



Urethral plate in tubularized incised plate urethroplasty: how wide is enough?

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Background: Previous reports found that a preincision urethral plate (UP) width <8 mm increased the occurrence of urethroplasty complications (UCs) in tubularized incised plate (TIP) hypospadias repair. However, is the classification of the UP width based on an 8 mm cut-off value to predict the outcome of TIP urethroplasty objective enough or universally applicable? The purpose of our study was to assess the effect of the UP width on the outcomes of TIP hypospadias repair in the Eastern population we served.

Methods: We retrospectively reviewed the records of patients who underwent TIP hypospadias repair by the same surgeon between August 2013 and December 2019 in our hospital. Data were collected, including demographics, intrinsic parameters of the penis, surgical parameters and subsequent surgical outcomes. The data were analyzed and the cut-off value of the UP width was calculated using a receiving-operator curve.

Results: Primary TIP urethroplasty was carried out in 116 patients with a mean age of 35.89 ± 29.40 months. The meatal location was distal in 49 patients, midshaft in 56 patients and proximal in 11 patients. The mean glans width was 12.28 ± 1.36 mm, the mean UP width was 5.74 ± 1.37 mm, the mean neourethral length was 1.96 ± 1.32 cm, and the mean operation duration was 87.52 ± 11.47 min. During a median follow-up of 42 (range: 6 to 80) months, UCs developed in 12 patients, and the UP width was significantly related to the occurrence of UCs ($P=0.014$). According to the 6 mm cut-off value of the UP width by the receiver operating characteristic curve, patients were divided into two groups. Group A (UP width ≥ 6 mm) included 69 patients, and Group B (UP width <6 mm), 47 patients. UCs occurred in 3 patients in Group A vs. 9 patients in Group B, $P=0.010$.

Conclusions: UP width is a potential risk factor for UCs after TIP hypospadias repair. Using this technique with an UP width ≥ 6 mm is sufficient to result in a good outcome of hypospadias repair.

Keywords: Tubularized incised plate (TIP); hypospadias; urethral plate (UP); urethroplasty complications (UCs)

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Introduction

The goal of hypospadias repair should be to achieve a normal-looking penis with good function and to reduce the occurrence of urethroplasty complications (UCs) postoperatively. Since Snodgrass described tubularized incised plate (TIP) urethroplasty in 1994 (1), this technique has

gradually become the most common method for hypospadias repair with preservation of the urethral plate (UP).

As the name implies, the outcomes of TIP urethroplasty depend on the condition of the UP. In this century, two reports found that a preincision UP width <8 mm increased the occurrence of UCs in TIP hypospadias repair (2,3). However, is the classification of the UP width based on

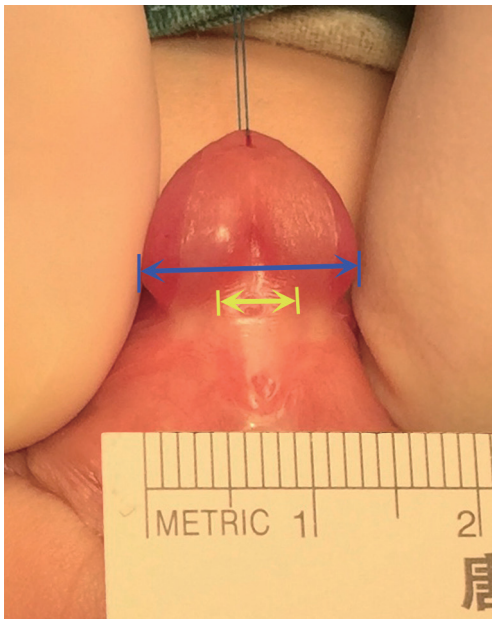


Figure 1 Measurements of glans width (blue line) and urethral plate width (yellow line).

an 8 mm cut-off value to predict the outcome of TIP urethroplasty objective enough or universally applicable? On the basis of predecessors, targeting the Eastern population we served, we reviewed our experience in TIP hypospadias repair and evaluated the effect of the UP width on the outcome of this technique.

