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Original Research Article

Pediatric penile biometry guides the surgical outcome following tubularised incised plate urethroplasty for hypospadias: a single centre study

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ABSTRACT

Background: In hypospadias urethral meatus opens onto the ventral surface of the penis proximal to tip of glans and its surgery is challenging. Recent focus of hypospadias surgery is on reduction of postoperative complications and objective assessment of penile anthropometry which can affect outcome. Aim of study was to assess the surgical outcome of tubularised incised plate urethroplasty on penile biometric parameters among children with coronal, distal penile and mid penile hypospadias.
Methods: Study was conducted in the department of pediatric surgery in IPGMER and SSKM Hospital in Kolkata during November 2019 to October 2021.
Results: Among 42 boys mean urethral plate length is 4.286 (coronal), 7.643 (distal penile) and 8.846 (mid penile), mean urethral plate width is 3.321 (coronal), 5.786 (distal penile) and 5.923 (mid penile), mean diameter at mid glans level is 4 (coronal), 5.071 (distal penile) and 5.923 (mid penile), mean diameter at coronal level is 5.75 (coronal), 6.429 (distal penile) and 6.769 (mid penile), mean stretched penile length is 39.2143 (coronal), 41.857 (distal penile) and 40.308 (mid penile) hypospadias respectively. P value is less than 0.05 for all except urethral plate depth which has a non-significant p value.
Conclusions: Urethral plate length, urethral plate width, mid glans diameter, glans diameter at coronal sulcus level and stretched penile length affect the outcome of the surgical process TIP urethroplasty in coronal, distal penile and mid penile type hypospadias but urethral plate depth does not.

Keywords: TIP urethroplasty, Pediatric penile biometry, Pediatric glans diameter, Urethral plate length and width

INTRODUCTION

Hypospadias is a developmental anomaly characterized by a urethral meatus that opens on the ventral surface of the penis, proximal to the end of the glans. Different position of meatus and associated other abnormalities like chordee, foreskin abnormalities & poor tissue development in the phallus, small sized phallus and abnormalities in the testis, make hypospadias a challenging field of urogenital reconstructive surgery with different techniques being currently used. Continuous re-evaluation and assessment of outcome may have a major impact on future clinical practice. The TIP (tubularised incised plate) urethroplasty is a modification of the Thiersch-Duplay tubularisation introduced by Snodgrass et al which involves a deep longitudinal, relaxing incision of the urethral plate in the midline.[1] The ultimate goal of forming a 'normal' penis for the child with hypospadias is normal voiding, erection and

normal appearance of the penis with a minimum of complications. Complication ranges from infection, hematoma to dehiscence of glans, skin necrosis, urethro cutaneous fistula, urethral stricture etc.[2-4] The most recent attempt for objective assessment of postoperative outcome is the paediatric penile perception score (PPPS), which seems to be the most reliable instrument to assess penile self -perception in children after hypospadias repair and for appraisal of the surgical results by parents. The score includes size of penis, glans appearance, appearance of the meatus, penile skin, curvature etc. rated by patient, parents and surgeons. The photographs/clinical appearance can be scored using 4 criteria i.e., overall appearance, mucosal collar, meatal location and configuration.[5] There are studies regarding penile anthropometry and pediatric penile nomogram in north Indian population.[6,7] This descriptive longitudinal study was conducted in the department of pediatric surgery in IPGME&R and SSKM Hospital in Kolkata which is a high-volume centre for hypospadias surgeries in eastern part of India. Our study aims to assess the surgical outcome (complications and cosmesis) of TIP urethroplasty on the following factors i.e. age, type of hypospadias, penile biometric parameters i.e., glans diameter at coronal sulcus level (GdCl); mid glans diameter (Gdmgl), urethral plate length, width and depth, stretched penile length. The assessment of outcome includes- complications like dehiscence, fistula and urethral stricture and cosmetic appearance of the penis with a terminal meatus on the ventral - distal aspect of the glans.

METHODS

Study design

This single institute based longitudinal descriptive study was conducted in the department of pediatric surgery, IPGMER & SSKM. Hospital from November 2019 to October 2021.

Inclusion criteria

All fresh cases of hypospadias (coronal, mid penile and distal penile type) between 6 months to 12 years attending pediatric surgery OPD of I.P.G.M.E.R. & S.S.K.M. Hospital during the study period were included in the study.

