

# Surgical Management of Female Voiding Dysfunction



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## KEYWORDS

- Female incontinence • Pelvic organ prolapse surgery • Female voiding dysfunction • Complications

## KEY POINTS

- Correct preoperative diagnosis is key to the outcome of surgery for female voiding dysfunction. Patients should be evaluated for effective low-pressure storage, effective emptying, and lack of obstruction.
- Vaginal and abdominal approaches, or a combination, are used for incontinence and prolapse.
- Anatomic landmarks for repair of pelvic organ prolapse include the sacrum, sacrospinous ligament, uterosacral ligaments, iliococcygeus muscles, levator muscles, obturator fascia, and the arcus tendineus fascia pelvis.
- Common complications of vaginal repairs include ureter, nerve or vessel injury, urethral obstruction, mesh or graft erosion, and levator muscle spasm.
- A prior history of mesh should raise the index of suspicion for complications especially in the setting of pelvic pain, bleeding, or discharge.

## INTRODUCTION

Voiding dysfunction, a multifactorial entity with a complex presentation, can be conceptualized more simply as a disorder of filling or emptying of the urinary bladder. The bladder functions to:

- Store volume at low pressures, a function dependent on compliance (the ability to stretch at low pressures), outlet resistance, and the absence of bladder contraction.
- Empty effectively, a function of adequate bladder contraction and absence of obstruction (such as bladder neck or external urethral sphincter obstruction, urethral stricture, obstructing cystocele, or sling).

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Compliance and contractility of the bladder change over time in response to:

- *Obstruction*: leading to hypertrophy with subsequent decompensation; examples include cystocele, detrusor sphincter dyssynergia, and prior antiincontinence surgery in the female.
- *Disinhibition*: upper motor neuron pathophysiology (eg, spinal cord injury or multiple sclerosis).
- *Denervation*: lower motor neuron pathophysiology (eg, abdominoperineal resection).

Successful surgical intervention for female voiding dysfunction depends on the proper preoperative diagnosis (See [Robert C. McDonough III, Stephen T. Ryan: Diagnosis and Management of Voiding Dysfunction](#), in this issue). Due to the subjective and often confounding nature of urinary and pelvic symptoms, a considerable time investment in the clinic is required to diagnose and determine management. It is not uncommon for referral centers to evaluate patients considered refractory to surgical treatment who have simply been misdiagnosed. When conducted properly, surgery for female voiding dysfunction is directed toward restoring native anatomy (eg, reduction of cystocele) or circumventing impaired bladder function (eg, paralyzing a neurogenic overactive bladder with onabotulinumtoxin A and having the patient straight catheterize).

## STRESS URINARY INCONTINENCE

*Stress urinary incontinence* (SUI) is defined as “the complaint of involuntary loss of urine on effort or physical exertion (eg, sporting activities), or on sneezing or coughing.”<sup>1</sup> In patients with mixed-type incontinence, including urgency or unaware leakage, all types are addressed concurrently. Operative intervention for the stress component is still warranted if the stress component is predominant. Stress urinary incontinence occurs due to urethral hypermobility or intrinsic sphincter deficiency, and often both.

### *Urethral Hypermobility*

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Urethral hypermobility occurs as a continuum of anterior vaginal wall laxity.<sup>2</sup> Loss of the functional valve created by support at the level of the urethra results in leakage when there is an increase in intraabdominal pressure. Surgical intervention for urethral hypermobility aims to restore this natural hammocklike support.<sup>3</sup>

### *Intrinsic Sphincteric Deficiency*

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Intrinsic sphincteric deficiency refers to low pressure generation by the external urethral sphincter muscle itself.<sup>4</sup> Intervention involves increasing outlet resistance, accomplished by use of an injectable urethral bulking agent or a more obstructing surgical repair (eg, sling).<sup>5</sup>

## STRESS URINARY INCONTINENCE PROCEDURES

### *Bulking Agents*

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A less invasive surgical therapy for stress urinary incontinence due to internal sphincter deficiency is the use of a urethral bulking agent. These are injected transurethally or periurethrally. Injectable agents function mainly by increasing coaptation of the sphincter and providing a central volume that increases the functional length of the muscle.<sup>6</sup> This approach is best suited for:

- Stress urinary incontinence caused by intrinsic sphincter deficiency without hypermobility;
- Patients who are poor surgical candidates (because this procedure can be performed in the office under local anesthesia)<sup>7</sup>; and
- Residual incontinence after a sling or retropubic procedure.

Various agents have historically been used for their bulking effect. However, many are no longer available due to lack of efficacy or adverse effects such as particle migration and local inflammatory reactions. The materials of historical mention include Durasphere, Teflon, and Collagen. Current agents on the market are coaptite and Macroplastique.

### ***Coaptite***

Approved by the US Food and Drug Administration (FDA) in 2005, this bulking agent is composed of calcium hydroxylapatite, a principal constituent in bone, with a carrier made of carboxymethylcellulose.<sup>8</sup> Coaptite is considered nonantigenic and nonmigratory.

### ***Macroplastique***

Approved by the FDA in 2006, this bulking agent is composed of polydimethylsiloxane microparticles with a carrier made of polyvinylpyrrolidone gel.<sup>9</sup> Macroplastique is considered to be inert and nonmigratory, with no reports of urethral abscess or mass formation.

### ***Technique***

- Local anesthesia or monitored anesthesia care.
- Dorsal lithotomy position.
- A rigid 22-French cystoscope is inserted and the transurethral injection needle is angled toward the urethra at a 30° to 45° angle. The needle enters distal to the site of injection (either external sphincter or bladder neck).
  - Calcium hydroxylapatite: approximately 2 mL total of material is delivered underneath the urethral mucosa at 3 and 9 o'clock.
  - Polyvinylpyrrolidone gel: approximately 5 mL of material is delivered at 10, 2, and 6 o'clock.

Two major drawbacks to urethral injection therapy are a lower efficacy (19%–72%)<sup>10</sup> and the lack of long-term treatment effect, where patients have only temporary relief from symptoms. The majority of data is published on collagen and newer products show promise for better durability.

