




Choosing an ideal second layer cover in snodgrass repair for various types of hypospadias

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ABSTRACT

Objective: In this study, we aimed to assess the results of tunica vaginalis flap (TVF), dorsal preputial dartos flap (DPF), and spongioplasty alone as additional cover after neourethra formation in a Snodgrass repair for various types of hypospadias as per the selection criteria decided.

Material and methods: This was a non-randomized experimental study of 97 patients with primary hypospadias treated via Snodgrass repair using various second layers (tunica vaginalis flap, dorsal preputial dartos flap, and spongiosum alone) as per the selection criteria in a single center by a single surgeon. The outcome of the procedure was assessed in terms of cosmesis, chordee correction, urinary stream, and uroflowmetry.

Results: Of the 97 patients, we used dorsal preputial dartos flap in 42 (43.3%), tunica vaginalis in 38 (39.2%), and spongioplasty only in 17 (17.5%) for primary hypospadias. Urethrocuteaneous fistula developed in four patients (three in DPF and one in the TVF groups). One patient each had skin necrosis, hematoma, and wound dehiscence in the DPF group. In the spongioplasty only group, one patient had meatal stenosis which was treated by meatoplasty after failing repeated periodic calibration.

Conclusion: DPF should be preferably used for distal penile and TVF for mid and proximal penile hypospadias to ensure excellent result with minimum complications. Spongioplasty only as a second layer is sufficient to avoid the complications wherever it is thick and robust.

Keywords: Complications, fistula, hypospadias, urethra

Introduction

Hypospadias is a congenital defect because of incomplete tubularization of the urethral plate with an incidence of 0.8–8.2 per 1000 live male births.^[1] Hypospadias can be classified according to the meatal location. Hadidi et al.^[2] in 2004 proposed the classification of hypospadias into glanular, distal (subcoronal, distal penile, and middle), and proximal (proximal penile, penoscrotal, scrotal, and perineal). To correct this condition, there are more than 200 different types of hypospadias repairs. The Snodgrass technique can be used for all types of hypospadias repairs from distal to proximal penile hypospadias, where the urethral plate can be preserved.^[3] Various healthy tissues (dorsal preputial dartos flap, de-epithelized skin flap, tunica vaginalis, and corpus spongiosum) have been used to cover the neourethra and avoid the complications of repair.^[4–6] A second vascular

cover on the tube such as spongiosum, dartos, or tunica vaginalis is known to minimize the complications of repair.^[3] However, which flap to use as a second cover in the primary repair of hypospadias is a matter of debate. In this study we aimed to assess the results of the various flaps (as the second layer) used as per selection criteria decided in the treatment of primary hypospadias by Snodgrass repair.

Material and methods

Study population

All the patients with primary hypospadias who had presented to our department during the said period and who qualified as per the selection criteria decided were included in the study.

Inclusion and exclusion criteria

We included 97 patients (n = 97) with only primary hypospadias repair who were suit-

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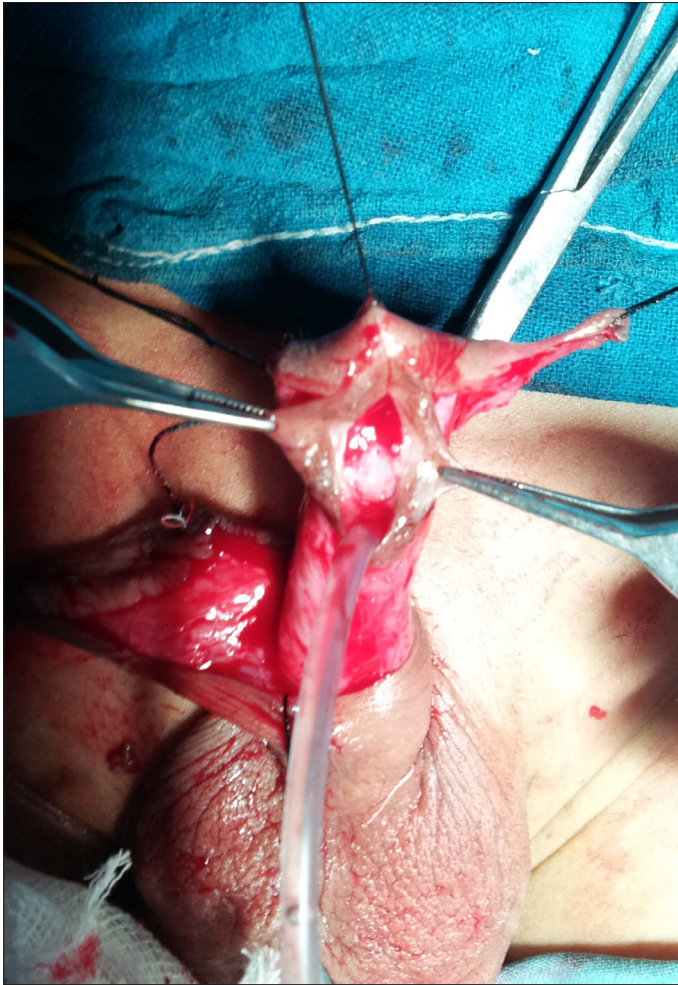