Exclusion criteria

Patients younger than 6 months and older than 12 years, re-do cases, patients with previous inguino scrotal surgeries (like hernia, hydrocele, orchidopexy or circumcision), Other types of Hypospadias (like glanular, penoscrotal, scrotal or perineal hypospadias), boys with genetic and endocrine disorders or genital anomaly, undescended testis, nonretractile prepuce, multiple congenital anomalies and most importantly patients with parental refusal to join were excluded from the study.

Data collection tool

Data was collected from pediatric surgery OPD register, OT register, bed head tickets (BHTs) and interview and clinical examination of selected patients. Data was collected by a suitable proforma mentioning demographic data, history and clinical examination findings, investigation reports, operative notes, early postoperative evaluation data and follow up records.

Parameters under evaluation

Parameters which were studied and tabulated include age, type of hypospadias, penile biometric parameters i.e., glans diameter at coronal sulcus level (GdCl); mid glans diameter (Gdmgl), urethral plate length, urethral plate width and depth and stretched penile length.

Preoperative measurements

Measurement of penile biometric parameters was done in OT. Penis was fully stretched till comfortably tolerated by the subject. SPL (streched penile length) was measured on the dorsal aspect of the penis as the distance between the tip of glans and the root of the penis. The penile measure used was the length of the flaccid penis fully stretched under maximum manual traction, from the pubopenile skin angle to the end of the glans, after the prepubic fat was depressed, with a ruler located on the penile dorsal surface (RSLmax) (Figure 1).

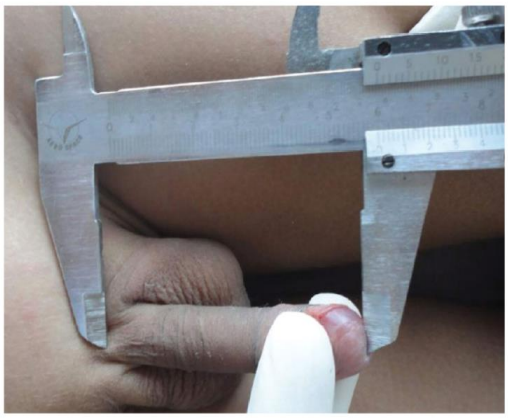

Figure 1: Measurement of the length of stretched penis.

Gdmgl (glans diameter at mid glans level) and GdCl (glans diameter at coronal level) are the horizontal distance between two lateral edges at mid glans and at coronal sulcus (Figure 2). Urethral plate length, width and depth was measured with calipers. All the measurements were taken by a single observer and taken twice to overcome the variability in measurements. The readings were found to be reproducible on examining the child second time in the majority of the cases, but in the case of difference between

the two readings, the mean of the two was taken for data analysis.

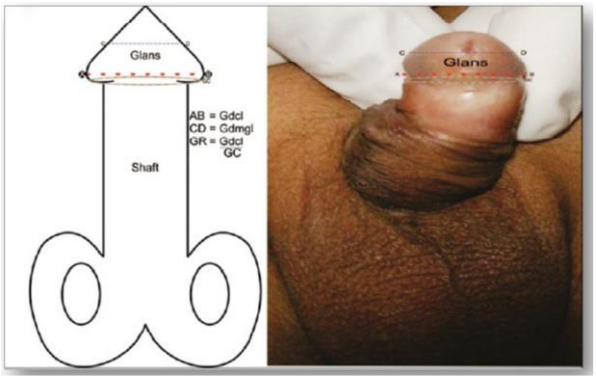

Figure 2: Glans anthropometry measurement, glans diameter at coronal sulcus, mid glans diameter, glans circumference and glans ratio.

