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# Multi-Institutional Outcomes of Minimally Invasive Harvest of Rectal Mucosa Graft for Anterior Urethral Reconstruction

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**Abbreviations and Acronyms**

BMG = buccal mucosa graft

LS = lichen sclerosus

RMG = rectal mucosa graft

TAMIS = transanal minimally invasive microsurgery

TEMS = transanal endoscopic microsurgery

TG = prior gender confirming surgery

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**Editor's Note: This article is the fifth of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 1216 and 1217.**

**Purpose:** We report multi-institutional outcomes in patients who underwent urethroplasty with a rectal mucosa graft.

**Materials and Methods:** We used the TURNS (Trauma and Urologic Reconstructive Network of Surgeons) database to identify patients who underwent urethral reconstruction with transanal harvest of a rectal mucosa graft. We reviewed preoperative demographics, stricture etiology, previous management and patient outcomes.

**Results:** We identified 13 patients from April 2013 to June 2017. Median age at surgery was 54 years. The stricture etiology was lichen sclerosus in 6 of 13 patients (46%), idiopathic in 2 (15%), hypospadias in 1 (7%), prior gender confirming surgery in 3 (23%) and rectourethral fistula after radiation for prostate cancer in 1 (7%). Prior procedures included failed urethroplasty with a buccal mucosa graft in 9 of 13 patients (69%), direct vision internal urethrotomy in 2 (15%) and none in 2 (15%). Median stricture length was 13 cm. Stricture location in the 9 cisgender patients was panurethral in 5 (56%), bulbopendulous in 2 (22%) and bulbar in 2 (22%). It was located at the junction of the fixed urethra extending into the neophallus in all 3 patients (100%) who underwent prior gender confirming surgery. Mean rectal mucosa graft length for urethroplasty was 10.6 cm (range 3 to 16). Repair types included dorsal or ventral onlay, or 2-stage repair. Stricture recurred at a median followup of 13.5 months in 2 of 13 patients (15%). Postoperative complications included glans dehiscence, urethrocutaneous fistula and compartment syndrome in 1 patient each (7%). No rectal or bowel related complications were reported.

**Conclusions:** Urethral reconstruction with a transanal harvested rectal mucosa graft is a safe technique when a buccal mucosa graft is unavailable or not indicated.

**Key Words:** urethral stricture, transplants, mucous membrane, rectum, reconstructive surgical procedures

THE management of complex, long segment urethral strictures can be challenging for the reconstructive urologist. Successful reconstruction often requires substitution urethroplasty and a BMG is the preferred first line graft with an 81% to 95% success rate.[1–3]

There are situations when additional graft material may be needed, namely when a BMG is contraindicated.[4] Examples include patients

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with oral cancer, oral leukoplakia, oral lichen planus or prior radiation exposure to buccal mucosa graft sites. Additional scenarios which limit the use of BMG include a prior history of bilateral BMG harvest and patient preference for no bilateral or any BMG harvest. In these patients alternative graft materials are needed for urethral reconstruction. While skin grafts and fasciocutaneous skin flaps may be used, skin is a relative contraindication in patients who have LS or other premalignant urethral lesions.[5,6]

Intestinal mucosa has been used as a graft source with encouraging outcomes but broader use has been limited by the morbidity associated with bowel resection.[7–9] Vanni et al reported urethral reconstruction with a RMG with the novel TEMS technique. This technique minimizes the morbidity associated with RMG harvest and has shown promise as a safe, effective alternative in patients in whom BMG is not available or is contraindicated.[10]

The objective of this study was to report multi-institutional outcomes in patients who underwent anterior urethroplasty with RMG harvested by a transanal approach.

## MATERIALS AND METHODS

### Study Population

We used the prospectively maintained, multi-institutional TURNS (Trauma and Urologic Reconstructive Network of Surgeons) database to identify patients who underwent urethral reconstruction with a RMG between April 2013 and June 2017. A total of 4 TURNS centers were included in patient enrollment. Institutional review board approval was obtained at all centers.

Patients were counseled on repair options, including possible BMG reharvest, perineal urethrostomy or urethroplasty with a RMG. Patients were considered candidates for RMG urethroplasty if BMG harvest was contraindicated or not available, or the patient preferred RMG harvest.

