Transurethral Incision with Transverse Mucosal Realignment for the Management of Bladder Neck Contracture and Vesicourethral Anastomotic Stenosis

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OBJECTIVE To assess efficacy and safety of a novel cystoscopic technique for definitive repair of bladder neck contracture (BNC) and vesicourethral anastomotic stenosis (VUAS).

METHODS A retrospective review of patients who underwent a transurethral incision with transverse mucosal realignment between July 2019 and December 2020 by a single surgeon was completed. This is novel procedure of incising a scar cystoscopically and using a laparoscopic suturing device transurethrally to bring healthy bladder mucosa across the defect, like a YV plasty. Patients were only included if they had ≥4 months follow-up. Surgical success was defined as ability to pass a 17 French flexible cystoscope through the previously stenotic segment at 4 month follow up.

RESULTS Nineteen patients with a median follow-up of 6 months were included in this analysis. Etiology of posterior urethral stenosis was 53% from VUAS and 47% from BNC, with 32% of patients having prior pelvic radiation. Success was achieved in 89% of patients after 1 procedure and 100% of patients achieved success after a second procedure. There was no de novo incontinence or major complications.

CONCLUSION Transurethral incision with transverse mucosal realignment for VUAS and BNC has a high success rate after only 1 procedure. This is the first reported series of an endoscopic Y-V plasty type repair for BNC and VUAS. Longer term follow up to ensure durability and reporting from other institutions will be needed to establish reproducibility. UROLOGY 152: 102–108, 2021.

It is estimated that 90,000 prostatectomies and 150,000 transurethral resections of the prostate are performed annually in the United States each year.[1,2] Vesicourethral anastomotic stenosis (VUAS) and bladder neck contractures (BNC) are well known side effects for treatment of prostate malignancies and benign prostate conditions, respectively. The rate of VUAS is less than 3% in contemporary robotic prostatectomy series.[3,4] Salvage radiation after prostatectomy increases the rate of VUAS to 2.7%-10%.[5,6] Benign prostate surgery for bladder outlet obstruction carries a similar incidence, with contemporary studies reporting a rate of 3%-12% with transurethral resection of the prostate,[7,8] 0%-7% for photo vaporization of the prostate[9-11] and 2.1%-4.7% in holmium laser enucleation of the prostate.[12,13]

Open surgery via abdomino-perineal approach is historically how these posterior stenoses were repaired however these are rather invasive and morbid surgeries.[14] With success rates of 58%-76%, endoscopic incisions with or without Mitomycin C (MMC), are often first line therapy.[15-19] When these endoscopic procedures fail, patients may require intermittent self-catheterization (ISC), urinary diversion or stricture repair by an open, laparoscopic, or robotic approaches.[20-22] These contemporary non-endoscopic approaches aim to incise the stricture longitudinally, and close healthy tissue across the incised region in a T or YV plasty type repair. Success rates are 75%-100% in these limited series. The complexity and morbidity of these non-endoscopic repairs requires nuanced reconstructive management. As a result, many patients

Abbreviations: *VUAS, vesicourethral anastomotic stenosis; BNC, bladder neck contracture; TUITMR, transurethral incision with transverse mucosal realignment; ISC, intermittent self-catheterization; IPSS, international prostate symptom score; PVR, post void residual; MMC, Mitomycin C*

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Submitted: December 28, 2020, accepted (with revisions): February 1, 2021

https://doi.org/10.1016/j.urology.2021.02.035
0090-4295

undergo multiple futile endoscopic incisional interventions, or are placed on ISC rather than referral for attempted definitive repair.

The idea of using a laparoscopic suture device for urologic purposes was first described by Humphreys et al[23] when they reported the use of the RD-180 (LSI Solutions, Rochester, NY) suture device during an endoscopic prostatectomy. After the prostate was removed, the suture device was used to pull the free bladder edge to the urethral edge using an end-firing suture and was then secured in place with the accompanying Ti Knot (LSI solutions, Rochester, NY). The RD-180 was later used in a porcine bladder model to replicate an endoscopic cystorrhophy.[24] We have previously described our novel technique for endoscopic repair of VUAS and BNC using the RD-180 and Ti Knot[25]. Herein, we report outcomes of our initial series.

METHODS

We performed a retrospective review of an institutional review board approved database of consecutive patients treated for BNC or VUAS between July 2019 and December 2020.

