

Original Research Article

Dorsal onlay versus dorsal inlay buccal mucosal graft urethroplasty for anterior urethral stricture: a single centre retrospective study

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ABSTRACT

Background: Urethral stricture is a relatively common disease. The choice of surgery is based on the stricture location, length of the stricture and etiology. Buccal mucosal graft (BMG) urethroplasty with Asopa and Kulkarni techniques, revolutionized the approach to anterior urethral stricture repair. Objective of the study was to compare both the dorsal onlay BMG urethroplasty technique of Kulkarni and the dorsal inlay BMG urethroplasty technique of Asopa for the management of long anterior urethral stricture.

Methods: From January 2015 to October 2019, a total of 90 patients with long anterior urethral strictures were randomized into two groups. Group A (42 patients) managed by Kulkarni technique. Group B (48 patients) managed by Asopa technique. BMG urethroplasty was considered successful if no further procedure required postoperatively with maximum flow rate >15 ml/s during the follow-up period.

Results: The success rate in group A and B were 80.9% and 87.5%, respectively. The mean operative time was significantly longer in group A (175 ± 22.6 min) than in group B (102 ± 18.14 min, p -value <0.001). The average blood loss was significantly higher in group A (154 ± 15.65 ml) than in group B (112.76 ± 12.62 ml, p -value <0.012).

Conclusions: The dorsal onlay technique of Kulkarni and the dorsal inlay technique of Asopa buccal mucosal graft urethroplasty are reliable and satisfactory procedures with good success rates and minimum complications.

Keywords: Anterior urethral stricture, Buccal mucosal graft, Dorsal inlay technique of Asopa, Dorsal onlay technique of Kulkarni, Urethroplasty

INTRODUCTION

Urethral stricture is a relatively common disease in men with different etiologies.¹ According to the World Health Organization consensus, stricture refers to disease of the anterior urethra.² The incidence of panurethral strictures continues to rise, particularly in Indian and Asian countries with different etiologies. Urethral reconstruction for urethral stricture is challenging. There are many surgical procedures for urethral stricture, such as direct vision internal urethrotomy (DVIU), stricture excision and primary end to end anastomosis, and non-

transecting urethroplasty with graft and skin flap.³⁻⁵ Another option is two-staged urethroplasty, which is indicated in patients with local adverse conditions.³⁻⁵ The choice of surgery is based on the stricture location, length of the stricture and stricture etiologies. Substitution urethroplasty is the mainstay of treatment for penile urethral and panurethral strictures. The material for reconstruction (flap or graft) and location of the graft on the urethral surface (ventral or dorsal) has become a contentious issue.⁵ Asopa et al popularized the dorsal inlay technique through a ventral sagittal urethrotomy approach in 2001, represents most important evolution of

one stage technique of urethroplasty.⁶ In 2000, Kulkarni et al described a new original dorsal onlay BMG urethroplasty technique through perineal incision and by one side mobilisation of the urethra. Using this technique, penile cosmesis is safeguarded and there is no risk of urethrocuteaneous fistula.⁷ The Asopa and Kulkarni techniques, using buccal mucosal graft (BMG), revolutionized the approach to penile and panurethral stricture repair suggesting that any type of penile skin flap is unnecessary in majority of patients. The aim of this retrospective study was to compare the dorsal onlay technique of Kulkarni and the dorsal inlay technique of Asopa for the management of long anterior urethral stricture. Authors present the short-term surgical outcome on follow-up.

METHODS

Ethical Approval was taken from ethical committee. This is a single centre retrospective study. 90 patients with long anterior urethral stricture randomized into two groups. group A consisting of 42 patients were managed with dorsal onlay BMG urethroplasty and group B consisting of 48 patients were managed by single stage dorsal inlay BMG urethroplasty at Department of Urology and Renal transplant, Gauhati Medical College and Hospital, Guwahati, Assam by a single surgeon. Period of study was from January 2015 to October 2019. Each patient was evaluated with detailed case history, physical examination, urine analysis, renal function test, retrograde urethrogram (RGU), voiding cystourethrogram (VCUG), uroflowmetry, American Urological Association Symptoms Score (AUASS) assessment and other routine investigations required for anesthetic fitness. On table urethra cystoscopy was done in all patients. Oral preparation was commenced on the 2nd preoperative day using hexetidine mouthwash three times a day. Records indicate that preoperative one dose of broad-spectrum antibiotic was given parenterally at induction of anaesthesia and same continued postoperatively.

