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## Our experience, technique and long-term outcomes in the management of posterior urethral strictures

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### KEYWORDS

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**Abstract** *Purpose:* To share our experience, technique and long-term outcomes in posterior urethral stricture management.

*Materials and methods:* Thirty-seven boys with post-traumatic posterior urethral stricture underwent resection and end-to-end anastomosis through pre-anal coronal approach or in combination with trans-pubic approach from January 2000 to December 2011. Follow up included symptomatic evaluation by micturating cystourethrogram and retrograde urethrogram in all patients, and urethroscopy in patients with voiding symptoms.

*Results:* Pre-anal coronal approach was used in 29 (78%) cases and in 8 (21%) cases it was combined with trans-pubic approach. In 33 (89.1%) patients it was first attempt, while in 4 (10.9%) it was redo surgery. Two patients required buccal mucosal graft to bridge the deficient urethra. Patient age was 5–17 years (mean 10.8 years). Mean follow up was 48.5 months (range 6–132 months). Thirty-two (86%) patients were symptom free. Failed repairs were successfully managed by urethral dilation in 3 and by redo urethroplasty in the remaining 2. All patients were continent. There was no chordee, penile shortening or urethral diverticula.

*Conclusions:* Resection and end-to-end anastomosis of posterior urethral stricture is possible through pre-anal coronal incision; however, if slightest difficulty is envisaged in creating a satisfactory end-to-end anastomosis, extension to trans-pubic approach should be done.

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## Introduction

Urethral strictures in children, irrespective of whether the etiology is post traumatic or post surgery, are difficult to treat. Posterior urethral trauma is considered the most debilitating injury because, if not managed properly, it may cause severe impairment of the quality of life, by affecting continence and potency, plus the development of urethral stricture that may require repeated interventions. Blunt trauma with disruption of the bony pelvis accounts for most posterior urethral injuries in children. There are various surgical procedures described to maintain the continuity of urethra following post-trauma disruption. Controversies still exist regarding early or delayed surgical intervention. We reviewed our experience with anastomotic urethroplasty for post-traumatic urethral stricture with a focus on the impact of our surgical technique on the final outcome.

## Material and methods

This was a retrospective single-center study done at our institute between January 2000 and December 2011. Thirty-seven patients treated for post-traumatic urethral stricture during the study period with a minimum 6 months of follow up following last procedure were included. Trauma included blunt trauma during fall from a height and road traffic accidents. Those with posterior urethral injury due to other etiology or incomplete records were excluded from the study. Approval for the study was obtained from the institute's ethical committee. Case records of those patients satisfying the inclusion criteria were analyzed. Preoperative work up to assess the site and length of stricture included retrograde urethrogram (RGU), micturating cystourethrogram (MCU), retrograde urethroscopy and antegrade cystourethroscopy. All the patients in our study group underwent delayed primary repair because they were all referred cases with supra-pubic cystostomy done as first procedure elsewhere. Length of stricture measured preoperatively was considered in planning the approach and incision, but the intraoperative length obtained on exploration was considered final.

All patients were operated by an experienced single surgeon under general anesthesia. Procedures were done in lithotomy position. Initial step in all patients was to explore first by mobilizing the proximal end of the distal urethra through the pre-anal coronal approach (Fig. 1). If satisfactory end-to-end anastomosis could not be executed, this approach was combined with a trans-pubic approach. Aim in all cases was complete mobilization along with excision of all scarred tissue and tension-free end-to-end anastomosis. Urethral anastomosis was done over a silicon catheter and a supra-pubic tube was placed in all cases for drainage. Periurethral cystogram was done 4 weeks following initial surgery. If there was no contrast leak then the perurethral catheter was removed along with clamping of supra-pubic tube. If child passed urine without any post-void residue then the supra-pubic tube was also removed. In the case of contrast leak at the anastomotic site, a repeat study was performed after 4 more weeks and decision for further intervention was then taken accordingly. Initially patients were followed 3 monthly in 1st year, 6 monthly in 2nd year,