Diagnosis of obstruction was confirmed by cystoscopy and inability to pass a 17 French flexible cystoscope. Patients who had complete obliteration were excluded from analysis as were those with stenosis of the membranous urethra. Patient demographics including age, comorbidities, cause of stricture, radiation history and prior attempts at treating the obstruction were recorded. Preoperative evaluation included international prostate symptom score (IPSS), post void bladder residual (PVR) volume, and flexible cystoscopy. Urine cultures were assessed preoperatively and were treated when positive.

Patients were informed during their preoperative visit that this was a new technique offered at our institution. Other treatments of endoscopic incision with MMC or robotic repair via Y-V plasty were also offered. Patients who elected for this transurethral incision with transverse mucosal realignment were considered to have undergone thorough informed consent.

The procedure has previously been described[25] (Figs. 1 and 2). In brief, using a 26 French continuous flow cystourethroscope with a visual obturator (Olympus Surgical Southborough, MA), the urethra was inspected to the level of obstruction. A 0.35-inch wire was passed through the stricture. We then use S-shaped dilators (Cook Medical, Bloomington IN) to dilate to 24 French. The cystourethroscope was then reintroduced and the visual obturator was exchanged for a working element, and a needle tip electrode. In the case of VUAS, we incised at the 3 and 9 o'clock position until the opening was estimated to be 30 French. In the case of BNC after prostate surgery, we would incise at the 3 and 9 o'clock position until healthy fat was encountered.

Leaving the outer sheath of the 26 French continuous flow sheath in position, the inner lumen and working element were removed. Through the outer sheath, a 5 French rigid ureteroscope (Olympus surgical) and the RD-180 were simultaneously passed down the channel into the bladder. Flow pressure is maintained at 150 millimeters of Mercury using the Thermedx fluid management system (Thermedx, Solon OH). As most of the fluid flushes out of the sheath, having a high flow improved visualization. The RD-180 was then used to grasp the mid aspect of the proximal edge of bladder mucosa using a 2-0 Monoglide suture (LSI Solutions, Rochester NY). A second throw is then made through the midpoint of the distal urethral mucosa. The ureteroscope and RD −180 are pulled out of the sheath, leaving the outer sheath in position. The suture is thread through the 1mm x 2 mm titanium Ti Knot and secured into position, pulling the bladder mucosa distally to realign to the urethral mucosa. In later cases, we used a disposable offset scope with a 6mm working channel from Neoscope (San Jose, CA). This facilitated better visualization and maintained bladder pressure during the procedure. An 18 French catheter is left indwelling for 1 week post operatively. Patients are then seen at 4 months for cystoscopy (Fig. 3). We define patency as the ability to pass a 17 French cystoscope. The bladder is assessed for clips, free in the bladder or attached, at that time. If present, the clip is removed with a grasper.

A paired *t* test was used to compare pre- and post- IPSS scores and PVR volumes.

RESULTS

Nineteen consecutive patients were evaluated in this analysis (Table 1). Median age was 73 years old (58-87), median body mass index was 29 kg/m2 (23-35). Median operative time was 55 minutes (34-86). Four patients (21%) had a history of diabetes. 10 patients (53%) had VUAS, 9 (47%) had a BNC. Six patients (32%) had a history of radiation, including salvage radiation after prostatectomy in 4, prostatectomy after radiation in 1, and 1 patient had a BNC after a neobladder to prostate, followed by radiation for prostate cancer. Four patients (21%) were on (ISC or had an indwelling catheter at the time of the operation. Eight patients (42%) were incontinent before surgery. Five patients had had no prior interventions, 5 had 1 prior intervention, and 9 patients had 2 or more prior surgeries to manage the stenosis.

At a median follow up of 6 months (4-15), 89% (17/19) of patients were considered stricture free after 1 treatment (Table 1). Of the 2 patients who failed initially, they were found to have recurred by the 4-month cystoscopy. One patient went on to an unsuccessful robotic Y-V plasty. Both failures then underwent a second endoscopic realignment. Each of these were successful after repeat intervention as noted by 4-month cystoscopy. No patients who were on preoperative ISC or had an indwelling catheter required postoperative ISC. The 2 initial failures were in the population of men on ISC or indwelling catheter. Pre- and post-operative IPSS score was 14.6 and 14.4, respectively ($P = 0.95$). The IPSS bother domain pre- and post-operatively was 3.8 and 3.3, respectively ($P = 0.37$).