We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/tau-20-1243>).

Methods

Patients who underwent TIP hypospadias repair by the same surgeon between August 2013 and December 2019 in the Urology Department, Children's Hospital of Fudan University, Shanghai, China, were retrospectively analyzed. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approved by the Ethics Board of the Children's Hospital of Fudan University [No. [2019]208}. Due to the retrospective nature of the study, individual consent was waived. Patients with proximal hypospadias found to have a ventral curvature $>30^\circ$ after degloving and dartos dissection were excluded from the study. Patients who had been operated on for hypospadias repair before and patients who had received

exogenous testosterone before were also excluded.

Data were collected, including demographics, intrinsic parameters of the penis, surgical parameters and subsequent surgical outcomes. Intrinsic parameters of the penis included the meatal location after cutting the membrane urethra, glans and UP width. Measurement was made at the widest point of the glans and UP using a flexible sterile ruler, as described by Holland (2). When measuring, the UP should be stretched horizontally to be flat (Figure 1). Surgical parameters included the neourethral length and operation duration.

All patients underwent the TIP procedure after measurement of various intrinsic parameters of the penis. After degloving and dartos dissection, if a mild ventral curvature (between 10° and 30°) remained, dorsal midline plication was performed to correct it. The bilateral edges of the UP were incised along the marked line from the true meatus to the distal margin, dissecting deeply down to the corpora cavernosa. The two wings of the glans were carefully expanded to at least the 3 and 9 o'clock positions of the penis, even the 2 and 10 o'clock positions in some cases, as described by Snodgrass (4).

With the help of an assistant, the UP was incised along the midline from within the meatus to the top edge, also reaching deeply down to the corpora cavernosa. Urethroplasty was carried out in two subepithelial layers using 7-0 polydioxanone with running sutures. The neourethra was covered with a single dartos flap harvested from dorsal preputial skin. Glansplasty was performed with two interrupted subepithelial sutures with 6-0 polyglactin approximating the glans wings without tension. A silicone Foley catheter (6–10 Fr) was used for urinary drainage in all patients, and then the surgical area was bandaged with gauze.

All patients were discharged with a urinary catheter on the third postoperative day after removal of the gauze and examination of the wound. The urinary catheter was removed between the 10th and 12th postoperative days at the outpatient department.

All postoperative patients were followed-up regularly at 6 weeks, 6 months, 1 year and annually. The UCs included any of the following during follow-up: fistula, glans dehiscence, diverticula, meatal stenosis, and urethral stricture. Glans dehiscence was defined as complete separation of the glans wings resulting in a coronal meatus. Meatal stenosis or urethral stricture was diagnosed by both obstructive voiding symptoms and calibration <8 Fr in infants or <10 Fr in older boys. Cystoscopy was performed

