

Surgical management of female urethral strictures

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Abstract: Female urethral stricture (FUS) represents a rare condition, yet one that can cause significant, bothersome lower urinary tract symptoms (LUTS). Historically, urethral dilation has been a preferred treatment choice for these patients. A variety of reconstructive surgical techniques have been described in recent years to provide more definitive management in this challenging group of patients. We present an overview of FUS and a summary of surgical management options.

Keywords: Female urethral stricture (FUS); operative technique; reconstructive urology; urethroplasty

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Female urethral stricture (FUS)

Bladder outlet obstruction (BOO) is relatively uncommon cause of lower urinary tract symptoms (LUTS) in women. It has been estimated that BOO accounts for between 2.7–8% of women with LUTS (1-5). In those women with known BOO, FUS account for between 4–18% of these cases (6,7). Symptoms of FUS may be variable, but often include hesitancy, poor flow, frequency, urgency, dysuria, and may lead to recurrent urinary tract infection (8) and overt urinary retention. The assessing clinician must therefore be aware of FUS as a cause of LUTS in females, to minimize the potential for misdiagnosis. Voiding dysfunction due to neuromuscular dysfunction of the pelvic floor and external urethral sphincter would appear to be relatively common (9), though accurate characterization of the cause of voiding dysfunction in women is lacking.

The causes of FUS may include trauma, iatrogenic injury, infection, malignancy, and radiation (10). There also exists no consensus on investigative modalities to make the diagnosis of FUS. Several investigations have been suggested, including: cysto-urethroscopy, retrograde and voiding cystourethrography, uroflowmetry, urodynamic evaluation, magnetic resonance imaging (MRI) and

measurement of post-void residual urine volumes (11).

There is currently no widely accepted definition for FUS. It has been described as a fixed anatomical narrowing between the bladder neck and distal urethra (<14 Fr), of inadequate caliber to allow catheterization (12). Osman's outstanding review proposed the definition of: "*A symptomatic, anatomical narrowing of the urethra based on a failure of catheterization, urethral calibration, visual inspection, or endoscopy or radiography.*" (13).

Though catheterization difficulties are common, most difficulty is not due to an anatomic narrowing. Rather, external sphincter closure is an unhelpful protective mechanism that is usually overcome by expert reassurance and effectively coaxing the urethra and patient to be relaxed during the procedure itself. General anaesthesia enables us to distinguish between a heightened protective reflex closure of the external sphincter and a fixed anatomic narrowing, or FUS.

Surgical management

Urethral dilation

Historically, urethral dilation has been a mainstay in the

treatment of FUS, though evidence for its effectiveness is limited. Some favourable long-term outcomes for urethral dilation for FUS have been reported. Smith *et al.* reported a 57% success rate at a mean follow-up of 21 months in seven women after dilation to 30 Fr (12). However, maintenance on clean intermittent catheterization (CIC) was employed in this cohort (12). Blavais *et al.* reported a subset of seven patients who underwent primary urethral dilation for FUS, with only one patient (14%) not requiring further intervention (14). In the largest published series on urethral dilation of FUS, Romman *et al.* had a 51% success rate in 91 patients for initial dilation to 41 Fr at presentation. A history of prior urethral dilation was a statistically significant predictor of failure in this group (15).

A contemporary series examining urethral dilation under general anaesthesia for FUS in 30 women demonstrated a success rate (defined as no secondary procedure or need for long-term CIC) of 43% (16). In those who failed the initial procedure, minimal benefit was noted with subsequent urethral dilation (16).

Endoscopic management with cold knife or laser incision of mid-urethral stricture has been suggested, typically incising at 3 and 9 o'clock positions (17). Urethral catheter is advocated in these cases, with or without post-operative CIC. Urethrotomy combined with urethral dilation has been reported to show short-term success in a single study of ten patients (18). This treatment, however, is thought to pose potential risk to the sphincter mechanism and may lead to urinary incontinence (16).

Urethral dilatation has also been used to lower detrusor leak point pressures in myelodysplastic patients with poor bladder compliance and high outlet resistance at the level of the external sphincter (19,20).

While urethral dilation has an important role in the management algorithm of FUS, it is likely best reserved as an initial treatment or very specific indications. It may also be a preferred choice in patients not suitable for more complex urethral reconstruction. Appropriate counseling on its modest efficacy and possible need for CIC to maintain patency remains important. Though there are few data, some strictures are unpassable and CIC is not a viable option.

Urethral reconstruction

When urethral stricture involves the distal urethral meatus in isolation, formal meatotomy or meatoplasty may be a prudent option. Circumferential excision of

the meatal stenosis, followed by re-approximation of the urethral lumen to the vaginal epithelium performed over a Foley catheter has been described (17). Due to the more proximal continence mechanism in females, this may be appropriate for strictures involving up to 1 cm of the distal urethra (17).

Several reconstructive techniques for the management of more extensive FUS have been described to date. These have included vaginal or labial flaps, as well as vaginal and oral mucosal grafts. Meatoplasty may be appropriate for strictures involving the distal few millimeters of the urethra, for which less complex reconstruction may be required. In terms of nomenclature, the operative techniques have been described in the literature based upon the analogous technique in the reconstruction of urethral strictures in males. Specifically, the dorsal approach refers to the 12 o'clock position, while ventral refers to the 6 o'clock position (21). It could be argued that designating the dorsal approach as "anterior", and ventral approach as "posterior" may be more apt in terms of anatomic description.

