

Role of tunica vaginalis flap and dartos flap in tubularized incisional plate for primary hypospadias repair: A retrospective monocentric study

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Summary *Background: In the tubularized incised plate (TIP) procedure, flap interposition between the skin and neourethra is highly recommended to decrease the postoperative fistula rate. However, there is no consensus regarding the ideal flap for this procedure. This study aimed to report our experiences in the one-stage TIP hypospadias surgery utilizing dartos flap (DF) (penile skin subcutaneous tissue) and tunica vaginalis flap (TVF) (parietal layer of the testis) as a tissue coverage of neourethra.*

Methods: In a retrospective study from Sep 2018 to May 2021, 16 cases of hypospadias with different types, ranging from mid-penile to penoscrotal types, were managed with TIP urethroplasty using DF or TVF as a tissue coverage of neourethra were enrolled. The demographic characteristics of the participants, type of hypospadias, outcome, and complications were analyzed and compared.

Result: We used TVF and DF as soft tissue coverage in 11 (68.8%) and 5 (31.3%) patients, respectively. The mean age was 56.38 ± 47.83 months. Mid-penile, proximal, and penoscrotal hypospadias were presented in 3 (18.8%), 8 (50.0%), and 5 (31.2%) patients, respectively. The total success rate was 14 (87.5%), while 2 (12.5%) patients developed a urethrocutaneous fistula, which required delayed closure later.

In comparison between TVF and DF groups: the TVF was applied in all patients with moderate and severe chordee and all patients with penoscrotal hypospadias, and six patients with proximal hypospadias, while only three patients with mild chordee and two patients with proximal hypospadias used the DF and showed statistical significance between groups ($p < 0.001$ and 0.012) respectively. The success rate was 90.9% vs. 80.0% in TVF and DF groups, respectively, with no statistical significance between groups ($p = 1.000$).

Conclusions: In the primary TIP repair, the TVF is a practical option as a DF for the interposition cover of a neourethra, especially in penoscrotal and proximal hypospadias with severe chordee.

KEY WORDS: Hypospadias; Dartos fascia; Tunica vaginalis; Tubularized incised plate.

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INTRODUCTION

Hypospadias, one of the most common congenital malformations, affects one in every 200 to 300 live births. It is typically accompanied by a band of fibrotic tissue arising from the abnormal meatal opening to the glans. It causes the shortens of the penile shafts in the ventral aspect, causing downward deformity of the penis (chordee) (1). Hypospadias is classified into penoscrotal, proximal, mid-penile, distal, and coronal hypospadias (2).

The techniques used to repair hypospadias are heavily influenced by the anomaly's components, including the size of the urethral plate and penis, the presence of penile chordee, the location of the meatal opening, and the experience of the surgeon (3). The main aim of hypospadias surgery is to correct the penile chordee and move the meatus opening to the glandular area (4). With over a hundred techniques published, the *tubularized incisional plate* (TIP) is presently the most fantastic procedure for primary hypospadias surgery (5).

Urethrocutaneous fistula is the most complication observed in TIP urethroplasty, with a range of incidence between 0 to 28%. To reduce the risk of urethrocutaneous fistula, most surgeons now perform tissue interposition between the neourethra and the skin of the penis as a standard step during TIP surgeries (3). The *Dartos flap* (DF) and *tunica vaginalis fascia* (TVF) are the most commonly used urethral interposition with good postoperative outcomes, though different research findings reported the results (6-8). There is no agreement on which DF or TVF flap techniques are superior (3). Our goal was to share our experiences of hypospadias surgery with TIP repair using TVF and DF, outcome, and complications.

MATERIALS AND METHODS

Study design

We retrospectively reviewed the medical records of 16 consecutive children with hypospadias repairs from Sep

2018 to May 2021. Patients' and operations' characteristics, such as type of hypospadias, degree of chordee, flap usage, success rate, and complications, were collected, analyzed, and compared. The ethics committees of Ibb University of Medical Sciences approved this thesis, which was carried out in compliance with the Helsinki Declaration. Additionally, informed consent was obtained from the patients' families to participate in our research.

Surgical procedure

We illustrate a case of penoscrotal hypospadias (Figure 1). All procedures were carried out while the patients were anesthetized. A stay suture was placed in the dorsal aspect of the glans to aid in traction of the phallus and fix the urethral catheter later. The penile skin was degloved. Then, if the penile chordee was greater than 30 degrees, the chordee was intraoperatively corrected. The urethral plate was incised from the hypospadias meatus to the penial glans. Then, the tabularization was made over a Nelaton catheter (6 to 10 French) depending on the patients' age. Then, subcuticular continuous suturing was made with a 6.0 Vicryl (1). The neourethra suture was completed to the subcoronal level (Figure 2).