Surgical procedure

TIP (tubularised incised plate) urethroplasty is done which involves a deep longitudinal, relaxing incision of the urethral plate in the midline and allows the lateral skin flaps to be mobilized and closed in the midline without tension. Nelaton catheter No 6 or 8 have been used according to age and size. Suture was used no 5-0 or 6-0 absorbable suture (polyglactin). Surgeries have been done under General anaesthesia with endotracheal intubation. Preoperative antibiotic (Injection Ceftriaxone 100mg/kg body weight 15 minutes before incision),

Post operative

Post operative intravenous antibiotics (ceftriaxone 100mg/kg body weight divided 12 hourly and Injection amikacin 15mg/kg once daily) for 5 days then oral antibiotics (cefixime 10 mg/kg body weight in two divided doses) for next 5 days have been given to all patients. Analgesia was maintained by infusion paracetamol 10 mg/kg body weight/dose 6 hourly for 2 days, then oral paracetamol 20 mg/kg body weight/dose as and when required. dressing was removed on 5th postoperative day and nelaton catheter was removed on 10th postoperative day. early postoperative data regarding complications have been collected on 1st, 3rd, 5th, 8th and 10th postoperative days by thorough clinical examination. patients were followed up at 1 month, 3rd month, 6th month and 1-year intervals postoperatively and complications, if any, were noted and tabulated.

Data analysis

All recorded data have been analysed with suitable diagrams, figures, tables and findings have been be discussed in details to draw appropriate conclusion using standard statistical analysis. analysis has been done by calculation of counts and percentages for categorical data and mean and standard deviation for numerical data. data was entered in and was analyzed by means of computer software (SPSS for Windows, SPSS Inc, Chicago, III) and Microsoft Excel. Different statistical methods were used to analyze the data according to our requirements.

Sample size calculation and distribution

In order to detect a statistically significant difference (at confidence level α) between the null population distribution having mean μ_0 and an alternative population distribution having mean μ_1 , with a power of 1-β we require a sample size as determined by Cochran's formula:

$$n = (Z\alpha/2 + Z\beta)2 * \Delta 2$$

Where $\Delta = \mu_1-\mu_2/(\sigma/\sqrt{2})$ is the scaled difference between μ1 and μ2. A sample size was calculated using the above power calculation considering previous published studies which yielded a power of 90% (Type II error = 0.1 i.e β=0.9 and 1-β= 0.1) and 5% Type 1 error (α=0.05 i.e 95% tolerance level is considered). From Z table it was found $Z_{\alpha/2}=Z_{0.05/2}=Z_{0.025}=1.96$ and $Z_\beta=1.282$. and scaled difference $\Delta^2=10.89$ with standard deviation σ=0.03429 and μ1- μ2=0.08. The sample size was calculated as n=42.

Statistical methodology

Here in this experiment the observed values are analysed using SPSS and MS Excel software. Data was entered in Microsoft Office Excel 2007 and was analyzed by means of computer software (SPSS for Windows, SPSS Inc, Chicago, III), $p<0.05$ was taken to be statistically significant. So, for a significant p value we can conclude that the parameter has an effect on the outcome of the surgical process. The null hypothesis for our experiment assumes that the parameters do not affect the outcome of the surgical process.

RESULTS

Demographic data of all patients (age distribution) are tabulated in. Data from measurements of urethral plate length (UPL), urethral plate breadth (UPB), urethral plate depth (UPD), mid glans diameter (Gdmgl), glans diameter at coronal sulcus level (GdCl), stretch penile length (SPL) of coronal, distal penile and mid penile hypospadias are depicted in results. Mean urethral plate length is 4.286 in coronal, 7.643 in distal penile and 8.846 in mid penile hypospadias. Mean urethral plate width is 3.321 in coronal, 5.786 in distalpenile and5.923 in mid penile hypospadias. Mean diameter at mid glans level is 4 for coronal, 5.071 for distal penile and 5.923 for mid penile hypospadias. Mean diameter at coronal level is 5.75 in coronal.6.429 in distal penile and 6.769 in mid penile hypospadias. Mean stretched penile length is 39.2143 in coronal, 41.857 in distal penile and40.308 in mid penile hypospadias. Mean age is 54.714 in coronal, 51.357 in distal penile and 44.231 for mid penile hypospadias. For the coronal, distal penile, and mid penile type, hypospadias

we can see that the p value is less than 0.05 for the age, urethral plate length, urethral plate width, mid glans diameter, glans diameter at coronal sulcus level, and stretched penile length which means that these are significant factors that will affect the outcome of the surgical process but urethral plate depth does not influence the outcome of the surgery as the data clearly shows that it has a non-significant p value.

Table 1: Age distribution of patients.

