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Original Article

Coverage of urethroplasty in pediatric hypospadias: Randomized comparison between different flaps

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Abbreviations & Acronyms
DDF = double dartos flap
NS = not significant
Q_{max} = maximum urinary flow rate
TIPU = tubularized incised plate urethroplasty
UCF = urethrocutaneous fistula

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Objectives: The use of covering urethroplasty with flaps in hypospadias surgery has been well recommended. Various techniques have been described for flap harvesting. The aim of the present study was to compare the outcome and complication rate of dorsal preputial flaps and ventral dartos flaps.

Methods: A total of 130 patients were prospectively evaluated from January 2008 to December 2011. Using the tubularized incised plate urethroplasty procedure, urethroplasty was carried out by a single surgeon. Patients were randomly divided in two groups: group A (57 patients), in which a preputial flap was carried out using three different techniques; and group B (73 patients), in which a single or a double ventral dartos flap was used.

Results: A total of 41 complications occurred in 24 patients. Urethrocutaneous fistulas were observed in 14.9%, quite equally distributed between groups A and B. There was only one urethrocutaneous fistula in a patient treated with the double ventral dartos flaps. Five cases (3.8%) of glans dehiscence were observed: four after single ventral dartos flap and one after dorsal preputial flap. Six patients in group A and seven in group B experienced meatal stenosis. In three cases of iatrogenic torsion of the penis, a dorsal preputial flap was laterally transposed. Finally, a lower complication rate was observed for double ventral dartos flap versus the other techniques.

Conclusions: The use of a double ventral dartos flap should represent the first-line technique for coverage of distal urethroplasty.

Key words: coverage flap, hypospadias, pediatrics.

Introduction

The use of neourethra covering flaps in hypospadias surgery is widely considered as an important factor leading to better results in terms of postoperative complications, especially with regard to dehiscence and UCF formation.

Although many different types of flaps have been described,[1–4] two techniques have gained acceptance in the past two decades: the dorsal preputial flaps[5] and, most recently, the ventral dartos flaps.[6,7]

To date, despite the use of covering flaps in hypospadias surgery being recommended, it is still a matter of debate as to the best technique in terms of complication rate and cosmetic results.

The aim of the present study was to evaluate and compare the use of flaps (dorsal preputial flaps *vs* ventral dartos flaps) in terms of complication rate in children undergoing TIPU repair for distal hypospadias.

Methods

From January 2008 to December 2011, at the Section of Pediatric Urology of the University of Palermo, Palermo, Italy, we prospectively studied patients undergoing surgery for hypospadias repair.

The following factors of inclusion were used: age range from 16 to 36 months, isolated anterior hypospadias, first urethral repair, no preoperative topical androgen therapy, TIPU

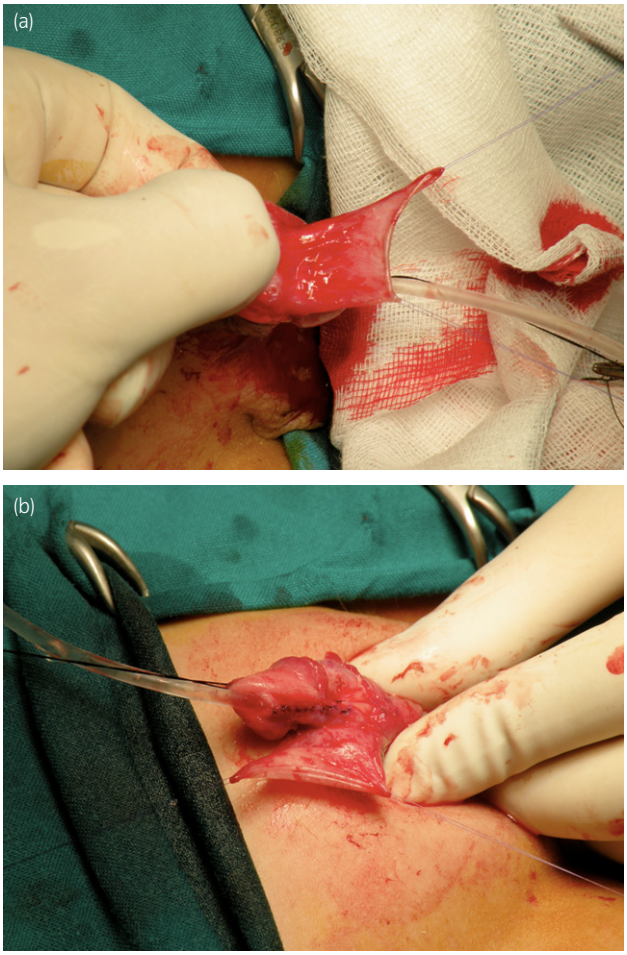

Fig. 1 (a) Full dorsal preputial flap. (b) Full dorsal preputial flap laterally twisted to cover the urethroplasty.

