

Vascularized Obliquely Extended Urethral Plate Flap for One Stage Reconstruction of Proximal Hypospadias

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ABSTRACT

In patients with proximal hypospadias, adequate urethral reconstruction depends on the good release of the chordee that leaves behind a long defect that needs to be repaired by a properly vascularized pliable thin non-hairy flap. This flap preferably incorporates the urethral plate and has no anastomotic lines. Most of the available techniques fail to meet such criteria in a single stage. They either are a multistage procedure, or rely on multiple end-to-end anastomosed grafts or flaps with increased cost, operative time, morbidity, and incidence of fistula formation.

This paper presents a technique that allows for adequate complete release of the chordee and development of a long well vascularized one flap. This flap utilizes all the available urethral plate skin and is extended to include part of the perpetual skin, or its remnants, without anastomotic lines.

The covering of the flap is from the remaining shaft skin in the proximal part and from the remaining tissue of the unfolded prepuce in its distal part. This achieves a long well covered wide highly vascularized urethra with significantly less incidence of fistula formation.

INTRODUCTION

Despite of the remarkable progress in reconstructive techniques and concepts in plastic surgery, hypospadiac patients with proximal meatal opening remain in need to receive a reconstructive one-stage procedure that would fulfill most of their reconstructive requirements.

The ultimate reconstructive goal would be a one-stage procedure that can get rid of the chordee and provide a long, adequately wide well vascularized, well covered pliable, thin, non-hairy neourethra, transmitting the meatus to the distal end of the glans, having minimal or no anastomotic lines and preferably utilizing tissue from the urethral plate with good aesthetic outcome.

Traditional techniques for the repair of hypospadias were multistage [1-6]. Though they still have their proponents [7-9], but with the advances in

surgical techniques and precision, and due to the improvement of the results, the one-stage procedures become more appealing for both the parents and surgeons.

Most of the available one-stage techniques are short of attaining all the reconstructive requirements in one stage, mainly; radically getting rid of the chordee [10] and providing a vascularized urethra in one stage. And if some techniques do, they depend on non-vascularized grafts [11-17] or meatally based flaps [18-19] that has doubtful vascularity or incorporate multiple anastomotic lines [20,21] resulting in a kinked and probably narrow poorly vascularized urethra with increased risk of fistula formation [22].

Flaps that are designed on vascular pedicles provided the optimum criteria for proper reconstruction. Adherence to vascular basis and meticulous surgery are the key factors in reduction of the incidence of fistula and improving the quality of repair.

Penile skin and underlying dartos fascia are rich in their blood supply [23]. The penile skin is supplied by a pair of axial arteries that are a direct extension of the external pudendal artery. They are embedded in the loose areolar connective tissue layer, the dartos fascia, and run along the penis and prepuce giving off a series of skin perforators [24].

Perpetual flaps [20,21] are well vascularized but are relatively short to achieve a proper length in very proximal defects where they need to be extended by proximal flap, with additional anastomotic lines, otherwise chordee is the result [22].

To have a long flap and to eliminate anastomotic lines, Broadbent [25] utilized the ventral penile skin as a long meatally based tubed flap that is

extended on the prepuce to be able to reach for the tip of the penis without any anastomotic lines. A mesentery is preserved but the vascularity becomes less as we go distally with this extremely long flap [26]. Snow [27] also described a technique utilizing the perpetual skin without anastomotic line but it has a relatively limited length and a complicated design.

Idea of the technique:

This paper presents a procedure with improved vascularity of the neourethra along its whole length by not dissecting the urethra from the adjacent skin or dartos fascia and only deepithelializing one of its lateral edges to undisturb its blood supply. Still the chordee can be completely get rid of by

dissecting underneath the urethral plate and the dartos fascia through the contra-lateral edge.

This flap utilizes all the available urethral plate skin and is extended obliquely around the coronal end of the penile skin to include part of the perpetual skin or its remnants. This extension forms the distal part of the tubed flap that compensate for the defect created after chordee release and is tunneled through the glans to bring the new meatus at the tip.

