



## Review article

## Review on midurethral sling procedures for stress urinary incontinence

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## ARTICLE INFO

## Article history:

Received 9 October 2014

Received in revised form

13 January 2015

Accepted 25 March 2015

Available online 9 April 2015

## Keywords:

minimally invasive surgery

stress urinary incontinence

suburethral slings

## ABSTRACT

Minimally invasive suburethral slings, namely the retropubic suburethral sling or the tension-free vaginal tape (TVT), has become the mainstay for surgical management of moderate to severe stress urinary incontinence (SUI) taking over the place of Burch's colposuspension after its introduction in the 1990s. Following the introduction of retropubic sling procedures are the transobturator (TVT-O) procedures and the mini-sling procedures. This review attempts to summarize the current trend of midurethral sling (MUS) procedures in the management of SUI.

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## Introduction

Stress urinary incontinence (SUI) is defined by the International Continence Society as any involuntary leakage of urine on exertion or effort, or on sneezing or coughing. UI, although benign and non-life-threatening is a worldwide quality-of-life problem which significantly impairs the social, physical, and psychological well-being of affected women, with associated low self-esteem, embarrassment, and in severe forms, social isolation. Minimally invasive midurethral slings (MUS) are currently the mainstay for the surgical treatment of women with SUI following unsuccessful conservative management strategies such as lifestyle changes, physical therapies, scheduled voiding regimens, and behavioral therapies.

Burch colposuspension and pubovaginal sling was considered the first line of treatment in the past several decades. Cochrane

reviews have shown that Burch colposuspension had long term efficacy with overall cure rates of 68.9–88%.<sup>1</sup> However, since the introduction of MUS in the mid-1990s, the retropubic sling has become the gold standard for treatment of female SUI. This surgical procedure is associated with high subjective and objective SUI cure rates (80–90%) after > 11 years of follow-up.<sup>2</sup> The original tension-free vaginal tape (TVT) sling, as described by Ulmsten et al.,<sup>3</sup> technique uses a retropubic route for the insertion of the tape. Intra- and postoperative complications resulting from the penetration of the surgical device into pelvic organs (bladder and bowel), nerves, and vessels, have been reported.<sup>4–6</sup> In an attempt to minimize the blind passage of the retropubic space and the subsequent risk of major bleeding and bladder injury, in 2001, Delorme proposed an outside-in transobturator (TOT) passage through the obturator foramen for suburethral tape placement<sup>7</sup> followed by an inside-out procedure (TVT-O) which was introduced in 2003 by De Leval.<sup>8</sup> More recently single incision slings have been developed in order to eliminate and further minimize the complication of blind passage of trocar for the insertions of suburethral slings.<sup>9–11</sup> This review will discuss the recent development on MUS, the efficacy, and complications.

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

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<http://dx.doi.org/10.1016/j.gmit.2015.04.003>

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## TVT

The TVT, also known as retropubic sling, is the most commonly used surgical approach for women who suffer from SUI. The entire procedure has been based on the integral theory. The elaboration of this theory demonstrated that the lack of support of the mid-urethra, due to weakness of the pubourethral ligaments and the anterior vaginal wall, is the main cause of SUI. The original TVT procedure described by Ulmsten et al<sup>3</sup> in 1996 used the bottom-up approach. The TVT sling procedure is performed through a small suburethral incision in the vagina and two small lower abdominal incisions (2 cm each side of the midline) above the pubic bone. It may be done with either local or general anesthesia. Marcaine and adrenaline diluted with saline is injected in the retropubic space for hydrodissection followed by incisions as above. Vaginal wall tissue is dissected off the urethra to expose the mid urethra along with paraurethral dissection towards the endopelvic fascia. A catheter guard is then placed to deflect the bladder away. The TVT trocar attached to the tape is then advanced from the vaginal incision through the space of Retzius and to the anterior abdominal wall. The trocar must hug the posterior wall of the pubic symphysis during this maneuver to reduce the risk of bowel perforation. Cystoscopy examination, to rule out bladder perforation, is performed after which the plastic sheath covering the tape is removed and the tape is adjusted without excessive tension. The tape is then trimmed and the vaginal and skin incisions are closed with absorbable sutures. Another approach for doing this procedure is by the top-down approach, which was developed with a view to more control over the passage of the needles in the retropubic space. The SPARC Sling system (American Medical Systems, Minnetonka, MN, USA) consists of two disposable needles with dilator-connector tips to create the sling tract and also help to attach the ends of the plastic sheath enclosing the mesh.

