlay urethroplasty group (128 ± 4.9 min, *P*-value <0.0001). The average blood loss was significantly higher in the dorsal onlay urethroplasty group (228 ± 5.32 mL) than in the dorsal inlay urethroplasty group (105 ± 12.05 mL, *P*-value <0.0001).
Conclusions: The dorsal onlay technique of Barbagli and the dorsal inlay technique of Asopa buccal mucosal graft urethroplasty provide similar success rates. The Asopa technique is easy to carry out, provides shorter operative time and less blood loss, and it is associated with fewer complications for anterior urethral stricture repair.

Key words: anterior uretheral sricture, buccal mucosal graft, dorsal inlay technique of Asopa, dorsal onlay technique of Barbagli.

Introduction

There are many surgical procedures for urethral stricture repair, such as internal urethrotomy, stent, stricture excision and primary re-anastomosis, graft augmented anastomotic procedure, and patch urethroplasty. Another option is two-staged urethroplasty, which is indicated in patients with local adverse conditions. The choice is based on the stricture length, location and depth, and the density of the spongiofibrosis. Substitution urethroplasty is the mainstay of treatment for long urethral strictures, anterior strictures and multiple urethral strictures.

In the past decade, BMG has become the favored tissue for management of anterior urethral stricture. Although the first BMG urethroplasty was achieved in 1941 by Humby, there was a resurgence of it after 1990.[1] Since then, it has been considered as an ideal graft material for substitution urethroplasty. Buccal grafts have several advantages: they are hairless, rich in blood supply and easy to harvest. Furthermore, BMG have a thin lamina propria facilitating early inosculation, thick epithelium minimizing the chance of graft contracture,[2] and natural resistance to infection and development of cutaneous diseases, such as lichen sclerosis. The oral donor site heals quickly; oral complications of this procedure are minor and subside gradually within the first year.[3]

A controversial issue has been the location of the graft on the urethral surface; the ventral onlay graft technique was described by Morey and McAninch in 1996.[4] Although it is a straightforward and easy to carry out technique,[5] ventrally-placed grafts are likely to be associated with ballooning and pseudo-diverticulum formation of the ventrally-positioned unsupported graft.[6] Since Barbagli *et al*. renewed the concept of the dorsal approach for carrying out urethroplasty, which was developed by Monseur, the dorsal onlay has become a new extension of urthroplasty techniques whenever a good vascular bed at the ventral site is compromised.[6] This is mostly the case at the penile urethra.

Asopa *et al*. popularized the dorsal inlay technique through a ventral sagittal urethrotomy approach in 2001, and postulated that the procedure is easier to carry out as it does not require urethral mobilization.[7]

The aim of the present prospective study was to compare both the dorsal onlay technique of Barbagli and the dorsal inlay technique of Asopa for the management of long anterior urethral stricture. To our knowledge, there is no previous comparative study between the two techniques.

Methods

After obtaining approval from the ethical committee in our faculty, a total of 47 male patients with long anterior urethral strictures were randomized to two groups. Both groups were managed by either dorsal onlay (25 patients) or dorsal inlay (22 patients) BMG urethroplasty, between January 2010 and May 2012. The method of randomization was every alternate patient with penile, bulbar or panurethral stricture being assigned to the dorsal onlay and dorsal inlay groups.

Preoperative evaluation included clinical history, physical examination, urine culture, residual urine measurement, uroflowmetry, and retrograde and voiding cystourethrography.

In the present study, the urethroplasty was carried out by two teams; one harvesting the BMG, and the other team exposing the stricture. A prophylactic broad-spectrum antibiotic (ceftriaxone) was administered before surgery and continued 5 days postoperatively. The urethroplasty was carried out under general endotracheal anesthesia with transnasal intubation. In case of bulbar strictures, a midline perineal incision was made. In the case of penile strictures, a subcoronal circumferential incision was made, and the penis was degloved.

