

Evolution of Urinary Tract Infections after Sub-urethral Sling Removal with and without Electrofulguration

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Abstract

Purpose: To compare the long-term outcomes regarding resolution of recurrent urinary tract infections in women who underwent vaginal sub-urethral sling removal (SSR) alone or with an associated endoscopic fulguration (EF).

Materials/Methods: Following IRB approval, a retrospective review of women with a history of rUTIs who underwent SSR for mid-urethral sling (MUS) complications, alone or with EF for associated cystitis lesions, and had at least 1 year of follow-up post-SSR was conducted. Primary outcome was rate of UTIs/year with success as no UTI/year, improvement as 1-2 UTIs/year, and failure as ≥ 3 UTIs/year or the need for repeat EF, at the most recent patient visit. UTI included any antibiotic treatment course for UTI-like symptoms and/or a positive urine culture. Based on the most recent patient visit, clinical success was defined. Patients were also staged based on the extent of their cystitis intra-operatively into 4 stages, allowing a sub-analysis of the role of EF in stages 1 (trigonitis only) and 2 (Stage 1 and bladder base).

Results: From 2004-2019, of 82/188 women who met study criteria, 13 patients undergoing SSR alone and 12 patients undergoing SSR with fulguration had stage 1 or 2 cystitis. At a median follow-up of 2.9 years, 10/13 (77%) patients with SSR alone experienced either success or improvement versus 9/11 (82%) in those who underwent SSR and EF when controlling for stage 1 or 2 cystitis.

Conclusion: SSR both with and without EF resulted in durable cure or improvement of UTIs in nearly two-thirds of patients.

Abbreviations and Acronyms

SUI = stress urinary incontinence
MUS = midurethral sling
rUTIs = recurrent urinary tract infections
SSR = suburethral sling removal
EF = endoscopic fulguration
CFU = colony forming units
PVR = post-void residual
IQR = interquartile ranges
ESBLs = extended spectrum beta lactamases

Keywords

Recurrent Urinary Tract Infections; Electrofulguration; Midurethral Sling; Sling Excision; Female Urology

Introduction

Stress urinary incontinence (SUI) is a costly and burdensome condition with high prevalence among elderly women [1]. Among surgical repairs, the midurethral sling (MUS) has been used when more conservative measures failed [2]. A subset of

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patients have experienced MUS complications including pelvic pain/dyspareunia, irritative or obstructive lower urinary tract symptoms possibly linked to bladder outlet obstruction, and/or recurrent urinary tract infections (rUTIs) [3]. rUTIs can be debilitating, eventually requiring suburethral sling removal (SSR) when there is no evidence of MUS erosion and a link can be established between MUS and rUTIs by way of urinary retention or obstruction, and/or timing since the MUS placement. However, despite SSR, UTIs may recur. Studies involving the pathophysiology of rUTIs suggest uropathogenic bacteria may form quiescent intracellular reservoirs within the bladder wall, establishing chronic infection refractory to antibiotic therapies [4-6]. During cystoscopy, inflammatory lesions such as trigonitis or more diffuse areas of cystitis can be identified which may correspond to sites of bacterial residence [7-9]. Cystoscopy with electrofulguration (EF), a minimally invasive technique that involves cauterization of these chronically inflamed sites, has been shown to durably reduce the recurrence rates of symptomatic UTIs [8,9]. Little is known about the success rates for resolution of rUTIs among women who undergo SSR alone. During the SSR procedure, areas of cystitis may be noted cystoscopically leading to a treatment dilemma. On one hand, it is possible that the relief of obstruction by SSR will facilitate the resolution of rUTIs without additional intervention. On the other hand, for patients whose rUTIs do not resolve with SSR and additional antibiotic therapies and in whom these lesions persist endoscopically, they may require EF later on. Therefore, knowing the long-term comparative outcomes of both treatment modalities would be useful to optimize the outcomes, risks, and costs in this patient population. This study assessed outcomes for women with rUTIs that underwent SSR with and without electrofulguration.

