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Outcome of Tubularized Incised Plate (TIP) Urethroplasty in Distal Penile Hypospadias in Pediatric Patients.

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ABSTRACT

Background:Tubularized incised plate (TIP) urethroplasty is widely regarded as a preferred technique for the correction of distal penile hypospadias due to its technical simplicity, reliability, and favourable cosmetic outcomes. However, surgical results may vary depending on tissue characteristics and operative factors. This study aimed to evaluate the functional and cosmetic outcomes, as well as the complication profile, of TIP urethroplasty in paediatric patients with distal penile hypospadias.

Methods: A prospective observational study was conducted involving 71 paediatric patients with primary distal penile hypospadias who underwent TIP urethroplasty between January 2019 and August 2025. Preoperative characteristics, intraoperative details, and postoperative outcomes were recorded. Cosmetic outcomes were assessed using the Hypospadias Objective Scoring Evaluation (HOSE) system, while parental satisfaction was evaluated through structured feedback. Statistical analysis was performed using SPSS, with a significance level set at $p < 0.05$.

Results: The mean age at surgery was 2.9 ± 1.4 years. Coronal hypospadias was the most common subtype (45.1%), and chordee was present in 25.4% of patients. Urethrocutaneous fistula occurred in 8.5% of cases, while meatal stenosis (5.6%) and glans dehiscence (2.8%) were less frequent. Poor urethral plate quality was significantly associated with fistula formation ($p = 0.013$). Good cosmetic outcomes (HOSE score ≥14) were achieved in 88.7% of patients, and 85.9% of parents reported satisfaction with the surgical results. Reoperation was required in 9.9% of cases.

Conclusion: TIP urethroplasty is a safe and effective option for the management of distal penile hypospadias in children. Careful assessment of urethral plate quality and meticulous surgical technique are essential to minimize complications and optimize outcomes.

Keywords: Tubularized Incised Plate, Hypospadias, Pediatric Urology, TIP Repair, Urethroplasty, Surgical Outcomes, HOSE Score

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1. INTRODUCTION

Hypospadias is one of the most common congenital anomalies of the male external genitalia and is characterized by an abnormally positioned urethral meatus on the ventral aspect of the penis. Based on meatal location, hypospadias is broadly classified into distal, mid-penile, and proximal forms, with distal variants (coronal, subcoronal, and distal penile) accounting for the majority of cases encountered in clinical practice [1-3].

The primary objectives of hypospadias repair include the creation of a functionally adequate and cosmetically acceptable urethra, preservation of penile straightness, and facilitation of normal voiding and sexual function later in life. Over time, multiple surgical techniques have been developed to achieve these goals. Among them, tubularized incised plate (TIP) urethroplasty, originally described by Snodgrass in the 1990s, has gained widespread acceptance, particularly for distal hypospadias, due to its reproducibility, technical simplicity, and favourable cosmetic outcomes [4-6].

Despite its advantages, TIP urethroplasty is not free from complications. Urethrocutaneous fistula, meatal stenosis, and glans dehiscence are the most commonly reported postoperative issues. Previous studies have suggested that these complications may be influenced by factors such as urethral plate quality, degree of chordee, and surgical technique, emphasizing the importance of careful preoperative assessment and meticulous operative execution [7-9].

The present study was undertaken to evaluate the outcomes of TIP urethroplasty in paediatric patients with distal penile hypospadias, with particular emphasis on postoperative complications, cosmetic and functional results, and the influence of urethral plate characteristics and operative factors on surgical success.

Methodology

It was a prospective observational study conducted over a period of five and a half years, from January 2019 to August 2025, at Govt. Sardar Begum Teaching Hospital, Sialkot, and Allama Iqbal Memorial Teaching Hospital, Sialkot. The study aimed to assess the surgical outcomes and complication profile associated with tubularized incised plate (TIP) urethroplasty in paediatric patients presenting with distal penile hypospadias.

A total of 71 primary (virgin) cases of distal penile hypospadias were included. Participants were enrolled using a non-probability consecutive sampling technique from patients presenting to the outpatient and surgical departments of paediatric surgery and urology during the study period.

