

# Surgical Repair of Mid-shaft Hypospadias Using a Transverse Preputial Island Flap and Pedicled Dartos Flap Around Urethral Orifice



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## Abstract

**Object** To evaluate the effects, particularly the incidence of anastomotic fistula, of a pedicled dartos flap around the urethral orifice in the treatment of urethroplasty of mid-shaft hypospadias.

**Methods** A total of 46 cases of congenital mid-shaft hypospadias were included in this study. The patients ranged in age from 0.7 to 25.4 years and the average was 5.8 years. The patients received penis chordee correction. A transverse preputial island flap was developed for urethral reconstruction. The proximal dartos of the urethral orifice was used to develop a pedicled dartos flap, which was transposed to cover and strengthen neourethral anastomosis. The ventral penile skin defect was repaired by another flap.

**Results** The 46 patients were examined during follow-up visits for 6 months to 3 years. An anastomotic fistula was observed in one case (2.2 %). Scar healing without fistula was observed in another patient due to poor blood supply to part of the ventral penile skin. No other incidences of fistula, urethral rupture, flap necrosis, wound infections, urinary tract (meatal) stenosis, or urethral diverticulum were observed in the patients.

**Conclusion** A pedicled dartos flap around the urethral orifice can take advantage of well-vascularized local tissue to add a protective layer to the proximal aspect of the

neourethral anastomosis for reducing the incidence of anastomotic fistula in mid-shaft hypospadias repair using a transverse preputial island flap.

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**Keywords** Hypospadias · Urethroplasty · Transverse preputial island flap · Fistula · Pedicled dartos flap

## Introduction

Hypospadias is a common congenital malformation of the male external genitalia characterized by displacement of the urethral orifice along the ventral surface. Mid-shaft hypospadias has the highest incidence among the distal, mid-shaft, or proximal penile hypospadiases. Surgical repair techniques such as tubularized incised plate urethroplasty (TIP), Mathieu's repair, and the Duckett method have been widely used for repairing mid-shaft hypospadiases. Urethral anastomosis is one of the most important steps in urethral reconstruction for mid-shaft hypospadias repair.

Anastomotic leakage may cause postoperative fistulae in mid-shaft hypospadias patients who usually have mild symptoms. It has been reported that postoperative fistulae occurred in 7.2–11.7 % of distal or mid-shaft hypospadias patients [1–3]. Most researchers agree that the protective cover layer on the neourethra is critical for reducing the risk of postoperative fistula [4]. Nominally, a dartos flap, a tunica vaginalis flap, or subcutaneous preputial tissue is used to cover the reconstructed urethra to reduce the

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incidence of postoperative fistula [5–10]. Seo et al. reported that dartos flaps created from the ventral and basal surface of the penis are effective for covering and strengthening the reconstructed urethra and reduce the incidence of postoperative fistulae to 4.1 % [11]. Using vascularized subcutaneous preputial tissue to cover the reconstructed urethra, Gapany et al. found that 3.5 % of patients had postoperative fistulae [12]. In the present study, we used a transverse preputial island flap in the urethroplasty for mid-shaft hypospadias repair, which might be a simple, safe, and effective surgical technique for mid-shaft hypospadias repair and can significantly reduce the incidence of anastomotic fistulae.

