

Enhancing Tubularized Incised Plate (TIP) Technique for Hypospadias Repair: The Role of Tunica Vaginalis Flap in Minimizing Urethrocutaneous Fistula

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ABSTRACT

Background: Tubularized incised plate (TIP) is the most popular technique performed in hypospadias without chordee. However, it is occasionally associated with some complications such as meatal stenosis, or urethrocutaneous fistula. Recent publications suggest that tunica vaginalis flap (TVF) may enhance the urethroplasty process by providing a robust vascularized tissue bed that supports better healing and reduces complications.

Objectives: To evaluate the impact of incorporating a TVF into the TIP technique to cover the urethroplasty tube in patients with deficient ventral skin, assessing its effectiveness in improving surgical outcomes and minimizing urethrocutaneous fistula. **Patients and Methods:** This is a retrospective study involving 18 patients operated upon by TIP urethroplasty technique using TVF as an intermediate protective layer. Operative findings were collected including urethral plate length, pre urethrotomy plate width, post urethrotomy plate width and tunica flap width and length. Also, postoperative complications and follow-up data were evaluated. **Results:** The most common form of hypospadias was mid-penile, found in 55.6% of cases. The pre-urethrotomy mean urethral plate width was 7.06 mm, increasing to 13.5 mm post-incision, and the mean tunica flap width was 21.5 mm. Complications were relatively low; no fistula or dehiscence occurred; however, meatal stenosis occurred in 22.2% of patients, managed by either dilatation or meatoplasty. **Conclusion:** Incorporating tunica vaginalis flaps into TIP urethroplasty may represent a significant additional step over the standard technique in selected cases. The use of TVF is an effective means to enhance surgical outcomes and to minimize rates of urethrocutaneous fistula and repair disruption.

Keywords: TIP, Hypospadias, Tunica vaginalis flap, Urethrocutaneous fistula.

INTRODUCTION

Hypospadias is a common congenital condition in males where the urethral opening is located abnormally along the underside of the penis. It affects 1 in 150 to 1 in 300 live births^(1,2). Traditional methods of repair, such as tubularized incised plate (TIP) urethroplasty described by Snodgrass had demonstrated variable complication rates, with urethrocutaneous fistulas being a significant concern⁽²⁻⁶⁾.

Studies have indicated that incorporating TVF can significantly lower these rates, providing a more reliable alternative to dartos flaps, especially in midshaft and proximal hypospadias repairs. Recent advancements in surgical methods have refined the use of TVF, making it a preferred option for both primary and complex cases of hypospadias⁽⁷⁻⁹⁾.

The tunica vaginalis is a serous membrane surrounding the testes, known for its excellent vascularity and elasticity, making it ideal for use as a flap in hypospadias surgery. Moreover, TVF is increasingly favoured in reoperative hypospadias surgeries due to its enhanced coverage capabilities⁽⁹⁻¹²⁾. The purpose of this study is to evaluate the outcome of TVF as an intermediate protective layer to primary TIP urethroplasty in patients with skin chordae or deficient ventral skin.

PATIENTS AND METHODS

Study design:

This retrospective study was conducted on 18 patients between January 2022 and January 2023 in the Pediatric Surgery Department, Mansoura University Children Hospital. The study focused on the use of the

tunica vaginalis flap (TVF) as a reinforcement layer in the tubularized incised plate (TIP) urethroplasty technique for patients with hypospadias.

The inclusion criteria encompassed all hypospadias cases repaired using the TIP technique with a tunica vaginalis flap as an intermediate layer between January 2022 and January 2023. Patients were excluded if they underwent hypospadias repair with techniques other than TIP urethroplasty or TIP urethroplasty with a dartos flap instead of a tunica vaginalis flap. Redo hypospadias cases were also excluded.

Surgical procedure:

The procedures were carried out under general anaesthesia. Skin chordae was corrected after complete degloving of the penis and was tested by an erection test. The standard TIP urethroplasty involved a U-shaped incision around the urethral plate followed by a longitudinal midline incision along the urethral plate. Then, tubularization was done over a 6 French urethral catheter using 7/0 polyglactin suture. The suturing was done continuously in a double-layered manner⁽¹³⁾.

