

Running Head: The UPW effect on TIP repair of distal penile Hypospadias

The effect of Pre-Incision Urethral Plate Width and Glanular Width on The Outcome of Tubularized Incised Urethral plate repair surgery in Distal Penile Hypospadias, A prospective study

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Key words: glans width (GW); hypospadias; hypospadias objective penile evaluation [HOPE]; tubularized incised plate (TIP) repair; urethral plate width (UPW).

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ABSTRACT

Purpose: To determine hypospadias repair's cosmetic and functional outcome concerning the urethral plate width and glanular width.

Materials and Methods: A prospective study including 38 patients. The urethral plate width (UPW) was measured preoperatively. The cosmetic outcome was evaluated by hypospadias objective penile evaluation [HOPE] score, and the urinary stream evaluated functional outcome. We included boys with distal penile hypospadias and excluded recurrent cases with severe chordee. All patients were operated on by Snodgrass tubularized incised plate repair (TIP); they were followed up for one year. Success was defined as slit-shaped meatus at the tip of the glans without fistula.

Results: The mean age of surgery was 4.5 ± 2.1 years. UPW was < 8 mm in 24 patients (63.2 %) (Group A), while 14 patients (36.8 %) (Group B) had a UPW ≥ 8 mm. Overall, the mean \pm SD of UPW was 4.84 ± 1.29 mm. The mean \pm SD of GW was 9.52 ± 1.56 mm. Overall success was documented in 35/38 patients (92.1 %). **No significant relation was founded between the complications and UPW of the patients (p -value = 0.7).** Overall, the mean \pm SD HOPE score was 39.1 ± 8.83 . **A significant relation was found between the cosmetic outcome of the two groups and the HOPE score (p -value = 0.02).**

Conclusion: The pre-incision urethral plate width and glanular width were not correlated with the TIP outcome. A better HOPE score is associated with a wide urethral plate.

INTRODUCTION

For the last two decades, tubularized incised urethral plate procedure (TIP) for repairing distal penile hypospadias has been the foremost common method at numerous institutions. In any case, a few downsides counting meatal and/or neourethral stenosis and the requirement for standard urethral dilatation have been recorded (1). The preservation of the urethral plate and the increase in the surface area with healthy epithelium give better outcomes (2).

TIP is a procedure that is more dependent on urethral plate quality in comparison with other surgical procedures. The plate quality is generally regarded as one of the intrinsic risk factors influencing the outcome of hypospadias repairs. However, there is currently no clear agreement on the evaluation of the urethral plate (3)

The urethral plate width was classified based on an arbitrary 8-mm cut-off value, while groove depth was graded as deep, moderate, and shallow. However, is the arbitrary value of 8 mm suitable for all penis sizes? (4).

Generally, urethral plate width increases with penis size as the patient grows. It might be more appropriate to evaluate urethral plate quality with a parameter scaled with penis size. In recent years, Glans–Urethral Meatus–Shaft score was proposed to classify the severity of hypospadias, providing a concise method for evaluating urethral plate quality (3, 5).

There is a debate regarding the effect of UPW and GW on post-operative complications post TIP surgery. Some reports have found that urethral plate (UP) widths < 8 mm before TIP incision increase urethroplasty complications (6).

While, Bush, N.C. and W. Snodgrass found that The UP width before incision did not increase urethroplasty complications. Surgeons do not need to measure or categorize the UP to determine suitability for TIP repair, as long as the plate incision was made deeply to the corpora. (7, 8)

Glans size didn't correlate with age in patients with hypospadias between 3 and 24 months old, supporting the decision to operate as early as three months in some centers. Small glans size, defined as width < 14 mm, is an independent risk factor for urethrocutaneous fistula (9).

To address this void, we aimed to answer a question, Are the UPW and GW controlling factors for hypospadias outcome regarding the functional and cosmetic outcome?

Materials and Methods:

Study population:-

After approval from Institutional Review Board, we conducted a prospective study that was carried out by the Urology department in Kafr Elsheikh University between November 2018 and November 2019. A total of 38 children diagnosed with distal penile hypospadias were included.

