# Management of Stress Urinary Incontinence

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## Introduction

Stress urinary incontinence is a common debilitating condition affecting millions of women worldwide. Conservative treatments are recommended as first-line therapies, but many women need surgical treatment if pelvic floor muscle training is ineffective. In the past the colposuspension operation was the gold standard, but over the last 15 years, this technique has been replaced by mid-urethral sling procedures. These have a high success rate and reduced morbidity. The original retropubic (down-up) sling has been modified and now transobturator slings (inside-out and outside-in) are also available. Recently, short single-incision slings (mini-slings) have been introduced, although current evidence suggests an inferior outcome. We are still learning the benefits and limitations of each type of sling, and many surgeons express a keen preference for one sling over another. Different surgeons obtain very different results with similar slings. As surgeons we should aim to audit our results so that we ensure we give our patients the best possible outcome. This article reviews the current surgical treatment options for stress urinary incontinence.

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Stress urinary incontinence (SUI) is defined by the International Continence Society as the involuntary leakage of urine on exertion, effort, coughing, or sneezing [1]. It adversely affects the quality of life of women of all ages [2]. The reported prevalence of SUI is variable, but several studies suggest that it may be as high as one in four adult women. A postal survey in 2004 conducted in four European countries (UK, France, Germany, and Spain) involving over 29,000 participants found that 35 % of women questioned admitted urinary incontinence [3]. SUI is the most common type of urinary incontinence. Despite this, less than a third of women will seek medical help. Reasons for this reticence are varied and include embarrassment, lack of knowledge of available treatment options, and the belief that incontinence is an inevitable consequence of childbirth or aging [3]. The management of SUI puts a significant burden on healthcare systems with an estimated cost in the USA of over $12 billion [4].

## Brief Pathophysiology

In order to maintain continence during bladder filling and urine storage, the bladder outlet and urethra must be closed at rest and remain so during periods of increased abdominal pressure. Normal bladder emptying occurs with a decrease in urethral resistance followed almost immediately by bladder contraction. Relaxation of the

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pelvic floor muscle and urinary sphincters permits urine to flow into the urethra. SUI occurs as a result of a poorly functioning urethra. The mechanism of SUI is from insufficient urethral closure pressure during exertion that raises intra-abdominal pressure. The lack of urethral closure pressure is due to anatomical changes in the bladder and urethra (e.g., cystocele) and weakness in the pelvic floor [2]. Risk factors for SUI include pregnancy, childbirth, menopause, obesity, constipation, and chronic cough. A thorough history taking and physical examination should be performed in all patients presenting with SUI. Voiding diaries and pad tests are important adjunctive assessments. Urodynamics studies are commonly used during the assessment of bladder symptoms [5], although recent evidence suggests that pressure flow cystometry is not mandatory for all women [6].

## Treatment Options

There are several well-established treatments for SUI and many have long-term data to support their use [2]. Behavioral modification changes such as weight loss and treatment of underlying constipation or cough are often first-line measures. Other treatments include pelvic floor exercises and medical therapies such as duloxetine. Surgical treatment is currently the mainstay of treatment for SUI [2].

According to the 2009 update of International Consultation on Incontinence Guidelines, the surgical techniques suggested in the treatment of SUI include Burch colposuspension, autologous slings, mid-urethral slings (such as TVT and TOT), insertion of artificial urinary sphincters, and periurethral bulking agents. Many factors should be considered when determining the optimal therapy for a patient with SUI. These include bladder capacity, voiding dysfunction, detrusor overactivity, sexual function, degree of discomfort to the patients, concurrent prolapse, and abdominal or pelvic pathology. The decision to treat symptomatic SUI with surgery should be made when the patient's symptoms are severe enough to warrant an elective operation and nonsurgical therapy is either not desired or has been previously ineffective.

### Pelvic Floor Muscle Training

Pelvic floor muscle training (PFMT) is a first-line therapy for women with stress incontinence [7]. It was first described by Arnold Kegel almost 60 years ago. PFMT exercises help to strengthen the muscles of pelvic floor. Numerous studies have evaluated its efficacy and durability with conflicting results. PFMT exercises consist of repeated, high-intensity, pelvic muscle contractions of both slow and fast twitch muscle fibers. Though studies have demonstrated significant improvement in symptoms with PFMT, patient compliance and motivation is essential for continued success [7]. The Cochrane review of PFMT suggests that only 15–20 % of women comply with a regimen [8]. Therefore a successful program of behavior modification and pelvic floor exercises requires a substantial commitment of time and perseverance from both physician and patient. However, in clinical practice, failure rates tend to be high and PFMT has consequently gained a reputation for both futility and poor efficacy [7]. A recent multicenter randomized trial comparing physiotherapy and the mid-urethral sling procedure (MUS) reported a 91 % subjective improvement in the MUS arm compared to 64 % in the physiotherapy arm [9].

