

# The Effects of Glans Size, Urethral Plate Width, and Age of Patients on Early Outcome of Tubularized Incised Plate for Distal Hypospadias Surgery

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## ABSTRACT

**Background:** The glans size can be assessed to determine whether there's a link between urethroplasty issues and hypospadias complications. The urethral plate width is regarded as a fundamental factor in hypospadias repairs.

**Aim:** To evaluate the relation of age with glans size and urethral plate width and the effect of glans size and plate width on postoperative complications.

**Patients and methods:** A Prospective case series study on patients with distal hypospadias treated by TIP classified into Group A with glans size  $\leq 12$ mm, Group B with glans size  $> 12$ mm, and Group C with urethral plate width  $\leq 8$  mm, Group D with urethral plate width  $> 8$ mm, all groups were evaluated for postoperative complications, the statistical analysis was performed by using IBM-SPSS 26.

**Results:** A total of 100 prepubertal boys, ranging in age (1-14 yr.). Glans size ( $\leq 12$ mm) 36 boys, while 64 boys had size ( $> 12$ mm), and the relation of glans size of both groups were weakly correlated with age. On the other hand, urethral plate width was ( $\leq 8$ mm) in 90 boys, while in 10 boys with a width ( $> 8$ mm), the relation between plate width and the age of patients was also weakly correlated. The presence and absence of complications among patients regarding age, glans size, and plate width show non-significant differences concerning these parameters.

**Conclusion:** In hypospadias surgery, a weak correlation exists between advancing age and the increase in penile glans size and urethral plate width. In addition, the postoperative complication was not correlated to glans size and urethral plate width measurements, so the best time for surgery could be arranged according to the penile biometers rather than the age.

**Keywords:** Hypospadias, Glans size, Urethral plate width, Tubularized Incised Plate.

## تأثير حجم الحشفة وصفيحة الإحليل وعمر المرضى على النتائج المبكرة للصفيحة الأنبوبية من أجل جراحة الإحليل التحتاني البعيدة

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### الخلاصة

**تمهيد:** فيما يتعلق بالمبال التحتاني يمكن تقييم حجم الحشفة بشكل موضوعي لمعرفة ما إذا كان هناك صلة بين مشكلات راب الإحليل ومضاعفات ما بعد الجراحة، ويعتبر عرض لوحة مجرى البول كأحد عوامل الخطر الأساسية لإصلاح المبال التحتاني.

**هدف الدراسة:** تقييم علاقة العمر بحجم الحشفة وعرض لوحة مجرى البول وتأثير كل من حجم الحشفة وعرض اللوحة على مضاعفات ما بعد الجراحة.

**المرضى والطرائق:** دراسة سلسلة الحالات المحتملة التي أجريت في مستشفى الخنساء التعليمي في مدينة الموصل / العراق، جميع المرضى الذين يعانون من المبال التحتاني البعيد الذين أجريت لهم عملية جراحية لتصحيح المبال التحتاني، وقد خضعوا لقياس ما قبل الجراحة من حجم الحشفة وعرض لوحة مجرى البول، وقد تم تصنيف المرضى إلى: المجموعة (أ) مع حجم الحشفة  $\geq 12$  مم، و إلى المجموعة (ب) مع حجم الحشفة  $< 12$  مم وإلى: المجموعة (ج) مع عرض لوحة مجرى البول  $\geq 8$  ملم، وإلى المجموعة (د) مع عرض لوحة مجرى البول  $< 8$  مم، وقد تم تقييم كلتا المجموعتين للحصول على نتائج تجميلية ووظيفية. التحليل الإحصائي الذي تم إجراؤه باستخدام IBM-SPSS 26.

