Current Role of Urethrolysis and Partial Excision in Patients Seeking Revision of Anti-Incontinence Sling

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Objectives: Stress urinary incontinence is highly prevalent and sling surgery has increased since 2000. Urethrolysis traditionally had been standard management of complications after anti-incontinence surgery; however, partial excision is a less aggressive option. This study describes the different populations in a contemporary cohort that undergo sling excision and urethrolysis and their surgical outcomes.

Methods: Chart analysis was performed on patients assigned Current Procedural Terminology codes for *removal or revision of sling for stress incontinence*, *urethrolysis*, or *revision of graft* at our institution from 2010 to 2015. Demographics, indications, outcomes, and subsequent treatment were evaluated.

Results: A total of 110 patients underwent surgery and were included. Partial excision was performed on 82 patients and urethrolysis on 28 patients. About 32.7% had prior revision, and median length to revision was 3.1 years. Overall success was 75.0% for urethrolysis and 86.6% for partial excision. Without concomitant sling placement, stress incontinence developed in 25.0% of urethrolysis and 21.6% of partial excision patients. New onset overactive bladder symptoms developed in 21.4% of urethrolysis patients and 7.3% of partial excision, which was significantly different ($P = 0.039$).

Conclusions: Both approaches had good success, 75.0% for formal urethrolysis and 86.6% for partial excision. New onset urgency was lower for partial excision, but rates of all other complications were similar. These procedures are often used for different patient populations, and thus, outcomes are not meant to be directly compared. Future work on sling revision should report these procedures separately.

Key Words: female, postoperative complications, urethral obstruction/surgery, urinary incontinence/surgery

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Stress urinary incontinence (SUI) is a bothersome condition that affects 5% to 30% of women.[1,2] Since the introduction of the first synthetic midurethral sling (transvaginal tape) by Ulmsten in 1996,[3] there has been a rapid rise in the number of midurethral slings introduced to the market and the adoption of these products. Long-term data from randomized control trials confirm the comparable safety and efficacy of midurethral sling to the traditional surgical procedures for SUI; however, complications may still occur after anti-incontinence surgery.[4–6] Bladder outlet obstruction after operations for SUI is not uncommon, and in the early postoperative period, retention rates across all sling procedures are reported to range from 1.5% to 17%.[1] These rates decrease to 2.4% to 7.6% by the sixth week after surgery, and surgical intervention is reported for only 0.6% to 3% of patients.[7,8] Other reported indications for sling revision include dysfunctional voiding, pain, urethral and intravesical mucosal mesh extrusion, and vaginal mesh exposure.[9–11]

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Urethrolysis had traditionally been the criterion standard for management of complications after anti-incontinence surgery; however, sling incision, with or without partial excision, is now preferred by many as a less aggressive option for managing obstruction from synthetic midurethral slings. At our institution, sling incision with partial excision is the first line method for handling most sling complications (ie, obstruction, suburethral pain, vaginal exposures). Urethrolysis is usually performed after a failed partial excision of a synthetic sling, for unidentifiable biological sling, for takedown of a nonsling anti-incontinence procedure, and in some exceptional cases in combination with a sling excision at surgeon discretion (Fig. 1).

Prior literature on the outcomes of urethrolysis originally came from a time when the synthetic midurethral sling was not considered the criterion standard. Furthermore, many women who were classified as having a urethrolysis currently would be candidates for partial excision. Therefore, historically reported urethrolysis outcomes may not apply to the current urethrolysis population, which is a more complicated group. Another issue found in the literature is that authors have failed to distinguish between urethrolysis and partial excision, 2 distinct surgical procures, when reporting outcomes from sling revision surgery. Urethrolysis and partial excision are often grouped together under the category of *sling removal* or *vaginal urethrolysis* when analyzing outcomes.[12–15] Our primary aim was to report the modern sling revision or removal population, and the secondary aims were to evaluate the complications of the 2 approaches and rate of de novo SUI and overactive bladder (OAB) symptoms after revision surgery.

