URETHROPLASTY USING BUCCAL MUCOSA FOR TREATMENT OF ANTERIOR URETHRAL STRICTURE

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ABSTRACT

Background: For the second half of the 20th century, the urethral reconstruction pendulum has swung from mainly two stage urethroplasty, then to grafts, then onto fasciocutaneous flaps, and currently, has swung back to grafts (buccal mucosa). Great promise lies with tissue engineering and regenerative medicine today. BMG is advantageous because it is associated with little donor site morbidity and it appears to resist infection well. **Aim of the work:** To evaluate the results of buccal mucosa graft urethroplasty in repair of anterior urethral stricture. **Patients and methods:** Between July 2009 and June 2012, 30 patients with anterior urethral stricture and stricture length > 2cm were operated as one stage ventral onlay buccal mucosa graft (BMG) urethroplasty. Posterior urethral stricture, active UTI and VIU or urethroplasty within the last 3 months were the exclusion criteria. All patients were subjected to complete urological and oral evaluation preoperatively. Ascending urethrography and micturating cystourethrography were done for all patients. Uro-flowmetry was done as a base line for follow-up. The study population was divided into 3 groups (penile, bulbar and peno-bulbar) according to the actual intra-operative stricture site. The graft was tailored according to site, length, and stricture characteristics and sutured to the edges of the opened urethra. The donor site was followed-up for oral bleeding, hematoma, cheek swelling and perioral numbness in the first week and after one month. The urethroplasty wound was followed-up for post-operative bleeding or infection. Whenever obstructive symptoms were met or maximum flow rate deteriorated to < 14 ml/sec, urethrography was done. Successful reconstruction was equal to normal voiding without need for any postoperative procedures including dilatation. **Results:** Of all patients, 66.67 % of the patients had stricture length ≤ 5 cm while 33.33 % of the patients had stricture length > 5 cm. The overall success rate was 83.33% at the end of the study**.** The success rates were 85.71%, 80% and 84.62% for penile, bulbar and peno-bulbar urethroplasty groups respectively. Out of the 5 patients who developed re-stricture during follow-up, 4 patients with initial stricture length > 5 cm had re-stricture at the proximal anastomotic site. The stricture length had a significant effect on the success rate, with strictures ≤ 5 cm having a better prognosis (*P* value = 0.0192). **Conclusion:** Buccal mucosa is an excellent graft for repairing anterior urethra stricture with minimal donor and recipient site complications. A ventrally placed buccal mucosa graft has the advantages of ease of stricture exposure, ideal richly vascularized graft bed and excellent long-term stricture-free rates.

Key words: buccal mucosa – graft - urethral stricture - urethroplasty.

INTRODUCTION

For the second half of the 20th century, the urethral reconstruction pendulum has swung from mainly two stage urethroplasty, then to grafts, then onto fasciocutaneous flaps, and currently, has swung back to grafts (buccal mucosa). Great promise lies with tissue engineering and regenerative medicine today [(1)].

Buccal mucosa grafting (BMG) for urethroplasty of both urethral stricture and hypospadias repair has gained widespread acceptance during the past 2 decades. With the initial description by Humby [(2)] dating back to 1941, the method was reintroduced into the urologic literature in 1992 by Burger et al [(3)] and by Dessanti et al [(4)].

In 1993, for the first time, El-Kasaby et al. [(5)] reported that a BMG from the lower lip was used for treatment of penile and bulbar urethral strictures in adult patients without hypospadias.

Buccal mucosa (BM) is readily available from all patients and is easily harvested from the inner cheek or lower lip, providing the advantage of a concealed donor site scar. Moreover, BM is hairless, has a thick elastin-rich epithelium, which makes it tough yet easy to handle, and has a thin and highly vascular lamina propria, which facilitates inosculation and imbibition [(6)]. BMG is also advantageous because it is associated with little donor site morbidity and it appears to resist infection well [(7)].

The techniques are various and the location of the patch has become a contentious issue with different series reporting BMGs placed either ventrally or dorsally to augment the strictured urethra [(8)].