One patient required manual bladder irrigation of his catheter in the recovery area, otherwise no complications were noted. Four patients (21%) had persistent clips noted at 4-month cystoscopy (Fig. 3), 3 of these were removed in the office with grasper, and 1 was taken to the operating room for removal; which was accomplished by pushing it off with the rigid scope. All patients who were incontinent preoperatively had persistent post-operative incontinence. There were no cases of de novo incontinence. Of the 8 patients with pre-existing incontinence, 4 patients have undergone successful anti-incontinence procedures since their endoscopic realignment. The remaining 4 incontinent patients are mild and no intervention is planned.

DISCUSSION

Conceptually, the idea of realigning mucosa after incision, rather than leaving a raw surgical bed exposed to urine

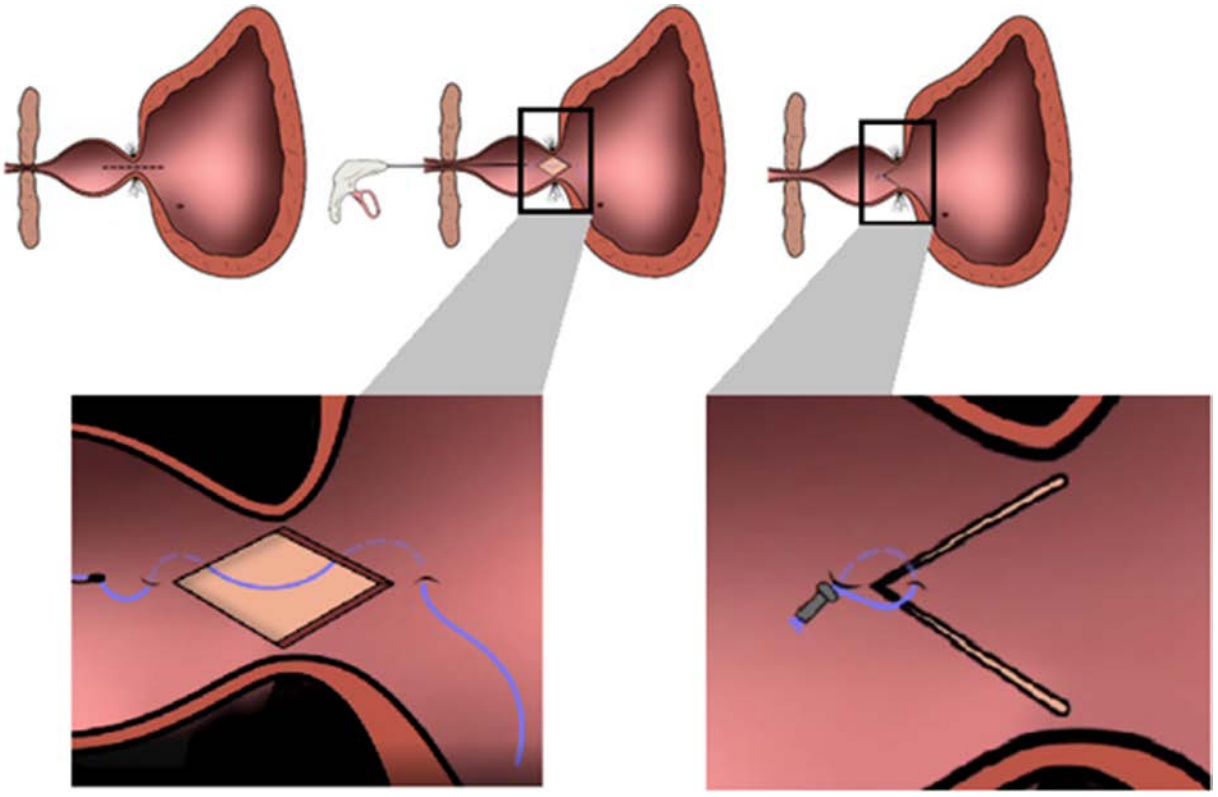

Figure 1. Animation of transurethral incision with transverse mucosal realignment. (Color version available online.)