TVF was harvested ensuring a well-vascularized pedicle. This flap was applied as an intermediate layer over the newly created urethra using 6/0 polyglactin sutures. Measurements taken during surgery included the pre-urethrotomy urethral plate width (at its narrowest point), urethral plate length (from the meatus to the native urethra), and post-urethrotomy urethral plate width (after the midline incision). The width and length of the harvested tunica vaginalis flap were also recorded (**Figure 1**).

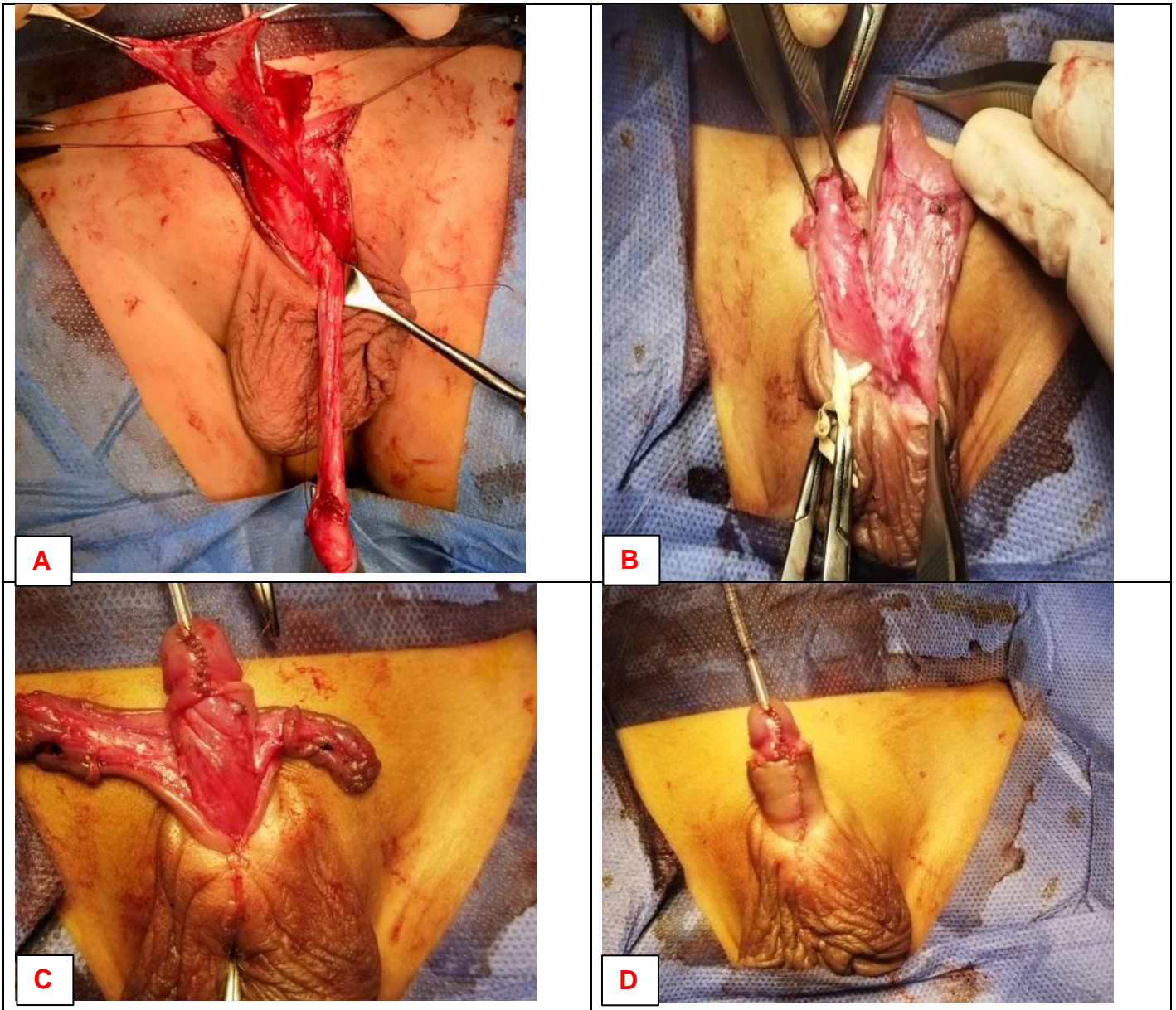


Figure (1): The use of the tunica vaginalis flap (TVF) as a secondary layer over the urethroplasty: **A:** The tunica is carefully harvested from one side **B:** freeing and mobilizing the flap to cover the neourethra ensuring sufficient vascularization. **C:** TVF is secured in place, followed by performing the glanuloplasty. **D:** the procedure is completed with skin closure

Postoperative care:

A Nelaton urethral catheter (6 Fr) was left in place for 5 to 10 days. Prophylactic antibiotics were administered during the catheterization period to prevent infection. Follow-up was conducted at 1 week, 1 month, 6 months, and 1 year postoperatively. Complications monitored included urethrocutaneous fistula, meatal stenosis, urethral stricture, hematoma formation, and catheter-related issues.

Ethical approval:

The Ethics Committee of the Mansoura Faculty of Medicine authorized this study. After receiving all of the information, caregivers of the participants signed their permission. The Helsinki Declaration was followed throughout the course of the investigation.

Statistical analysis