Methods

A retrospective chart review of women who underwent SSR for rUTIs was conducted from a prospectively maintained institutional review board-approved database with data accrued from an EMR. All included patients had at least 1 year of follow-up after SSR. The definition of rUTI was at least 3 symptomatic and culture-proven urinary tract infections (UTIs) with ≥ 105 colony forming units (CFU) in a year [10]. Due to our large referral in a tertiary care center, a complete detail of prior urine culture results was not always available. In this case, a diagnosis of rUTIs by the referring physician was also used to include patients when they met the aforementioned definition of rUTIs. Exclusion criteria included uncontrolled diabetes (HgbA1c $>7\%$), pelvic organ prolapse $\geq$ stage II, prior mesh for pelvic organ prolapse with concomitant sling implantation, more than one MUS implanted, neurogenic bladder such as multiple sclerosis or spinal cord injury, and those with a chronic indwelling catheter or suprapubic tube that could predispose them to RUTIs. EF patients without a 6-month post-EF office cystoscopy to determine the effectiveness of EF in eradicating cystitis sites were also excluded. Demographic data, indication for SSR, lower urinary tract symptoms, urinary incontinence type (stress urinary incontinence (SUI), urge urinary incontinence (UII), mixed urinary incontinence (MUI)), UDI-6 short-form questionnaire scores (pre- and post-EF), post-EF urine culture findings, maximum detrusor pressure from urodynamic studies when available, and non-invasive uroflow study data such as maximum flow rate and post-void residual (PVR) were collected.

SSR was performed under general anesthesia with or without EF as indicated. The indication to proceed with EF was based on the presence of inflammatory lesions over the trigone (trigonitis) and beyond at the time of the SSR procedure. Patients were staged based on the extent of their lesions, where 0=no trigonitis or active infection observed; 1=trigonitis; 2=trigonitis and

lesions extending over the bladder base; 3=trigonitis and lesions over bladder base as well as the lateral bladder walls; and 4=all bladder walls involved (pancystitis). Urethrocystoscopy was done to help locate the sling and exclude erosion along the urethra. A short transverse vaginal incision was made over the presumed course of the MUS. The MUS was then located on the side of the urethra to reduce the chance of urethral injury in the middle. After the MUS was divided on one side, it was carefully dissected off the undersurface of the urethra towards the opposite side until the sub-urethral portion of the MUS was removed. Lateral arms were typically left in place. Urethroscopy was repeated to confirm lack of urethral injury. All removed parts of the sling were photographed and sent for pathology review for medicolegal documentation [11]. Electrofulguration of all inflammatory lesions was performed either with SSR or later on when indicated on an outpatient basis under general anesthesia using a 17.5-fr female urethroscope and a fine-tip Bugbee electrode on a low setting of 20 [9]. Office cystoscopy was performed at or around 6 months post-EF to inspect the urethra, bladder neck, trigone, and the remainder of the bladder including retroflexion. All endoscopic procedures were performed by FPMRS-physician assistants or faculty. As a negative urinalysis was necessary to perform this procedure, all patients undergoing cystoscopy were infection-free. All inflammatory lesions were photographed, and those pictures were compared to intraoperative EF pictures to document resolution or persistence of lesions.

The primary outcome was the rate of post-operative UTIs. A "post-operative UTI" was defined as any antibiotic course for UTI-like symptoms alone or with an associated positive urine culture with ≥ 105 CFU. Clinical success was defined as no UTI during the follow-up period, improvement as 1-2 UTIs/year, and failure as ≥ 3 UTIs/year, based on the most recent patient visit. Patients in the SSR-only group who later required a fulguration for recurring sites of cystitis were also classified as clinical failure. Urine culture characteristics were reviewed and recorded including presence of *Escherichia coli*, multiple organisms in a single culture each at ≥ 105 CFU, and antibiotic resistance patterns. Highly resistant organisms were defined as having resistance to more than 3 classes of antibiotics. Post-operative follow-up period began the day of SSR but 6 months post-operatively for patients that received EF in conjunction with SSR, because, due to the superficial burning effect from EF, symptoms linked to EF can be confused with those of a UTI. Therefore, a 6-month post-EF period allows for healing of the fulgurated bladder wall before symptoms are assessed. Also noted was the use of post-procedure antibiotic regimens including suppressive daily antibiotics, self-start antibiotic therapy, coital prophylaxis, and IV antibiotics as well as repeat EF. The date of last follow-up was the most recent clinic visit or correspondence as documented in the medical record. For women not seen over 1 year, a phone interview with a standardized script incorporating the UDI-6 questionnaire and specific questions regarding frequency of post-operative UTIs, positive urine cultures, and antibiotic treatment for UTIs was attempted to determine their UTI progression after SSR. Descriptive statistics were provided as frequencies and percentages for categorical variables and medians and interquartile ranges (IQR) for continuous variables. Fisher's exact test was used to test for associations between outcome and intervention groups and categorical variables, and the non-parametric Kruskal-Wallis test was used to test for differences in the distribution of continuous variables. All tests were performed at the 0.05 significance level using SAS 9.4 (SAS Institute Inc., Cary NC).