### ***Considerations***

- Injectable agents are appreciable on imaging and can be misinterpreted as a urethral stone or diverticulum.
- Complications include urinary tract infection, obstruction, vaginal mass, and (very rarely) abscess.

### ***Open or Laparoscopic Surgical Intervention for Stress Urinary Incontinence***

Open surgical intervention can be separated into historical and contemporary including mesh and native tissue. As described in the American Urological Association guidelines, in addition to injectables, there are 4 types of interventions available for stress incontinence: retropubic suspensions, laparoscopic suspensions, midurethral slings, and pubovaginal slings.<sup>11</sup>

### **Retropubic suspension**

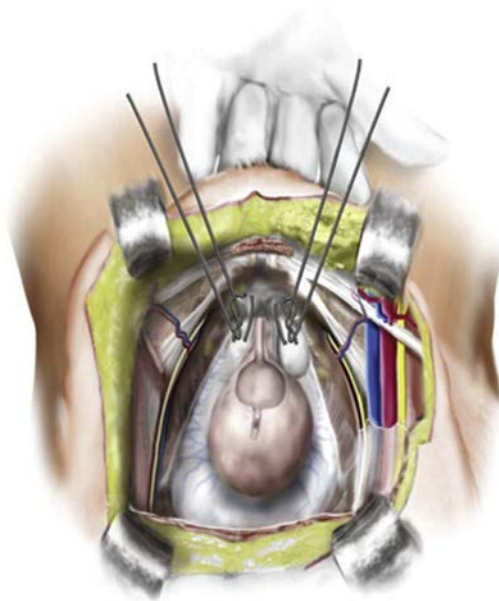
**Marshall Marchetti Krantz procedure** The *Marshall Marchetti Krantz* procedure was described in the 1940s as suspending the urethral wall and periurethral tissues (**Fig. 1**) to the pubic symphysis.<sup>12</sup> Long-term considerations include urethral devascularization, obstruction, secondary cystocele, and perioperative osteitis pubis.<sup>13</sup>

**Burch colposuspension** *Burch colposuspension* was introduced in the 1960s as anchoring the vaginal wall next to the bladder neck to Cooper's ligaments bilaterally to provide more reliable support and to avoid manipulation of the periurethral tissue (**Fig. 2**).<sup>14</sup> Long-term considerations include urethral obstruction and secondary cystocele. The procedure is still commonly performed either via retropubic or laparoscopic incisions.

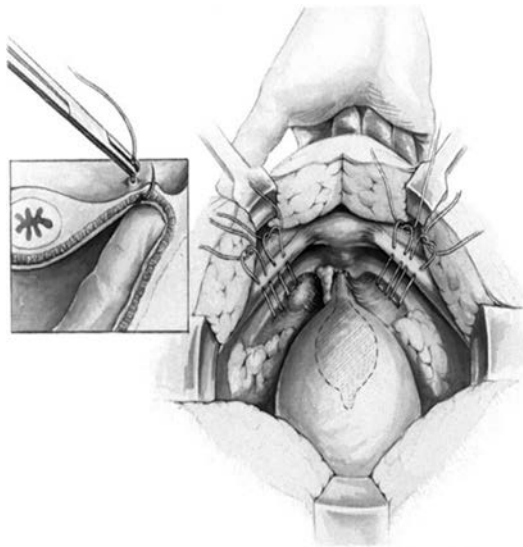
### **Needle suspensions**

These procedures involve a retropubic pass using a “needle” with varying risk of bladder injury and retropubic bleeding. Adopted from Takacs and Zimmern,<sup>15</sup> below is a brief list of suspensions.

**Four-corner bladder neck (needle) suspension** A 4-corner bladder neck (needle) suspension involves 2 sites of suspension on each side supporting both the bladder neck and the upper vagina with multiple suture passes (**Fig. 3**). Lateral support of the bladder base is restored and the vesicourethral junction into a high retropubic junction.<sup>16</sup> Suture pull-through led to lower success rates.



**Fig. 1.** Marshall–Marchetti–Krantz procedure. Suture placed bilaterally at the bladder neck, then through the pubic symphysis periosteum. (From Karram MM. Retropubic urethropexy for stress incontinence. In: Atlas of pelvic anatomy and gynecologic surgery. Philadelphia: Saunders; 2011. p. 423–6; with permission.)



**Fig. 2.** Burch colposuspension technique. (*From Walters MD. Retropubic operations for stress urinary incontinence, In: Walters MD, Karram MM, editors. Urogynecology and reconstructive pelvic surgery. 4th edition. Philadelphia: Elsevier Saunders; 2015; with permission.*)

**Anterior vaginal wall suspension** Anterior vaginal wall suspension is a modification of the 4-corner bladder neck suspension. Helical sutures through the width of the anterior vaginal wall lead to lower potential for suture pull-through (**Fig. 4**). They are passed retropubic and tied off-tension overlying the rectus fascia.<sup>17</sup> This is a current procedure that allows for support of the anterior vaginal wall at the same time as correcting the hypermobility component of stress incontinence.

**Pereyra** Pereyra involves a small transverse suprapubic incision, stainless steel suture, 2 passes per side.<sup>18</sup> Suture pull-through impacted the success of this procedure.