MATERIALS AND METHODS

Patients and Data Source

This retrospective cohort study was approved by the internal review board. The study included 110 patients who underwent sling excision or removal surgery between 2010 and 2015. Patients were identified through a search of the electronic medical record for those assigned a Current Procedural Terminology code of 57287, 53500, or 57295 for removal or revision of sling for stress incontinence, urethrolysis, or revision of graft. Of the 131 cases identified, 110 met the inclusion criteria (Fig. 2). Demographic data, surgical history, operative approach, outcomes, and subsequent treatment of patients undergoing sling revision surgery were collected from the electronic medical record.

In a formal transvaginal urethrolysis at our institution, the urethra is dissected circumferentially and released from any surrounding scar or attachments until it is freely mobile. If done after sling placement, it also includes removal of the entire or any remaining vaginal portion of the sling. During a partial excision, the suburethral portion of the sling is identified and divided, and a portion of the sling on each side of the midline incision is removed. In cases of pain or failed prior incisions or excisions, the arms of the sling may be more aggressively resected. With either approach, if there is a high suspicion that SUI will be

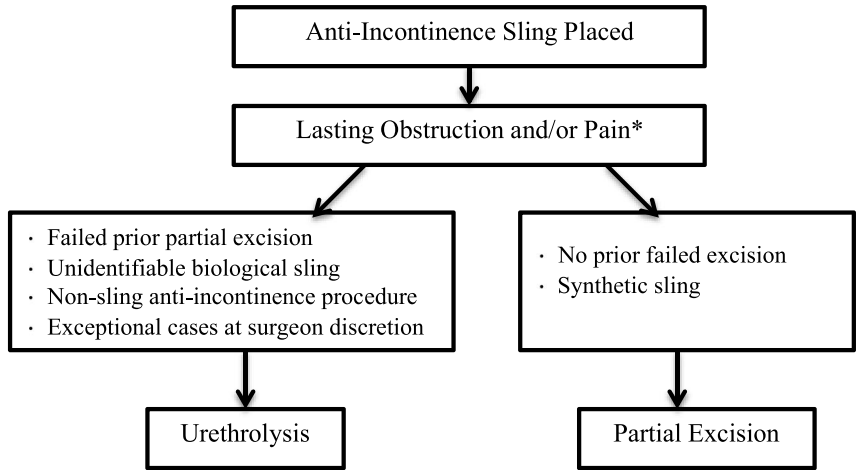

FIGURE 1. Decision tree for urethrolysis versus partial excision. *See Appendix.

present after surgery (ie, SUI is present preoperatively), a concomitant sling may be offered to the patient.

Study Variables and Measures

Our primary outcome was to examine the differences in the patient populations treated with each type of surgical intervention. The number of prior attempts at sling revision was the primary measure used to assess the complexity of patient at the time of presentation. Secondary outcomes included complications due to the revision surgery and the incidence of de novo SUI and OAB symptoms (ie, storage symptoms: frequency, urgency, and urgency incontinence). In addition, we noted whether the revision was done primarily for obstruction (voiding symptoms, incomplete bladder emptying, or complete obstruction) or pain (including mesh extrusion or exposure). All patients with pain also had irritative or obstructive voiding symptoms but were classified as pain if it was their dominant symptom or mesh erosion or extrusion was present. The presence of SUI and OAB before surgery and the incidence of concomitant sling placement were noted. Any postoperative intervention to address de novo SUI and OAB symptoms was recorded. Two independent reviewers assessed the record to determine the indications for intervention and treatment outcomes. This was based on retrospective review and the clinical assessment at last follow-up. The data were analyzed to assess for surgical success, which was defined as cure or improvement of the primary symptom.

