



ONCOLOGY/RECONSTRUCTION
ORIGINAL ARTICLE

Twin penile skin flap, is it the answer for repair of long anterior urethral strictures?

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KEYWORDS

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ABBREVIATIONS

LS, lichen sclerosis;
 Q_{max} , peak urinary
flow rate;
VIU, visual internal
urethrotomy

Abstract Objective: To present our twin ventral penile skin flap technique for the management of complex long anterior urethral strictures not caused by lichen sclerosis (LS), with evaluation of surgical outcome and complications.

Patients and methods: We retrospectively reviewed patients diagnosed with long complex anterior urethral strictures who were all referred to Ain Shams University hospital and operated on by three reconstructive surgeons. The surgical procedure was carried out as follows: exposure of the urethra through a ventral longitudinal penile skin incision and another perineal incision; two ventral longitudinal dartos-based penile skin flaps are used for urethral augmentation as onlay flaps. Clinical data were collected in a dedicated database. Preoperative, intraoperative, and postoperative follow-up data for each patient were recorded and analysed. A descriptive data analysis was performed.

Results: Between January 2012 and February 2015, 47 patients diagnosed by urethrograms as having long anterior urethral strictures, with a mean (SD, range) length of 17.56 (2.09; 14–21) cm, were managed by twin penile skin flap repair. Four patients were lost to follow-up, thus 43 patients constituted the study cohort. The mean (range) follow-up period was 31 (22–36) months. The overall success rate was 95.35% (41/43). At 12-months postoperatively, the 41 successful cases had a mean (SD, range) peak urinary flow rate of 20.26 (3.06, 14–25) mL/s and American Urological Association Symptom Score of 5.6 (1.85, 3–8). Postoperative complications included urethrocutaneous fistula in three patients (6.97%), mild sacculation of the flap in seven patients (16.52%), post-micturition dribbling in 34 patients

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(79.07%), decreased penile girth in two patients (4.65%), and chordae of $< 15^\circ$ with no need for repair in three patients (6.97%).

Conclusions: In the presence of a favourable urethral plate and ample non-hirsute penile skin, one-stage twin penile skin flap urethroplasty provides excellent results for non-LS related complex strictures, with minimal acceptable complications. It proved to be especially efficient in circumcised patients.

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Introduction

Repair of long anterior urethral strictures has always been a challenge for urologists. Surgical options include one-stage or two-staged procedures, using either single or multiple tissue transfer, which ranges between mucosal or extragenital skin grafts and genital skin flaps.

Choosing an appropriate surgical technique is influenced by the location, length, depth, and availability of healthy non-hirsute genital skin, previous repair, and surgeon's experience [1]. As the field of urethral reconstruction has developed there has been an upward trend towards one-stage repair [2].

Advantages of the use of penile skin include its non-hirsute nature, proximity to the urethra, length, flexibility, versatility, and good vascularity, even in recurrent cases. It is a good alternative especially if buccal mucosa cannot be used, e.g. in patients with oral leucoplakia. Earlier reports have proven that penile skin is a reliable urethral substitute, particularly when the dorsal urethral plate can be preserved [3]. Even in previously circumcised men good cosmetic results can be attained using penile skin. However, lichen sclerosis (LS) is a contraindication to repair using genital skin as in our opinion it affects extragenital skin as well.

Preputial and various penile skin flaps, such as longitudinal flap, the 'hockey stick' flap, and the circular penile fasciocutaneous flap based on dartos have been used for penile urethral reconstruction. After Orandi [4] first described a longitudinal penile skin flap for single-stage urethroplasty in 1968, the technique has been the most popular method of repair for anterior urethral strictures. Quartey [5] used the same principle and described a ventral flap with a dorsal or circumferential 'hockey stick' extension, which could provide a length of up to 13 cm to repair long urethral strictures with a success rate of 90%.

A transverse penile island flap was used by el-Kasaby et al. [6] in 1986 for repair of hypospadias, also a distal circumferential/circumpenile flap, devised by McAninch and Morey [3] in 1993, became one of the most versatile flaps, which provides a full circular non-hirsute skin flap up to 12–15 cm in adults. For synchronous urethral strictures, the flap may be divided into two pieces and/ or passed under a scrotal tunnel to reach up to the prox-

imal urethra; this technique had a 79% success rate. The Q-flap is a modification of the circumferential flap extended ventrally in order to gain additional length for use in panurethral strictures. [7].

