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Functional urethral obstruction following tubularised incised plate repair of hypospadias

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Hypospadias;
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Abstract

Purpose: To report functional urethral obstruction (FUO) following the tubularised incised plate (TIP) procedure for hypospadias repair and its management.

Materials and Methods: Between January 2003 and December 2010, 263 patients were referred with complications following TIP repair and who were reviewed on regular follow up after further correction. One hundred and twenty-nine of these patients presented with persistent obstructive voiding signs and symptoms in spite of apparently successful calibration or dilatation, 32 presented with persistent stenosis, and 97 with recurrent fistula. The mean age at surgery was 2.9 years (range 1–4). The complications were corrected using 1 of 2 techniques: modified Mathieu (112) and lateral onlay flap (17). The mean follow-up was 4 years (range 1–9).

Results: The obstructive symptoms were corrected with a single procedure in 120 (93%). Nine patients (7%) developed complications in the form of fistula (7 patients) and glanular dehiscence (2 patients) that were corrected successfully in a second operation.

Conclusions: The incised urethral plate may heal forming a deep narrow groove resulting in FUO. Patients with FUO present with obstructive voiding symptoms in spite of successful calibration or dilatation. These symptoms disappear after reconstruction of a wide fully epithelised neo-urethra.

During the last decade, the tubularised incised plate (TIP) technique for repair of hypospadias has become a popular procedure [1]. To my knowledge this is the first report of functional urethral obstruction (FUO) as a complication of the TIP procedure.

For the purpose of the study Functional Urethral Obstruction (FUO) is defined as persistent obstructive voiding symptoms (dysuria, pain and/or persistent straining) and/or clinical signs of back pressure (e.g. increased bladder wall thickness, acquired reflux and/or residual urine in bladder after micturition) or recurrent fistula in spite of the ability to pass catheter size F8 through the neo-urethra. The patients did not have these symptoms and/or signs before hypospadias repair.

1. Material

The medical records of 375 patients referred between January 2003 and December 2010 with complications of

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hypospadias repair were reviewed. Two hundred and sixty three patients with complications after TIP repair and who had a further corrective operation and were reviewed on a regular follow up. The remainder had other techniques of repair or did not maintain regular follow up.

There were 129 patients who presented with persistent obstructive symptoms; 32 presented with persistent dysuria; and 97 with recurrent fistula. Of the 129 patients with persistent obstructive symptoms, 112 patients were born with distal hypospadias and 17 patients born with proximal hypospadias. One common finding in all the 129 patients was the ability to pass a catheter size F 8 through the neo-urethra.

The mean age at the time of corrective surgery for the complications was 2.9 years (range 1 to 4 years). The mean number of procedures performed prior to referral, was 2.4 (range 1 to 4). The time interval between the initial failed repair and the salvage urethroplasty was more than 6 months. The mean follow-up period was 4 years (range 1 to 9 years).

The 129 patients with FUO were subdivided into 2 groups. Group 1 included 32 patients who had persistent difficulty with micturition which had not been cured by dilatation although temporary improvement had occurred in some patients. Repeated dilatation had been performed in some every 2 weeks over prolonged periods. Three patients had a transurethral catheter inserted for more than a month without effecting a cure. One patient was referred with supra-pubic catheter for 5 weeks due to persistent dysuria following TIP repair. Patients in Group 2 (97 patients) presented with dysuria and recurrent fistula after closure as shown (Fig. 1).