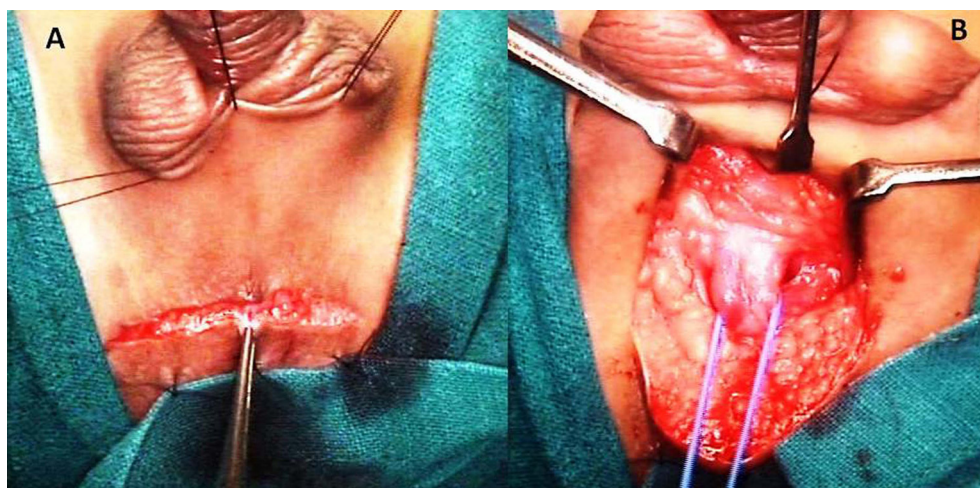
and yearly thereafter. Follow up included symptomatic evaluation and cystourethroscopy in patients with voiding symptoms. Clinical outcome was considered as successful when no postoperative procedure was needed.

## Results

The study included 37 male patients with a mean age of 10.8 years (range 5–17 years). We used either the pre-anal coronal approach or pre-anal with trans-pubic approach depending upon the length of the stricture. As all the patients were already on suprapubic diversion at presentation, definitive surgical procedure was planned after proper preoperative assessment using various radiological investigations on an average 6 months following the trauma. Stricture length assessed on preoperative MCU and RGU was used in planning the approach but intraoperative length was considered final. Mean stricture length was 2.6 cm (range 1.5–3 cm) and the preoperative radiological assessment correlated with the intraoperative findings in all the cases. Out of 37 patients, 8 patients had stricture length < 2 cm (only membranous urethra), 25 patients had stricture length between 2 and 2.5 cm (membranous urethra and distal part of prostatic urethra) and 4 patients had > 2.5 cm (membranous urethra and major part of prostatic urethra). Mean follow-up period was 48.5 months (range 6–132 months).

Authors used pre-anal coronal approach in patients with stricture length < 2 cm (only membranous urethra) and in patients with length of stricture between 2 cm and 2.5 cm (membranous urethra and distal part of prostatic urethra) where tension-free mucosa-to-mucosa anastomosis could be achieved after complete urethral mobilization. Pre-anal coronal approach alone was used in 29 (78.3%) cases while in the others it was combined with the trans-pubic approach. Complete urethral mobilization along with tension-free anastomosis could be achieved in all cases. Patients who were managed by pre-anal coronal approach alone were followed regularly and any complications at any stage of follow up were treated. One (3.4%) child developed an anastomotic stricture in the first 6 months, and this was managed successfully with urethral dilatation at 1-month intervals for 3 months. Two children required redo urethroplasty which was done using the trans-pubic approach 6 months following the first surgery. Ultrasonography and urodynamic study were done at 6-month intervals for 1st year and then if asymptomatic yearly ultrasound for upper tract dilatation and post-void residue. None of the patients treated by this pre-anal coronal approach alone had upper tract dilatation, post-void residue, abnormal bladder dynamics, febrile UTI or lower urinary tract symptoms during follow up. Advantages of pre-anal coronal approach are shorter intraoperative time, less blood loss and postoperative pain, and fewer lower urinary tract symptoms during follow up. Disadvantage of the approach is the difficulty in treating long strictures, more proximal strictures and recurrent strictures.