**Raz-modified Pereyra** The Raz-modified Pereyra incorporated an inverted U incision, accessing the retropubic space for mobilization of the bladder neck and fingertip guidance during needle passage, and full-thickness vaginal wall helical anchoring sutures.<sup>19</sup>

**Stamey** The Stamey procedure includes the addition of a Dacron pledget to buttress the periurethral tissue, and performance of a concurrent cystoscopy during needle passage.<sup>20</sup>

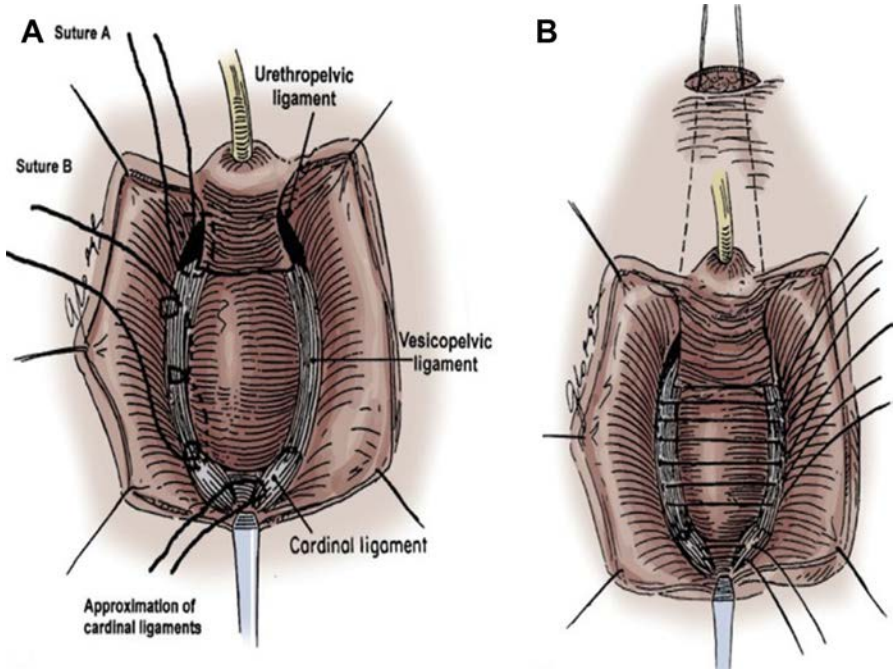
**Gittes** The Gittes procedure is a no-incision, full-thickness “autologous pledget” tied suprapubically.<sup>21</sup>

### **Vaginal repair**

**Kelly-type plication** The Kelly-type procedure includes plication of the pubocervical fascia (circular muscular layers of the vagina) overlying the bladder neck and urethra with imbricating sutures. No longer used as a primary procedure for stress incontinence due to low success rates. See Kelly Kennedy Plication.

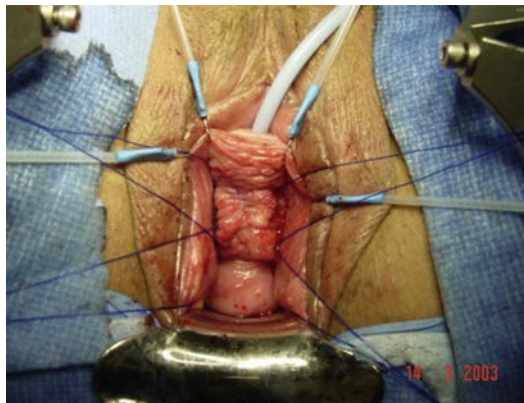
### **Slings**

According to the American Urogynecologic Society and the Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction, the polypropylene mesh

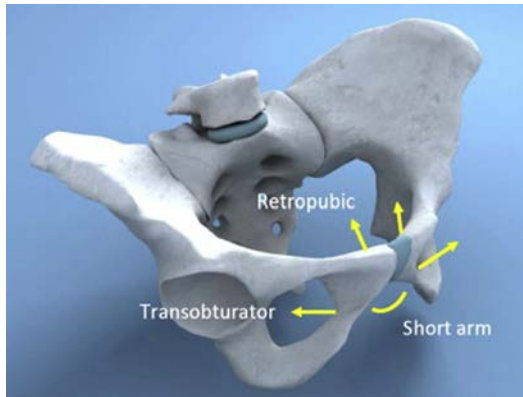


**Fig. 3.** (A) Four-corner suspension through goal-post incision. Suture A: periurethral tissue at mid urethra. Suture B: endopelvic fascia at bladder neck, perivesical fascia, and ipsilateral cardinal ligament. (B) Imbricating sutures to reduce the cystocele. Suspension sutures are transferred suprapubically. (From Karram M. Vaginal reconstructive surgery for sphincteric incontinence. In: Wein AJ, Kavoussi LR, Novick AC, et al, editors. Campbell-Walsh urology. Philadelphia: Saunders; 2007; with permission.)

midurethral (retropubic and transobturator) sling (**Fig. 5**) is now the recognized standard of care for the surgical treatment of stress urinary incontinence.<sup>22</sup> Because midurethral slings involve mesh, and due to anatomic concerns regarding long-term restoration of support, this recommendation is not universal.<sup>5</sup>



**Fig. 4.** Anterior vaginal wall suspension: "French window" configuration of helical sutures.



**Fig. 5.** Pelvic model. The *arrows* indicate the location of the retropubic sling, the transobturator sling and the short-arm sling. (From Riss P, Hinterholzer S. Maintaining standards for surgery for female urinary incontinence. *Maturitas* 2010;65(1):5–10; with permission.)

**Retropubic midurethral mesh slings** Trocars traverse the suprapubic area, the retropubic space, and the mid urethra. Severe vascular or nerve injury and bowel perforation as well as death have been reported due to injury along the trajectory of the trocars. Bladder perforation is a more common and less serious consequence.

**Transobturator midurethral mesh sling** Trocars traverse the obturator foramen at the junction of the inferior pubic ramus with the pubic symphysis via the notch posterior to the insertion of the adductor longus tendon and a vaginal incision along the mid urethra. The obturator nerve provides adduction (adductor muscles), lateral rotation of the hip (gracilis muscle), and sensory innervation of the inner side of the thigh and knee. Injury can impact adduction and leg crossing, leading to pain and paresthesias. There can also be anomalous branches of nerve or the obturator vessels. Injury to the adductor longus tendon can lead to severe pain and immobility. Early detection before fibrosis is essential because it allows for complete removal.

**Single incision mesh sling** A single incision mesh sling requires only a vaginal incision and self-anchors to the obturator membrane (or endopelvic fascia in the direction of the retropubic space).