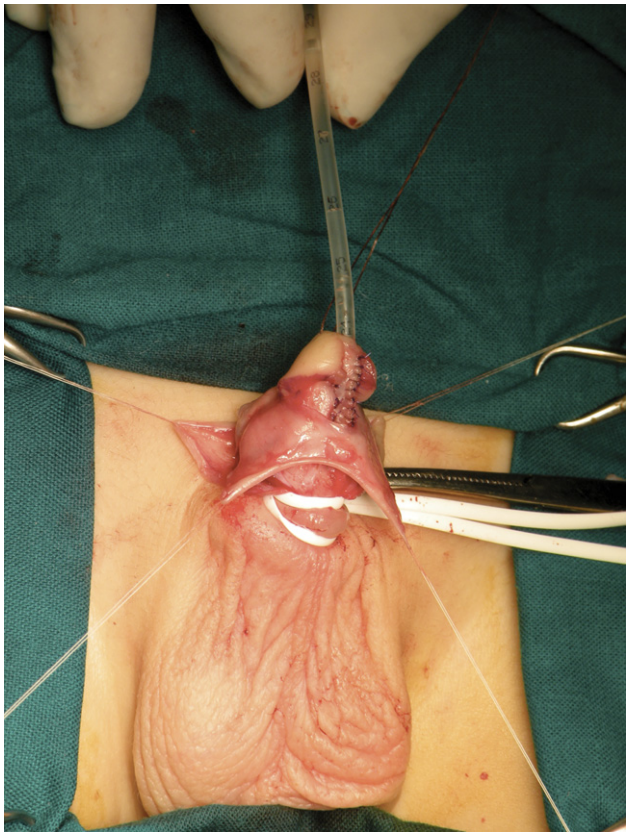

Fig. 2 Full dorsal preputial flap ventrally twisted in a buttonhole fashion.

procedure according to Snodgrass, urethroplasty using reabsorbable detached 6-0 monofilament and at least 4 months postoperative follow up.

All surgical procedures were carried out by a single surgeon (MC).

Patients were randomly divided into two groups, A and B, then in five subgroups. The technique used for flap transposition in group A was randomly assigned, based on computing software available at http://www.randomization.com. In group B, the techniques were alternatively carried out. Approval of the local ethical committee was previously obtained.

Patients receiving a dorsal preputial flap were enrolled into group A. These patients were furthermore stratified into three subgroups: A_1, laterally twisted preputial flap (Fig. 1); A_2, ventrally twisted flap in a buttonhole fashion (Fig. 2); and A_3, preputial flap divided in two wings and laterally twisted (Fig. 3).

The preputial flap was de-epithelialized and then twisted ventrally using three different techniques previously described in the literature.[5,8,9] Regardless of the technique used, the flaps were fixed in the ventral position with 6/0 reabsorbable monofilament detached sutures. Circumcision was finally carried out in all patients.

Group B was made up of patients who received a ventral dartos flap. Patients were furthermore divided in two subgroups: B_1, single layer flap (Fig. 4); and B_2, double layer flap (Fig. 5). In both groups, flaps were obtained by subcutaneous penile ventral dartos. The ventral dartos was carefully dissected from the overhanging ventral skin. Dartos flaps can be prepared on both the right and left side, taking care to avoid neourethra injuries, assuring a good blood supply.

Once prepared, every flap was transposed contralaterally covering the neourethra, and fixed with 6/0 detached sutures; the first flap resulting immediately above the neouretra, while the second flap interposed between the first dartos flap and the ventral penile skin. After flap anchorage, a glanduloplasty with 5/0 monofilament was carried out. Prepuce was left untouched, thus a preputioplasty was finally carried out.

For all groups of patients, the postoperative course was standardized as follows.

