

Original Research Article

Comparative study between modified Mathieu technique and tubularized incised plate technique in primary repair of distal hypospadias

Sadia Shamsad^{1*}, M. Samidur Rahman², M. Masum Billah³, Zannatul Ferdous Peu⁴,
Zinat Tanjida⁵, Prosenjit Datta², Tania Akter⁶

¹Department of Pediatric Surgery, Evercare Hospital, Dhaka, Bangladesh

²Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh

³Pediatric Nephrology, National Institute of Kidney Diseases and Urology, Dhaka, Bangladesh

⁴Department of Pediatric Surgery, Bangladesh Medical University, Dhaka, Bangladesh

⁵Department of Biochemistry, National Institute of Disease of the Chest and Hospital, Dhaka, Bangladesh

⁶Department of Pediatric Surgery, Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh

Received: 16 February 2026

Revised: 13 March 2026

Accepted: 06 April 2026

*Correspondence:

Dr. Sadia Shamsad,

E-mail: abontika.arefin@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Hypospadias is a congenital anomaly in which the urethral opening is located on the ventral surface of the penis proximal to the glans tip. Among various surgical options, tubularized incised plate (TIP) urethroplasty is widely used. However, anatomical factors such as a narrow urethral plate and shallow glans may limit its success and increase complications. A modified technique combining features of TIP and the Mathieu procedure has been proposed to address these limitations. This study aimed to compare outcomes of the Modified Mathieu (Mathieu-IP) technique and TIP urethroplasty in primary distal hypospadias repair.

Methods: This study was conducted at DMCH from January 2021 to June 2022, including 44 patients aged 1-12 years with primary distal hypospadias. Patients were purposively divided into two groups: 22 underwent the Modified Mathieu technique and 22 underwent TIP repair. Follow-up was done on postoperative days 7 and 14, and at 1 and 3 months (excluding four patients lost to follow-up). Data on perioperative variables and complications were analyzed using Student's t-test, Chi-square test, and Fisher's exact test, with $p < 0.05$ considered significant.

Results: No significant difference was observed in neo-meatus formation. Meatal stenosis occurred in two (10%) TIP patients. Urethrocutaneous fistula was seen in five (25%) TIP patients and three (15%) Modified Mathieu patients. Splayed urinary stream occurred in 15% and 25% of patients, respectively, while 10% of TIP patients had a narrow stream. These differences were not statistically significant ($p=0.219$).

Conclusions: No significant difference was found between the Modified Mathieu and TIP techniques in primary distal hypospadias repair.

Keywords: Distal hypospadias, Mathieu-IP repair, TIP, Urethroplasty

INTRODUCTION

Hypospadias is an abortive development of the urethral spongiosum and ventral prepuce along with an arrest in

the normal embryological correction of penile curvature.¹ It is a developmental anomaly characterized by a urethral meatus that opens onto the ventral surface of the penis, proximal to the tip of the glans. It is one of the most

common congenital anomalies, occurring in approximately 1 in 250 male births.² Probable cause of hypospadias includes genetic factors, inadequate hormonal stimulation, maternal or placental factors, environmental factors.³

Hypospadias is classified by the location of the external urethral meatus into anterior, middle, and posterior variety. Anterior include glanular, sub-coronal and distal penile hypospadias. Middle variety includes mid penile hypospadias which located along the middle third of the penile shaft. Posterior variety include proximal, penoscrotal, scrotal and perineal hypospadias.⁴

There are two methods that have been widely used, peri meatal based flap (Mathieu technique) and tubularized incised plate urethroplasty (TIP urethroplasty). In 1932, Mathieu described a single-stage, meatal-base flap technique to repair the distal form of hypospadias. It gained more popularity in next 80 years. In 1994, Snodgrass first described TIP urethroplasty, which involves a deep longitudinal incision of the urethral plate in the midline, which allows the lateral skin flaps to be mobilized and closed in the midline without tension.

Advantage of Mathieu technique is it can be performed in case of narrow urethral plate (less than 8mm width) along with calibrated neourethra formation. Some disadvantages of Mathieu technique are formation of horizontal, rounded neo-meatus which is less acceptable than the slit like neo-meatus of TIP technique.^{5,6}

The disadvantages of TIP urethroplasty are relatively high incidence of urethra-cutaneous fistula (0-33%, varies from centre to centre and surgeon to surgeon) and meatal stenosis that need regular dilatation and sometimes need meatotomy.^{7,8}

The present study aimed to compare the outcomes of the Modified Mathieu technique and the tubularized incised plate technique in the primary repair of distal hypospadias.

METHODS

Study design

The research was conducted using a prospective, comparative study approach.

Study period

This study was conducted at Dhaka Medical College Hospital from January 2021 to June 2022.

Study place

All procedures and data collection were conducted in the Department of Paediatric Surgery at Dhaka Medical College Hospital, Dhaka.