**النتائج:** كان من مجموعة ١٠٠ صبي قبل سن البلوغ يتراوح عمرهم في وقت الجراحة (١-١٤ سنة)، وقد كان حجم الحشفة ( $\geq 12$  مم) في ٣٦ مريضاً. بينما ٦٤ مريضاً كان الحجم ( $< 12$  مم)، ولوحظ ان علاقة حجم الحشفة من كلتا المجموعتين كانت مرتبطة بشكل ضعيف مع التقدم في العمر. من ناحية أخرى كان عرض لوحة مجرى البول ( $\geq 8$  مم) في ٩٠ مريضاً. بينما ١٠ مريضاً مع العرض ( $< 8$  مم)، كانت العلاقة بين عرض اللوحة وعمر المرضى مرتبطة بشكل ضعيف أيضاً، وقد تبين ان الاختلافات في وجود وغياب المضاعفات بين المرضى فيما يتعلق بالعمر، وحجم الحشفة، وعرض لوحة مجرى البول غير ذات قيمة فيما يتعلق بهذه المعلمات وهي ذات دلالة إحصائية ( $p = 0.001$ ).

**الاستنتاج:** هناك ارتباط ضعيف بين العمر والزيادة الحاصلة في حجم حشفة القضيب وكذلك الزيادة في عرض لوحة مجرى البول، كما ان مضاعفات ما بعد الجراحة لا ترتبط بحجم الحشفة وقياسات عرض اللوحة البولية، لذلك يمكن اعتبار أفضل وقت للجراحة وفقاً لمقاييس القضيب الحيوية بدلاً من العمر.

**الكلمات المفتاحية:** مبال تحتاني، حجم حشفة القضيب، عرض اللوحة البولية، عملية تجميل المبال التحتاني.

## INTRODUCTION

Hypospadias is the most common congenital deformity of the penis<sup>1,2</sup>. It is classified anatomically based on the meatus level without considering curvature<sup>3</sup>. While the urethral meatus (before and after chordee correction), the prepuce (incomplete or complete), the glans (cleft, incomplete cleft, or flat), the width of the urethral plate, the degree of penile rotation if present, and the presence of scrotal transposition were all classified in a more recent classification<sup>3</sup>.

The glans size and the urethral plate width are suggested to be important factors affecting hypospadias correction, which can be objectively assessed to see if there is a link between urethroplasty issues and hypospadias repair complications in addition to other factors influence the outcome of hypospadias surgery<sup>4</sup>.

However, the impact of age on surgical complications is still being debated. The appropriate repair for hypospadias was mainly determined by the surgical procedures used, such as the TIP approach<sup>4</sup>. According to the American Pediatric Academy, the best age for surgery is between 6 and 12 months<sup>4</sup>. Some authors have shown modest hypospadias repair complications in patients aged 4 to 6 months<sup>5</sup>.

In recent years, they have started to use the glans size and the urethral plate width as indicators to assess the postoperative results; in multiple studies providing circumferences in children with hypospadias, the size of the glans may be more easily quantified. However, no systematic measurements of penile diameters in males have been reported. Measurements were taken at the point of maximal glans width and were taken using a ruler in the outpatient clinic at the time of initial presentation (Fig. 1)<sup>6</sup>.

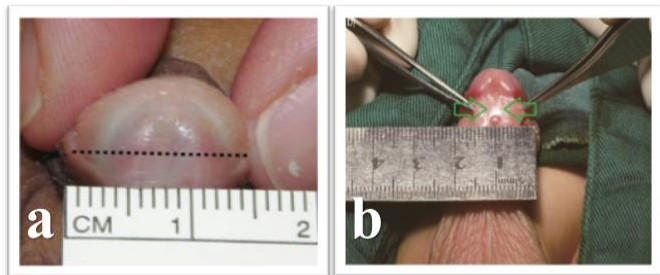


Figure 1: The maximal glans diameter was measured with a ruler (a), and the glans measurement was noted with a dashed line. Regardless of the prepuce, the ruler measures the broadest point. In the same patient, with the foreskin retracted, calipers were used to measure the broadest region of the glans (b). This patient's maximum glans diameter was 14 mm<sup>6</sup>.

The urethral plate width (the narrowest point when the urethral plate was horizontally stretched to be flat) is widely regarded as one of the fundamental risk factors impacting the results of hypospadias repairs<sup>7</sup>.

The study aims to evaluate the relation of age with the glans size and the urethral plate width with a particular concentration on their effect on postoperative complications and to predict the appropriate size for successful repair.