An 8-Fr urethral stent was left *in situ* for 10 days. Compressive penile dressing was removed on the second day postoperatively. Antibiotic therapy with a third generation cephalosporin was given to all patients until the urethral

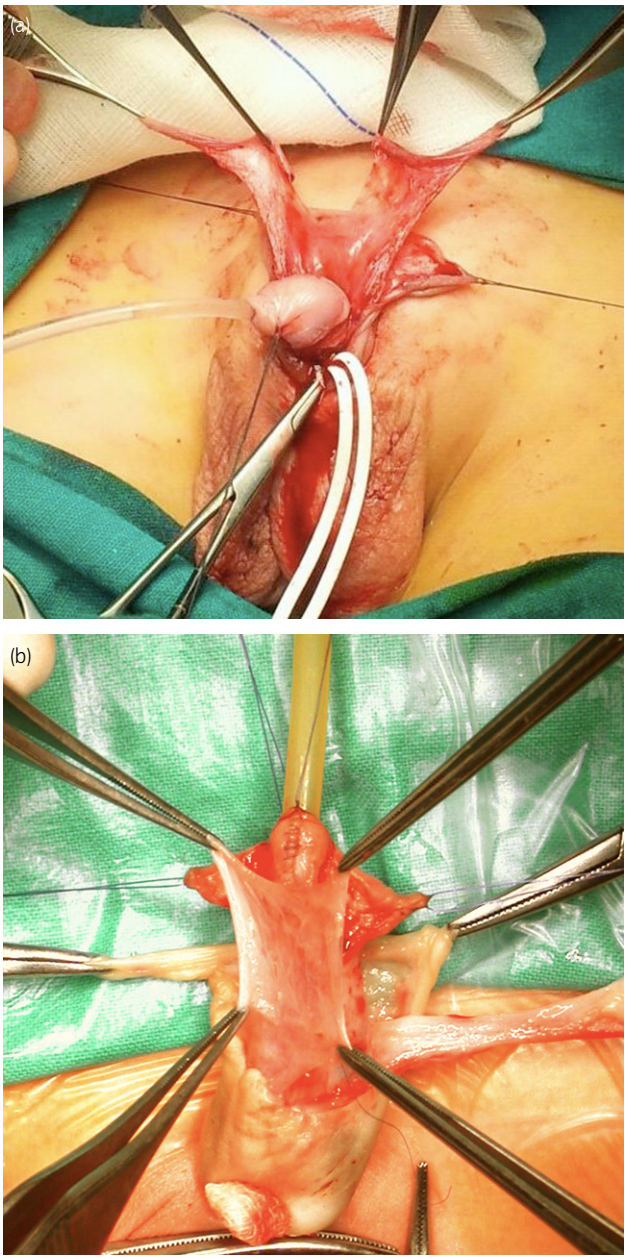

Fig. 3 (a) Full dorsal preputial flap divided in two wings. (b) The first wing is laterally twisted.

stent was removed. Calibration in sedation of neourethra was carried out, only in selected cases, when parents reported an apparent reduction in urinary flow.

Success was defined as no complications requiring re-intervention with good cosmetic result. Functional result was defined as good if a normal voiding at uroflowmetry was obtained. Cosmetic parameters evaluated were: normal appearance of meatus (size, position and orientation), normal appearance of prepuce and parental satisfaction.

Statistical analysis was carried out entering data on a two-way contingency table analysis at http://statpages.org/ctab2x2.html and Fisher's exact test was assumed for statistical significance ($P < 0.05$).

