Surgical treatment of urinary incontinence

Rohana Kearney

Abstract
Surgery for stress urinary incontinence is a commonly performed procedure. Thorough preoperative assessment, counselling and selection of the appropriate procedure are essential to a good surgical outcome. In the surgical treatment of stress urinary incontinence, evidence favours either a retropubic type 1 mesh mid-urethral tape using the bottom-up approach, or colposuspension. Data supporting the use of the transobturator technique for the insertion of a mid-urethral tape is emerging. The complications of the retropubic and transobturator tapes differ. Intravesical bulking agents are associated with few complications but have poorer efficacy and often require repeated injections. Artificial urinary sphincters and urinary diversion are indicated only when other operations have failed. Augmentation cystoplasty for the treatment of urge incontinence is now less commonly performed due to the new modalities of sacral neuromodulation and botulinum A toxin. However, long-term data on the safety and outcome of these new treatments are awaited.

Keywords incontinence procedure; stress urinary incontinence; urge incontinence

Introduction
Urinary incontinence is the complaint of any involuntary leakage of urine. The prevalence of urinary incontinence in women increases with age and is a significant socioeconomic burden. Although only a proportion of women with urinary incontinence seek medical care, surgery for urinary incontinence is a frequently performed procedure, with 11% of women undergoing surgery for urinary incontinence or pelvic organ prolapse by the age of 80 year. More than one-quarter of women undergoing surgery for urinary incontinence are women and states that the best surgical outcome for urinary incontinence is achieved when the surgeon has specialist training and regular practice in continence surgery. All women opting or considering surgery should be counselled in detail about the alternatives to surgery and should be offered conservative treatments. Adequate preoperative assessment is critical to a good outcome, and the patient should be informed of the risks of surgery and provided with information on the outcome and possible complications.

When deciding on which surgical procedure to perform, the surgeon must consider factors specific to the patient and the variety of procedures that he or she can competently undertake. In recent years, the emergence of newer, ‘quick-fix’ procedures may tempt the surgeon to perform ‘in vogue’ surgery. It is essential

Factors to consider when deciding on surgical procedure for the treatment of stress urinary incontinence

Relating to the patient

- Age
- Severity of incontinence
- General medical health
- Lifestyle
- Previous surgery
- Prolapse
- Overactive bladder symptoms
- Preoperative voiding
- Future childbirth
- Patient’s preference

Relating to the surgeon and procedure

- Surgeon’s experience
- Availability of equipment
- Cure rate and outcome data
- Complication rate
- National and institutional guidelines

Table 1

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that the surgical choice is based on evidence of good outcome and safety.

**Surgery for stress urinary incontinence**

The surgical management of stress urinary incontinence continues to expand (Table 2). The 2006 NICE guidelines recommend three types of procedure for the surgical management of stress urinary incontinence: retropubic mid-urethral tape procedures, colposuspension and autologous rectus fascia slings. These procedures are discussed below, with commonly performed variants. Anterior colporrhaphy, the Marshall–Marchetti–Krantz (MMR) procedure and needle suspensions are no longer recommended due to poor outcome. Artificial urinary sphincters and urinary diversion procedures are also discussed, as these more complex procedures may be considered in patients in whom other surgical interventions have failed.

**Mid-urethral tapes**

At the time of writing, there are 28 types of tape for the treatment of stress urinary incontinence, at least 15 of which are available in the UK. This review considers the current evidence supporting the selection of specific tapes. Tapes vary in the composition of the mesh and the approach used for insertion. It is essential that surgeons are aware of the properties of the mesh that they are using. Many meshes currently available commercially have been introduced without any data to support their safety and efficacy. The tape may be inserted retropubically, using a bottom-up or a top-down approach. Alternatively, the tape may be inserted using a transobturator technique. Recently, a newer version was introduced in which the tape is simply secured in the vagina.

**Retropubic tapes**

**Bottom-up approach** – in 1996, Ulmsten first proposed using a mid-urethral tape to surgically treat stress urinary incontinence based on the integral theory of incontinence. The tape used (Gynecare TVT) is a synthetic, polypropylene, monofilamentous mesh with a pore size of 75–150 μm (type 1 mesh) and measures 40 cm long by 11 mm wide. By 2001, over 100,000 TVT procedures had been performed.