Inclusion criteria were distal penile hypospadias, primary, uncircumcised, no or mild chordee (less than 30°), aged < 10 years, no associated syndromes, and boys able and willing to comply with follow up schedule. ***We excluded boys*** who were recurrent, circumcised, with severe chordee.

A detailed description of the operation and expected complications were explained, and the parents signed written consents. Informed consent was obtained from a parent and/or legal guardian.

Procedures:-

A single pediatric urologist performed all operations. Preoperative intravenous antibiotic prophylaxis was given. A circumferential subcoronal incision was made proximal to the hypospadiac urethral meatus (Fig 1 a,b). The penis was degloved. A bilateral longitudinal incision was made along the urethral plate to prepare the glanular wings(Fig 1c,d). The flap was obtained from the inner dartos muscle and sutured overlying the incision line with 6/0 vicryl. The flap width and length were different in every case according to the location of the meatus, urethral plate characteristics, and depth of the midline incision. Urethroplasty was performed using 6/0 Vicryl continuous subcuticular then interrupted sutures and 2nd layer cover using dartos fascia flap (Fig

2a,b). Glanular approximation was done with 6/0 Vicryl (Fig 2c). A stent was kept for 7-10 days (Fig 2d).

Evaluation:-

All 38 patients were routinely followed up for cosmetic and functional results at three months intervals for one year. By routine examination of the external genitalia, evaluation of the voiding symptoms, uroflowmetry study was performed if possible, and it was repeated when the voided volume was insufficient or when the result was inconsistent with the physical examination and history.

The overall acceptable cosmetic appearance of the penis was decided according to the slit-like appearance of the neo-meatus; an independent blinded observer judged the straight position of the penis and this cosmetic aspect (Fig 3 a,b). Hypospadias Objective Penile Evaluation (HOPE) is a valuable tool for assessing the outcome (10). We used two medical interobserver, and the mean was taken. The glans width and UPW were measured using a ruler in mm, flow rate using a uroflowmetry device connected to the electronic sensor was measured in ml/sec.

Statistical analysis

Statistical analysis was performed with IBM Statistical Package for Social Sciences (SPSS) for Windows version 25.0 (Armonk, NY). Quantitative data were expressed as mean & SD, and qualitative data were expressed as numbers and percentages. The Chi-square test was used to compare qualitative data, and the independent t-test and paired t-test were used for quantitative data. Pearson's correlation coefficient was used to find the correlation between quantitative data.

Significance level was set to *P*-value < 0.05 for significant results

RESULTS

All 38 patients were followed up for one year. The mean age at surgery was 4.5 ± 2.1 years. Of the 38 patients who had their distal hypospadias repaired using TIP, eight patients (21.1 %) had glanular hypospadias, 15 patients (39.5 %) had coronal hypospadias, and 15 patients (39.5 %) had distal penile hypospadias (**Table 1**).

Overall, the mean \pm SD of UPW was 4.84 ± 1.29 mm. **24 patients (63.2 %)** (Group A) had a urethral plate width of less than 8 mm **while 14 patients (36.8 %)** (Group B) had a urethral plate width greater or equal to 8 mm. The mean \pm SD of GW was 9.55 ± 1.54 mm.

Functional outcome

The average urine flow rate (Q-max) of 38 patients was 7 ml/sec (5.3-10.3). 20 (83.3 %) patients in group A had good urinary stream (Single stream), which improved after six months and became 23 patients (95.8 %), while 12 patients (85.7 %) in (group B) had good urinary stream after 3 and 6 months post-operative. **There was no significant relationship between the good urinary stream and the mean UPW of the studied groups (p -value = 0.61).**

Cosmetic outcome

The cosmetic outcome was assessed using Hypospadias Objective Penile Evaluation (HOPE), as **shown in Table 3**. Overall, the mean \pm SD hypospadias objective penile evaluation (HOPE) score was 39.1 ± 8.83 . Group A patients had a mean HOPE score of 37.2 ± 6.4 SD, while Group B patients had a mean HOPE score of 42.4 ± 6.1 SD. **A significant relation was found between the cosmetic outcome of the two groups (HOPE score), and UPW of the patients with an increase in scores among cases had UPW \geq 8mm (p -value = 0.02).**