Surgical technique

Operation was performed under general anaesthesia with nasotracheal intubation and the patient were put in exaggerated lithotomy position. Operation was done in a 2-team approach where one team engaged in urethral procedure and other team in harvesting the buccal mucosa with separate sets of instruments. The oral mucosa was harvested from cheeks as described by Barbagli et al.⁸ Authors used the surgical techniques of BMG urethroplasty described by Asopa and Kulkarni.^{6,7}

One team harvested the buccal mucosal graft of adequate length from the inner cheek area below the Stensen's duct without injuring it. Usually 4-6 cm long and about 2.5 cm wide, to create about 26-30-gauge neourethra, can easily be harvested from the inner cheek. If required, another graft harvested from opposite cheek. Incision was marked

with pen. Lignocaine (2%) with adrenaline (1:200000) was injected into the edges of the desired graft length before harvesting to get better hemostasis. Stay sutures were placed into the corners and the graft was harvested. Proper hemostasis was achieved by monopolar cautery. The graft was defatted and tailored to its proper size.

Skin preparation was done by washing thoroughly with savlon (a solution of cetrimide and chlorhexidine gluconate) and then scrubbed with alcohol and followed by draping. Preoperatively, on table urethroscopy was performed using a 6 Fr with semirigid Ureteroscope or mini nephroscope. A midline perineal incision of 3-4 cm was made in all cases. Skin, subcutaneous tissue and fats were dissected off the corpus spongiosus muscle on either side of the incision. A Lone Star perineal ring retractor with hooks were positioned to maximize the exposure. The penis was inverted through the perineal wound by cutting the Gallaudet's fascia (Figure 1a). This can be accomplished by applying steady pressure on the penis from above while sharply incising the thin fascia over the urethra.

Dorsal onlay technique of Kulkarni

In Kulkarni technique, the bulbar urethra was dissected along the left lateral border from the corpora cavernosa, 1cm proximal and 1 cm distal to stricture part of urethra (Figure 1b). The urethra was mobilized across the midline to the contralateral attachment to the corpora cavernosa, which was left intact. This helps to preserve the neurovascular supply to the urethra. Once mobilization was complete, the dorsal aspect of the urethra was exposed and opened longitudinally in midline (Figure 2a).

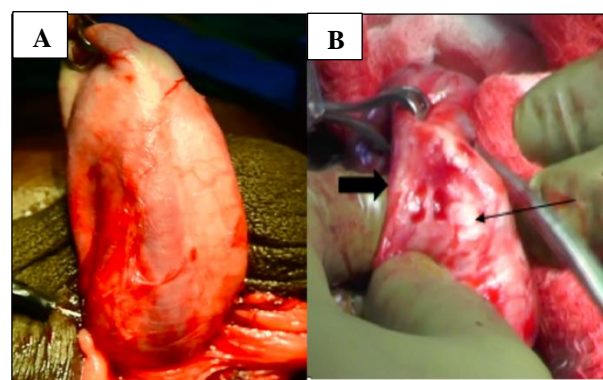


Figure 1: (a) Penis inverted through the perineal wound, (b) lateral dissection of urethra (thick arrow-urethra, thin arrow- lateral dissection from corpora cavernosa).

Continuous upward traction is applied to the inverted penis to mimic stretched penile length. Grafts are placed dorsally while the penis is on stretch. This ensures adequate length of graft to prevent chordee during erection. BMG was placed over the bed at corpora cavernosa, sutured at distal and proximal margin of

urethrotomy. The grafts are 2.5 cm in width. Graft was spread and sutured to the corpora in 3 lines continuous 5-0 polydioxanone suture (PDS) with cutting needle and quilting sutures in between (Figure 2b). A 14 Fr silicone urethral catheter was inserted. Opened urethra was closed with 4-0 PDS. Penis was kept back in normal position and perineal wound closed in layers without any drain.

