Comparison of the clinical outcomes of transobturator and single-incision slings for stress urinary incontinence

Ling-Ying Wu, Tsai-Hwa Yang, Fu-Tsai Kung, Fei-Chi Chuang, Kuan-Hui Huang*

Department of Obstetrics and Gynecology, Kaohsiung Chang Gung Memorial Hospital, Kaohsiung City, Taiwan

Received 20 January 2016; accepted 26 May 2016
Available online 27 June 2016

KEYWORDS
Stress; Suburethral slings; Urinary Incontinence; Urodynamics

Abstract The aim of this study was to compare the clinical outcomes of anti-incontinence surgeries employing the transobturator sling and single-incision sling (SIS). Our hypothesis is that the outcome of the SIS is not inferior to the obturator sling. This retrospective study reviewed the medical records of patients who underwent anti-incontinence surgery with the transobturator sling or SIS from July 2005 to November 2014. Patients who underwent concomitant pelvic organ reconstruction with an artificial mesh were excluded. Assessments included preoperative and postoperative urodynamic examinations, perioperative complications, and postoperative urogenital symptoms. A total of 122 women were recruited according to the inclusion and exclusion criteria. Among them, 68 patients underwent transobturator sling procedures while 54 patients underwent SIS procedures. The subjective failure rate of the transobturator sling and SIS were 10.2% and 18.5%, respectively (p = 0.292). The objective failure rate, defined as a pad test showing more than 2 g of urine, was 10.2% for the transobturator sling and 12.9% for the SIS (p = 0.777). SIS resulted in less blood loss, operative time, length of hospital stay, and transient voiding dysfunction after the operation. No major complication occurred after either surgical intervention. In conclusion, SIS and transobturator slings might have similar efficacy, safety, and effects on new-onset urogenital symptoms.

Copyright © 2016, Kaohsiung Medical University. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Conflicts of interest: All authors declare no conflicts of interest.

* Corresponding author. Division of Urogynecology, Department of Obstetrics and Gynecology, Kaohsiung Chang Gung Memorial Hospital, 9F, Numer 123, Ta-Pei Road, Niaosung District, Kaohsiung City 833, Taiwan.
E-mail address: gynh2436@cgmh.org.tw (K.-H. Huang).
Introduction

Stress urinary incontinence (SUI) is the involuntary leakage of urinary flow as abdominal pressure increases, and the bladder neck opens. It is the most common type of urinary incontinence in women and leads to deterioration in the quality of life of those affected. The prevalence of SUI ranges from 4% to 35% [1, 2] and increasing numbers of patients are complaining about the problem. One possibility for this increase is that people are living longer, and aging is a risk factor for SUI [3].

Determining the optimal management of SUI is essential due to its adverse effect on quality of life. The initial management of SUI includes conservative therapy such as pelvic floor muscle training, electrical stimulation, biofeedback, and pessary use. However, patients often consider these treatments time-consuming and less effective.

The Burch colposuspension procedure was regarded as the “gold standard” initially; nevertheless, with the development of reproducible minimally invasive techniques, anti-incontinence slings have become the commonest SUI treatment [4]. The first synthetic polypropylene midurethral sling, known as tension-free vaginal tape (TVT), was introduced by Ulmsten in 1996, and it had satisfactory effects on SUI [5, 6]. In an 11-year prospective study, the subjective cure rate was 77% while the objective cure rate was 90% [7]. In another prospective study lasting 17 years, the subjective cure rate was 90%, and the objective cure rate was 87% [8]. In a previous study conducted, concomitant surgery with TVT had a satisfactory objective cure rate of 84.9–86.8% [9].

To minimize tissue trauma and complications, the sling was inserted towards the transobturator area and was called transobturator sling. Such slings were known as TVT-O (tension-free vaginal tape-obturator, Ethicon, NJ, USA) and Monarc (American Medical Systems, Eden Prairie, MN, USA). A systematic review and a prospective randomized trial revealed that their efficacies were satisfactory to patients compared with TVT [10, 11].