We reviewed preoperative demographics, medical history, the indication for urethral reconstruction, previous management, repair type and patient outcomes. The primary outcome was anatomical urethroplasty success, defined as the ability to pass a 17Fr cystoscope through the reconstruction area. Secondary outcomes included any additional patient reported complaints or complications.

### Preoperative Preparation

All patients were administered a preoperative bowel preparation consisting of polyethylene glycol solution and an enema the day before surgery. The preoperative antibiotic regimen consisted of cefazolin, ciprofloxacin and metronidazole to provide broad-spectrum and anaerobic antibiosis. Routine colonoscopy or flexible sigmoidoscopy was not performed unless the patient had known preexisting rectal or bowel pathology.

### Rectal Mucosa Graft Harvest Technique

In 1 patient open RMG harvest was done. In the remaining 12 patients the RMG was harvested using a previously described TEMS technique[9] or a TAMIS technique. A colorectal surgeon performed the rectal harvest and selection of the technique depended on surgeon preference.

Patients were placed in a modified lithotomy position. The rectal mucosa was thoroughly inspected by endoscopy or robotic assisted laparoscopy to assess for any inflammatory changes in the rectum or suspicious lesions that would preclude RMG.

RMG harvesting begins after the RMG length is determined. In the TEMS approach the procedure is performed using TEM with a long beveled operating proctoscope 40 mm in diameter and an operating system (Richard Wolf Medical Instruments, Vernon Hills, Illinois). The device is inserted under direct vision and then secured to the table by a support arm. The 4 ports in the operating system allow for instrument insertion (figs. 1 and 2).[10] In the TAMIS approach an anal block with 2% lidocaine is performed in all 4 quadrants of the intersphincteric space. The TAMIS port (Applied Medical, Rancho Santa Margarita, California) with preplaced robotic and assistant ports is placed in the rectum and secured with 2 interrupted zero silk sutures. An AirSeal® is used to maintain 12 mm Hg pneumorectum throughout dissection (figs. 3 to 6).

In each approach dissection begins approximately 2 cm above the dentate line with a submucosal injection of saline with epinephrine. The mucosal graft is approximately

**Figure 1.** Transanal endoscopic microsurgery technique setup

**Figure 2.** Rectal mucosa visualization by transanal endoscopic microsurgery technique.

**Figure 3.** Placement of transanal minimally invasive microsurgery port secured with silk sutures.

3 to 4 cm wide. Length is determined intraoperatively by the urologist but it is typically 10 to 15 cm. Dissection is preferentially done in the posterior midline to avoid perforation and entry into the peritoneal cavity. A combination of monopolar and bipolar electrocautery is used for dissection. The graft is then removed transanally and prepared for implantation. The wound is irrigated, hemostasis is achieved and the site remains open to heal by secondary intent. Postoperatively the diet is advanced liberally with the use of stool softeners or fiber supplementation.

Of note, 1 patient was treated for a rectourethral fistula after radiation for prostate cancer. This patient was already in the prone position and healthy-appearing rectal mucosa was readily available. A 5 × 2 cm piece of RMG was harvested via an open approach and the site was closed primarily. The mucosa was sutured to the débrided fistula edges and supported with gracilis muscle.

### Urethral Reconstruction Technique

The RMG is irrigated with a bacitracin-polymyxin solution. Urethral reconstruction consists of a 1-stage or 2-stage operation. The selection of 1 vs 2 stages depends on surgeon preference. In patients with 1-stage repair the dorsal and ventral approaches were used. The ventral onlay was performed using a pseudospongioplasty technique with the dartos fascia as the graft bed.[11] A 16Fr Foley catheter was placed at the end of the case for an anticipated duration of 3 weeks.

### Followup Protocol

All patients had initial separate postoperative visits with the colorectal surgeon who performed RMG harvest at 2 to 4 weeks, 3 months and as needed thereafter. The assessment for postoperative complications and patient reported complaints from RMG harvest were recorded and reviewed in the electronic medical record. Urological followup was done approximately 3 weeks and 3 to 6 months postoperatively and yearly thereafter with routine uroflowmetry and/or post-void residual urine measurement and cystoscopy. The postoperative imaging modalities to assess the integrity of the repair site was left to the urologist discretion.

