



# The transvaginal tape surgery vs. trans-obturator tape for stress urinary incontinence

Apurva B. Pancholy

Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Texas, McGovern Medical School, Houston, TX, USA

Correspondence to: Apurva B. Pancholy, MD. Department of Obstetrics, Gynecology, and Reproductive Sciences, University of Texas, McGovern Medical School, Houston, TX, USA. Email: Apurva.B.Pancholy@uth.tmc.edu.

**Abstract:** Female urinary incontinence is a highly prevalent condition affecting women's quality of life and is associated with considerable personal and societal stress. Stress urinary incontinence (SUI) is thought to be due to the loss of urethral support vs. a weakness of the urethra itself. Multiple treatment options exist for the SUI including conservative behavioral modifications, physical therapy, medications, and surgical options. Surgical options can be offered to patients who achieve unsatisfactory results from non-surgical options or who prefer to have surgery by choice. Numerous surgical options for SUI have been described and have evolved over time. This evolution of surgery for SUI has led to more minimally invasive surgical options. The gains in the knowledge of anatomy of the bladder and urethra has also shifted the focus of continence mechanism to be at the mid urethra and not just the bladder neck as previously thought. This has led the mid urethral sling (MUS) to be the surgical options of choice by most surgeons. Patient selection and knowledge of the anatomy associated with midurethral slings are critical as the outcomes and complications associated with surgery are the results of these factors. The retropubic [transvaginal tape (TVT)] and the transobturator [trans-obturator tape (TOT)] MUSs are the main surgical options for SUI. Between the TVT and TOT sling, there is no one sling better or worse than the other.

**Keywords:** Stress urinary incontinence (SUI); sling; mesh; incontinence surgery; outcomes

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## Introduction

Urinary incontinence is the accidental loss of urine. Urinary incontinence is a highly prevalent condition afflicting more than 1 in 3 women in their lifetime (1). The international continence society (ICS) defines stress urinary incontinence (SUI) as “the complaint of any involuntary loss of urine on effort or physical exertion or on sneezing or coughing” (2). The exact pathophysiology of SUI is unknown but prevailing theories include lack of coaptation of urethra, muscular compression of the proximal urethra, and stabilization of the bladder neck and proximal urethra that allows equal pressure transmission of increased abdominal pressure.

Multiple treatment options, including non-surgical and surgical, are available for the treatment of SUI. Historically,

most surgical treatment options have focused on the bladder neck and the urethra. Numerous sutures and grafts have been described and techniques have evolved leading to conceptual modifications. The one constant goal of surgery for SUI in this evolution of surgery has been to provide continence while avoiding voiding difficulty. Of all the surgeries available, the mid urethral sling (MUS) has become the most popular surgery performed for the treatment of SUI in the last century. The MUS is most likely the most studied surgery for SUI and proves to be one of the least invasive operation with high efficacy. In this article, we will discuss the two popular techniques of MUSs. The transvaginal tape (TVT) and the trans-obturator tape (TOT) MUSs are the most common surgeries studied and performed.

## Evolution of MUS

The TVT is a retropubic synthetic MUS. Most anti-incontinence surgeries prior to the invention of TVT focused on supporting the bladder neck or the proximal urethra. In 1990, Petros and Ulmsten described the “Integral theory” of female urinary continence in which they looked at different slings placed at different locations under the urethra (3). The theory describes a physiologic backboard created via the pubo-urethral ligaments and levator ani muscles which increases the support of the vaginal hammock. This theory states that the loss of this backboard support leads to SUI. This led to the idea of passing a synthetic mesh strip under the mid urethra in a tension free manner. This mesh strip was placed in the retropubic space through an anterior abdominal wall and vaginal incisions by using specially designed trocars (4). The first tension free vaginal tape or TVT (Gynecare, Somerville, NJ) was first marketed commercially as a kit consisting of two specially designed trocars and a strip of polypropylene mesh. The procedure was performed by passing the trocars on each side of the urethra via a small vaginal incision. Since the trocars are passed from the vaginal incision to the anterior abdominal wall, the approach has been termed “bottom up” approach. Several minor modifications led to different kits marketed by other companies. A “top down” approach was also made where the trocars are passed retropubically from the anterior abdominal wall to the vaginal incision. In all these approaches, the vaginal tape is placed at the mid urethra and then pulled up to the abdominal wall. The TVT procedure requires the blind passage of trocars through the retropubic space which potentially brings the trocars in close proximity of bladder, blood vessels, and bowels. Rare but serious complications related to blood vessel and bowel injuries have been reported. These complications led to the invention of the Transobturator Tape procedure as described by Dr. Emmanuel Delorme (5). This technique avoided the retropubic space and therefore avoided the potential bladder, blood vessel, and bowel injuries. Different approaches for placement of the sling using the transobturator space have also been described. The “outside in” approach has a vaginal incision with the helical trocars being passed from the crural fold incision to the vagina and the “inside out” approach passes the helical trocars from the vaginal incision to the crural fold incision.