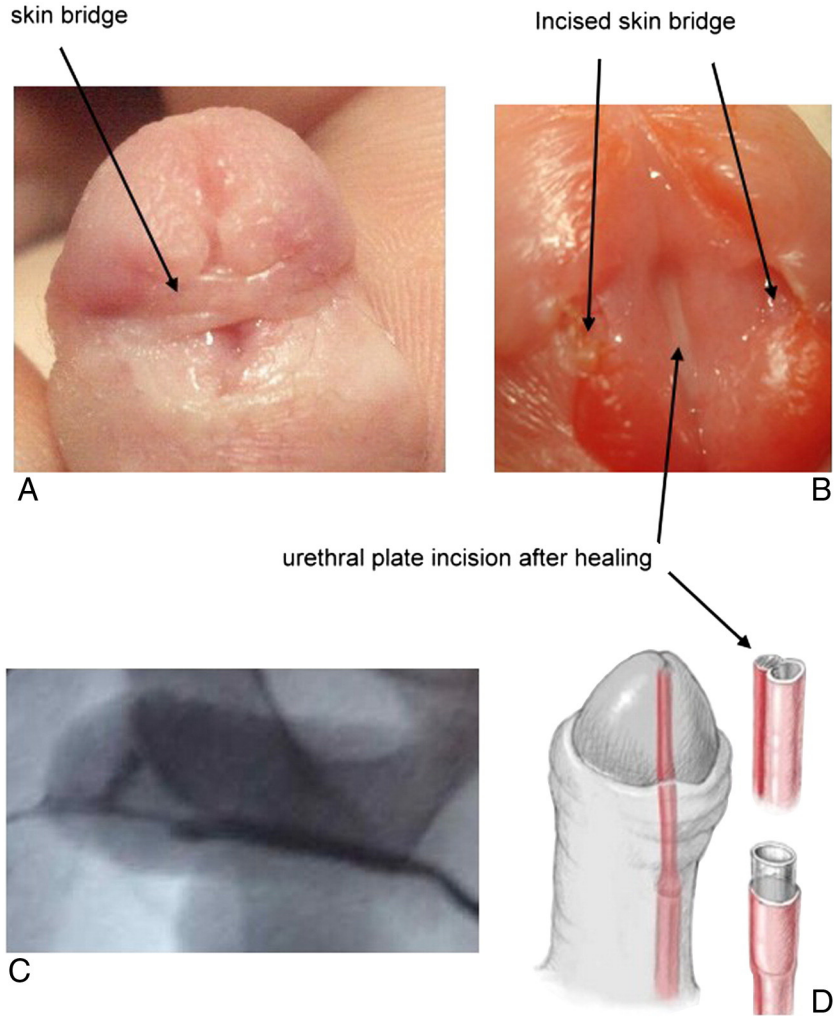

Fig. 1 Functional urethral obstruction: A, Failed TIP showing a skin bridge and urethral stenosis associated with fistula. B. Incision of the bridge shows that incision of the urethral plate heals as a deep groove that does not increase the diameter of the neo-urethra. C. Urethrography with contrast injected along the urethra showing the anterior narrow urethra which causes functional narrowing and the more dilated posterior urethra (the artefact is dye spilling around the coronal sulcus on the glans). D. Diagram showing the mechanism of functional urethral obstruction where the concertinoed urethra is causing narrowing but the insertion of a firm catheter expands the neo-urethra giving the false impression that the urethra is wide. (From: Hadidi AT, Azmy AF (Eds.) Hypospadias Surgery, 2nd Edition, Springer-Verlag, Berlin Heidelberg with permission (in Press).

1.1. Management

Under anaesthesia, the urethral meatus and the availability and quality of foreskin and penile skin were assessed. It was possible to pass a catheter size F8 in all the 129 children with FUO.

The neo-urethra was incised until a normal, wide urethra was reached. It was found that the urethral plate incision has healed forming a scarred narrow, deep groove that yielded temporarily to dilatation and gave a false impression that the neo-urethra is not narrow. The explanation of this paradoxical finding is illustrated in Fig. 1.

Patients with distal hypospadias had the Slit Like Adjusted Mathieu technique (SLAM) [2] employed (Fig. 2). Patients with proximal hypospadias had a Lateral Based Onlay foreskin (LABO) [3] flap to construct a neo-urethra (Fig. 3).

The urethroplasty was reconstructed using vicryl 6/0 on a cutting needle in a continuous subcuticular manner [4] around the appropriate catheter according to the calibre of the proximal healthy urethra. All distal urethroplasties were covered with a second protective intermediate layer from preputial or penile dartos fascia. For patients with complicated proximal hypospadias scrotal dartos fascia and/or tunica vaginalis was the standard second protective layer employed.

Distal forms of hypospadias had a transurethral Nelaton catheter for 3 days. Proximal forms of hypospadias had a single transurethral silastic catheter for one week.

All patients had a standard dressing in the form of gentamicin local ointment, gauze and adhesive tape that compresses the penis, gauze and catheter against the lower abdominal wall and allows the free mobility of the patient [5]. The dressing was removed at the time of removal of the transurethral catheter and the penis was left exposed. If the dressing became wet with urine or soaked with blood, the dressing was changed using the same standard dressing technique.

Broad-spectrum antibiotics (second generation cephalosporin) were used for one week in distal forms of hypospadias and for two weeks in proximal forms.