## PATIENTS AND METHODS

A prospective case series study of 100 boys with distal hypospadias who underwent primary TIP repair at Al-Khansa Teaching Hospital in Mosul city/Iraq, from February 2019 to August 2021, by Two pediatric surgeons worked as a team. Patients with distal penile hypospadias (1-14) years and non-circumcised were included in this study, while patients with Proximal hypospadias, redo surgery, and patients who received preoperative hormonal therapy were excluded from the study. All patients underwent preoperative measurement of the glans size and the urethral plate's width using Vernier (Figure).

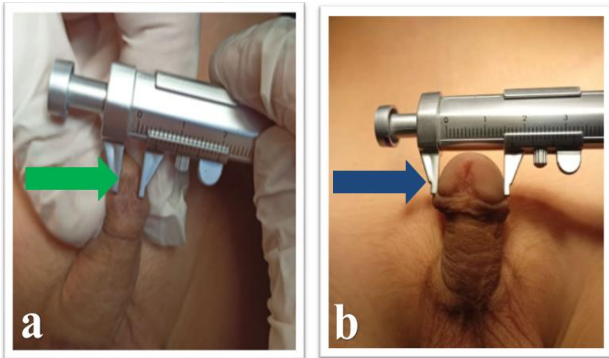


Figure 2: (a, b) Green arrows show the edge of the urethral plate, which was stretched horizontally to be flat, and the blue arrow shows the glans size (Al-Khanssa Teaching Hospital Pediatric Surgery Department).

The measurements were recorded in millimeters (mm). At least two measurements were recorded; the first was taken a day before surgery, and the second was under general anesthesia. As a result of this, observer variations decreased. Both recorded measurements were correlated with the patient's age and the intra and postoperative complications at the time of surgical correction and in the early postoperative follow-up.

Our patients were classified as follows:

- Group A, where the glans size  $\leq 12$ mm,**
- Group B, where the glans size  $>12$ mm,**
- Group C, where the urethral plate width  $\leq 8$  mm and**
- Group D where urethral plate width  $> 8$ mm.**

All patients were treated as outpatient surgery, keeping them for eight hrs. postoperatively under the coverage of broad-spectrum antibiotics and analgesia for five days; twice dressing was done for them at 3 to 4 days intervals before removal of the stent.

These groups were evaluated postoperatively and followed in the outpatient clinic two weeks after the stent removal for possible complications. The evaluation continued monthly for at least six months to assess the cosmetic and functional results by routine examination of the external genitalia and assessing the voiding symptoms urine stream using video taken by the patient's parents or caregiver during voiding. The slit-like appearance of the neo-meatus, glans shape, and the straight position of the penis determined the overall acceptable cosmetic look of the penis.

## RESULTS

A total of 100 prepubertal boys underwent tubularized incised plate repair for primary distal hypospadias. The range of age at the time of surgery was (1-14 yr.) with a median of (4 yr.) with 25% and 75% quartile is (2.08 and 9.0 respectively). Sixty-seven (67%) patients presented in the first six years of life; forty-three of them (43%) were between (1-3 yr.) old, 24 patients (24%) were between (3-6 yr.) and 21 patients (21%) between (9-14 yr.). The differences between group A and group B at the age intervals (1-3), (3-6), and (6-9) are statistically non-significant, while at the (9-14) age interval, the difference is significant with (p-value 0.019).

The relation between glans size and the age of patients depicts that the size of the glans is weakly correlated with the age ( $r = 0.227$ ) in a statistically significant way (p-value = 0.023 (figure 3).

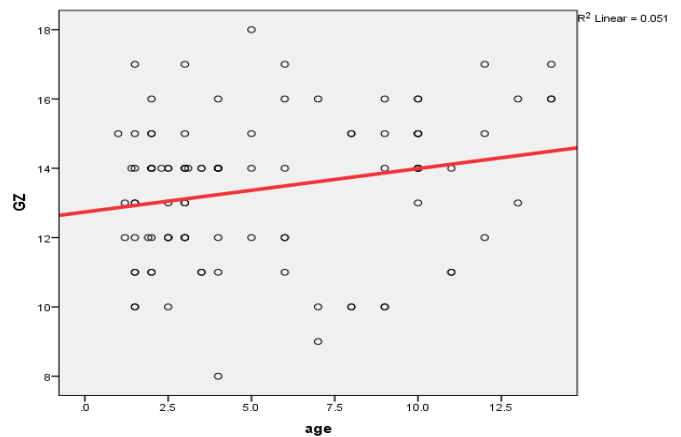


Figure 3: Spearman correlation of Glans size with age.