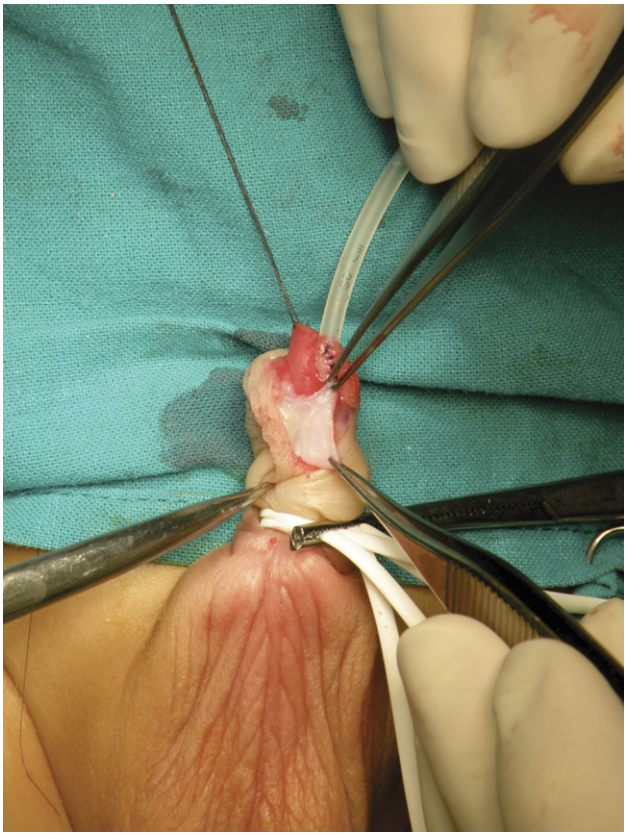

Fig. 4 Single ventral dartos flap.

Results

From January 2008 to December 2011, 189 patients underwent TIPU repair for distal hypospadias.

Based on the inclusion criteria previously described, 130 of these patients were studied.

A total of 57 patients receiving a dorsal preputial flap formed group A. Subgroup A_1 included 19 patients in which the flap was laterally twisted as described by Retik;[5] subgroup A_2 included 19 patients in which the flap was twisted ventrally in a buttonhole fashion as described by Snodgrass;[8] and subgroup A_3 included 19 patients in which the preputial flap was divided into two wings and then laterally twisted as described by Appignani *et al*.[9]

A total of 73 patients receiving a ventral dartos flap formed group B. Subgroup B_1 collected 36 patients who received a covering single dartos flap, whereas subgroup B_2 collected 37 patients who received a DDF.

The mean follow-up time was 20 months (range 4–45 months) for group A and 18 months for group B (range 4–46); the mean age at time of surgery was 21 months for both groups (range 16–36 months).

Overall, surgery was successful in 106 patients (81.4%). A total of 41 (31.5%) complications were observed in 24 patients: 21 (36.8%) complications occurred in group A and 20 (27.4%) occurred in group B.

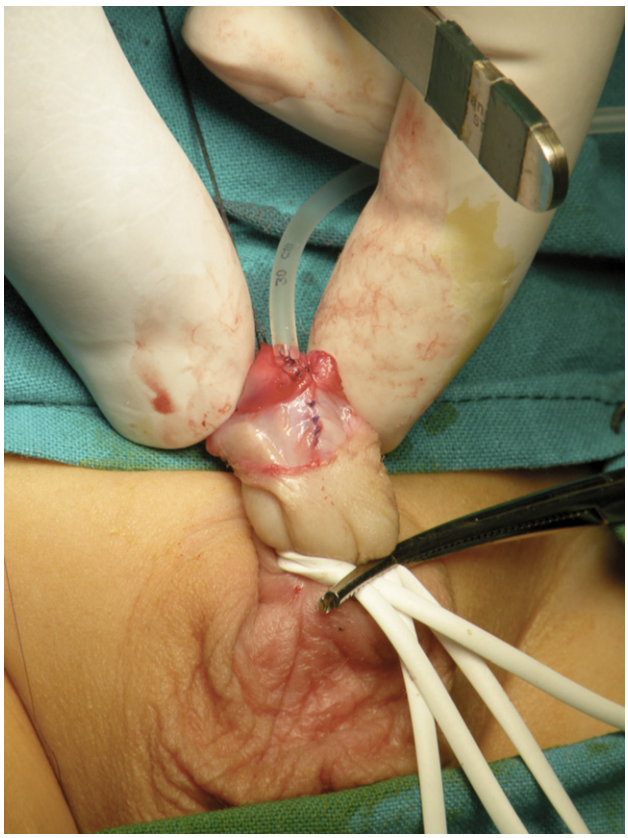

Fig. 5 Double ventral dartos flap at the end of covering.

UCF were observed in 19 (14.6%) patients: 10 (17.5%) in group A and nine (12.3%) in group B (P = NS).

Three cases (2.3%) of penile iatrogenic rotation occurred in group A, all of these patients were treated with lateral transposition of the Retik preputial flap (Table 1). Preputioplasty in group B was complicated by dehiscence in three cases (4.1%) and foreskin fistula in seven (9.5%).

Comparing group A versus group B, no statistically significant difference was found (Table 1). In group B, the use of DDF decreased fistula occurrence ($P = 0.01$) and glans dehiscence ($P = 0.05$). The fistula developed in subgroup B_2 was observed in a patient who experienced a subcoronal epidermal cyst.