## Materials and Methods

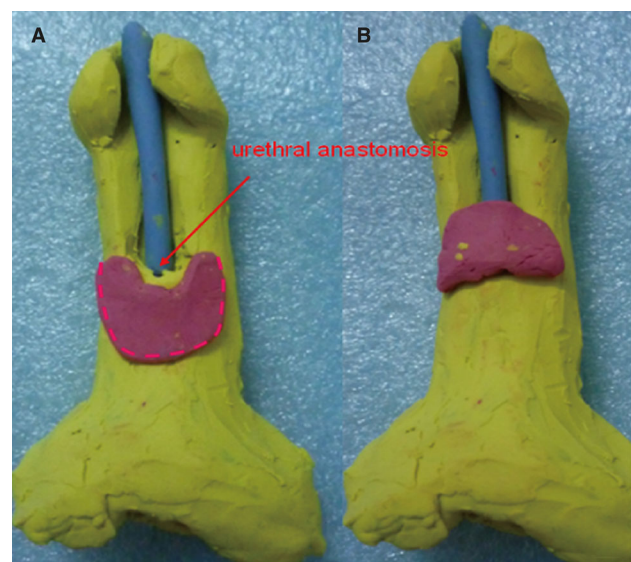
### Patients

From January 2010 to December 2014, a total of 46 cases of mid-shaft hypospadias treated in the Department of Plastic Surgery were included in the present study. The age of the 46 patients ranged from 0.7 to 25.4 years, and the average and median ages were 5.8 and 3.5 years, respectively. Inclusion criteria were as follows: (1) the patients had no previous hypospadias repair surgery; (2) abundant inner plate of prepuce tissue (inner prepuce tissue) which is conducive to conduct hypospadias repair using the transverse preputial island flap to reach an appropriate urethral length; (3) combine distal hypospadias with moderate to severe chordee of penis, distal hypospadias with dartoid urethra (after penis chordee correction and dissecting dartoid urethra, urethral orifice was directed to the mid-shaft of penis), and mild chordee penis mid-shaft hypospadias; (4) there was no age limit. All human studies have been approved by [XXX]. All human studies were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