**Pubovaginal sling** This was the originally described “sling.” It involves placing sling material, usually the patient’s own autologous rectus fascia or fascia lata (alternatives include cadaveric, porcine, or mesh material) at the level of the bladder neck, traversing the retropubic space, and tying off-tension overlying the rectus fascia.

**Readjustable sling** The readjustable sling consists of an adjustable veritensor and polypropylene mesh and is typically used for refractory patients. The Prolene sutures on either side of this mesh sling (substitutable for biological material) are passed from the vaginal incision through the retropubic space and rectus fascia and are secured in the veritensor overlying the rectus fascia. The veritensor is adjusted once the patient is awake then the “key” is removed. It can also be reaccessed with a new key and adjusted at a time remote from the original procedure.<sup>23</sup>



## PELVIC ORGAN PROLAPSE: NATIVE TISSUE AND MESH

*Pelvic organ prolapse (POP)* is the “descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix), or the apex of the vagina (the vaginal vault or cuff scar after hysterectomy).”<sup>1</sup> It is further categorized by the prolapsing organ.

- Anterior compartment prolapse often involves the bladder and is known as a *cystocele*.
- Posterior compartment prolapse often involves the rectum and is referred to as a *rectocele*.
- Prolapse of bowel is called *enterocele*.
- Descent of the perineal body and levator plate is known as a *perineocele*.
- The involvement of all 3 compartments including the uterus is collectively known as *prolapsedia*.

POP can be completely asymptomatic. Symptoms occur most often once the prolapse passes the hymenal remnant. They may worsen as the prolapse advances, and include pelvic pressure, and sexual, defecatory, and urinary symptoms such as obstruction and urge urinary incontinence. Furthermore, severe consequences can result, such as urinary tract obstruction, urinary tract infections, or in cases of severe neglect ulceration with bowel evisceration (Fig. 6). Surgical options are considered if conservative measures are insufficient, if symptoms are a significant detriment to quality of life, or if there is a health consequence posed due to the POP.

Surgical correction of POP requires knowledge of the main supports available for a safe, durable repair. These supports include the arcus tendineus fascia pelvis, levator



**Fig. 6.** Bowel evisceration via ulcerated prolapsedia in a neglected nursing home patient. (Courtesy of Brian Murray MD, Albany, NY.)



muscles, uterosacral ligaments, sacrospinous ligament, iliococcygeus muscle, rectus fascia, and the sacral promontory, which must be accessed without injuring the nerves, vessels, ureters, or adjacent organs within the pelvis. Assessment for involvement of each compartment is essential to completing the appropriate intervention. The vagina is “a house of cards,” such that improving support to one compartment may increase strain on the others.

Treatment of POP has changed over time. In an effort to increase the durability of repairs, the use of mesh increased until 2008, at which point (and again in 2011) FDA warnings were published regarding mesh complications. Due to increased concerns over the use of transvaginal mesh, sacrocolpopexy placing mesh abdominally via minimally invasive techniques has increased.<sup>24</sup> Although vaginal mesh is still marketed, many companies have pulled their products from the market. Consequently, native tissue vaginal approaches have reemerged.

Due to the numerous repairs that have been available over time, it is important for the general surgeon to understand both current and historic approaches in the patient’s surgical history, to plan further surgery or manage complications in a safe and effective manner.<sup>25</sup>

### ***Vaginal Vault Suspension***

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For apical prolapse with or without the uterus present, there are 5 main options.

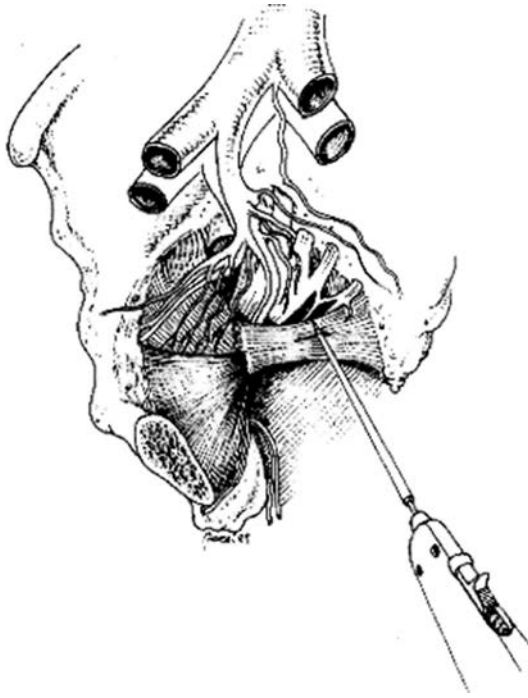
#### ***Vaginal approach***

**Sacrospinous ligament suspension** Transvaginal suspension of the vaginal apex to the sacrospinous ligament undertakes both its dissection and suture placement in the extraperitoneal space.<sup>26</sup> Sutures are placed slightly caudad in the midportion of the sacrospinous ligament (**Figs. 7** and **8**). Injury can occur to the pudendal nerve and vessels laterally or the sciatic outflow more cephalad. There are many anatomic variations of the pudendal nerve. For example, the inferior rectal nerve (a branch) can penetrate directly through the sacrospinous ligament. Injury of this branch can lead to fecal incontinence. The sciatic nerve lies 2 cm from the sacrospinous ligament (**Fig. 9**).

**Iliococcygeus suspension** The iliococcygeus suspension uses similar principles to the sacrospinous ligament vault fixation, but in an effort to avoid the dangers surrounding the sacrospinous ligament, utilizes the iliococcygeus muscle.<sup>27</sup>

**Vaginal uterosacral ligament suspension** Intraperitoneal access is gained transvaginally via cuff dissection or at the time of hysterectomy. The vaginal apex is suspended to the uterosacral ligaments bilaterally (**Figs. 10–13**).<sup>28</sup> Due to the fact that the ureter is 1 cm from the uterosacral ligament on its cephalad end, ureteric injury rates are reported as high as 11%.<sup>29</sup> The majority of injuries are identified and addressed intraoperatively at the time with the administration of ureteric chromatic agents. It is debated whether to place ureteric stents before the procedure.