BMG were harvested from the inner cheeks with care to avoid injury to the Stensen's duct, opposite the upper second molar. The defect of the graft harvest site was closed with chromic catgut sutures. The harvested graft fat and submucosal layers were removed using scissors for thinning before it was applied as a patch. It was tailored to the shape of the incision. Mouth washes with povidone-iodine oral solution were started 2 days before graft harvesting and continued postoperatively for 3 days.

In dorsal onlay, we used the surgical technique that was described by Barbagli.[8] The corpus spongiosum was carefully dissected away from the corpora cavernosa and rotated. A dorsal urethrostomy was carried out with extension of the incision beyond the strictured segment proximally and distally into the normal urethral lumen. The graft was spread fixed to the corpora cavernosa. After fixing the graft, several quilting sutures were added to it, and small incisions along the graft were made to prevent hematoma or edema formation. The aim of the fixation and quilting sutures was to create good contact between the graft and the corporeal bed for securing the graft taking. After introduction of a 16-Fr silicone catheter, the edges of the stricturotomy were then sutured to the graft, as well as to the corpora cavernosa.

In dorsal inlay, we used the surgical technique that was described by Asopa.[7] Urethral dissection and rotation is not required, so blood supply was not affected. A ventral urethrostomy was carried out with extension of the incision beyond the strictured segment proximally and distally into the normal urethral lumen. The dorsal surface of the urethra was incised in the midline. Using sharp dissection, the margins of the incised dorsal urethra were dissected from the tunica albuginea, without lifting the two edges of the bisected urethra. This dissection results in an elliptical raw area as wide as 1.5–2 cm between the bisected edges of the urethra over the tunica albuginea. The harvested BMG were spread fixed over the raw area to cover the defect. After fixing the graft, several quilting sutures were added to it to prevent dead space. The margins of the graft were attached to the edges of the incised urethra. The ventral urethrostomy was closed by continuous sutures over a 16-Fr silicone catheter and reinforced with interrupted sutures.

A total of 3 weeks after surgery, a retrograde pericatheter urethrography was carried out, and if there was no extravasation the urethral catheter was removed. Patients were followed up with uroflowmetry and urine culture every 3 months. Urethrography and urethroscopy were considered in the presence of obstructive symptoms or if the Qmax was less than 15 mL/s. The urothroplasty was considered a failure when postoperative intervention was required.

Results

A total of 47 patients (mean age 36.6 years, range 16–59 years) with anterior urethral stricture underwent BMG urethroplasty by dorsal onlay BMG urethroplasty in 25 patients (group 1) and dorsal inlay BMG urethroplasty in 22 patients (group 2). The etiology of strictures was trauma in 61.7%, iatrogenic in 19.1%, infection in 12.8% and idiopathic in 6.4%. Of the 47 patients, 34 (72.3%) had a total of 78 internal urethrotomy procedures (average 1.7 per patient). The stricture site in both groups is shown in Table 1.

The average stricture length, according to retrograde and voiding cystourethrography, in the dorsal onlay urethroplasty group was 4.9 cm (range 4–15 cm), and in the dorsal inlay urethroplasty group 4.4 cm (range 4–12 cm). The mean operative time was significantly longer in the dorsal onlay urethroplasty group (205 ± 19.63 min) than in the dorsal inlay urethroplasty group (128 ± 4.9 min, *P*-value <0.0001). The mean follow up in both groups was 22.6 and 24.2 months, respectively. The average blood loss was significantly higher in the first group (228 ± 5.32 mL) than in the second group (105 ± 12.05 mL, *P*-value <0.0001). Only one patient in the dorsal onlay urethroplasty group required postoperative blood transfusion. Hospitalization in the first and second groups averaged 4.3 days (range 4–6 days) and 3.2 days (range 2–6 days), respectively.