## RESULTS

We identified 13 patients who underwent urethral reconstruction with a RMG between April 2013 and June 2017. Median age at surgery was 54 years. The etiology of urethral stricture was LS in 6 of 13 patients (46%), idiopathic in 2 (15%), hypospadias in 1 (7%), TG in 3 (23%) and a rectourethral fistula after radiation for prostate cancer in 1 (7%) (see table). The remaining RMGs were harvested by TEMS in 9 patients and by TAMIS in 3.

Prior procedures included failed urethroplasty with BMG in 9 of 13 patients (69%), direct vision internal urethrotomy in 2 (15%) and none in 2 (15%). The 2 patients without a prior procedure included

Figure 4. Visualization of rectal mucosa before harvest using AirSeal to maintain pneumorectum.

one with a 21 cm LS stricture and a patient who underwent TG and preferred RMG. Patients without prior BMG harvest had a preference against bilateral graft harvest or had a contraindication such as oral lichen planus (see table).

Median operative stricture length was 13 cm (range 5 to 21). In the 9 cisgender patients the stricture location was panurethral in 5 (56%), bulbopendulous in 2 (22%) and bulbar in 2 (22%). The stricture location in patients with TG was at the junction of the fixed urethra and extending into the neophallus (see table).

The repair type was ventral and dorsal RMG onlay in 6 and 3 cases, respectively, and 2-stage RMG repair in 4. Mean RMG length was 10.6 cm (range 3 to 16) (see table). Two patients treated with RMG urethroplasty also had a concomitant BMG with a mean length of 9.5 cm (range 6 to 13).

Median catheter duration was 21 days. Postoperative complications included glans dehiscence in 1 patients (7%), which was not surgically corrected since the patient elected a hypospadiac meatus. Other postoperative complications included a urethrocutaneous fistula in 1, which was Clavien-Dindo grade IIIb and treated with delayed surgical repair, and compartment syndrome in 1 (7%), which was

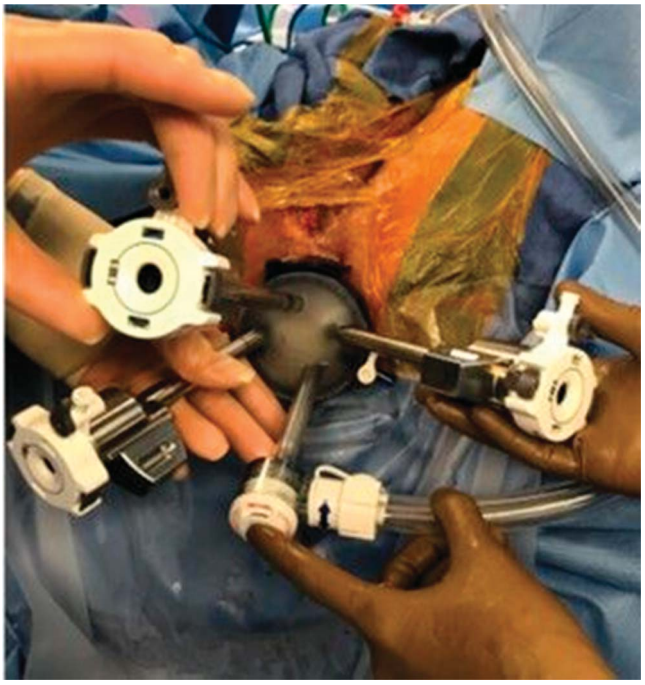

Figure 5. Transanal minimally invasive microsurgery port placement.

Clavien-Dindo Grade IIIb and treated with urgent fasciotomy. No bowel related complications were reported. Median followup was 13.5 months (range 5 to 42 months) and stricture recurred in 2 of the 13 patients (15%). In 1 patient this was successfully managed by endoscopic dilation 30 months after dilation. In the other patient with TG repeat urethroplasty with RMG is planned.