Follow up protocol included examination after 3 months, 12 months and every 2 years till they reach the age of 15 years. Mean follow up period was 4 years (range1–9 years). Uroflowmetry was performed in 19 toilet trained children. Peak flow within 2 standard deviations from mean for age was considered normal.

2. Results

One hundred and twenty patients had satisfactory outcome of surgery, 7 patients developed fistula following the SLAM technique and 2 patients developed glanular wound dehiscence following the LABO technique. The 9 patients with complications were corrected in a single second operation. The fistula was closed primarily and a second layer from the surrounding fascia was used. The two patients

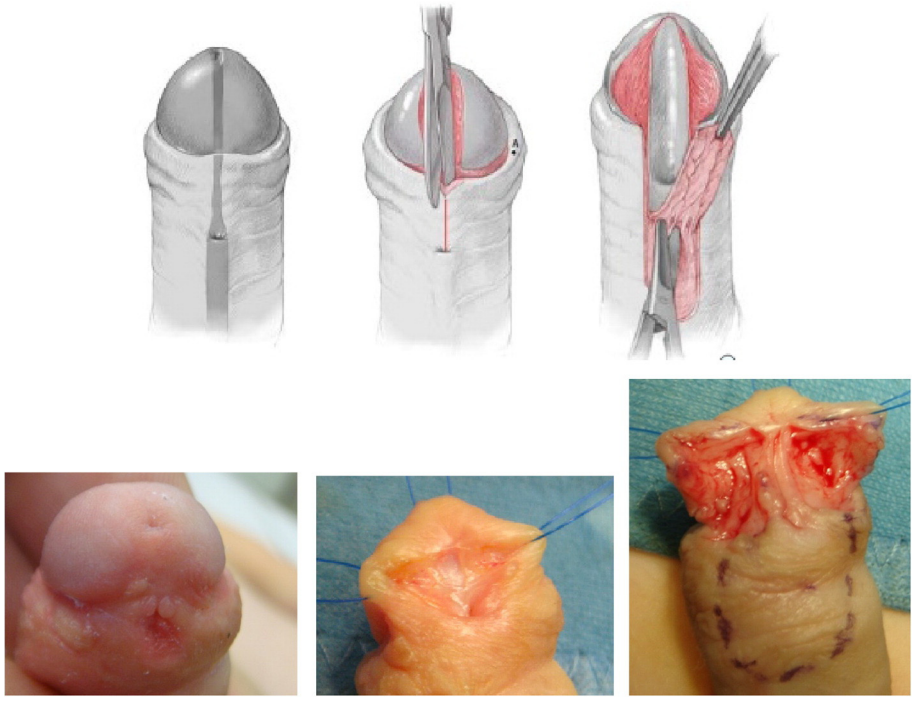

Fig. 2 Slit like adjusted Mathieu (SLAM) technique for the correction of narrow urethra after TIP for distal hypospadias. The narrow new urethra is incised until a healthy wide urethra is reached and a meatal based flap is designed to reconstruct a wide fully epithelialised new urethra.

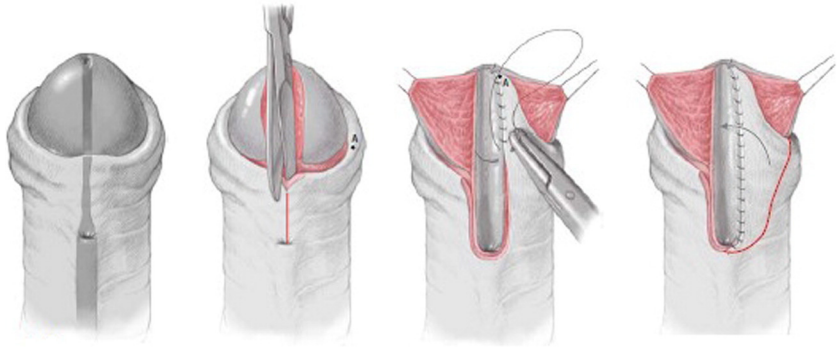

Fig. 3 Lateral based onlay (LABO [3]) for correction of complicated proximal TIP. The narrow urethra is incised until a healthy wide urethra is reached. The patient had adequate lateral skin that was sutured to the incised narrow urethra (A to A′). from: Hadidi A T, with permission.

with glanular dehiscence following LABO technique had a meatal flap for correction. None of the patients had obstructive voiding symptoms after corrective surgery.