Post-operative complications

Early post-operative complication (Infection & Glanular dehiscence) occurred in 3 (7.9 %) patients; 1 (4.2 %) cases in group A developed early post-operative complications while 2 (14.3 %) cases in group B developed these complications. Meatal stenosis was developed in 6 (15.8%) patients (spray urinary stream and straining with urination); 4 (16.7 %) patients in group A, while 2 (14.3 %) cases in group B and they underwent serial urethral dilatation by a medical thermometer which improved after six months and became 3 (7.9 %) patients; 2 (8.3 %) in group A and 1 (7.14 %) in group B.

Late post-operative complications that required redo operation occurred in 3 (7.9 %) patients who developed small urethrocutaneous fistula; 2 (8.3 %) cases in group A developed late post-operative complications while 1 (7.14 %) case in group B developed these complications.

No statistical significance relation was found between the complications and the mean UPW of the patients (p -value = 0.7).

DISCUSSION

Hypospadias is an extremely common anomaly. Different procedures have been described for the adjustment of hypospadias since the presence of various hypospadias presentations. Be that as it may, no single technique had a 100 % satisfactory result. Hypospadias surgery goals include developing a urethra of sufficient caliber and length, orthotopic meatus at the tip of the glans permitting the patient to void in a straight stream without maddening spreading (11). Moreover, obtaining a conical glans and rearrangement of the dorsal skin provide a uniform ventral skin cover and correction of penile curvature to achieve proper sexual intercourse and effectively inseminate (12). Despite the recognition of the urethral plate as the tissue distinct from the glans and penile skin that would have formed the urethra and as having a well-vascularized connective tissue and its incorporation in hypospadias repair, an objective way of assessing the impact of the urethral plate on the outcome is yet to be established.

Snodgrass, in 1994, reported his own technique of tubularized incised plate urethroplasty (TIP) repair for distal hypospadias that gained widespread use for its perceived simplicity and good cosmetic outcomes in the majority of cases (10). Besides, 53.5% of 170 surgeons participating in an internet international-based survey done with a multiple-choice questionnaire on google forms comparing the outcomes of different surgical procedures prefer tubularized incised plate hypospadias repair (TIP) as the best method of surgery for simple distal hypospadias(13).

In the current study, we evaluated the effect of the width of the urethral plate and glanular width on the outcome of hypospadias repair. Most of our patients had Coronal and Distal penile hypospadias (30 patients 78.9 %), the same findings by Prat et al.; The reason for this is not clear but might be explained by the geographical location (14). We used 8 mm in the present study because urethral plate width 8 mm or greater is essential for the creation of adequate neourethra and successful hypospadias repair (16), Nguyen et al. (9) and Aboutaleb et al. (6) in their studies

also used 8 mm as the dividing line. **While** Da Silva et al. (15) in their study used 10 mm as the dividing line between narrow and wide urethral plates. The urethral plate of more than 8 mm is associated with good cosmetic outcomes (16, 17).

On the assessment of the functional outcome, there was no statistically significant difference between the two groups (p -value = 0.61). Our findings followed Nguyen et al., 2004 & Da Silva EA et al., 2014, who reported that the width of the urethral plate does not affect the functional outcome of hypospadias repair (9, 15).

However, other studies concluded that a narrow urethral plate is associated with a poor functional outcome such as poor urinary stream and complications such as meatal stenosis and urethrocutaneous fistula (17-19). This is related to the fact that there were confounding variables in their studies, such as penile size, glans shape, and vascularity of the prepuce, which were not separately analyzed. We did not assess the penile size, glans shape, and vascularity of the prepuce in the current study.

There was a statistical significance increase in HOPE score among cases which had UPW ≥ 8 mm compared to cases < 8 (P -value = 0.02) [There was a statistical positive correlation between HOPE score and UPW ($r = 0.41$, P -value = 0.02)]. These findings are in accordance with **Krull, Rissmann et al. 2018** who reported a significant correlation between the HOPE-Score and the outcome after hypospadias repair was observed. (15). **However, K E Chukwubuiké et al.;** in their study, found that the HOPE-Score after hypospadias repair may not be determined by UPW (16)

There was a diversity in the complications following hypospadias repair. It ranges from 6-30% (17, 18). The most common complication we recorded was the urethrocutaneous fistula. The

difference in surgical expertise may explain these differences in complication rates due to our department's low volume of hypospadias repairs per year.

