Urethral bulking with native tissue during artificial urinary sphincter surgery

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RABINOWITZ MJ, LIU JL, LEVY JA, DUCOMB W, BURNETT AL. Urethral bulking with native tissue during artificial urinary sphincter surgery. *Can J Urol* 2023;30(2):11516-11519.

The artificial urinary sphincter (AUS) is the "gold standard" surgical treatment for severe stress urinary incontinence. However, a subset of patients with frail urethras may require technical adjuncts to ensure optimal cuff function. Our objective is to provide a detailed tutorial of our institution's method for performing urethral bulking with native tissue in patients with frail urethras during AUS surgery.

We have found that urethral bulking with native tissue provides a cost-efficient and durable technique for improved AUS cuff coaptation. Our experience demonstrates adequate short and intermediate term efficacy with limited complications. These techniques equip surgeons with an alternative surgical approach for appropriate patients receiving AUS surgery who have been previously exposed to pelvic radiation and/or significant surgical morbidity resulting in frail urethral tissue.

Key Words: artificial urinary sphincter, urinary stress incontinence, prostate cancer, urethral disease

Introduction

Artificial urinary sphincter (AUS) surgery is the gold standard treatment option for managing moderate-to-severe stress urinary incontinence (SUI). While the potential for short and intermediate term complications of the AUS is low, the mechanical impermanence of the device and associated functional decline are obstacles for long term continence.[1] At time of AUS placement, proper coaptation of the urethra by the device cuff is critical for long term success. In a subset of patients, particularly those who have received previous pelvic radiation, radical prostatectomy, or prior urethral surgery, the presence of a frail urethra can complicate adequate coaptation of the urethra.[2]

There are multiple mechanisms through which the urethral tissue may become damaged. Previous urethral reconstruction may compromise the urethral blood supply resulting in atrophic changes.[3] Pelvic radiation also damages the urethra by inducing significant fibrosis and ultimately hypovascularity, even when the irradiated field does not directly involve the bulbar urethra.[4] Moreover, medical factors such as cardiovascular disease, diabetes, and overall frailty can contribute to poor tissue quality and wound healing.[2] Finally, prior operations involving the urethra or bladder neck, such as radical prostatectomy or multiple AUS revisions, also increase the risk for scarring and can further complicate surgical approaches.

Accepted for publication March 2023

Acknowledgment
We recognize Dr. Nora Haney for her contributions in narrating the video of our surgical experience.

A video clip is available online at www.canjurol.com

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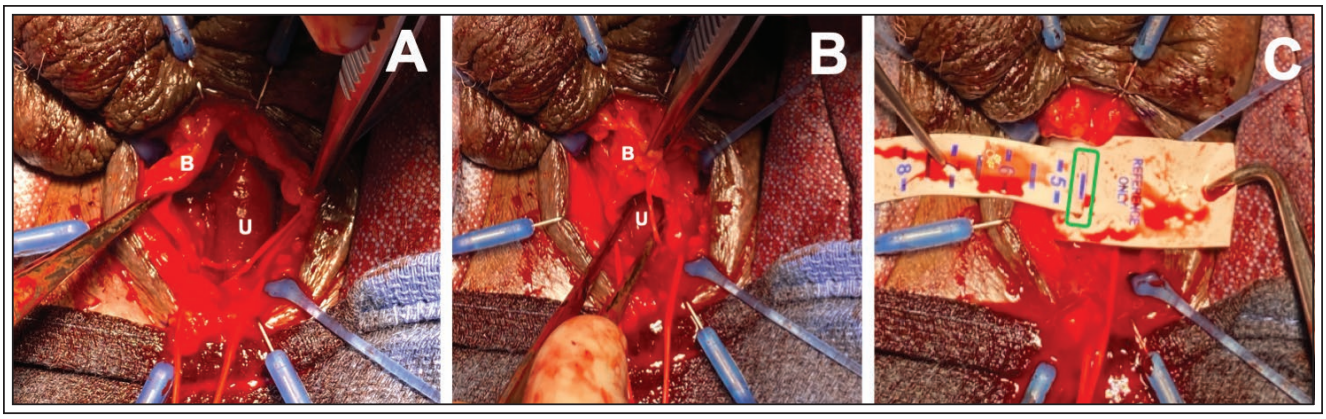

Figure 1. Bulbar urethral bulking with bulbocavernosus muscle. **[A]** The bulbar urethra **(U)** is dissected from the corpora cavernosa. The bulbocavernosus musculature **(B)** is divided. **[B]** The bulbocavernosus musculature is released laterally with reapproximation ventrally. **[C]** The buttressed urethra shows appropriate bulk.

The aim of this manuscript is to highlight our institution's approach for AUS placement or revisions under conditions of frail urethras using native periurethral tissue. Herein, we describe urethral bulking using either a bulbocavernosus-derived flap or a bulbar urethral flap. Additionally, we present a case series and narrated video illustrating the durability and safety of performing these adjunctive techniques.