**Mesh** The most comprehensive pictorial for the mesh kits can be found in “Insertion and Removal of vaginal Mesh for Pelvic Organ Prolapse,” by Muffly and Barber.<sup>30</sup> This article catalogs the products that were available in 2010, their routes of insertion, types of mesh, and sites of fixation. The mesh kits use the same points of fixation as native tissue surgery: the sacrospinous ligament, iliococcygeus muscle, arcus tendineus fascia pelvis, obturator fascia, and levator muscles. The route of trocar passage and type of mesh (open pore monofilament is preferable), as well as presence of infection will dictate the outcome and potential for complications (**Fig. 14**).



**Fig. 7.** Loaded inserter's shaft is pushed through the body of the coccygeus muscle and sacrospinous ligament, to the ischial spine to avoid the pudendal complex and sciatic nerve, found under the lateral third of the sacrospinous ligament. (From Giberti C. Transvaginal sacrospinous colpopexy by palpation—a new minimally invasive procedure using an anchoring system. *Urology* 2001;57(4):666–8; with permission.)

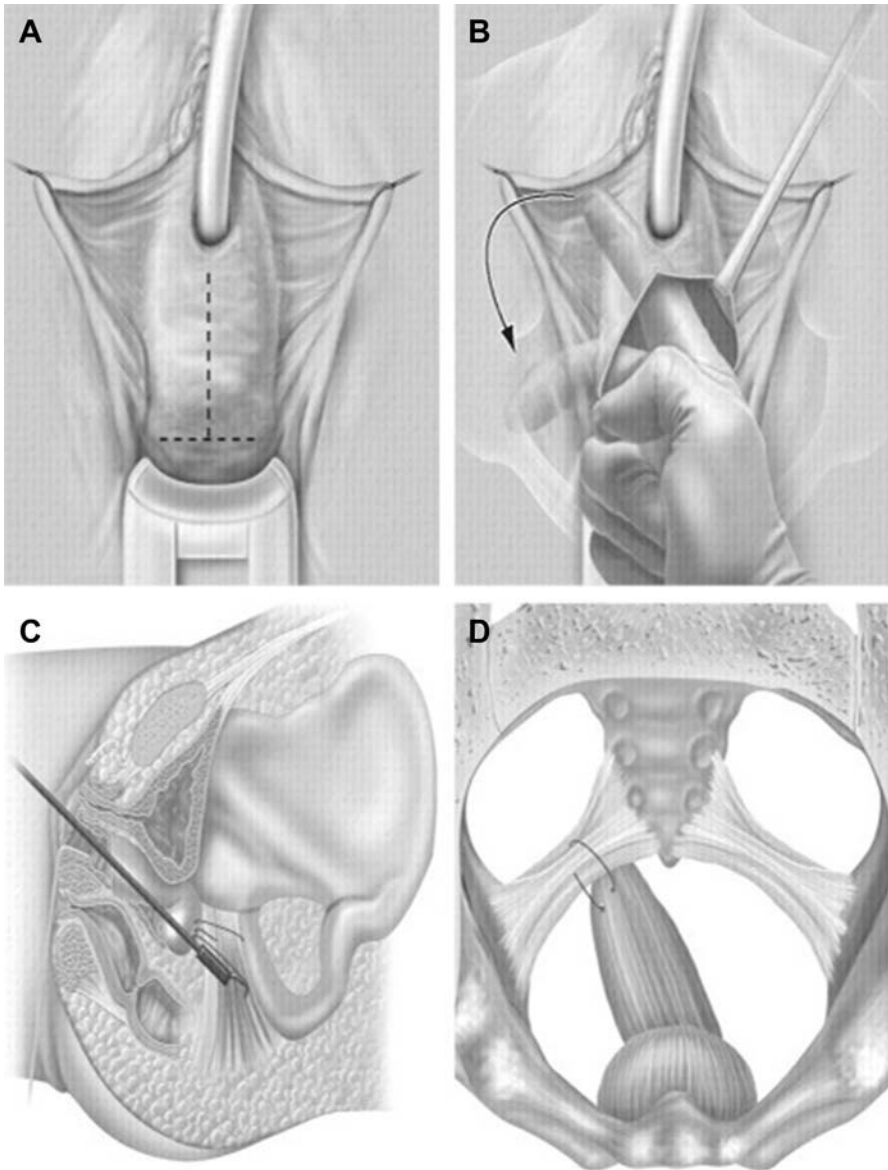
### **Abdominal approach**

**Abdominal sacrocolpopexy** Abdominal sacrocolpopexy may be performed via an open, laparoscopic, or robotic-assisted approach. The peritoneum is dissected from the vagina, synthetic Y-mesh is tacked to the anterior and posterior aspect of the vagina, then sutured to the anterior longitudinal ligament at S1 and S2 (**Fig. 15**). Randomized studies have demonstrated that biological material is inferior and therefore synthetic mesh is uniformly used.<sup>31</sup> During dissection, injury to the ureter, bladder, rectum, hypogastric nerves, middle sacral vessels, or iliac vessels can occur. If the mesh is not re-peritonealized, the patient is at risk of bowel obstruction due to adherence to the mesh. Rarely, sacral osteomyelitis or discitis can occur. Vaginal mesh erosion is a possibility, although of lower likelihood than with the vaginal approaches. The cervix is left in place due to high rates of erosion with concurrent trachelectomy.<sup>32</sup>