(with or without MMC injection), makes surgical sense. However, the ability to perform this endoscopically has evaded urologists until now. Herein we report the highly successful outcomes of patients undergoing our novel endoscopic technique to transversely realign the incised edges of a VUAS or a BNC.

In our series, success was achieved in the majority of patients after 1 intervention 17/19 (89%). The remaining 2 patients were rendered stricture free after a second intervention. In comparison, the success rate in the initial report on MMC by Vanni et al was 72% (13/18 patients) after 1 treatment and 89% (16/18) after 2 procedures.[19] In a multi-institutional cohort of patients undergoing incision with MMC, the success was noted to only be 58% (32/55) after 1 treatment, and while not all failures had a second incision in this cohort, the final success was 75%.[17] In the population of men undergoing deep lateral incisions alone, the initial success was 36 out of 50 (72%) and 86% after 2 treatments.[16] In the present study and others, overall success increases with a second treatment. In our series, both patients that failed initial intervention had successful secondary treatments as verified by cystoscopy at 4 months. While our follow up is short, most treatment recurrences generally occur early. Indeed, Redshaw et al noted a mean time to recurrence of 3.7 months[17] and Ramirez et al detected all treatment failures at 2-month cystoscopy.[16]

Figure 2. Intraoperative photographs of transurethral incision with transverse mucosal realignment. Panel 1: Incising through scarred tissue. Panel 2: Suturing with RD-180 in Bladder Mucosa. Panel 3: Final lumen of posterior urethra with Ti Knot clips in place. (Color version available online.)