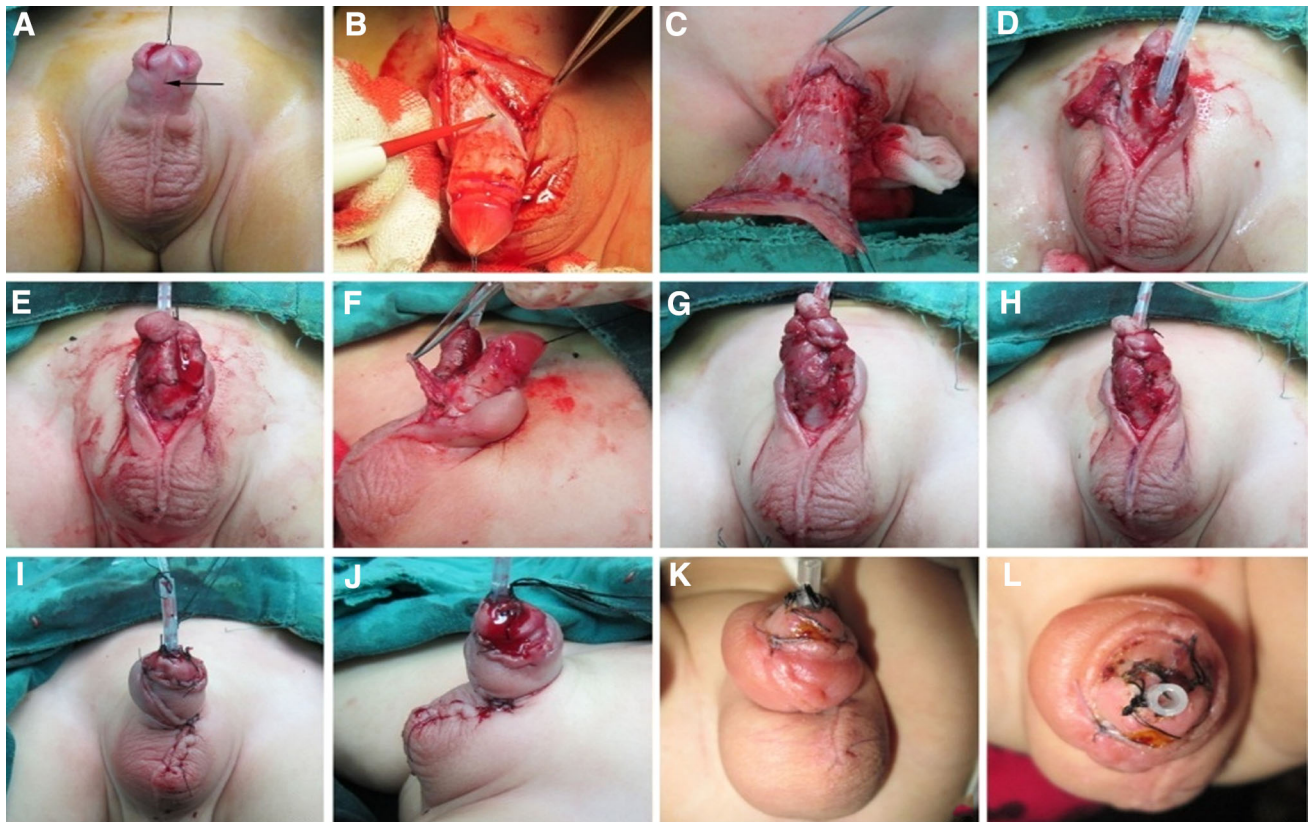
### Surgery

The surgeries were conducted under general tracheal anesthesia or combined spinal epidural anesthesia. In a circular incision 5 mm under the corona, the foreskin tissue was carefully dissected along the Colles' and Buck's fasciae to deglove to the bottom of the penis. The penis was straightened by removing the urethral plate and fibrosis tissue around the distal urethral orifice. In cases of a narrow urethral meatus or dysplasia in the urinary tract tissue around the ventral urethral orifice, the urethral orifice on the ventral penile shaft was longitudinally incised until normal tissue was exposed to expand the urethral orifice, and the urethral orifice was directed to the mid-shaft of

penis. A transverse preputial island flap was designed according to the position of the urethral orifice and the length of the urethral defect. Generally, the flap length was 30 % longer than that of the length of the urethral defect. The flap width (15–20 mm) was determined according to the patients' age and the diameter of the proximal urethra. The pedicle of the transverse preputial island flap was fully loosened to avoid penis rotation when it was transferred to reconstruct the urethra. A urethral stent was placed in the urethra and a silicone catheter was introduced through the urethral stent and into the bladder to drain urine. Then, the transverse preputial island flap was transferred to the ventral penis for urethral anastomosis using 5–0 absorbable sutures. The urethra was reconstructed along the urethral stent by continuous mattress suturing, using 5–0 absorbable sutures, of the transverse preputial island flap. A pedicled dartos flap was designed around the urethral orifice to cover and strengthen the urethral anastomosis (Fig. 1). The dartos with depth to the cavernous body and tunica albuginea was flipped to cover the neourethra that was further strengthened by suturing the dartos pedicle of the transverse preputial island flap with the opposite tunica albuginea. The reconstructed urethra was placed in a tunnel, formed by splitting the glans, in the shaft of the penis. The dorsal foreskin in the avascular zone was cut to divide it into a Byars' flap, and transferred to the ventral penis for covering ventral skin defects. As there was still a large skin defect or wound tension, an additional scrotum flap was used to cover the ventral penile skin defects if it was necessary (Fig. 2).



**Fig. 1** A model showing the construction of the peri-meatus pedicled dartos flap. **a** The dartos pedicle flap was created according to the marker line. **b** The urethral anastomosis was covered by the peri-meatus pedicled dartos flap



**Fig. 2** Surgical repair of mid-shaft hypospadias using a transverse preputial island flap and a peri-meatus pedicled dartos flap. **a** The original urethral orifice on the ventral surface of the shaft (*arrow*). **b** The foreskin of the penis was degloved and dissected down to the peno-scrotal junction. **c** Development of the transverse preputial island flap. **d** The transverse preputial island flap was moved to the ventral shaft. **e** The urethra was reconstructed along the urethral stent by continuous mattress suture of the transverse preputial island flap

