

Dorsal Versus Ventral Dartos Flap to Prevent Fistula Formation in Tubularized Incised Plate Urethroplasty for Hypospadias

Doğakan Yiğit^{1*}, Dinçer Avlan²

Purpose: The purpose of this study is to evaluate the results of two different flap procedures for the prevention of urethrocutaneous fistula in hypospadias patients undergoing tubularized incised plate urethroplasty .

Patients and Methods: We retrospectively reviewed 89 patients who underwent hypospadias repair. The standard technique of tubularized incised plate urethroplasty was used. There were 45 patients in Group 1 and 44 patients in Group 2, in which ventral and dorsal dartos flaps were used to cover the neourethra respectively. Surgical complications were assessed as the main outcomes. The results were analyzed with Chi-square and Mann-whitney U tests.

Results: There was no significant difference between the groups in terms of age and meatus location. We observed postoperative surgical complications in 15 (33.3 %) patients in Group 1 and in 4 (9.1 %) patients in Group 2. The complications noted in the Group 1 were urethrocutaneous fistula in 10 patients (22.2 %) and meatal stenosis in 5 patients (11.1 %). In Group 2, fistula was observed in 2 patients (4.6 %) and stenosis in again 2 patients (4.6 %). Urethrocutaneous fistulas occurred statistically more frequently when ventral based dartos flaps were used ($P < .05$).

Conclusion: Several flap procedures and their modifications have been suggested to avoid fistula formation. With-in these procedures, dartos flaps are reported to be very useful for primary distal or proximal hypospadias repair and reoperations. In this study, we concluded that vascularized dorsal preputial dartos flap procedure is safe and more effective than ventral based flap in the prevention of fistula formation.

Keywords: dartos flap; hypospadias; tubularized incised plate urethroplasty; urethrocutaneous fistula

INTRODUCTION

Hypospadias is one of the most common malformations of the external male genitalia and the incidence is about 1/200 to 1/300 of live births⁽¹⁾. Although, numerous different techniques are described for hypospadias repair, complications, such as urethrocutaneous fistula and urethral stenosis, still remain a major problem in a significant amount of patients⁽²⁾. Tubularized incised plate urethroplasty (TIPU) has gained vast popularity among pediatric urologists for hypospadias repair, because of its low complication rate and better cosmetic results, especially anatomical appearance of glans with slit like meatus⁽³⁾. However, urethrocutaneous fistula formation and meatal stenosis still exist as common complications, which are reported as high as 16 - 25 % and 15 - 21 % respectively^(4,5,6,7). Other possible complications of TIPU procedure are wound dehiscence, urethral diverticula, skin necrosis, penile necrosis, and hematoma⁽⁷⁾. One of the most important factors in reducing fistula formation in hypospadias repair is the application of a protective intermediate layer between the neourethra and the skin. For this reason, several flap procedures and their modifications have been suggested to avoid fistula formation⁽⁸⁻¹²⁾. Within these procedures, dartos flaps are reported to be very

useful for primary distal or proximal hypospadias repair and the reoperations^(9,11).

In this study, we aimed to investigate the efficacy of dorsal preputial dartos flap and ventral dartos flap in the prevention of fistula formation in TIPU surgery.

PATIENTS AND METHODS

Study population

After approval from the ethics committee (08.06.2021/1915), we retrospectively reviewed the records of 89 patients who had undergone hypospadias repair in the Pediatric Surgery and the Pediatric Urology Departments of Prof.Dr.Cemil Taşcıoğlu City Hospital and Trakya University Hospital between 2015 and 2020 . Patients of only two surgeons were enrolled in the study. Patients who were operated on with TIPU procedure for distal and midpenile hypospadias were included in the study.

Study design

This study was designed as a retrospective study and conducted with patients of two different centers. Patients' files, examination notes and surgery notes were investigated and surgical complications, mainly urethrocutaneous fistula and meatal stenosis were recorded.

¹Department of Pediatric Surgery and Pediatric Urology, Health Sciences University Prof. Dr. Cemil Taşcıoğlu City Hospital, İstanbul, Turkey.

²Department Of Pediatric Surgery and Pediatric Urology, Trakya University Hospital, Edirne, Turkey.

*Correspondence: Department of Pediatric Surgery and Pediatric Urology , İstanbul , Turkey.