Results

From 2004-2019, 82 women met study criteria (Figure 1).

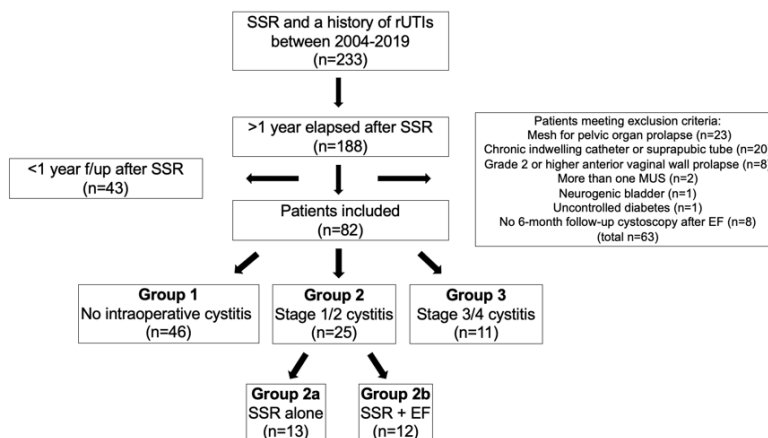


Figure 1: Treatment group flowchart

Our data includes 3 groups based on the severity of intraoperative cystitis: 1) patients who had no evidence of cystitis (stage 0) intraoperatively and underwent SSR alone (n=46) 2a) patients with stage 1/2 cystitis who underwent SSR alone (n=13) 2b) patients with stage 1/2 cystitis who underwent SSR and EF (n=12) 3) patients with stage 3/4 cystitis intraoperatively (n=11). Excluded groups are listed in (Figure 1). For patients with intra-operative cystitis, patient characteristics stratified by the procedure are shown in (Table 1). Patients were predominantly Caucasian and post-menopausal. Over a median follow-up period of 2.9 years (IQR 1.7-4.1), 5/14 (36%) that underwent SSR alone experienced clinical cure, while 6/22 (27%) patients that underwent SSR and EF concomitantly showed clinical cure. In total 10/14 (71%) patients that underwent SSR alone showed clinical improvement or cure as well as 14/22 (63%) patients that underwent SSR and EF concomitantly. There was no difference in clinical outcome between patients with intra-operative cystitis who underwent SSR alone versus those who underwent SSR with fulguration concomitantly ($P = 0.91$). The severity of cystitis by stage was significantly different between groups ($P = 0.0085$). To control for cystitis stage, a comparison was done between patients with cystitis stages 1 and 2, and no significant difference in clinical outcome was observed when controlling for cystitis stage ($P > 0.99$). Thirteen patients with SSR alone had stage 1 or 2 cystitis: 5 with success (38%), 5 with improvement (38%), and 3 with failure (23%). Similarly, twelve patients with SSR with fulguration had stage 1 or cystitis: 4 with success (33%), 5 with improvement (42%), and 3 with failure (25%).