Dartos flap

A dartos layer from penile skin subcutaneous tissue was dissected to cover the neourethral suture line and fixed

Figure 1a, b.

Show the penoscrotal hypospadias with meatus opening (yellow arrow).



Figure 2a, b.

(A) Show the postoperative meatal opening (yellow arrow) and the skin covered with the pineal midshaft buttonhole (green arrow). (B) Show the postoperative meatal opening after dartos flap (yellow arrow).



with PDS 5/0. Then by creating the buttonhole in the midshaft skin of the penis, the penis was delivered through it and sutured with vicryl 5/0. A thin dressing was used to keep the penis in place. A suprapubic catheter was inserted into the bladder and fixed with silk 2/0. On the second postoperative day, an open dressing was applied. The patient was discharged on the fourth day following the operation with the proper antibiotic. The suprapubic and urethral catheters were removed on the 10th and 14th postoperative days.

Tunica vaginalis flap

Harvesting for additional TVF coverage was done (left or right side testicular vaginalis). Using micro-scissors, an adequate TVF was harvested from the dorsal part of the vaginalis. The flap was at least 5 mm in width and long enough to cover the neourethra. To avoid glans dehiscence, the distal end of the TVF was fixed in the subcoronal area. An interrupted suture was used to place the graft over the neourethra. The remainder of the procedure was similar to that described in the DF procedure.

Statistical analysis

The variables' descriptive statistics were calculated as mean, standard deviation, maximum, and minimum, and qualitative variables with frequency (percentage) were presented. An independent sample T-test or Mann-Whitney test compared the qualitative variables. The Chi-square test or Fisher's exact test compared the qualitative variables. Data were analyzed using statistical software (SPSS Inc., Chicago, IL, USA) version 22. A P value < 0.01 was considered a significant level.

RESULTS

Out of 16 hypospadias patients who underwent primary TIP repair, in 11 (68.8%) of patients, we used TVF as a soft tissue coverage. In 5 (31.3%) patients, the DF was utilized for coverage. The mean age was 56.38 ± 47.83 (22.50-94.50) months. Mild, moderate, and severe degree of chordee was presented in 3 (18.8%), 2 (12.5%), and 9 (56.2%), respectively, and it was corrected successfully in both groups. The chordee was repaired by complete degloving of the penis and release of dysplastic dartos tissues in most patients, and only two cases with penoscrotal hypospadias required multiple transverse incisions of the ventral aspect of the corpus cavernosum. The total success rate was 14 (87.5%), while 2 (12.5%) patients developed fistula, which required delayed closure later. After surgery, urinary tract infection (UTI) was presented in 3 (18.8%) patients and was treated with a proper antibiotic. Pain during micturition after surgery was presented in 3 (18.8%) patients and was treated with oxybutynin. After 24 months of follow-up, there was no incidence of new fistula, meatal stricture, or other complications.

Comparison between using TVF and DF

The mean age of patients who underwent TVF was 72.36 ± 49.77 months, and the mean age of patients who underwent DF was 21.20 ± 11.69 months, and their age was significantly different ($p = 0.007$). The TVF was applied in all patients with moderate and severe chordee,

while only in three patients with mild chordee the DF was used showing statistical significance between groups ($p < 0.001$). For all the patients with penoscrotal hypospadias and six patients with proximal hypospadias, the TVF was applied. Only in two patients with proximal hypospadias the DF was used with statistical significance between groups ($p = 0.012$). The time of operation for both groups was similar at 2 hours. In the TVF group, the success rate was 90.9%, while the success rate in the DF group was 80.0%, with no statistical significance between groups ($p = 1.000$) (Table 1).

DISCUSSION

Hypospadias surgery is continually changing, suggesting that no single technique is thought to be ideal. The use of interposition flaps in the research is well demonstrated, such as triangular soft tissue flaps and Belman flaps harvested from the prepuce. Smith D flap is derived from the penile skin, whereas Buck's fascial flap is derived from the penile, shaft, and DF from penile skin subcutaneous tissue. The TVF is derived from the testis, and the scrotal DF is derived from the scrotum (3).