## Results

In the present study, we successfully conducted reconstructive surgery in 46 cases of one-stage hypospadias repair using transverse preputial flaps. The dressing was removed 5–6 days postoperatively. Poor blood supply to the ventral skin of the penis was observed only in one case. In the remainder of the cases, the incision healed without infection or hematoma, and the ventral skin of the penis and flap had good blood supply. The silicone catheter was removed from all patients 7–8 days postoperatively and the patients urinated with a good stream. No urinary split, fistula, or urinary extravasation was found in the patients. In the patient who had poor blood supply to the ventral skin, a local scab formed but no urinary fistula was seen. All patients were discharged without any complications. One case of anastomotic fistula (~2 mm) was found in a single patient on the 30-day postoperative follow-up. For the patient who had poor blood supply to the ventral skin of the penis, the local scab fell off with scar healing

and urethral anastomosis. **f** The pedicled dartos flap around the urethral orifice. **g**. The pedicled dartos flap was used to cover and strengthen the neourethral anastomosis. **h** A scrotum flap was used to cover the defected surface of the penis. **i** Front view. **j** Lateral view. **k** Front view 9 days postoperatively. The catheter was removed and no fistula was observed. **l** The neourinary meatus was located in the middle of the glans 9 days postoperatively

but no urinary fistula was found. After urethral stent removal, all patients underwent a follow-up examination after 6 months to 3 years. Anastomotic urethral fistula was found in one case (2.2 %) during the follow-up examination. The urinary meatus was located on the top of the penis. The penis had a normal shape without penis rotation or penile deformity. No urinary fistulae, urethral ruptures, urethral stenoses, or urethral diverticula were found.

## Discussion

Fistulae, especially anastomotic fistulae, are one of the major postoperative complications of hypospadias correction. Surgery is usually needed for repairing postoperative fistulae, causing stress and economic burden to the patients and their families [13, 14].

Using tissue with a good blood supply, such as a foreskin flap, a penile dartos flap, scrotal dartos flap, or tunica vaginalis flap, to cover the neourethra is an effective



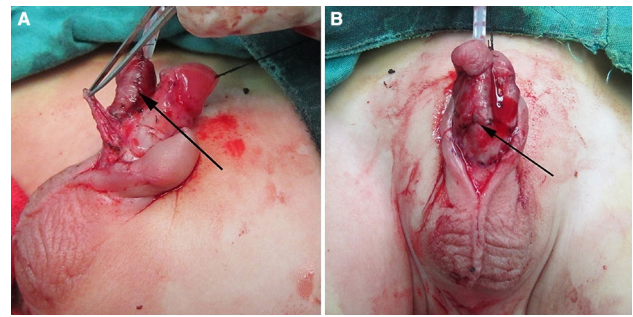
approach for reducing the incidence of postoperative anastomotic fistula [15]. However, even when these approaches are used, postoperative fistulae have still been reported in up to approximately 10 % of the cases [16].

Clinically, MAGPI, TIP, and Snodgrass surgeries have been widely used in one-stage repair of distal penile and mid-shaft hypospadias. However, these surgeries are not effective in straightening penis and glans curvature deformities. Transverse preputial island flaps, which have good blood supply and high tissue compatibility, have been widely used in urethral reconstruction. However, fistulae are still a major complication of urethral reconstruction using transverse preputial island flaps, which are usually used to repair proximal rather than distal hypospadias [17, 18].

In the present study, we used a transverse preputial island flap to repair mid-shaft hypospadias. The transverse preputial island flap was used successfully to reconstruct the urethra and to correct penis deformity fully. The transverse preputial island flap is preferred over other surgical procedures in which the dorsal penile cavernosum is folded to correct penis deformity. For hypospadias with penile dysplasia, the transverse preputial island flap is a good option because an appropriate urethra length can be reached without limiting the penis length. The fair length of penis and urethra can reduce the incidence of anastomotic dehiscence during erection. Therefore, in the present study, the transverse preputial island flap was used to repair mid-shaft hypospadias.

Another advantage of the transverse preputial island flap in mid-shaft hypospadias repair is that the longitudinal anastomosis line of the tubular urethra is transferred to the back of the urethra (the ventral side of the cavernosum). Therefore, the neourethra is protected and supported by cavernous tissue, reducing the incidence of fistulae. The urethral anastomosis was a horizontal arc. While the urethral anastomosis was partially covered by the ventral cavernosum, most of the urethral anastomosis is still located in the ventral urethra without protection of other tissues, leading to a chance of urinary fistula (Fig. 3). Generally, the incidence of fistulae along the longitudinal anastomosis line is lower than that of the incidence of fistula in urethral anastomosis [19].