Inclusion Criteria

Male patients aged 6 months to 10 years

Diagnosed with coronal, subcoronal, or distal penile hypospadias

No prior history of hypospadias repair

Written informed consent obtained from parents or legal guardians

Exclusion Criteria

Proximal hypospadias, intersex conditions, or major penile anomalies

Severe chordee requiring staged repair

Previously operated cases

Systemic comorbidities contraindicating anaesthesia or surgery

All patients underwent a detailed preoperative clinical assessment. The type and location of hypospadias, presence of chordee, and quality of the urethral plate were evaluated and documented. Clinical photographs and measurements were obtained with parental consent for record purposes.

All procedures were performed under general anaesthesia with caudal block for postoperative analgesia. The tubularized incised plate (TIP) urethroplasty, as originally described by Snodgrass, was performed in all cases. A midline incision was made in the urethral plate to facilitate tubularization. The neourethra was constructed using absorbable sutures (6-0 Vicryl or PDS), selected based on surgeon preference and intraoperative considerations. A silicone urethral stent was placed for urinary diversion.

The neourethra was covered with a vascularized dartos flap, and glans wings were approximated without tension. Skin closure was completed in layers. Operative duration, suture material used, and intraoperative findings or modifications were recorded for each case.

Postoperatively, patients were monitored in the hospital for 48 to 96 hours. The urethral stent was maintained for approximately 7–10 days and removed under sterile conditions. Parents were counseled regarding wound care and hygiene. Follow-up visits were scheduled at 1 week, 2 weeks, 1 month, 3 months, and 6 months after surgery.

Outcomes were evaluated based on:

Early postoperative complications: oedema, bleeding, wound infection, skin necrosis

Late complications: urethrocutaneous fistula, meatal stenosis, glans dehiscence, urethral stricture

Cosmetic outcome: assessed using the Hypospadias Objective Scoring Evaluation (HOSE) system

Parental satisfaction: recorded using a structured feedback form

Data were entered and analyzed using SPSS version 25. Descriptive statistics were calculated for all variables. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Associations between categorical variables, particularly urethral plate quality and fistula formation, were analyzed using the Chi-square test, with a p-value < 0.05 considered statistically significant.

RESULTS

A total of 71 paediatric patients with distal penile hypospadias underwent tubularized incised plate (TIP) urethroplasty during the study period. The age of patients ranged from 1 to 7 years, with a mean age of 2.9 ± 1.4 years. The mean weight at surgery was 12.8 ± 3.1 kg. Most patients were from urban areas (60.6%), and the majority were born at term (91.5%). These demographic characteristics indicate that the study population largely consisted of young, otherwise healthy children undergoing primary repair.

Table 1: Demographic Characteristics of Study Participants (n = 71)

Variable	Frequency (%)	Mean ± SD
Age at surgery (years)	–	**2.9 ± 1.4**
Weight at surgery (kg)	–	**12.8 ± 3.1**
Residence		
– Urban	**43 (60.6%)**	
– Rural	**28 (39.4%)**	
Gestational age		
– Full-term	**65 (91.5%)**	
– Preterm	**6 (8.5%)**	

On preoperative evaluation, coronal hypospadias was the most common anatomical subtype (45.1%), followed by subcoronal (36.6%) and distal penile hypospadias (18.3%). Chordee was present in 25.4% of patients. Assessment of urethral plate quality showed that 69.0% had good-quality plates, while 25.4% were fair and 5.6% were poor , highlighting the variability in tissue characteristics among patients.

Table 2: Preoperative Clinical Features

Variable	Frequency (%)
Hypospadias type	
– Coronal	**32 (45.1%)**
– Subcoronal	**26 (36.6%)**
– Distal penile	**13 (18.3%)**

Chordee present	**18 (25.4%)**
Chordee absent	**53 (74.6%)**
Urethral plate quality	
– Good	**49 (69.0%)**
– Fair	**18 (25.4%)**
– Poor	**4 (5.6%)**

All patients underwent TIP urethroplasty under general anaesthesia. The mean operative time was 72.5 ± 11.6 minutes. Absorbable sutures were used in all cases, with Vicryl 6/0 used in 71.8% and PDS in 28.2% of procedures. Urethral stents were placed in all patients, with a mean stenting duration of 7.0 ± 1.2 days, reflecting standardized postoperative urinary diversion.