PATIENTS AND METHODS

This study was carried out in the Department of Urology, Zagazig University Hospitals from July 2009 to June 2012. The study was conducted on 30 patients with urethral stricture.

Patients with anterior urethral stricture and stricture length > 2cm were enrolled in the study while patients with posterior urethral stricture, active urinary tract infection (UTI) and visual internal urethrotomy (VIU) or urethroplasty within the last 3 months were excluded from the study.

All patients were subjected to complete urological and oral evaluation preoperatively with special emphasis on: history of urethral catheterization, urethral discharge, urethral trauma, urethral dilatation, VIU, and previous

urethral operation, history positive for heavy smoking and previous oral surgery or pathology.

Physical examination with special attention to: spongio-fibrosis, perineal or penile scar, normal oral conditions that may necessitate the need to delay oral mucosa harvest until site conditions improve as: cutaneous freckle and ectopic sebaceous glands, pathologic oral conditions that would contraindicate oral mucosa harvesting such as: leukemia, mucositis, oral lichen planus and recurrent aphthous stomatitis.

Laboratory investigations included urinalysis and urine culture if indicated. Radiological investigations included ascending urethrography (Figure 1) and micturating cystourethrography and sono-urethrography. Uro-flowmetry was done as a base line for follow-up.

The study population (30 patients) was divided into 3 groups according to the actual intra-operative stricture site. The 3 groups were penile, bulbar and peno-bulbar.

All patients were operated as one stage ventral onlay buccal mucosa graft urethroplasty. The urethroplasty and buccal graft harvest were done by the same surgeon.

Preoperative

Three days prior to surgery, the patient began using a chlorhexidine-based mouthwash for oral cleansing. The day before surgery, the patient received intravenous prophylactic antibiotics.

Surgical procedure

The patient was intubated through the nose, allowing the mouth to be completely free. By using an appropriate mouth retractor, only one assistant was needed to harvest the oral graft.

Urethroplasty

A. Penile Urethroplasty

A circumcoronal incision was made through the foreskin, completely degloving the penis. The penile urethra was exposed and the strictured tract was fully opened by a ventral midline incision (Figure 2 A&B).

Graft harvest

Mouth opener was used and stay sutures were placed along the external edge of cheek to keep the buccal mucosa stretched. Stensen's duct, located at the level of the second upper molar, was identified and the desired graft size was measured and marked in an ovoid or rectangle shape, 1.5 cm from Stensen's duct and 1.5 cm from the edge of the cheek**.**

Lidocaine hydrochloride (HCL) 1% with epinephrine (1:100 000) was injected along the edges of the graft to enhance hemostasis. The outlined graft was sharply dissected and removed, leaving the muscle intact. The donor site was carefully examined for bleeding.

The harvesting site was closed with 5-0 polyglactin continuous suture. When necessary, another graft could be harvested from the other cheek using the same technique. After careful defatting, the graft was tailored according to site, length, and stricture characteristics (Figure 3 A&B).

After buccal mucosa graft harvest, the graft was sutured to the edges of the opened urethra using interrupted 6-O polyglactin sutures. The urethra was closed over a Foley 18-French silicone catheter (Figure 4 A&B).

B. Bulbar urethroplasty

The patient was placed in lithotomy position. A midline or inverted Y perineal incision was made. The bulbocavernosus muscles were separated in the midline and a self-retractor was positioned. The bulbar urethra was freed for its entire length.

The distal extent of the stenosis was identified by gently inserting a suitable catheter or sound until it has met resistance. The corpus spongiosum was incised in the ventral midline until the catheter tip and urethral lumen were exposed. The stricture was then incised along its entire length by extending the urethrotomy distally and proximally. Once the entire stricture has been incised, the length and width of the remaining urethral plate were measured.

The BMG was trimmed to its appropriate size, according to the length and width of the urethrotomy. The two ends of the graft were sutured to the proximal and distal apices of the urethrotomy. A Foley 18-Fr silicone catheter was inserted. The graft was rotated over the catheter and a running 6-O polyglactin suture was used to make a watertight anastomosis between the right and left margins of the graft and the right and left margins of the mucosal urethral plate.