### **Cystocele Repair**

#### **Kelly Kennedy plication**

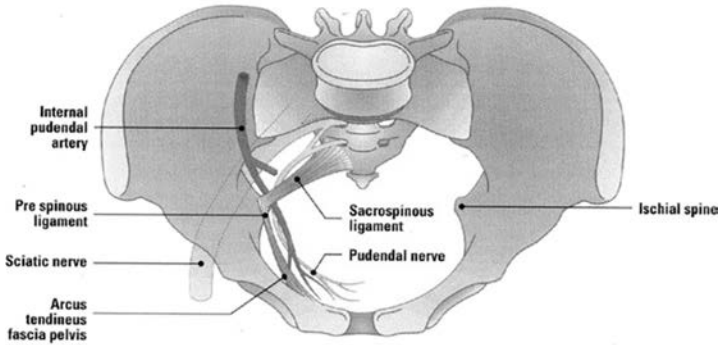
Kelly Kennedy plication involves a midline plication of the pubocervical fascia (the circular muscular layers of the vagina) after dissecting under the vaginal mucosa (**Figs. 16** and **17**). Additional imbrication overlying the urethra is considered the Kelly plication with a 30% to 50% success rate for stress urinary incontinence.<sup>33</sup>



**Fig. 8.** Dissection for anterior sacrospinous vaginal vault suspension. (A) Incision (*dotted lines*). (B) Perforation into retropubic space through anterior vaginal wall incision and dissection. (C) Placement of suture in sacrospinous ligament with straight capio device. (D) Suspension of vaginal vault to sacrospinous ligament. (From Botros SM, Goldberg RP, Sand PK. Sacrospinous ligament suspension for vaginal vault prolapse. In: Raz S, Rodriguez L, editors. *Female urology*. Philadelphia: Saunders; 2008. p. 673–82; with permission.)

#### **Site-specific graft augment**

Site-specific graft augment may be undertaken with biological material (human cadaveric, porcine, bovine)<sup>34</sup> or mesh (**Fig. 18**). Currently, mesh is made of polypropylene monofilament but prior products included multifilament and small pore products



**Fig. 9.** Superior aspect of pelvis with sacrospinous ligament and iliococcygeus fascia and their relationship to major nerves and vessels. (From Maher CF. Iliococcygeus or sacrospinous fixation for vaginal vault prolapse. *Obstet Gynecol* 2001;98(1):40–4; with permission.)

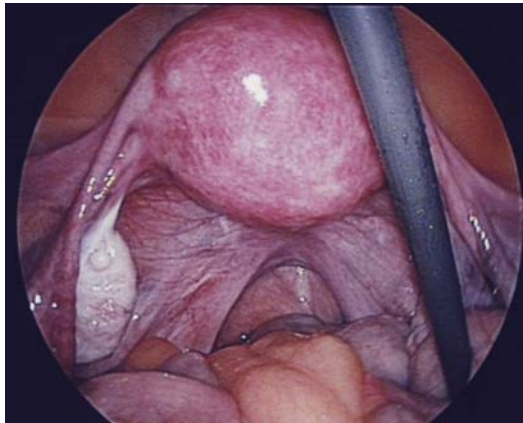
with poor incorporation and tolerance. Site-specific grafts in cystocele repair are typically secured to the arcus tendineus fascia pelvis laterally (level II support), and/or the sacrospinous ligament (level I support) cephalad.

#### ***Lateral paravaginal repair (relatively historic)***

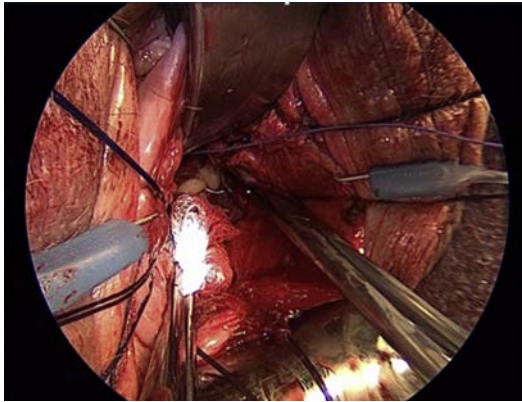
The vagina is plicated in the midline and the lateral attachments are taken down and recreated with sutures to the lateral pelvic sidewall.<sup>35</sup> Although little is published on this technique, reports include relatively high transfusion rates.<sup>36</sup>

#### ***Anterior vaginal wall suspension***

Anterior vaginal wall suspension is a needle suspension technique that involves helical sutures placed in a horizontal plane on each side of the vagina, as described regarding its application to stress urinary incontinence. The retroperitoneal space is entered bilaterally by taking down the endopelvic fascia. The surgeon's finger is passed up and under the anterior rectus sheath, protecting the bladder and other structures, such as ectopically positioned bowel. A small lower abdominal incision is created above the pubic symphysis and a dual pronged needle passer is passed to the



**Fig. 10.** Uterosacral ligaments are visible medially when the uterus is placed on tension (laparoscopic view).



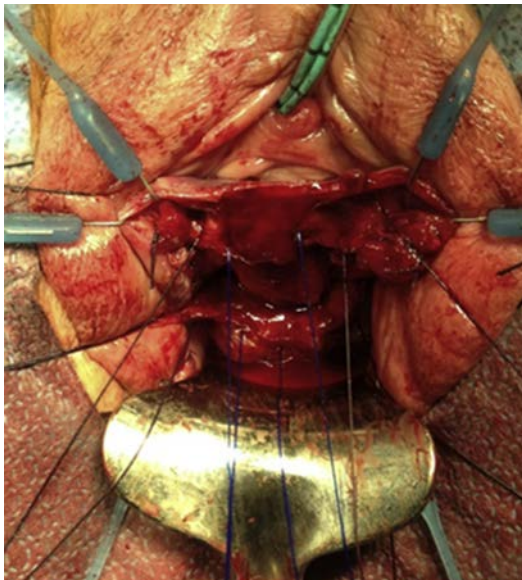
**Fig. 11.** Suture in the uterosacral ligament from the vaginal approach.

surgeon's finger bilaterally, then led into the vagina. The vaginal sutures are threaded into the passer and delivered from the vagina to the anterior abdominal wall, then tied overlying the rectus fascia off tension. Complications include hematoma and injury to the ilioinguinal nerve.<sup>17</sup>