The DDF versus dorsal preputial flap decreased fistula occurrence ($P = 0.04$) and penile rotation ($P = 0.03$).

Finally, comparing DDF versus the other techniques, we found a statistically significant result in terms of total complication rate, except for the buttonhole preputial flap (Table 2).

A slit-like neomeatus on the tip of the glans was obtained in most of cases, with preservation of the prepuce for a better cosmetic result. On this topic, to estimate parental satisfaction a questionnaire was dispensed. Parents were asked to evaluate the cosmetic appearance of the penis as good, acceptable, bad or indifferent to. A "good" cosmetic result was reported in 63% of group B, but in just 17.5% of group A.

Uroflowmetry was obtained in 90 toilet-trained patients with 12 months follow up: in 68 (75.5%) a normal uroflow was obtained, with values of maximum flow within the normal range (mean Q_{max} 15.8 ± 3.1 mL/s). In 22 (24.5%) asymptomatic patients, an obstructive pattern was observed (mean Q_{max}10.1 ± 2.8 mL/s). However, the obstructive pattern was unrelated to the technique used for neourethra coverage ($P > 0.05$).

Discussion

The use of DDF on covering urethroplasty might represent a good tool to address better results in long-term follow up of patients affected by distal hypospadias.

The use of TIPU, since the first description by Snodgrass, has widely gained acceptance for better cosmetic results and functional outcomes, and has been progressively used also for proximal hypospadias.[10–13] However, despite advances in surgical techniques, there is still a small number of patients experiencing complications; UCF, meatal stenosis, glans dehiscence and urethral stricture are the most common. In this scenario, UCF are still the most frequent complication, occurring in 2–16% of cases[14–17] regardless of the technique used.

The introduction of a protective layer between the neourethra and the overhanging skin strongly reduces fistulas occurrence and overall complications incidence.[18] Although a protective layer is nowadays recommended to optimize results, there is no accordance among pediatric urologists on the most effective technique.

Since Retik *et al*. first described the use of preputial dartos for neourethra coverage, a de-epithelized preputial dartos flap has been widely used.[5] Nevertheless, the lateral transposition described by Retik was a limiting factor in cases of asymmetric or insufficient flap formation. In these cases, in fact, if a strong mobilization of flap is required, the blood support of the flap could be insufficient for the neourethra. Furthermore, an incomplete or difficult mobilization of the flap allows iatrogenic penile rotation.

To solve this inconvenience, Snodgrass described in 2002 an innovative technique of flap transposition. A buttonhole is created on the flap, and it is twisted ventrally, the penis passing through the buttonhole.[8]

The use of a double protective layer has been described with good results. In 2005, Kamal described a series of patients without complications after the use of a double protective layer obtained from the dorsal prepuce and penile skin, supporting the idea that the double flap decreases fistulas occurrence.[18]

Appignani *et al*. described the formation of a double prepuce flap obtained by dividing a single one.[9] Every semi-flap is transposed ventrally, one on the right and one on the left side.

Table 1 Overall results and statistical analysis by comparison the two groups

	Group A 57 patients	Group B 73 patients	Total 130 patients	*P*-value <0.05
Fistula	10 (17.5%)	9 (12.3%)	19 (14.6%)	NS
Glans dehiscence	1 (1.7%)	4 (5.5%)	5 (3.8%)	NS
Penile rotation	3 (5.2%)	–	3 (2.3%)	NS
Diverticulum	1 (1.7%)	–	1 (0.7%)	NS
Meatal stenosis	6 (10.5%)	7 (9.6%)	13 (10%)	NS
Urethral strictures	–	–	–	
Total	21 (36.8%)	20 (27.4%)	41 (31.5%)	NS

Table 2 Analysis of complications and comparison between double dartos flap and other techniques

	DDF (37 patients)	SWPF (19 patients)	BPF (19 patients)	DWPF (19 patients)	SDF (36 patients)
Fistulas	1 (2.7%)	4 (21%) ($P = 0.04$)	2 (10.5%) (NS)	4 (21%) ($P = 0.04$)	8 (22.2%) ($P = 0.01$)
Meatal stenosis	3 (8.1%)	2 (10.5%) (NS)	1 (5.2%) (NS)	3 (15.7%) (NS)	4 (11.1%) (NS)
Glans dehiscence	–	–	1 (5.2%) (NS)	–	4 (11.1%) ($P = 0.05$)
Penile rotation	–	3 (15.7%) ($P = 0.03$)	–	–	–
Total	4 (10.8%)	9 (47.3%) ($P < 0.01$)	4 (21%) (NS)	7 (36.8%) ($P = 0.03$)	12 (33.3%) ($P = 0.02$)

BPF, buttonhole preputial flap; DDF, double dartos flap; DWPF, double wings preputial flap; SDF, single dartos flap; SWPF, single wing preputial flap.