Combined approach (pre-anal coronal and trans-pubic) was used in patients with urethral stricture length > 2.5 cm (membranous urethra and major part of prostatic urethra) and in recurrent stricture cases irrespective of first approach. Trans-pubic approach was required in 8/37 (21.62%) cases. Of these, 4 (50%) were a first attempt while



**Figure 1** (A) Pre-anal coronal skin incision for repair of posterior urethral stricture. (B) Proximal end of the distal urethra taken in a sling for mobilization through pre-anal coronal approach.

in the other 4 (50%) cases, which included 2 cases of redo urethroplasty, it was a second surgery. Of these 4 second attempts, 2 children required substitution urethroplasty for a larger defect. Substitution was done using buccal mucosa graft. Both of these 2 children are doing well without requiring any further intervention. Final outcome in the 4 children in whom surgery was performed as 2nd attempt was similar to that of primary cases. Follow-up criteria used for pre-anal coronal approach were also used for patients treated by combined approach. Out of the 8 patients in whom trans-pubic approach was performed, 2 developed stricture which was managed with regular urethral dilations under sedation every month for 3 months. Two cases who developed stricture and required urethral dilatation had occasional lower urinary tract symptoms in the form of stress incontinence during last follow up at 6 months. One of the two had post-void residual volume above 20 ml in the follow-up ultrasound scan done at 6 months' follow up. Ultrasonography of upper urinary tracts was normal in all patients. None of the patients had chordee, urethral shortening, urethral diverticula or febrile UTI. Urodynamic evaluation performed in the postoperative period was normal except in two patients: one with lower urinary tract symptoms had a high-pressure, low-capacity system, and one with post-void residue above 20 ml had uninhibited detrusor contractions; both were managed by anticholinergic (tab oxybutynin). After stabilization of bladder dynamics and disappearance of post-void residue, anticholinergic therapy was tapered and then discontinued. Advantage of the combined approach is its ease of use in assessing long strictures, more proximal strictures and recurrent strictures. Main disadvantages are longer intra-operative time, and more blood loss, postoperative pain and lower urinary tract symptoms during follow up.

## Discussion

Urethral distraction injuries are a disturbingly common sequel of pelvic fracture, occurring in 4–14% of cases [1]. The most common cause of urethral stricture in children is

iatrogenic injury, representing 44–86% of cases in published series [2]. Blunt trauma with disruption of the bony pelvis accounts for most posterior urethral injuries in children. About 5% of males with a fractured pelvis will also have an injury to the posterior urethra [3]. The diagnosis of urethral trauma is relatively straightforward but for a successful treatment outcome proper planning is required. The aim is a patent, continent durable repair of the urethra with the least number of procedures and minimal urethral instrumentation. In children, the majority of posterior urethral injuries can be managed non-operatively. Various surgical procedures are described for complex posterior urethral injuries with a success rate of 85–100% [4–6].

There are several treatment options to manage urethral strictures in children; in general they include urethral dilatation, endoscopic visual internal urethrotomy and open urethral reconstruction. Dilatation is often used as an initial treatment, with some success, but the long-term results have been poor and this procedure should not be considered curative. All the patients in our study group underwent delayed primary repair at 6 months following trauma because they all were referred cases with supra-pubic cystostomy already done as first procedure. Doubt still exists regarding early or delayed repair. For children encountered with urethral trauma, early attempts may be the best, not only for primary realignment, but also for anastomosis. Traditionally, many surgeons have prohibited immediate surgical management in children, thinking that any attempt to evacuate the pelvic hematoma may trigger more bleeding and result in greater injury to the pelvic nerves and vessels. Balkan et al. [4] compared the results of repair of posterior urethral injury in children managed by delayed repair versus early realignment, and they concluded that urethral stricture in patients who underwent early realignment was less developed than in those who underwent delayed repair. Nerh et al. [5] reported their long-term follow up of 22 children and documented that immediate urethral realignment in children should be attempted to prevent long-term complications. Gundogdu et al. [6] used primary realignment in the treatment of 12 children with complete posterior urethral rupture and reported that the stricture that developed in

most of them was dilatable. They concluded that primary urethral realignment should be the initial treatment of choice for such patients.