Our new technique is based on the use of a modified Orandi's longitudinal penile skin flap for the repair of long anterior urethral strictures (14–21 cm). This is achieved by the use of twin longitudinal ventral penile skin flaps, each flap is dartos based on one side of the ventral longitudinal penile incision. Its main advantage is that it can be used in repair of long strictures in which buccal mucosa is not sufficient to augment the whole stricture length, even if both cheeks and lower lip mucosae are harvested.

Patients and methods

Between January 2012 and February 2015, 47 patients with complex long anterior urethral strictures of variable aetiologies were recruited for single-stage repair using a twin penile skin flap technique. Four patients were lost to follow-up, thus 43 patients constituted the study cohort. The mean (SD, range) age was 38.37 (10.17, 19–58) years. Patients with LS were excluded after clinical examination and biopsy from the penile skin and external meatus in suspected cases. Patients with a urethral calibre of $< 8F$ were also excluded. All patients were circumcised. The presence of ample non-hirsute penile skin was a mandatory prerequisite in all patients; it has to be sufficient for the flaps and tension-free closure of the penile incision. The causes of the strictures included: 12 post-traumatic (27.9%), 12 iatrogenic (27.9%), 11 (25.6%) idiopathic, and eight were inflammatory in origin (18.6%). In 30 patients (69.8%), stricture involved the fossa navicularis and in 13 patients (30.2%) it was spared. In all, 15 patients (34.9%) had recurrent strictures after various procedures and 28 patients (65.1%) had non-recurrent strictures (Table 1). The mean (SD, range) stricture length was 17.56 (2.09, 14–21) cm.

A detailed history was taken and a full clinical examination of the external genitalia was performed. All patients underwent a retrograde urethrogram, voiding cystourethrogram (VCUG) in patients who could void, uroflowmetry, and AUA Symptom Score assessment.

Table 1 Characteristics of the strictures in the study cohort.

Characteristic	N (%)
Cause	
Traumatic	12 (27.9)
Iatrogenic	12 (27.9)
Idiopathic	11 (25.6)
Inflammatory	8 (18.6)
Involvement of fossa navicularis	
Involved	30 (69.8)
Not involved	13 (30.2)
Recurrent	
Recurrent	15 (34.9)
Non-recurrent	28 (65.1)

Data were analysed using the Statistical Package for the Social Sciences (SPSS®) version 18.0 (SPSS Inc., IBM Corp., Armonk, NY, USA). Quantitative data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequencies and percentages. A paired sample *t*-test was used when comparing related samples. A $P < 0.05$ was considered to indicate statistical significance.

Surgical technique

The operation was performed under general anaesthesia, with the patient in standard lithotomy. Penile hair is not shaved until the hair line is marked to ensure that the harvested flaps are of non-hirsute skin. After sterilisation and draping, under anaesthesia we spare a 3-cm width of ventral skin and try to approximate lateral skin virtual lines of incisions using non-toothed forceps. If it is not under tension we proceed. The urethral meatus is inspected and calibrated. A Nelaton catheter 16–20 F is introduced until the distal end of the stenosed segment. A ventral longitudinal penile skin incision is made along the estimated stricture site (Fig. 1). The fascia dartos is incised and dissected down to the urethra. Another perineal incision is made to expose the bulbar urethra.

Then ventral longitudinal stricturotomy is carried out guided by a lacrimal probe and previously injected methylene blue, the mucosa of the urethral plate is marked with 4-0 polyglactin 910 (Vicryl®, Ethicon Inc., Somerville, NJ, USA) stay sutures on each side. Stricturotomy is continued proximally through the perineal incision until healthy urethra of adequate calibre (24–26 F) is reached. The stricture length is then measured with the penis fully stretched.

A longitudinal ventral penile skin flap of 1.5-cm width is marked on one side of the incision, limited by the coronal sulcus distally and the hair line proximally (Fig. 1). The flap is then dissected *in situ* by creating a plane between the skin and dartos fascia laterally, dissection is continued until a good plane is developed



Fig. 1 Marking of the ventral incisions and flaps.

sufficient for free mobilisation of the flap medially to augment the floor of the incised urethral plate, and also for tension-free penile skin closure. The flap is sutured to a full thickness of urethral plate as an onlay flap in the presence of a Nelaton catheter 22–24 F using 4-0 polyglactin 910 continuous running sutures supported by interrupted full-thickness sutures, which also give better haemostasis (Fig. 2). Suturing is carried on proximally short of the end of the flap.