#### ***Mesh kits***

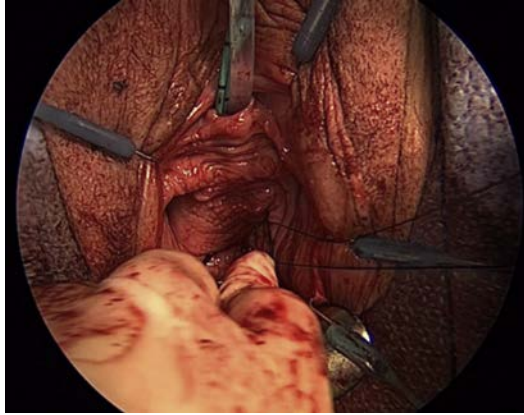
Mesh kits for anterior repair have been shown in randomized trials to decrease the incidence of reoperation for recurrence of prolapse but to increase the likelihood of reoperation for complications such as mesh erosion.<sup>31</sup> Mesh kits for support of the anterior vaginal wall can involve the following.<sup>30</sup>

- Trocar passage through the obturator membrane at 2 sites (closer to and farther from the pubic symphysis);



**Fig. 12.** Uterosacral ligament vault fixation sutures place in succession at the apex.





**Fig. 13.** Tying the uterosacral ligament suspension sutures.

- Fastening mechanisms from within the vaginal incision to the arcus tendineus fascia pelvis, levator muscles, or obturator foramen; or
- The addition of vault support fastening mechanisms including the sacrospinous ligaments bilaterally.

In general, the single-incision kits are easier to remove if needed, because the trocar-based mesh kits leave material adhered within planes of the bony and muscular pelvis.

### ***Rectocele Repair***

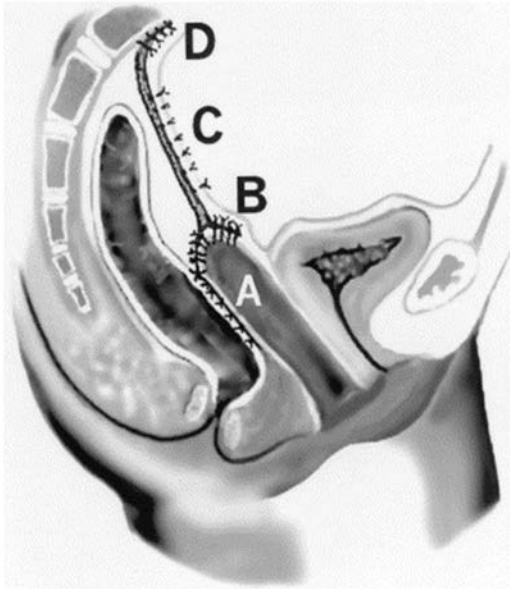
Rectocele repair can be achieved in many ways, and often includes a perineorrhaphy, reconstruction of the perineal body in the midline.

### ***Posterior colporrhaphy***

Mattress sutures plicate the rectovaginal muscularis across the midline similar to the midline Kelly Kennedy or rectovaginal fascial plication.<sup>37</sup>



**Fig. 14.** After introducing the straps of the Gynecare Prolift mesh through the loops of the retrieval devices they are pulled sequentially through the cannulas. (From Reisenauer C. Anatomic conditions for pelvic floor reconstruction with polypropylene implant and its application for the treatment of vaginal prolapse. *Eur J Obstet Gynecol Reprod Biol* 2007;131(2):214–25; with permission.)



**Fig. 15.** Sagittal view of a completed abdominal sacrocolpopexy. Posterior wall enterocele repair (A) is shown with its attachment to the posterior limb of the mesh. The vagina is attached to the Y of the mesh (B), and the other end is attached to the anterior longitudinal ligament of the sacrum using multiple permanent sutures (D). The overlying peritoneum is then closed to completely cover the suspending mesh (C). (From Cespedes RD. Diagnosis and treatment of vaginal vault prolapse conditions. *Urology* 2002;60(1):8–15; with permission.)

#### ***Site-specific defect repair***

Interrupted sutures reapproximate the detached edges of the rectovaginal fascia (the circular muscular layers of the vagina), correcting appreciable defects.<sup>38</sup> This method can be used in combination with the other techniques.

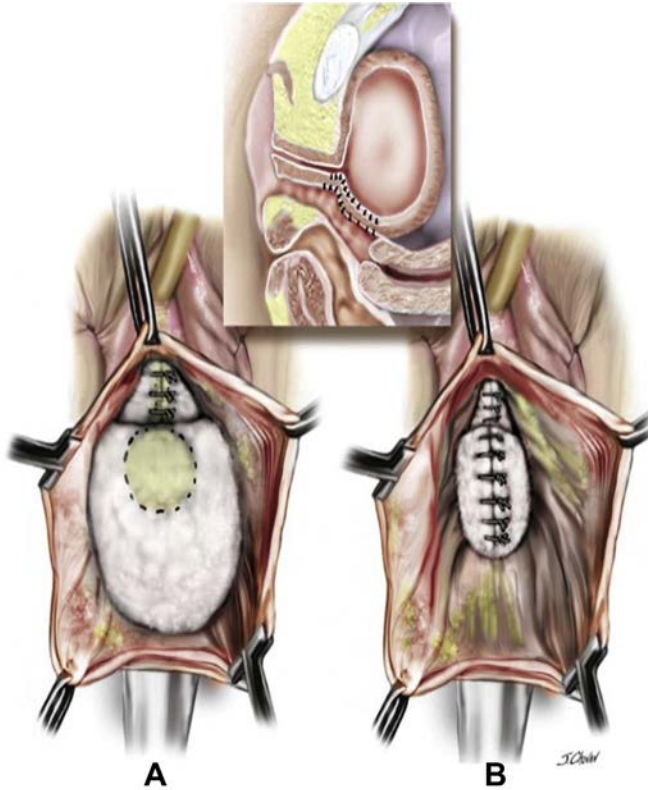
#### ***Site-specific graft augment***

Site-specific graft augment with biological material (human cadaveric, porcine, bovine)<sup>31,39</sup> or synthetic graft.<sup>40</sup> When compared with traditional repair, this approach has poorer outcomes. However, the only high-quality data include porcine material,



**Fig. 16.** Dissection for cystocele repair.





**Fig. 17.** Anterior colporrhaphy with Kelly–Kennedy plication. (A) The vaginal mucosa is opened and interrupted sutures are started under the urethra. (B) The completed colporrhaphy uses midline plication with interrupted sutures. Preferential support is provided to the proximal urethra over that provided to the bladder. (From Maher CF, Karram MM. Surgical management of anterior vaginal wall prolapse. In: Karram MM, Maher CF, editors. Surgical management of pelvic organ prolapse. Philadelphia: Saunders; 2013; with permission.)