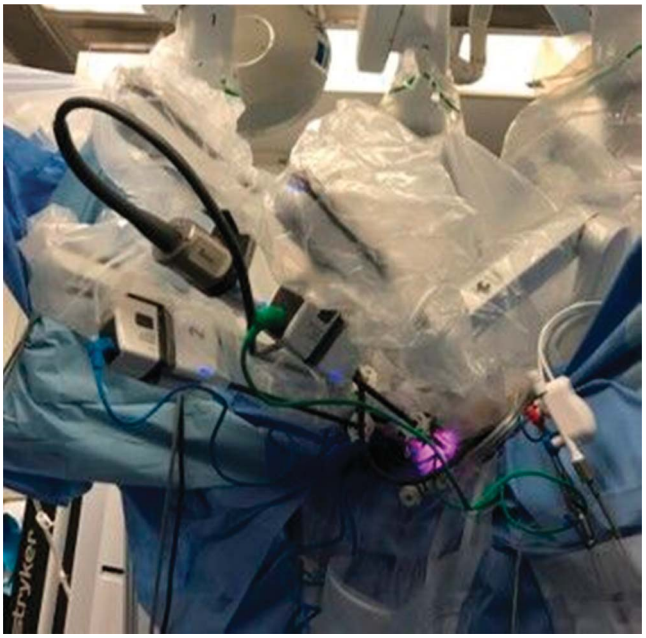

Figure 6. Robot docking during transanal minimally invasive microsurgery approach.

*Patient demographics and operative characteristics*

| | | |
|---|---|---|
| No. pts | 13 | |
| Median age | 54 | |
| No. etiology (%): | 13 | |
| Lichen sclerosus | 6 | (46) |
| Idiopathic | 2 | (15) |
| Hypospadias | 1 | (7) |
| Failed prior gender confirming surgery repair | 3 | (23) |
| Radiation rectourethral fistula | 1 | (7) |
| No. prior procedures (%): | 13 | |
| Failed buccal mucosa graft urethroplasty | 9 | (69) |
| Direct vision internal urethrotomy | 2 | (15) |
| None | 2 | (15) |
| Median cm stricture length (range) | 13 | (5–21) |
| No. cisgender stricture location (%): | 9 | |
| Panurethral | 5 | (56) |
| Bulbopendulous | 2 | (22) |
| Bulbar | 2 | (22) |
| No. repair: | | |
| Ventral rectal onlay | 6 | |
| Dorsal rectal onlay | 3 | |
| 2-Stage | 4 | |
| Mean rectal mucosa graft length (cm) | 10.6 | |
| No. rectal mucosa graft harvest technique: | | |
| Transanal endoscopic microsurgery | 9 | |
| Transanal minimally invasive microsurgery | 3 | |
| Open | 1 | |

## DISCUSSION

To our knowledge this is the first multi-institutional study exclusively focusing on the outcomes of urethral reconstruction using a RMG. The first major finding of this study is that repair of long segment urethral strictures with a RMG is a safe, feasible technique with acceptable morbidity. In our study with short-term followup the recurrence rate was 15%, comparable to prior studies of the success rate of substitution urethroplasty.[1–3] The intent of this technique is not to supplant urethroplasty with a BMG as first line treatment when substitution urethroplasty is performed. Rather, it is to provide an additional option for the reconstructive urologist in patients who need substitution urethroplasty and have contraindications to or preferences against BMG harvest.

In our study recurrence developed in 2 patients. The 2 failures included a case of a recurrent 14 cm panurethral LS stricture in which ventral RMG onlay urethroplasty was done. The recurrence was detected 10 months postoperatively by cystoscopy when the patient complained of a subjectively weak stream. The recurrence was successfully managed by urethral dilation and the patient currently remains free of stricture at a total followup of 31 months. The second patient had undergone TG and had a prior obliterative stricture along the neourethra for which first stage urethroplasty with BMG had failed. This patient ultimately underwent repeat first stage urethroplasty which required an 11 cm RMG. Ultimately recurrence developed 42 days after surgery with a subjectively weak stream. This was managed by a suprapubic tube with plans for repeat RMG urethroplasty.