The covering of the flap is from; the available lateral shaft skin, with the underlying dartos fascia, that is undermined and advanced to cover the flap in the proximal part and from the remaining tissue of the unfolded prepuce in its distal part (Fig. 1).

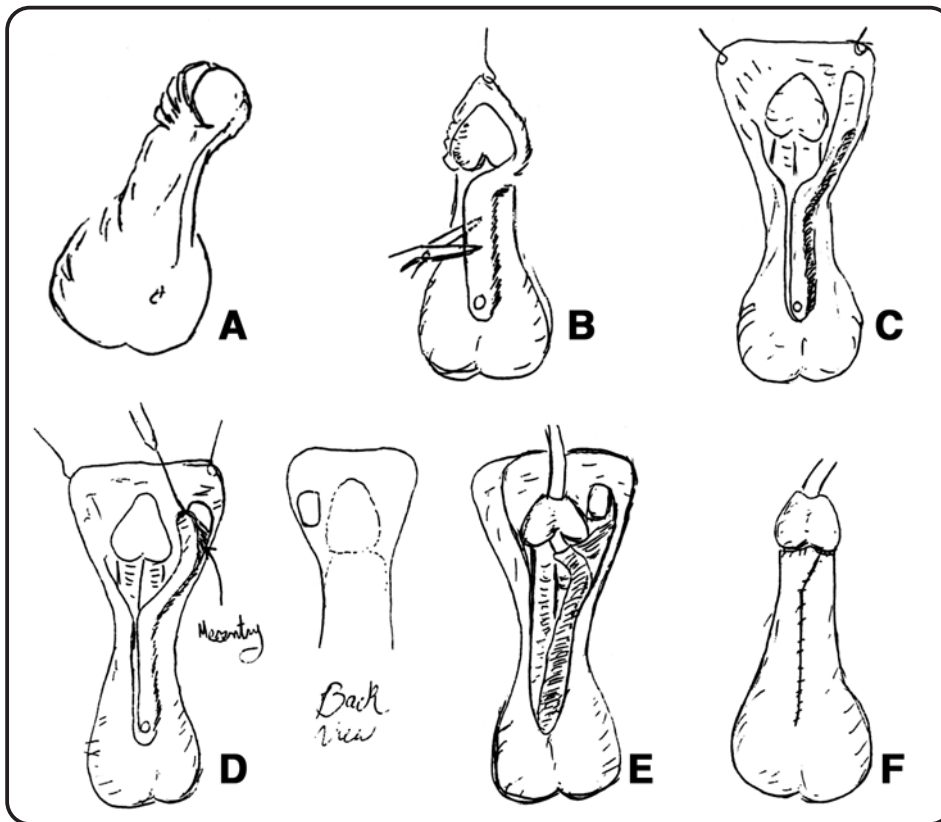


Fig. (1): Diagrammatic illustration of the technique.

A): The deformity.

B): Design of the proximal part of the flap with its cut edge on the right (straight line) and the deepithelialized edge on the left (dashed line). Excision of the chordee is done from the right incision.

C): Full design of the flap after release of the chordee with its distal extension on the prepuce.

D): Part of the urethral flap to be tunneled through the glans and its mesentery, frontal and dorsal views.

E): After tubing of the flap and just before tunneling. F): Final appearance.

MATERIAL AND METHODS

This technique was used in 14 patients with proximal hypospadias through the period from

September 2004 to February 2007. All patients were uncircumcised and were not operated upon before. Their age ranged between 3 to 17 years. Five patients had proximal penile and nine patients

had peno-scrotal hypospadias. Patients were followed-up for at least six months.

Technique:

Design:

The patient is positioned supine in penile cases and either supine with frog leg or, better, in the lithotomy position in scrotal cases.

Laxity of the skin is assessed specially in the proximal shaft. A holding 4-0 prolene® suture on a rounded needle is placed at the tip of the glans 2mm dorsal to the site of the future meatus (Fig. 2-B).

