

# Studying The Relationship between the width of penile glans and urethral caliber in neonates

## Abstract

**Background:** During the final 2 decades, tabularized incised plate procedure (TIP) for repair of distal penile hypospadias is the foremost common method at numerous institutions.

**Aim and objectives:** the aim of the study was to study the relationship between penile glans diameter and urethral caliber in neonates with normal penile development, as a preliminary step to understand the underlying factors for glans dehiscence after hypospadias repair in babies with small glans.

**Subjects and methods:** This prospective observational clinical study was conducted in General Surgery Department of Benha University Hospital, on 100 Boys with normally developed penis. The duration of the study was 10 months.

**Results:** Glans Width (cm) in the study population ranged from 1.1 to 1.9 with mean  $\pm$  SD =  $1.5 \pm 0.16$ . Meatal Caliber (F) in the study population ranged from 4 to 9 with mean  $\pm$  SD =  $5.97 \pm 1.01$ . Correlation between Glans width (cm) and Meatal caliber (F) was 0.59 which indicates a strong positive correlation.

**Conclusion:** The present study highlights the value of the width proportion of the urethral caliber to the glans diameter which in turn serves as an independent factor influencing outcomes in tabularized incised plate repair.

**Keywords:** Penile glans; urethral caliber; neonates; glans; Meatal caliber.

## INTRODUCTION

The male urethra is a narrow fibro-muscular tube that conducts urine and semen from the bladder and ejaculatory ducts, respectively, to the exterior of the body. Although the male urethra is a single structure, it is composed of a heterogeneous series of segments: prostatic, membranous, and spongy. [1]

The anterior urethra is the portion of the urethra from the tip of the penis to just before the prostate. The posterior urethra is the part of the urethra that travels through the prostate and the external sphincter valve. [2]

A study on glans anthropometry in 0–24 months, 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. [3]

The wide spectrum of hypospadias is most likely due to disorganization and arrested distal migration of the ventral penile mesenchyme into ventral stroma and fascia (The Disorganization Hypothesis). Arrested migration of the ventral mesenchyme will keep the urethral edges apart, preventing fusion of the edges of the urethral groove and resulting in hypospadias. [4]

Glans dehiscence, defined as complete separation of the glans wings, occurred in significantly more patients after proximal or re-operative (15%) than primary distal TIP (4 %). Recurrent glans dehiscence occurred in 27 % of re-operative TIP glansplasties and over 50 % of third glansplasties. [3]

Multivariable analysis found that primary proximal and re-operative TIP had greater odds for glans dehiscence than distal TIP. Other potential factors, including age, small glans and glansplasty suture (chromic vs. polyglactin), did not predict this complication. [5]

## **PATIENTS AND METHODS**

This prospective observational clinical study was conducted in General Surgery Department of Benha University Hospital, on 100 Boys with normally developed penis. Patients were randomly selected from outpatient clinic. The maximum glans diameter was measured in consecutive boys aged 0-12 month coming for circumcision or other operations as inguinal hernia. The study period started from September 2021 to June 2022.

The study included boys aged 0-12 months and those with normally developed penis. While the following boys were excluded from this study; Boys with genetic, endocrine disorders, having genital anomaly and boys whom parents refuse to take part in the study. All boys who met the inclusion criteria were subjected to the following history; Personal history (name and age), present illness, past history of any disease, family history of any disease. All boys were examined in a warm room, in the supine position, in the presence of a parent or a legal guardian. Glans length and shaft length were measured with a ruler on dorsal aspect of penis (Fig. 1, 2). Meatal calibration was taken with Nelaton catheters. (Fig. 3). All measurements were performed after retraction of the foreskin, The glans width was measured at the point of maximum glans width with a Hollister calibration test (Fig. 4)



**Fig.1:** glans length by a ruler



**Fig.2:** shaft length by a ruler



**Fig.3:** Meatal caliber by nelaton catheter



**Fig.4:** glans diameter by Hollister Calibration test

**Time schedule of the study:**

<b>Topic</b>	<b>Period</b>
<b>Preparatory phase</b>	<b>1 month</b>
<b>Design of examination sheet</b>	<b>1 month</b>
<b>Review of literature</b>	<b>3 months</b>
<b>Collection, organization, entering of data and statistical analysis</b>	<b>5 months</b>

## Administrative and Ethical Design :

An Official permission was obtained from Faculty of Medicine, Benha University. An official permission was obtained from General Surgery Department of Benha University Hospital. Approval from the ethical committee of the faculty of medicine (Institutional Research Board IRB). All parents were informed and give their consent that their children to be involved in the study.