After completion of graft suturing the corpus spongiosum was closed over the graft with 4-O polyglactin interrupted suture. The bulbocavernosus muscle was re-approximated over the spongiosum tissue and Colles' fascia, the perineal fat and the skin were closed with interrupted absorbable sutures (Figure 5 A-F).

Follow-up

A. Early post-operative period:

- The donor site was followed-up for early post-operative complications such as oral bleeding, hematoma, cheek swelling and perioral numbness, then in the first week and after one month.
- The urethroplasty wound was followed-up for post-operative bleeding or infection.

B. After catheter removal:

- Peri-urethrogram was done just before catheter removal (Figure 6).

- Urethral catheter was removed after 3 weeks post-operative.
- Uroflowmetry and urine analysis (and urine culture if needed) were done every 3 months in the first year and annually thereafter.
- All patients were followed-up for oral tightness, persistent oral numbness and urethral extravasation.

Outcomes

- Whenever obstructive symptoms were met or maximum flow rate deteriorated to < 14 ml/sec, urethrography and urethroscopy were done.
- Successful reconstruction was equal to normal voiding without need for any postoperative procedures including dilatation.
- Success rate and complications were analyzed.

Stastical analysis

- Data were represented as the mean (SD) or median and groups were compared using *One-way* ANOVA and Student's *t*-test.
- The success rates were estimated by Kaplan-Meier curves and differences between groups were calculated using the log-rank test.
- P < 0.05 was considered to be statistically significant.

Results

The baseline patients' characteristics are shown in table (1). There was no statistically significant difference between the mean age among the 3 groups. The relevant history of the 3 study groups revealed that 36.67 % of patients were catheterized for different purposes and 63.33 % of patients had prior VIU**.**

Of all patients, 46.67% had inflammatory causes while 30% had traumatic causes and the remaining 23.33% had idiopathic causes of stricture**.** Regarding stricture length, 66.67 % of the patients had stricture length ≤ 5 cm while 33.33 % of the patients had stricture length > 5 cm (Table 2).

There was an improvement in the peak urinary flow rate and the differences between the mean pre- and post-operative values were statistically significant (Table 3)

The overall success rate of the whole study population was 83.33% at the end of the study**.** The success rates were 85.71%, 80% and 84.62% for penile, bulbar and peno-bulbar urethroplasty groups respectively. Among the 3 groups, there was no statistically significant difference in success rate in relation to the site.

Out of the 5 patients who developed re-stricture during follow-up, 4 patients with initial stricture length > 5 cm had re-stricture at the proximal anastomotic site at a median of 19.5 months. The fifth patient had an initial stricture length ≤ 5cm and developed re-stricture at 18th month.

The stricture length had a significant effect on the success rate, with strictures ≤ 5 cm having a better prognosis (*P* value = 0.0192, Figure 5).

The 5 patients who had failure in the 3 groups were managed by VIU in 4 patients and the remaining patient refused revision, preferring regular intermittent dilation with an acceptable flow rate.

Among the study population, the age of the patient had no statistically significant effect on the success rate (*P*-value = 0.0847, Figure 7).

Previous intervention in the form of VIU represented 63.33% of the study population. The remainder had urethral catheterization for different purposes. Previous intervention had no statistically significant effect on the success rate (*P*-value = 0.9984, Figure 8).

Early complications consisted of cheek swelling and perioral numbness occurred in all patients with spontaneous resolution within 48 hours. No late oral complications were noticed as oral tightness or persistent numbness.

From the penile group, one patient was complicated by meatal stenosis at the 6th month of follow-up due to catheterization. This patient had stricture length **>** 5cm. This meatal stenosis was away from the reconstruction site. It was managed by ventral meatotomy.