The most recent surgical development for the treatment of SUI is the single-incision sling (SIS), also known as the MiniArc (American Medical Systems), which was developed in 2007. The MiniArc needs only one incision in the vaginal wall, and the sling is much shorter than previous midurethral slings. Because the sling is only around 8 cm in length, its insertion trajectory is shorter, so complications such as bladder perforation, major vascular injury, and postoperative pain in the groin region are avoided. A prospective study reporting 1-year outcomes for the MiniArc showed that 90.6% of the patients had a negative cough stress test after the procedure [12]. Another two studies showed equal efficacy of the transobturator sling and SIS [13, 14]. Nevertheless, a meta-analysis collecting data from nine randomized, controlled trials showed inferior subjective and objective cure rates and higher reoperation rates for SUI when SIS was compared with the standard midurethral sling [15]. Because the efficacy of the SIS compared with the transobturator sling is still under debate, we compared the effectiveness of both procedures for the treatment of SUI and its associated urogenital symptoms.

Methods

In this retrospective study, we compared the clinical outcomes of two types of anti-incontinence slings, the transobturator sling and the SIS. We enrolled patients who underwent anti-incontinence surgery using the TVT-O, Monarc, or MiniArc techniques and slings at a tertiary referral urogynecological center in Kaohsiung, Taiwan from July 2005 to November 2014. Data on the TVT-O procedure was collected from May 2007 to November 2014. Data on the Monarc sling procedure was collected from July 2005 to July 2009, while MiniArc sling data was collected from September 2010 to July 2014. All study candidates were both clinically and urodynamically diagnosed with SUI. We excluded patients who underwent concomitant pelvic organ reconstruction surgery with an artificial mesh in order to exclude other factors that could have impacted the urodynamic studies and clinical outcomes. Baseline characteristics, blood loss, operative time, length of hospital stay, and preoperative and postoperative urodynamic studies were assessed. Perioperative complications, failure, and the effects on urogenital symptoms were also analyzed and compared.

All of the surgeries were performed by two experienced surgeons (KHH and FCC). Prophylactic antibiotics (intravenous cefazolin 1 g) were administered 30 minutes before surgery and every 8 hours for 2 days after surgery. All of the procedures were performed in the lithotomy position under general anesthesia, except when the patient’s condition was unsuitable; then, the anesthesia was converted to spinal anesthesia. The slings were inserted according to the techniques described by the manufacturers. Intraoperative cystoscopy was performed on each patient following sling insertion to detect possible bladder injury. Thereafter, vaginal packing with gauze for compression and Foley catheter for urination were placed appropriately.

Usually, the vaginal gauze and Foley catheter were removed the following day if the patient underwent SIS and after 2 days for the group that underwent transobturator sling insertion. Residual urine (RU) after self-voiding was checked with ultrasound, and if the RU was more than 100 mL, we performed intermittent catheterization until the RU was less than 100 mL. Once patients voided smoothly, and the RU was less than 100 mL twice consecutively, the patients could be discharged. Postoperative monitoring in the outpatient department was conducted at 1 week, 1 month, 3 months, 6 months, and 12 months after the surgery, and then annually. Postoperative urodynamic studies and the urinary pad test were completed 6 months after the surgery.

We reviewed the charts and recorded the patients’ subjective complaints regarding new-onset and postoperative urogenital symptoms and the times at which they occurred. Such symptoms included urgency, urgency incontinence, nocturia, urinary retention sensation, enuresis, and dyspareunia. Because we intended to identify the de novo symptoms, if the patients had complained of these symptoms before the surgery, they were classified into the unaffected group.

Collected data was analyzed using independent and paired t-tests for parametric and nonparametric continuous
variables and the Fisher exact test for categorical variables. Additionally, we used the Kaplan–Meier method to determine if there were statistically different probabilities of occurrence of an event at a certain point in time between two groups. A \( p \) value of less than 0.05 was considered statistically significant.