Three patients in the first group and four patients in the second group had postoperative wound infection, all were managed successfully with a change in antibiotics according to a culture sensitivity test using a wound swab. One patient in the dorsal inlay urethroplasty group showed extravasation of contrast medium on pericatheter urethrogram after 3 weeks of operation, he was managed successfully by 2 weeks of additional catheterization. In the dorsal onlay group, two patients developed significant chordee after surgery, which was managed by dorsal plication. Four patients in first group suffered from bothersome post-void dribbling, while only one patient in second group developed bothersome

Table 1 Preoperative and postoperative criteria of the two groups

	Dorsal onlay group	Dorsal inlay group	*P*-value
No. patients	25	22	
Mean age (years)	37 years (16–59)	36.2 years (17–55)	
Mean stricture length	4.9 cm (4–15)	4.4 cm (4–12)	
Stricture site:			
Penile	14	12	
Bulbar	9	8	
Panurethral	2	2	
Mean operative time	205.00 ± 19.632	128.00 ± 4.899	<0.0001
Mean blood loss	228.00 ± 5.323	105.00 ± 12.051	<0.0001
Hospitalization	4.3 days (4–6)	3.2 days (2–6)	
AUA symptom score			
Preoperative:	22.4	23.5	
Postoperative:	4.8	5.1	
Qmax			
Preoperative:	8.2 mL/s	9.1 mL/s	
Postoperative:	23.4 mL/s	24.5 mL/s	
Postvoid dribbling	4	1	
Chordee	2	–	
Mean follow up	22.6 months (12–29)	24.2 months (14–31)	
Success rate	88%	86.4%	

postvoid dribbling, and could be managed conservatively by manual urethral compression. There was no postoperative diverticulum formation, urinary incontinence or de novo erectile dysfunction.

Three patients (12.8%) in each group developed stricture at 3, 6, 12 and 18 months' follow up. Patients with recurrent stricture presented with weak urinary stream, diminished urinary flow (peak urinary flow <15 mL/s), dysuria and recurrent urinary tract infection. Four of the failure cases developed a distal anastomotic stricture, and one had two stenotic rings at the distal and proximal site of anastomosis; all of them responded well to internal urethrotomy. Another patient (group 2) developed long segment stricture and required open surgery. Five of the patients with recurrent stricture had undergone multiple endoscopic procedures with resultant periurethral fibrosis and marked spongiofibrosis. The six strictures, which recurred in the present study according to the preoperative site of the stricture, were one penile, two bulbar and three panurethral. It is well known that panurethral stricture repair is a difficult problem to solve, and the success rate is lower when compared with simple penile or bulbar stricture repair.

Peak urinary flow rates improved in the first group from an average of 8.2 mL/s preoperatively to 23.4 mL/s postoperatively. In the second group, the maximum urinary flow increased from an average of 9.1 mL/s preoperatively to 24.5 mL/s postoperatively. The AUA symptom score decreased from a mean of 22.4 preoperatively to 4.8 postoperatively in the first group. Also, the AUA symptom score decreased from a mean of 23.5 preoperatively to 5.1 postoperatively in the second group.

The donor sites were all fully epithelialized by 6 weeks. There were no long-term complications in regard to the donor site. Four patients suffered from difficulty opening their mouth, and a salivary flow problem up to 3 months after surgery, but later they overcame the disability.

BMG urethroplasty was considered successful if no intervention in the form of dilatation or optical urethrotomy was required, and the maximum flow rate was >15 mL/s during the follow-up period. The overall success rate in the dorsal onlay group was 88%, whereas in the dorsal inlay group the success rate was 86.4% during the follow-up period.