A twin longitudinal ventral penile skin flap is marked on the contralateral side of the penile incision. Four 4-0 polyglactin 910 stay sutures are placed to mark the angles of the flap, which is then elevated based on the dartos fascia with careful dissection laterally in one plane between the penile skin and dartos fascia and another plane between the dartos and Buck's fascia, in order to have a freely mobile flap based on a tension-free pedicle. A release incision is made at the upper border of the dartos pedicle, to allow tension-free mobilisation of the flap to the perineal incision (Fig. 3). The flap, which is based on penile and scrotal dartos, is then rotated so that its distal end is mobilised to the proximal end of the stricture, rotation makes the distal end of the

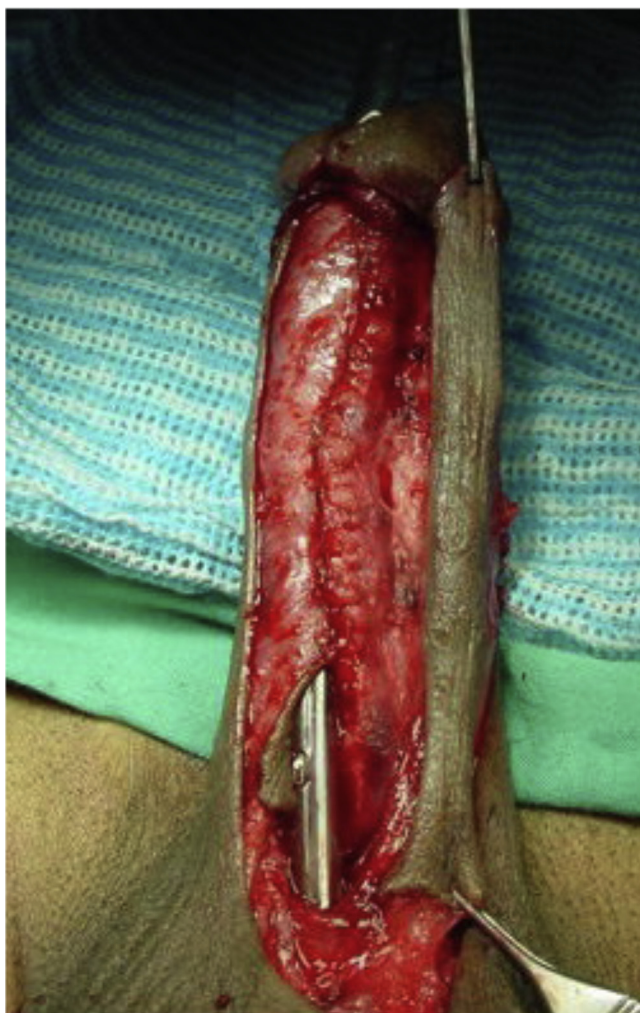


Fig. 2 First onlay flap augmenting distal end of the stricture.

flap reach the proximal stricture end easily and this rotation did not show any vascular impairment of the flap, which retained its viable colour throughout the procedure. On the contrary, trying to move the flap as a whole, putting its proximal end to the proximal stricture end, requires extensive dissection of the pedicle to gain length and needs an even deeper release incision of the upper border of the flap pedicle, which would impair blood supply significantly (Fig. 4). The flap is mobilised through a tunnel underneath the scrotum, and sutured to the edge of urethral plate using continuous 4-0 polyglactin 910 sutures starting at the proximal end (Fig. 5).

At the site of anastomosis of both flaps, their ends are trimmed and the anastomosis is fashioned obliquely to avoid anastomotic stricture between the twin flaps (Fig. 6). The Nelaton catheter is replaced by a silicone Foley catheter after suturing of the flaps to the urethral plate and before skin closure.

A second covering layer from the remaining dartos is used to cover the suture line. Then the penile skin is sutured with interrupted 5-0 polyglactin 910 sutures.



Fig. 3 Dissection of the second flap and release incision of its pedicle.

The perineal incision is closed in layers with a suction drain placed for ≥ 48 h. An 18-F silicone urethral catheter is left *in situ* and the suprapubic catheter is placed if the patient already had one, this was done in early cases but later it became routine to use a suprapubic catheter in all patients. Fig. 7 shows both penile and perineal incisions.

Patients were on average discharged with catheter on the fourth or fifth postoperative day. The urethral catheter was removed after 3 weeks when a pericatheter urethrogram showed no extravasation.

With subjective improvement, urethrogram, uroflowmetry and AUA Symptom Score were repeated at 3- and 12-months postoperatively, and every year thereafter for 3 years, and if re-stenosis was suspected at any time during follow up.