Statistical Analysis

χ^2 tests and 2-sided Fisher exact tests were used to evaluate dichotomous variables, and Student *t* test was used for continuous normally distributed data. Univariate and multivariate logistic regression models were constructed to identify independent risk factors associated with de novo OAB. Odds ratios and 95% confidence intervals (CIs) are reported. A *P* value of less than 0.05 was considered statistically significant. On post hoc analysis, there was 84% power to find a difference in prior sling revision and 95% for concomitant sling at revision. We were able to identify an effect size of 0.6 (medium) of group demographics with 80% power and α of 0.05. Statistical analysis was performed using SPSS Statistics package v23 (IBM).

RESULTS

We identified 110 patients who underwent sling revision or urethrolysis at our tertiary care center during the study period and had sufficient data to be included in final analysis. Sling incision and partial excision were performed on 82 patients and urethrolysis on 28. Of those included, there were no significant differences in mean age, body mass index, history of diabetes, neurogenic bladder, number of slings placed previously, time from placement of index sling to revision, or duration of postrevision follow-up between the urethrolysis and partial excision groups (Table 1). There was also no difference in material or surgical route of index sling (retropubic, transobturator, minisling, or bone

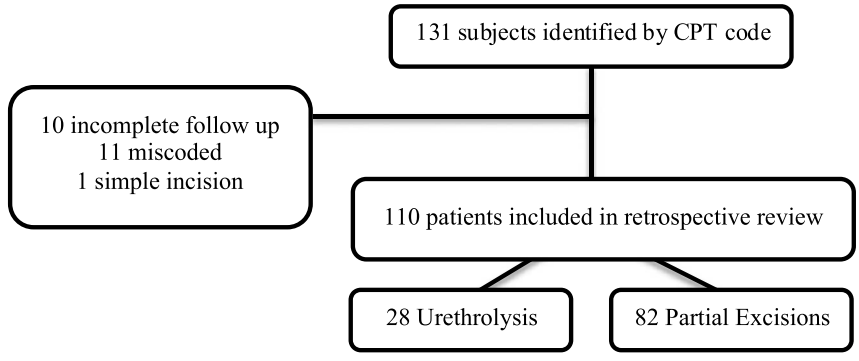

FIGURE 2. Enrollment of study subjects.

TABLE 1. Demographics by Procedure

	Urethrolysis (n = 28)	Partial Excision (n = 82)	*P* (95% CI)
Age ± SD, y	62.3 ± 13.5	61.2 ± 11.7	0.69 (4.2 to +6.4)
BMI ± SD	26.9 ± 4.9	28.7 ± 5.4	0.16 (−4.25 to +0.71)
Time from index surgery to revision ± SD, y			
Mean ± SD	5.4 ± 6.3	4.2 ± 3.7	0.38 (−0.83 to +3.2)
Median	2.8	3.2	
Range	0.26–25.2	0.08–15.6	
Postrevision follow-up ± SD, mo			
Mean ± SD	11.1 ± 13.4	10.8 ± 11.4	0.92 (−5.0 to +5.6)
Median	6.5	5.3	
Range	0.57–53.6	0.33–44.0	
Multiple prior slings	7 (25.0%) median 2	10 (12.2%) median 2	0.11
Prior sling revision	17 (60.7%)	19 (23.1%)	<0.001
Concomitant sling at revision	12 (42.9%)	8 (9.8%)	<0.001
Concomitant prolapse repair	1 (3.6%)	9 (11.0%)	0.45[F]

All *P* values calculated are Pearson unless marked [F] for Fisher.
BMI, body mass index.

anchored). The median length to revision was 2.8 years for the urethrolysis and 3.2 years for the partial excision patients.

A statistically significant difference was seen in the rates of concomitant sling placement but not for prolapse repair done for each procedure. Whereas 42.9% (12/28) of the patients undergoing urethrolysis had a concomitant sling placed at the time of revision, only 9.8% (8/82) of patients undergoing partial excision had a concomitant sling placed ($P < 0.001$). This corresponds to the difference in reported SUI before surgery. Sixteen (57.1%) of 28 urethrolysis patients reported preoperative symptoms of SUI, whereas only 21.2% (11/82) of partial excision patients reported any preoperative SUI. When anterior and posterior prolapse repairs were considered, 3.6% (1/28) of urethrolysis patients underwent concomitant prolapse repair compared with 11% (9/82) of partial excision patients ($P = 0.45$).