In the peno-bulbar urethroplasty group, one patient was complicated by extravasation at proximal anastomotic site after catheter removal. This patient had stricture length > 5 cm, with age > 50 years and gave history of VIU. This complication was managed conservatively by catheter re-fixation for 2 weeks. The patient was improved after catheter re-fixation. Another patient was complicated by oral bleeding in the first day post-operative. This patient was managed conservatively.

Two patients were complicated by urethroplasty wound infection. One patient was from the bulbar group and the other patient was from the peno-bulbar group. The 2 patients were managed conservatively with antibiotics (Table 4).

DISCUSSION

Urethral reconstruction is a very rich field by its variable techniques and their modifications. The awareness and malleability of such techniques points in favor of good and durable results [9].

The repair of extensive urethral strictures is a difficult procedure and there is no widely accepted standard approach described in the published literatures. The ideal surgical technique

for substitution urethroplasty should be simple, safe, reliable and reproducible in the hands of any surgeon [10].

Since 1980s, BM has proved to be a versatile graft material well suited to repair of the urethra because it is a wet epithelium, which is easily harvested and amenable to surgical manipulation, has a privileged immunity rendering it less prone to infection, and is more resistant to stricture recurrence than skin [11].

Barbagli et al.[12] introduced the dorsal onlay graft procedure, which has possible advantages compared with ventral graft urethroplasty that include better mechanical support, a better blood supply to the graft, and prevention of urethral diverticula. However, our experience, and that of other investigators, has shown that ventral onlay grafts have similar successful outcomes, with the advantage of easier placement.

In our study, the overall success rate of ventral onlay BM grafting was 83.33%. and the success rate of bulbar urethroplasty was 80% which is compared to the published outcomes of *Dubey et al.* [13] which was 77.8%, *Barbagli et al.* [8] which was 83% and lower than that of *McLaughlin et al.* [14] which was 94%, *El-Kassaby et al.* [9] who applied the ventral onlay technique with an overall success rate of 93.7%, and *Palminteri et al.* [15] which was 95.5%.

In the present study, being ventrally placed BM graft in bulbar urethra, none of the patients was complicated by sacculation at the urethroplasty site. Only one patient developed extravasation which was treated conservatively.

Morey and McAninch [16] published in their initial series that none of their patients developed sacculation or out-pouchings of the graft, and no radiologic evidence of graft contracture was seen.

Kane et al. [17] reported a multicenter experience in 53 patients followed-up for an average of 25 months with an overall success rate of 94.3%. 7.5% of the patients had sacculation in the region of the graft but with good postoperative urine flow rates but minimal symptoms.

Due to the relative deficiency of covering tissues in the penile urethra, there is reduced potential for the survival of ventrally applied free grafts [11].

Our results of penile urethroplasty showed that ventrally placed BM graft had satisfactory success rate of 85.71% which was comparable to the published series of *Fichtner* and colleagues [18]. They published their long-term outcomes with ventrally applied BM grafts for penile urethral stricture. They describe 17 patients undergoing urethroplasty, with a success rate of 88.2% to a mean follow-up of 6.9 years. They noted that recurrences all occurred at the proximal end of the graft, similar to those seen in the bulbar urethra, and were managed by VIU with good results. Also, in our study the failure occurred at the proximal anastomotic site and was managed by VIU in 4 patients and the fifth patient refused revision, preferring regular intermittent dilation with an acceptable flow rate**.**

Peno-bulbar strictures pose a challenge for the urethral surgeon. The length of graft required is often long and frequently may require a bilateral buccal mucosal graft harvest, or a combination of oral grafts may be used [10]. The other grafts that have been described include skin grafts (in the absence of lichen sclerosis) [19], bladder mucosa [20], colonic mucosa [21], tunica albuginea from the corpora cavernosa [22], and even tissue-engineered grafts [23].

In our study, patients with peno-bulbar strictures represent 43.33% of the study population. There mean (range) stricture length was 5.38 (3-11) cm. The success rate of this group was 84.62%.

Altaf et al. [24] in their systematic review showed in ten articles describing the outcomes of peno-bulbar urethroplasty, including 240 patients, with an average follow-up of 30.11 months and an average success of 88.16% ; that one of the 10 authors used a two-stage approach with a reported success of 91.7% at 6 months follow-up. At present no recommendations may be made on the approach to long peno-bulbar urethral stricture surgery.

