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ORIGINAL ARTICLE

Staged transverse preputial island flap urethroplasty for proximal hypospadias: a single-center experience

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Abstract

Purpose To evaluate the intermediate outcomes of our institution's experience with staged TPIF urethroplasty for proximal hypospadias repair.

Methods We retrospectively evaluated the medical records of patients who underwent repair of proximal hypospadias using staged TPIF urethroplasty at our hospital from 2011 to 2017.

Results One hundred and two patients were included in the present study. The mean follow-up was 52.4 months (range 13–74 months). The mean age at the time of the first surgery was 13.5 months (range 11–65 months). There were two main types of initial complications including meatal stenosis in four (3.9%) and urethrocutaneous fistula in three (2.9%) patients after the first stage. Surgical complications were seen in 15 patients after second stage, including urethrocutaneous fistulas in 8 (7.8%), urethral strictures in 5 (4.9%), urethral diverticula in 2 (1.9%). Overall complication rates after second stage were 14.7%. The incidence of fistulas was lower in patients who underwent repair with a tunica vaginalis flap (1/29, 3.4%) than with the dartos fascia (7/73, 9.6%; $p = 0.435$).

Conclusions Our results show that staged TPIF urethroplasty is a viable and durable technique for primary severe proximal hypospadias. This procedure was associated with a 14.7% complication rate in the present study. Staged TPIF urethroplasty can reduce the incidence of urethral strictures and diverticula associated with the second stage.

Keywords Hypospadias · Two-stage repair · Complication

Introduction

Hypospadias is one of the most common congenital anomalies in males. Despite the evolution and improvement of surgical techniques used for treatment of hypospadias, the best approach for treatment of proximal hypospadias has not been standardized. Complications of hypospadias is usually associated with the presence and degree of ventral curvature, the location of the meatus, and the quality (width and depth) of the urethral plate. Several recent studies have shown higher complication rates than previously reported for proximal hypospadias, ranging from 30 to 68% [1–4].

Chen et al. first reported their preliminary experience with staged transverse preputial island flap (TPIF) urethroplasty in patients with proximal hypospadias. The overall complication rate was only 7.1%, with two patients developing a fistula and one with a diverticulum requiring a secondary procedure [5]. The follow-up duration is important because complications of primary hypospadias repair often present late in the clinical course [6–8]. In the present retrospective study, we report our institution's experience with staged TPIF urethroplasty for the repair of proximal hypospadias.

Materials and methods

We retrospectively evaluated the medical records of patients who underwent repair of proximal hypospadias using staged TPIF urethroplasty at our hospital from 2011 to 2017. Four different surgeons performed this technique.

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Proximal hypospadias was defined as proximal penile, penoscrotal, or perineal hypospadias based on the location of the urethral meatus. The exclusion criteria were repair at another hospital, the presence of distal hypospadias, and lack of completion of the second stage of the procedure.

Urethroplasty complications were defined as any problem that required surgical correction. Urethroplasty complications included meatal stenosis, fistula, urethral stricture, and urethral diverticulum. Meatal stenosis was defined as meatal narrowing smaller than 8 Fr. Urethral stricture was defined as obstructive voiding symptoms and calibration < 8 Fr. Diverticulum was defined as visible ballooning of the neourethra while voiding.

Surgical technique

In the first stage, a circumferential incision preserving urethral plate was made. Then we degloved the penile skin completely to excise the whole ventral bands (Fig. 1a). The presence of chordee was evaluated by inducing artificial erection. When the penis could not be straightened because of severe chordee, the urethral plate was transected. If residual curvature remained, dorsal midline plication was performed to achieve a straight penis. Then, a 12-mm-wide rectangular flap was harvested from the inner aspect of the dorsal prepuce (Fig. 1b), and the mobilized foreskin was rolled into a tube over a catheter and closed with running 6/0 monofilament sutures. The tube should be calibrated to an 8F silicone catheter. Subsequently, the glans channel was then created adequately in size, and the neourethra was transposed ventrally and brought through the channel (Fig. 1c). The distal meatus was attached to the top of the glans with interrupted fine sutures (Fig. 1d). The base of the proximal end of the preputial tube was anastomosed with the underlying corporal body. Then, Byar's flaps were created (Fig. 1e) and swung ventrally to cover the ventral defect between the original hypospadiac meatus and distal neourethra (Fig. 1f). A 6/0 absorbable multifilament suture