A patient may have had multiple indications leading to the revision; however, the primary indications coded were obstruction in 60 patients and pain in the 50 remaining patients.

There was no significant difference between classified indications (obstruction and pain) for the 2 procedures. (Appendix). The patients with primary pain indication tended to be younger and had a longer duration of time between the index surgery and the revision compared with those with obstruction being the primary indication (57.0 vs 65.3, $P < 0.001$; and 5.5 vs 3.6 years, $P = 0.03$, respectively).

Overall success rate was 75.0% for urethrolysis and 86.6% for partial excision ($P = 0.15$) (Table 2). No significant difference was seen for symptom specific success rates between approaches, with improvement in pain and/or mesh exposure in 72.7% of urethrolysis and 89.7% of partial excisions ($P = 0.15$) and improvement in obstructive symptoms in 76.5% of urethrolysis and 85.7% of partial excisions ($P = 0.51$). Of patients with any complaint of storage symptoms before revision, 31.3% (5/16) of urethrolysis patients and 40.0% (18/45) of partial excision patients had improvement/or resolution of these symptoms at last follow-up, without additional intervention.

In total, 36 of the 110 revisions in this study were repeat attempts. Significantly more of the patients who were undergoing a repeat attempt at handling sling complication were done with urethrolysis; 60.7% (17/28) of urethrolysis cases had failed a prior excision compared with 23.1% (19/82) of partial excisions ($P < 0.001$). This is not surprising because one of the major indications for urethrolysis at our institution is prior sling excision failure.

Without concomitant sling placement at the time of intervention, SUI developed in 21.6% (16/74) of partial excision and 25.0% (4/16) of urethrolysis patients. Overactive bladder symptoms developed in 7.3% (6/82) of partial excision and 21.4% (6/28) of urethrolysis patients, which was significant ($P = 0.039$) (Table 3).

Subsequent treatment rates for SUI were similar (Table 3). After urethrolysis, 7.1% (2/28) had pubovaginal sling, 7.1% (2/28) midurethral sling, and 14.3% (4/28) bulking agent for SUI, and after partial excision 6.1% (5/82) had pubovaginal sling, 3.7% (3/82) midurethral sling, and 14.1% (12/82) bulking agent. Repeat

TABLE 2. Outcome of Primary Indications by Procedure

	Urethrolysis			Partial Excision			
	Preop (n)	Cured/Improved	%	Preop (n)	Cured/Improved	%	*P*
Primary symptom	28	21	75.0	82	71	86.6	0.15
Pain (pelvic, dyspareunia, mesh exposure/extrusion)	11	8	72.7	39	35	89.7	0.15
Obstruction (voiding symptoms, incomplete bladder emptying, retention	17	13	76.5	43	36	85.7	0.51

Preop, preoperative.

TABLE 3. Subsequent Treatment

	Urethrolysis (n = 28)	Partial Excision (n = 82)	*P*
Any patients requiring SUI treatment (bulking agent, MUS, PVS, Burch)	6 (21.4%)	17 (20.7%)	0.77
Patients without concomitant sling requiring SUI treatment	4 (25.0%)	18 (21.6%)	0.38
Patients requiring any frequency, urgency/UUI treatment (OAB medication, Botox, PTNS, Interstim)	14 (50.0%)	26 (31.7%)	0.20
Patients requiring new frequency, urgency/UUI treatment	6 (21.4%)	6 (7.3%)	0.039

MUS, midurethral sling; OAB, overactive bladder; PTNS, percutaneous tibial nerve stimulation; PVS, pubovaginal sling; UUI, urge urinary incontinence.

revision was needed in no patient (0%) after urethrolysis and 3 (3.7%) after partial excision.