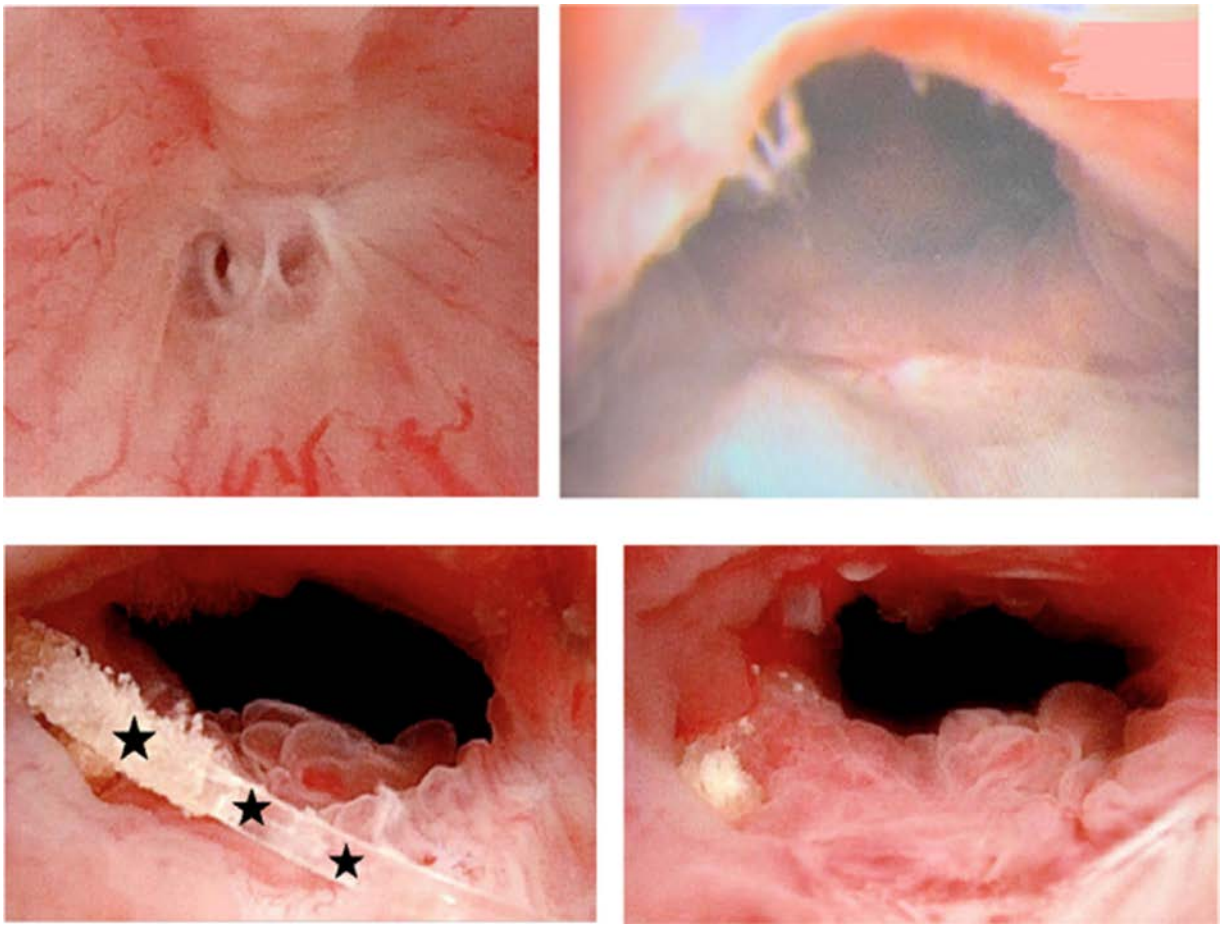

Figure 3. Panel 1: Preoperative cystoscopy. Panel 2: Cystoscopy 4 months post operatively. Panel 3: Clip in situ (black star) at 4 month cystoscopy. Panel 4: after clip knocked off with cystoscope. (Color version available online.)

In our present series, the assessment of mucosal realignment was considered a success upon completion of the first procedure in those 2 patients that failed. The difference was these were earlier in our series before changing to the Neoscope offset scope. The visualization is far superior, and it is probable that the improved visualization is the reason for the success of the second operation.

Table 1. Demographics and outcomes

Demographics	
n	19
Age	73 years (58-87)
Operative time	55 minutes (34-86)
VUAS	53% (10)
BNC	47% (9)
Radiated	32% (6)
Outcomes	
Median follow up	6 months (4-14)
Success after 1 procedure	89% (17)
Success after 2 procedures	100% (19)
De novo incontinence	0% (0)

Age and operative time reported as median values

As we have had no failures since we began using the new offset scope, this aspect of the procedure warrants further discussion. When Humphreys et al described the use of the RD-180, an offset scope was used that is not commercially available.[23] In the second study looking at the use of RD-180 in a porcine bladder injury model, the cystoscope used was not described, but was likely a 30 French laparoscope that had the necessary 6mm working channel.[24] The 30 French laparoscope is no longer available and is too large for most urethras. For that reason, we needed an alternative means to accommodate the instrument and suture. Initially, using the 26 French outer sheath of the cystoscope was an effective way to protect the urethra while passing the RD-180 alongside a rigid ureteroscope seemed like a reasonable option. Using this method, most cases were easy to perform but some were tedious. This prompted us to seek an alternative scope. The Neoscope has a digital camera and light source that minimizes the needed footprint for optics, allowing a 24 French outer sheath with a 6mm working channel. To our knowledge there is no other commercially available device that meets these requirements.

The complications were minimal in our series. One patient had hematuria requiring hand irrigation in the early post-operative period. In comparison, the multi-institutional series by Redshaw et al reported 7% serious adverse events: 2 patients with osteitis pubis, 1 patient with rectourethral fistula, and 1 with extensive necrosis. It is speculated that there was too much MMC or misplaced MMC that lead to this problem, like MMC causing issues after bladder perforation for bladder tumor resections.[26-28] Avoiding MMC eliminates this possibility. In addition, favoring the lateral incisions avoids the pubic bone and rectum.

One complication unique to this procedure is related to the limitations to the existing equipment. The suture is large, at 2-0, with a long absorption time of 120 days. Also, it is secured with a small titanium knot (1 mm x 2 mm). This has the potential to be lithogenic. In the 38 clips placed (2 per patient), 4 required intervention (10%). One patient was taken to the operating room for removal because we did not have a grasper available for in-office removal. This clip was pushed off easily in the operating room. The patients are extensively counseled with this potential risk and thus the importance of the 4-month cystoscopy to ensure the clips have passed. A 90% of clips passed without intervention, and all patients have undergone 4-month cystoscopy.

While we report our IPSS and PVR, these values were not significantly different between patients pre and post operatively. This is likely a reflection of the few patients we have in our series. We saw no cases of de novo incontinence. However, we feel the VUAS are at the greatest risk. We ensure during preoperative workup that the patients' membranous urethra is not involved by asking them to actively contract the sphincter, and proving no involvement. If the membranous urethra is involved, then the procedure is not offered. In addition, we limit the incision of the VUAS to accommodate only 26-30 French. Thus far, this tactic has been successful.