Results were considered satisfactory when the boy achieves an apical slit-like meatus at the tip of the glans penis, single forward stream, unimpeded voiding, good cosmesis and no need for secondary surgery for the urethra. Assessment of the results was performed by an independent out-patient nurse.

Uroflowmetry was performed on 19 toilet trained patients post-operatively. Fifteen patients had uroflow within two standard deviation of normal. The remaining four patients have an equivocal or flat uroflow without any symptoms or signs of obstruction and are being followed. They are currently symptom free.

3. Discussion

Incision of the urethral plate was first described by Reddy in 1975 [6], Orkiszewski 1987 [7], Rich 1989 [8] and popularized by Snodgrass 1994 [9]. The technique has become increasingly popular in recent years partly because of the slit-like meatus that can be achieved [1].

The concept behind the TIP technique is that the urethral plate (UP) is a specialised tissue designed for the formation of the urethra and the new urethra should ideally be reconstructed only from the urethral plate. In hypospadias, the (UP) is usually too narrow to reconstruct the new urethra. Therefore, incision of the urethral plate may increase its width to reconstruct a wide urethra. Fig. 4 demonstrates the 3 possible pathways of healing of the incised urethral plate. Fig. 4A demonstrates the desired pathway of healing after incision of the urethral plate with a wide new urethra. However, the incised urethral plate may heal as a deep narrow groove that yields to a sound or a catheter passing through the new urethra (Figs. 1 and 4B) or as a linear scar resulting in stenosis (Fig. 4C).

The standard protocol for surgeons dealing with a complicated hypospadias is to insert a catheter or a probe inside the urethra to ensure that the new urethra is not narrow. If the TIP has healed with a linear scar and stenosis, the probe or catheter will not pass through and stenosis can be easily identified. If the new urethra has healed forming a deep narrow groove as was the case in 129 patients included in the study (Figs. 1 and 4B), the deep groove will yield to the catheter which will pass through and will give the false impression that the new urethra is not narrow. After removal of the catheter, the deep groove will gradually recoil resulting in a narrow passage for urine and recurrence of fistula or dysuria.

To our knowledge, functional urethral obstruction (FUO) was not reported before. Those patients presented with persistent pain, dysuria and/or recurrent fistula. This phenomenon was first identified in a child with persistent pain and dysuria in spite of frequent calibration and dilatation under anaesthesia in 2 other centres. Urethrography confirmed the passage of the dye through the narrow new urethra. The deep narrow grove was seen clearly after incision of the narrow urethra.

Is there objective evidence to support the FUO hypothesis? Two experimental studies support this hypothesis;

Eassa et al [10] conducted a well designed objective study on 12 rabbits and made a 3 cm tattoo in the dorsal urethral plate midline before incising the urethral plate. They measured the stretched width between the incised tattooed edges followed by tubularisation of the incised urethral plate. The rabbits were sacrificed two weeks later and they measured the distance separating the tattoo incision after healing and examined sections at this point histologically. The study concluded that the initial width of the midline relaxing incision significantly decreased after complete epithelialisation and the average gain in urethral width was only 2 mm. Sections of the healed incised plate in rabbits showed the typical deep groove seen in children with complicated TIP repair presenting with FUO (Fig. 1).

Hafez at al [11] used the same rabbit model to study the healing after the TIP technique and they could calibrate the neo-urethra up to F12 sounds. The disparity between the conclusions of the two studies can be explained by FUO and shows that "*calibration*" can be misleading.

Urethrography is an objective investigation to diagnose FUO pre-operatively. The dye is injected through a catheter