Patient symptoms, incontinence type, and UDI-6 data for patients with cystitis stage >0 are shown in (Table 2). Patients undergoing SSR with concomitant fulguration were more likely to have higher pre-SSR UDI-6 Q2 and Q3 scores, corresponding to urge urinary incontinence ($P = 0.028$) and small amounts of urine leakage ($P = 0.021$) respectively. Uroflow data for patients with cystitis stage >0 are shown in (Table 3). Patients undergoing SSR with fulguration had a higher median post-SSR noninvasive max flow rate on urodynamic studies (median 17.8; $P = 0.018$). Patients without intraoperative cystitis (stage 0; n=46) underwent SSR alone and are presented as an observational cohort, because none of the patients with stage 0 cystitis underwent SSR with EF. Data regarding this cohort are included in Tables 4, 5, and 6. Patient characteristics for all patients who underwent SSR alone are shown in (Table 4). Over a median follow-up period of 2.8 years (IQR 1.5-5.0), 16/60 (27%) of patients undergoing SSR alone experienced clinical cure. In total 44/60 (73%) of patients

that underwent SSR alone showed either clinical improvement or cure. Patient symptoms and questionnaire data for patients undergoing SSR alone can be found in (Table 5). UDS data collected from SSR alone patients is shown in (Table 6).

Discussion

The aim of this study was to determine whether patients with a history of rUTIs and in need of a suburethral sling removal had better outcomes if they also underwent EF when inflammatory bladder lesions were noted during cystoscopy under anesthesia as part of the SSR procedure. To our knowledge our group is the first to stage the severity of cystitis based on the extent of bladder wall infection. Presumably patients with a greater stage of cystitis would have a lower likelihood of clinical success or improvement due to a larger surface area of infected bladder. We observed similar rates of clinical success or improvement between the two treatment groups when cystitis was observed intraoperatively (72% for SSR alone vs 63% for SSR with fulguration). Patients who underwent SSR with concomitant fulguration were more likely to have a higher stage of cystitis compared to patients who underwent SSR alone. Given these findings, it is possible the results in this group are biased towards worse outcomes and patients with cystitis are better served by undergoing fulguration. However, when the severity of cystitis was controlled for stages 1 and 2, there was no difference in outcomes between the two groups. In an observational cohort of all patients undergoing SSR alone, nearly three quarters of patients experienced clinical success or improvement. A prior study from our group looking at the resolution of rUTIs in patients with stage 1 cystitis who underwent EF found 96% of patient's experienced clinical success or improvement in the post-EF follow-up period [12]. Advances in our knowledge of the pathophysiology of rUTIs suggest bacteria may form quiescent intracellular reservoirs (QIRs) that seed the urothelium of the bladder [4]. These bacterial communities act as a reservoir for new infections and may be immune to the effect of antibiotics, explaining their recurrence pattern once the acute UTI episode has resolved [5,13]. If so, attempting to eradicate these areas of chronic inflammation in the bladder at the time of the SSR could reduce the need for additional antibiotics or a subsequent EF procedure. It is possible QIRs also play a role in the development of rUTIs in patients with an obstructive sling. However, the high rate of clinical improvement or cure in SSR-only patients suggests obstruction is the predominant factor in the development of rUTIs in this population. The lack of difference in outcomes between interventional groups when controlling for