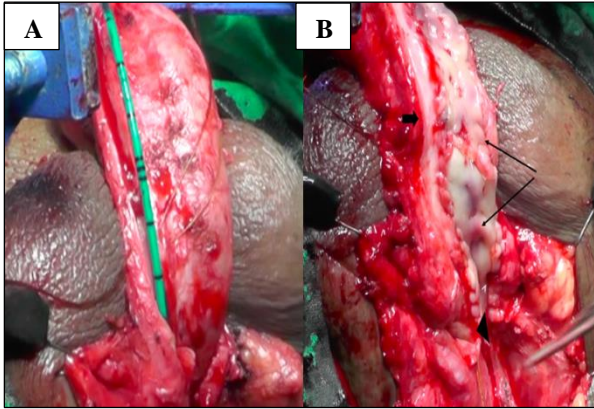


Figure 2: (a) Dorsal aspect of the urethra was exposed and opened longitudinally in midline, (b) BMG placed over the bed at corpora cavernosa (thick arrow-urethral plate, thin arrow-two buccal mucosal graft, arrowhead- urethral opening).

Dorsal inlay technique of Asopa

In Asopa technique, no urethral mobilization was done hence neurovascularity of urethra is not jeopardised. Ventral sagittal urethrotomy over the strictured segment, 1 cm proximally and distally into the normal urethral lumen was made, which acted as a window to access the dorsal surface of the urethra (Figure 3a). The dorsal surface of the urethra was incised in the midline 1 cm proximal and distal beyond the strictured segment (Figure 3b). Using sharp dissection, the margins of the incised dorsal urethra were dissected from the tunica albuginea, without lifting the two edges of the incised urethra. This dissection results in an elliptical raw area as wide as 1.5-2.5 cm between the edges of the urethra over the tunica albuginea. The harvested BMG were spread and fixed over the raw area in 3 lines continuous 5-0 PDS with cutting needle starting at midline as two lateral edges can be trimmed as required (Figure 4). After fixing the graft, few quilting sutures were applied. The ventral urethrotomy was closed by continuous sutures over a 14 Fr silicone catheter. Dartos layer was closed as reinforcing layer over the urethral closer.

Peri catheter study was done on the 21st postoperative day, and if there was no extravasation of contrast, the catheter was removed or delayed for 1 week if there was extravasation. Patient followed up with physical examination, AUASS assessment and uroflowmetry at 3 months and 6 months after catheter removal. RGU was performed at 6 months or if Qmax was <15 ml/s. A successful outcome was defined as normal voiding.

Failure was defined for any intervention during the follow-up period. Authors also recorded and evaluated the complications including wound infections, wound dehiscence, urethrocuteous fistula formation, recurrent stricture and donor site complications.

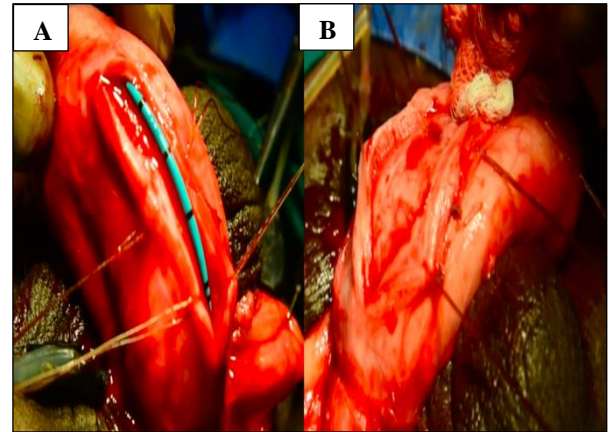


Figure 3: (a) Ventral sagittal urethrotomy over the strictured segment, (b) dorsal surface of the urethra (graft bed).