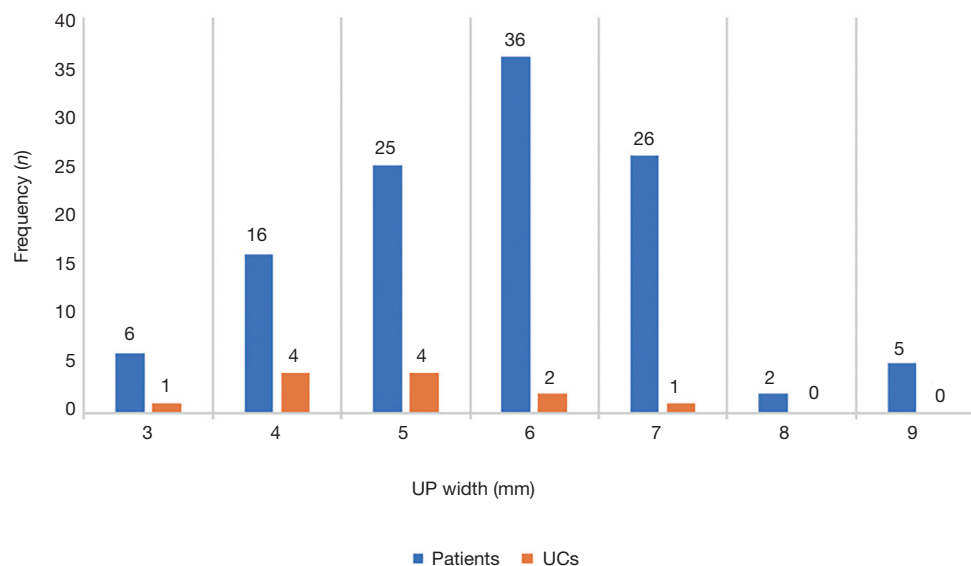


Figure 2 Frequency of patients and urethroplasty complications (UCs) for different urethral plate (UP) widths.

for further confirmation when managing meatal stenosis or urethral stricture.

Another experienced pediatric urologist made the diagnosis of UCs, and all the complications were managed by the original surgeon.

Statistical analysis

All analyses were carried out using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Univariate analysis with a Chi-squared or t test was used to assess possible risk factors for UCs, and the difference between two groups was distinguished by the cut-off value of the UP width. The cut-off value of the UP width was further analyzed by ROC analysis. All tests were two-sided, and P values <0.05 were considered significant.

Results

During the study period, the single surgeon (Dr. Zhang) performed TIP hypospadias repair for 134 individuals, in which, 18 patients were excluded because of exclusion criteria. A total of 116 patients were enrolled in this study at a mean age of 35.89 ± 29.40 months. The meatal location was distal in 49 (42.24%) patients, midshaft in 56 (48.28%) patients and proximal in 11 (9.48%) patients. The mean glans width was 12.28 ± 1.36 mm, the mean UP width was 5.74 ± 1.37 mm, the mean neourethral length

was 1.96 ± 1.32 cm, and the mean operation duration was 87.52 ± 11.47 min. The UP width was ≥ 8 mm in only 7/116 (6.03%) patients.

During a median follow-up of 42 (range 6 to 80) months, UCs developed in 12 patients (10.34%) and consisted of fistula in 8 (6.90%), glans dehiscence in 3 (2.59%) and meatal stenosis in 1 (0.86%). No diverticula or urethral stricture was observed in any case.

A univariate analysis of the possible risk factors for UCs is shown in *Table 1*. Age at operation ($P=0.633$), meatal location ($P=0.759$), glans width ($P=0.409$), neourethral length ($P=0.675$) and operation duration ($P=0.110$) had no impact on the occurrence of UCs. However, the UP width was significantly related to the occurrence of UCs ($P=0.014$).

Figure 2 shows the frequency of patients and UCs for different UP widths. ROC analysis was used to determine the value of the UP width, with area under the curves of 0.719. According to the Youden index, the cut-off value was 5.5 mm. Due to the precise unit when measuring, 6 mm cut-off value of the UP width was finally determined. Accordingly, patients were divided into two groups: Group A (UP width ≥ 6 mm) and Group B (UP width < 6 mm) (*Table 2*). Group A included 69/116 (59.48%) patients, and Group B included 47/116 (40.52%) patients. Between the two groups, the differences were not statistically significant in age at operation ($P=0.153$), meatal location ($P=0.075$), glans width ($P=0.126$), neourethral length ($P=0.957$) and operation duration ($P=0.111$). Therefore, the surgical

Table 1 Univariate analysis of the possible risk factors for urethroplasty complications

	Total (n=116)	No UCs (n=104)	UCs (n=12)	P
Age at operation (month)	35.89±29.40	35.44±29.86	39.75±25.87	0.633
Meatal location (n)				0.759
Distal	49 (42.24%)	45	4	
Midshaft	56 (48.28%)	49	7	
Proximal	11 (9.48%)	10	1	
Glans width (mm)	12.28±1.36	12.24±1.38	12.58±1.08	0.409
UP width (mm)	5.74±1.37	5.85±1.38	4.83±0.84	0.014
Neourethral length (cm)	1.96±1.32	1.98±1.39	1.81±0.49	0.675
Operation duration (min)	87.52±11.47	88.10±11.73	82.50±7.54	0.110

UCs, urethroplasty complications.