	Total (n=36)	SSR Alone (n=14)	SSR+Fulguration (n=22)	P
Medium follow-up, years (IQR)	2.9(1.7-4.1)	2.2 (1.4-4.9)	3.1 (2.1-3.9)	0.71
Medium age, years (IQR)	63.5 (50.5-68)	62.5 (52-68)	63.5 (50-67)	0.73
Race				0.73
Black	1 (3%)	0 (0%)	1 (5%)	
Hispanic	3 (8%)	2 (14%)	1 (5%)	
White	32 (89%)	12 (86%)	20 (91%)	
Medium BMI (IQR)	30 (26.7-32.6%)	29.5 (25-35%)	29.5 (25-35%)	0.82
Median parity (IQR)	2 (2-2%)	2 (2-3%)	2 (2-3%)	0.18
Smoking status				
Current smoker	8(22%)	4 (29%)	4 (18%)	0.68
Nover/former smoker	28 (78%)	10 (71%)	18 (82%)	
Menopause status				
Post-menopause	31 (86%)	12 (86%)	19 (86%)	>0.99
Pre-menopause	5 (14%)	2 (14%)	3 (14%)	
Prior HRT use	7 (19%)	2 (14%)	5 (23%)	0.68
Sexually active	10 (29%)	3 (23%)	7 (32%)	0.71
Indication for SSR				
Dyspareunia pain	17(49%)	7(50%)	10(48%)	0.25
Erosion/exposure	1(3%)	1(7%)	0(0%)	
Incontinence	8(23%)	1(7%)	7(33%)	
LUTS/UTI	6(17%)	3(21%)	3(14%)	
Obstruction	3(9%)	2(14%)	1(5%)	
Past UTI history				
Suppressive antibiotics	6(17%)	2(14%)	4(18%)	>0.99
IV antibiotics	1(3%)	0(0%)	1(5%)	>0.99
Pyelonephritis	1(3%)	0(0%)	1(5%)	>0.99
Past surgical history				
Hysterectomy	33(92%)	12(86%)	21(95%)	0.55
Prolapse repair	12(33%)	5(36%)	7(32%)	>0.99
Bulking agent injection	2(6%)	1(7%)	1(5%)	>0.99
Bladder neck suspension	8(22%)	4(29%)	4(18%)	0.68
Cystitis stage				
1	17(47%)	11(79%)	6(27%)	0.0085
2	8(22%)	2(14%)	6(27%)	
3	11(31%)	1(7%)	10(45%)	
Clinical outcomes				
success	11(31%)	5(36%)	6(27%)	0.91
improved	13(36%)	5(36%)	8(36%)	
failed	12(33%)	4(29%)	8(36%)	
Post-operative UTI characteristics				
E.coli	10(40%)	4(44%)	6(38%)	>0.99
Multiple organisms	2(8%)	1(11%)	1(6%)	>0.99
Multi-drug resistance	1(4%)	0(0%)	1(6%)	>0.99
Fluoroquinolones	5(20%)	1(11%)	4(25%)	0.62
TMP/SMX	12(48%)	2(22%)	10(63%)	0.097
ESBL	12(48%)	3(33%)	9(56%)	0.41
Post-operative UTI management				
Suppressive antibiotics	7(19%)	1(7%)	6(27%)	0.21
Post-SSR fulguration	9(25%)	4(29%)	5(23%)	0.71

Table 1: Patient characteristics stratified by procedure, for cystitis > stage 0

cystitis stage further endorses obstruction as the main factor predisposing this cohort to recurrent infections.

Estimates place the rate of negative outcomes (e.g. refractory chronic pain, fistulas, urethral obstruction or erosion requiring surgery, rUTIs, etc.) for women who undergo MUS at 15% or greater [14]. One study of 100 women found the incidence of

rUTIs after MUS placement to be 7.3% after 12 months [15]. Long-term antibiotics are effective at suppressing infection but leave patients vulnerable to recurrence upon cessation of therapy [16]. Further, in patients with obstructive MUS, urine retention may act as a nidus of infection and prove refractory to medical treatment. Existing literature discussing the resolution of rUTIs