The statistical analysis was performed using SPSS version 26. Normality was assessed using the Shapiro-Wilk test. For dichotomous variables, frequency and percentage were used, while descriptive statistics were presented as mean and standard deviation (SD) for normally distributed data, and median and range for non-normally distributed data. Graphs were generated using Microsoft Excel.

RESULTS

The baseline characteristics of the studied patients are shown in table 1.

Table (1): Baseline characteristics of the included patients.

Variable	Mean ± SD, or median (range)
Age (months)	15 (9-78)
Urethral plate length (mm)	18 (6-34)
Pre-urethrotomy urethral plate width (mm)	7.06 ± 1.79
Post-urethrotomy urethral plate width (mm)	13.5 (10-17)
Tunica flap width (mm)	21.5 ± 7.27
Urethral catheter duration (days)	7 ± 1.7

SD: standard deviation

The most common type of hypospadias encountered in this study was mid-penile hypospadias in 10 case (55.6%), follow by distal-penile hypospadias in 4 cases (22.2%) (**Figure 2**).

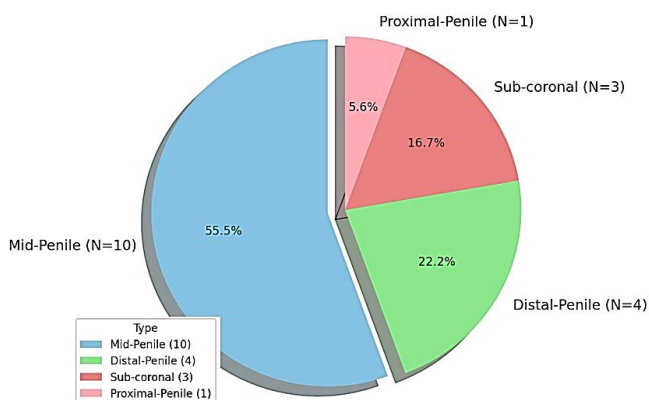


Figure (2): Type of hypospadias of the included patients.

The most commonly reported complication was meatal stenosis which occurred in 4 cases (22.2%); three of them (16.7%) were managed by meatoplasty, while one underwent only dilatation under anaesthesia. Postoperative scrotal hematoma, phimosis, and postoperative skin ischemia were reported in 3 cases (16.7%) each. Moreover, postoperative fistula and dehiscence didn't occur in any patients of the 18 included patients (**Table 2**).

Table (2): Postoperative complications of the included patients.