The difference in plate width according to age intervals shows non-significant differences between the study groups at all the sampled age intervals, table (1):

Table 1: Difference of plate width according to age.

Age	Plate width		p-value*
	Group C (p $\leq 8$ mm) No. (%)	Group D (p $> 8$ mm) No. (%)	
(1-3)yr.	40 (40.0%)	3 (3.0%)	0.381
(3-6)yr.	23(23.0%)	1 (1.0%)	0.274
(6-9)yr.	10 (10.0%)	2 (2.0%)	0.412
(9-14)yr.	17 (17.0%)	4 (4.0%)	0.119
Total	90	10	
*Chi-square test			

The relation between plate width and the age of patients portrays that the plate width is correlating weakly ( $r = 0.225$ ) with age in a statistically significant way ( $p$ -value =0.024), figure (4).

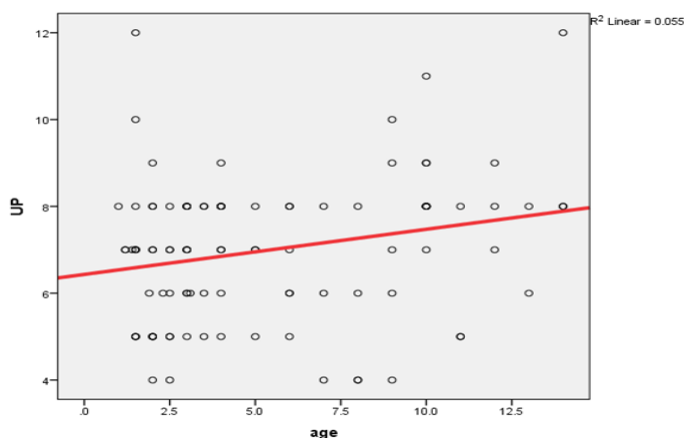


Figure4:Spearman correlation of plate width with age.

Postoperative evaluation for complications like fistula and glans dehiscence, cosmetic outcome, and urine stream quality were done.

The presence and absence of complications among patients regarding age, glans size, and plate width show non-significant differences concerning these parameters, table (2).

Table 2: Complications regarding age, glans size, and plate width.

Parameters	Descriptions	Complications		p-value
		Present No. (%)	Absent No. (%)	
Age	(1-3)yr.	4 (9.3%)	39(90.7%)	0.240*
	(3-6)yr.	3(12.5%)	21(87.5%)	1.0**
	(6-9)yr.	2(16.7%)	10(83.3%)	1.0**
	(9-14)yr.	5(23.8%)	16(76.2%)	0.164**
Glans size	≤ 12mm	6(16.7%)	30(83.3%)	0.564*
	>12mm	8(12.5%)	56(87.5%)	
Plate width	≤ 8 mm	13(14.4%)	77(85.6%)	1.0**
	>8mm	1(10.0%)	9(90.0%)	

\*Chi square test \*\* Fissure Exact test

Postoperative complications in relation to age show that fistula occurred in 6 patients (6.0%), retrusive meatus in 4 patients (4.0%), glans dehiscence in 3 patients (3.0%), and weak urine stream in 1 patient (1.0%).

## DISCUSSION

Generally, the width of the urethral plate usually increases as the patient's penis grows. It could be more appropriate to assess urethral plate quality using a metric that is proportional to penis size; whatever the initial urethral plate configuration or width, tubularized incised plate urethroplasty can be used to treat distal hypospadias. Cosmetic and functional outcomes are good with few difficulties when technical elements are paid attention to by combining glans and shaft skin into the neourethra; enlarging a flat or narrow plate is unnecessary<sup>8</sup>.

In this study, the median age of our patients at the time of surgery was nearly similar to Aboutaleb et al.<sup>9</sup>. Still, it differed from Snodgrass et al.<sup>10</sup> and Bush et al.<sup>6</sup> in which all patients aged between (0-24 months), this could be due to decrease awareness of the community about the proper timing of surgery in the developing countries.

