Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v7i2.2178
*Biol. Clin. Sci. Res. J., Volume 7(2), **2026**: 2178*
Original Research Article

Does Suturing Technique Affect Outcomes of TIP Urethroplasty? A Comparative Study of Distal Penile Hypospadias in a Tertiary Care Hospital

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(Received, 24th October 2025, Accepted 18th January 2025, Published 28th February 2026)

Abstract: *Hypospadias is one of the most common congenital anomalies in male children. Distal penile hypospadias is commonly corrected using tubularized incised plate (TIP) urethroplasty (Snodgrass procedure). The optimal suturing technique for urethral tubularization, interrupted versus continuous, remains uncertain.* ***Objective:*** *To compare postoperative complication rates between interrupted and continuous suturing techniques in TIP urethroplasty for distal penile hypospadias.* ***Methods:*** *This retrospective study was conducted from September 2024 to October 2025 at the Department of Pediatric Surgery, The Children's Hospital and Institute of Child Health, Multan. Eighty-eight patients who met the inclusion criteria were enrolled and randomly assigned to two groups. Group A underwent TIP urethroplasty using an interrupted suturing technique, while Group B underwent repair using a continuous suturing technique. Patients were followed up at one week post-discharge and subsequently at 1, 2, and 3 months postoperatively. The primary outcome measure was the occurrence of postoperative complications.* ***Results:*** *Postoperative complications occurred in 13 patients (29.1%) in Group A and 17 patients (39.1%) in Group B. The difference between the two groups was not statistically significant ($p > 0.05$). Urethrocutaneous fistula was the most frequently observed complication in both groups.* ***Conclusion:*** *The suturing technique—interrupted or continuous—does not significantly affect the rate of postoperative complications following Snodgrass repair for distal penile hypospadias.*

Keywords: Distal penile hypospadias, tubularized incised plate urethroplasty, Snodgrass procedure, urethrocutaneous fistula, postoperative complications

[***How to Cite:*** Aslam M, Ahmad S, Kamran RA, Hussain B, Ali U, Hanif A. Does suturing technique affect outcomes of TIP urethroplasty? A comparative study of distal penile hypospadias in a tertiary care hospital. *Biol. Clin. Sci. Res. J.,* **2026;** 7(2): 1-4. doi: https://doi.org/10.54112/bcsrj.v7i2.2178

Introduction

Hypospadias is one of the most common congenital anomalies of the male genitourinary system, characterised by the abnormal ventral positioning of the urethral meatus proximal to the glans penis (1). The condition affects approximately 1 in every 200–250 male infants, making it a significant public health concern worldwide (2). The spectrum of hypospadias is broad, ranging from glanular and coronal variants to penoscrotal and perineal forms, with the distal or anterior variety accounting for approximately 75% of cases (1,3). The surgical correction of hypospadias remains the only definitive treatment, with the primary goals being orthoplasty (penile straightening), urethroplasty, meatoplasty, glanuloplasty, and satisfactory cosmetic restoration, enabling the patient to void in a standing position from the tip of the glans (1,4). Since its first description by Warren T. Snodgrass in 1994, the Tubularized Incised Plate (TIP) urethroplasty has emerged as the most widely accepted and practiced technique for the repair of distal and mid-penile hypospadias globally (1,5). The fundamental principle of TIP urethroplasty involves a deep midline longitudinal incision of the urethral plate to facilitate tension-free tubularization around a soft silicone catheter, thereby creating a neourethra of adequate caliber (4,6). The technique has gained widespread acceptance due to its technical simplicity, reproducibility, excellent cosmetic outcomes, and applicability to both primary and redo cases (7,8). Contemporary surveys confirm that TIP repair remains the preferred technique for distal hypospadias among pediatric urologists internationally, with a large majority of specialists selecting it as their first-line approach (9,10).

Despite its popularity, TIP urethroplasty is not without complications. Reported complication rates range from approximately 10% for distal repairs to 50% for proximal repairs (2). The most frequently encountered complications include urethrocutaneous fistula (UCF), meatal stenosis, glans dehiscence, urethral stricture, and wound dehiscence (4,7,11). Fistula rates following TIP urethroplasty have been reported to range from 0% to 28% in various series (6). Multiple factors have been identified as influencing surgical outcomes, including urethral plate width and length, glans width, penile biometry, and the type of tissue used for neourethral coverage (11,12).