In our study, the stricture length had a significant effect on the overall success rate; with stricture length ≤ 5cm had a better prognosis. In the published series of *Palminteri et al.* [15], (121 patients, mean stricture length 3.7 cm, range 1.5 – 8 cm), also the stricture length had a significant effect on the success rate with strictures of ≤ 4 cm had a better prognosis.

In our study as well as in the published paper of *Palminteri et al* [15] the stricture site, patient age and previous urethrotomy had no statistically significant effect on the success rate. The published results of *Abdolrasoul et al.* [25] showed that the primary etiology, stricture site, and multiple operations had no significant effect on postoperative outcome. Also, *Abdolrasoul et al.* [25] stated that they did find an association between urethral stricture length and outcome.

No one of our patients reported sexual dysfunction. Nevertheless, similar to other investigators, we didn't use a validated questionnaire for rigorous assessment of sexual

function. Thus a larger series with longer follow-up and adapted questionnaires will be needed.

The incidence of postoperative oral complications following BM harvesting is still an open and difficult issue to deal with, because most of the articles reported in the literature group together different harvesting techniques or do not report the graft size and shape [26].

In our study, we were meticulous during harvesting the graft to avoid and/or minimize oral complications. All patients included in the study complained from cheek swelling and perioral numbness. These complications were self-limited and resolved within the first 48 hours post-operatively. No one of our patients complained from late oral complications as oral tightness or persistent numbness.

Our results are comparable to that of *Barbagli et al.* [27]. He stated that early post-operative complications were self-limited and included bleeding from the harvesting site, no pain in 85.2% patients and slight swelling in the immediate postoperative course in 65.8% patients. Also, he stated that the majority of the patients (82.8%) declared that they had no numbness in the mouth or oral tightness as late complications of graft harvesting.

Laurence et al. [7] stated in his study that the perioperative morbidity at all operative sites (mouth, penis and perineum) were low. At the graft harvest site he noted no complications such as hematoma, prolonged pain, numbness or mouth deformity despite closure of the donor site at surgery, which was recently reported in the literature to increase postoperative morbidity.

CONCLUSION

Buccal mucosa is an excellent graft for repairing anterior urethra stricture with minimal donor and recipient site complications. A ventrally placed buccal mucosa graft has many advantages, including ease of stricture exposure, an ideal richly vascularized graft bed and excellent long-term stricture-free rates. So, urethroplasty using buccal mucosa for treatment of anterior urethral stricture is safe and effective procedure.

Figure 1: Pre-operative ascending urethrogram showing long peno-bulbar urethral stricture

Figure 6: Peri-catheter urethrogram showing free flow of the dye with no extravasation

A. Degloving the penis

B. Graft length was measured

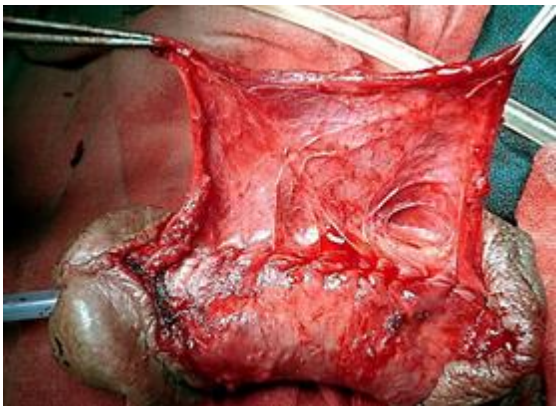
Figure 2 (A&B): penile urethroplasty (degloving and ventral urethral incision)