Holland and Smith advocated an 8-mm cut-off number for urethral plate width, ignoring the penile size.<sup>11</sup> Carmak et al. evaluate the glans size and urethral plate per-operatively when the TIP repair is planned. The normal size of the glans had rarely been registered in our patients; the glans size ranges from (8-18mm), and the median is (14.0mm); this was nearly similar to Wei Ru et al.<sup>7</sup>, who found a median glans size was (13.9mm) and differed from Bush et al.,<sup>6</sup> and Faasse et al.,<sup>12</sup> in which the median glans size was (15mm).

In the present study, we divided the patients into categories according to the glans size, group A (≤ 12mm) in diameter and group B (>12mm) in diameter, in 36 patients (36.0%) and 64 patients (64.0%) respectively, our study differ from Bush et al., which determined the (small glans size) the maximum glans diameter (<14mm) and (large glans size ) (>or =14mm)<sup>6</sup>.

In this study, the relation between the glans size and age was weakly correlated ( $r = 0.227$ ) in a statistically significant way ( $p$ -value=0.023), this was differing from Bush et al.<sup>6</sup> and Faasse et al.<sup>12</sup> found glans size did not correlate significantly with patient age ( $R^2=0.01$ ;  $P=0.21$ ) and it didn't increase with the advancing age, this may be related to geographic differences, ethnicities diversions and in some extent to the hormonal effects and this may need further study. As a result, we can depend on the glans size rather than the age of the patients to determine the appropriate time for surgical correction.

This study documented a statistically non-significant difference in complication rate among both groups (small size (<12mm) and acceptable size (>12mm) glans); as we operate on glans size equal to 9-10 mm, this means that small glans size is not a risk factor for postoperative complications,

our finding is similar to Faasse et al., who found that after hypospadias repair, the breadth of the glans penis was not found to be a risk factor for postoperative problems,<sup>12</sup> and our finding differ from Snodgrass et al., who found the small glans was thought to be a risk factor for glans dehiscence.<sup>13</sup> Our result of low and non-significant complications may be due to using a loop magnifier during operations. Still, rather technical difficulties require experience and suitable instrumentation for better results.

The relation of age and plate width was presented in two groups: in group C, the plate was equal and below eight millimeters ( $\leq 8\text{mm}$ ), and in group D, the plate above eight millimeters ( $>8\text{mm}$ ) in 90 patients (90.0%) and ten patients (10.0%) respectively. We depend (on 8mm) in our study since the width of the urethral plate (8mm) is essential for tubularization of the neourethra and reasonable outcome<sup>14</sup> Nguyen et al.,<sup>8</sup> and Aboutaleb et al.<sup>9</sup> also depended on (8mm) as dividing limit in their study.

We found that the plate width was weakly correlated with the age ( $r = 0.225$ ) in a statistically significant way ( $p\text{-value}=0.024$ ), while Wei Ru et al. found the urethral plate width increases as the patient becomes older.<sup>7</sup>

Regarding the relation between urethral plate width and postoperative complications, our study showed that there was no statistically significant difference in complication rate among the two groups, C ( $\leq 8\text{mm}$ ) and D ( $>8\text{mm}$ ); this means that the narrow plate width is not a risk factor for postoperative complications, our finding is similar to Nguyen and Snodgrass whose found that whatever the initial urethral plate configuration or width, tubularized incised plate urethroplasty can be used to treat distal hypospadias, cosmetic and functional outcomes are suitable with few difficulties when technical elements are paid attention,<sup>8</sup> However our findings differ from Holland and Smith, who concluded that narrow urethral plate ( $\leq 8\text{mm}$ ) associated with high postoperative complication<sup>11</sup>.

We think the complications may be due to technical factors rather than a difference in penile anatomy. Also, using magnifying loops with acceptable suturing technique and suture material, in addition to the surgeon's experience, will lead to satisfactory and good postoperative results of hypospadias repair by TIP procedure.