A U shaped flap is designed and drawn on the ventral aspect of the penis centered over the urethral plate starting just proximal and including the meatus and extending distally. The width of the flap is determined according to the age of the patient and the diameter of the catheter to be used.

For right-handed surgeons, the right limb of the incision is extended from just below the present meatus to the level of coronal sulcus where it turns to the left side as circumcising incision around the glans to about its left mid lateral point. It can be extended more distally depending on the size of the defect after getting rid of the chordee. This is the cut edge of the flap.

The left limb of the U incision runs parallel to the right one and away from it by a distance equal to the width of the proposed urethra. This is the deepithelialized edge of the flap.

Steps:

The right edge of the flap is incised till the coronal sulcus exposing the fibrous chordee beneath the urethral plate (Fig. 2-C). The fibrous chordee is completely excised from the present meatus to the glans (Fig. 2-D). The incision is then extended turning to the left as designed (Fig. 2-E), so the penis now is completely released and straight (Fig. 2-F). Artificial erection test may be done if complete chordee excision is questionable. The actual length of the defect is now determined, adding to it the length needed for the glanular tunnel, and the flap is extended accordingly.

1-2mm strip of the ventral penile skin is de-epithelialized along the left edge of the flap preserving all the dartos attachments between the flap and the penile skin as a longitudinal lateral pedicle to the neourethra.

The distal 1-2cm of the tube, that to be tunneled through the glans, might need to be freed from the lateral attachment by blunt spreading technique to facilitate its tunneling without kink. To increase the vascularity of this segment, the other side of the prepuce is deepithelialized keeping all the underlying fascial attachments as a thick mesentery.

The site of the new meatus is marked and incised in a V manner. The glanular tunnel is formed (Fig. 2-F), and a proper catheter is passed through it and passed through the present meatus. The catheter position is ensured in the bladder, its distal orifice is occluded to prevent urine flow during the operation. The distal part of the catheter is drawn in the gap between the glans and the meatus to facilitate urethral tubing.

The flap is tubed around the catheter by suturing its right incised edge to the near edge of the de-epithelialized strip starting proximally around the meatus and proceeding distally using 6/0 vicryl® sutures (Fig. 2-H,I). The tube is then tunneled through the glans by pulling the catheter distally. Now the flap is in place (Fig. 2-J), and the distal end of the tube is secured to the new meatal position including the V flap interrupting the circular end of the new urethra to prevent latter meatal constriction and produce a natural slit like meatus.

The penile skin is undermined beneath the dartos plane and the remaining shaft skin on the right to the flap is mobilized medially and is sutured to the far edge of the de-epithelialized strip to cover the reconstructed urethra. If some restriction of the skin mobility is encountered distally, the remaining part of the unrolled prepuce is transposed ventrally. Remaining incisions are closed and the catheter is fixed and left for ten days (Fig. 2-K). Light compression dressing is applied for one week.

RESULTS

All patients healed well and had smooth post-operative course. In all patients, there were no residual chordee and the urine stream was strong and adequate. Three patients had fistulae (21%); two were at the site of the original meatus and the remaining one at the coronal sulcus. This patient showed dehiscence of the skin at this point exposing the reconstructed urethra. Two patients needed secondary intervention. The overall aesthetic appearance was excellent (Figs. 2,3).