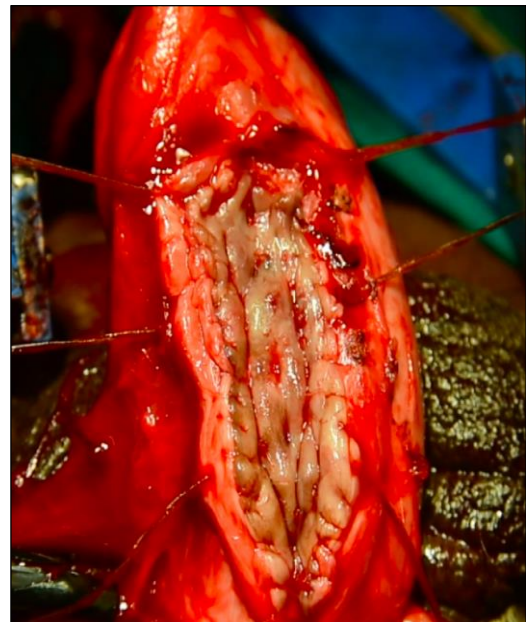


Figure 4: Dorsal inlay BMG.

Statistical analysis

Data were analyzed using SPSS software (version 16.0) with chi-square test. *P* values less than 0.05 were considered statistically significant. Authors analyzed the results including success and complication rates and age, history of previous surgery, etiology of strictures, site of stricture, postoperative parameters, Qmax and AUASS (pre- and post-surgery) in between two groups according to dorsal onlay technique of Kulkarni and dorsal inlay technique of Asopa.

RESULTS

A total of 90 patients (mean age 38.7 years, range 17-62 years) with anterior urethral stricture underwent BMG urethroplasty by dorsal onlay BMG urethroplasty in 42 patients (group A) and dorsal inlay BMG urethroplasty in 48 patients (group B). The etiology of strictures was idiopathic in 52.2%, BXO/lichen sclerosus and inflammatory in 21.1%, traumatic in 17.7% and iatrogenic in 8.8% (Table 1).

Table 1: The etiology of anterior urethral stricture of patients (n=90).

Etiology	Group A (n=42)	Group B (n=48)	Total= 90 (n=90)
	N (%)	N (%)	N (%)
Idiopathic	24 (57.1)	25 (52.0)	49 (54.4)
BXO/lichen sclerosus/ inflammatory	13 (30.9)	19 (39.5)	32 (35.5)
Iatrogenic	5 (11.9)	4 (8.3)	9 (10.0)

Table 2: Pre-operative parameters.

Pre-operative Parameters	Group A (n=42)	Group B (n=48)	P value
	N (%)	N (%)	
Mean age (years)	39.5 (17-62)	38 (18-60)	0.73
Mean stricture length (cm)	6.7 (3.8-10.2)	7.4 (4-10.5)	0.08
Stricture site			0.83
Penile	20	22	
Bulbar	15	16	
Panurethral	7	10	
Mean AUASS	22.1±5.06	21.9±6.42	0.07
Mean Qmax (ml/s)	5.65±2.47	5.40±2.75	0.12

The stricture site in both groups is shown in Table 2. According to urethrocytoscopic and per operative findings where RGU and MCU was also contributory the average stricture length in group A was 6.74 cm (range 3.8-10.2 cm), and in group B was 7.4 cm (range 4-10.5 cm). The average AUASS in group A and group B were 22.1±5.06 and 21.9±6.42. The mean Qmax between both groups were 5.65±2.47 and 5.40±2.75 ml/s subsequently (Table 2).

The mean operative time was significantly longer in the group A (175±22.6 min) than in group B (102±18.14 min, p-value <0.05). The mean follows up in both groups were 16.4 and 17.2 months, respectively. The average blood loss was significantly higher in the group A (154±15.65 ml) than in the group B (112.76±12.62 ml, p-value <0.05). Only one patient in the group A required postoperative blood transfusion. The hospitalization

period in group A (4.5±2.2 days) was significantly longer than B (3.1±1.6 days, p<0.05). Calibre of diseased urethra in group A and B were 7.28±1.5 Fr and 7.55±1.75 Fr, respectively (Table 3).