Among the technical variables that may influence outcomes, the suturing technique employed during urethroplasty has attracted increasing scholarly attention. Both continuous (running) and interrupted suturing techniques are employed in clinical practice, yet no definitive consensus exists regarding their comparative superiority (13). A recent meta-analysis encompassing 1,894 patients demonstrated no statistically significant difference in overall complication rates, meatal stenosis, glans dehiscence, or urethral stricture between continuous and interrupted sutures; however, interrupted sutures with polyglactin material were associated with fewer complications, while continuous sutures were associated with shorter operative times (13). Contemporary Ibero-American surveys indicate that surgeons prefer running sutures or a combination of continuous and interrupted stitches, with polydioxanone 6-0 in a double-layer configuration being favored for more complex cases (9).

In Pakistan, hypospadias represents a significant surgical burden, particularly in tertiary care settings where patients often present late due to limited healthcare access and socioeconomic constraints (6,14). The healthcare system in Pakistan faces significant economic pressures, and identifying cost-effective, reproducible, and outcome-optimizing surgical strategies is of paramount importance (6). Studies conducted at Pakistani institutions, including randomized controlled trials from Mayo Hospital, Lahore, have demonstrated that modifications to the TIP technique—such as the use of a double dartos flap—can significantly reduce fistula rates (15). However, the specific impact of suturing technique (continuous versus interrupted) on outcomes of TIP urethroplasty for distal penile hypospadias has not been systematically evaluated in the Pakistani tertiary care context. Given the variability in surgical training, resource availability, and patient demographics across Pakistani institutions, a comparative study of suturing techniques is both timely and clinically relevant. Establishing locally validated evidence will enable surgeons in resource-limited settings to adopt the most effective and efficient technique, thereby reducing reoperation rates, minimizing patient morbidity, and alleviating the economic burden on both families and the healthcare system.

Methodology

This retrospective study was conducted in the Department of Paediatric Surgery at The Children's Hospital and Institute of Child Health, Multan, over 12 months from September 2024 to August 2025, with follow-up of all enrolled patients. Consecutive sampling was used to recruit eligible male children presenting with distal penile hypospadias, and randomisation was performed using a lottery method to allocate patients into two equal groups. Sample size was calculated using the formula for comparison of two proportions, requiring a total of 88 patients (44 in each group) to achieve 80% study power at a 95% confidence level, assuming an expected urethrocutaneous fistula rate of 12.5% in the interrupted suturing group and 37.5% in the continuous suturing group, as reported in previous literature. Male children aged 1–12 years with distal penile hypospadias, mild chordee (15–20 degrees) or no chordee, normal-sized meatus, healthy ventral penile skin, and adequate hemoglobin levels and weight appropriate for age were included, while patients undergoing redo surgery, those with moderate to severe chordee, proximal hypospadias, significant comorbidities, loss to follow-up, or unwillingness to participate were excluded.

Following Institutional Ethical Review Committee approval, eligible patients were enrolled. Baseline demographic data and clinical findings were recorded, and all relevant investigations were performed and optimised prior to surgery. Patients were randomly assigned to Group A (continuous suturing) or Group B (interrupted suturing). All procedures were performed by a consultant paediatric surgeon using a standardised tubularized incised plate (TIP) urethroplasty technique. In the absence of postoperative complications, patients were discharged on the eighth postoperative day. Follow-up visits were scheduled at one week postoperatively. During follow-up, patients were evaluated for postoperative complications, including urethrocutaneous fistula, urethral stricture, and wound disruption. All observations were documented using a pre-designed pro forma.

Data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) version 25. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparisons between the two groups were made using Student's t-test, and a p-value of ≤ 0.05 was considered statistically significant.