## Indication and patient selection

The indication for the placement of a mid-urethral sling

include symptomatic SUI and occult SUI affecting a patient's quality of life. Initial studies of mid-urethral slings only included women who had SUI with hypermobile urethra, had no prolapse, and who were not obese. Over time, studies included complex patients who were obese, who had fixed urethra, who demonstrated symptoms of mixed urinary incontinence or recurrent incontinence, and the MUS proved to be efficacious in these populations also. The absolute contraindications of the procedures would be the alteration of the anatomy in the path of the trocars and the sling such as bowel in retropubic space after a previous retropubic surgery, pelvic kidney, vascular graft, hernias, pregnancy, and oral anticoagulation therapy. In these scenarios, a transobturator sling offers the advantage of avoiding the retropubic space and therefore can be offered in patients except in patients on oral anticoagulation. A MUS is also probably inappropriate in patients who have undergone urethral reconstructive surgery in past or who are undergoing reconstruction simultaneously such as vesico or urethrovaginal fistula. In such cases, the use of biologic pubovaginal slings have been shown to be efficacious without the added risk of synthetic mesh related complications. Also, patients with neurogenic bladders or urinary retention are not a good candidate for MUSs as they are mostly dependent on intermittent catheterization and don't achieve the compression needed from a tension free mid-urethral sling. Synthetic MUSs are also avoided in patients with history of pelvic radiation unless a Martius graft is also performed to ensure adequate blood supply and tissue around the sling. Future desire for child bearing and previous history of synthetic mesh complication are relative contraindications for synthetic MUS.

## Anatomy and technique

Unlike the traditional pubovaginal fascial slings, the MUSs involve small vaginal incision with minimal dissection and blind passage of trocars. The TVT sling passes the trocars blindly through the retropubic space and the TOT sling passes the trocars blindly through the obturator space. The technique for “bottom up” TVT sling begins with the patient being in dorsal lithotomy position in horizontal or slight Trendelenburg position to displace the bowels away from the pelvis. Antibiotics prophylaxis is given as indicated. A Foley catheter is placed in urethra and the bladder is drained to gravity. A Foley catheter guide is placed. Suprapubic stab incision sites are marked. These sites are a 2 finger-breadths later to the midline and the