## Data management and Statistical Analysis :

The collected data were tabulated and presented in suitable figures. Quantitative data was summarized using mean and standard deviation, while qualitative data by using frequency and percentage. Data was analyzed by the aid of software package of SPSS using suitable statistical tests. The accepted level of significance in this work was 0.05 ( $P < 0.05$  was considered significant).

## Dissemination of results:

The results and recommendations were sent to the library of Benha Faculty of Medicine and Benha university as well as to the other universities. Lastly, outcome and recommendations were published in the peer reviewed journals.

## Statistical Analysis

All data were collected, tabulated and statistically analyzed using SPSS 26.0 for windows (SPSS Inc., Chicago, IL, USA). Qualitative data were de-scribed using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. The used tests were Pearson correlation coefficient: used to measure the strength of a relationship is between two variables.

## Results

**Table (1): Demographic characteristics of the studied babies.**

	Studied babies (n = 100)
Age (months)	
Mean $\pm$ SD.	<b>6.25 <math>\pm</math> 3.64</b>
Median (IQR)	<b>7 ( 3 - 9 )</b>
Range (Min-Max)	<b>11 ( 1 - 12 )</b>

**Table (1):** showed Demographic characteristics of the studied babies. The Age in the study population ranged from 1 to 12 with mean  $\pm$  SD = 6.25  $\pm$  3.64

**Table (2): Measurements of Shaft length (cm) among the studied babies**

	Studied babies (n = 100)
Shaft length (cm)	
Mean $\pm$ SD.	<b>2.5 <math>\pm</math> 0.26</b>
Median (IQR)	<b>2.5 ( 2.3 - 2.7 )</b>
Range (Min-Max)	<b>1.4 ( 1.8 - 3.2 )</b>

**Table (2):** showed Measurements of Shaft length (cm) among the studied neonates. Shaft length (cm) in the study population ranged from 1.8 to 3.2 with mean  $\pm$  SD = 2.5  $\pm$  0.26

**Table (3): Measurements of Glans length (cm) among the studied babies.**

	Studied babies(n = 100)
Glans length (cm)	
Mean $\pm$ SD.	<b>1.74 <math>\pm</math> 0.1</b>
Median (IQR)	<b>1.7 ( 1.7 - 1.8 )</b>
Range (Min-Max)	<b>0.5 ( 1.5 - 2 )</b>

**Table (3):** showed Measurements of Glans length (cm) among the studied babies. Glans length (cm) in the study population ranged from 1.5 to 2 with mean  $\pm$  SD = 1.74  $\pm$  0.1

**Table (4): Measurements of Glans Width (cm) among the studied babies.**

	Studied babies (n = 100)
Glans Width (cm)	
Mean $\pm$ SD.	<b>1.5 <math>\pm</math> 0.16</b>
Median (IQR)	<b>1.5 ( 1.4 - 1.6 )</b>
Range (Min-Max)	<b>0.8 ( 1.1 - 1.9 )</b>

**Table (4):** showed Measurements of Glans Width (cm) among the studied babies. Glans Width (cm) in the study population ranged from 1.1 to 1.9 with mean  $\pm$  SD = 1.5  $\pm$  0.16

**Table (5): Measurements of Meatal Caliber (F) among the studied babies**

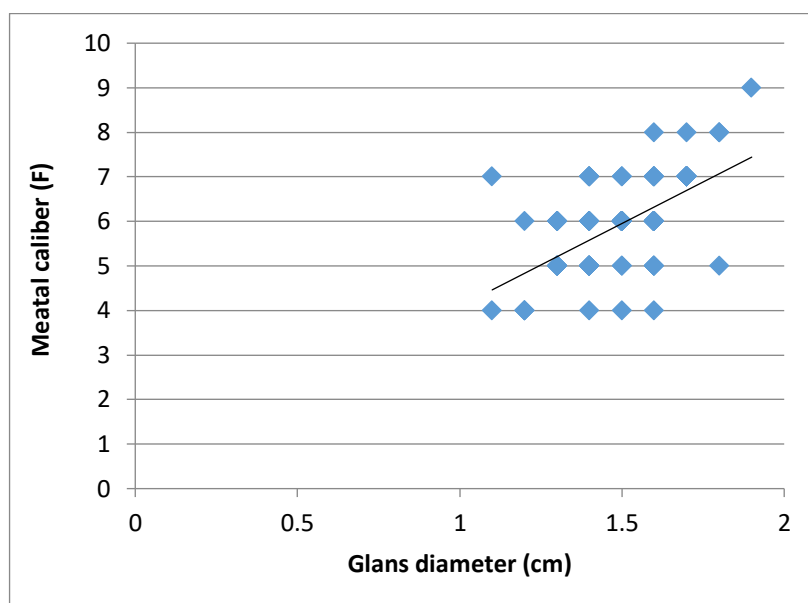
	Studied babies (n = 100)
Meatal Caliber (F)	
Mean $\pm$ SD.	<b>5.97 <math>\pm</math> 1.01</b>
Median (IQR)	<b>6 ( 5 - 7 )</b>
Range (Min-Max)	<b>5 ( 4 - 9 )</b>