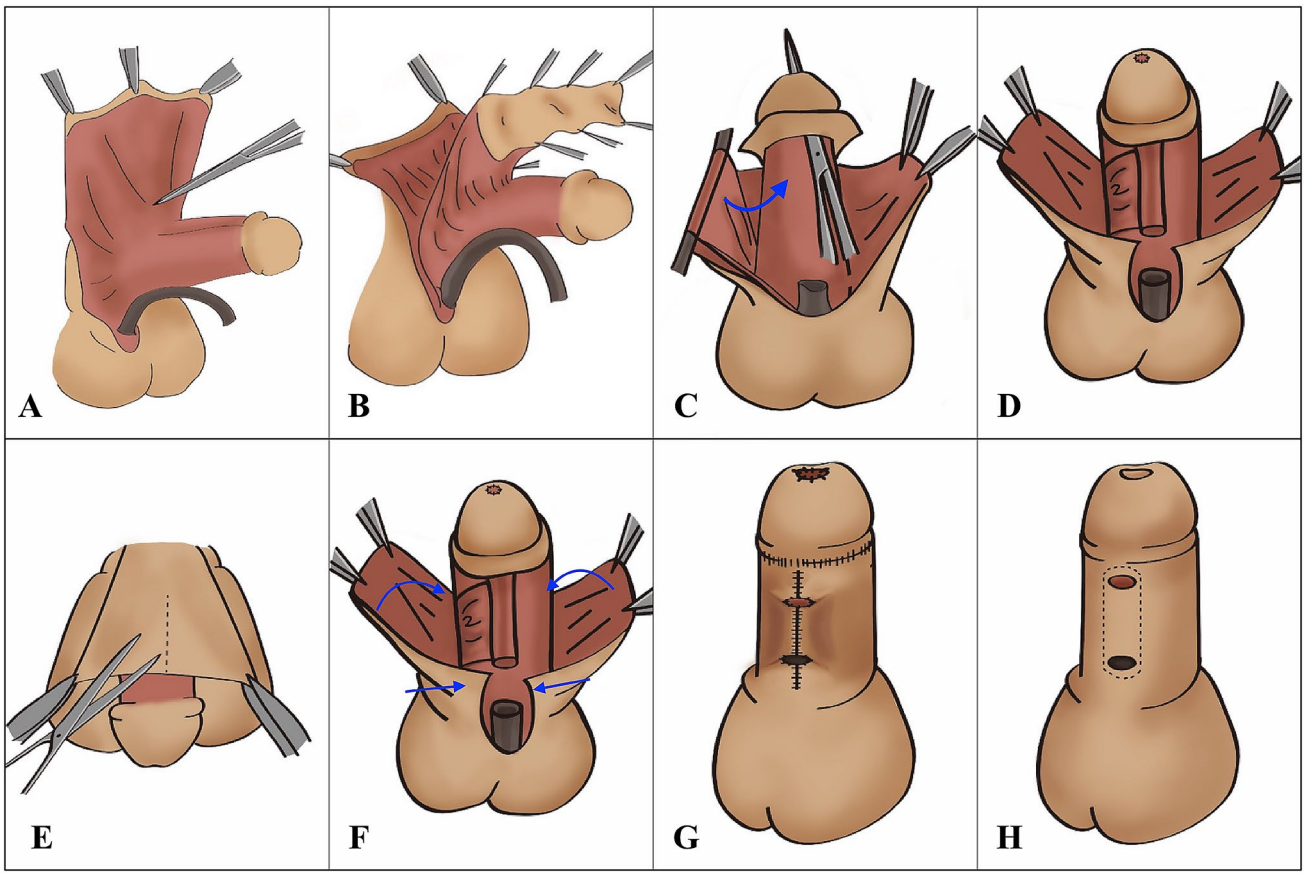

Fig. 1 Intraoperative photos: **a** the penile skin is degloved to the root of the penis. **b** Rectangular flap is harvested from the inner aspect of the dorsal prepuce. **c** The mobilized foreskin is rolled into a tube over a catheter. The neourethra is transposed ventrally and brought through the channel. **d** The neourethra is brought through the channel and the distal meatus is attached to the top of the glans with interrupted fine sutures. **e** Byars flaps are created. **f** Byars flaps cover neourethra and the ventral defect between the original hypospadiac meatus and distal island flap neourethra. **g** Appearance right after first stage. **h** In the second stage, a 12–15 mm wide strip is designed that extended from the hypospadiac meatus up to the distal neourethra

was applied for closure of the subcutaneous tissues. The remaining skin was brought together in the midline to cover the neourethra (Fig. 1g). A 6–8 Fr silicone catheter is left in place through the distal neourethra and the proximal hypospadiac meatus all the way into the bladder for 7–10 days postoperaively. Prophylactic antibiotics were administered until the catheter was removed.