### Duloxetine

Duloxetine hydrochloride is a potent balanced serotonin noradrenaline reuptake inhibitor (SNRI) and was the first available pharmacological option licensed for SUI [10]. It has a centrally mediated mechanism of action via the neurotransmitter glutamate. A systematic review of 3,063 women showed a significant reduction in incontinence episode frequency, which was decreased by half when duloxetine was commenced. This led to improvements in quality of life and significant increases in voiding intervals [11]. Ghoniem then demonstrated in an RCT that duloxetine was more

effective than pelvic floor muscle training (PFMT) and its effect was synergistic with PFMT [12]. However, duloxetine is poorly tolerated outside of randomized controlled trials with one study reporting only 9 % of patients using duloxetine after 1 year and 82 % opting for a mid-urethral tape [13, 14]. The commonest reason for discontinuation was side effects, specifically nausea in 56 % of women. This was followed by lack of efficacy (33 %) and an unwillingness to take long-term medication (11 %) [11]. The place for duloxetine still remains unclear. The UK's National Institute for Health and Care Excellence (NICE) guidelines from 2013 do not recommend duloxetine as first- or second-line treatment as most women would choose to have a one-off minimally invasive surgical procedure with a higher success rate. Duloxetine may be best considered in women who are unfit for surgery, who do not wish to undergo surgery, or those with severe stress incontinence who are awaiting surgery or are yet to complete their families [10]. Duloxetine is unavailable and remains unlicensed for the treatment of stress urinary incontinence in many countries.

## Burch Colposuspension

The aim of surgical treatment for SUI is bladder neck suspension to reduce urethral hypermobility. There have been multiple procedures described, of which, the Burch Colposuspension has been the most extensively studied. It was first introduced in the early 1960s. The basic principle of colposuspension is the fixation of the bladder neck and proximal urethra via suspending sutures placed laterally into the tissue on either side of the paravaginal fascia, at the level of the proximal urethra. These sutures are then placed through the ipsilateral iliopectineal ligament thereby supporting the vesicourethral junction within the retropubic space [15]. It has been described as the most effective surgical procedure for treatment of stress incontinence. Many studies have demonstrated excellent long-term success rates. Burch colposuspension is a time-honored procedure with a 10-year success rate in the range of 55–70 % [16, 17]. However, it is associated with high rates of de novo detrusor overactivity (17 %), voiding dysfunction (10.3 %), and pelvic organ prolapse (13.6 %) [17]. It is also a major surgical procedure and usually involves several days in hospital and a prolonged recovery. In situations where MUS tapes are not available or costly, this may be a valuable option.

## Laparoscopic Colposuspension

Laparoscopic Burch colposuspension, one of the first minimal-access techniques for the treatment of SUI was described by Vancaille and Schuessler in 1991 [18]. Laparoscopic colposuspension procedures use similar techniques to open colposuspension procedures with the additional benefits of laparoscopic surgery: less intraoperative blood loss, less postoperative pain, shorter hospital stay, quicker return to normal activities, and shorter duration of catheterization compared to an open procedure. However, it requires a higher level of technical skill and laparoscopic training to perform. The laparoscopic approach is associated with higher complication rates and longer operating times [19]. A study by Dean et al. comparing the outcomes of laparoscopic colposuspension and TVT revealed a statistically significant higher cure rate for TVT [19]. Due to the high success of the MUS procedure, few laparoscopic colposuspensions are now performed.

## Pubovaginal Slings

Pubovaginal slings have been described almost 100 years ago [2, 15]. Historically, autologous rectus fascia and fascia lata were among the most commonly used sling materials. Autologous fascial sling procedures were widely used in the late twentieth century [20]. Pubovaginal slings work on the principle of providing support to the proximal or mid-urethra. Long-term subjective and objective cure rates were 82.4 and 85.3 %, respectively. As with the colposuspension, this technique has largely fallen into disregard with the increased use of the MUS. There may still be a place for this technique where MUS procedures have failed.

## Mid-Urethral Sling Procedures

### Retropubic Tapes: Tension-Free Vaginal Tapes (TVT)

Development of the tension-free vaginal tape (TVT) has occurred in the mid-1990s and works on a similar principle to sling procedures. The original tape was produced by a single manufacturer, but there are now many similar tapes produced from a variety of companies. There is very little direct research comparing tapes produced by different companies.