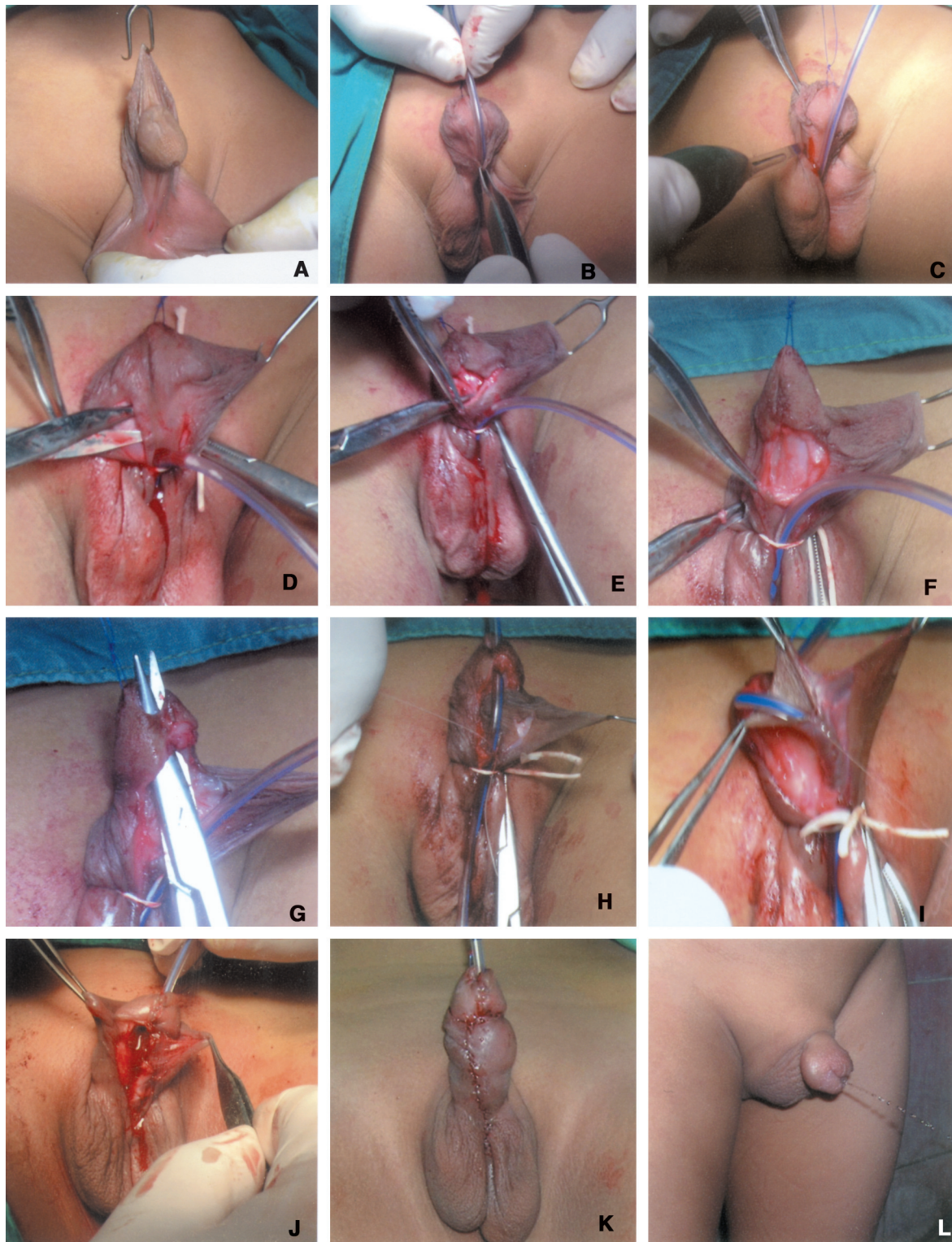


Fig. (2): A five-year-old patient with penoscrotal hypospadias. Steps of the technique:

- A): Site of the meatus and extent of the chordee.
 B): Assessment of skin laxity.
 C): Cut edge of the flap.
 D): Excision of the chordee under the urethral plate.
 E): Turning point of the cut edge at the level of coronal sulcus.
 F): The chordee is completely released and the penis is strait.

- G): Glanular tunnel is formed.
 H): Other edge is deepithelialized and flap is tubed.
 I): Tubing in progress and the distal part to be tunneled is seen with its thick mesentery.
 J): Flap is tunneled and the meatus is now at the tip of the penis.
 K): Immediate postoperative appearance.
 L): Follow-up after four weeks.