Figure 1. Intraoperative picture in a patient with distal penile hypospadias with poor spongiosum.

able candidates for the Snodgrass repair. The suitable candidates for Snodgrass repair were patients who had a deep grooved urethral plate, plate width > 8 mm and glans width

Main Points:

- The appropriate flap to be used as a second cover in primary repair of hypospadias is a matter of debate.
- A second vascular cover on the urethral tube such as spongiosum, dartos, or tunica vaginalis are known to minimize the complications of repair.
- Our study assessed the results of various flaps used as per selection criteria decided in the treatment of primary hypospadias by Snodgrass repair.
- Dorsal preputial dartos flap should be preferably used for distal penile and tunica vaginalis flap for mid and proximal penile hypospadias.
- Spongioplasty only as a second layer is sufficient wherever it is thick and robust.

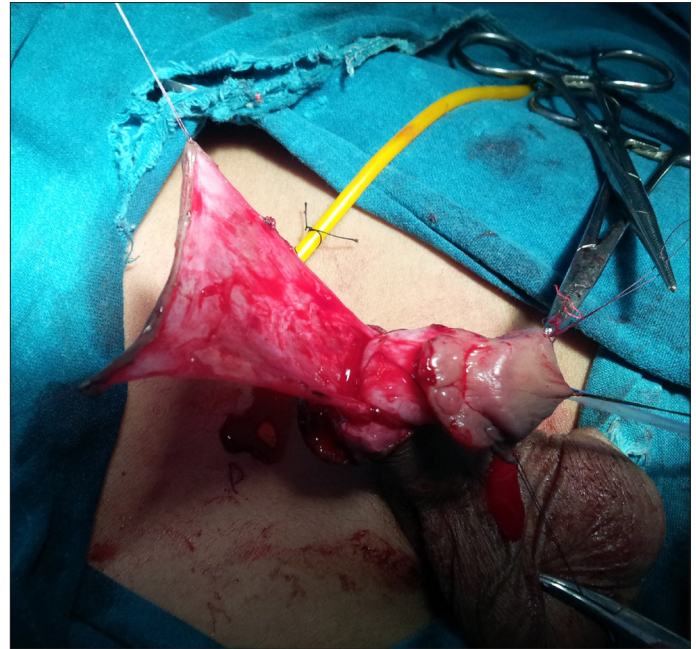


Figure 2. Complete dissection of the dorsal preputial dartos flap to be rotated ventrally and used as the second layer to cover the suture line in a patient with distal penile hypospadias with poor spongiosum.

> 14 mm with correctable chordee. The parents (for minors) and the patients were informed about the merits and the complications of the procedure, and written informed consent was obtained for the surgery as well as inclusion in the study. Approval was sought from the ethical committee of Grant Government Medical College and Sir JJ Hospital, Mumbai (Ethics committee no. IEC/Pharm/144/2014, received date -12/06/2014). All the patients were operated upon by a single surgeon.

Study design

A non-randomized experimental study was carried out at our institution between June 2014 and March 2019.

Selection criteria for the type of the second layer used was based on intraoperative findings. The second layers used in our study were spongiosum alone, tunica vaginalis, and dorsal preputial dartos flap.

Selection criteria

1. Dorsal preputial dartos flap - patients who had distal penile hypospadias, well-developed preputial hood, and deficient and weak spongiosum (Figures 1 and 2).

2. Tunica vaginalis flap - patients having mid penile and proximal penile hypospadias and/or who had circumcised penis and/or had weak spongiosum (Figures 3 and 4).

3. Spongiosum alone- We divided the spongiosa into three types intraoperatively, depending on its appearance and vascularity.