ı. Marking the Stensen's duct and the site of incision

A. Harvesting the graft.

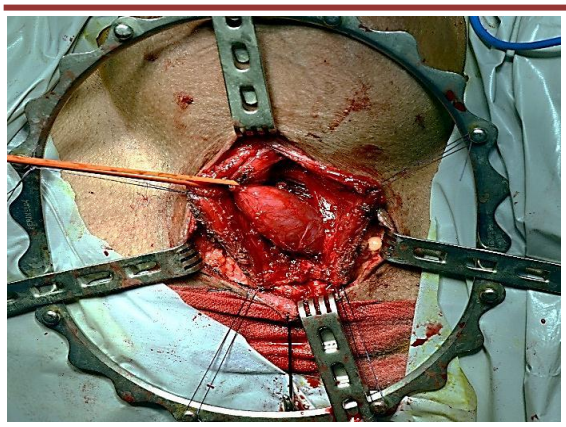
Figure 3(A&B): penile urethroplasty (degloving and ventral urethral incision)

B. Suturing the graft to urethral edges

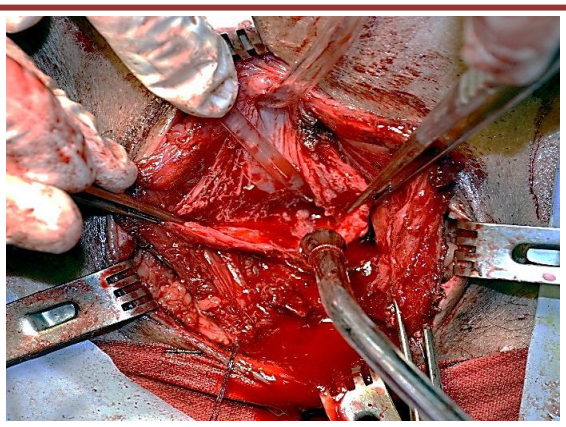


Covering the suture line with the second layer

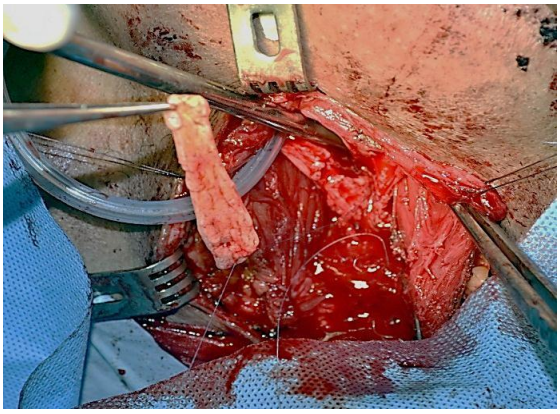
Figure 4 (A&B): Ventral onlay buccal mucosa graft penile urethroplasty



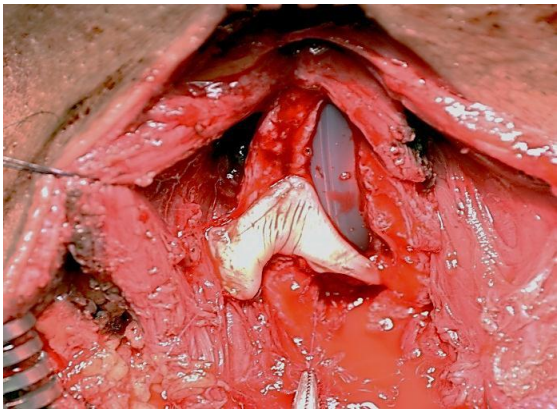
A. Exposing the corpus spongiosum



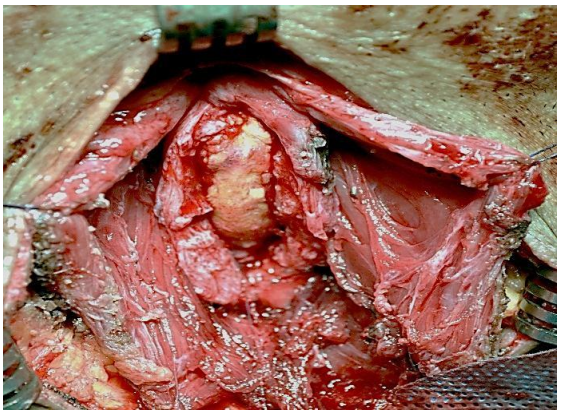
B. Incising the corpus spongiosum and the bulbar urethra ventrally.