The procedure was first described as a day-case procedure performed under local anaesthesia, though it is now also performed under regional or general anaesthesia. Ulmsten described the use of a local anesthetic, prilocaine with adrenaline, diluted with saline, injected suprapubically and vaginally into the retropubic space to hydros dissect the tissues and make passage of the tunneller easier and more haemostatic. A vertical midline suburethral incision of 1–1.5 cm is made in the vagina and scissors are used to dissect on either side of the urethra towards the retropubic space. Two 1 cm incisions are made suprapubically 2.5 cm from the midline just above the pubic bone. A rigid catheter guide is placed inside an 18 Fr Foley catheter to deflect the bladder away from the insertion path. The trocar and tnneller containing the tape covered with a plastic sheath is used to traverse the retropubic space on either side close to the pubic bone to avoid bladder injury and emerge through the suprapubic incisions. Cystoscopy is performed after insertion of the trocar on either side to diagnose any bladder injury that may have inadvertently occurred. If the bladder has been perforated, the trocar is withdrawn and reinserted on that side. The tension of the tape is adjusted under the mid-urethra with the aim of curing incontinence while avoiding or minimizing postoperative voiding difficulty. When the procedure is performed under local or regional anaesthesia, the patient is asked to cough with 250–300 ml of fluid in the bladder and the tape is adjusted until only a drop leaks on coughing. A plastic sheath over the tape is then removed and the vaginal and suprapubic incisions are closed.

Although this procedure is easy to perform, there is a risk of bladder, bowel and major blood vessel injury. The overall short- and long-term complication rate has been reported as low. Finland and Austria have national registers of TVT procedures including 1453 and 2795 patients, respectively. They report bladder injury in 3.8% and 2.7% of cases. The Finnish register reports voiding difficulties in 7.6% and urinary tract infection (UTI) in 4.1%. The Austrian register reports a higher UTI rate of 17%. Major vascular and bowel injury are reported at rates of 0.07% and 0.04%, respectively. The reported rate of de novo urge symptoms is 6%.

**Top-down approach** was developed after the vaginal approach. The SPARC Sling System tape is designed to be inserted in this manner and comprises two suspension needles, dilators, connectors, plastic sheath and mesh sling. A vaginal incision and two suprapubic incisions are made similar to those in the TVT procedure. Hydrodissection with local anaesthetic or saline may be used. Dissection laterally at the level of the mid-urethra is performed as in the bottom-up approach. The needle is passed from the suprapubic incision to the pubic bone and through the rectus fascia and muscle. The needle handle is then rotated through

**Table 2**

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90° to keep the needle close to the dorsal surface of the pubic bone. When the needle reaches the endopelvic fascia, a finger is placed in the vagina to guide the needle through the dissected area to emerge on either side of the mid-urethra. The sling is then attached to the needle tips in the vagina with the connectors. The needles are pushed backwards into the retropubic space and the sling is pulled through the suprapubic incisions. Cystoscopy is then performed. The tension is adjusted, the plastic sheath is removed and incisions are closed in a similar manner to the TVT procedure.

The complications are the same as those of the TVT procedure, as is the frequency of bladder perforation, blood loss, de novo urgency and mesh erosion. Acute urinary retention requiring loosening of the tape is more common with the SPARC procedure.

**Transobturator approach** for the insertion of a suburethral tape was described by Delorme in 2001. This was an outside-in procedure (TOT). Subsequently, a tension-free vaginal tape obturator approach (Gynecare TVT-O), an inside-out procedure, was introduced.

**Outside-in** – the patient is placed in the lithotomy position with 120°, which differs from the 70° used in the retropubic procedures. An incision is made at the level of the mid-urethra and dissection is lateral towards the ischiopubic ramus. A small incision is then made 1.5 cm lateral to the ischiopubic ramus on either side. Using a specially designed tunneller, the obturator membrane is perforated and the tunneller is turned medially to exit through the vaginal incision. An index finger is placed in the vagina to guide the tunneller. The tape is then loaded onto the tunneller and is pulled out through the groin incision. The tension of the tape is adjusted so that it lies flat underneath the urethra with sufficient room for the insertion of scissors between the urethra and the tape. The incisions are then closed.

**Inside-out** – 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 foramen is punctured with scissors and the introducer is passed at a 45° angle until it perforates the membrane. 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 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. This approach reduces the risk of organ injury that may occur with retropubic operations. Although it was initially introduced as a technique that did not require cystoscopy, bladder injuries have been reported. Therefore, it is prudent to perform cystoscopy after completion of the procedure. Vaginal erosion, groin pain and abscesses have also been reported.

**Outcome evidence**

TVT is the most extensively evaluated tape in research studies, with a reported 2-year cure rate of 84%. TVT has been compared with colposuspension in a multi-centre randomized trial and has been shown to be equally efficacious (63% vs 51%) at 2 years. Reported objective and subjective cure rates were 81.3% in 7-year follow-up data on 80 women from a cohort originally comprising 90 women. Further studies have shown TVT to be an effective intervention for the treatment of recurrent incontinence and mixed incontinence.