Open reconstruction of urethral stricture in children follows the same principles as in adults. Before proceeding for surgical intervention, preoperative work up should be done to assess the site and length of stricture using RGU, MCU, retrograde urethroscopy and antegrade cysto-urethroscopy. Historically, a one-stage Badenoch pull-through procedure of the bulbar urethra was used for strictures of <2 cm, while longer strictures were managed by trans-pubic anastomotic urethroplasty or by a two-stage substitution urethroplasty and scroto-urethral inlay. The abdomino-perineal repair was reserved for posterior urethral defects, which included those associated with bladder neck abnormalities, fistulae to the bladder base or rectum, peri-urethral cavities, and those patients with skeletal abnormalities precluding perineal access. Until recently it was believed that perineal urethroplasty in children is technically difficult because the bladder and prostate are located in the abdomen, the pelvis is less capacious [7], and the perineum is confined [8], but the concept changed completely in the 1970s when Turner-Warwick popularized a delayed one-stage perineal approach, comprising urethral mobilization followed by bulbo-prostatic anastomosis, to bridge defects of up to 2.5 cm [9]. This procedure became the standard repair for short strictures, while substitution urethroplasty or trans-pubic urethroplasty continued to be used for longer defects or complex posterior urethral defects, respectively. Buccal mucosa has proved to be a successful grafting material, especially as a patch, for long-segment strictures not amenable to anastomotic urethroplasty. Koraitim [10] in his series was able to achieve a satisfactory perineal anastomosis if the stricture segment was up to 3 cm, and he resorted to trans-pubic urethroplasty in larger segments. He also measured the length of the bulbar urethra and its elastic index, and he concluded that the bulbar urethra can extend to bridge a stricture for a maximum of one third of its length; beyond that the anastomosis would be under tension. Morey and Kizer [11] also demonstrated that urethral reconstruction is proportional to the length and elasticity of the distal urethral segment. The key to a high success rate in urethral stricture repair is excision of all the fibrous tissue along with complete mobilization of the proximal and distal urethra to achieve a tension-free anastomosis, a point which Morey and McAninch [12] and Koraitim [10] stressed as well.

There is no agreement in the literature about the maximum length of stricture that can be treated by end-to-end anastomosis. Most urologists agree that 2.5 cm is a safe defect length to be treated by end-to-end anastomosis [10] being tension-free to achieve a 100% success rate. Many authors have demonstrated a higher success rate, with excessive urethral mobilization that just allowed them to bridge a gap reaching 5 cm [11].

Hafez et al. [13] were able to bridge a gap of up to 5 cm by the perineal route achieving a success rate of 100%. Perineal anastomotic urethroplasty carries a high success rate of 93%–100%. In our series, pre-anal coronal anastomotic urethroplasty was successful with only 3 (10.3%) cases out of 29 having an anastomotic urethral stricture in the first year following the repair. Two (6.8%) cases required redo urethroplasty through trans-pubic approach using substitution

urethroplasty while 1 (3.4%) case was managed with urethral dilatation only. Of the 8 patients who underwent an additional trans-pubic approach, 2 (12.5%) developed stricture in the first year following repair which required urethral dilatation only until the last follow up. As in our study, many other authors [14–17] have demonstrated a high success rate with repeated dilatation in the management of recurrent stricture following urethroplasty. We used the pre-anal coronal approach as published before [18]. The trans-pubic approach was added in cases where satisfactory end-to-end anastomosis was not possible. Koraitim [10] reported his findings in a series of 68 children, and concluded that the initial attempt in every case of urethral stricture should be by perineal approach and the trans-pubic procedure should only be used if a tension-free anastomosis could not be obtained.

Two of our patients developed lower urinary tract symptoms, one of whom had a post-void residue above 20 ml and abnormal bladder dynamics, and were managed on oxybutynin. All of our children are continent with no penile curvature and no penile shortening at last follow up. None of the children included in our series underwent any assessment of erectile function.

## Conclusions

The resection and end-to-end anastomosis technique is possible through pre-anal coronal incision; however, if the slightest difficulty is envisaged in achieving a satisfactory result, extension to trans-pubic approach should be done. The latter approach was found to be very effective. It has a high success rate with durable long-term results. Complications are few. The procedure is simple, less demanding and especially suitable in patients with post-traumatic posterior urethral strictures.

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