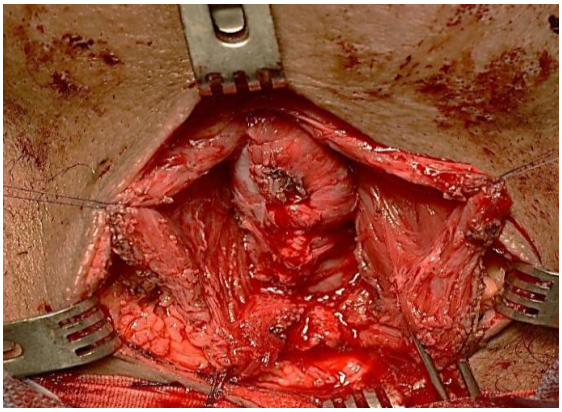
C. Suturing the buccal graft ventrally to the proximal urethrotomy



D. Suturing the buccal graft ventrally



E. Completing the graft sutures



F. Closure of the wound in layers

Figure 5(A-F): Ventral onlay buccal mucosa graft bulbar urethroplasty.

Table (1): Patients' characteristics

	Penile	Bulbar	Peno-bulbar	*p* value
No. patients	7	10	13	
Age (years),				
Mean ± SD	49 ± 11.29	48.6 ± 15.25	49.3 ± 10.17	0.991
(Range)	(25 – 59)	(19-65)	(27-63)	
Median (range) follow-up (months)	18 (12-27)	21 (15-24)	21 (12-27)	

Table (2): Stricture length

	Penile (n=7)	Bulbar (n=10)	Peno-bulbar (n=13)	Total (n=30)
≤ 5 cm	4	7	9	20
> 5 cm	3	3	4	10
Stricture length (cm):				
Mean ± SD	4.85±2.70	4.70±0.78	5.38±2.42	
(Range)	(2.5-9)	(3.5-5.5)	(3-11)	

Table (3): Peak urinary flow rate

Q max ml/s / Site	Pre-operative Mean ± SD	Last follow-up Mean ± SD	*P value*
Penile (n=7)	6.60 ± 4.21	17.74 ± 3.66	0.003
Bulbar (n=10)	7.48±3.03	15.17±4.03	0.001
Peno-bulbar (n=13)	8.33±2.65	16.40±4.24	0.001

Table (4): Post-operative complications

Group / Complications	Penile (n=7)	Bulbar (n=10)	Peno-bulbar (n=13)
Meatal stenosis	1	0	0
Extravasation	0	0	1
Wound infection	0	1	1
Oral bleeding	0	0	1

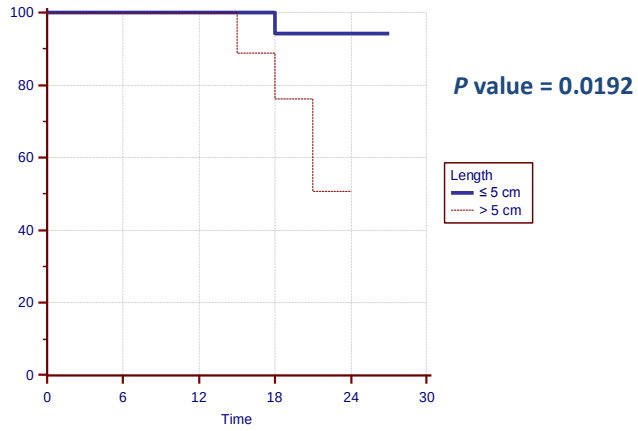


Figure 5: Kaplan-Meier curve shows the correlation between the success rate and the length of the stricture.