Type 1. Poorly developed: Thin spongiosal tissue with decreased vascularity. The diameter of the neourethra covered by spongiosum after spongioplasty was less than the proximal healthy urethra.

Type 2. Moderately developed: Average thickness and vascularity of spongiosum tissue. The diameter of the neourethra covered by spongiosum after spongioplasty was almost equal to that of the proximal healthy urethra.



Figure 3. Intraoperative picture of a patient with mid penile hypospadias showing poorly developed spongiosum.

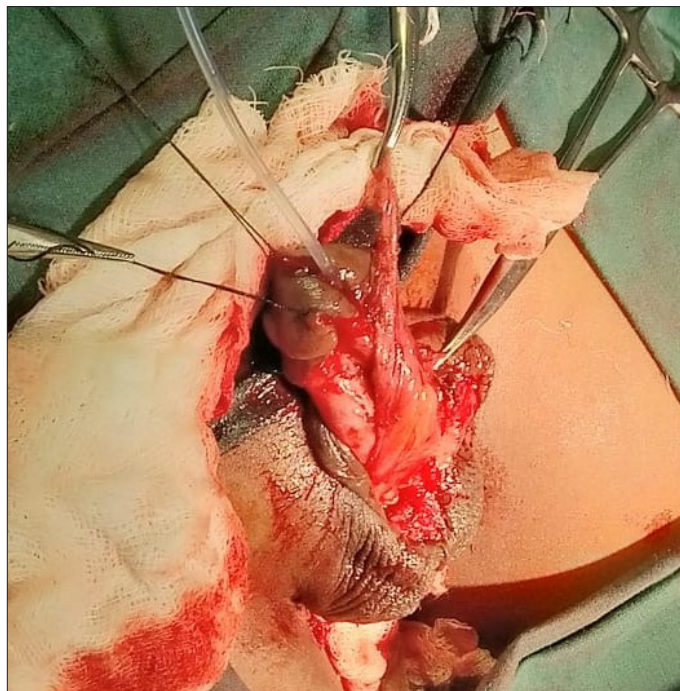


Figure 4. Harvested tunica vaginalis flap used as the second layer in a patient with mid penile hypospadias showing poorly developed spongiosum.



Figure 5. Intraoperative picture of an adult patient showing well-developed, thick, and robust spongiosum Type 3.



Figure 6. Intraoperative picture of an 8-year-old child with mid penile hypospadias showing adequate mobilization of spongiosum.

Type 3. Well developed: Robust, thick spongiosum with good vascularity. The diameter of the neourethra covered by spongiosum was greater than that of the proximal healthy urethra (Figures 5 and 6).

We used spongioplasty alone where spongiosum was type 3 category, barring the site of primary hypospadias, presence or absence of prepuce, and availability of tunica vaginalis.

Procedure

All the patients underwent the repair using the techniques described by Snodgrass with fine instruments, using bipolar cautery without the use of a tourniquet or use of adrenaline, under general anesthesia. A U-shaped incision was made encircling the meatus to the corona, preserving the urethral plate, and then extended circumferentially around the corona. Penile de-gloving was done to the root of the penis by creating a plane at the level of the buck's fascia. The goniometer was not used to measure the chordee. Chordee correction was checked by the Gittes test. None of the patients required additional procedures for correction of chordee after penile de-gloving. A vertical incision was done over the urethral plate to the mid glans. Over an appropriately sized catheter, using 6-0 Vicryl suture, the neourethra was

created by subcuticular technique. As per the selection criteria decided, the second layer was chosen.