DISCUSSION

This study shows that in modern sling revisions the population undergoing urethrolysis is distinct from that reported in the original urethrolysis literature. At our institution, women undergoing urethrolysis have a more complex treatment history than those receiving a partial excision. As such, it is not surprising that their surgical outcomes are significantly different. This study does not answer the question of whether this is the right decision for these patients, which would require a prospective trial or more comparative data, but it does underscore the need to report outcomes of the 2 procedures separately in future studies. Partial excision and urethrolysis are distinct procedures that unfortunately have had outcomes reported together. Furthermore, there are implications for proper patient counseling before sling revision. Outcomes reported in earlier studies of urethrolysis may not apply to the current day urethrolysis patient.

Like all reported data on sling excisions, this study is limited to retrospective review. Part of the difficulty in analyzing outcomes of SUI procedures is that definitions of *cure*, *success*, and *failure* are not standardized.[16] Prior reporting on adverse effects and need for retreatment has been found to be limited and inconsistent.[16–18] An objective measure of SUI, such as a cough stress test, pad test, or urodynamic evaluation, was not performed consistently for all patients during follow-up, nor were standardized questionnaires used to evaluate OAB. As such, we defined de novo OAB symptoms and recurrence of SUI as those bothersome enough to be offered medication or intervention within the first year of follow-up, as this is a clinically practical objective outcome to assess. In addition, this is a single-center study and other institutions may have different criteria for urethrolysis.

Urethrolysis has been reported in other studies as the best approach for success after prior failure with partial sling excision. One retrospective study of 47 women who had failed initial treatment for mesh sling complications found that, similar to our series, salvage surgery on these patients was largely successful with only 1 patient with urethral obstruction requiring a subsequent procedure and an overall success rate of 93% for those with urethral obstruction.[13] A review by Scarpero et al[19] reported a 92% success rate in resolution of obstruction using an aggressive repeat urethrolysis via either a retropubic or transvaginal route. When primary attempts at sling resection fail, repeat attempt with more aggressive resection is warranted and results should be applicable to centers employing urethrolysis in those cases. In our cohort, those patients treated with urethrolysis for the primary indication of pain had the lowest successes at about 73% resolution. Further work may suggest that urethrolysis for a primary pain indication is not needed as a first line, as our algorithm presented in Figure 1 suggests.

Interestingly, in this study, de novo OAB was lower for partial excision than for urethrolysis, with 7.3% in the partial excision patients and 21.4% de novo OAB seen in the urethrolysis patients ($P = 0.039$). This difference remained significant after logistic regression controlling for the number of prior revisions and the placement of concomitant sling. The number of patients receiving treatment for OAB postoperatively did not reach statistical significance, although there was a trend toward higher rates of treatment for storage symptoms after urethrolysis with 50% of urethrolysis patients requiring OAB treatment in the subsequent 12 months compared with 31.7% of partial excision patients ($P = 0.20$). Rates of de novo OAB after partial excision were similar to those previously reported for partial excision[12,15]; however, there is limited data in the literature concerning rates of de novo OAB after urethrolysis (especially after midurethral sling complications) and further study is warranted in this population. Of those who underwent urethrolysis in our study, 18 were the primary procedure to handle the complication (often because of a fixed urethra or extreme pain) and 10 had failed a prior sling incision. There was no significant difference in development of de novo OAB among the patients based on indication for urethrolysis.

Several theories could explain the higher incidence of de novo OAB in the urethrolysis patients. The rate of concomitant sling placement was higher in this group (11 autologous and 1 synthetic), and de novo OAB is a known complication after autologous and synthetic slings in the range of 9% and 6%, respectively.[20] However, this did not hold up on our regression analysis. Animal models support the theory that bladder outlet obstruction from the sling leads to OAB. The hypothesized pathophysiology is that obstruction leads to altered receptor function, myogenic denervation, and imbalance of neurotransmitters, in turn causing detrusor overactivity.[21] Patients who underwent urethrolysis were more likely to have undergone a prior revision and underwent greater dissection during the urethrolysis itself than those who had only a partial excision. It is postulated that some denervation may occur during dissection in prior SUI surgery leading to OAB symptoms. This is supported by one study of 956 consecutive women with SUI aimed to identify risk factors for de novo OAB and urgency incontinence after placement of a midurethral sling. Their analysis found that intrinsic sphincter deficiency and previous stress incontinence surgery increased the risk of de novo OAB.[22]