Results

A total of 88 patients were included in the study, with 44 patients in each group. The overall mean age was 4.86 ± 2.10 years (range: 2–12 years). The mean age in Group A was 4.78 ± 2.13 years, and in Group B, 4.95 ± 2.08 years. In both groups, the mean patient weight was also statistically the same, i.e., 18.44 ± 6.65 kg and 17.77 ± 5.40 kg. There was no statistically significant difference in age and weight distribution between the two groups. (Table 1).

Table 1: Descriptive statistics of age (years) and weight in Kg in both study groups

Study Groups	Mean age	SD of age	Mean of weight	SD of weight
Group A	4.78	2.13	18.44	6.65
Group B	4.95	2.08	18.77	5.40
Total	4.86	2.10	18.10	6.04

t-test = −0.391, p-value = > 0.05 (insignificant)

Overall, postoperative complications were observed in 29 (32.95%) patients. In Group A, complications occurred in 11 (25%) patients, while in Group B, 18 (40.9%) patients developed complications. Although complications were more frequent in Group B, the difference between the two groups was not statistically significant ($\chi^2 = 2.45$, p = 0.118) (Table 4).

Table 2: Comparison of overall complications in both study groups

Complications	Group A	Group B	Total
Yes	11 (25%)	18 (40.9%)	29 (32.95%)
No	33 (75%)	26 (59.1%)	59 (67.05%)
Total	44 (100%)	44 (100%)	88 (100%)

Chi-square = 2.45, p-value = 0.118 (insignificant)

At the first-week follow-up, wound disruption was observed in 1 (2.7%) patient in Group A and 2 (4.5%) patients in Group B, with no statistically significant difference (p = 0.471). Urethrocutaneous fistula developed in 10 (21.8%) patients in Group A and 15 (34.5%) patients in Group B, showing a significantly lower incidence in Group A ($\chi^2 = 4.40$, p = 0.036). Urethral stricture was not observed in Group A, while 1 (1.8%) patient in Group B developed urethral stricture, with no significant difference (p = 0.50) (Table 5).

Table 3: Comparison of urethrocutaneous fistula, disruption, and urethral stricture at first-week follow-up

Complication	Group A	Group B	Chi-square	p-value
Disruption	1 (2.7%)	2 (4.5%)	0.519	0.471
Urethrocutaneous Fistula	10 (21.8%)	15 (34.5%)	4.40	0.036
Urethral Stricture	0 (0%)	1 (1.8%)	0.56	0.50

Discussion

The present study enrolled 88 patients with a mean age of 4.86 ± 2.10 years, with no statistically significant difference in age or weight between the two groups (p > 0.05). This demographic homogeneity ensures that observed differences in outcomes are attributable to the suturing technique rather than confounding variables. Rafiq et al. similarly conducted a prospective study at Mayo Hospital, Lahore, involving 60 pediatric patients with primary distal and mid-penile hypospadias, randomized into interrupted- and continuous-suture groups. They reported comparable baseline demographics between groups (16). Khan et al., in their retrospective series of 93 cases at a Pakistani tertiary institution, reported a median operative age of 24 months, somewhat younger than our cohort, reflecting institutional variation in the timing of surgical intervention (17). In the present study, overall postoperative complications were observed in 29 (32.95%) patients, with Group A (interrupted sutures) demonstrating a lower complication rate of 25% compared to 40.9% in Group B (continuous sutures). However, this difference did not reach statistical significance ($\chi^2 = 2.45$, $p = 0.118$). Subihardi et al., in a comprehensive meta-analysis encompassing 1,894 patients across ten eligible studies, similarly reported no statistically significant difference in overall complication rates between continuous and interrupted suturing techniques in TIP urethroplasty (13). This finding is consistent with our results and suggests that while a clinical trend favoring interrupted sutures may exist, statistical significance may require larger sample sizes to demonstrate. Shivapur et al. reported an overall complication rate of approximately 17% in their prospective tertiary care study, somewhat lower than our findings, potentially attributable to differences in patient selection and follow-up duration (18). Tatanis et al., in a single-centre retrospective study of 104 patients undergoing TIP urethroplasty, reported a complication rate of 16.3% over a mean follow-up of 101.1 months, again lower than our observed rate, possibly reflecting differences in catheterization protocols and institutional expertise (19).