Operative technique used for the second layer

In TVF, de-gloving was done to the root of the penis. The TV flap was raised by bringing the right testis into the operative field. Contralateral TV was not used. A strip of TV 15–20 mm wide was separated from the parietal layer of the TV of the right testis by sharp dissection. Tunica was incised near the lower pole of the testis only (near the head of the epididymis) in the transverse axis, preserving spermatic fascia to create an island of TV based on the pedicle of the spermatic fascia. After obtaining adequate length, the flap was raised if necessary, even up to the external ring, and this was used to cover the entire length of the tube and then secured in place. In DPF, the dartos flap was raised by dissecting between the skin and the dartos fascia. Dissection was extended proximally until it was adequate to cover the suture line ventrally, taking care to avoid injury to the skin blood supply or the preputial pedicle (dartos flap). The remaining part of the inner surface of the prepuce was excised, and the length of the pedicle flap was re-assessed. This preputial flap was rotated ventrally from the right or left side and was used to cover the ventral suture line. In spongioplasty only, the spongiosum was dissected just proximal to the meatus between the buck's fascia and the tunica albuginea from lateral to medial on both sides till its approximation was possible without tension (Figures 5 and 6). The urethral plate along with the spongiosum was mobilized from the corpora without damaging the spongiosum or cavernosum, ensuring that the blood supply to the spongiosum and the urethral plate was maintained. As spongiosal pillars spread beneath the glans wings on either side, we took care mobilizing the glans wings distally with an oblique incision above, at about 45°, which left healthy thick glans wings and yet intact spongiosum. Spongioplasty was done over the neourethra as the second layer. Skin closure was done by using Byar's flap. A light compression dressing was applied, and intravenous antibiotics were administered for five days followed by oral antibiotics till the dressing was removed. Dressing and the catheter were removed on the 10th postoperative day. If there was any soakage of the dressing, it was changed in between; but a clean dressing was left in place for at least 10 days. All the patients were put on an anti-cholinergic and laxatives to prevent bladder spasms and straining. The outcome of the procedure was assessed first at the end of three months, and thereafter three monthly for one year, and then six monthly for the next five years in terms of cosmeses. Cosmeses was assessed through a clinical examination by the operating surgeon and a subjective assessment based on acceptance by the patients or their parents. Chordee correction was also assessed by unaided visual inspection. The functional assessment of the outcome was measured by performing a visual inspection of the urinary stream and uroflowmetry (curve and maximum flow rate). Statistical analysis was performed using Microsoft excel 2010 and IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA).

Results

As explained in the methods section, 97 patients were included in the study. Most of the patients who presented were less than five years of age (72.2%). There were no significant differences in the associated findings or duration of follow-up between the groups (Table 1). Premature catheter/dressing removal or accidental pulling out of the catheter was not encountered in any of the patients. We used various flaps as per the selection criteria decided, and the results of the second layer were assessed in terms of cosmeses, visual assessment of urinary stream, and complications (Table 2).

DPF was used in 42 (43.3%) patients, who had distal penile hypospadias. In this group, the overall complication rate was

Table 1. Demographic Profile of Patients and the Associated Clinical Findings Observed

Age (years)	0–2	2–5	5–10	10–15	>15
No. of patients (n = 97)	25 (25.8%)	45 (46.4%)	10 (10.3%)	8 (8.2%)	9 (9.3%)
Associated findings					
Circumcised (8.2%)	2	3	1	1	1
Clinically notable chordee (< 30 degree) (25.8%)	4	8	6	4	3

Table 2. Site-wise Distribution and the Complications Encountered with respect to Type of Second Layer Used

Second layer used	Dorsal preputial dartos flap (DPF)	Tunica vaginalis flap (TVF)	Spongiosum alone
No. of patients (n = 97)	42 (43.3%)	38 (39.2%)	17 (17.5%)
Site wise distribution			
Distal penile	42	0	8
Mid penile	0	32	5
Proximal penile	0	6	4
Complications			
Fistula	3 (7.1%)	1 (2.6%)	0
Meatal stenosis	0	0	1 (5.9%)
Skin necrosis	1 (2.4%)	0	0
Scrotal edema	0	1 (2.6%)	0
Wound dehiscence	1 (2.4%)	0	0

11.9% (five patients), which included urethrocutaneous fistula in three (7.1%) patients, one (2.4%) patient had skin necrosis, and one (2.4%) patient had wound dehiscence. All the urethrocutaneous fistulae were at the hypospadiatic meatus site and were successfully repaired by Durham Smith Vest-Over-Pant technique after six months. Superficial skin blackening was found in one patient, which resolved after conservative treatment. One patient who had wound dehiscence underwent re-do Snodgrass repair after six months using TVF as the second layer.

TVF was used in 38 (39.2%) patients, which included mid penile (32) and proximal penile hypospadias (6). Of the total eight patients who were circumcised, five were in the TVF group. In the TVF group, overall complication rate was 5.3% (two patients) which included urethrocutaneous fistula in one (2.6%) patient and scrotal edema in one (2.6%) patient. The urethrocutaneous fistula was found at the hypospadiatic meatus in a patient having mid penile hypospadias, which was repaired with Durham Smith Vest-Over-Pant technique after six months. One patient who developed scrotal edema was managed conservatively.