In our study, on the assessment of the post-operative complications, there was no statistically significant difference between the two groups (**p-value = 0.7**). This finding agrees with the result from da Silva, E.A. et al.2014 as they found that UP width does not significantly affect the complication rate of TIP repair in distal hypospadias; (19)While, **Aboutaleb et al.**; reported a higher incidence in fistula in patients with narrow urethral plates when compared to those with wide urethral plate (6, 18)

Meatal stenosis could be blamed for distal obstruction predisposing to fistula formation, which could be resolved with urethral dilation. In our study, the meatal stenosis of 3 cases (2 cases in group A & 1 case in group B) resolved with urethral dilation that agrees with the result from A Elbakry, 1999 and Radojicic ZI et al., 2006 as they found that regular urethral dilatation is important in preventing adhesions between both sides of the incised plate, which could result in meatal stenosis and fistula (20, 21).

Though this study was a prospective study, it was limited by a small sample size that hindered the significant statistical difference detection in complications. Moreover, the outcome of repair, including complications done by a single surgeon, cannot be generalized as it depends on the surgeon's skills, among other factors.

CONCLUSION

The pre-incision urethral plate width and glanular width were not correlated with TIP outcome. A better HOPE score was associated with a wide urethral plate. However, the width of the urethral plate and glanular width may predict the functional outcome (urinary stream).

Accepted

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Ethical committee: - The article has been accepted by Kafr el sheikh faculty of medicine ethical committee in compliance with Ethical Standards

Ethical approval: All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research editorial boards and with the 1964 Helsinki Declaration and its later amendments and comparable ethical standards.

Consent to participate: Both written and verbal consent for participation in the study that involves an education and information exchange that takes place between the patients' parents and us.

Consent for publication: Formal consent was signed by the patients' parents to share and to publish their data in this research.

Availability of data and materials: The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request. Data was collected patient by patient with utmost accuracy. The data was collected in a paper form as we don't have electronic patient file system (PIS) or global health information system (HIS).

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Authors contributions:-

Dr M.G and Dr K.Z collect data of the article.

Dr D.T wrote the article.

Dr T.A and Dr H.N revised the article

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Tables' legends:-

	Title
Table (1)	Patients' demographic and clinical characteristics
Table (2)	Operation data among the studied cases
Table (3)	The outcome in relation to UPW

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Table 1. Patients' demographic and clinical characteristics.

<i>Variable</i>		<i>Distal hypospadias (N= 38)</i>	
Age "years" (mean ± SD)		4.5 ± 2.1	
Weight "Kg" (mean ± SD)		17.45 ± 3.94	
BMI (Kg/m ²)		16.06 ± 1.64	
Presentation	Abnormal EUM	38 (100%)	
ASA score	1	38 (100%)	
Un-Circumcised	Yes	38 (100 %)	
Congenital anomalies	Absent	38 (100%)	
Testis	Palpable	38 (100%)	
Meatal location	Glanular	8 (21.1 %)	
	Coronal	15 (39.5 %)	
	Distal penile	15 (39.5 %)	
urethral plate width (UPW)		4.84 ± 1.29	
urethral plate width	<8mm	24 (63.2%)	
	≥8mm	14 (36.8%)	
Urethral plate adequacy	Adequate	30 (78.9 %)	
	Deficient	8 (21.1%)	
Glans length (mean ± SD)		7.29 ± 1.64	
Glanular width (mean ± SD)		9.55 ± 1.54	
GW	<14 mm	36 (94.7%)	
	≥14 mm	2 (5.3%)	
Chordae (Ventral Curvature)	Present	10-30	3 (7.9 %)
		≤ 10	5 (13.2 %)
	Absent		30 (78.9%)

Data are presented as mean ± SD or number (percent)