Type of Hypospadias	N	Mean age (months)	SD	Chi Square (x^2)	DF	Significance (P value)
Coronal Hypospadias	14	54.714	28.521	377.54	10	<0.05
DPH	15	51.357	25.05	466.19	11	
MPH	13	44.231	22.96	151.5	9	

Table 2: Analysis for coronal hypospadias.

Type of Hypospadias	Urethral plate length (mm)	Urethral plate breadth (mm)	Urethral plate depth (mm)	Mid glans level diameter (mm)	Coronal level diameter (mm)	Stretch penile length (mm)	Outcome
Coronal	5	2	1	4	5	45	Good
	4	3	1	4	5	45	Bad
	6.5	2.5	2	7	7.5	41	Good
	4	1	2	4	9	35	Good
	4.5	2	1	5	6	35	Good
	5	7	1	4	5	40	Bad
	5	7	2	5	6	45	Good
	5	4	2	7	8	38	Good
	3	2	1	2	3	40	Good
	3	3	2	2	5	35	Good
	6	3	2	5	6	45	Good
	3	4	1	3	5	35	Bad
	3	3	2	2	5	35	Good
	3	3	2	2	5	35	Good
Mean	4.286	3.321	1.571	4	5.75	39.2143	
SD	1.188	1.750	0.514	1.710	1.529	4.3532	
Chi square (x^2)	17.73	28.24	6.43	16.34	23.02	196.27	
DF	10	10	10	10	10	10	
P value	**0.0160**	**0.0017**	**0.7777**	**0.0902**	**0.0107**	**9.67E-37**	

Urethral plate length (UPL), urethral plate breadth (UPB), urethral plate depth (UPD), mid glans diameter (Gdmgl), glans diameter at coronal sulcus level (GdCl), stretched penile length (SPL), standard deviation (SD)

The mean and the standard deviation (SD) values for the urethral plate length, width and depth are shown in the bar graph coronal, distal penile and mid penile type. From the bar graph also, we can see that there is less deviation for the urethral plate depth which is in sync from our p value results that means that the ere is significant less deviation for our plate depth. In the next bar chart the mean and SD for the mid glans level diameter and the coronal diameter are shown with their corresponding error bars for coronal, distal penile and mid penile type.

DISCUSSION

Tracing back the history hypospadias surgery seems to have evolved from the art of circumcision, followed by amputation of distal curved portion, few attempts by knives and cautery to groove and reshape penis, silver probe or trocar for canalization of glans and many more. Surgical progress started from 19th century starting from correction of chordee then urethral reconstruction by scrotal tissue, local tissue flaps by Therish perineal urinary diversion and two-stage technique by Duplay, Browne's 'buried strip' technique, Blair's "dorsal prepuceal slit", Byars two-stage technique, followed by split-thickness skin graft Ombredanne "buttonhole type" of preputial hood flap Asopa's "rotated island flap", Duckett's "disassociated (separately mobilized) preputial island flap" etc.[8-14] The TIP (Tubularised Incised Plate) urethroplasty is a modification of the Thiersch-Duplay tubularisation introduced by Snodgrass et al which involves a deep longitudinal, relaxing incision of the urethral plate in the midline.[1] Our study aims to assess the surgical outcome (complications and cosmesis) of TIP

urethroplasty. American academy of pediatrics (AAP) and European association of urology (EAU) guidelines recommend hypospadias surgery between the ages of six and 18 months.[15]

Table 3: Analysis for distal penile hypospadias.

Type of Hypospadias	Urethral plate length (mm)	Urethral plate breadth (mm)	Urethral plate depth (mm)	Mid glans level diameter (mm)	Coronal level diameter (mm)	Stretch penile length (mm)	Outcome
Distal penile	6	3	2	6	7	48	Good
	8	5	3	4	2	65	Good
	7	5	2	6	6	45	Good
	7	4	2	6	8	40	Bad
	1	5	2	5	2	45	Good
	7	6	2	4	8	42	Good
	7	7	2	4	9	41	Good
	5	4	2	4	6	35	Good
	7	6	2	6	8	40	Good
	5	5	3	7	7	38	Bad
	7	3	1	3	5	40	Good
	10	7	2	4	5	35	Good
	12	8	2	6	8	40	Bad
	12	8	2	6	8	40	Good
	12	8	2	6	8	40	Good
Mean	7.643	5.786	2.071	5.071	6.429	41.857	
SD	3.079	1.626	0.475	1.207	2.243	7.263	
Chi square (x^2)	60.67	33.51	12.70	32.25	47.33	222.94	
DF	11	11	11	11	11	11	
P value	6.97-09	0.004	0.3137	0.007	1.88E-06	1.26E-41	

Table 4: Analysis for mid penile hypospadias.