Method and technique

A retrospective chart review was performed evaluating patients undergoing AUS placement or revision from a single surgeon from 2009 (the earliest date available using our current electronic medical record system) through 2021. Institutional review board approval was obtained for this purpose. All patients who required urethral bulking at the time of initial AUS device placement or at the time of AUS revision were included.

Surgical technique: urethral bulking with bulbocavernosus muscle

The patient is placed in standard lithotomy position, a cystoscopy is performed to assess the quality of the urethra, and a 20 French foley catheter is placed to guide dissection. A 4 cm midline incision is made in the perineum and sharp dissection is carried out down to the level of the bulbar urethra. Circumferential dissection is performed by separating the corpus spongiosum from the corpora cavernosa, see video clip. Prior to measurement of urethral circumference, the catheter is removed. A measurement of the urethra is then obtained. The measuring tape should not cause any tissue blanching but should gently surround the urethra.

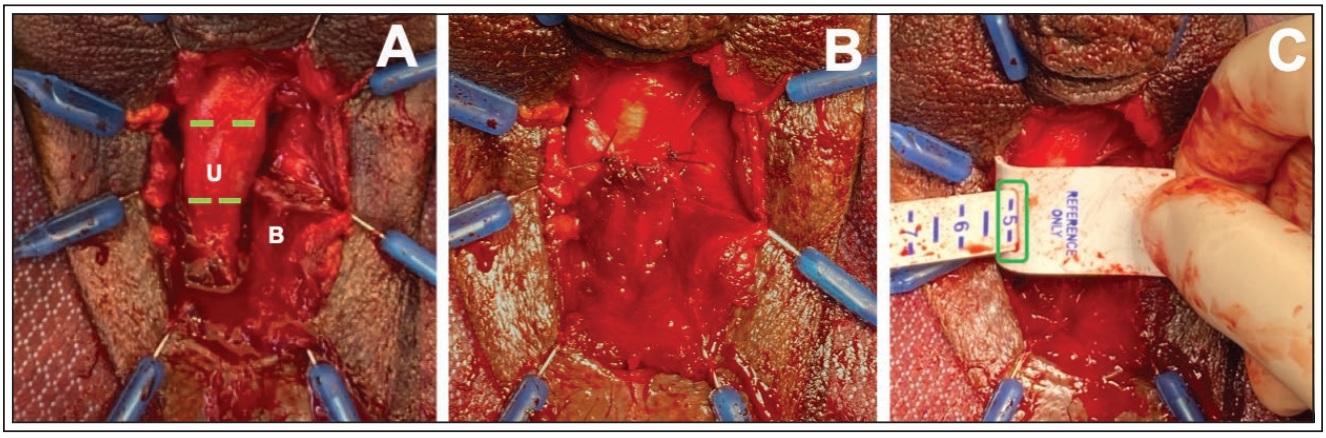

Figure 2. Bolstering of the bulbar urethra. **[A]** The bulbar urethra **(U)** is dissected circumferentially. Dotted lines denote standard AUS cuff position. **[B]** The bulbar area is released and a distally transferred flap is closed. **[C]** The buttressed urethra shows appropriate bulk.

The urethral tissue is assessed for its integrity and girth. For urethral circumference measurements less than 4 cm, additional dissection of the bulbocavernosus musculature at the level of the bulbar urethra is carried out laterally, Figure 1a, 1b. A repeat circumferential measurement encloses both the urethra and bulbocavernosus musculature, often providing up to an additional 1 cm of circumference. An AUS cuff size is then selected, Figure 1c.

Surgical technique: bolstering of the bulbar urethra

In instances of frail urethras in which there is insufficient bulbocavernosus musculature for urethral bulking, an alternative technique can be performed using the tissue of the bulbar urethra, see video clip. Further dissection is done proximally along the bulbar urethra to create a small (1 cm-2 cm), overlapping bulbar segment that is mobilized distally as a ventral flap and secured with 3-0 Monocryl sutures, Figure 2a, 2b. An AUS cuff size is then selected, Figure 2c.

Results

From 2009-2021, urethral bulking with native tissue was performed in ten patients, seven of whom received primary AUS placements with the other three receiving revisions to previous implants; nine patients received urethral bulking via a bulbocavernosus-muscle derived flap, and one receive a bulbar urethral flap. As displayed in Table 1, median patient age at time of surgery was 63.5 years (interquartile range [IQR]: 57, 72). Median follow up interval was 6 months (IQR: 3.25, 36). Nine of our patients (90%) had a history significant of prostate cancer, eight of whom received radical prostatectomy and one (10%) had a remote history of rectal cancer treated with neoadjuvant chemoradiation and subsequent sacral excision and left hemicolectomy. Eight subjects (80%) had received prior pelvic radiation therapy.

Postoperatively, no patients experienced infection or displayed evidence of early cuff erosion, Table 1. One patient (10%) experienced postoperative urinary retention, which required temporary suprapubic catheterization. All devices (100%) were activated as scheduled 4-6 weeks after surgery. At 3 months of follow up, all ten patients were fully continent and satisfied with the function of their device.