Inclusion criteria

Boys within the pediatric age range with distal hypospadias, characterized by a meatal opening located at the coronal, subcoronal, or distal penile levels, were included. Patients with no chordee or only minimal curvature were eligible. In addition, informed written consent was obtained from the parents or legal guardians of all participants.

Exclusion criteria

Patients with additional genital anomalies or active infection of the genital region were excluded.

Sampling technique

Eligible participants were divided into two groups using purposive sampling. One group underwent the Modified Mathieu technique, and the other group underwent the Tubularized Incised Plate (TIP) urethroplasty.

Surgical procedures

Children meeting the criteria were admitted for surgery. Following history taking, clinical evaluation, and necessary preoperative investigations, patients were prepared for the planned operative day. Standard preoperative hygiene measures and antiseptic preparation of the genitalia were ensured.

Under general anesthesia with caudal analgesia, each child underwent the assigned surgical procedure either the Modified Mathieu technique or TIP urethroplasty. A urethral stent of appropriate size was placed, and a compressive dressing was applied. Intravenous antibiotics were provided initially, followed by an oral course. Analgesia was maintained according to postoperative comfort needs. Dressings and the stent were removed after the early postoperative period, and relevant clinical findings were recorded. Families were counseled regarding possible early and late complications and instructed about scheduled follow-ups.

Data collection

Clinical data and investigation results were collected from the specified study setting. A structured data sheet was used to ensure uniform documentation. Information was obtained using a prescribed questionnaire after informed consent. Follow-up findings were recorded using a semi-structured questionnaire.

Sample size

The required sample size was determined using a standard statistical formula based on outcome proportions reported in previous research. Although the calculated sample size provided equal allocation between the two study arms, the actual number of eligible participants was

limited due to pandemic-related constraints. A small number of patients were removed from final analysis due to loss of follow-up.

Data analysis

After data collection, all entries were carefully reviewed and cleaned before analysis. Data coding and statistical evaluation were performed using specialized statistical software. Results were expressed through frequencies, percentages, tables, and graphical presentations. Continuous variables were summarized using mean and standard deviation, while categorical variables were assessed through appropriate statistical tests. A standard significance threshold was applied to determine the relevance of observed differences.

RESULTS

There was no significant difference between ages of two groups as the $p=0.952$ (obtained by Unpaired t-test) (Table 1).

Table 1: Age-wise distribution of the study subjects (n=40).

Age (years)	Mathieu-IP	TIP	P value
≤5, N (%)	11 (55.0)	12 (60.0)	0.952
>5, N (%)	9 (45.0)	8 (40.0)	
Mean±SD	5.41±2.77	5.47±3.16	
Min-max	2-12	1-12	

There was no statistically significant difference in pre-operative assessment between two groups of the study subjects (Table 2).

Table 2: Preoperative assessment of the study subjects (n=40).

	Mathieu-IP, N (%)	TIP, N (%)	P value
Site of meatus			
Coronal	14 (70.0)	12 (60.0)	0.749
Sub-coronal	5 (25.0)	6 (30.0)	
Distal penile	1 (5.0)	2 (10.0)	
Glans			
Grooved	9 (45.0)	7 (35.0)	0.778
Non grooved	9 (45.0)	10 (50.0)	
Flat	2 (10.0)	3 (15.0)	
Urethral plate width			
<8mm	6 (30.0)	8 (40.0)	0.796
8mm	9 (45.0)	8 (40.0)	
>8mm	5 (25.0)	4 (20.0)	

Postoperatively, among the 40 patients, a normal urinary stream was observed in 17 (85.0%) of the Mathieu-IP group versus 13 (65.0%) of the TIP group; a splayed stream occurred in 3 (15.0%) of Mathieu-IP and 5

(25.0%) of TIP patients, while a narrow stream was seen only in the TIP group (2 patients, 10.0%). The difference in the distribution of stream types between the two surgical techniques did not reach statistical significance ($p=0.219$) (Figure 1).

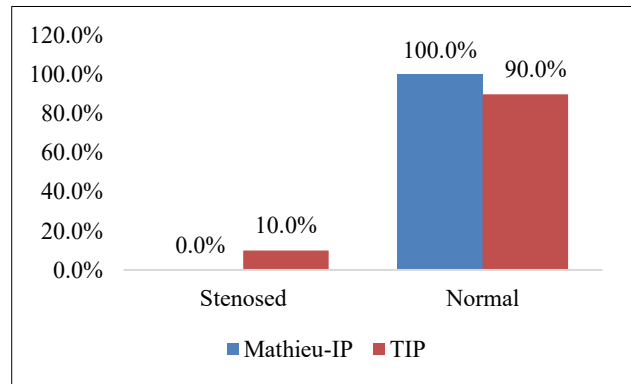


Figure 1: Postoperative neo-meatus at different follow ups.