Complication	Number	Percentage
Postoperative scrotal hematoma	3	16.7 %
Phimosis	3	16.7 %
Postoperative fistula	0	0%
Postoperative skin ischemia	3	16.7%
Postoperative dehiscence	0	0%
Need of meatoplasty	3	16.7 %

DISCUSSION

TIP urethroplasty, first described by Snodgrass, has become a cornerstone in hypospadias repair due to its simplicity and versatility ⁽¹³⁾. However, complications such as urethrocutaneous fistula, meatal stenosis, and glans dehiscence remain prevalent concerns with rates ranging from 5% to 23% in various

studies ⁽¹⁴⁻¹⁸⁾. Our study aimed to assess the efficacy of incorporating TVF into the TIP procedure to enhance surgical outcomes by prevention of urethrocutaneous fistula and repair disruption.

In this study, the median age was 15 months, with mid-penile hypospadias being the most common presentation (55.6%). The preoperative urethral plate width increased post-urethrotomy, aligning with results by **Sozubir and Snodgrass** ⁽¹⁹⁾, who emphasized the importance of adequate urethral plate width for successful TIP repair.

The findings of this study align with previous research that explored the advantages of using TVF over other soft tissue covers, such as dartos fascia. For instance, studies have shown that TVF provides a more robust vascularized tissue bed, which is crucial for the healing process following urethroplasty with better outcome than dartos flap ^(7,9,12,20-22).

A comparative meta-analysis by **Yang et al.** demonstrated that TVF significantly reduces the risk of postoperative complications compared to dartos fascia, particularly in complex cases of hypospadias repair ^(9, 10). The current study corroborates these findings, as no instances of urethrocutaneous fistula were reported among the 18 patients treated with TVF.

Moreover, previous studies have indicated that the use of TVF can lower the fistula rate to as low as 0% in certain cohorts, which is consistent with our results ^(8,23). The absence of fistula formation in our patient population underscores the efficacy of TVF as an intermediate layer, particularly in cases where dorsal dartos flap may compromise skin vascularity.

While our study reported a 22.2% incidence of meatal stenosis, which is a notable complication, this rate is comparable to or even lower than those observed in other studies utilizing TIP without additional coverage. For example, **Hamid and Baba** reported higher rates of complications associated with TIP repairs without TVF support ⁽⁴⁾.

Other complications observed included scrotal hematoma, phimosis, and skin ischemia, each occurring in 16.7% of cases. While these complications are within the reported range in the literature, their incidence underscores the need for meticulous surgical technique and postoperative care. **Chatterjee et al.** emphasized the importance of preserving vascular supply during flap harvest to minimize flap ischemia and scrotal hematomas ⁽²⁴⁾.

The technical aspects surrounding the harvesting and application of the TVF are critical in achieving optimal results. The procedure requires meticulous dissection to ensure adequate vascularity while avoiding damage to surrounding structures such as vas deferens and testicular vessels. Previous studies have emphasized the importance of preserving blood supply during flap harvesting to prevent complications related to flap failure ^(7,20, 25). Our findings support this notion, as careful surgical technique was paramount in achieving favourable outcomes.

Furthermore, research indicates that TVF not only improves surgical outcomes but also enhances cosmetic results, making it a preferred choice among pediatric surgeons and urologists for complex cases (9,22).

Despite the promising results observed in this study, certain limitations must be acknowledged. The retrospective nature of this case series study may introduce biases related to patient selection and data collection. Additionally, the relatively small sample size limits the generalizability of our findings. Future prospective studies with larger cohorts and comparison to dartos flaps are necessary to validate these results further and explore long-term outcomes associated with TVF use.

CONCLUSION

Incorporating tunica vaginalis flaps into TIP urethroplasty may represent a significant additional step over the standard technique in selected cases. Our findings support existing literature that advocates the use of TVF as an effective means to enhance surgical outcomes and minimize rates of urethrocutaneous fistula and repair disruption especially in cases with deficient ventral skin.

Conflict of interest: None.

Financial disclosures: None.

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