**SPARC** – a randomized controlled trial (RCT) of TVT and SPARC in 301 operations showed similar objective cure rates at 6 weeks (97.3% vs 97.4%) but a higher subjective cure rate with TVT (87.1% vs 76.5%). A retrospective study comparing TVT and SPARC in 122 women showed higher objective (95% vs 70%) and subjective (86% vs 60%) cure rates with the TVT procedure. Subjective and objective cure rates with the SPARC procedure were reported as 72% and 90% in a trial of 104 women.

**Transobturator approach** – a recent systematic review and meta-analysis comparing transobturator tapes (TVT-O, TOT) with retropubic tapes (TVT), comprising five RCTs of the effectiveness and complications, found that the subjective cure rate at 2–12 months was no better with the transobturator tapes than with the retropubic tapes (OR 0.85; 95% CI 0.60–1.21); however, bladder injury (OR 0.13; 95% CI 0.06–0.27) and voiding difficulties (OR 0.56; 95% CI 0.32–0.99) were less common. Vaginal injuries, mesh erosions (OR 2.08; 95% CI 0.89–4.95) and groin pain (OR 9.34; 95% CI 3.02–28.9) were more common with the transobturator approach. De novo frequency and urgency symptoms were similar (OR 0.89; 95% CI 0.54–1.86) with the two approaches.

**Other tape techniques:** a technique for the insertion of a mid-urethral sling using the fibromuscular tissue behind the perineal membrane for fixation has been reported in 36 patients with a cure rate of 83.4%. There are no other data currently available to support the use of this method.

**Colposuspension**

Marshall, Marchetti and Krantz were the first to describe a technique for retropubic colposuspension. Many variations in the technique have since been described, but the Tanagho method of a Burch colposuspension has long been considered the gold-standard operation for stress incontinence. Vancaille and Schuessler described a laparoscopic modification of the MMK technique in 1991.

The procedure can be performed through an abdominal incision or laparoscopically. In the open technique, a lower midline incision is made, and after incision of the rectus sheath layer, the space of Retzius is dissected bluntly. Two non-absorbable sutures are placed in the endopelvic fascia on either side of the urethra and bladder neck and are tied to elevate the fascia to Cooper’s ligament without causing hyperelevation of the urethra.

Laparoscopic colposuspension is performed using four ports (one umbilical, one suprapubic and two lateral). A transperitoneal or extraperitoneal approach to the space of Retzius can be used. The space of Retzius can be dissected using monopolar scissors or a Harmonic Scalpel. Two 0 Ethibond sutures are placed on either side to elevate the vagina (Figure 1).

The dissection for colposuspension exposes an area with a very rich blood supply and haemorrhage is a significant risk. Bladder trauma may occur during dissection or placement of the sutures. Therefore, cystoscopy is recommended at the end of the procedure to exclude the inadvertent placement of a suture in the bladder and to confirm ureteral patency. Urinary retention is a common complication and in the Ward and Hilton study
was reported to occur in 21% of cases. Other later complications include de novo urgency, dyspareunia and prolapse.

**Outcome:** colposuspension remains the procedure with the longest record of data showing a good outcome; overall cure rates for open colposuspension are reported as between 68.9% and 88.0%. Data comparing open colposuspension with laparoscopic colposuspension have been difficult to interpret due to variations in technique used and the methodology of the studies. However, two RCTs comparing the laparoscopic and open procedures published in 2006 show that there is no difference in cure rates between the two. The laparoscopic approach requires the surgeon to have advanced laparoscopic skills to enable him or her to suture effectively. As a result, the recent NICE guidelines state that laparoscopic colposuspension should be performed only by an experienced laparoscopic surgeon working in a multidisciplinary team with expertise in the assessment and treatment of urinary incontinence. Laparoscopic colposuspension has also been compared to TVT, and the two procedures had similar outcomes.

**Intraurethral bulking agents**
This is the least invasive technique for the surgical treatment of stress urinary incontinence but is associated with a lower success rate than both mid-urethral tapes and colposuspension. The materials and technique vary. Currently, the most commonly used materials are GAX collagen (Contigen) and silicone particles (Macroplastique). More recently, carbon-coated zirconium beads and a non-animal-stabilized hyaluronic acid/dextranomer (NASHA/Dx) copolymer have been introduced. Teflon and autologous fat are no longer recommended due to a higher incidence of complications.

Collagen can be injected transurethrally or para-urethrally under cystoscopic guidance. The variable success rate reported may be due to difficulty in accurate placement. A device for blind injection of NASHA/Dx under local anaesthesia in an outpatient setting has been introduced to help standardize the procedure.

There are few complications with these injectable materials; they include infection and voiding difficulty.