Snodgrass presented use of a flap that was dissected from the dorsal preputial and shaft skin to provide additional coverage of the ventral aspect of the neourethra. This dissection requires experience, and there is a risk of dermal necrosis (3, 9). However, there are many choices for soft tissue covers, and the suitable one has yet to be discovered (10).

DF is easily obtainable, easy to mobilize, provides excellent coverage for repeat proximal hypospadias surgery, and does not require an additional extra incision (3).

In contrast, TVF is a good choice for re-do hypospadias cases and proximal and penoscrotal hypospadias where dissection is extended to the root of the penis (11). TVF

can be harvested via a penile incision degloving up to the basis of the penis or via an additional scrotal incision reaching and covering the neourethra via a subcutaneous scrotal tunnel (6). Snow and associations were the first to document the use of TVF as an interposition graft in 1995, with a postoperative fistula rate of about 9% (12). Similar findings were reported by *Shankar et al.* (13).

Our study used the TVF for all patients with penoscrotal hypospadias and six patients with proximal hypospadias, while the DF was used in only two patients with proximal hypospadias. We find that TVF is a good interposition flap in proximal and penoscrotal hypospadias. A similar result was reported by *Radhakrishnan et al.* and *Braga et al.* (14, 15).

Regarding the age of surgery, the mean age of patients who underwent TVF and DF were 72.36 ± 49.77 months vs. 21.20 ± 11.69 months, respectively, and their age was significantly different ($p = 0.007$). Delayed presentations in our patients were due to misinterpreting hypospadias as a normal variation (Paribor or cut by angels), being told by general physicians that repair is futile, and fear of future surgery complications. Similar reasons were reported by *Zargooshi et al.* (16). Additionally, age is not a predisposing factor for postoperative complications. *Bush and Snodgrass* obtained a similar result in 186 patients operated on for hypospadias. They find that of preoperative factors, including meatal location, urethral plate width, glans width, and age, only glans width less than 14 mm was associated with increased urethroplasty complications (17).

The American Academy of pediatrics chordee survey classifies penile curvature as mild, moderate, and severe. The mild curvature is less than 30 degrees, moderate is 30 to 43 degrees, and severe is more than 43 degrees (18).

In our study, mild, moderate, and severe degree of chordee was presented in 3 (18.8%), 2 (12.5%), and 9

(56.2%) patients, respectively. Additionally, the TVF was applied in all patients with moderate and severe chordee, while only two patients with mild chordee used the DF and showed statistical significance between groups ($p < 0.001$). TVF was used to correct chordees in children with severe hypospadias (19). However, the reported findings of this technique have been contradictory. *Ritchey* reported excellent results with TVF. At a median follow-up of 9 months during second stage repair, only 1 of their 25 patients with scrotal or perineal hypospadias had evidence of recurrent ventral chordee (20). In 25 patients with scrotal or perineal hypospadias associated with severe ventral chordee, *Ritchey and associations et al.* reported excellent results with TVF of the corpora without chordee recurrence (21).

A recent study by *Braga et al.* mentioned that in the short-term out-

Table 1.
Comparison between tunica vaginalis flap (TVF) and dartos flap (DF).

Variable *	Subgroups	Total n (%)	Type of surgery		P-value**
			TVF (11, 68.8%)	DF (5, 31.3%)	
Outcome	Success	14 (87.5)	10 (90.9)	4 (80.0)	1.000
	Failure	2 (12.5)	1 (9.1)	1 (20.0)	
Type of hypospadias	Middle	3 (18.8)	0 (0.0)	3 (60.0)	0.012
	Proximal	8 (50.0)	6 (54.5)	2 (40.0)	
	Penoscrotal	5 (31.3)	5 (45.5)	0 (0.0)	
Age (year)	< 3	7 (43.8)	3 (27.3)	4 (80.0)	0.077
	≥ 3	9 (56.3)	8 (72.7)	1 (20.0)	
Complication	No	8 (50.0)	5 (45.5)	3 (60.0)	0.769
	Fistula	2 (12.5)	1 (9.1)	1 (20.0)	
	UTI	3 (18.8)	3 (27.3)	0 (0.0)	
	Pain in micturition	3 (18.8)	2 (18.2)	1 (20.0)	
Type of chordee	No	2 (12.5)	0 (0.0)	2 (40.0)	< 0.001
	Mild (less than 30)	3 (18.8)	0 (0.0)	3 (60.0)	
	Moderate (30-43)	2 (12.5)	2 (18.2)	0 (0.0)	
	Severe (more than 43 degree)	9 (56.3)	9 (81.8)	0 (0.0)	
Associated anomaly	No	14 (87.5)	9 (81.8)	5 (100)	1.000
	UDT	1 (6.3)	1 (9.1)	0 (0.0)	
	Cleft plate	1 (6.3)	1 (9.1)	0 (0.0)	