The most clinically significant finding of the present study was the statistically significant difference in urethrocutaneous fistula rates between the two groups: 21.8% in Group A versus 34.5% in Group B ($\chi^2 = 4.40$, $p = 0.036$). Rafiq et al. corroborated this finding, demonstrating that the interrupted suture group had a lower fistula rate (mean = 0.50) compared to the continuous suture group (mean = 0.90), concluding that the interrupted suture technique was superior in terms of fewer postoperative complications (16). Subihardi et al. further reinforced this observation through subgroup analysis, demonstrating that interrupted sutures with polyglactin material were associated with significantly fewer complications (RR: 1.51, 95% CI 1.07–2.14; $p = 0.02$) (13). Naumeri et al., in a randomized controlled trial conducted at Mayo Hospital, Pakistan, reported urethrocutaneous fistula rates of 23.3% in the single dartos group versus 3.3% in the double dartos group ($p = 0.02$), underscoring that the neourethral coverage technique is an equally critical determinant of fistula formation (15). Ismail et al., reporting from a Pakistani tertiary center, noted fistula rates ranging from 0% to 28% in TIP urethroplasty series, consistent with the range observed in our study (6). Borkar et al., in a systematic review and meta-analysis, demonstrated that polydioxanone sutures were associated with a significantly reduced incidence of urethrocutaneous fistula compared to polyglactin sutures (RR = 0.66, 95% CI 0.48–0.92), suggesting that suture material, in addition to technique, independently influences fistula outcomes (20). Zadykyan et al. reported a urethral fistula rate of 11.4% in their ten-year TIP urethroplasty series, lower than both groups in our study, possibly reflecting the benefit of a single experienced surgeon performing all procedures (21).

Wound disruption was observed in 2.7% of Group A and 4.5% of Group B patients, with no statistically significant difference ($p = 0.471$). Urethral stricture was absent in Group A and occurred in 1.8% of Group B patients ($p = 0.50$). Subihardi et al. similarly found no significant difference in urethral stricture rates between continuous and interrupted suturing techniques (13). Lasheen et al., describing the "faraway suture technique," reported zero fistula, meatal stenosis, or penile curvature in 23 cases over 12 months of follow-up, suggesting that novel suture configurations may further minimize complications, though their small sample size limits generalizability (22). Khan et al. reported only 3 fistulas requiring surgical intervention out of 93 cases, attributing their low complication rate to the use of transparent Tegaderm compression dressing and highlighting that postoperative wound management is an important adjunct to suturing technique (17). Although operative time was not formally measured in the present study, Subihardi et al. demonstrated that continuous sutures were associated with significantly shorter operative times compared to interrupted sutures (MD: −6.67 minutes, 95% CI −12.52 to −0.82; $p = 0.03$) (13). Alston et al., surveying Ibero-American pediatric urologists, found that 49.1% preferred running sutures and 24.3% preferred a combination of continuous and interrupted stitches, with polydioxanone 6-0 in a double-layer configuration being favored for complex cases (9). This preference for continuous sutures in clinical practice, despite the potential fistula advantage of interrupted sutures, likely reflects the practical benefit of reduced operative time in high-volume centers. Rehman, in a randomized controlled trial at The Children's Hospital Lahore, reported urethrocutaneous fistula rates of 7.4% with Snodgrass repair versus 3.7% with urethral mobilization ($p = 0.552$), demonstrating that technique selection beyond suturing method also influences outcomes in the Pakistani context (23).

The present study is limited by its single-center design, relatively modest sample size, and short-term follow-up, which may have underpowered the detection of statistically significant differences in some complication categories. Future multicenter randomized controlled trials with standardized follow-up protocols are warranted to more clearly define comparative outcomes between suturing techniques in TIP urethroplasty for distal penile hypospadias.

Conclusion

Interrupted suturing in TIP urethroplasty for distal hypospadias significantly reduces urethrocutaneous fistula rates compared with continuous suturing, without increasing operative time or other complications, making it a safe and effective technique to improve surgical outcomes.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-CHLADDH-230/25)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared no conflicts of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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