Complications after hypospadias surgery are not uncommon<sup>14</sup>. In our study, postoperative complications were more common in the older age group (9-14yr.) with a percentage of (23.8%), but this was not statistically significant concerning this parameter. Our finding is similar to that of Bush et al., in which there was no association between age and complication after hypospadias repair<sup>15</sup>. Our result differed from Ziada et al., who found that the later age of hypospadias repair was associated with more postoperative complications<sup>16</sup>. However, this might be because the tissue healing process was better in the younger age group. It is suggested that these findings may be related to the patient's factor that plays an important role in certain conditions, as we observed in our study that patients with the same criteria and similar techniques and follow-up but have different results; this issue may need further study.

Fourteen patients (14%) had complications post TIP repair; our findings were nearly similar to those of Keays et al., who found that the complications rate was (15%) in distal hypospadias<sup>17</sup>, but our findings differed from Chukwubuike et al. who found 31% of his patients developed complications postoperatively<sup>14</sup>. These variations in rates of complications may be due to differences in surgical experience.

The most common complication of our study was urethra-cutaneous fistula (6%), which was nearly similar to Pfistermulle et al., who found that the rate of urethra-cutaneous fistula in distal hypospadias repair by TIP was (5.7%)<sup>18</sup>. At the same time, our finding differed from Snodgrass et al., who found that the fistula rate was (2%)<sup>19</sup>. This difference might be attributed to the experience of Snodgrass, who invented the TIP technique. However, our finding was not statistically significant in all parameters mentioned above (patient age, glans size, plate width), which was similar to Chukwubuike et al., who concluded fistula was not related to the width of the urethral plate<sup>14</sup> and differ from Holland and Smith<sup>11</sup> and Aboutaleb et al.<sup>9</sup>

The lack of a standardized method for evaluating hypospadias surgery's cosmetic and functional outcomes has made comparing operational treatments uncertain and subjective<sup>20</sup>. More than 70% of all hypospadias correction patients had an acceptable cosmetic outcome<sup>21</sup>.

We assess the cosmetic and functional results by doing a routine examination of the external genitalia and assessing voiding symptoms urine stream by video taken by the patient's parents or his caregiver during voiding for good urine stream, direction, and post-void residual U/S; we did not use uroflowmetry because it was not available in our hospital. The slit-like appearance of the neomeatus, glans shape, and the straight position of the penis determined the overall acceptable cosmetic look of the penis.

Our study showed non-acceptable cosmetic results in (4%) and a narrow urine stream in (1%) patients. Our finding was not statistically significant in all parameters mentioned above (glans size, plate width). It was similar to Nguyen et al.<sup>8</sup>, and Da Silva et al.<sup>22</sup>, who found urethral plate width does not affect the cosmetic and functional results of TIP repair, While we differ from Chukwubuike et al.<sup>14</sup>, who concluded that Urethral plate widths may not be a reliable indicator of the cosmetic success of hypospadias correction. On the other hand, the width of the urethral plate can affect the functional consequence (urinary stream). However, Insufficient comparable evidence was available to allow for a pooled analysis of cosmetic and functional outcomes<sup>23</sup>.

## CONCLUSION

In hypospadias surgery, there is a weak correlation between age and an increase in penile glans size and urethral plate width, so the best time for surgery could be arranged according to the penile biometers rather than the age. The postoperative complication was not correlated to glans size and urethral plate width measurements.

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## Conflict of Interest

There are no conflicts of interest regarding the publication of this manuscript.