Postoperatively, a vertically slit-like meatus was observed in 18 patients (90.0%) in the Mathieu-IP group and in all 20 patients (100.0%) in the TIP group, while a rounded meatus was seen only in the Mathieu-IP group (2 patients, 10.0%). However, this difference in meatal shape between the two techniques was not statistically significant ($p=1.000$, Fisher’s Exact test) (Figure 2).

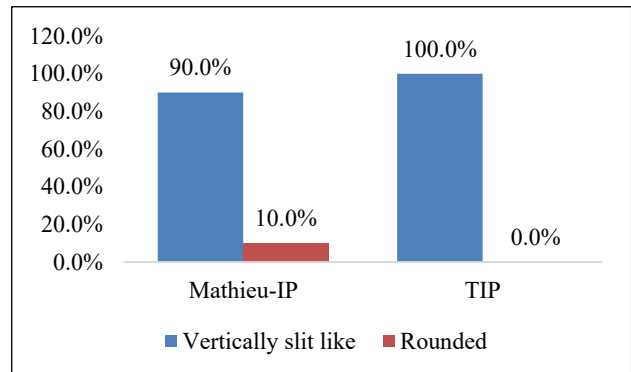


Figure 2: Postoperative shape of meatus.

Postoperatively, fistula formation occurred in 3 patients (15.0%) in the Mathieu-IP group and in 5 patients (25.0%) in the TIP group, while the majority in both groups had no fistula 17 patients (85.0%) in Mathieu-IP and 15 patients (75.0%) in TIP. The difference in fistula incidence between the two techniques was not statistically significant ($p=1.000$, Fisher’s Exact test) (Table 3).

Postoperatively, a normal urinary stream was observed in 17 patients (85.0%) in the Mathieu-IP group compared to 13 patients (65.0%) in the TIP group. Splayed stream was seen in 3 patients (15.0%) undergoing Mathieu-IP and 5 patients (25.0%) undergoing TIP, while a narrow stream

occurred only in the TIP group (2 patients, 10.0%). Overall, the difference in urinary stream outcomes between the two techniques was not statistically significant ($p=0.219$) (Table 4).

Table 3: Postoperative fistula (n=40).

Postoperative fistula	Mathieu-IP, N (%)	TIP, N (%)	P value
Fistula	3 (15.0)	5 (25.0)	1.000
No fistula	17 (85.0)	15 (75.0)	

Fisher’s Exact test was done

Table 4: Postoperative stream of urine (n=40).

Stream of urine	Mathieu-IP, N (%)	TIP, N (%)	P value
Normal	17 (85.0)	13 (65.0)	0.219
Splayed	3 (15.0)	5 (25.0)	
Narrow	0	2 (10.0)	

Fisher’s Exact test was done

DISCUSSION

In the present study, the age distribution between the Mathieu-IP and TIP groups was comparable, with mean ages of 5.41 ± 2.77 years and 5.47 ± 3.16 years respectively. This similarity in age profile minimizes potential confounding effects related to tissue healing capacity or urethral plate development. Comparable age distributions have also been noted in studies where the majority of distal hypospadias repairs were performed between 3-7 years, supporting that both techniques are typically applied within similar pediatric age groups.

Postoperative urinary stream is a crucial indicator of functional success in hypospadias repair. In our study, the Mathieu-IP technique produced a normal urinary stream in 85% of patients, compared to 65% in the TIP group. Although this difference was not statistically significant, it suggests a trend toward better functional outcomes with Mathieu-IP in terms of stream quality. Studies have reported that TIP urethroplasty often yields satisfactory urinary flow, yet minor irregularities such as splaying or spraying are not uncommon due to neourethral calibration issues.⁹ In contrast, the modified Mathieu technique, especially with an incised plate, has been shown in the work to produce reliable urinary stream outcomes comparable to TIP, supporting our findings.¹⁰

In relation to meatal shape, our findings revealed that 100% of the TIP group achieved a vertically slit-like meatus, while 90% of the Mathieu-IP group demonstrated this aesthetically favorable outcome. Only 10% in the Mathieu-IP group had a rounded meatus. The superiority of TIP in producing a consistently slit-like meatus has been widely emphasized in literature. Snodgrass originally described the TIP technique as one that reliably produces a vertical, glanular meatus resembling natural anatomy. However, several recent modifications of the

Mathieu technique including the incised plate variant have improved its cosmetic results, as documented in studies which similarly reported slit-like meatus in over 85% of cases.¹¹ Thus, our findings align with global evidence showing that while TIP offers a slight cosmetic advantage, Mathieu-IP produces comparably acceptable outcomes.