Table 3: Intraoperative Findings and Surgical Details

Variable	Frequency (%)	Mean ± SD
Duration of surgery (minutes)	–	**72.5 ± 11.6**
Suture material used		
– Vicryl 6/0	**51 (71.8%)**	
– PDS	**20 (28.2%)**	
Urethral stent used	**71 (100%)**	
Duration of stenting (days)	–	**7.0 ± 1.2**

Early postoperative complications were generally mild and self-limiting. Edema was the most frequently observed early complication (8.5%), followed by wound infection (5.6%), bleeding (4.2%), and minor skin necrosis (1.4%). During follow-up, urethrocutaneous fistula developed in 8.5% of patients, meatal stenosis in 5.6%, and glans dehiscence in 2.8%. One patient (1.4%) developed urethral stricture, and 7 patients (9.9%) required reoperation due to postoperative complications.

Table 4: Postoperative Outcomes and Complications

Variable	Frequency (%)
Early complications	
– Bleeding	**3 (4.2%)**
– Wound infection	**4 (5.6%)**
– Edema	**6 (8.5%)**
– Skin necrosis	**1 (1.4%)**
Late complications	
– Urethrocutaneous fistula	**6 (8.5%)**
– Meatal stenosis	**4 (5.6%)**
– Glans dehiscence	**2 (2.8%)**
– Urethral stricture	**1 (1.4%)**
Reoperation required	**7 (9.9%)**

A statistically significant association was observed between urethral plate quality and urethrocutaneous fistula formation. Patients with poor-quality urethral plates demonstrated a markedly higher incidence of fistula, and this relationship was statistically significant (p = 0.013).

Table 5: Association of Urethral Plate Quality with Fistula Formation

Urethral Plate Quality	Fistula (n = 6)	No Fistula (n = 65)	p-value
Good	**1**	**48**	**0.013**
Fair	**3**	**15**	
Poor	**2**	**2**	

Cosmetic outcomes were favourable in the majority of patients. Based on the HOSE (Hypospadias Objective Scoring Evaluation) system, 88.7% of patients achieved a good cosmetic outcome (score ≥14). Parental feedback indicated that 85.9% were satisfied with the surgical outcome, while a small proportion reported neutral or dissatisfied responses.

Table 6: Cosmetic Outcome and Parental Satisfaction

Outcome Measure	Frequency (%)
HOSE score ≥14 (good outcome)	**63 (88.7%)**
HOSE score <14	**8 (11.3%)**
Parental satisfaction	
– Satisfied	**61 (85.9%)**
– Neutral	**8 (11.3%)**
– Dissatisfied	**2 (2.8%)**