**Outcome:** peri-urethral injection therapy is associated with short-term improvement in incontinence and a lower incidence of complications than with more invasive therapy. However, repeat injections may be required and the efficacy decreases with time. The success rate is inferior to that of surgery, but it is a worthwhile treatment option in women who are unsuitable for or do not wish to undergo more extensive surgery.

**Pubovaginal slings**
The autologous pubovaginal sling has been used for many decades as an effective means of treating stress incontinence. However, this operation has declined in popularity due to the development of synthetic mid-urethral tapes. The sling is most commonly harvested from the patient’s rectus fascia or fascia lata. Allograft materials such as cadaveric fascia lata and xenografts such as porcine dermis are also used.

Complications of the procedure include infection and wound problems at the site of the graft.

**Outcome** of the pubovaginal sling procedure with autologous fascia appears to be as good as that of TVT, with cure rates of around 80% at 12–36 months. There is evidence that the use of porcine collagen as a sling material is associated with a poorer outcome.

**Artificial urinary sphincters**
Artificial urinary sphincters are used to treat stress urinary incontinence in women in whom other procedures such as tapes, colposuspension and slings have failed. The sphincter device comprises an inflatable cuff, a balloon to control pressure and a pump. It can be placed through the vagina or through the abdomen.

Complications include bladder or urethral injury. Infection and erosion of the sphincter are common complications often requiring revision and replacement.

**Outcome:** one study of 68 women who had an AUS inserted showed that at 7 years after the procedure 37% had the original device in situ and were continent. The device was replaced in 18% for loss of function and 45% had the device removed for infection or erosion. The overall continence rate was 81%.

**Urinary diversion**
Urinary diversion procedures involve creation of a reservoir for urine that may or may not include the patients’ own bladder, and an emptying mechanism that is controlled by a sphincter or an intermittently catheterized stoma. A rectosigmoid diversion can also be created that does not require a stoma. These procedures require complex urological reconstructive skills and are outside the remit of most gynaecologists.

**Surgery for urge incontinence**
Surgery for urge incontinence due to detrusor overactivity is undertaken only in patients in whom conservative treatment has failed. The aim of surgery is to increase the ability of the bladder to store urine, by increasing its compliance and reducing detrusor contractions. The mainstay of surgical treatment
has been augmentation cystoplasty (‘CLAM’), but the newer modalities sacral neuromodulation and botulinum A toxin have recently been introduced. As a consequence, fewer women now require reconstructive surgery for intractable detrusor overactivity.

**Botulinum A toxin**
Cystoscopic injection of botulinum A toxin into the detrusor muscle is a promising new treatment for refractory detrusor overactivity. A dose of 200 units is injected at 20 sites into the detrusor muscle, sparing the trigone in women with idiopathic detrusor overactivity. Complications include voiding difficulty requiring self-catheterization and UTI.

**Outcome:** reported cure rates are 75–88% at 12 weeks following injection in women with idiopathic detrusor overactivity. There are no long-term data available on the outcome or safety of this intervention. Women must be counselled on the lack of data on long-term use, and the possible need for repeat injections and self-catheterization.

**Sacral neuromodulation**
Sacral neuromodulation is recommended for the treatment of detrusor overactivity in women in whom conservative treatments have failed. The target is the somatic afferent pathway of the micturition pathway in the spinal cord. It is achieved by placing leads in the S3 foramen and is usually performed as a two-stage procedure. In a trial step, a stimulation lead is placed next to the dorsal root of S3; if the symptoms show an adequate response, a generator unit is permanently implanted in the subcutaneous tissue. Complications include failure of the device, infection and wound problems relating to implantation of the generator.

A study of 41 patients treated with sacral neuromodulation for refractory urge incontinence showed that 90% of patients had a 50% or greater reduction in symptoms at 12 months.

**Augmentation cystoplasty**
This involves the creation of a bladder with increased functional capacity by bivalving the bladder and inserting a piece of detubularized sigmoid colon or ileum. Complications include voiding difficulty requiring self-catheterization, infection, mucus production and metabolic disorders. Lifetime follow-up with cystoscopy is recommended because of a supposed risk of malignancy, though the data to support this are poor.

This operation is very effective for detrusor overactivity. One series of 40 cases reports that 75% of patients were cured and voiding spontaneously following CLAM ileocystoplasty.

**Conclusion**
Stress urinary incontinence is the most common indication for surgery. The strongest evidence supports the use of a macroporous, polypropylene, type 1 mesh mid-urethral tape or colposuspension. There is little evidence to support the use of other types of mesh. Major reconstructive surgery for urge urinary incontinence is now less commonly performed, as both sacral neuromodulation and botulinum A toxin are less invasive alternatives. However, patients need to be informed that the long-term efficacy and safety of these newer treatments are unknown.

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**FURTHER READING**