Fig. (3)

A): A 17-year-old patient with scrotal hypospadias.

B): Immediate post operative appearance.

C): Follow-up after three months.

DISCUSSION

Among all types of congenital anomalies, none had such number of different techniques for reconstruction. Till now, new techniques and concepts still emerge in a hope to reach a perfect outcome. The superiority of any technique relies upon how it would ensure optimal vascular supply for the neourethra.

Though the design of this flap might look similar to that of Broadbent [25], yet there is marked difference in the vascular concept behind. When Broadbent [25] introduced his technique in 1961, the flap vascularity as a concept was not yet developed. His technique is only partially vascularized and that long meatally based flap has a length to base ratio reaching up to 8:1 and depends on a mesentery and the meatal connections with gradual diminution of the flap vascularity as we proceed distally. So, the distal part is more like a skin graft increasing the tendency to fistulaization [26].

The proposed flap in this paper has a unique longitudinal pedicle that allows for a rich vascular supply via the dartos vascularization that is not interrupted whatever length of the flap. This allows the flap to be extended in the most proximal cases without compromising its blood supply.

The distal part of the flap, which lies in the glanular tunnel, is not only meatally based but also depends on a rich vascular supply through its mesentery that is attached to the dartos. This is more than adequate for this short segment.

The comparable flaps in vascularity are the perpetual flaps; the transverse island [20], the onlay [21], the Toksu flap [28] and the Yoki flap [27]. All these techniques, except for the later one, require the presence of at least one anastomotic line, or

more in proximal cases, as these flaps are not long enough to reach scrotal meatus were additional proximal flaps are needed. With these combined procedures, there is always another anastomosis to heal and another complication to occur. The absence of anastomotic lines in the proposed technique improves the results and decreasing the possibility of stricture formation.

The flap utilizes all the available urethral plate. There are findings encouraging the use of the urethral plate as incisions within it produce no significant fibrosis after healing. So, utilizing the urethral plate for proximal urethra formation minimizes any tendency to stenosis even if it needed to be longitudinally incised to accommodate larger catheters [10].

The design of the flap is simple and is not complicated as other techniques [27]. Few measurements are required and it allows the flap to be extended longitudinally as desired without the need to predetermine its length. It is extended as needed and the distal limit needs only be incised after chordee release and precisely know the actual length of the defect. The separation of the distal part of the tube, to be tunneled through the glans, is postponed until needed after finishing the tubing on cut as you go basis.

In primary cases, the lateral skin is usually extensible and lax, permitting the utilization of a considerable part of its width without constriction. In difficult situation there is always some extra perpetual skin to be used even in circumcised patients, otherwise, dorsal slit might be resorted to. In all of our cases, though utilizing relatively large catheter in some, there was no problem in skin cover even in the young patients. However, the use of this flap is limited in patients with neat circumcision or unhealthy extensively scared or

un-lax penile skin as there will be difficulty to cover the reconstructed urethra in such cases.

The aesthetic outcome of the technique is excellent as it does not produce the crumbled appearance of the shaft associated with the rotation of the perpetual flaps to the vertical position in the shaft (Fig. 2).

The suture lines of the urethral and the skin cover are in proximity to each other increasing the possibility of fistulaization, but this risk is minimized due to the excellent vascularity that was proved by our technique.

In conclusion:

This paper introduces a new concept in vascularization of the reconstructed urethra; that is the laterally based flap on a deepithelialized pedicle. This is merely the first flap, as far as we could get from the available literature, to be vascularized through such manner, and the deepithelialization concept described herein is unique.

This one stage technique is easy, versatile and provides wide excellently vascularized neourethra. It is a useful tool in the hands of surgeons dealing with hypospadias patients. It can be used in any degree of primary proximal hypospadias. It can also be used in secondary cases if the ventral skin is adequate without much scarring and a reasonable amount of the foreskin is available. This is individualized according to the case, but there is usually enough skin to perform it especially in older patients.

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