Discussion

Patients with long (>2 cm) or complex urethral strictures, require substitution urethroplasty.[9] BMG are considered to be the best material for urethroplasty due to different factors, including rich blood supply, easy accessibility and resistance to infection, in addition to a thick epithelium and a thin lamina propria facilitating early inosculation.[1,3]

Not only the type of graft tissue, but also the site for graft placement is crucial, as the blood supply of the recipient area and the graft support are both essential in graft uptake.[7,10–12] The dorsal onlay technique was popularized by Barbagli *et al*. in 1998; it involves dissection of the urethra from the corpora cavernosa and its rotation of 180°.[13] In case of previous repeated dilations or internal urethrotomies, the urethral detachment from the corpora is difficulty because of the fibrotic adhesions; furthermore, this approach could damage erectile function and the bulbar arteries when very proximal dissection from the corpora is required.[14,15]

Asopa popularized the dorsal inlay technique[7] by the ventral sagittal urethrotomy approach. In the Asopa procedure, the urethra is not mobilized or dissected, which not only preserves the urethral blood supply coming through circumflex and perforating vessels, but also simplifies the procedure.

The aim of the present prospective study was to compare the results of the dorsal onlay (Barbagli) technique and dorsal inlay (Asopa) technique in management of long anterior urethral stricture. To our knowledge, there were no previous studies comparing the two techniques before the present study. A randomized study on urethroplasty techniques is difficult, as

Table 2 Outcomes of BMG urethroplasty

Series	No. patients	Technique	Follow up	Success rate
Asopa *et al.* (2001[7])	12	Dorsal inlay	26 months (8–40)	91.7
Gupta *et al.* (2004[17])	12	Dorsal inlay	12 months (10–16)	91.7
Barbagli *et al.* (2008[18])	38	Dorsal onlay	111 months (80–149)	65.8
Jain *et al.* (2007[19])	12	Dorsal onlay	14.2 months (2–26)	91.7
Datta *et al.* (2007[20])	43	Dorsal onlay	48 months (12–84)	88.4
Pisapati *et al.* (2009[21])	45	Dorsal inlay	42 months (12–60)	87

different factors such as stricture length, site, previous intervention and degree of spongiofibrosis affect the procedure results. The patients with different variables were well balanced in both groups. The degree of spongiofibrosis was the only uncontrolled parameter. Urethral sonography is unreliable in diagnosing the depth of spongiofibrosis in comparison with histopathological correlation.[16]

In the present study, BMG dorsal onlay urethroplasty and BMG dorsal Inlay urethroplasty provided comparable outcomes for anterior urethral strictures repair. We reported a success rate of 88% in the dorsal onlay group, whereas the success rate in the dorsal inlay group was 86.4%. The overall success rate of both groups is comparable with those in other series of BMG urethroplasty (Table 2) using the Barbagli technique or Asopa technique for anterior urethral stricture repair.

Using Asopa's technique, no mobilization of the urethra is required, which not only preserves the urethral blood supply coming through circumflex and perforating vessels, but also simplifies the procedure, as no urethral dissection is required to place the graft dorsally. In the present study, the mean operative time with Asopa's technique was significantly shorter (128 ± 4.89 min) than the mean operative time in Barbagli's technique (205 ± 19.63 min, *P*-value <0.0001). The other distinct advantage of Asopa's technique is that the stricture site is directly seen, and the BMG can be tailored to the dorsal urethrotomy defect; in Barbagli's technique, visualization is rendered difficult by the rotation necessary for urethral incision dorsally. Asopa's technique might also be more suitable when the urethra is adherent to underlying corpora cavernosa as a consequence of repeated optical urethrotomy and in obese patients where a dorsal approach could be particularly difficult.[22] In the present study, the average blood loss in the first group was significantly more than in the second group (228 ± 5.32 *vs* 105 ± 12.05, *P*-value <0.0001), which could be attributed to urethral dissection and rotation in Barbagli's technique. However in Asopa's technique, the bleeding from the edges of the spongious urethra at the ventral urethrotomy site is more than in the dorsal onlay technique, but can usually be controlled effectively with diathermy or sutures.

The dorsal onlay technique of Barbagli and dorsal inlay technique of Asopa BMG urethroplasty provide similar success rates. Compared with Barbagli's technique, Asopa's technique is easy to carry out, has a shorter operative time and less blood loss, and is associated with fewer complications for anterior urethral stricture repair.

Conflict of interest

None declared.

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