Table 2 Parameters and urethroplasty complications correlated to urethral plate width

	Group A (n=69), UP width ≥6 mm	Group B (n=47), UP width <6 mm	P
Age at operation (month)	39.12±34.72	31.15±18.47	0.153
Meatal location (n)			0.075
Distal	35	14	
Midshaft	29	27	
Proximal	5	6	
Glans width (mm)	12.43±1.60	12.04±0.83	0.126
Neourethral length (cm)	1.97±1.67	1.95±0.53	0.957
Operation duration (min)	86.12±12.89	89.57±8.71	0.111
UCs (n)	3	9	0.010

UCs, urethroplasty complications; UP, urethral plate.

outcomes of Group A and Group B were comparable. UCs occurred in 3/69 (4.35%) patients in Group A vs. 9/47 (21.3%) patients in Group B, P=0.010.

Discussion

Hypospadias is always a concern because of its high incidence, occurring in 1 in 200 to 1 in 300 live births (5,6). Surgical repair is the only way to treat hypospadias and is recommended for functional, psychological, and cosmetic reasons (7). The aim of hypospadias repair is the creation of a straight penis with a slit-like meatus at the tip of the glans (8). Because of its relatively simple surgical concepts, low UC rates, and good cosmetic outcome, the

TIP procedure, which was described by Snodgrass in 1994, has gained worldwide acceptance for distal and midshaft hypospadias repair (9,10). This technique of urethroplasty is recommended even for more severe hypospadias and reoperation cases (11).

The essence of the TIP procedure lies in the fact that urethroplasty does not require any other urethral substitutes, such as inner prepuce flap, oral mucosal graft, scrotal flap, etc., but only the original urethral tissue. Therefore, compared with other surgical methods, the TIP procedure depends more on the development of the UP. In recent years, many studies have reported on the UP characteristics in the success of TIP hypospadias repair. Holland *et al.* first reported that a pre-relaxing incision UP

width <8 mm predicted an increased risk for fistulas after distal TIP urethroplasty, which occurred in all patients with this plate diameter (2). Subsequently, Sarhan *et al.* also found that the UP characteristics had a nonsignificant impact on the complication rate except for the plate width and recommended that an adequate UP width (8 mm or greater) was essential for successful TIP repair (3). Other studies reported that the UP characteristics have no effect on the outcome of TIP hypospadias repair. Because of the low complication rate after TIP urethroplasty regardless of the urethral plate configuration or width, the TIP procedure promoted by Nguyen *et al.* is potentially applicable in all cases of primary distal hypospadias (12). In a series of 224 primary TIP repairs reported by Bush and Snodgrass (13), 86% of the UP widths were <8 mm, remarkably higher than the 37.5% reported by Holland (2) and 48.8% reported by Sarhan (3). However, they found that the UP width before incision did not increase the occurrence of UCs. Rather, they confirmed that a glans width <14 mm increases the likelihood of complications.

Penile dimensions vary among different ethnicities, and penis size is generally slightly smaller in Chinese patients than in Western patients (14–17). Ru *et al.* reported in their study of 442 Chinese boys who underwent TIP hypospadias repair that the mean age was 2.8 years, the mean glans width was 13.9 mm, and the mean UP width was 5.3 mm (18). From our data in this study, the mean age was 35.89 months, the mean glans width was 12.28 mm, and the mean UP width was 5.74 mm, similar to what Ru reported. Current guidelines consider the optimal age for hypospadias repair to be somewhere between 6 and 18 months, depending on the severity and the need for multiple procedures (19). Does this mean that TIP repair is not suitable for Eastern boys with hypospadias, or is it necessary to wait until boys are old enough such that their penis size is sufficient for surgery? Our data must be retrospectively analyzed to evaluate the potential risk factors in relation to UCs after TIP hypospadias repair.