## REFERENCES

1. Hadidi AT. History of hypospadias: Lost in translation. *J. Pediatr Surg.* 2017;52(2):211–7.
2. Sultan SM, AbdelBaky TM, ElShazly M, Youssef KMMZE, Badawy A. Comparative Study Between Tubularized Incised Urethral Plate and Tubularized Incised Plate with Preputial Graft in Hypospadias Repair. *Egypt J Hosp Med.* 2020;81(7):2352–60.
3. Woodhouse CRJ. Hypospadias Surgery: an Illustrated Guide. *Eur J Plast Surg.* 2004;27(4).
4. Yildiz T, Tahtali IN, Ates DC, Keles I, Ilce Z. Age of patient is a risk factor for urethrocutaneous fistula in hypospadias surgery. *J Pediatr Urol.* 2013;9(6 PART A):900–3.
5. Duarsa GWK, Tirtayasa PMW, Daryanto B, Nurhadi P, Renaldo J, Tarmono T, et al., Common Practice of Hypospadias Management by Pediatric Urologists in Indonesia: A Multi-center Descriptive Study from Referral Hospitals. *Open Access Maced J Med Sci.* 2019;7(14):2242–5.
6. Bush NC, Dajusta D, Snodgrass WT. Glans penis width in patients with hypospadias compared to healthy controls. *J Pediatr Urol.* 2013;9(6 PART B):1188–91.
7. Ru W, Shen J, Tang D, Xu S, Wu D, Tao C, et al. Width proportion of the urethral plate to the glans can serve as an appraisal index of the urethral plate in hypospadias repair. *Int J Urol.* 2018;25(7):649–53.
8. Nguyen MT, Snodgrass WT. Effect of urethral plate characteristics on tubularized incised plate urethroplasty. *J Urol.* 2004;171(3):1260–2.
9. Aboutaleb H. Role of the urethral plate characters in the success of tubularized incised plate urethroplasty. *Indian J Plast Surg.* 2014;47(2):227–31.
10. Snodgrass WT, Bush N, Cost N. Tubularized incised plate hypospadias repair for distal hypospadias. *J Pediatr Urol.* 2010;6(4):408–13.
11. Holland AJA, Smith GHH. Effect of the depth and width of the urethral plate on tubularized incised plate urethroplasty. *J Urol.* 2000;164(2):489–91.
12. Faasse MA, Johnson EK, Bowen DK, Lindgren BW, Maizels M, Marcus CR, et al. Is glans penis width a risk factor for complications after hypospadias repair? *J Pediatr Urol.* 2016;12(4):202.e1-202.e5.

13. Snodgrass W, Cost N, Nakonezny PA, Bush N. Analysis of risk factors for glans dehiscence after tubularized incised plate hypospadias repair. *J Urol.* 2011;185(5):1845–51.
14. Chukwubuike KE, Obianyo NEN, Ekenze SO, Ezomike UO. Assessment of the effect of urethral plate width on outcome of hypospadias repair. *J Pediatr Urol.* 2019;15(6):627.e1-627.e6.
15. Bush NC, Holzer M, Zhang S, Snodgrass W. Age does not impact risk for urethroplasty complications after tubularized incised plate repair of hypospadias in prepubertal boys. *J Pediatr Urol.* 2013;9(3):252–6.
16. Ziada A, Hamza A, Abdel-Rassoul M, Habib E, Mohamed A, Daw M. Outcomes of hypospadias repair in older children: A prospective study. *J Urol.* 2011;185(6 SUPPL.):2483–6.
17. Keys MA, Starke N, Lee SC, Bernstein I, Snodgrass WT, Bush NC. Patient Reported Outcomes in Preoperative and Postoperative Patients with Hypospadias. *J Urol.* 2016;195(4):1215–20.
18. Pfistermuller KLM, McArdle AJ, Cuckow PM. Meta-analysis of complication rates of the tubularized incised plate (TIP) repair. *J Pediatr Urol.* 2015;11(2):54–9.
19. Snodgrass WT. Surgical Atlas Snodgrass technique for hypospadias repair. *BJU Int.* 2005;95(4):683–93.
20. Holland AJA. HOSE: an objective scoring system for evaluating the results of hypospadias surgery. *BJU Int.* 2001;88:255–8.
21. Van der Horst HJR, de Wall LL. Hypospadias, all there is to know. *Eur J Pediatr.* 2017;176(4):435–41.
22. Da Silva EA, Lobountchenko T, Marun MN, Rondon A, Damião R. Role of penile biometric characteristics on surgical outcome of hypospadias repair. *Pediatr Surg Int.* 2014;30(3):339–44.
23. Alshafei A, Cascio S, Boland F, O'Shea N, Hickey A, Quinn F. Comparing the outcomes of tubularized incised plate urethroplasty and dorsal inlay graft urethroplasty in children with hypospadias: a systematic review and meta-analysis. *J Pediatr Urol.* 2020;16(2):154–61.