SD: Standard deviation

Table 2. Operation data among the studied cases:-

Variable		Distal hypospadias (N= 38)		
Type of operation	TIP	38 (100%)		
Operation time "min" (mean ± SD)		133.82 ± 20.84		
New urethral tube	Yes	38 (100%)		
Covering flap	Dartos flap	38 (100%)		
Torniquite time "min" (mean ± SD)		79.61 ± 10.03		
Nerve block	No	38 (100%)		
Diathermy	No	7 (18.4%)		
	Yes (Bipolar)	31 (81.6%)		
Hospital stay "Days" (mean ± SD)		11.79 ± 1.73		
Urine Cath	Yes	38 (100%)		
Type	Nelton 6F	6 (15.8%)		
	Nelton 8F	25 (65.8%)		
	Nelton 10F	7 (18.4%)		
Urine PH	Acidic	38 (100%)		
UTI (Pre-operative)	No	26 (68.4%)		
	Yes	12 (31.6%)	E coli	7 (18.4%)
			Proteus	2 (5.3%)
			Klebseilla	1 (2.6%)
			Other	2 (5.3%)
Creatinine "mg / dL" (mean ± SD)		0.38 ± 0.17		
Hb pre "gm / dL " (mean ± SD)		11.73 ± 0.79		
Hb post "gm / dL " (mean ± SD)		11.22 ± 0.70		
P		< 0.001**		
HCT pre "%" (mean ± SD)		32.99 ± 0.55		
HCT post "%" (mean ± SD)		32.89 ± 0.49		
P		0.34 NS		

SD: Standard deviation P: Paired t test NS: non-significant (P > 0.05) **: highly significant (P < 0.001)

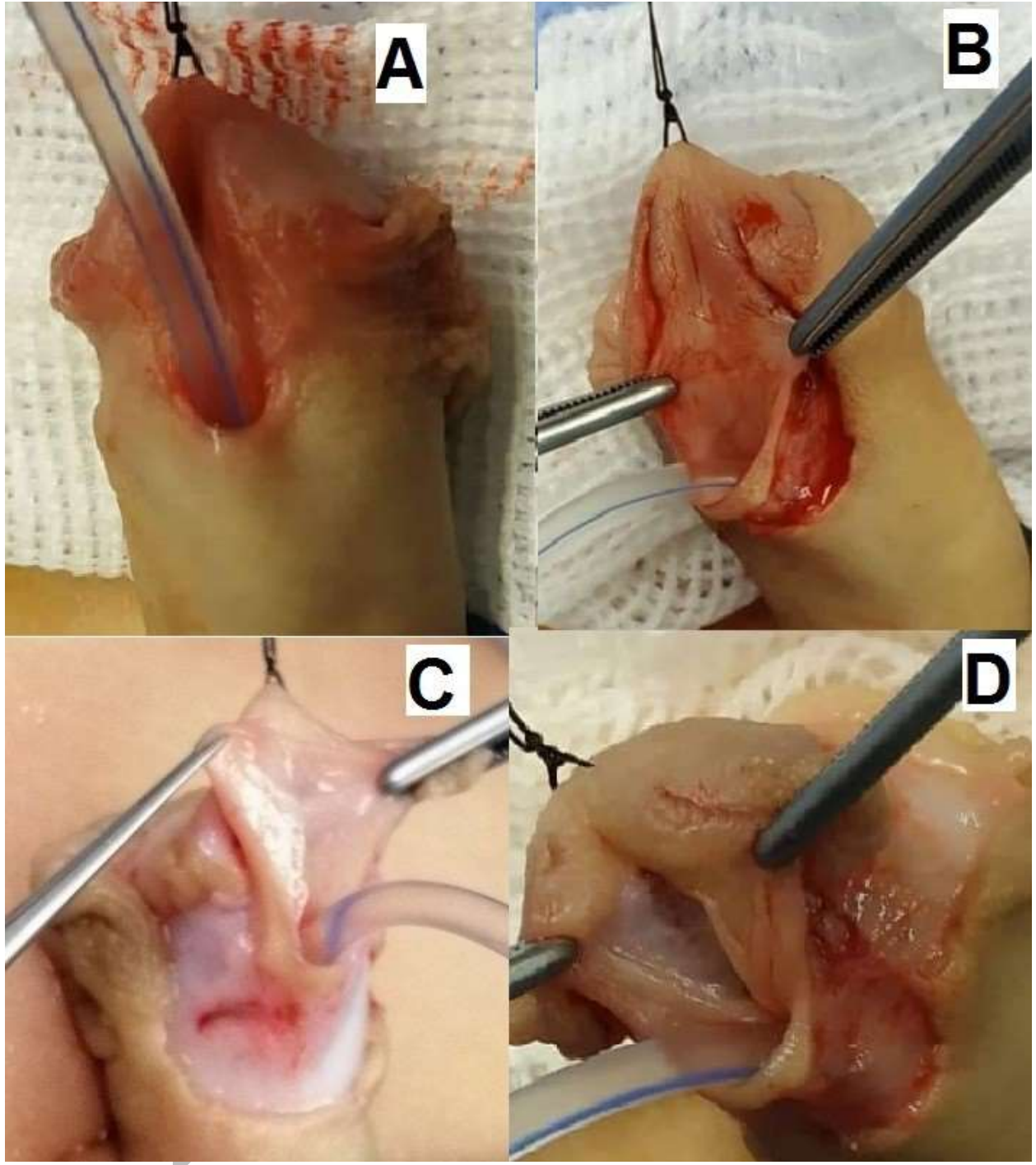
Table 4. Outcome in relation to UPW:

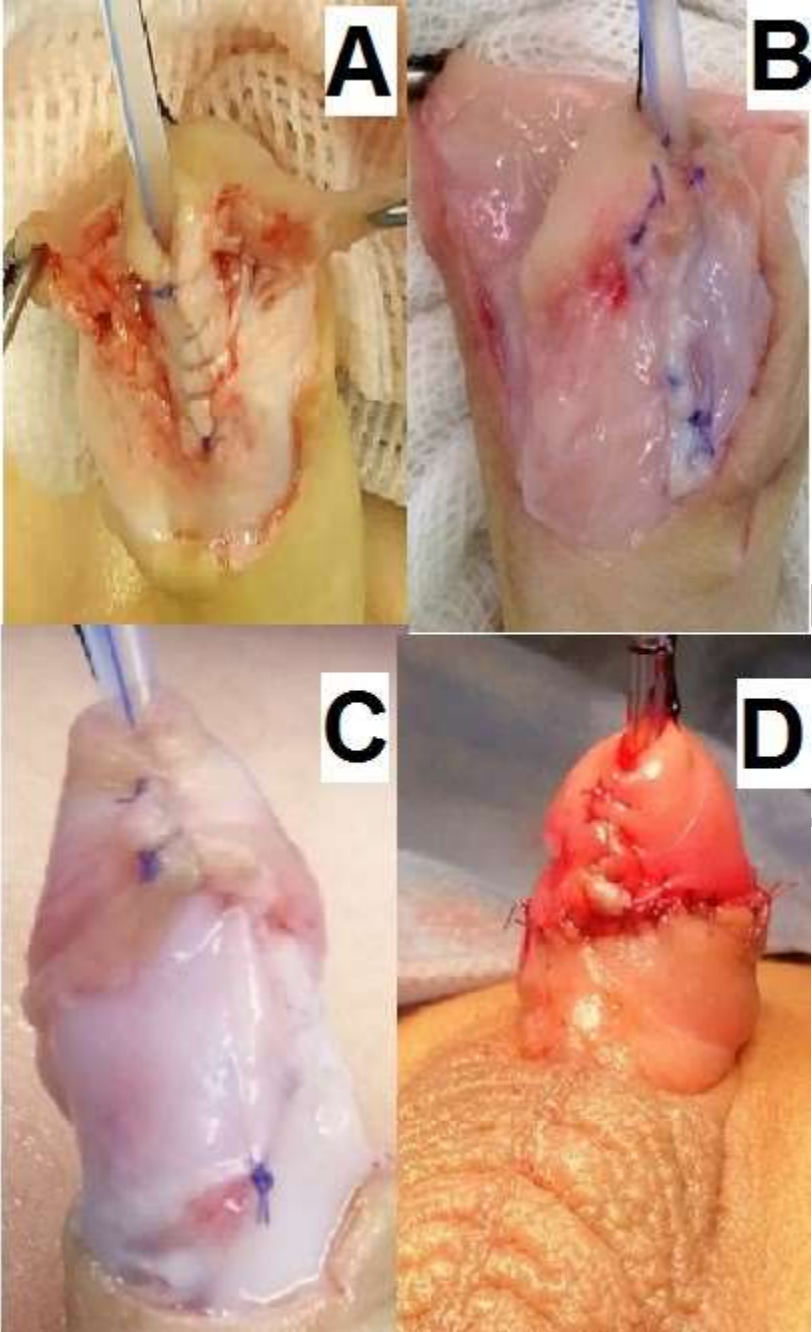
			UPW ≤ 8 mm (N= 24)	UPW ≥ 8 mm (N= 14)	χ²/t	m
Success	Failure		2 (8.3%)	1 (7.1%)	1.9	0.17
	Succeed		22 (91.7%)	13 (92.9%)		NS
Compli cations	Early	No comp	23 (95.8%)	12 (85.7%)	0.02	0.90
		Infection(Glanular dehiscence)	1 (4.2%)	2 (14.3%)		NS
	Late	No comp	22 (91.8%)	13 (92.9%)	0.01	0.99
		Meatal stenosis	2 (8.3%)	1 (7.1%)		NS
		UC fistula	2 (8.3%)	1 (7.1%)		
Slit like urethra			20 (83.3%)	12 (85.7%)	0.04	0.85 NS
Straight penis			20 (83.3%)	12 (85.7%)	0.04	0.85 NS
Skin shape	Normal		20 (83.3%)	12 (85.7%)	0.04	0.85
	Slightly abnormal		4 (16.7%)	2 (14.3%)		NS
Glans shape	Normal		20 (83.3%)	12 (85.7%)	0.04	0.85
	Slightly abnormal		4 (16.7%)	2 (14.3%)		NS
Meatal shape	Vertical slit		20 (83.3%)	12 (85.7%)	2.33	0.31
	Circular		4 (16.7%)	1 (7.1%)		
	Abnormal		0 (0%)	1 (7.1%)		
Meatus position	Distal glanular		20 (83.3%)	12 (85.7%)	5.77	0.06
	Proximal glanular		4 (16.7%)	0 (0%)		
	Coronal		0 (0%)	2 (14.3)		
Urinary stream	Single stream		20 (83.3%)	12 (85.7%)	0.04	0.85
	Spray		4 (16.7%)	2 (14.3%)		NS
Cosmetic out come	Good		20 (83.3%)	12 (85.7%)	0.04	0.85
	Bad		4 (16.7%)	2 (14.3 %)		NS
Q max (mean ± SD)			8.4 ± 2.4	10.4 ± 3.1	1.98	0.61 NS
HOPE			37.2 ± 6.4	42.4 ± 6.1	2.46	0.02 *

SD: Standard deviation - t: Independent t test - χ²: Chi square test - NS: non-significant (P>0.05) *: Significant (P<0.05)

Figure legends

	Figure title
Figure (1)	<p>(A) A traction suture using a 5–0 silk is placed in the glans just beyond the anticipated dorsal lip of the neomeatus</p> <p>(B) Separate the urethral plate from the glans wings</p> <p>(C) A circumferential subcoronal incision was made proximal to the hypospadiac urethral meatus, then degloving of the penile skin to the penoscrotal junction.</p> <p>(D) The urethral plate is incised longitudinally after complete penile degloving</p>
Figure (2)	<p>(A) Neourethral tubularization</p> <p>(B) Dartos flap is transposed ventrally and fixed to cover the entire neourethra after the creation of the neourethra</p> <p>(C) Glanular wings approximation</p> <p>(D) Closure of Penile skin</p>
Figure (3)	<p>(A) Dressings were applied, and the stent drips into the diaper; the 1st dressing was done after five days</p> <p>(B) Post-operative follow up of Snodgrass patient after 12 months</p>





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