**Results**

A total of 122 patients met the study criteria. Among them, 68 patients underwent transobturator sling procedures, including the Monarc \((N = 43)\) and TVT-O \((N = 25)\) procedures while 54 underwent SIS procedures including the MiniArc \((N = 54)\). The overall mean postoperative follow-up period was 20.8 months (range, 15–90 months). Table 1 shows the demographic data of the transobturator sling and SIS groups. There were no significant differences between the two groups for age, parity, type of delivery, body mass index, history of diabetes mellitus, incontinence surgery, or hysterectomy. More women had reached menopause in the SIS group than in the transobturator sling group (70.4% vs. 50%; \( p = 0.022 \)).

The preoperative urodynamic parameters were similar in the two groups (Table 2), except for the urethral functional length, which was significantly less in the SIS group. The postoperative urodynamic parameters (Table 2) were also similar, except for maximal urethral closure pressure (MUCP) and functional length, which were statistically lower in the SIS group.

Comparing the preoperative and postoperative urodynamic studies in the two groups (Table 3), we found that both groups had remarkable improvements in the pad test (from 39.6 g to 1.5 g of urine in the transobturator sling group; from 40.6 g to 3.75 g of urine in the SIS group; \( p < 0.001 \) for both). The MUCP decreased remarkably after SIS insertion (\( p = 0.017 \)) but not in the transobturator group. The other parameters did not differ significantly between the groups.

In the transobturator sling group, two patients underwent the surgery due to recurrence. One patient had undergone TVT-O insertion 4 years earlier. After the anti-incontinence surgery with transobturator sling this time, she complained about recurrent SUI 4 months later, although the pad test showed 0 g until the 48-month follow-up visit. She then underwent extracorporeal magnetic innervation. The other patient had undergone an unknown type of sling insertion for urinary incontinence 6 years earlier. She underwent the transobturator sling procedure this time, and her pad test was negative and no recurrence was found during follow-up.

### Table 1 Baseline characteristics.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Transobturator sling ((N = 68))</th>
<th>Single-incision sling ((N = 54))</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>54.3 (15.8)</td>
<td>58.2 (9.7)</td>
<td>0.110</td>
</tr>
<tr>
<td>Parity</td>
<td>3.3 (0–8)</td>
<td>3.0 (0–6)</td>
<td>0.128</td>
</tr>
<tr>
<td>VD</td>
<td>2.7 (1.4)</td>
<td>2.8 (1.2)</td>
<td>0.532</td>
</tr>
<tr>
<td>CS</td>
<td>0.1 (0.4)</td>
<td>0.1 (0.5)</td>
<td>0.939</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.8 (4.5)</td>
<td>25.7 (3.8)</td>
<td>0.190</td>
</tr>
<tr>
<td>DM</td>
<td>11 (16.1)</td>
<td>12 (22.2)</td>
<td>0.396</td>
</tr>
<tr>
<td>Prior surgery</td>
<td>2 (2.9)</td>
<td>3 (5.5)</td>
<td>0.469</td>
</tr>
<tr>
<td>Prior hysterectomy</td>
<td>11 (16.1)</td>
<td>6 (11.1)</td>
<td>0.446</td>
</tr>
<tr>
<td>Menopause</td>
<td>34 (50)</td>
<td>38 (70.4)</td>
<td>0.022*</td>
</tr>
<tr>
<td>HRT</td>
<td>5 (7.3)</td>
<td>1 (1.8)</td>
<td>0.163</td>
</tr>
</tbody>
</table>

Calculated with independent t test. Values are given as mean (standard deviation) or number of patients (%).

BMI = body mass index; CS = cesarean section; DM = diabetes mellitus; HRT = hormone replacement therapy; VD = vaginal delivery.

* \( p < 0.05 \) is considered statistically significant.