Type of Hypospadias	Urethral plate length (mm)	Urethral plate breadth (mm)	Urethral plate depth (mm)	Mid glans level diameter (mm)	Coronal level diameter (mm)	Stretch penile length (mm)	Outcome
Mid penile	14	4	3	7	4	50	Bad
	8	7	3	7	8	41	Good
	7	5	3	7	7	40	Good
	7	8	3	5	8	40	Good
	9	7	2	6	7	40	Good
	7	3	2	5	7	40	Good
	5	3	1	2	3	30	Good
	10	5	2	6	8	41	Bad
	8	6	3	6	7	41	Good
	9	7	2	6	7	40	Good
	9	7	3	7	7	42	Good
	10	8	2	6	7	41	Bad
	12	7	3	7	8	38	Good
Mean	8.846	5.923	2.462	5.923	6.769	40.308	
SD	3.262	2.312	0.914	2.066	2.335	11.501	
Chi-square (x^2)	45.06	24.39	10.35	26.13	30.24	186.93	
DF	9	9	9	9	9	9	
P value	9.00E-07	0.0037	0.3229	0.0019	0.0004	1.81E-35	

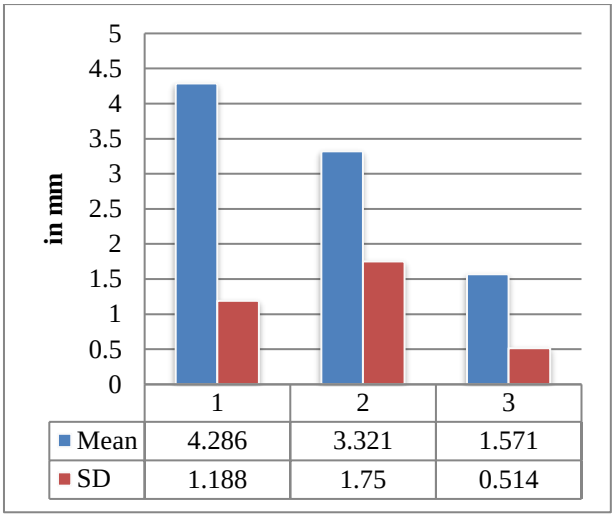

Figure 1: Mean and standard deviation for coronal hypospadias for UPL (1), UPB (2) and UPD (3).

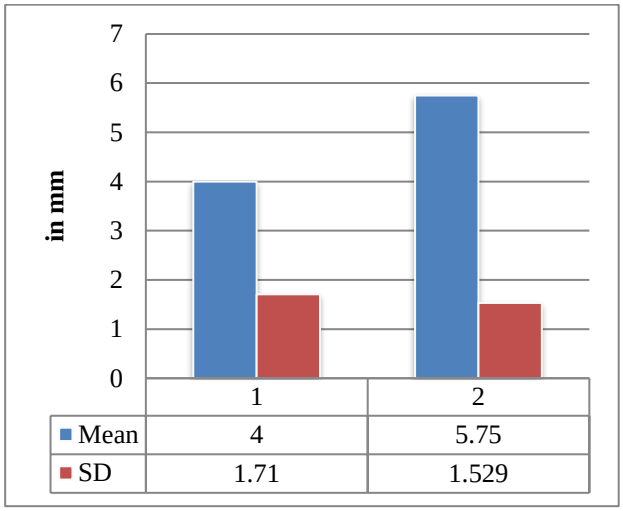

Figure 2: Mean and SD value for coronal hypospadias at mid glans level diameter (1) and coronal level diameter (2).