Urethrocuteaneous fistula remains one of the most common complications following hypospadias repair. In our study, fistula formation occurred in 15% of patients undergoing Mathieu-IP and 25% undergoing TIP, with no significant difference between groups. The fistula rate in our TIP cohort is consistent with the 5-23% range reported in various series. Other study has noted that fistula rates in TIP decrease significantly with increased surgeon experience and use of well-vascularized dartos flaps.¹² For the Mathieu repair, reported fistula rates generally range from 5-15%, similar to our findings. The slight trend toward fewer fistulas in Mathieu-IP may be attributed to the dual-layer coverage inherent in this technique, which several studies including those by Kaya and Bhat suggest provides superior protection against breakdown.

Overall, our findings suggest that both Mathieu-IP and TIP urethroplasty produce comparable surgical outcomes in terms of functional urinary stream, meatal shape, and fistula formation, with no parameter showing statistically significant differences. This observation supports the conclusions of multiple comparative studies which emphasize that surgeon familiarity, patient anatomy, and meticulous technique are often more important determinants of success than the choice of procedure itself.¹³ The slight advantages noted with TIP in meatal appearance and with Mathieu-IP in urinary stream and fistula rate underscore the importance of individualized surgical planning.

This study has few limitations. First, the study included only 44 patients, which may limit the statistical power and generalizability of the findings. Second, patients were followed for only up to 3 months after surgery, which may not be sufficient to detect late complications such as urethral stricture or long-term functional outcomes. Third, the research was conducted in a single institution (DMCH), which may limit the applicability of the results to other clinical settings or populations.

CONCLUSION

There was no significant difference between Modified Mathieu technique (Mathieu I-P) and Tubularized Incised Plate urethroplasty in primary repair of distal hypospadias. While the TIP repair produced a slightly higher rate of vertically slit-like meatus, the Mathieu-IP technique showed a trend toward fewer fistulas and a greater proportion of normal urinary streams. Overall, both procedures proved to be safe and effective, indicating that the choice of technique may be guided by

surgeon preference, patient anatomy, and individualized clinical judgment rather than clear superiority of one method over the other.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Baskin LS, Duckett JW, Lue TF. Penile curvature. *Urol.* 1996;48(3):347-56.
2. Paulozzi LJ, Erickson JD, Jackson RJ. Hypospadias trends in two US surveillance systems. *Pediatrics.* 1997;100(5):831-4.
3. Bouty A, Ayers KL, Pask A, Heloury Y, Sinclair AH. The genetic and environmental factors underlying hypospadias. *Sexual Developm.* 2016;9(5):239-59.
4. Baskin LS, Ebberts MB. Hypospadias: anatomy, etiology, and technique. *J Pediatr Surg.* 2006;41(3):463-72.
5. Yesildag E, Tekant G, Sarimurat N, Buyukunal SC. Do patch procedures prevent complications of the Mathieu technique?. *J Urol.* 2004;171(6):2623-5.
6. Holland AJ, Smith GH. Effect of the depth and width of the urethral plate on tubularized incised plate urethroplasty. *J Urol.* 2000;164(2):489-91.
7. Gonzales Jr ET, Veeraraghavan KA, Delaune J. The management of distal hypospadias with meatal-based, vascularized flaps. *J Urol.* 1983;129(1):119-20.
8. Snodgrass W, Macedo A, Hoebeke P, Mouriquand PD. Hypospadias dilemmas: a round table. *J Pediatr Urol.* 2011;7(2):145-57.
9. İmamoğlu MA, Bakırtaş H. Comparison of two methods-Mathieu and Snodgrass-in hypospadias repair. *Urolog international.* 2003;71(3):251-4.
10. Kalfa N, Philibert P, Sultan C. Is hypospadias a genetic, endocrine or environmental disease, or still an unexplained malformation?. *Int J Androl.* 2009;32(3):187-97.
11. Kalfa N, Philibert P, Baskin LS, Sultan C. Hypospadias: interactions between environment and genetics. *Mole Cell Endocrinol.* 2011;335(2):89-95.
12. Khalil M, Gharib T, El-Shaer W, Sebaey A, Elmohamady B, Elgamal K. Mathieu technique with incision of the urethral plate versus standard tubularised incised-plate urethroplasty in primary repair of distal hypospadias: A prospective randomised study. *Arab J Urol.* 2017;15(3):242-7.
13. Lund L, Engebjerg MC, Pedersen L, Ehrenstein V, Nørgaard M, Sørensen HT. Prevalence of hypospadias in Danish boys: a longitudinal study, 1977-2005. *Europ Urol.* 2009;55(5):1022-6.

Cite this article as: Shamsad S, Rahman MS, Billah MM, Peu ZF, Tanjida Z, Datta P, et al. Comparative study between modified Mathieu technique and tubularized incised plate technique in primary repair of distal hypospadias. *Int J Contemp Pediatr* 2026;13:728-32.