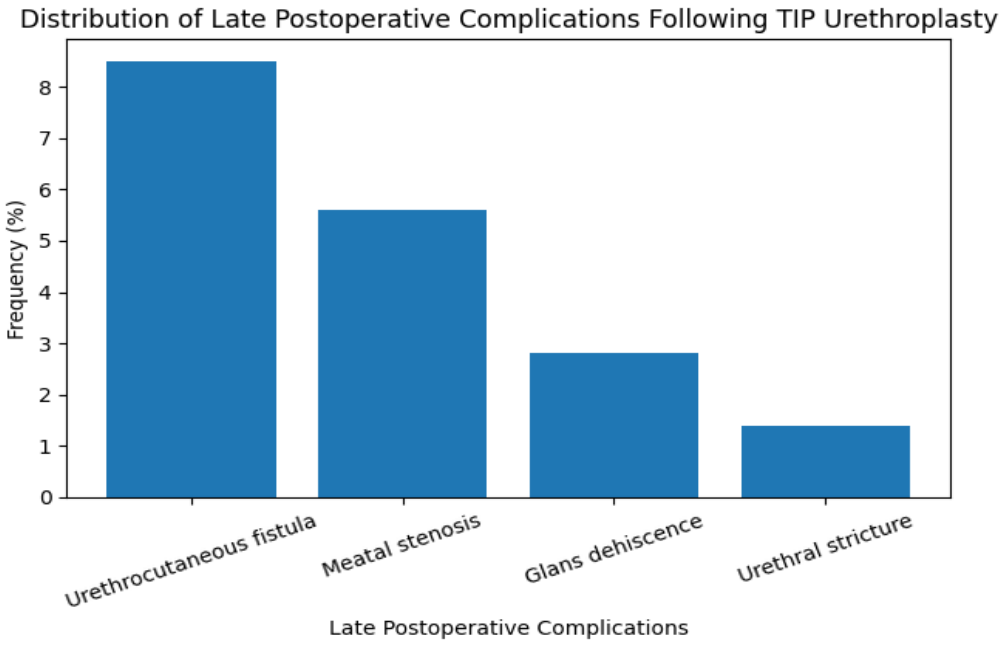

Figure 1. Distribution of late postoperative complications following tubularized incised plate (TIP) urethroplasty in pediatric patients.

2. DISCUSSION

Tubularized incised plate (TIP) urethroplasty, commonly referred to as the Snodgrass procedure, continues to be one of the

most widely accepted techniques for the repair of distal penile hypospadias. In the present series of 71 paediatric patients, the procedure demonstrated favourable functional and cosmetic outcomes, consistent with findings reported in both regional and international literature [10-12].

The overall complication profile observed was acceptable and comparable to published data. Urethrocutaneous fistula occurred in 8.5% of patients, a rate that falls within the commonly reported range of 5–10% for distal hypospadias repair using the TIP technique [13-15]. Previous studies have highlighted that fistula formation is often influenced by tissue quality, surgical tension, and local vascularity, rather than the technique itself. The observed complication rate therefore reflects realistic outcomes in routine clinical practice.

Meatal stenosis (5.6%) and glans dehiscence (2.8%) were infrequent and similar to rates reported in studies emphasizing the importance of meticulous glans dissection and tension-free closure [16-18]. Importantly, a statistically significant association between poor urethral plate quality and fistula formation ($p = 0.013$) was demonstrated. This finding reinforces the growing evidence that urethral plate characteristics are a critical determinant of surgical success. Other investigators have similarly recommended urethral plate augmentation or alternative reconstructive strategies when the native plate is narrow or of poor quality[19].

Operative variables, including mean surgical duration (72.5 ± 11.6 minutes), use of absorbable sutures (Vicryl or PDS), and short-term stenting (7.0 ± 1.2 days), reflect standardized and contemporary surgical practice. These factors may have contributed to the relatively low incidence of severe complications and facilitated early postoperative recovery. Nevertheless, 9.9% of patients required reoperation, primarily due to fistula or stenosis, underscoring that secondary procedures remain an important consideration even with optimized primary repair

Cosmetic and functional outcomes were highly satisfactory. Based on the HOSE scoring system, 88.7% of patients achieved a good cosmetic outcome (score ≥ 14). In parallel, 85.9% of parents reported satisfaction with the surgical results. These findings are consistent with reports from diverse healthcare settings, confirming that TIP urethroplasty offers reproducible and cosmetically acceptable results when performed with appropriate patient selection and surgical precision[20].

Overall, the updated findings further support the role of TIP urethroplasty as a reliable first-line procedure for distal hypospadias repair, while emphasizing the need for careful intraoperative judgment in patients with compromised urethral plate anatomy.

3. CONCLUSION

Tubularized incised plate urethroplasty is a safe, effective, and reproducible technique for the management of distal penile hypospadias in paediatric patients. The procedure provides excellent cosmetic and functional outcomes, as reflected by favorable HOSE scores and high parental satisfaction. Although complication rates remain low, urethral plate quality plays a pivotal role in postoperative success, with poor-quality plates associated with an increased risk of fistula formation. The need for reoperation in a minority of cases highlights the importance of meticulous surgical technique and careful patient selection. Long-term follow-up and multicenter studies are recommended to further refine surgical strategies and optimize outcomes.

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