Tel : +90 212 3145500. Fax : +90 212 3145512. E-mail: dogakanyigit@gmail.com

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Table 1. Clinical features of the patients

	Group 1 (N=45)	Group 2 (N=44)	P value
Age (years)			
Mean ± SD	4.8 ± 2.5	5.4 ± 2.5	.182 ^a
Median (IQR)	4.0 (3.0-6.5)	5.0 (4.0-7.0)	
		Mean difference: 0.6	
Follow-up (months)			
Mean ± SD	25.6 ± 11.7	26.5 ± 13.0	.858 ^a
Median (IQR)	24.0 (21.0-36.0)	24.0 (12.0-36.0)	
		Mean difference: 0.9	
	N (%)	N (%)	
Distal penile	40 (88.9 %)	38 (86.4 %)	.714 ^b
Mid penile	5 (11.1 %)	6 (13.4 %)	
Chordee	9 (20 %)	6 (13.4 %)	.423 ^b

^aMann - Whitney U Test^bChi-Square Test**Inclusion criteria**

Patients operated with TIPU procedure for distal and midpenile hypospadias were included in the study. Patients with proximal hypospadias, even if they were operated on with single stage TIPU procedure, and patients with repeated TIPU procedures were not included in the study.

Surgical technique

The standard technique of TIPU was used for hypospadias repair in all patients. Briefly; after placing a traction suture at the tip of the glans, a U-shaped incision extending along the edges of the urethral plate to healthy skin, proximal to the hypospadiac meatus is made. Then, penis was degloved and if there is any chordee, it was corrected by dorsal plication. The urethral plate was widened by a deep midline incision including the mucosa and submucosa from the midglandular meatus to the tip of the urethral plate. This incised urethral plate was then tubularized in a one layer running subcuticular fashion with absorbable 6/0 or 7/0 polydioxanone sutures (PDS, Ethicon) over a 6 –or 8- Fr. feeding tube, depending on

the age and the width of native urethral plate. In Group 1 (ventral based dartos flap N=45), after completion of urethroplasty, a ventral based vascularized dartos flap was created from both the right and the left side of the urethral corporal groove (**Figure 1a,1b**). The dissection was terminated before the native meatus was reached to avoid any injury threatening vascular supply of the flap. To cover neourethra completely, the flap was fixed into the lateral recesses of the raised glans' wings with absorbable sutures. In Group 2 (dorsal preputial dartos flap N=44), the sutures were placed to the borders of the inner face of the prepuce, and the flap was incised just into the subcutaneous tissue level. The underlying dartos layer was sharply dissected to the base of the penis. Thus, a vascularized dorsal preputial dartos flap was harvested (**Figure 2**). The flap was then rotated from the lateral side of the penis to cover the neourethra, and sutured around the neomeatus and inner surface of the glandular wings on each side, using interrupted absorbable sutures. In both groups; the glandular wings were brought gently together with no tension and closed over the neourethra and dartos flap. In all patients, the ure-

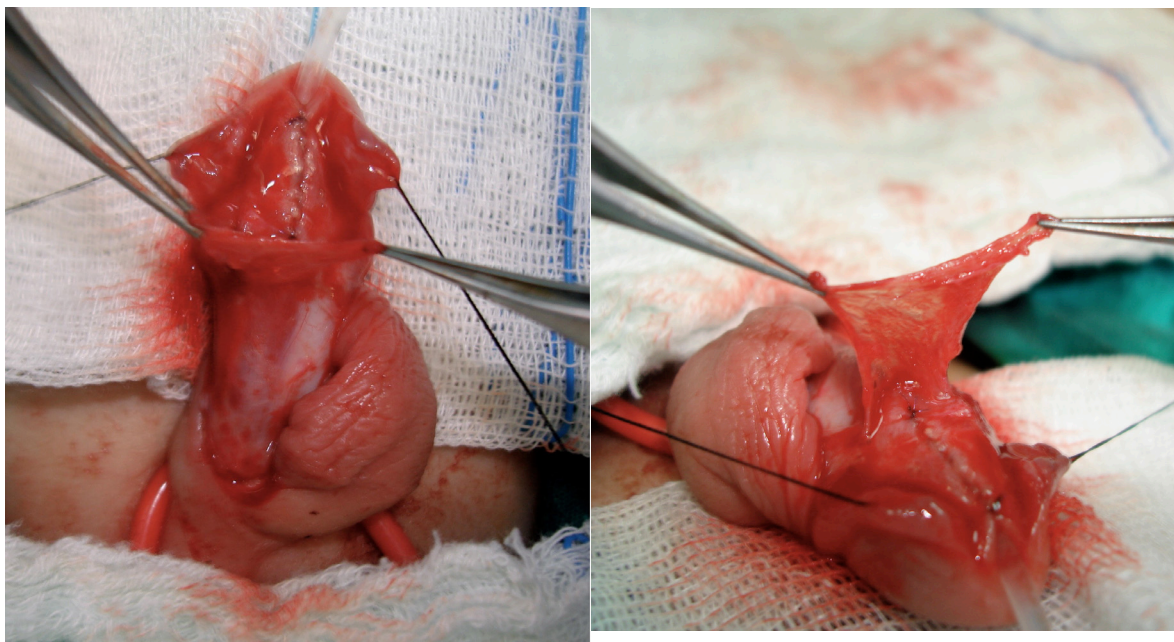
**Figure 1. a:** Ventral appearance of the ventral based flap. **b:** Appearance from above the flap