**Table (5):** showed Measurements of Meatal Caliber (F) among the studied neonates. Meatal Caliber (F) in the study population ranged from 4 to 9 with mean  $\pm$  SD = 5.97  $\pm$  1.01

**Table (6): Pearson’s correlation coefficients(r) between Glans diameter (cm) and Meatal caliber (F)**

	Glans diameter (cm)	
	Pearson’s correlation coefficients (r)	P
Meatal caliber (F)		
	<b>0.590</b>	<b>&lt;0.001</b>

**Table (6)** showed Pearson’s correlation coefficients (r) between Glans diameter (cm) and Meatal caliber (F). Pearson's Correlation Coefficient (r) between Glans diameter (cm) and Meatal caliber (F) was 0.59 which indicates a strong positive correlation.



**Fig.5:** Scatter plot graph showing correlation between Glans diameter (cm) and Meatal caliber (F)

## DISCUSSION

During final 2 decades, tabularized incised plate procedure (TIP) for repair of distal penile hypospadias is the commonest method at numerous institutions. In any case, a few downsides counting metal and/or urethral stenosis and the require for standard urethral dilatation have been recorded. [6]

The preservation of the urethral plate and the increase in the surface area with healthy epithelium give better outcome TIP is a procedure that is more dependent on urethral plate quality in comparison with other surgical procedures. [7]

The goal of the surgical reconstruction of hypospadias is to achieve “normal” functional and esthetic penile features. Optimal surgical outcomes include a slit-like urethral opening at the vertex of the penile glans, a straight penis during erection, a conical-shaped glans, typical scrotal configuration and adequate urinary flow. The achievement of such remarkable results remains a great challenge. A significant number of post hypospadias repair complications still exist, reaching about 10% for distal and 40% for proximal hypospadias,

despite the contemporary procedures providing more favorable results. Several anatomical features play a role during the selection process among the different surgical approaches, including glans size, UP width, meatal position, and the degree of penile curvature. However, a limited number of studies have looked in detail the impact of such variables on the postoperative outcomes. [8]

The main aim of this study was to study the relationship between penile glans diameter and urethral caliber in neonates with normal penile development, as a preliminary step to understand the underlying factors for glans dehiscence after hypospadias repair in babies with small glans. This prospective observational clinical study was conducted in General Surgery Department of Benha University Hospital, on 100 Boys with normally developed penis. The duration of the study was 10 months.

**The main results of this study were as following:**

The Age in the study population ranged from 1 to 12 with mean  $\pm$  SD =  $6.25 \pm 3.64$ . The Weight in the study population ranged from 2.6 to 10.7 with mean  $\pm$  SD =  $7.51 \pm 2.19$ . The mean of Length in the study population was 65.99 with SD of 8.38.

Our results were supported by study of, **2021** [9] as they reported that all 30 patients were evaluated at 1 year of follow up. Mean age was  $4.5 \pm 2.1$  years.

While in the study of, **2018**, [10] they reported that the study was carried out in 442 patients at a mean age of 2.8 years (range 0.5–12 years).

The present study showed that the mean of penile length in the study population was 4.17 with SD of 0.59. Shaft length (cm) in the study population ranged from 1.8 to 3.2 with mean  $\pm$  SD =  $2.5 \pm 0.26$ . Glans length (cm) in the study population ranged from 1.5 to 2 with mean  $\pm$  SD =  $1.74 \pm 0.1$ . Glans Width (cm) in the study population ranged from 1.1 to 1.9 with mean  $\pm$  SD =  $1.5 \pm 0.16$ . Meatal Caliber (F) in the study population ranged from 4 to 9 with mean  $\pm$  SD =  $5.97 \pm 1.01$ . As regard Correlation between Glans diameter and meatal caliber. Pearson's Correlation Coefficient (r) between Glans diameter (cm) and Meatal caliber (F) was 0.59 which indicates a strong positive correlation.