In the spongiosum group, we used spongiosum only where spongiosum was of type 3, barring the site of primary hypospadias, presence or absence of prepuce, and availability of tunica vaginalis in 17 (17.5%) patients, (eight distal penile, five mid-penile, and four proximal penile). Of the 17 patients who underwent spongiosum alone, three patients were circumcised. In this group, only one (5.9%) patient had a meatal stenosis with distal hypospadias, which was corrected by meatoplasty after a trial of repeated meatal calibration failure. No fistula or any other complications were encountered in this group. Therefore, the overall complications in this group were 5.9%.

At the end of one-year follow-up, all the patients including patients who had complications were functionally (on the basis of uroflowmetry) and cosmetically normal. Descriptive statistical analyses were performed in the study.

Discussion

Snodgrass popularized tubularized incised urethral plate urethroplasty (TIPU) for hypospadias, which gained widespread acceptance owing to its versatility, low complications rate, and creation of vertically oriented meatus.^[7]

Nowadays, Snodgrass repair is the procedure of choice for distal and mid-shaft hypospadias and is increasingly being used for the proximal hypospadias with excellent results and reported complication rates of 0% to 33%, the most common being urethrocutaneous fistula.^[4, 8] The basic aim of any hypospadias surgery is to reduce the complication rate to less than 5% in the distal and less than 10% in the proximal penile hypospadias.^[6] One of

the most important factors in reducing fistula formation is a protective intermediate layer between the neourethra and the skin. Although various protective layers were used, the most common being DPF, TVF, and spongiosum, an ideal one has not been found.^[6] As there were no selection criteria for choosing the second layer to date, we made selection criteria depending on the availability of the second layer, site of hypospadias, development of prepuce, and thickness and robustness of spongiosum; and the results were assessed.

Snodgrass in his editorial comment reported that the dorsal-based flap had the advantage of local availability and did not require another incision or extension of the incision as in TVF.^[9] Dhua et al.^[6] have found that DPF and TVF provide robust cover to the neourethra; however, harvesting dartos fascia without damaging the intrinsic blood supply to the outer skin when the flap was transposed ventrally requires skilful dissection and may lead to either superficial or deep skin necrosis.

We feel that the use of DPF in mid and proximal penile hypospadias repair may result in a shortage of skin and skin necrosis because of the damage to intrinsic blood supply, which made us choose DPF in only patients with distal hypospadias. Snow et al.^[10] in 1995, were the first to report the use of TVF as an intermediate graft. Dhua et al.^[6] have reported that harvesting TVF was easy, could be done by beginners, and the ventral incision was continued posteriorly along the median raphe, which gave good access to the testis. However, we believe that there is no need to extend the incision when used for mid penile and proximal penile hypospadias in the majority of patients as the dissection was done to the root of the penis, which made accessing the tunica easier. Chatterjee et al.^[11] have reported that when TVF was used for distal penile, there was a need for a separate incision over the scrotum; and if it was used only for mid and proximal penile, there was no need for a separate incision, similar to our study.

Bhat et al.^[4] intraoperatively divided the spongiosa into three groups as mild, moderate, and well-developed according to the thickness, vascularity, and robustness; and recommended the spongiosum to be incorporated as an essential step in all the patients as a protective intermediate layer. The use of spongiosum makes sense as it is locally available and decreases the tension on the suture line of urethroplasty in midline, especially during erection, restores normal urethra, and provides good support. The use of corpora spongiosum alone to cover the neourethra is infrequent. In their prospective study of 113 patients with primary hypospadias repair with spongioplasty by well-developed spongiosum as the second layer in mid, distal, and proximal penile hypospadias, they found 0% fistula rate. However, the reported fistula rate of TIPU with spongioplasty ranges from 4%–40%.^[12] Dodat et al.^[13] have shown no fistula formation

in any of 51 patients who underwent TIPU with spongioplasty only, as in our study. Yerkes et al.^[14] mobilized spongiosum into glans without incising it transversely at the corona when doing spongioplasty, which was done to the distal most part of the neourethra, and they found the added advantage of preventing fistula formation at coronal sulcus level, as was done in our study. Several investigators have reported the variable success rate of spongioplasty, depending on the availability and development of the spongiosum.^[15] We used type 3 spongiosum in 17 patients (17.5%) having mid, distal, and proximal penile hypospadias without any fistula or major complications, except one patient who had meatal stenosis, which was treated by meatoplasty after failing the periodic calibration. Therefore, we believe additional cover along with spongioplasty is not necessary.