UTI: urinary tract infection, UDT: Undescended testicle. Note: * Data was presented as n (%). ** P-values of < 0.01 were considered significant.

come of ventral penile lengthening, TVF alone to correct severe chordee is favorable, with a 95% success rate (15). Our result was similar to those reports. On the other hand, *Caesar* reported that 60% of TVF patients had recurrent ventral chordees (22). *Vandersteen and Husmann* also discovered late-onset recurrent chordee after successful hypospadias repair with TVF (23).

Correction of penile chordee begins with complete degloving of the penial skin, the release of the dysplastic dartos tissues, and induction of an artificial erection (21). When the chordee is severe, the urethral plate is mobilized from the underlying corpus cavernosum, accompanied by movements of the normal proximal urethra up to the bulbar urethra (19). In our cases, the chordee was repaired by complete degloving of the penis and release of the dysplastic dartos tissues, and only two patients with penoscrotal hypospadias required multiple transverse incisions in the penile ventral aspect that had a maximum curvature; our result in chordee correction was similar to the experience reported by *Snodgrass et al.* (24). The final step in hypospadias repair is skin covering, and it is critical to resurface the penis after the TIP procedure. Numerous procedures have been used to accomplish skin covering. Some techniques involve suturing the lateral skin edges together in the ventral aspect of the penis. However, this technique may cause skin tension, and a dorsal skin incision for avoiding tension may be required. In some other method, as in our cases, creating a button-hole incision in the midshaft skin of the penis, delivering the penis through it, and suturing was made (2, 25).

Complications of TIP hypospadias procedure include urethrocutaneous fistula formation, stenosis of the new meatus, diverticulum formation, and TVF complications such as scrotal hematoma in the 2% to 4% range. Fistula formation is the most frequent complication, with reported incidences ranging from 3% to 50% (26). We report a similar result in fistula rate of 9.1% and 20% for TVF and DF, respectively, without statistically significant ($p = 0.769$). In a prospective study comparing the DF vs. TVF as flap coverage for primary TIP procedure, *Chatterjee et al.* found that the fistula rate was 0% and up to 20% for TVF and DF, respectively (11). *Dhua* and the association reported that TVF had an optimal tissue coverage of the neourethra than the DF (3 fistulae in the DF group) (3). In contrast, *Zheng et al.* reported similar fistula rates of DF and TVF (27). A systematic review recommended a double DF for distal hypospadias and TVF for proximal hypospadias during TIP surgery (28). The reasons for a different incidence rate of fistula in our study with previously published articles were that all the patients with penoscrotal and proximal hypospadias were repaired using TVF. In contrast, the DF was used in two patients with proximal hypospadias. Additional reasons are older age at operation in the TVF group, and a small number of patients explain this different fistula rate in both groups.

A similar reason was mentioned by *Dhua et al.* (3).

In our study, we insert suprapubic catheter drainage at the end of the procedure to improve the healing of the new urethra and minimize the risk of urethrocutaneous fistula. According to *Duarsa et al.*, the suprapubic cystostomy insertion could reduce the risk of urethrocutaneous

fistula following hypospadias surgery (29). Most of our patients achieved the external meatal orifice up to the subcoronal level, particularly those with proximal or penoscrotal hypospadias.

A subcoronal meatus was appropriate by patients' families in cases where local anatomy was not allowed to prefer spreading the neourethra up to the glanular area. Counseling before operation with family is essential. Furthermore, it is well documented that the meatal orifice location at the subcoronal area is functional with acceptable cosmetic outcomes (26, 30).

There were several limitations to the current study. First and foremost, the small number of patients (only 16) and TVF and DF groups do not have similar cases. Secondly, the TVF was used in all cases of penoscrotal hypospadias and most proximal hypospadias cases, while the DF was used only in two cases of proximal hypospadias. Finally, a retrospective analysis could have resulted in selection bias. Additional prospective studies with strict follow-up and large sample size are required to evaluate the outcome and complication rate after primary TIP with TVF vs. DF as tissue coverage.

CONCLUSIONS

In the primary TIP repair, the TVF is a practical option as a DF for the interposition cover of a neourethra. This finding needs to be confirmed in a large cohort study with long-term post-procedural follow-up to demonstrate the superiority of TVF over DF.

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