	Total (n=36)	SSR Alone (n=14)	SSR+Fulguration (n=22)	P
Symptoms present				
Frequency	31(86%)	12(86%)	19(86%)	>0.99
Urgency	22(61%)	8(57%)	14(64%)	0.74
Straining	4(11%)	2(14%)	2(9%)	0.63
Weak stream	11(31%)	6(43%)	5(23%)	0.27
Nocturia	20(56%)	8(57%)	12(55%)	>0.99
Incomplete emptying	19(53%)	7(50%)	12(55%)	>0.99
Incompetence type				
None	7(19%)	2(14%)	5(23%)	0.71
SUI	15(42%)	7(50%)	8(36%)	
UII	6(17%)	3(21%)	3(14%)	
MUI	8(22%)	2(14%)	6(27%)	
Pre- SSR UDI-6	(n=14)	(n=5)	(n=9)	
Median total score (0-18%)	11.5(8-16)	8(4-12)	14(11-18)	0.094
UDI-6 Q1-Frequency				
0-1	2(14%)	2(40%)	0(0%)	0.11
2.3	12(86%)	3(60%)	9(100%)	
UDI-6 Q2- UII				
0-1	3(21%)	2(40%)	0(0%)	0.028
2.3	11(79%)	3(60%)	9(100%)	
UDI-6 Q3- SUI				
0-1	6(43%)	3(60%)	3(33%)	0.58
2.3	8(57%)	2(40%)	6(67%)	
UDI-6 Q4- Drops				
0-1	7(50%)	5(100%)	2(22%)	0.021
2.3	7(50%)	0(0%)	7(78%)	
UDI-6 Q5- Emptying				
0-1	8(57%)	3(60%)	5(56%)	>0.99
2.3	6(43%)	2(40%)	4(44%)	
UDI-6 Q6- Pain				
0-1	5(36%)	2(40%)	3(33%)	>0.99
2.3	9(64)	3(60)	6(67)	
Last follow-up UDI-6	(n=26)	(n=11)	(n=15)	
Median total score (0-18%)	7(5-11%)	9 (6-11%)	6 (5-11%)	0.25
UDI-6 Q1-Frequency				
0-1	12(46%)	5(45%)	7(47%)	>0.99
2.3	14(54%)	6(55%)	8(52%)	
UDI-6 Q2- UII				
0-1	15(58%)	4(36%)	11(73%)	0.11
2.3	11(42%)	7(64%)	4(27%)	
UDI-6 Q3- SUI				
0-1	12(46%)	4(36%)	8(53%)	0.41
2.3	14(54%)	7(64%)	7(47%)	
UDI-6 Q4- Drops				
0-1	16(62%)	7(64%)	9(60%)	>0.99
2.3	14(54%)	4(36%)	6(40%)	
UDI-6 Q5- Emptying				
0-1	23(88%)	10(91%)	13(87%)	>0.99
2.3	3(12%)	1(9%)	2(13%)	
UDI-6 Q6- Pain				
0-1	17(65%)	6(55%)	11(73%)	0.42
2.3	9(35%)	5(45%)	4(27%)	

Table 2: Symptoms and questionnaire data stratified by procedure for cystitis > stage 0

	SSR Alone (n=14)		SSR + Fulguration (n=22)		P
	n	Median (IQR)	n	Median (IQR)	
Pre-SSR PdetQmax	9	25(12.2-39.9)	14	26.9(13.5-30)	
Non-invasive Qmax					
Pre-SSR	9	9 (7-14.4)	15	11.8(7-18)	0.43
Post-SSR	10	10.6(5.4-12)	14	17.8 (12-20)	0.018
Post-Pre change	7	0.4 (-5.5-1)	10	3.8 (-1.5-10.7)	0.065
Post-void residual					
Pre-SSR	10	10 (0-95)	20	19 (0-96)	0.76
Post-SSR	13	2 (0-50)	20	0(0-20)	0.78
Post-Pre change	9	-15(-60-0)	18	-19 (-100-0)	0.69

Table 3: Relevant urodynamic data stratified by procedure for cystitis > stage 0

SSR Alone (n=60)	
Median follow-up, years (IQR)	2.8(1.5-5.0)
Median age, years (IQR)	56 (46-67)
Race	
Black	1 (2%)
Hispanic	3 (5%)
White	56 (93%)
Median BMI (IQR)	27.6 (23.5-32)
Median parity (IQR)	2 (2-3)
Smoking status	
Current smoker	17 (28%)
Never/former smoker	43 (72%)
Menopause status	
Post-menopause	42 (70%)
Pre-menopause	18 (30%)
Prior HRT use	16 (27%)
Sexually active	23 (40%)
Past UTI history	
Suppressive antibiotics	10 (17%)
Coital prophylaxis	1 (2%)
IV antibiotics	5 (8%)
Pyelonephritis	4 (7%)
Past surgical history	
Hysterectomy	47 (82%)
Dilation	2 (3%)
Prolapse repair	19 (32%)
Bulking agent injection	6 (10%)
Bladder neck suspension	12 (20%)
Cystitis stage	
0	46 (77%)
1	11 (18%)
2	2 (3%)
3	1 (2%)
Clinical outcomes	
Success	16 (27%)
Improved	28 (47%)
Failed	16 (27%)
Post-operative UTI characteristics	
<i>E. coli</i>	24 (55%)
Multiple organisms	4 (9%)
Multi-drug resistance	6 (14%)
Fluoroquinolones	12 (27%)
TMP/SMX	14 (32%)
ESBL	
Post-operative UTI management	17 (39%)
Suppressive antibiotics	8 (13%)
Post-SSR fulguration	4 (7%)