The connection between the original urethral orifice and the neourethral anastomosis is a weak point with limited tissue support, leading to a high incidence of urinary fistulae [20]. In surgical repair of distal hypospadias, the dartos, which is used as the pedicle of a transverse preputial island flap, can strengthen the neourethra and fully cover the proximal urethral anastomosis without influence on the rotation of and blood supply to the dartos flap. For moderate and severe proximal and mid-shaft hypospadias, there is limited dartos tissue that can be used to cover the



**Fig. 3** Urethral anastomosis line in the surgical repair of mid-shaft hypospadias using transverse preputial island flap. **a** The longitudinal anastomosis line (arrow) was embedded on the back of the urethra (the ventral side of sponge) with protection and support of cavernous tissue. **b** The urethral anastomosis was a horizontal arc (arrow) without sufficient support, leading to a high incidence of urinary fistula

neourethra. To avoid poor blood supply to the dartos caused by over-rotation and extension, it is not advised to use the dartos to cover and strengthen the urethral anastomosis for proximal and mid-shaft hypospadiases. Development of methods to safely and easily strengthen the urethral anastomosis using dartos tissue has become a major research topic in one-stage repair of proximal and mid-shaft hypospadiases.

In the present study, we used a pedicled dartos flap around the urethral orifice to cover the constructed urethra to reduce the incidence of anastomotic fistulae in mid-shaft hypospadias repair. Penoscrotal hypospadias and scrotal and perineal hypospadias were not included in the present study because sufficient scrotal dartos tissue is available to cover the urethral anastomosis after urethral reconstruction. In addition, other procedures such as the TIP and scrotal skin flap can use enough tissue to cover the urethral anastomosis. Therefore, these cases were not included in the present study.

Loss and fibrosis of the subcutaneous dartos in the ventral penile shaft from the glans to the urethral orifice is the major cause of penile curvature deformities in hypospadias patients [21]. According to the Mathieu's surgery of urethral reconstruction, the dartos tissue, with its rich blood supply around the urethral orifice, can be used to develop a dartos pedicle flap for urethral reconstruction. However, the proximal section of dartos tissue around the urethral orifice is not considered by many surgeons in hypospadias surgery. In the present study, without the need of a scrotal dartos flap or a tunica vaginalis flap, we used a pedicled dartos flap around the urethral orifice for the treatment of mid-shaft hypospadias. Development of a pedicled dartos flap is a simple surgery without obvious secondary surgical injury.

Traditionally, the entire layer of dartos tissue and foreskin were degloved to generate a transverse preputial island

flap in one-stage hypospadias. Given that the dartos is used as the pedicle of the flap, the ventral urethral anastomosis is not well protected. In the present study, the proximal dartos was used to construct the pedicled dartos flap around the urethral orifice during the process of dartos and foreskin degloving. The pedicled dartos flap was flipped to cover and strengthen the urethral anastomosis, which can reduce the incidence of anastomotic fistula.

We followed the principles of local flap design to construct the pedicled dartos flap. The ratio of the length and width of the flap was not over 2:1 and typically 1.5:1. Herein, the length of the dartos flap was 1.5–3 cm, and the width was 1.5–2.0 cm. In addition, the pedicle of the dartos flap should not be over-stripped off to ensure sufficient blood supply and good clinical outcomes.

The limitation of this study is that a high level of skill is required for the surgeon to dissect a transverse preputial island flap with pedicled dartos.

## Conclusion

In mid-shaft hypospadias patients, the penis foreskin and peri-meatus dartos pedicled flap are usually well developed, which can be used to construct a transverse preputial island flap for one-stage hypospadias repair. We used the proximal dartos of the urethral orifice to utilize well-vascularized local tissue to add a protective layer to the proximal aspect of the neourethral anastomosis. Our results suggest that the surgical procedure is a simple, safe, and effective technique for mid-shaft hypospadias repair and can significantly reduce the incidence of anastomotic fistula.

## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest to disclose.

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