superior rim of the pubic bone. Care is taken to avoid injury to the Ilioinguinal nerve by keeping the incisions within the pubic tubercle. A speculum is placed in vagina and the mid urethral anterior vaginal wall and the suprapubic sites can be infiltrated with a solution of preference for hydrodissection. A small mid urethral vaginal and two suprapubic stab incisions are made. Vagina is dissected from the urethra with sharp dissection and tunnels are created on both sides of the urethra. The Foley catheter guide is moved to the ipsilateral side of the trocar placement to move the urethra and the bladder neck to the contralateral side. Abbasy *et al.* showed an average of 1.4 cm bladder neck displacement using the Foley catheter guide (6). Other studies have failed to show any benefit of the Foley catheter guide in preventing urethral injury (7,8). The trocar pierces the Urogenital diaphragm and traverses the Space of Retzius along the back of the symphysis pubis. It then pierces through the rectus muscle and the abdominal wall fascia and exits via the suprapubic stab incision. With the trocar in place, cystourethroscopy is performed to confirm bladder and urethral integrity. The same process is repeated on the opposite side. Several studies have shown the proximity of the TVT trocars to the major vessels. Muir *et al.* reported mean distance from the lateral edge of the trocar to the medial edge of the vessels in the abdominal wall and the retropubic space. The distance from the superficial epigastric and inferior epigastric was noted to be 3.9 cm, external iliac 4.9 cm, and Obturator 3.2 cm (9). Abbas *et al.* in a similar cadaver study reported a mean distance of 4 cm from the Obturator vessels, 4 cm from the internal iliac, and 6 cm from the external iliac vessels (10). The sling which is attached to the trocars is then pulled out to the skin. Care is taken to avoid any twisting of the sling. Appropriate tensioning of the sling is then performed and in general, the sling is left loose enough to allow the passage of a surgical clamp or a No. 8 Hagar dilator between the mesh and the posterior urethra. Plastic sheaths around the mesh are removed and the suprapubic stab wounds are re-approximated with liquid adhesive or suture. The vaginal incision is irrigated and closed with a 3-0 delayed absorbable suture. A voiding trial is performed prior to discharge home to confirm voiding efficiency. The same procedure is performed for the “top down” approach except the trocars are inserted from the suprapubic stab incisions and brought down to the vaginal incision. The mesh tape is loaded on the trocars and then pulled up to the suprapubic sites. Tensioning is performed as described for the “bottom up” technique.

The “outside in” TOT sling differs mainly the way the helical trocar traverses the obturator space and avoid passage of the retropubic space. Similar to the TVT, vaginal incision is made and tunnels are created on both sides of urethra. The skin incision is made in the crural fold, just beneath the adductor longus tendon insertion site. This is generally 2 cm above the level of the urethra and 2 cm lateral to the labial fold. Hydrodissection is performed in similar fashion as TVT. The helical trocar is passed, penetrating the gracilis, adductor brevis, obturator externus, obturator membrane, the obturator internus muscle, periurethral endopelvic connective tissue and ending up at the mid urethra. The TOT trocar traverses on average 1.1 cm from the most medial branch of the medial division of the obturator vessels and 2.3 cm inferior-medial to the obturator canal (11). The “inside out” technique uses a winged guide to pass the trocar from the vagina, via the obturator space, to the groin. This technique has slightly higher risk of groin pain (12,13). The tensioning of TOT slings is slightly tighter than the TVT sling.

### Efficacy of MUSs

Multiple surgical options for treatment of SUI have been studied and different success rates and complications have been reported. This variation in the success rates reported is mostly due to the differing definitions of success used in the studies. Both TVT and TOT have been studied, including randomized controlled trials, in comparison with other surgical treatment options of SUI and also with each other.

### MUS vs. colposuspension

In a prospective randomized trial, Ward and Hilton compared TVT with open colposuspension for SUI in a large group of women. They found that the TVT was as effective as colposuspension after 2 years of follow up (14). Paraiso *et al.* compared TVT and Laparoscopic Burch colposuspension and found greater objective and subjective cure rates with TVT at a mean of 20.6 months follow up (15). Asıcıoglu *et al.* compared the TOT sling with Burch colposuspension in a retrospective study found the 5-year cure rates to be similar in 2 groups (objective cure rate, 73.9% vs. 77.5%,  $P=0.574$ ) (16). Bandarian *et al.* in a randomized clinical trial found the rate of complete cure, improvement and failure in the TOT group was 90.3%, 9.7% and 0%, respectively, as well as 74.2%, 19.4% and 6.5% in the Burch group (17). Therefore, in comparison to

Burch colposuspension, both TVT and TOT appear to be equally effective in the treatment of SUI.