### Table 2 Comparison of urodynamic study of transobturator and single-incision sling.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transobturator sling ((N = 68))</td>
<td>Single-incision sling ((N = 54))</td>
<td>Transobturator sling ((N = 68))</td>
</tr>
<tr>
<td>Qmax (mL/s)</td>
<td>25.0 (10.0)</td>
<td>28.5 (11.1)</td>
<td>0.065</td>
</tr>
<tr>
<td>Qavg (mL/s)</td>
<td>10.0 (4.6)</td>
<td>10.2 (5.3)</td>
<td>0.881</td>
</tr>
<tr>
<td>VV (mL)</td>
<td>363.7 (222.0)</td>
<td>348.4 (152.9)</td>
<td>0.654</td>
</tr>
<tr>
<td>RU (mL)</td>
<td>39.0 (42.6)</td>
<td>27.5 (20.1)</td>
<td>0.051</td>
</tr>
<tr>
<td>MaxCap (mL)</td>
<td>375.0 (108.8)</td>
<td>356.6 (74.1)</td>
<td>0.245</td>
</tr>
<tr>
<td>MUCP (cmH₂O)</td>
<td>68.5 (29.8)</td>
<td>59.7 (27.0)</td>
<td>0.093</td>
</tr>
<tr>
<td>FL (mm)</td>
<td>34.1 (8.3)</td>
<td>25.7 (8.5)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>FD (mL)</td>
<td>164.3 (65.6)</td>
<td>150.2 (42.2)</td>
<td>0.152</td>
</tr>
<tr>
<td>Pad test (g)</td>
<td>39.6 (33.8)</td>
<td>40.6 (44.2)</td>
<td>0.893</td>
</tr>
<tr>
<td>Pad test &gt; 2 g</td>
<td>7 (10.2)</td>
<td>7 (12.9)</td>
<td>0.777</td>
</tr>
<tr>
<td>Improvement*</td>
<td>2 (2.9)</td>
<td>4 (7.4)</td>
<td>0.311</td>
</tr>
</tbody>
</table>

Calculated with independent t test and Chi-square test. Values are given as mean (standard deviation) or number of patients (%).

* \( p < 0.05 \) is considered statistically significant.

FD = first desire to void; FL = functional length; MaxCap = maximal capacity; MUCP = maximal urethral closure pressure; Qavg = average flow rate; Qmax = maximal flow rate; RU = residual urine; VV = voided volume.

* Improvement means pad test as 0–2 g.
In the SIS group, three patients underwent the surgery a second time due to recurrence. Two had undergone TVT insertion, and the other had had the Monarc sling previously. After the SIS procedure, one had a positive 23-g pad test 6 months later. However, she was satisfied with the operation and did not have to use pad protection again. Another patient had a positive 12-g pad test 34 months after the current SIS procedure. The third patient returned to the outpatient department 6 months after the current SIS operation and at that time she was satisfied with the intervention and the pad test was negative.

Regarding perioperative complications, SIS resulted in less blood loss, operative time, length of hospital stay, and need for intermittent catheterization after removal of the Foley catheter (Table 4).

Table 5 compares the postoperative, new-onset urogenital symptoms. Most of the urogenital symptoms did not differ between the two groups. No bladder or bowel perforation occurred in either group.

The subjective failure rate of the transobturator sling and SIS groups were 10.2% and 18.5%, respectively (p = 0.0292). Objective failure, defined as a pad test of more than 2 g, occurred in 10.2% and 12.9% of patients in the transobturator sling and SIS groups (p = 0.777; Table 5).

The Kaplan–Meier analysis showed that the new-onset urogenital symptoms did not differ statistically between the two groups after correcting the tracing time, nor did the subjective and objective failure rates (Figures 1 and 2).

Discussion

The outcomes of the transobturator sling and SIS procedures differ between studies. A prospective study including 162 patients showed objective cure rates of 86.9% in the transobturator sling group and 90.9% in the SIS group [16]. A retrospective, dual-center, cohort study of the transobturator sling and the SIS surgeries showed that 91% of the patients in both populations had negative cough stress tests at the 6-month follow-up and 89% and 85%, respectively, maintained a negative cough stress test at the 1-year follow-up visit [13]. Another prospective,
randomized controlled trial including 194 patients reported statistically lower objective cure rates for the SIS group (97.6% vs. 83.6%) [17]. In our study, the SIS group had pad tests less than 2 g in 87.1% of patients at the 6-month follow-up, and both subjective and objective satisfaction were comparable to those of the transobturator sling.