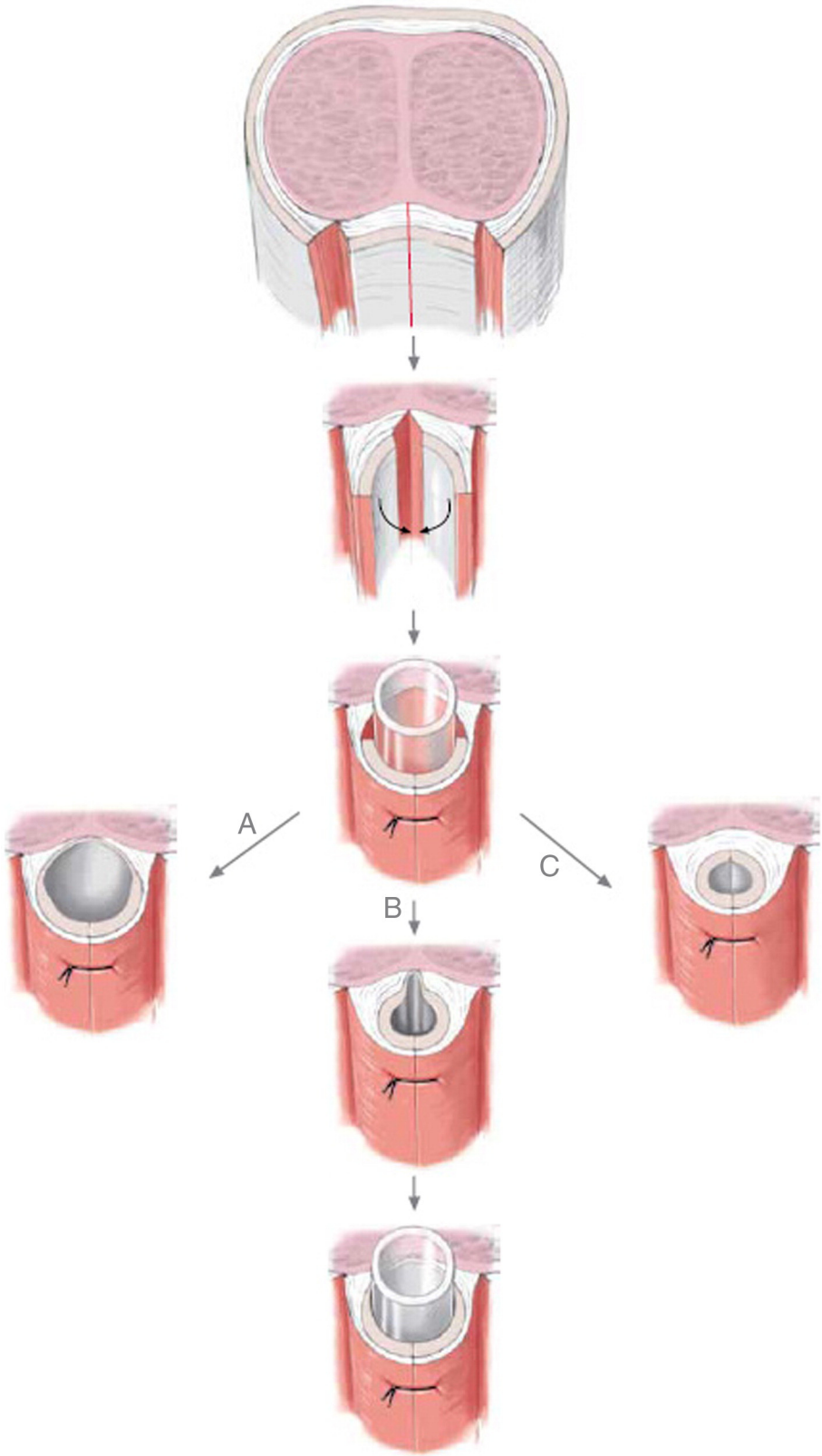

Fig. 4 The 3 possible pathways of healing of the incised urethral plate. A. the incised urethral plate has healed resulting in the formation of a wide new urethra. B, the incised urethral plate has healed as a deep narrow groove that yields to a sound or a catheter passing through the new urethra resulting in Functional Urethral Obstruction (FUO). C, the incised urethral plate has healed as a linear scar resulting in urethral stricture. from: Hadidi A T, with permission.

F6. This was used in 14 patients early in the study and when the diagnosis was uncertain. It was not justified to perform biopsy or expose all patients with persistent pain and dysuria to radiation (for urethrography).

Calibration or cystoscopy is unreliable and may be misleading as the sound or cystoscope will dilate and open the deep narrow groove temporarily and will appear as a wide shallow groove.

Uroflowmetry is frustrating in children and often produces flat curves despite satisfactory urethroplasty and the shape of the curve has uncertain significance [12]. Therefore, it was not performed pre-operatively as a routine in this study.

Local skin flaps were the first choice for the author. Slit-Like adjusted Mathieu (SLAM) [2] technique gave satisfactory functional and cosmetic outcome in 94% of the patients with complicated distal hypospadias. Lateral Based Onlay flap (LABO) [3] gave satisfactory functional and cosmetic results in patients with complicated proximal hypospadias included in the study.

This group of patients with FUO did not have persistent chordee or severe scarring and there was adequate local skin to reconstruct a wide neo-urethra and there was no indication to use grafts or to perform a two stage repair.

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