Many factors may influence the timing of hypospadias repair. In our study age limit ranges from 6 months to 12 years. Data from different studies say that no association between age of initial hypospadias repair and number of complications.[16-18] The ultimate goal of forming a 'normal' penis for the child with hypospadias is normal voiding, erection and normal appearance of the penis with a minimum of complications. Complication ranges from infection, hematoma to dehiscence of glans, skin necrosis, urethro cutaneous fistula, urethral stricture etc.[2-4] Few controversial findings concerning possible anaesthetic risks, psychological impact and postoperative complications, have led to discussion as to whether or not surgery should be delayed until the child is able to meaningfully participate in the decision-making process. The main goal for hypospadias repair is to achieve both cosmetic and functional normalities. Reasons for treating hypospadias include spraying of urinary stream, inability to urinate in standing position, curvature leading to difficulties during intercourse, fertility issues because of difficulty with sperm deposition, and decreased satisfaction with genital appearance.[15]

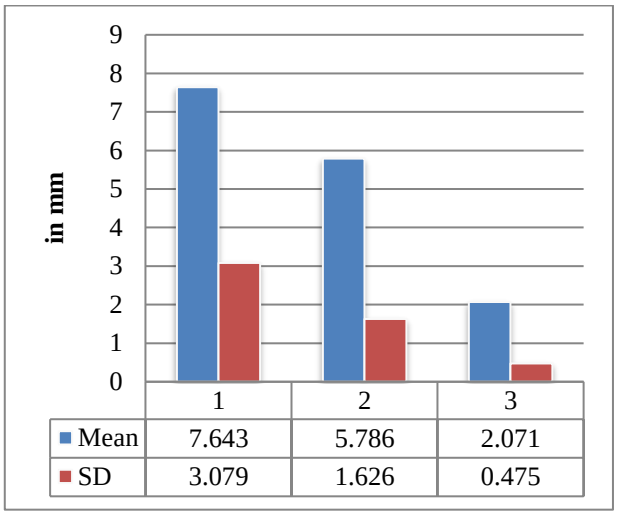

Figure 3: Mean and standard deviation for DPH for UPL (1), UPB (2) and UPD (3).

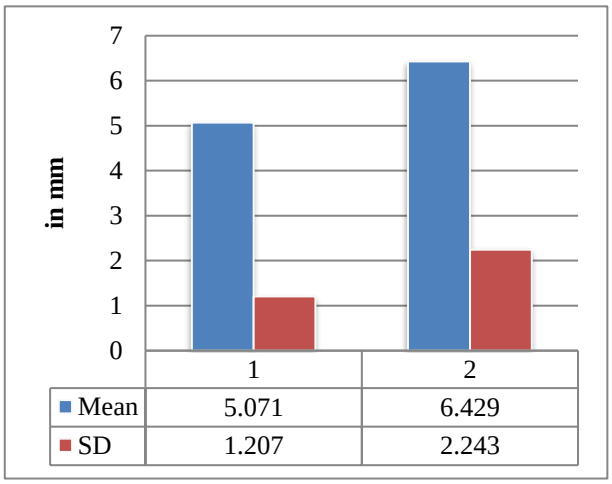

Figure 4: Mean and SD value for DPH mid Glans level diameter (1) and DPH level diameter (2).

The most recent attempt for objective assessment of postoperative outcome is the Paediatric Penile Perception Score (PPPS), which seems to be the most reliable instrument to assess penile self -perception in children after hypospadias repair and for appraisal of the surgical results by parents. The score includes size of penis, glans appearance, appearance of the meatus, penile skin, curvature etc. rated by patient, parents and surgeons. The photographs/clinical appearance can be scored using 4 criteria i.e., overall appearance, mucosal collar, meatal location and configuration.[5] Penile biometrics in hypospadias is currently the focus of much research[9]. However, in the absence of comprehensive paediatric penile anthropometry nomograms, the assessments are

often subjective and are prone to interobserver variations.[19]

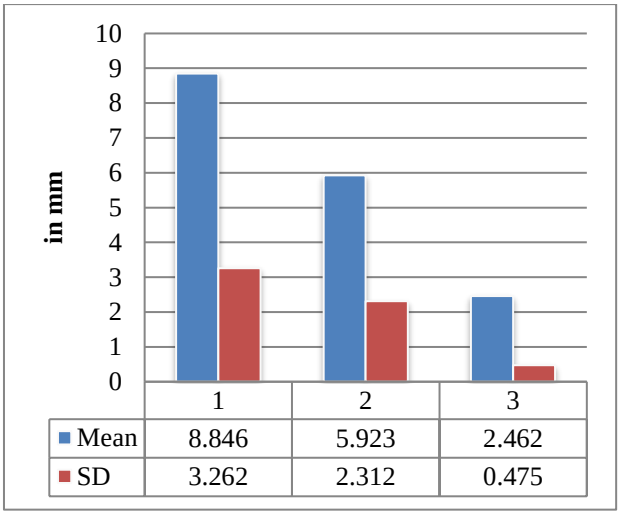

Figure 5: Mean and standard deviation for MPH for UPL (1), UPB (2) and UPD (3).