Recently, the use of a ventral dartos flap has been described. In a retrospective study,[6] Savanelli *et al*. compared two groups of patients with distal hypospadias treated respectively with and without ventral dartos coverage after TIPU repair; the authors found significant differences in fistula occurrence, with better results in patients treated with "covered TIPU".

In a recent study by Ygiter, the percentage of fistula occurrence went from 0.7% using a double ventral dartos flap to 26% and 29.4% with a single dartos flap and with no flaps, respectively.[7] Also, Braga showed that a neourethra coverage represents an important element for prevention of fistulas occurrence, especially if associated with urethral stenting.[19]

In our population, the overall complications rate was 36.8% in group A versus 27.4% in group B (Table 1). However, in each group, almost 10% of patients experienced meatal stenosis, which is not correlated with the use of different flaps for coverage. The most common complications observed were UCF. We observed 18 early fistulas and one late fistula that developed 1 year postoperatively. The overall incidence was 14.6%, with no statistical significance between groups A and B (17.5% and 12.3%, respectively, $P = $ NS). Nevertheless, significant differences were observed in subgroups. The use of DDF showed better results in terms of UCF if compared with a single dartos flap, with an incidence of 2.7% and 22.2%, respectively ($P = 0.01$). These findings are similar to those reported by Ygiter and Savanelli. The unique fistula observed in patients receiving a DDF was a late fistula. In this patient, a small coronal epidermal cyst developed, and a UCF developed underneath the cyst during the first year after surgery. We believe that the chronic inflammation as a result of the epidermal cyst played an important role in the fistula formation in this patient.

Furthermore, in the present series, DDF also showed better results if compared with a single and double wing preputial flap: the difference in incidence of UCF, in fact, showed statistical significance ($P = 0.04$) for both techniques. These results seem to confirm the advantage in the use of a double layer covering flap if compared with a single flap, and interestingly, the difference seems more significant if a ventral dartos flap is used. Penile iatrogenic rotation occurred in three patients in group A, and obviously no case was encountered in group B ($P = $ NS). All cases occurred if lateral transposition of the preputial flap was carried out according to Retik. All patients required surgical correction.

Starting from these observations, we progressively reduced the use of the preputial flap for neourethra coverage. In fact, even if small, there is a percentage of patients who will require hypospadias redone in the future; in these patients, we believe, the untouched prepuce could be used: (i) as a scar-free covering layer for the redone urethroplasty; (ii) as a new urethral plate in a two-stage repair, as a free graft; and (iii) as an onlay island flap.

Three cases of dehiscence of the ventral prepuce occurred in patients who underwent preputioplasty, which required circumcision. In a previous study, we reported that after a mean follow up of 3.7 years, 90% of children treated with preputioplasty, during surgery for distal hypospadias, had retractable prepuce, without signs of phimosis or dehiscence.[20]

Indeed, recent data hypothesized that the blood supply of the prepuce could be congenitally hypoplasic in hypospadic patients.[21–23] This could result in a failed surgical repair or in the development of complications.

In 22 patients (24.5%), the uroflowmetry showed an obstructive pattern that did not require any surgical revision of the urethra. According with our conservative management, Andersson *et al*. reported a spontaneous improvement of obstructive uroflow at late follow up after TIPU.[24]

In conclusion, based on our experience, we suggest that the use of DDF, associated with preputioplasty, could represent the first-line of treatment for distal hypospadias repair.

We showed that a ventral penile dartos flap can be easily transposed on the neourethra, preserving a good blood flap supply.

Secondary preservation of the prepuce can provide a better chance for treating patients undergoing re-intervention and in cases of additional complications related to hypospadias. Furthermore, preputioplasty helps to restore the normal appearance of the penile anatomy, and the use of DDF reduces the risk for penile iatrogenic rotation.

Conflict of interest

None declared.

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