Table 2. Postoperative complications

	Group 1 (N=45)	Group 2 (N=44)	Total (N = 89)	OR (95%CI)	P value
Fistula	10 (22.2%)	2 (4.6 %)	12 (13.4 %)	5.892 (1.145- 58.83)	.029 ^a
Stenosis	5 (11.1%)	2 (4.6%)	7 (7.8 %)	2.083 (0.2807, 24.22)	.676 ^a
Total	15 (33.3%)	4 (9.1)	19 (21.3 %)	4.912 (1.379, 22.43)	.005 ^b

^aFisher's Exact Test^bChi-Square Test

thral catheter was removed 1 week after the operation. Until the time of catheter removal, oral antibiotics and anticholinergics were used to prevent postoperative infection and urinary leakage due to bladder irritation.

Evaluation

Surgical complications were collected retrospectively as the main outcomes of this trial. The total number of surgical complications and specifically the rate of fistula formation were compared between the two different flap techniques used.

Statistical analysis

The data were analyzed using IBM SPSS version 26.0 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) statistical software. The continuous variables were presented as mean \pm SD and median (minimum-maximum) values; the categorical variables were presented as numbers and percentages. Mann-Whitney U Test was used to compare the mean age of the two groups. Type of hypospadias, chordee and complication percentages of two groups were compared using Chi-square test and Fisher's exact test respectively.

RESULTS

89 patients with distal and midpenile hypospadias who were operated on with TIPU technique were included

in the study. The mean age of the patients was 5.1 years (range 1-12). 78 patients had distal penile and 11 patients had midpenile hypospadias. There was no significant difference between the groups in terms of age, meatus location, and the presence of chordee ($P > .05$). Clinical features of the patients are shown in Table 1. Mean follow-up was 25.6 \pm 11.7 (median:24, IQR:21-36) months for Group 1 and 26.5 \pm 13.0 (median:24, IQR :12-36) months for Group 2. There was no statistical significance between groups in terms of follow-up duration ($P = .858$).

We recorded postoperative complications in 15 patients (33.3 %) in Group 1, and in 4 patients (9.1 %) in Group 2. In Group 1, urethrocutaneous fistula was detected in 10 patients (22.2 %), and meatal stenosis in 5 patients (11.1 %). There was urethrocutaneous fistula in all patients who also had meatal stenosis. In Group 2, fistula was detected in 2 patients (4.6 %) and stenosis in 2 patients (4.6 %). All patients with meatal stenosis had also urethrocutaneous fistula. These patients were easily treated with urethral dilatation. The frequency of fistula was found to be statistically higher in Group 1 patients (95 % CI : 1.145- 58.83 , OR = 5.892 , $P < .05$). There was no significant difference between the groups in terms of stenosis frequency (95% CI : 0.2807 - 24.22 , OR = 2.083 , $P = .284$). Complications belonging to the groups are listed in **Table 2**. In the postoperative