A successful procedure was defined as objective and subjective improvement in urinary flow, absence of evidence of stricture on radiographic assessment, and no further need for urethral instrumentation.

Results

Four patients were lost to follow-up, thus 43 patients were evaluated. No major intraoperative complications were encountered and no blood transfusions were needed. The mean (range) follow-up was 31 (22–36) months.

The pericatheter urethrogram at 3 weeks revealed extravasation in four patients, in three of them at the anastomotic site between the two flaps, and in one at



Fig. 4 Second flap is passed to perineal incision through a tunnel beneath the scrotum.

the proximal anastomosis. All extravasations resolved by leaving the catheter for another week. After catheter removal, all patients voided with good streams. Two patients (4.65%) had a decreased stream of urine (one of them had extravasation in the pericatheter urethrogram), with a weak stream occurring during the first 3 months of follow-up. In one patient, his urethrogram showed narrowing at the site of anastomosis of the two flaps. However, this patient showed solid improvement after a single visual internal urethrotomy (VIU) with no need for further intervention. In the other patient, his urethrogram showed a recurrent stricture of ~5 cm in length and was planned for another repair at 6 months postoperatively.

Postoperative complications included: urethrocutaneous fistula in three patients (6.97%), mild sacculation of the flap in seven patients (16.52%), post-micturition dribbling in 34 patients (79.07%), and decreased penile girth reported by two patients (4.65%), but at 3 months after surgery penile girth looked normal in all patients.

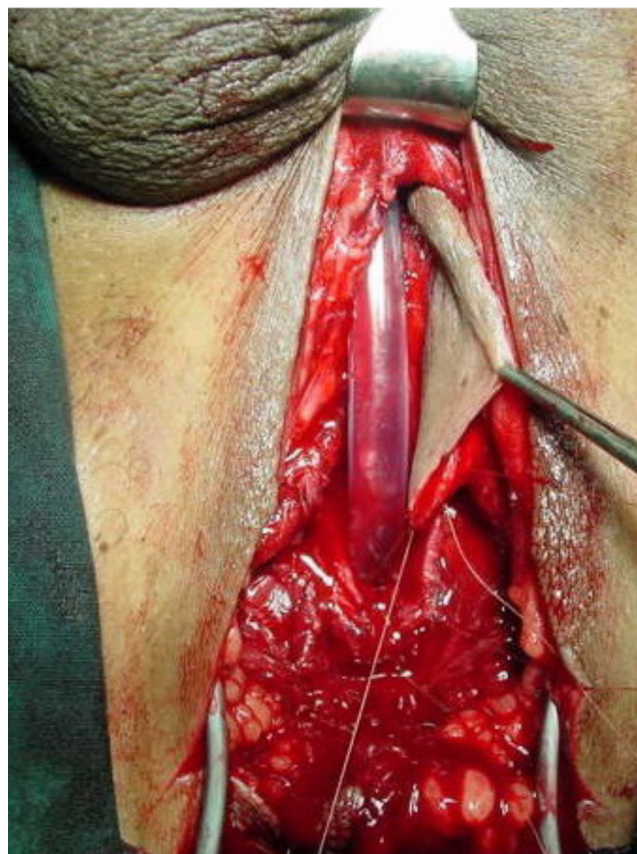


Fig. 5 Suturing of the second flap starting at the proximal end of the stricture.

Chordae of $< 15^\circ$, with no need for repair, occurred in three patients (6.97%).

A successful outcome was achieved in 41 patients in whom the mean (SD, range) peak urinary flow rate (Q_{max}) was 20.53 (3.39, 13–25) mL/s and AUA Symptom Score was 5.56 (1.61, 4–8) at 3 months after surgery. At 12-months postoperatively, the mean (SD, range) Q_{max} was 20.26 (3.06, 14–25) mL/s and AUA Symptom Score was 5.60 (1.85, 3–8) (Table 2). The overall success rate was 95.35% (41/43) and 2.32% (one of 43) showed a sustained good voiding stream after a single VIU. Fig. 8 shows preoperative and postoperative urethrogram in a successful case.

Discussion

Reconstructive surgery of the urethra has always been a challenging procedure. Several techniques have been described for urethroplasty with wide variability in the extent of technical complexity. However, extensive surgeon experience can minimise the complications of such urethral reconstruction [8].