### ***MUS vs. pubovaginal sling***

Several studies have compared MUS with pubovaginal slings. Most studies have compared TVT sling with few studies comparing TOT sling with pubovaginal sling. Bai *et al.* in a randomized trial showed that fascial sling was superior than TVT and Burch with 92.8% of patients cured at 12 months follow up, compared to 87% of TVT patients and 87.8% of the Burch colposuspension patients (18). Another randomized trial by Wadie *et al.* reported similar cure rates of 92%, between TVT and pubovaginal sling, at 6 months follow up (19). Al Azzawi *et al.* randomized patients to TOT *vs.* fascial sling and found comparable efficacy and safety between the two procedures (20).

### ***Retropubic vs. transobturator sling***

In a randomized controlled trial, Laurikainen *et al.* compared the TVT sling with TOT sling. Even though the TVT had slightly higher cure rate than TOT (98.5% *vs.* 95.4%), this was not statistically significant. Also, the subjective cure rates in both groups were similar (21). Another study by Deffieux *et al.* in a randomized controlled trial, showed no significant difference between retropubic and transobturator slings at 24 months follow up (22). The Trial of Mid-Urethral Sling (TOMUS) trial was a large multicenter randomized controlled trial of 597 participants (23). The evidence did not show a difference between TVT and TOT slings. Another randomized controlled trial by Barber *et al.* did a noninferiority study comparing TVT and TOT and concluded that the transobturator tape is not inferior to TVT for the treatment of SUI (24). Angioli *et al.* performed a randomized controlled trial with a 5-year follow up and concluded that both retropubic and transobturator slings had similar objective cure rates (71% and 72.9% respectively) (25). Another 5-year longitudinal follow up after retropubic and transobturator sling by Kenton *et al.* showed slightly higher success with retropubic sling but the study finding was not statistically different between the two slings. A Cochrane review of Midurethral slings, which included 81 trial and 12,113 women, showed a cure or significant improvement in 80% of women with SUI for up to 5 years after surgery, irrespective of the tapes used and the route of tape insertion (26).

## **Outcomes in specific scenarios**

Patients with mixed urinary incontinence (MUI) pose a challenging problem as they symptoms of both SUI and urgency urinary incontinence. About one-third of patients with SUI also have detrusor overactivity. In patients with MUI, the cure rates are lower than the patients with straight SUI (27,28). Holmgren *et al.*, in a 2–8 years follow up, showed a deterioration of success over time (29). Women with pure SUI had 82% cure after 8 years while the women with MUI had cure rate decline to 30% after 4–8 years. Approximately 9% of patients experience de novo urgency incontinence symptoms after Midurethral sling (30). Overall, patients with MUI should not be excluded from undergoing Midurethral sling and should be counseled that the urge component mostly improves but it may also persist or worsen.

A meta-analysis by Greer *et al.* evaluated the efficacy of TVT in the obese population and no significant difference at 24 months in terms of cure rate but a higher rate of UUI in the obese group (31,32). For the TOT sling, Liu *et al.* found no difference in the cure rate of normal or obese patients (33). In contrast, Haverkorn *et al.* found a significantly lower cure rate in the obese population (81.2% *vs.* 91.9%,  $P < 0.001$ ) (34).

The effect of age on the outcome of Midurethral sling is difficult as confounding variables like detrusor overactivity and intrinsic sphincter deficiency (ISD) are more prevalent in the elderly. Malek *et al.* compared the outcomes of SUI after Midurethral sling in women above or below the age of 70 and found no difference in the outcomes (35). Stav *et al.* compared the efficacy of midurethral sling in women above and below the age of 80 years (36). There was no difference in the overall subjective cure rate (elderly 81%, younger 85%,  $P = 0.32$ ) and also no significant difference in cure rate between retropubic and transobturator sling in the elderly group (82% *vs.* 79.3%,  $P = 0.75$ ).