Three patients in the group A and one patient in the group B had postoperative wound infection, all were managed successfully with change of antibiotics according to a culture sensitivity test using wound swab. One patient in the group A showed extravasation of contrast on peri catheter urethrogram at 3 weeks of operation and was managed successfully by one week of additional catheterization. Graft necrosis occurred in three patients in group A and one patient in group B. The donor sites were all fully epithelialized by 2 weeks. There were no long-term complications in regard to the donor site. One patient in each group developed donor site complication and suffered from difficulty in opening their mouth for a short period, and five patients in group A and three patients in group B developed post-void dribbling and could be managed conservatively. There was no postoperative diverticulum formation, urinary incontinence or de novo erectile dysfunction. In current study, no significant difference found in terms of postoperative complication in both groups (Table 4).

Table 3: Post-operative parameters.

Post-operative parameters	Group A (n=42)	Group B (n=48)	P value
Mean blood loss (ml)	154±15.65	112.76±12.62	0.012
Mean operative time (minutes)	175±22.6	102±18.14	0.001
Mean hospital stays (days)	4.5±2.2	3.1±1.6	0.035
Calibre of diseased urethra (Fr)	7.28±1.5	7.55±1.75	0.56

Table 4: Complications and failure rate (recurrent stricture).

Complications	Group A (n=42)	Group B (n=48)	P value
	N (%)	N (%)	
Surgical site infection	3 (7.14)	1 (2.01)	0.42
Graft necrosis	3 (7.14)	1 (2.01)	0.35
Donor site complication	1 (2.4)	1 (2.01)	0.06
Postvoid dribbling	5 (11.9)	3 (6.2)	0.34
Recurrent stricture (failure at 3 months, Qmax ≤15 ml/s)	5 (11.9)	4 (8.33)	0.14
Recurrent stricture (failure at 6 months, Qmax ≤15 ml/s)	3 (7.14)	2 (4.02)	0.17

Eight patients (19.0%) in group A and six patients in group B (12.5%) developed stricture at 3 and 6 months'

follow up. Patients with recurrent stricture presented with diminished urinary flow (peak urinary flow <15 ml/s), dysuria and recurrent urinary tract infection. Three failure cases developed a distal anastomotic stricture, and two failure cases had two stenotic rings at the distal and proximal site of anastomosis and all of them responded well to DVIU. Another five patients in both groups developed short segment stricture and managed with BMG urethroplasty. These five recurrent stricture patients, in the present study had one penile, two bulbar and two panurethral stricture. Rest four failures had undergone multiple endoscopic procedures with poor outcome (Table 4).

The AUASS score significantly decreased from a mean of 22.1 ± 5.06 preoperatively to 5.16 ± 3.84 and 6.05 ± 4.12 postoperatively at 3 and 6 months in the group A (p value <0.05). Also, the AUASS score significantly decreased from a mean of 21.9 ± 6.42 preoperatively to 5.05 ± 4.06 and 5.95 ± 3.96 postoperatively at 3 and 6 months in the group B (p value <0.05). Mean peak urinary flow rate (Qmax) improved in the group A from an average of 5.65 ± 2.47 ml/s preoperatively to 17.75 ± 4.05 ml/s and 16.82 ± 3.42 ml/s postoperatively at 3 and 6 months (p value <0.05). In the group B, the maximum urinary flow rate (Qmax) increased from an average of 5.40 ± 2.75 ml/s preoperatively to 17.14 ± 3.34 ml/s and 16.40 ± 4.75 ml/s postoperatively at 3 and 6 months (p value <0.05) (Table 5).

Table 5: Follow up parameters.