In the study of, **2018**, [10] meatal location was distal in 157 (35.5%), midshaft in 214 (48.4%) and proximal in 71 (16.1%) patients. Glans size was distributed with a mean of 13.9 mm (range 9–24 mm), whereas urethral plate width was distributed with a mean of 5.3 mm (range 2–12 mm). A total of 90.7% of urethral plates measured <8 mm. Width proportion of the urethral plate to the glans (U/G) ranged from 0.18 to 0.73, with a mean of 0.39. Bivariate correlation analysis showed that urethral plate width had a good linear relationship with glans width (Pearson correlation coefficient 0.648,  $P < 0.001$ ). On the contrary, U/G was weakly correlated to glans width (Pearson correlation coefficient  $-0.09$ ,  $P = 0.049$ ).

Penis size can be evaluated by glans width and, obviously, increases with age. The mean glans width of  $1.5 \pm 0.16$  mm in the present study was smaller than that of 15 mm reported by, **2013** [3] and , **2016**, [11] although the mean age was greater than theirs. Therefore, penis size can vary across geographic regions or ethnicities in addition to age.



Thus, the classification of urethral plate width based on an 8-mm cut-off value, irrespective of penis size, was not reasonable to be generally applicable. Furthermore, the showed that urethral plate width had a good linear relationship with glans width. On the contrary, U/G was weakly correlated to wider glans. From the above, there was extraordinary superiority of U/G – a parameter scale with penis size – in urethral plate evaluation compared with urethral plate width, **2018**.<sup>[10]</sup>

In the study of , **2022**,<sup>[13]</sup> glans diameter average was 13.9 + 0.10 mm and 57.0% of the patients had a glans diameter greater than 14 mm. Single-layer and double-layer urethroplasty were used in 55.3% (n = 83) and 44.7%(n = 67) of patients respectively. Overall complication rate was 23.3% (n = 35) which included fistula (3.3%, n = 5), glans dehiscence (12.7%, n = 19) and meatal stenosis (8.6%, n = 13). Glandular meatus localization (OR 58.8, p = 0.001) and smaller glans diameter (OR 0.39, p = 0.001) were significant predictors in multivariate analysis of overall complications. For fistula complication, only short operation time (OR 0.83, p = 0.03) was found as a significant predictor. Glans width (< 14 mm) was the only significant predictor of both glans dehiscence (OR 3.4,p = 0.03) and stenosis (OR 5.67,p = 0.013) complication.

Also, **2022**<sup>[14]</sup> revealed that 1023 boys were included. 273 had glandular, 468 distal, 194 proximal and 88 perineal hypospadias. The mean glans width was 14 mm with a range of 8 to 20 mm. The mean glans width for glanular hypospadias was 14.0 mm (range 9-19 mm), 14.0 mm (range 10-20 mm) for distal hypospadias (p>0.05), 13.1 mm (range 9-19 mm) for proximal hypospadias (p<0.0001) and 11.1 mm (range 8-16 mm) for perineal hypospadias (p<0.0001). 460 (45.0%) of all patients presented with a small glans width. In glanular hypospadias it was 99 (36.3%), 167 (35.7%) in distal hypospadias, 111 (57.5%) in proximal hypospadias and 83 (94.3%) in perineal hypospadias. There was no significant difference in the glans size between the age of 6 and 24 months (p>0.2), but there was a difference when compared to patients older than 25 months (p<0.05).

In addition, **2021**<sup>[9]</sup> stated that all 38 patients were evaluated at 6 months and 1 year follows up. The mean age at surgery was 4.5 ± 2.1 years. Overall, the mean ± SD of UPW was 10.92 ± 1.24 mm. 24 patients (61.5 %) (Group A) had a urethral plate width of less than 8 mm while 14 patients (35.9 %) (group B) had a urethral plate width greater or equal to 8 mm. the mean ± SD of GW was 9.52 ± 1.56 mm. Success was documented in 36/38 patients (94.3%). The only complication was Fistula in two patients (6.7 %), glans dehiscence in three patients (10%). Success rate was not statistically different in correlation of UPW and GW (p=0.5).

In a systematic review held by , **2021**,<sup>[15]</sup> nine articles (2084 pediatric subjects) were included in the final review. Mean meatal caliber increases non-linearly with age, with accelerated growth occurring during infancy (mini puberty) and adolescence (puberty). Meatal calibre can be approximately grouped by age as follows: neonate (6-10Fr); infant (10-12Fr); child (12-14Fr); and adolescent (14-18Fr). There is substantial individual variability for same-aged children. Meatal caliber has been independently related to height, weight, and penile size, but the effects of ethnicity and circumcision remain unclear.

## **CONCLUSION**



The present study highlights the value of the width proportion of the urethral caliber to the glans diameter which in turn serves as an independent factor influencing outcomes in tubularized incised plate repair. A strong positive correlation between Glans diameter (cm) and Meatal caliber (F) according to Pearson's correlation coefficients (r) had been declared by the present study.

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