Intrinsic sphincter deficiency (ISD) is defined in literature as urodynamic finding of Valsalva leak point pressure of less than 60 cmH<sub>2</sub>O or a maximum urethral closure pressure of less than 20 cmH<sub>2</sub>O. Several studies have compared retropubic *vs.* transobturator slings in patients with ISD. Jeon *et al.*, after a 2-year follow up, reported cure rates of 86.9% with TVT, 87.3% with pubovaginal sling, and 34.9% with TOT sling (37). At 31 months, Gungorduk *et al.* reported cure rates of 78.3% with TVT *vs.* 52.5% with TOT sling and found that the TOT sling was 5 times more likely than

TVT to fail in patients with ISD (38). In a prospective randomized trial of TVT *vs.* TOT in patients with ISD, Schierlitz *et al.* looked at the urodynamic SUI at 6 months (39). Twenty-one percent of the TVT group had SUI on urodynamics *vs.* 45% in the TOT group ( $P=0.004$ ). In contrast, a retrospective study by Rapp and colleagues found no difference between TVT and TOT slings in women with ISD with success rates of 76% and 77%, respectively (40). A study by Haliloglu *et al.* examined the impact of ISD and urethral hypermobility in patients undergoing TOT slings (41). At 24 months, the patients with ISD and no urethral hypermobility had significantly lower cure rates. They concluded that a lack of urethral hypermobility may be a risk factor for TOT failure and suggested that even in the presence of ISD, the coexistence of urethral hypermobility still indicates likely good outcomes with transobturator slings.

Regarding the effectiveness of midurethral slings in recurrent SUI, Pradhan *et al.* reviewed the literature and found the overall subjective cure rate following midurethral sling for recurrent SUI after any surgery was 78.5% after a 30-month follow up (42). The cure rate seems to be lower with transobturator compared to the retropubic tape for recurrent SUI after previous surgery.

The prevention of postoperative SUI after pelvic organ prolapse repair can be a challenging issue. Forty percent of women with POP also report SUI, and up to 80% who do not report SUI will demonstrate it after prolapse reduction (occult SUI). An additional 22% will report de novo SUI after repair (43-45). The OPUS (Outcomes following vaginal prolapse repair and MUS) trial randomized 332 continent women with pelvic organ prolapse undergoing vaginal surgery to receive a prophylactic TVT or sham incisions (46). Overall, the rate of de novo SUI at 3 months was 23.6% in the sling group and 49.4% in the sham group with similar results at 12 months. In women with a positive preoperative prolapse reduction stress test, 71.9% developed de novo SUI at 3 months in the sham group compared with 29.6% in the TVT group,  $P$  value less than 0.0001. Based on these findings, the authors concluded that a prophylactic midurethral sling inserted during vaginal prolapse surgery resulted in a lower rate of urinary incontinence at 3 and 12 months.

### Complications of MUSs

Complications of retropubic midurethral slings include bladder perforation, visceral and vascular injuries, mesh

erosion, voiding dysfunction, de novo urgency or urgency incontinence, and urinary tract infections. Retropubic slings have a higher risk of bladder perforation (5.5% *vs.* 0.3%), post-operative voiding dysfunction, and urinary tract infections compared to TOT slings (23). Transobturator slings have a higher incidence of transient groin pain (12%). These findings were also confirmed by Novara *et al.*, who also found that retropubic slings have a higher rate of hematoma (OR 2.62, 95% CI: 1.75–3.57) and vaginal perforation (OR 2.62, 95% CI: 1.35–5.08), as well as storage lower urinary tract symptoms (OR 1.35, 95% CI: 1.05–1.72) (47). The overall reported rates of tape-related erosion of the tape into the vagina at about 2% for both routes of tape insertion (26,48).

### Conclusions

Compared to other surgical treatment options for SUI, the midurethral sling has been shown to be a safe and effective option. The safety, durability, and patient satisfaction with MUS has been well described, especially with TVT sling (49). The passage of the trocars of both the TVT and TOT slings are believed to create vectors which have been explanation for differences noted in the efficacy of the two slings. The same passage of the different trocars also accounts for the differences noted in the complications associated with the midurethral slings. Patient selection can be tailored based on the data obtained from studies, even though more long-term studies are required. A surgeon should have expertise in both approaches for sling and should be able to use the data available and counsel the patient appropriately and offer both procedures. This is especially critical in the current mesh era. Midurethral slings have transformed anti-incontinence surgery and continue to evolve, providing durable treatment and minimizing the risks of the procedure.

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