Basavaraju and Balaji^[3] have reviewed the data of 83 patients with primary hypospadias repair and found mild scrotal edema in five patients of 36 patients in the tunica vaginalis group; and eight patients had a fistula, two had glans breakdown, and one had meatal stenosis where DPF was used. In our study, we used DPF in 42 patients and TVF in 38 patients; and in the DPF group, we found urethrocuteous fistula in three patients, skin necrosis in one, and wound dehiscence in one patient. In the TVF group, only one patient had urethrocuteous fistula, and another had scrotal edema.

Duckett et al.^[16] have described the reason for skin necrosis in DPF flap as a result of the separation of dartos from the skin. Dhua et al.^[6] have reported superficial skin necrosis in three patients following the use of DPF as the second layer. Bhat and Mandal^[17] have reviewed literature reports regarding complications of hypospadias and stated that skin necrosis may be superficial and dermal, which heals without permanent damage as happened in our case. Wound dehiscence is a very rare complication, and only a few cases have been reported. Sharma^[15] in his study of 33 patients, found complete dehiscence in one where he used DPF as the second layer and had good results with redo TIPU after six months as in our patient.

Chatterjee et al.^[11] in their study of 49 patients with various types of hypospadias from coronal to penoscrotal have reported a 15% fistula rate in DPF and 0% in TVF. Babu and Hariharasudhan in their study of 83 patients, used DPF in 26 patients with mid penile and 36 patients with distal penile hypospadias and TVF in 21 patients with mid penile hypospadias. They found skin necrosis in 23% of the patients and urethrocuteous fistula in 13 patients where DPF was used for mid penile hypospadias. They concluded that TIP repair using inner preputial dartos flap had a significantly higher complication rate when used for mid-shaft hypospadias than distal hypospadias. TVF was superior to the inner preputial dartos flap as a waterproofing layer for primary TIP repair in mid shaft hypospadias as it reduced the fistula rate. TVF is superior to

DPF in proximal hypospadias in preventing the complications.^[18] Reported fistula rates when TVF was used as the second layer is 0%–9 %, and Snodgrass^[9] in his recent experience found reduced fistula rate up to 0% with the use of TVF.

In our study, DPF was used only in distal penile hypospadias, and TVF was used for mid and proximal penile hypospadias. We found three patients who had urethrocutaneous fistula in the DPF group and one patient in the TVF group, which were comparable to other studies. As per Dhua et al.^[6], TVF may have an edge over dartos flap; however, we believe that the selection of the second layer should be based on clinical and intraoperative findings to have good results.

To assess the outcome of each surgery, we used clinical examination; unaided visual inspection for chordee assessment; subjective assessment of cosmeses by the operating surgeon, patients, or their parents; and functional outcome using uroflowmetry. However, the assessment of outcome in such cases should be done using an objective method, such as the Hypospadias Objective Scoring Evaluation (HOSE) system. Ciftci et al.^[19] in their study of 42 proximal hypospadias patients treated by modified Hinderer's technique evaluated the outcomes of their patients with an objective scoring system (HOSE). They found acceptable cosmetic results in 85% of the patients. However, in our study, we did not use the objective scoring system for cosmeses evaluation, but used the subjective criteria described above; and the cosmeses and functional results were satisfactory in all the patients.

We recommend DPF be used preferably in distal and TVF in mid and proximal penile hypospadias. We also recommend that whenever robust, thick, and vascular spongiosum is available, only spongioplasty is sufficient to avoid complications like fistula in mid, proximal, and distal penile hypospadias.

Limitations

Our study was a non-randomized experimental study. Because of the lack of a control group and it being a non-comparative study, we only assessed the outcomes of each second layer used as per the selection criteria. However, this study can be used as a pilot study for comparison between the three types of tissues used as the second layer in future studies. There is a need for a randomized, controlled, analytical, and comparative study with a large sample size for confirmation of our results.

In conclusion, the DPF should be preferably used for distal penile and TVF for mid and proximal penile hypospadias to have an excellent result with minimum complications. Spongioplasty only as a second layer is sufficient to avoid the complications like fistula in mid, proximal, and distal penile hypospadias, wherever it is thick and robust.