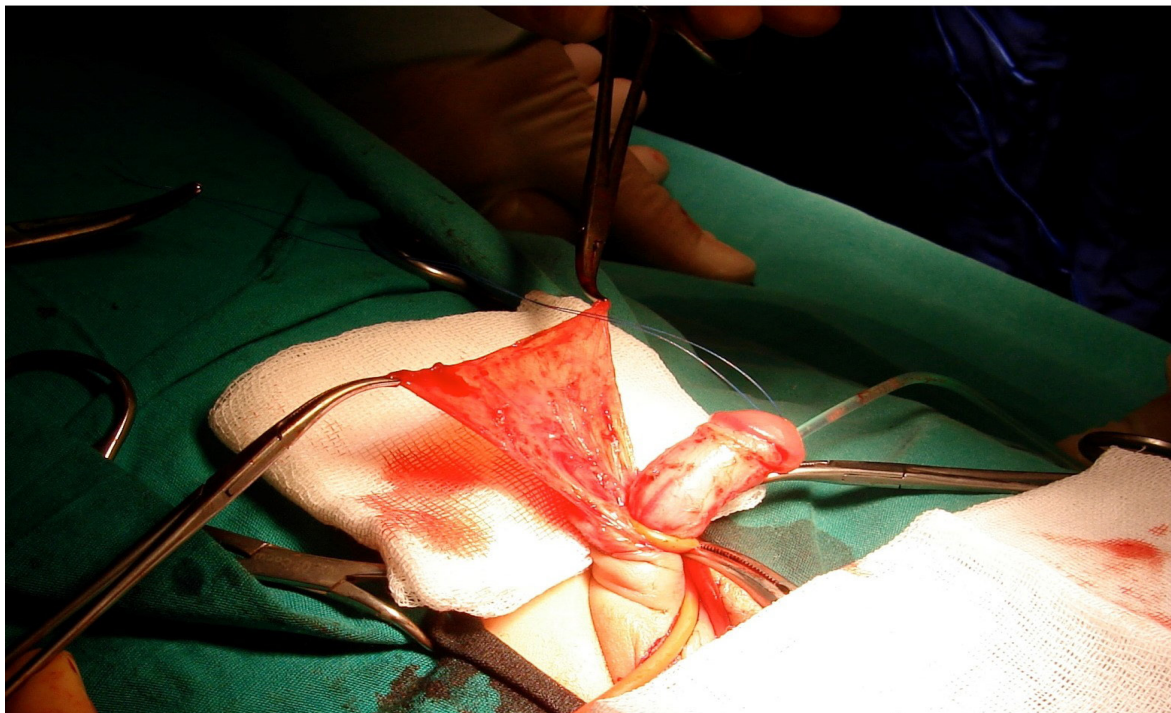


Figure 2. Dorsal preputial dartos flap is rotated from the lateral side of the penis.

period, we did not detect any vascular complications of the flap or penile rotation in any patient.

DISCUSSION

Although there are many different surgical techniques for hypospadias repair, the ideal surgical procedure with the least complication rate is yet to be described. TIPU operation has gained respect by pediatric urologists for the treatment of many different types of hypospadias^(3,13,14). Moreover, TIPU has been used not only for primary hypospadias repair surgery but also used for reoperation of hypospadias^(15,16). Despite obvious excellent surgical results with this technique, urethrocutaneous fistula still remains to be a complication even in well-experienced hands. The rates of fistula for TIPU procedure in distal and proximal types of hypospadias and in the reoperation cases as well were reported in a variable range of 0-to-33 %^(4,5,13,15,16).

The risk of fistula formation without a flap, covering neourethra, is higher than the techniques where a flap was used. Telfer et al. reported that using a protective intermediate layer reduced the fistula rate from 64 to 4.5 %⁽¹⁷⁾. One of the most important factors in avoiding the fistula formation is to cover the neourethra with a second layer. It has been suggested that the interposition of a well vascularized tissue between neourethra and penile skin reduces the incidence of fistula^(3,8,18). Initially, an epithelialized skin flap technique was described by Smith in 1973 as an intermediate layer⁽¹⁹⁾. Since then, various procedures and different tissues such as de-epithelialized skin, tunica vaginalis, and dartos flaps were described to solve this problem.