Our review has several limitations. This is a small retrospective cohort. Because the failure rate is so low, we are not able to assess risk factors associated with failure, or optimal timing of anti-incontinence procedures. While our follow-up is limited, the shortest patient follow-up is 4 months, and knowing that most recurrences occur within 4 months is reassuring. Finally, the procedure itself continues to evolve and improve. We first performed the operation through an outer sheath with a ureteroscope alongside the RD-180. While successful, this was a tedious endeavor that was not widely reproducible. With the introduction of the offset scope that allows passage of the RD-180 and Ti Knot, the procedure has been highly reproducible and easy to perform. Finally, 26% of our patients were first time treatments, never having a prior operation. While many of these would have likely done well with just the incision, with or without MMC, the added time and morbidity of realignment is negligible.

CONCLUSIONS

Transurethral incision with transverse mucosal realignment for VUAS or BNC has a high success rate after only one procedure. Further follow up will be needed to determine risk factors for failure, and durability of outcomes.

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EDITORIAL COMMENTS

Bladder neck contracture (BNC) and vesicourethral anastomotic stricture (VUAS) are increasingly common in urological practise in general and in genitourinary reconstructive surgical practise in particular. Each year 65-90,000 radical prostatectomies (RP) and 126-150,000 trans-urethral resections of prostate are performed in the USA.[1,2] VUAS occurs in 3%-10% of men following RP (with higher rates in men who have adjuvant radiotherapy) whilst BNC occurs in 3%-12% following transurethral resections of prostate meaning between 1950 and 9000 men develop VUAS and between 3780-18,000 men develop BNC each year.[3,4]

This paper describes a novel minimally invasive technique for managing this prevalent and often recalcitrant problem. The technique appears to be relatively simple with a cystoscopic incision of the VUAS or BNC followed by transurethral suture using a laparoscopic suture device and an off-set cystoscope to bring healthy mucosa across the defect – performing a cystoscopic V-Y plasty in effect. In the 19 patients in this series at >4 months follow-up urethral patency was achieved in 89% after 1 and 100% after 2 procedures. There were no significant complications, in particular no new onset urinary incontinence.

The urethral patency rate of this new technique compares favourably with that of other treatment modalities; urethral dilatation ± corticosteroid (CS) or mitomycin C injection (0%-89%),[5] DVIU ± CS or MMC injection (20%-86%),[6] trans-urethral resection (TUR) (40%-58%),[7] redo-VUA (60%-91%)[8] and open or robotic V-Y or T-plasty of BNC (83%-100%).[9] The incidence of complications, in particular new onset urinary incontinence, appears to be far lower with this new technique. Urinary incontinence occurs following urethral dilatation ±CS or mitomycin C injection in 0%-11%,[5] following DVIU ± CS or MMC injection in 0%-10%,[6] following TUR of BNC in 0%-1.7% for BNC,[7] following TUR of VUAS in 38%-50%,[7] following retropubic redo-VUA in 0%-50%, following perineal redo-VUA in 100%[8] and following open or robotic V-Y or T-plasty of bladder neck in 19%-82%.[9]

Caution should however be exercised before widespread uptake of this technique. There was no significant change in IPSS and PVR following surgery and longer-term outcome data in larger numbers of patients are required to verify safety and efficacy. It would be apposite for a group of interested and expert surgeons such as TURNs to collaborate on a prospective study to establish these outcomes for the wider urological surgical and patient community.

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https://doi.org/10.1016/j.urology.2021.02.037
UROLOGY 152: 107, 2021.

AUTHOR REPLY

As more patients are accrued and longer follow up is achieved, we are only encouraged by the success of this novel operation. The current major limitation on wide spread adoption of the technique is access to the appropriate cystoscopes to perform the procedure. The offset scope used in later cases works well but there have been some concerns that this is a smaller company and generating a sufficient quantity of scopes has been a challenge. In addition, as it is a disposable item, the long term adoption may be limited. We are working with different groups to develop reusable devices to facilitate an easier and more sustainable operation. We hope to start a collaboration with a group such as TURNS once we identify a more permanent solution.

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https://doi.org/10.1016/j.urology.2021.02.038
UROLOGY 152: 107–108, 2021.