One patient (10%) experienced a complication (Clavien Dindo Class IIIb): after 4 years, this patient, with a history of brachytherapy and urethral strictures, experienced a repeat bladder neck contracture. This contracture warranted transurethral resection of the bladder neck, direct vision internal urethrotomy, and subsequently cystectomy with urinary diversion. One patient (10%) required revision of his device secondary to a fluid leak, which occurred 4 years after his original operation. When the AUS cuff was explanted at the time of this revision, and replaced at a site just distal to the original cuff, no recurrent urethral frailty or flap atrophy was observed. To date, nine patients (90%) remain with functioning devices and satisfactory continence, Table 1.

TABLE 1. **Bulking patients' characteristics and outcomes**

Preoperative characteristics	**n (%) or median (IQR)**
Total patients	10 (100%)
Surgical technique	
Bulbocavernosus muscle flap	9 (90%)
Bulbar urethral flap	1 (10%)
Nature of procedure	
Primary implant	7 (70%)
Revision	3 (30%)
Age at surgery	63.5 (57, 72)
Body mass index (kg/m^2)	27.5 (25.95, 28.01)
Follow up (months)	6 (3.25, 36)
Past medical history	
Prostate cancer	9 (90%)
Rectal cancer	1 (10%)
Pelvic radiation	8 (80%)
Tobacco use	2 (20%)
Diabetes mellitus	2 (20%)
Hypertension	4 (40%)
Cuff size (cm)	4 (4, 4.5)
Postoperative outcomes	**n (%)**
Surgical infection	0 (0%)
Acute urinary retention	1 (10%)
Early cuff erosion (< 6 mo)	0 (0%)
Device activation	
Scheduled	10 (100%)
Delayed	0 (0%)
Continence at 3 months	
Yes (0-1 pad/day)	10 (100%)
No (> 1 pad/day)	0 (0%)
Continence at maximum follow up	
Yes (0-1 pad/day)	9 (90%)
No (> 1 pad/day)	1 (10%)
Required revision	
Device failure (fluid leak)	1 (10%)
Complications	
Bladder neck contracture	1 (10%)

Discussion

In this study, we describe our institution's 12-year experience performing urethral bulking with native periurethral tissue during AUS surgery for men with frail urethras. The techniques described herein are easily performed, expedient, and effective technical procedures that do not affect the corpora cavernosa or influence sexual function following surgery. They can also be safely performed in patients with penile prosthetic implants. The use of either a bulbocavernosus muscle-derived flap or a bulbar urethra flap advantageously employs local, vascularized tissue for bulking. Our approach avoids the associated morbidity of a larger muscular flap and, as suggested by our social continence outcomes and paucity of surgical revisions, is not fraught with short and intermediate term atrophy beneath the implanted AUS cuff.[5]

A paucity of surgical approaches are available to address frail urethras at the time of AUS surgery. Using the smaller, 3.5 cm circumference cuff or employing a double (tandem) cuff have been described, yet both have fallen out of favor with concerns of increased rates of cuff erosion with use of the 3.5 cm cuff in irradiated urethras and increased surgical complications without additional benefit to overall continence or quality of life.[6,7] The transcorporal cuff, incorporating tissues from the corpora cavernosa, has the concern of narrowing the caliber of the corpora cavernosal bodies, thus hampering erectile function in these patients.[1] Surgical variations to the transcorporal cuff, such as the "gull-wing door" technique, have been proposed to mitigate the risk of cuff erosion and minimize disturbances to the corpora cavernosa.[8] Non-native grafting techniques have also been described using synthetic or allogenic materials, although these may incur a greater risk of rejection and are limited by their availability.[9,10]

Our report is limited by our small sample size. However, the sample reflects the very selective application of these techniques in complex patients. Our median follow up interval of 6 months is negatively skewed because subjects commonly continue their routine care in the community setting following device activation at 4-6 weeks postoperatively; it is reasonable to assume these patients would return to our institution if complications arose. Additionally, the case series described represents a single-armed sample without comparison to other techniques. Lastly, while we report our series' social continence outcomes in a retrospective manner, objective continence datapoints collected prospectively, such as number of pads required per day and pad weight, would provide support to our findings, and more accurately represent long-term continence outcomes.

Conclusion

We have demonstrated our institution's unique approach to urethral bulking with native periurethral tissue in patients with frail urethras undergoing AUS surgery. We describe the use of bulking with either bulbocavernosus muscle or bulbar urethral bolstering to buttress frail urethral tissue, offering a cost-efficient and durable alternative to implanting inflammatory and avascular materials. Patient outcomes during our 12-year experience illustrate adequate short and intermediate term safety and durability. Our techniques equip surgeons with an alternative surgical approach for appropriate, high-risk patients. Future studies would benefit from larger, multi-institutional samples enabling for the stratification of patients based on known risk factors such as previous pelvic radiation and comorbidities. □

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