Baccala et al. have used de-epithelialized dorsal skin flaps as interposed tissue to cover neourethra⁽¹²⁾. Shanberg et al. have reported that a lateral based de-epithelialized skin flap was successfully used in reoperated hypospadias patients⁽²⁰⁾. Although Snodgrass has described using a dorsal based dartos flap in the original article of himself in 1994, many pediatric urologists have already used ventral based dartos flap and its modifications in TIPU. Furness reported that using the ventral based vascularized dartos flap to cover the neourethra in TIPU, has a success rate of 98.2 % without any major complications⁽²¹⁾. In a recent study by Carmine et al., dissection of fascial flaps also demonstrated a reduction in stenotic complications even in the surgical correction of phymosis⁽²²⁾.

In a prospective randomized comparative study, Savanelli et al. showed that the use of ventral based vascularized subcutaneous dartos tissue has reduced fistula formation compared to non-covered urethroplasty in TUPU repair for distal hypospadias⁽²³⁾. The fistula rate was reported as 3.8% in this study. Soygur et al. have used the ventral based dartos flap in combination with mucosal collars as an effective modification. The authors reported that the incidence of the fistula was 8.3 %⁽¹¹⁾. In addition, it was revealed in a study that using ventral based dartos flap in several different kinds of urethroplasty reduced the fistula formation⁽¹⁰⁾. On the other hand, Smith used the ventral based pedicle flap for covering the neourethra in TIPU in 64 patients and reported that fistula rate was 12,5 %⁽²⁴⁾. On the contrary, our fistula rate in group 1 was 22.2 %. Probably, the most important reason of a high fistula rate in our study was technical failure in the preparation of the ventral based flap, which resulted in insufficient blood supply

of the flap itself or a very thin flap tissue, which compromised the perfusion.

In the original article of Snodgrass, a transverse island of dorsal subcutaneous tissue was used to cover the neourethra⁽³⁾. Later on, different reports reported mobilizing a vascularized pedicle flap from dorsal prepuce and transposing it to the ventral side of the penis^(25,26). Because the latter technique was reported to cause some potential complications such as penile torsion, chordee or skin loss, Sözübir and Snodgrass performed a pedicled dartos flap, which was buttonholed and transposed ventrally for urethral coverage⁽¹⁸⁾. However, we suggest that if the dorsal dartos is dissected deeply through the radix of penis without causing any tension of skin, these complications can easily be avoided. Fistula rates in TIPU using dorsal preputial dartos flap have been reported to vary from 0 % to 13 %^(8,18). Furthermore, there are studies suggesting that the use of a double dorsal dartos flap was more effective than a single layer flap^(9,27). The fistula rate after using a double flap was reported as 0 % in both studies.

Jia et al. compared the complication results of TIPU repair using either dorsal dartos flap or meatus-based ventral dartos flap⁽²⁸⁾. They reported ventral skin necrosis in 2.7 % of patients and penile rotation in 3.8% of patients in the dorsal dartos flap group ($P = .039$, $P = .016$ respectively). Fistula rates were found to be 2.7% in the dorsal dartos flap group and %2.9 meatus-based ventral dartos flap group ($P = .902$). In another study, Fahmy et al. compared the results of dartos flap and tunica vaginalis flap and stated that complication rates were the lowest in the patients with double dartos flap ($P = .004$)⁽²⁹⁾. He also stated that there may be complications such as vascular and penile rotation with the dartos flap. In our study Group 2 consisted of patients that we used dorsal preputial dartos flap. The flap was harvested from preputial skin and deeply dissected to the radix penis, and then the flap was transposed from the left or right side to the ventral aspect of the penis. Penile rotation was avoided because the flap has dissected without tension through the radix penis. Besides, we have not detected any vascular complications in our dorsal flaps. The use of this technique achieved satisfactory outcomes in our patients. In this group, all fistulas developed only in association with meatal stenosis. We suppose that the meatal stenosis could be the underlying reason for urethrocutaneous fistula formation. The strength of this study is that it was conducted with a homogenous patient group with similar age and similar type of hypospadias. The weakness of this study is that it is a retrospective study. Further prospective studies will help to confirm our results.

CONCLUSIONS

In conclusion, TIPU repair represents an effective procedure to treat patients with hypospadias.. The dorsal preputial dartos flap provided a much better outcomes and less fistula formation in our study. We explain the advantages of this technique is possibly a thicker, wider and more vascularized flap tissue compared to a ventral based flap, which led us to name it as “the blanket of neourethra” or “the omentum of the penis”. We believe that the vascularized dorsal dartos flap procedure is safer and more effective than ventral based flap to prevent fistula formation.

CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

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