The second stage of the procedure was usually carried out 6–12 months later. The Thiersch–Duplay technique was used to repair the remaining proximal urethral defect. Incision lines were marked, and a 12- to 15-mm-wide strip was designed to extend from the hypospadiac meatus up to the distal neourethra (Fig. 1h). The neourethral plate was incised to a depth that extended to Buck's fascia, followed by tubularization over an A6F/8F silicone catheter. Closure of the urethral plate was achieved with running 6/0 absorbable monofilament sutures. If a tunica vaginalis flap was selected, one testis was brought out through the same incision. The tunica vaginalis was incised and then brought over the neourethra through the subcutaneous tunnel. The subcutaneous tissue was placed along the neourethra with interrupted sutures in layers over the repair site without tension. The catheter was withdrawn 10 days postoperatively.

Follow-up protocol

All patients were required to visit our clinic at 3 months postoperatively, 12 months routine after the surgery and, if possible, at puberty. Patients were advised to visit our clinic with the latest voiding video. Follow-up assessment was essentially based on evaluation of micturition by parents and the surgeon, but not on the routine calibration or uroflowometry. When suspected urethral strictures, calibration was performed in general anesthesia.

Results

A total of 134 patients who underwent staged TPIF urethroplasty were identified. Of those, 102 patients had followed up more than 1 year after surgery were included. Of the 32 patients, 13 lost follow-up and 19 reviewed in one clinic appointment and remained in follow-up. This study included 102 patients with a mean follow-up of 52.4 months (range, 13–74 months). Of the 102 patients who underwent staged TPIF urethroplasty, 29, 56, and 17 had proximal penile, penoscrotal, and perineal hypospadias, respectively. Preoperative and postoperative data for the patients are summarized in the Table 1.

There were two main types of initial complications, urethrocutaneous fistula in three (2.9%) patients and meatal stenosis in four (3.9%) patients after the first stage. Urethrocutaneous fistulas were all repaired during the second stage. In three patients with meatal stenosis, dilatation was performed, and further meatotomy was necessary in only one patient.

Table 1 Patients characteristics

Location of meatus	Number of patients
Proximal penile	29
Penoscrotal	56
Perineal	17
Surgical aspects	Mean (range)
Age at first stage, months	13.5 (11–65)
Age at second stage, months	25.5 (21–78)
Time between stages, months	12.0 (8–14)
Follow-up, months	52.4 (13–74)

Table 2 Complications for staged TPIF

Type of complication	Number of patients (%)
Surgical complications after stage I	
Fistula	3 (2.9%)
Meatal stenosis	4 (3.9%)
Total complications	7 (6.9%)
Surgical complications after stage II	
Fistula	8 (7.8%)
Urethral stricture	5 (4.9%)
Diverticula	2 (2.0%)
Total complications	15 (14.7%)

Surgical complications were seen in 15 patients after the second stage, including urethrocutaneous fistulas in 8 (7.8%), urethral strictures in 5 (4.9%), and urethral diverticula in 2 (1.9%) patients. Overall complication rates after the second stage were 14.7% (Table 2). All urethral strictures were treated successfully with one or more dilatations, and none required more complex surgical resolution.

On univariate analysis, age at the time of surgery, meatus location (proximal penile, penoscrotal or perineal), and use of tunica albuginea flap during the second stage did not predict complications (Table 3).

The neourethra was covered by a tunica vaginalis flap in 29 (33.3%) patients in the second stage. The incidence of fistulas was lower in patients who underwent repair with a tunica vaginalis flap (1/29, 3.4%) than with the dartos fascia (7/73, 9.6%; $p = 0.435$).

Discussion

Whether one- or two-stage urethroplasty is a more suitable technique for treating proximal hypospadias with severe chordee remains controversial. In the 1960s and 1970s,

Table 3 Univariable analysis of complication predictor

Variable	Complication		*P*
	No	Yes	
Number of patients, *N* (%)	87 (85.3)	15 (14.7)	
Meatal location			0.341
Proximal penile	27 (26.5)	2 (2.0)	
Penoscrotal	47 (46.1)	9 (8.8)	
Perineal	13 (12.7)	4 (3.9)	
Mean age at first surgery (mos)	13.1	13.8	0.096
No. tunica vaginalis (%)			0.751
No	73 (71.6)	10 (9.8)	
Yes	29 (28.4)	5 (4.9)	

two-stage repair was considered the standard. Duckett popularized the transverse preputial island flap in 1981; since then, preputial skin flaps have been described for single-stage hypospadias repair [9]. However, this method is now favored by few pediatric urologists because of high complications rate and long learning curves. A systematic review of 20 years of publications on severe hypospadias repair suggests that the overall complication rates after preputial island tubes were 37.9% [10]. A worldwide survey revealed that two-stage repair for proximal hypospadias was preferred by 43.3–76.6% of respondents [11]. The shift in interest from single-stage to staged repair is the result of improvements in complication rates and cosmetic outcomes.