Follow up parameters	Group A (n=42)	Group B (n=48)	P value
Mean AUASS (preoperative)	22.1 ± 5.06	21.9 ± 6.42	0.07
Mean AUASS (at 3 months)	5.16 ± 3.84	5.05 ± 4.06	0.86
Mean AUASS (at 6 months)	6.05 ± 4.12	5.95 ± 3.96	0.69
P value between preoperative AUASS and AUASS at 3 and 6 months	0.032	0.018	
Mean Qmax (ml/s) preoperative	5.65 ± 2.47	5.40 ± 2.75	0.12
Mean Qmax (ml/s) at 3 months	17.75 ± 4.05	17.14 ± 3.34	0.74
Mean Qmax (ml/s) at 6 months	16.82 ± 3.42	16.40 ± 4.75	0.32
P value between preoperative Qmax and Qmax at 3 and 6 months	0.007	0.003	

BMG urethroplasty was considered successful if no further procedure required postoperatively and the maximum flow rate was >15 ml/s during the follow-up period. The overall success rate in the dorsal onlay group was 80.9%, whereas in the dorsal inlay group the success rate was 87.5% during the follow-up period.

DISCUSSION

The aim of this retrospective study was to compare the results of the dorsal onlay Kulkarni technique and dorsal inlay Asopa technique of BMG urethroplasty in management of long anterior urethral strictures. To authors knowledge, there were no previous studies comparing the two techniques before the present study. The choice of method depends on the experience of the surgeon and the choice of the patient which should be considered before the final decision.⁹ In the present study, Kulkarni dorsal onlay BMG urethroplasty and Asopa dorsal inlay BMG urethroplasty provided comparable outcomes for anterior urethral strictures repair.

Hampson et al showed that many techniques utilized for urethroplasty depends on the location, length and etiology of the stricture.¹⁰ However, many of the modalities are fraught with high morbidity and stricture recurrence.¹¹ Resection and spatulated end-to-end anastomosis is gradually disfavored by many reconstructive urologists, except in traumatic cause of stricture urethra after proper counselling.¹² Anterior

urethral stricture more than 2 cm long should be treated with substitution urethroplasty to avoid postoperative chordee formation. Free skin grafts used as patch or tube graft in substitution urethroplasty are associated with complications like graft shrinkage, diverticulum formation and recurrent stricture, although results of patch grafts are better than tube grafts.¹³

Humby was the first to use buccal mucosa for urethral reconstruction in a series of single stage hypospadias repair.¹⁴ However, BMG urethroplasty has emerged as a popular technique in 1990s. Since 1993 El-Kasaby et al reported the first experience with buccal mucosa urethroplasty for treatment of penile and bulbar urethral strictures.¹⁵ BMG has recently gained its popularity as a substitute for urethral reconstruction for both strictures and complex hypospadias. Ventral onlay graft is more prone to fistula formation, sacculation and diverticula formation leading to urinary stasis and ejaculatory dysfunction.³²

On the other hand, dorsal onlay graft procedure for the anterior urethral stricture provides the advantages of better mechanical support and better vascularity by the corporal bodies for better take up of graft, with less incidence of sacculation and fistula formation.¹⁶

In 1996, Morey and McAninch fully described the ventral onlay oral mucosal graft urethroplasty.¹⁷ 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°. Although Alsika et al in their study showed that there was no significant difference between the use of penile skin graft and buccal mucosal graft for urethral reconstruction.¹⁹

Barbagli et al showed that the skin graft urethroplasty had a higher failure rate compared to the buccal mucosa graft.²⁰ Barbagli et al also showed that the success rate of ventral BMG urethroplasty was 83% in their first study and 91.4% in another study with more follow-up. On the other hand, the success rate for dorsal onlay BMG and ventral onlay BMG urethroplasty was 85% and 79.2%, respectively. With the extended followup, the success rate decreased slightly, although this difference may be primarily selected for patients showing complex, long urethral strictures and also due to recurrent stricture after previous urethroplasty.²¹

One stage urethroplasty begins in 1999 when Hayes and Malone, described the use of dorsal BMG with urethral plate incision for hypospadias salvage. They combined the principle of Snodgrass technique and BMG was placed in midline of incised urethral plate.^{22,23}

Asopa popularized the dorsal inlay technique 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.⁶ In Barbagli's experience using Asopa's technique, oral mucosa was better than skin graft material, but the difference (82% versus 78%) does not justify the use of oral mucosa as a first choice.²⁴ Also Pisapati et al. reported success rate of 87% using the same technique for recurrent anterior urethral strictures in which none of the recurrences had occurred in penile strictures.²⁵