A synthetic mesh tape is placed suburethrally at the mid-urethral point to create a pubourethral "neoligament" that is anchored suprapubically. A long thin strip of polypropylene mesh tape tightens around the urethra on increased intra-abdominal pressure [2] (Fig. 7.1). A MUS procedure may be performed as a day case procedure under general anesthesia, but it is important to check that the patient is voiding adequately before discharge. Alternatively, MUS can be performed under local anesthesia, although this is usually combined with sedation. Initial follow-up data has shown it to be highly effective treatment for stress leakage with success rates of 95 % at 5 years [21]. Multicenter randomized controlled trials comparing TVT with colposuspension by Ward et al. demonstrated an 81 % objective cure rate for TVT compared to 90 % for colposuspension [22]. These results were supported by a further two meta-analysis. The MUS procedure has a low rate of complications in experienced hands, the most common of which was bladder perforation, which generally causes no long-term effects if identified intraoperatively. Though voiding disorders may occur post-insertion of an MUS, it appears to be less likely than with other incontinence procedures [15]. Other complications include urinary retention rates of approximately 2 % and de novo detrusor overactivity in about 5 % of patients. Compared to open colposuspension, TVT was associated with decreased operative time, analgesia requirement and hospital stay. A further consideration with the MUS is the vast number of different tapes currently available. Each tape varies in pore size and whether they are knitted or weaved, which are important factors when considering tape infection and erosion. To limit the risk of rejection and complications, it is

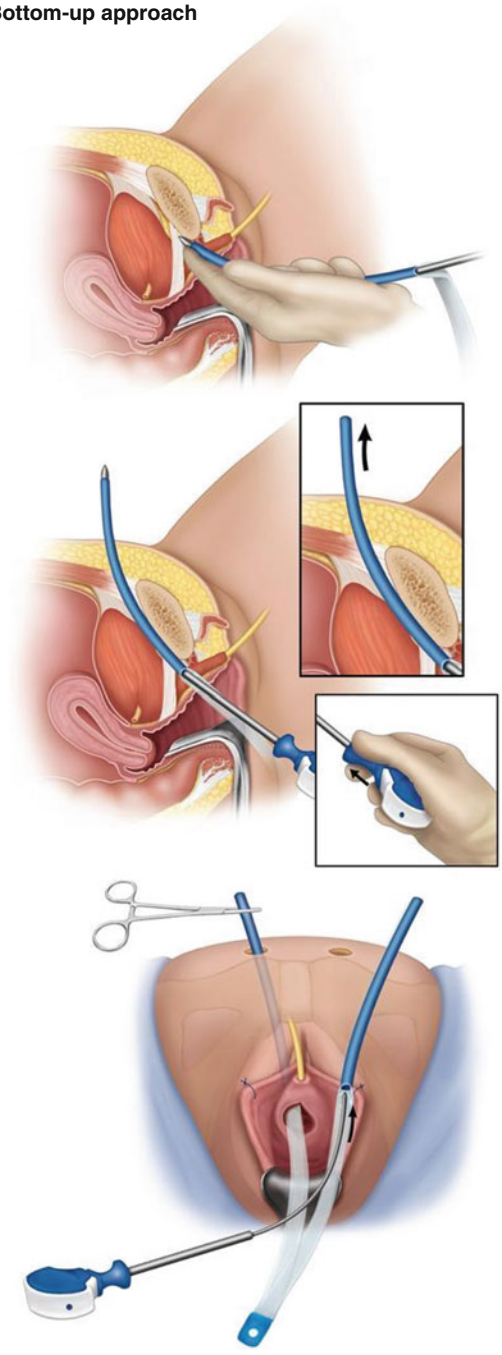


**Fig. 7.1** The retropubic approach of mid-urethral sling, with needle passage from bottom-up (From: Noblett et al. [34]; with permission)

important that the tape is macroporous and a monofilament.

Nilsson et al. reported that at 11-year follow-up, objective and subjective cure rates of the TVT were as high as 90 and 77 %, respectively, without any significant late-onset adverse effects [23]. This has been collaborated by a 10-year follow-up data by Svenningsen et al. who demonstrated an 89.9 % objective cure rate and a 76.1 % subjective cure rate with only 2.3 % of patients requiring repeat SUI surgery [24]. Recent publications now describe similar success rates at 17 years [25]. Due to its effective long-term success rates and low complication rates, retropubic MUS procedures are currently considered the gold standard for the treatment of SUI.