Urethrocutaneous fistula was the most common complication in our patients, occurring in 7.8% of patients, which was lower than the rates reported in the literature [10]. The explanation is that a shorter urethral defect may predict a lower complication rate in patients with hypospadias. Staged TPIF urethroplasty involves repairing the distal urethral defect with tubed flaps, followed by application of Byar's flaps to cover the residual ventral urethral defect between the neourethra and the original hypospadiac orifice in the first stage; the second stage is equal to repairing a fistula. Another explanation is that we prefer the tunica vaginalis flap when there is lack of waterproof tissue covering the neourethra in the second stage. In our series, the incidence of fistula formation in patients who underwent repair with a tunica vaginalis flap was only 3.4%. In agreement with the findings of Snodgrass et al. and Pierre et al. the tunica vaginalis flap showed excellent results as an intermediate layer to cover the neourethra [12, 13]. A systematic review of recent studies suggested that the tunica vaginalis flap should be the first-line therapy for recurrent cases and fistula repairs, and it is particularly well suited for the repair of large or multiple fistulas [14]. The incidence of fistula formation was slightly lower in patients who underwent repair with a tunica vaginalis flap (1/29, 3.4%) than with the dartos fascia (7/73, 9.6%; $p=0.435$). The failure to reach statistical significance may have been due to the low overall incidence of fistula formation in our study. In some patients in the present study, however, the residual urethral defect was longer than expected; this result was associated with a scarce preputial flap used for tissue reconstruction in the first stage and scar contracture of the distal neourethra before the second stage.

Our urethral stricture rate of 4.9% is lower than the reported rate of 12.5% in a systematic review [10]. As reported in the literature, urethral strictures were mainly caused by a circular anastomosis between the neourethra and the native urethra in patients undergoing the single-stage (Duckett) procedure. With respect to prevention of urethral stricture, Huang et al. described a modified TPIF urethroplasty technique involving trimming the two ends of the flap into a V shape and anastomosing them with the spatulated urethra proximally and urethral plate distally before tubularization [15]. In staged TPIF repair, the Thiersch–Duplay technique could decrease the urethral stricture rate if a semicircular anastomosis is created during the first stage of the procedure. Attention should be drawn to a careful examination of the distal neourethra at the beginning of the second stage. We routinely performed urethral calibration for inspection of the presence of meatal stenosis or distal neourethral stricture.

From experience, the majority of the patients with diverticula have normal urethral calibration without apparent distal urethral obstruction. A diverticulum has been proposed to be secondary to the distensible neourethral tissue, lack of support tissue and high voiding pressure from the tighter distal glans [16, 17]. The staged TPIF still voids through the original meatus after the first stage, thus reducing the risk of backpressure and shock from the high flow of urine on the distal reconstructed neourethra in the early postoperative period. It provided more time for the reconstructed neourethra to develop a more stable binding with the corpora than those cases repaired by single-stage tube flap, which was one explanation to prevent diverticula formation [18, 19].

The major limitation of our study is its retrospective nature. The technique was performed by four different surgeons, and the choice of a tunica vaginalis flap was largely determined by the surgeon's preference and practice. There may be underreporting of complications compared with other studies because late complication could become visible long after the initial surgery. The real incidence of diverticula in the present study may be underreported because the follow-up time may not be sufficiently long for diverticular formation, especially for staged TPIF. Moreover, the patients with diverticula are most likely to seek medical attention due to an obstruction phenomenon, while some asymptomatic diverticula may be overlooked when the follow-up was stopped.

Last, we have only highlighted the data regarding surgical complications. Lack of follow-up into puberty prevents us

from obtaining information regarding sexual function, psychological outcomes, and penile cosmetic evaluation, thus limiting the estimation of the final outcomes. Future research should focus on these questions in our institution.

Conclusions

Our results show that staged TPIF urethroplasty is a viable and durable technique for primary severe proximal hypospadias. This procedure was associated with an 14.7% complication rate in the present study. Staged TPIF urethroplasty can reduce the incidence of urethral strictures and diverticula associated with the second stage.

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Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interests regarding the publication of this paper. All authors have received grants from Beijing Children's Hospital.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

Informed consent No informed consent has been collected since it is a retrospective study.

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