In a study by Kulkarni et al 24 patients underwent dorsal onlay BMG urethroplasty, out of them 22 (92%) had a successful outcome and two (8%) had failures. One

failure was treated by definitive perineal urethrostomy and another failure underwent successful internal urethrotomy. The overall mean (range) follow-up was 22 (12-55) months.²⁶

Barbagli et al published a retrospective study of 50 cases with bulbar urethral stricture where buccal mucosal graft urethroplasty was 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.²⁷

In a study, Kulkarni et al both together described that the graft should be placed dorsally in distal bulbar urethra and ventral onlay graft preferred in the proximal part where the spongiosum is abundant. The success rate of study was 90.9%.²⁸ Datta et al studied that, following the dorsal onlay BMG urethroplasty only five patients developed re-stricture at anastomotic sites, (one of them at distal and other four at proximal anastomotic site). Three patients developed stricture within 6 months of operation and another two patients showed evidence of stricture on RGU after 24 months of operation. Three of them (6.9%) were considered as failure.²⁹

Tabassi et al showed that, the mean follow up of 19.4±6.9 months, success rate for penile urethroplasty using dorsally placed onlay BMG was 97.83%. Postoperative complications seen in this group were wound infection, meatal stenosis, and ring stenosis in 6.25%, 4.35%, and 2.17%, respectively.³⁰

Kulkarni et al reported overall success rate of 83.7% in panurethral BMG urethroplasty. In their study success rate was 86.5% for primary urethroplasty and 61.5% in previously failed urethroplasty.³¹ On the other hand, dorsal onlay and inlay BMG urethroplasty have shown a success rate from 85.5% to 98.2% with a follow-up ranging from 6 to 149 months (Table 6).^{6,24,25,32-36}

Table 6: Outcomes of BMG urethroplasty.

Series	Patients	Technique	Follow up	Success rate
Asopa et al ⁶	12	Dorsal inlay	26 months (8-40)	91.7
Gupta et al ³²	12	Dorsal inlay	12 months (10-16)	91.7
Barbagli et al ²⁴	38	Dorsal onlay	111 months (80-149)	85.8
Jain et al ³³	12	Dorsal onlay	14.2 months (2-26)	91.7
Datta et al ²⁹	43	Dorsal onlay	48 months (12-84)	88.4
Pisapati et al ²⁵	45	Dorsal inlay	42 months (12-60)	87
Dubey et al ³⁴	109	Dorsal onlay	41 months (24- 64)	88.8
Pansadoro et al ³⁵	56	Dorsal onlay	42 months (6-94)	98.2

In this study, 90 patients had long segment urethral strictures with mean length of 6.7 and 7.4 cm in group A and B, respectively with different etiologies. The mean operative time with Asopa's technique was significantly shorter (102±18.14 min) than the mean operative time in Kulkarni's technique (175±22.6 min, p-value <0.001). In

the present study, the average blood loss in the group A was significantly more than in the second group (154±15.65 vs 112.76±12.62, p<0.012), which could be attributed to urethral dissection in Kulkarni's technique. These results are comparable with another prospective study of dorsal onlay (Barbagli technique) versus dorsal

inlay (Asopa technique) buccal mucosal graft urethroplasty for anterior urethral stricture by Aldaqadossi et al.³⁶ Mean AUASS and mean Qmax significantly improved postoperatively at 6 months follow-up in both groups (p value <0.05). The overall success rate in the group A and group B were 80.9% and 87.5%, respectively, during 6 months follow-up period.

So, this techniques of both urethroplasty for long segment urerthral stricture is relatively comparable with the results of other studies.

CONCLUSION

Dorsal onlay technique of Kulkarni and dorsal inlay technique of Asopa BMG urethroplasty are reliable and satisfactory procedures to manage long anterior urethral strictures with good success rates and minimum complications. However, Asopa technique is easy to perform with shorter operative time.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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