### Transobturator Tape (TOT)

Transobturator tape (TOT) insertion is a newer development of the MUS and is a modification on the retropubic technique. It dates back to the early 2000s and similarly involves the placement of a manufactured synthetic tape suburethrally. However, in TOT, the tape is anchored through the obturator foramen [2, 15]. Avoiding the retropubic space makes TOT procedures both less invasive and safer [2, 15]. There are two methods of inserting a transobturator tape with the difference being the direction of penetration. With the "inside-out" technique, the needle passes from the midline suburethral position laterally, while for the "outside-in" method, the needle is passed from a lateral position to sit suburethrally. A review by Latthe et al. identified no major difference in efficacy or morbidity between the two techniques [26]. Both techniques avoid the blind passage of the needle through the retropubic space, which is required in the insertion of the TVT [2]. Two meta-analyses demonstrated that TVT and TOT have similar efficacy. However, the risk of bladder perforations and pelvic hematoma are significantly less common in patients treated with TOT [15]. The TOT operation is associated with more groin pain postoperatively. Large studies using observational data suggests that the TOT may have a slightly lower success rate than the retropubic MUS [27].

### Mini-slings

Mini-slings were first introduced in 2006. The aim of the mini-sling was to further reduce morbidity related to MUS. The mini-sling is a short tape mesh sling measuring between 8 and 14 cm with paired anchors at each end, inserted under local analgesia via a single vaginal incision. The mini-sling can be deployed either into the retropubic space or in a similar fashion to the TOT. The fixation ends of the tape are often placed in indeterminate soft tissue. Consequently, fixation into good tissue can neither be guaranteed nor tested at time of surgery. The potential benefit of mini-slings is the reduction of adverse events such as pain and visceral injury. This hypothesis has been tested by Smith et al. Their 2-year data showed excellent tolerance of local analgesia, early return to normal, and low morbidity, but very poor success rates [28]. Mini-slings could therefore be potentially used in an outpatient setting. The original mini-slings had a poor success rate [29]. Newer slings with improved design may have a better success rate [30], and this hypothesis is currently being studied in a large trial in the UK.

However, there are a few well-powered studies testing the long-term efficacy of mini-slings resulting in conflicting results. A multicenter randomized trial comparing mini-slings with TOT conducted by Mostafa et al. demonstrated that at 1-year follow-up, there were no differences in terms of subjective satisfaction or quality of life score found between the two groups, with similar success rates [30]. However, a systematic review and other studies suggest a lower cure rate for mini-slings [31]. Longer-term and multicenter outcome data is necessary to evaluate the place of mini-sling in the treatment of SUI.

## Artificial Urinary Sphincter (AUS)

These are considered as a "last hope" treatment for recurrent stress incontinence and are only offered after other surgical interventions have failed. They were introduced in the 1970s. The principle of this procedure involves increasing outlet resistance using a patient-controlled inflatable cuff around the proximal urethra. This

allows intermittent deflation and bladder emptying. Good results have been reported when AUS is inserted for SUI secondary to intrinsic sphincter deficiency. Webster et al. (1992) reported over 90 % continence at 2.5 years following AUS insertion in women without previous surgery for SUI [32]. However, longer-term results are less optimistic. In addition, there is a high rate of sphincter removal due to infection or erosion [2]. This should not be unexpected as these devices are usually inserted to tissues which are scarred and damaged by previous failed surgery.

## Periurethral Bulking Agents

Periurethral bulking agents have been used for the treatment of SUI in women for decades. They create submucosal cushions ensuring apposition of the urethral wall, which aids continence. It can be carried out under local anesthesia and as a day case procedure. It is therefore associated with a low patient morbidity. A variety of substances have been reported to be safe and effective, but others have been withdrawn from the market after a variety of complications. A Cochrane review published in 2003 by Pickard concluded that bulking agents result in both subjective and objective short-term improvement in women with symptoms of SUI [33]. A study by Corcos in 2001 compared periurethral bulking agents with open colposuspension and TVT. Objective pad weight testing after 12 months revealed an increased curative rate but significantly higher complication rates after the latter two operations [2]. Periurethral bulking agents also have an apparent absence of postoperative de novo detrusor overactivity. However, it is recognized that two or more treatments may be necessary for the majority of patients, and the success rate is probably inferior to other surgical treatments. Despite this, some patients may prefer the low risk of complications and its minimally invasive nature as an initial treatment for SUI prior to considering more invasive surgery. Bulking agents are recommended for use in patients unfit for general anesthesia. They are most commonly used for patients after a failed MUS.

**Conclusion**

In conclusion, the ideal therapy for SUI has yet to be clearly identified. However, in this area of significant morbidity affecting quality of life significantly, there is good evidence for the efficacy of various treatment modalities.

In treating patients with stress urinary incontinence, the decision on the best course of treatment should be made in light of the available evidence and in conjunction with the patient's own preferences.

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