Table 4: Patient characteristics for all SSR alone patients

SSR Alone (n=60)	
Symptoms present	
Frequency	47 (78%)
Urgency	44 (73%)
Straining	12 (20%)
Weak stream	15 (25%)
Nocturia	37 (62%)
Incomplete emptying	26 (43%)
Incontinence type	
None	17 (29%)
SUI	19 (32%)
UII	12 (20%)
MUI	11 (19%)
Pre-SSR UDI-6 (n=28)	
Median total score (0-18)	
13 (6-17)	
UDI-6 Q1 - Frequency	
0-1	6 (21%)
2-3	22 (79%)
UDI-6 Q2 - UII	
0-1	10 (36%)
2-3	18 (64%)
UDI-6 Q3 - SUI	
0-1	13 (46%)
2-3	15 (54%)
UDI-6 Q4 - Drops	
0-1	14 (50%)
2-3	14 (50%)
UDI-6 Q5 - Emptying	
0-1	9 (32 %)
2-3	19 (68%)
UDI-6 Q6 -Pain	
0-1	7 (25%)
2-3	21 (75%)
Last follow-up UDI-6 (n=51)	
Median total score (0-18)	
11 (6-12)	
UDI-6 Q1 - Frequency	
0-1	20 (39%)
2-3	31 (61%)
UDI-6 Q2 - UII	
0-1	16 (31%)
2-3	35 (69%)
UDI-6 Q3 - SUI	
0-1	18 (35%)
2-3	33 (65%)
UDI-6 Q4 - Drops	
0-1	24 (47%)
2-3	27 (53%)
UDI-6 Q5 - Emptying	
0-1	33 (65%)
2-3	18 (35%)
UDI-6 Q6 -Pain	
0-1	30 (59%)
2-3	21 (41%)

Table 5: Symptoms and questionnaire data for all SSR alone patients

after SSR is sparse. Our group previously found that 42% of women who underwent SSR with a history of rUTIs had no evidence of recurrent infection at the most recent patient visit [3]. To our knowledge, the current study is the first to report the frequency of UTI recurrence over the entire post-SSR period. Our results show SSR can lead to complete UTI clinical improvement or cure in >70% of cases. In women with an MUS and rUTIs refractory to antibiotic therapies, removal of the sling represents a suitable option to resolve their infection. Upon removal of the

	n	Median (IQR)
Pre-SSR PdetQmax	32	20.5 (12.1-36.5)
Non-invasive Qmax		
Pre-SSR	38	12 (7-16)
Post-SSR	39	14 (8.9-20)
Post- Pre change	24	1.7 (-0.9-5.9)
Post-void residual		
Pre-SSR	46	15.5 (0.89)
Post-SSR	51	0 (0-40)
Post-Pre change	38	-5.5 (60-2)

Table 6: Relevant urodynamic data for all SSR alone patients

sling, one would expect SUI to recur. Indeed, previous reports have noted recurrence rates of 52% and 58% [17,18]. For these women, bulking agents have been proposed as a minimally invasive alternative for improving continence [19,20]. This study has several strengths: a median follow-up period of 2.9 years; an independent investigator not involved in treatment of the patients performed the chart review; and strict exclusion criteria to exclude factors that may predispose patients to rUTIs (neurogenic bladder, uncontrolled diabetes, chronic indwelling catheterization or suprapubic tube, etc.). Limitations included a limited cohort size, a lack of complete urine culture history for referred patients, the possibility of patients receiving antibiotics from other care centers without our knowledge, an inability to verify every symptomatic UTI event with a positive culture, and a loss of follow-up, which was partially compensated by attempting telephone interviews.

Conclusion

In this retrospective study of 82 women with rUTIs linked to a suburethral sling followed through a prospectively maintained database, SSR both with and without EF resulted in clinical cure in >25% of cases and clinical improvement or cure in >60% of cases. Further studies may be necessary to clarify the indications for SSR alone versus the combination of SSR and EF. Regardless, SSR may be a promising step towards resolution of rUTIs in women with an obstructive sling when more conservative measures have failed.

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