Potential benefits of the dorsal approach would include the avoidance of a vaginal incision and its associated post-operative complications, including issues with urethro-vaginal fistula and wound complications. The dorsal approach, however, may be an unfamiliar surgical dissection for many, compared to a ventral approach.

There are several potential advantages of the ventral approach to reconstruction of FUS. Avoidance of dorsal urethral dissection would avoid neurovascular structures of the clitoris, which could potentially minimize the risk of post-operative sexual dysfunction. It would also avoid division of the pubo-urethral ligaments, and incision of the urethral sphincter at its dorsal aspect, theoretically reducing the risk of urinary incontinence.

While sexual function is not reported as an outcome measure in any of the case series, there is often mention of avoidance of clitoral tissues (22). It is important to consider, however, that the relationship between the urethra and the clitoris is often underrepresented in anatomical texts, and appears to be more extensive than often thought. Caution should be exercised during the informed consent process, in addition to carrying out the dorsal urethral dissection itself (23,24).

Both dorsal and ventral approaches are gaining momentum in the literature and are considered acceptable treatment options with few cases of post-operative stress urinary incontinence or complications noted.

Vaginal flaps

Vaginal flap urethroplasty comprise some the earliest published urethral reconstructive techniques, with Blavais describing it as an alternative to bladder flap neo urethra formation in 1989 (25).

In 2002, Tanello *et al.* described their labia minora pedicle flap, which is tunneled beneath the vaginal epithelial layer, and was successful in both reported patients at 2 years follow-up (26).

Montorsi *et al.* published the largest series of vaginal flap urethroplasty in 17 patients (27). Importantly, these represented distal urethral strictures without prior intervention, and employed a dorsal approach. An 88% success was noted with post-operative calibration to 28 Fr (27).

Several published series have examined the use of ventral vaginal flap urethroplasty with success rates between 80–100% (14,28–30). These techniques may utilize either a “U-shaped” or “C-shaped” vaginal flap inlay to reconstruct the urethra. One advantage of the ventral vaginal flap urethroplasty is that it lends itself well to the concomitant placement of pubo-vaginal sling or Martius flap, should they be deemed necessary.

With longer follow-up duration, Kowalik *et al.* noted that two out of five patients in their series undergoing ventral vaginal flap urethroplasty each required two additional urethral dilations post-operatively (failure noted at 20 and 34 months, respectively) (22). While success rates in the published case series are good, it does remain possible that with longer term follow-up, the failure rate may increase.

Vaginal grafts

Vaginal graft urethroplasty was described by Tsivian and Sidi in 2006, where two patients underwent successful reconstruction with a dorsal vaginal graft (31). Petrou *et al.* published the largest series employing the dorsal vaginal graft urethroplasty, based on Tsivian and Sidi’s technique (32). They published their experience in 11 patients, with three of the patients requiring subsequent urethral dilation within a follow-up range of 6–46 months (32).

Three series have examined the use of ventral inlay labial graft urethroplasty, with success rates ranging between 75–100%, and mean follow-up between 15–24 months (33–35).

The vaginal flap and graft urethroplasty are advantageous in that they do not require oral graft harvest, and rely on readily accessible local tissues. Thus, the morbidity of buccal or lingual mucosa harvest is circumvented. In

addition, both techniques are feasibly performed in either a dorsal or ventral approach, dependent on patient factors and surgeon experience. However, these techniques rely on the relative health of these local tissues, and may not be suitable when the vaginal mucosa is atrophic, radiated, or has been subject to trauma or scarring from prior procedures.

Oral mucosal grafts

Several published series have demonstrated excellent outcomes after urethroplasty for FUS using buccal or lingual mucosa in a dorsal onlay technique (14,22,28,31,36–39). While the individual series are limited by small patient numbers and lack of long-term data, the results are indeed promising.

The buccal mucosal graft urethroplasty utilizing the ventral onlay technique has been presented in two separate series, comprising of two patients each (28,40). While successful outcomes were noted in three of the four patients, it is difficult to infer feasibility and efficacy of this technique due to limited patient numbers. A novel modification to a ventral inlay technique utilizing a vaginal-sparing approach has been described, which may minimize risk of post-operative complications (41). Further study in the ventral technique is warranted.

Overall, reconstruction with oral mucosal graft urethroplasty for FUS has proven an excellent treatment option, with a combined success rate of 94%, though patient numbers remain small and its durability long-term is yet to be proven (21).

Conclusions

While FUS remains a rare cause of BOO in women, the clinician must have a high degree of suspicion for the diagnosis in order to accurately diagnose the condition and provide optimal treatment. While urethral dilation is an appropriate initial management step, urethral reconstruction should be considered as a definitive surgical option in those refractory to one dilatation. While the various techniques reported in case series to date have all demonstrated excellent success rates, the best approach has yet to be elucidated. Overall, an individualized approach based on patient factors, stricture characteristics, and surgeon experience is most appropriate.

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Footnote

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