One major survey involving a review of English literature from Medline/PubMed over 13 years reported that the UC rate of the TIP procedure ranged from 0 to 50% with a median rate of 7.3% (20). Published results for more than 2,000 patients who had undergone TIP urethroplasty for primary hypospadias repair have been summarized, and the mean UC rate after TIP repair was 10.8% (21–23). In our study, the overall UC rate was 10.34%, almost identical to that reported in the literature above. This similarity means that TIP hypospadias repair is still suitable for

Eastern boys, even though the penis size is not sufficient. We also found that the occurrence of UCs after TIP repair was not correlated with age, meatal location, glans width, neourethral length or operation duration but only with UP width. Sarhan *et al.* also analyzed the effect of the suturing technique on the UC rate (3). Although they proved that the suture technique had no influence on the outcome of TIP urethroplasty, we unified the suture technique used for all patients to avoid this potential risk factor.

In our study, the mean UP width was 5.74 mm, which was similar to the 6 mm reported by Bush (13) and 5.3 mm reported by Ru (18) but remarkably smaller than the 8 mm reported by Sarhan (3). Meanwhile, the UP width was ≥ 8 mm only in 7/116 (6.03%) patients. Obviously, classification of the UP width based on an 8 mm cut-off value to predict the outcome of TIP urethroplasty, first described by Holland (2), is not universally applicable. Nevertheless, we tried to use a 6 mm cut-off value based on the frequency of patients and UCs for different UP widths. In fact, our results indicated that UCs after TIP urethroplasty occurred more often in patients with UP widths of less than 6 mm ($P=0.010$). Bush *et al.* emphasized that the UP width did not require consideration as long as the TIP incision was sufficiently deep (13). However, Eassa *et al.* completed an experimental animal study and declared that the average gain in UP width after the midline relaxing incision was only 2 mm (24). Accordingly, we may need to consider the narrow UP and use different surgical methods to improve the success rate of surgery and reduce postoperative complications. Kolon *et al.* (25) and Asanuma *et al.* (23) both recommended dorsal inlay graft urethroplasty (DIGU) to effectively reduce the risk of UC in hypospadias repair with small glans and narrow UP, which make tubularization difficult. However, some other surgeons preferred to use the onlay island flap (OIF) technique in these cases (26,27).

According to the literature, different from our measurement of UP, there were also several useful methods of UP quality assessment in TIP urethroplasty. Ru *et al.* reported the width proportion of the urethral plate to the glans (U/G) was an appropriate evaluation for urethral plate quality in TIP repair (18). In addition, Abbas *et al.* recommended a Plate Objective Scoring Tool (POST) score for the objective assessment of UP characteristics (28). The advantage of this method was that it had a high degree of inter and intra-observer reliability.

Our study has limitations. While the UP width was mainly studied, we did not entirely assess factors such as

the type of hypospadias because of the small sample size. We hope that after expanding the sample size, making a stratified study may be more convincing. Meanwhile, it is a retrospective study. The parameters measurement during the surgery was completed by the same surgeon which resulted in observer bias. In the future, we need a multi-center prospective study to verify our results.

Conclusions

Based on our findings, the UP width is a potential risk factor for UCs after TIP hypospadias repair. Using this technique with an UP width ≥ 6 mm is sufficient to result in a good outcome of hypospadias repair. Furthermore, when the UP width < 6 mm, other choices, such as the DIGU or OIF technique, may be better to improve the results of hypospadias repair.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/tau-20-1243>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approved by the Ethics Board of the Children's Hospital of Fudan University [No. [2019]208]. Due to the retrospective nature of the study, individual consent was waived.

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