In addition to an encouraging success rate, RMG harvest had acceptable morbidity. Harvest site morbidity is a well-known complication of BMG and RMG harvesting.[12,13] For BMGs the known complications include postoperative swelling, bleeding, infection, oral numbness and scar contracture which may limit jaw opening and/or smiling.[13] On the other hand, RMG harvest has known complications including but not limited to rectal bleeding, perforation, fecal incontinence and rectal stenosis.[14] In our study we did not note any intraoperative or postoperative harvest site related complications. Prior literature mentions up to a 30% rate of intraoperative complications for a TEM technique with rectal perforation most common, followed by intraoperative bleeding requiring transfusion.[14–17] A 20% postoperative complication rate was also reported but most cases were self-limited rectal bleeding.[14]

A couple of reasons explain this discrepancy. In these prior reported studies the TEMS technique was used for endoscopic resection of rectal tumors and not for RMG harvest. This represents a distinctly different patient population with risk factors for RMG complications, including prior neoadjuvant chemotherapy or radiation prior to endoscopic resection. Further, in patients undergoing resection of rectal cancer a more aggressive endoscopic approach may be used to resect all visible tumor. Due to this one can expect a higher complication rate, including an increased risk of perforation. Although our study numbers were limited, it was encouraging to find that no bowel related complications were reported.

We noted 3 complications of urethral reconstruction in our study for an overall 23% complication rate. This compares favorably to prior studies in which the overall complication rate was assessed after urethral reconstruction,[18–20] although the individual rate of fistula, glans dehiscence and compartment syndrome was higher in our series. The first complication was a urethrocutaneous fistula in a patient with LS who received a dorsal RMG onlay for a 21 cm panurethral stricture. The second complication was glans dehiscence in a patient with LS who received a ventral RMG onlay for a 13 cm panurethral stricture.

The third complication was compartment syndrome in the left thigh of a male patient in whom an idiopathic 8 cm bulbar urethral stricture required ventral onlay urethroplasty with rectal and buccal mucosa grafts. A gracilis flap was used to augment vascular support to the ventral onlay grafts. The etiology of compartment syndrome was prolonged lithotomy time despite preoperative subcutaneous heparin administration. In hindsight RMG harvest, urethroplasty and gracilis harvest with the patient in the lithotomy position led to prolonged operative time and likely to the unfortunate complication.

Since this is a new technique with a learning curve, surgeons should be mindful of and seek ways to minimize lithotomy time if possible. Although individual complication rates in our series may be higher as mentioned, our patient population was significantly more complex than in other urethroplasty series. Of our patients 77% had undergone a prior failed BMG urethroplasty or had a stricture following gender affirming phalloplasty. These patients have an impaired blood supply and reduced wound healing potential compared to patients who have not undergone previous reconstruction. Also, postoperative complications are more likely to develop in these cases. Overall we found acceptable short-term and long-term morbidity after urethral reconstruction and RMG harvest.

Another notable finding is that we observed no major differences in the approach or the complication rate between TEMS and TAMIS. The selection of TEMS or TAMIS was institution dependent and tissue was harvested by an experienced colorectal surgeon. Benefits of the TAMIS approach include a 360-degree view, easy adaptability at centers with a da Vinci® robot but no TEMS equipment and ease of harvest for those familiar with robotic surgery. The success of each RMG harvesting method should increase the applicability of our approach at other reconstructive centers of excellence.

Our study must be interpreted in the context of its limitations. The retrospective nature may have introduced measurement or recall bias. When assessing postoperative complications, we relied on patient reported complaints rather than on validated questionnaires. Specifically we did not use any standardized postoperative questionnaires to assess patient reported complaints about or complications of RMG harvest or urethral reconstruction.

With respect to the assessment of bowel related complications the patients were seen by a colorectal surgeon 2 to 4 weeks and 3 months postoperatively, and as needed thereafter. If no complications were reported, patients had further urology followup. Further dedicated long-term followup with a colorectal surgeon using a dedicated questionnaire may have detected additional patient reported complaints or complications. The multicenter component of this study could have led to variations in procedure selection, technical performance and outcomes. A standardized questionnaire would be ideal to evaluate patient reported outcomes and this will be a focus of future research.

Despite these limitations to our knowledge this study represents the first multicenter evaluation of the outcomes of RMGs for long segment urethral strictures. Our study demonstrates that this is an effective technique with minimal morbidity which can be replicated at high volume reconstructive centers.

## CONCLUSIONS

Urethral reconstruction with a RMG is a safe technique with acceptable morbidity and outcomes. This should prove useful in the repertoire of the reconstructive urologist to manage complex urethral strictures when a BMG is not indicated or available. Further studies with longer followup are needed to validate these findings.

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