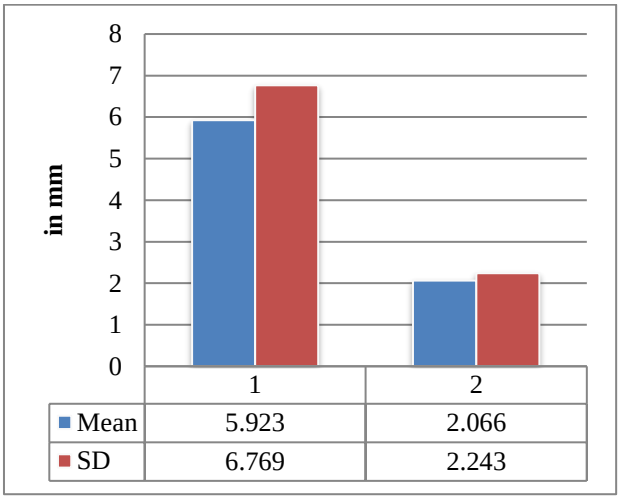

Figure 6: Mean and SD value for MPH mid glans level diameter (1) and MPH level diameter (2).

There are few studies describing penile anthropometry in children beyond neonatal age, and still few that describe penile nomograms other than penile length and diameter.[6,7] There is scarcity of data on glans anthropometry. A study on glans anthropometry defined small glans as maximum glans width of <14 mm, and identified it as one of the determinants contributing to glans dehiscence following hypospadias repair.[20] Da Silva et. al. in their study concluded that glans shape, urethral plate width, urethral plate length, prepuce vascularization and penile size do not significantly affect the complication rate of TIP repair in distal hypospadias.[21] In our study 42 patients of different ages and of distal penile, mid penile and coronal hypospadias types were studied after Snodgrass TIP urethroplasty repair and their outcome was assessed on basis of penile anthropometry. The result showed urethral plate length, urethral plate width, mid glans diameter, glans diameter at coronal sulcas and stretch penile length all parameters measured gave statistically significant value on outcome of three types of hypospadias repair. Urethral plate depth does not influence the outcome of the surgery as the data clearly shows that it has a non-significant p value. Few more studies support our result as we searched literature. Holland and Smith assessed exclusively UP shape and width and concluded that a shallow groove predisposes to a narrower neourethra and meatal stenosis subsequently.[22] Dhua et al measured ventral glans length (VGL), meatus (M) size, and their ratio VGL/M (R) in normal Indian boys and compared these with the respective equivalent dimensions in boys with distal and mid-penile hypospadias using anatomic landmarks.[23] Although TIP technique has been described some time ago, studies of penile anthropometric measurements comparing postoperative outcome, in patients with hypospadias, are recent. Our study enriches the knowledge of penile anthropometry in children with hypospadias. This study involved only 42 patients, which is barely minimum a number. A good study should include a large sample size and long follow up period. Our follow up period also was short. Thus, to detect factors affecting outcome after surgery, study with a prolonged follow up is required in future.

CONCLUSION

Pediatric penile biometry is a recent tool in hypospadias surgery. Our study assessed influence of penile biometry on the outcome of Snodgrass TIP urethroplasty repair. Short term follow-up upto 6 months revealed that the values are significant for urethral plate length, urethral plate width, mid glans diameter, glans diameter at coronal sulcus level and stretched penile length and they affect the outcome of the surgical process Snodgrass TIP urethroplasty in coronal, distal penile and mid penile type hypospadias but urethral plate depth does not influence the outcome of the surgery. Future study with long follow up and large population size will definitely guide to minimise postoperative complications and improved outcome after hypospadias surgery.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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