Outcome evidence for TVT is the most extensively evaluated procedure. The longest reported follow-up to date by Nilsson et al<sup>4</sup> showed a subjective and objective cure rate of 77% and 90%, respectively, at 11.5 years after TVT. In another study by Nilsson et al<sup>12</sup> looking at a 17-year follow-up, they report that 48/55 (87.2%) of the women regarded themselves cured or significantly better than before surgery. Objective cure, defined as a negative stress test, was seen in 42/46 women (91.3%). Only one woman had a further stress incontinence procedure. TVT is equally effective in treating SUI secondary to intrinsic sphincter deficiency (ISD) and urethral hypermobility.<sup>13</sup> A multicenter randomized trial result at 5 years follow up comparing TVT with colposuspension showed equal efficacy of TVT to colposuspension for cure of SUI (81% for TVT and 90% for colposuspension,  $p = 0.21$ ).<sup>14,15</sup>

Although TVT is a minimally invasive technique, the reported complications that have been associated with the procedure have included urinary bladder perforations, bleeding complications, mesh erosions and, in some rare cases, bowel perforations. Bladder perforations reported were at the level of 2.7%, however, it seems that the bladder injury which resulted from the TVT inserter did not bring about any significant postoperative clinical morbidity. Vascular injury and bowel perforations are at 0.07% and 0.04%, respectively.<sup>16,17</sup>

## Transobturator tapes (TOT/TVT-O)

The transobturator slings procedure was first introduced in 2001 by Delorme,<sup>7</sup> with the aim of decreasing the risk of complication associated with the retropubic passage of the trocar, especially bowel and bladder injury. The TOT procedure is performed with the female patient placed in the dorsal lithotomy position

with her thighs flexed at a 120° angle.<sup>18</sup> A single vertical mid-urethral incision and two other smaller incisions in the groin inferiorly to the pubic ramus are then made. Two methods of inserting a transobturator tape are currently employed and both involve the passage of a curved needle through the obturator foramen. The difference is in the direction of penetration. The TOT procedure uses needles passed from the outside of the groin into the vagina, in the direction of the midurethral vertical incision, following the line of the pubic bone (outside-in). A small skin incision is made on either side 1.5 cm lateral to the ischiopubic ramus. Using specially designed needles, the obturator membrane is perforated and then the needle is turned medially. It is then guided with a finger in the vaginal incision to exit in the vagina. The tape is then loaded on to the needle and pulled through the skin incision. The TVT-O procedure uses plastic tubes containing the tape, helical passers, and an introducer. The vaginal incision and dissection are the same as in the outside-in approach. The obturator membrane is punctured with scissors and the introducer (wing guide) is passed at a 45° angle through the vaginal incisions. Groin incisions are made at a point 2 cm above the urethra and 2 cm lateral to the inner thigh folds. The tubing attached to the helical passer is placed within the introducer (wing guide) and rotated to exit through the groin incisions. The tubing is then pulled from the passer as the passer is brought back out through the vaginal incision and the tape is pulled through out to the groin (inside-out). In both orientations, the monofilament tape is adjusted to the appropriate tension.<sup>19</sup>

Outcome measures in a systematic review of the literature reported by Novara et al<sup>20</sup> verified that patients treated with TOT had slightly lower cure rates than the TVT group, but TOT had a significantly lower risk of bladder and vaginal perforations. Richter et al<sup>21</sup> in a multicenter, randomized equivalence trial comparing outcomes with retropubic and transobturator MUS in 565 women with stress incontinence found objectively assessed treatment success rates were 80.8% in the retropubic-sling group and 77.7% at 12 months. Theoretically, the TOT avoids the retropubic space and therefore has less bladder, bowel, and blood vessel injuries compared with retropubic slings. However, the transobturator route is associated with an increased risk of groin and leg pain and a lower success rate in patients with ISD.<sup>22</sup> In a randomized, controlled study of 164 women with ISD, Schierlitz et al<sup>22</sup> found that the long-term cure rates for the retropubic sling were higher than TOT at 3 years follow-up; 15/75 (20%) women in the TOT group underwent repeat surgery to correct recurrent or persistent SUI compared with 1/72 (1.4%) in the TVT group. The median time to repeat surgery was 15.6 months and 43.7 months for TOT and TVT, respectively. Abdel-Fattah et al<sup>23</sup> in his study comparing both transobturator routes, inside-out versus outside-in slings, found that there were no differences in objective and subjective SUI cure rates. Meta-analysis by Madhuvrata et al<sup>24</sup> showed no evidence of statistically significant differences in subjective or objective cure/improvement [odds ratio (OR) 1.25, 95% confidence interval (CI) 0.78, 1.99;  $p = 0.35$ ] and (OR 1.66, 95% CI 0.8, 3.34,  $p = 0.17$ ) between the inside-out and outside-in groups. Sensitivity analysis confirmed similar results (OR 2.03, CI 0.82, 5.01,  $p = 0.12$ ). Vaginal angle injuries were significantly higher with the outside-in route (OR 0.14, 95% CI 0.05, 0.41,  $p = 0.0003$ ). Groin/thigh pain and *de novo* urgency were not significantly higher with the inside-out route (OR 1.42, 95% CI 0.94, 2.13,  $p = 0.10$  and OR 1.46, 95% CI 0.63, 3.36,  $p = 0.38$ , respectively).

## Single incision mini-sling

The first mini-sling introduced into the market in 2006 was the TVT-Secur (TVT-S; Gynecare, Bridgewater, NJ, USA) followed by

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