Ethics Committee Approval: Approval was sought from the ethical committee of Grant Government Medical College and Sir JJ Hospital, Mumbai (Ethics committee no. IEC/Pharm/144/2014, received date -12/06/2014)

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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References

1. Bath AS, Bhandari PS, Mukherjee MK. Repair of distal hypospadias by the tubularised incised plate urethroplasty: a simple versatile technique. *Indian J Plast Surg* 2003;36:23-5.
2. Hadidi AT. Classification of hypospadias. Hadidi AT, Azmy A, editors. *Hypospadias Surgery*. Berlin Heidelberg: Springer; 2004.p.79-82. [\[Crossref\]](#)
3. Basavaraju M, Balaji DK. Choosing an ideal vascular cover for Snodgrass repair. *Urol Ann* 2017;9:348-52. [\[Crossref\]](#)
4. Bhat A, Sabharwal K, Bhat M, Saran R, Singla M, Kumar V. Outcome of tubularized incised plate urethroplasty with spongioplasty alone as additional tissue cover: a prospective study. *Indian J Urol* 2014;30:392-7. [\[Crossref\]](#)
5. Bhat A, Bhat M, Kumar R, Bhat A. Double breasting spongioplasty in tubularized/tubularized incise plate urethroplasty: a new technique. *Indian J Urol* 2017;33:58-63. [\[Crossref\]](#)
6. Dhua AK, Aggarwal SK, Sinha S, Ratan SK. Soft tissue covers in hypospadias surgery: is tunica vaginalis better than dartos flap. *J Indian Assoc Pediatr Surg* 2012;17:16-9. [\[Crossref\]](#)
7. Snodgrass W. Tubularised, incised plate urethroplasty for distal hypospadias. *J Urol* 1994; 151:464-5. [\[Crossref\]](#)
8. Borer JG, Bauer SB, Peters CA, Diamond DA, Atala A, Cilento BG, et al. Tubularised incised plate urethroplasty: expanded use in primary and repeat surgery for hypospadias. *J Urol* 2001;165:581-5. [\[Crossref\]](#)
9. Snodgrass WT. Editorial comment. *J Urol* 2007;178:1456. [\[Crossref\]](#)
10. Snow BW, Cartwright PC, Unger K. Tunica vaginalis blanket wrap to prevent urethrocutaneous fistula: an 8-year experience. *J Urol* 1995;153:472-3. [\[Crossref\]](#)
11. Chatterjee US, Mandal MK, Basu S, Das R, Majhi T. Comparative study of dartos fascia and tunica vaginalis pedicle wrap for the tubularized incised plate in primary hypospadias repair. *BJU Int* 2004;94:1102-4. [\[Crossref\]](#)

12. Gamal WM, Zaki M, Rashi A, Mostafa M, Abozeid A. Tubularised incised plate repair augmented by spongioplasty for distal and mid penile hypospadias. *UIJ* 2009;2. [\[Crossref\]](#)
13. Dodat H, Landry JL, Szwarc C, Culem S, Murat FJ, Dubois R. Spongioplasty and separation of the corpora cavernosa for hypospadias repair. *BJU Int* 2003;91:528-31. [\[Crossref\]](#)
14. Yerkes EB, Adams MC, Miller DA, Pope JC 4th, Rink RC, Brock JW 3rd. Y-to-I wrap use of the distal spongiosum for hypospadias repair. *J Urol* 2000;163:1538-9. [\[Crossref\]](#)
15. Sharma GR. Tubularized incised plate urethroplasty (TIP) for distal and midshaft hypospadias a preliminary experience. *Indian J Urol* 2004;20:15-8.
16. Duckett JW. Hypospadias. Walsh PC, Retik AB, Vaughan ED, Wein AJ, editors. *Campbell's Urology*. Philadelphia: W.B. Saunders; 1998.p.2093-119.
17. Bhat A, Mandal AK. Acute postoperative complications of hypospadias repair. *Indian J Urol* 2008;24:241-8. [\[Crossref\]](#)
18. Babu R, Hariharasudhan S. Tunica vaginalis flap is superior to inner preputial dartos flap as a waterproofing layer for primary TIP repair in midshaft hypospadias. *J Pediatr Urol* 2013;9:804-7. [\[Crossref\]](#)
19. Ciftci I, Gunduz M, Sekmenli T. Modified Hinderer's technique for serious proximal hypospadias with ventral curvature: outcomes and our experience. *Urol J* 2019;16:478-81.