The management of such strictures was initially managed by staged repairs. The initial salvage procedure for non-LS complex anterior urethral strictures was a ‘staged’ Johansen approach [9], in which the urethra is



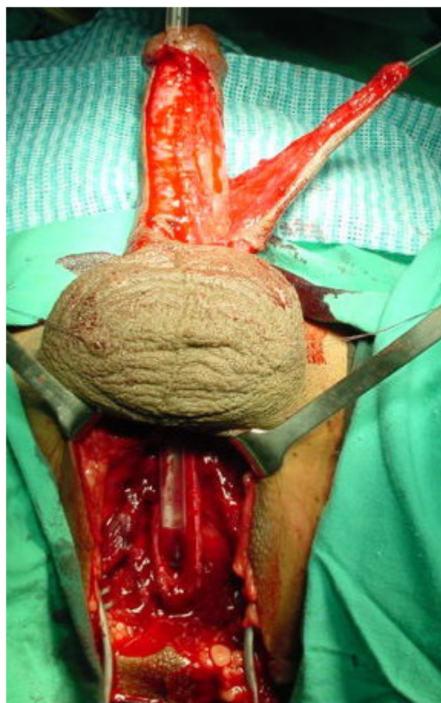
Fig. 6 Oblique anastomosis of the two flaps.

opened and marsupialised to penile skin, and then tubularised after 3–6 months around a suitable sized catheter. Thus, Johansen urethroplasty is considered one of the simplest procedures. However, as the field of urethral reconstruction developed there was a move towards the use of free grafts or flaps for single-stage urethroplasty [10].

Penile/preputial flaps emerged as a reasonable option for substitution urethroplasty, when Orandi [4] introduced this principle in 1968. It provides the advantages of rich vascularity, malleability, and achievability. It is an ideal option for long strictures in the distal urethra [11–13]. It has thus become our first choice for the one-stage repair of strictures of the penile urethra. It maintains its pliability postoperatively with little tendency for shrinkage and re-stricture. The main limitation of its usage is the availability of adequate non-hirsute penile skin.

The mean stricture length in our present study was 17.56 cm, which precluded the use of other penile skin-flap techniques, as we stated before that our patients were circumcised. The overall success rate was 95.34% with a few acceptable complications. In our present study, postvoid dribbling occurred in 34 patients (79.07%), with the need to squeeze the penis for complete evacuation. One patient developed anastomotic stricture between the two flaps, this was one of our early cases and was subsequently avoided by trimming the ends of the flaps at the site of anastomosis to be fashioned obliquely.

In comparison to our present technique, Kulkarni et al. [14–16] in 2000 first described a new full-length



(a)



(b)

Fig. 7 Penile and perineal incisions: (a) during surgery and (b) after closure.

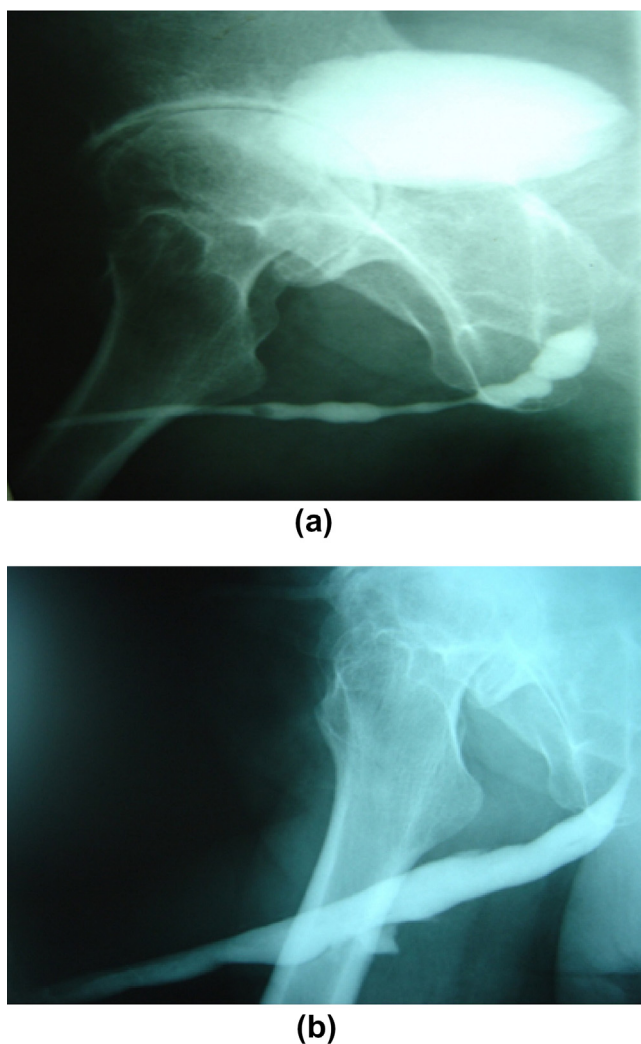


Fig. 8 Preoperative (a) and 3-months postoperative (b) retrograde urethrograms in a 50-year-old man with a severe long anterior urethral stricture.