Our review found no statistically significant difference in rates of other complications, including recurrence of SUI, between urethrolysis and partial excision. Recurrence of SUI was analyzed with the entire study sample, and a subanalysis was done limited to patients who did not undergo placement of a concomitant sling at revision. The subanalysis found 25% of SUI after urethrolysis and 21.6% prevalence of SUI after partial excision ($P = 0.58$), which is similar to previous reported SUI rates. A review of 17

studies reported recurrent SUI rates ranging from 3% to 25%, although these were all small studies with 4 to 51 patients.[23] Studies of patients who had undergone a prior sling revision have shown similar rates of SUI. A retrospective study with patients who underwent aggressive repeat urethrolysis reported that 18% had recurrent SUI.[19] Subanalysis of patients who had undergone a prior sling incision in our study similarly did not show a significant difference in recurrence of SUI between patients undergoing primary versus repeat sling revisions. A strength is the size of our sample, which is larger than prior reported cohorts of women who underwent sling excision, but still low absolute numbers do make subgroup comparisons potentially subject to type II errors.

In conclusion, we found that, at our institution, patients undergoing urethrolysis were more likely to have failed a prior sling revision and to have a concomitant sling placed during the revision, making them a discretely different patient population. Although both procedures are used in the management of complications after sling placement, in the current day, most clinicians perform partial excisions owing to their lower morbidity, whereas urethrolysis is reserved for higher complexity patients. We found that those who had urethrolysis were in turn more likely to develop postoperative OAB symptoms, which remained true after logistic regression controlling for concomitant sling placement and prior revisions. Recurrence rates of SUI, cure or improvement of indication for surgery, and subsequent therapies were similar for the 2 procedures; however, urethrolysis and partial excision are unique procedures performed for different patients. Further work on these procedures should clearly define the intervention and reported the entities distinctly.

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APPENDIX 1. Demographics and Outcomes by Primary Symptom

	Obstruction (n = 60)	Pain (n = 50)	*P* (95% CI)
Age ± SD, y	65.3 ± 11.7	57 ± 11.1	<0.001 (3.9–12.6)
BMI ± SD	28.4 ± 6.0	28.0 ± 4.8	0.72 (−1.8 to +2.6)
Original sling route			
Retropubic	22 (36.7%)	19 (38%)	0.79
Transobturator	28 (46.7%)	25 (50%)	
Other (mini, TFS, autologous, unknown)	10 (16.7%)	6 (50%)	
Time from index surgery to revision ± SD, y			
Mean ± SD	3.6 ± 4.3	5.5 ± 4.5	0.03 (−3.5 to 1.15)
Range	0.08–16.2	0.28–25.2	
Revision procedure			
Urethrolysis	17 (28.3%)	11 (22%)	0.31
Partial excision	43 (71.7%)	39 (78%)	
Postrevision follow-up ± SD, mo			
Mean ± SD	10.7 ± 11.8	11.2 ± 12.1	0.83 (−5.1 to +4.1)
Range	0.33 – 53.6	0.57 – 44.0	
Multiple prior slings	9 (15%) median 2	8 (16%) median 2	0.89
Prior sling revision	16 (26.7%)	20 (40%)	0.14
Concomitant sling at revision	9 (15%)	11 (22%)	0.35
Concomitant prolapse repair	8 (13.3%)	2 (4%)	0.09[F]
Primary symptom cured/improved	49 (81.7%)	43 (86.0%)	0.42
De novo SUI	16/47 (34.0%)	15/34 (44.1%)	0.36
De novo OAB	6/19 (31.6%)	6/27 (22.2%)	0.06

All *P* values calculated are Pearson unless marked [F] for Fisher.
BMI, body mass index; TFS, tissue fixation system.