Regardless of patients choosing the transobturator sling or SIS, the outcomes did not differ. Nonetheless, we found that the SIS was a more favorable procedure than the transobturator sling in terms of blood loss (96.3 mL vs. 50.3 mL, \( p < 0.001 \)), operative time (79.2 minutes vs. 51.3 minutes, \( p < 0.001 \)), and length of hospital stay (3.7 days vs. 2.4 days, \( p < 0.001 \)), as reported previously [18]. Additionally, another benefit of this procedure was that the SIS group required less intermittent catheterization for postoperative temporary urinary retention, although the rate (7.4%) in our study was higher than in previous studies (3.2%) [19]. The operative time was much longer than in previous studies because the patients also underwent concomitant conventional pelvic reconstruction surgery or hysterectomy for benign disease in our study. No major intraoperative complication occurred.

In our study, we found that the MUCP both declined after anti-incontinence surgery. With the transobturator sling, it declined from 68.5 cmH2O to 64.3 cmH2O while it declined from 59.7 cmH2O to 50.9 cmH2O in the SIS group. These alterations might be associated with periurethral destruction during dissection for sling insertion.

The preoperative functional urethral length was shorter in the SIS than in the transobturator group (25.7 mm vs. 34.1 mm, \( p < 0.001 \)) in our study. In reviewing previous studies, the few studies we found suggested that a shorter functional urethral length was not associated with an unfavorable outcome [20].

There was only one (1.4%) patient in the transobturator sling group that experienced sling exposure. The patient recovered well after excision of the exposed sling and suturing of the disrupted vaginal wall. Our result was similar to the previous studies which showed the rate of transobturator sling exposure ranging from less than 1% to 3% [21−23]. There was only a few available publications illustrating the rate of exposure of SIS and most of the studies analyzed the TVT-Secur which showed that the rate was about 3% [24]. There was no sling exposure after SIS insertion in our study and we used MiniArc mostly; therefore, this might be the benefit of utilizing this kind of sling for anti-incontinence surgery.

The new-onset urogenital symptoms were similar in the two interventional groups and this result was compatible with a previous study [16].

Because the follow-up times differed between the groups, we used the Kaplan−Meier analysis to eliminate the bias. The Kaplan−Meier analysis showed that the new-onset urogenital symptoms did not differ statistically between the two groups after correcting the tracing time; nor did the subjective and objective failure rates (Figures 1 and 2).

Similar to previous studies, we concluded that the SIS procedure was at least as good as the transobturator sling procedure [13,18]. Nonetheless, our results are limited by the retrospective study design, relatively small sample size, short follow-up duration, and lack of results of the

---

**Figure 1.** Probability of subjective failure of transobturator sling and single-incision sling. Kaplan−Meier event-free survival of the transobturator sling and single-incision sling groups during the study period: similar subjective (\( p = 0.091 \)) in the two groups.

**Figure 2.** Probability of objective failure of transobturator sling and single-incision sling. Kaplan−Meier event-free survival of the transobturator sling and single-incision sling groups during the study period: objective failure (\( p = 0.620 \)) in the two groups.
questionnaire. A well-designed, prospective randomized controlled trial is needed to validate the results.

In conclusion, according to our results, SIS and transobturator slings might have similar efficacy and effects on new-onset urogenital symptoms. They also have similar anti-incontinence results. The transobturator sling procedure required more operative time, had greater intraoperative blood loss, a longer hospital stay, and greater transient urine retention. The postoperative complication was very low in both procedures.

Acknowledgments

This study was approved by the Institutional Ethics Review Board of Chang Gung Memorial Hospital (Institutional Review Board Number 104-2549B).

References