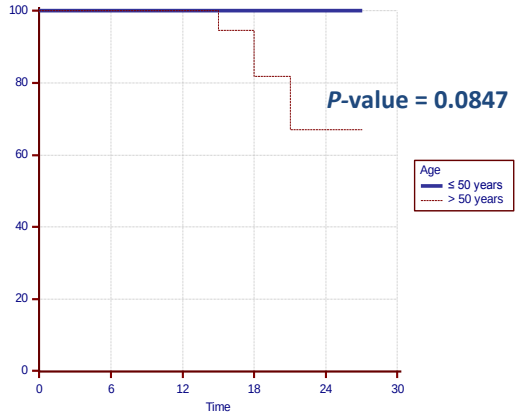


Figure 6: Kaplan-Meier curve shows the correlation between the success rate and the age of the patient.

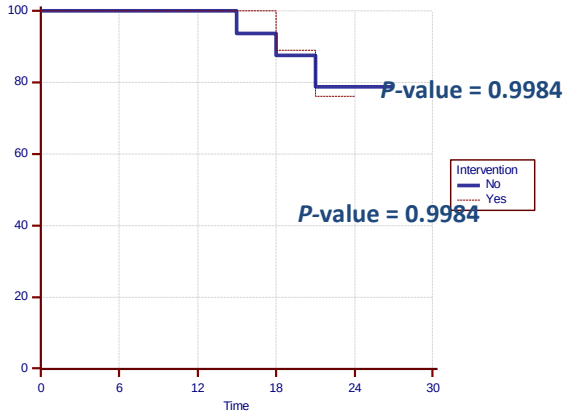


Figure 7: Kaplan-Meier curve shows the correlation between the success rate and previous intervention

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إصلاح ضيق مجرى البول الامامى بإستخدام الغشاء المخاطى المبطن للفم

لقد مر إصلاح ضيق مجرى البول خلال النصف الثانى من القرن العشرين بمراحل مختلفة ابتداءً من اصلاح الضيق على مرحلتين ثم الترقيع بانسجة من اماكن مختلفة من الجسم ثم عن طريق استخدام السدائل الجلدية وفى النهاية الترقيع بإستخدام الغشاء المخاطى المبطن للفم (مخاطية الشدق). وعُوداً كبيرة تقع اليوم على عاتق الهندسة الوراثية والطب التجديدي، ومع ذلك لكى يعرف إلى أين نحن ذاهبون ، غالبا ما يكون من المفيد أن نعرف أين كنا.

ولقد لاقى استخدام مخاطية الشدق فى السنين العشرون الاخيرة قبولاً كبيراً فى إصلاح ضيق مجرى البول وعيوب مجرى البول الخلقية.ومن مميزات مخاطية الشدق انها متوفرة فى جميع المرضى حيث يمكن اخذها من داخل الخد او من داخل الشفة السفلية. وايضاً فإنها تترك ندبة مخفية ، علاوة على ذلك ، فهى خالية من الشعر ولها خصائص نسيجية مميزة مما يساعد على التصاقها وثباتها فى مكانها الجديد فى مجرى البول.

وتهدف هذه الرسالة المستقبلية هو تقييم إستخدام مخاطية الشدق فى إصلاح ضيق مجرى البول الامامى جراحياً.ولقد تمت الدراسة على ٣٠ مريضاً مِن مَن يعانون ضيقاً بمجرى البول الامامى اكثر من ٢ سم. وتم إجراء الجراحات بقسم جراحة المسالك البولية بجامعة الزقازيق فى الفترة من يوليو ٢٠٠٩ الى يونيو ٢٠١٢. وتم تقييم الضيق فى جميع المرضى بإستخدام الاشعة الصاعدة بالصبغة على مجرى البول واثناء التبول.

وكانت النتيجة ان نسبة النجاح العامه هى ٨٣,٣٣ % . ولوحظ ان المرضى الذين لم تنجح لهم الجراحة كانوا يعانون من ضيق بمجرى البول اكبر من ٥ سم. ولم تكن هناك مضاعفات خطيرة فى الفم نتيجة اخذ جزء من الغشاء المخاطى المبطن للفم.

وبالتالى فإن الغشاء المخاطى المبطن للفم هو رقعة ممتازة لإستخدامها فى إصلاح ضيق مجرى البول الامامى.