one-stage oral mucosal graft urethroplasty, with a reported success rate of 91% of patients in a preliminary study that included 36 patients with panurethral strictures due to LS. Dubey et al. [17] performed Kulkarni's operation in 25 patients with panurethral strictures caused by LS and reported success in 88% of patients.

In another study, Brady et al. [18] reported their experience with single-stage buccal mucosal urethroplasty combined with other techniques in 24 patients, of whom 10 had LS, with pendulous urethral strictures with a mean (range) stricture length of 7.65 (1–19) cm. They reported an 87.5% success rate at a mean follow-up of 26.6 months.

In 1998, Mcaninch and Morey [3] used a penile circular fasciocutaneous flap for one-stage urethroplasty for long segment and complex urethral strictures in 66 men. The mean (range) stricture length in their series was 9.08 (4–24) cm. In 54 patients, onlay procedures were performed, whilst 12 others underwent flap

Table 2 Patients' characteristics before and after urethroplasty.

Characteristic	Mean (SD, range)	Paired <i>t</i> -test	
		<i>t</i>	<i>P</i>
Age, years	38.37 (10.17, 19.00–58.00)		
Stricture length, cm	17.56 (2.09, 14.00–21.00)		
Q_{max}, mL/s			
Preoperative	5.12 (1.35, 0.90–7.00)		
3 months postoperatively	20.53 (3.39, 13.00–25.00)	29.521	<0.001*
12 months postoperatively	20.26 (3.06, 14.00–25.00)	31.341	<0.001*
AUA Symptom Score			
Preoperative	30.00 (2.52, 26.00–35.00)		
3 months postoperatively	5.56 (1.61, 3.00–8.00)	63.855	<0.001*
12 months postoperatively	5.60 (1.85, 3.00–8.00)	54.925	<0.001*

tubularisation for urethral substitution. Tissue transfer was carried out in 18 patients, including a proximal graft for a panurethral stricture in nine and excision and re-anastomosis for a focally dense stricture in nine. The initial success rate was 79%.

On the other hand, Wessells et al. [19] used multiple tissue transfer in the repair of complex anterior strictures using either fasciocutaneous flap combined with buccal mucosal graft, bladder mucosal graft and skin graft, or combined end-to-end anastomosis proximally with penile skin flap distally or augmented Russell urethroplasty. In 25 patients, the overall success rate was 88%.

Our present results showed a solid improvement in Q_{max} and AUA Symptom Score at 3- and 12-months postoperatively. Q_{max} significantly improved at 3- and 12-months postoperatively (both *P* < 0.001; Table 2). Furthermore, the AUA Symptom Score significantly improved at 3- and 12-months postoperatively (both *P* < 0.001; Table 2).

By using the twin penile skin flap for the management of complex long anterior urethral strictures, we addressed several points. Firstly, the availability of enough non-hirsute penile skin, then that the use of this technique is amenable for circumcised patients. Also the use of the twin penile skin flap in the repair of pan-anterior strictures provides an adequate and reliable source of tissue for urethral substitution, with no need for multiple tissue transfer from different sites. In other words, the procedure is accomplished using the same incisions. The limitations of this technique are absence of sufficient healthy penile skin, severely scarred penile skin, urethral strictures with a calibre of < 8 F, and LS.

The authors' extensive experience with the use of penile flaps in urethroplasty has made it a reasonable

and feasible approach for repair of long complex anterior urethral strictures in absence of LS.

However, the present study still has some limitations. One is its relatively short follow-up period. Another limitation is its retrospective nature and the small sample size included. Thus, it is recommended to apply this technique in a larger sample of patients with a longer follow-up period.

Conclusions

In the presence of a favourable urethral plate and ample non-hirsute penile skin, one-stage twin penile skin flap urethroplasty provides excellent results for non-LS-related complex strictures. With minimal acceptable complications, it proved to be efficient especially in circumcised patients and when patients lack suitable oral mucosa [20]. Nevertheless, it needs long-term follow-up to assess its durability as an objective solution for such patients.

Conflict of interest

None.

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