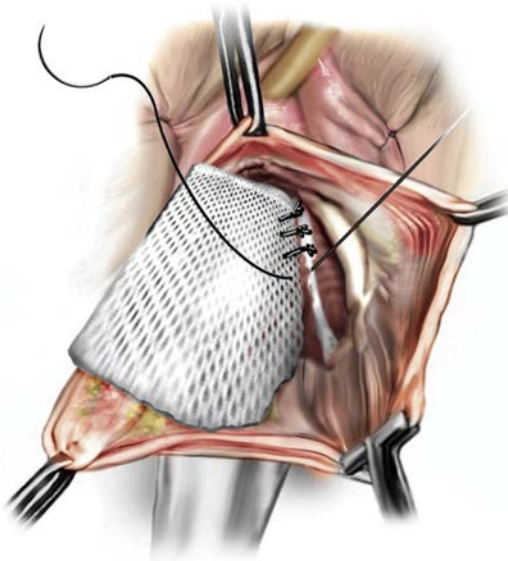
which may be more immunogenic than human products. Mesh grafts overlying the rectum have led to rectovaginal fistula with significant difficulty in repair due to the dense adhesions of the surrounding tissue to the mesh and often overlying infection. Colostomy and removal of a significant margin of (if not all) the mesh, are fundamental to the operative plan (Fig. 19).<sup>41</sup>

#### **Levator myorrhaphy**

Levator myorrhaphy involves plicating the levator muscles in the midline as the foundation of the support for the rectal wall.<sup>42</sup> Pelvic pain and dyspareunia rates are high enough that this approach is not often used.

#### **High midline levator myorrhaphy**

High midline levator myorrhaphy typically involves opening the peritoneal cavity and fixing the vault of the vagina to a reconstructed shelf of levators high in the pelvis. This approach involves the closure of the enterocele inherent in an open peritoneal dissection. This approach reports lower rates of pain, perhaps due to the higher location on the levator muscles.<sup>43</sup>



**Fig. 18.** Graft augmentation of lateral cystocele repair, suturing to the arcus tendineus fascia pelvis, the condensation of endopelvic fascia forming a fibrous band from the pubic symphysis to the ischial spine. (From Nitti VW, Karram M. Repair of anterior vaginal prolapse. In: Vaginal surgery for the urologist. Philadelphia: Saunders; 2012. p. 23–34; with permission.)

### **Mesh kits**

As with the anterior repair, there are trocar-based kits and single incision site-specific kits. All involve mesh but as the kits evolved some reduced the volume of mesh or incorporated a biologic component. Most of these products have been removed from the market.

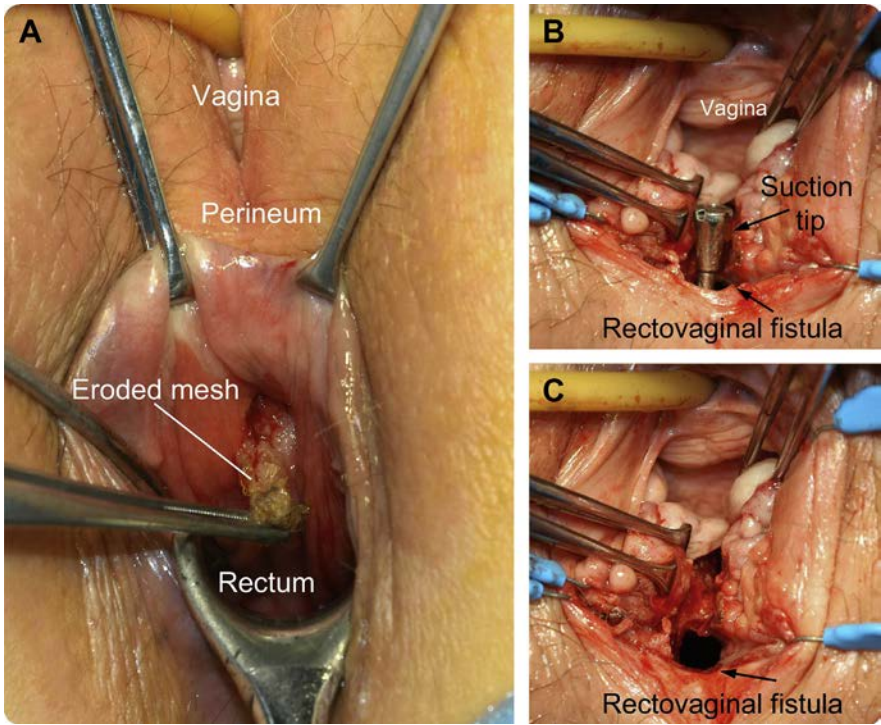
- Trocar routes typically traversed transgluteally and pararectally up through the iliococcygeus muscle or sacrospinous ligament.
- Single incision nontrocar fixation typically involves the sacrospinous ligament and the levator muscles.
- Depending on the mesh character and the plane of dissection, rectal perforation and erosion can be a serious consequence of this approach in addition to the typical risks of ureter, nerve and vascular injury. More subtle rectal findings could involve compression and kinking.

## **URGE URINARY INCONTINENCE**

*Urgency (urinary) incontinence* is defined as “the complaint of involuntary loss of urine associated with urgency.”<sup>1</sup> Treatments are typically behavioral and medical but for refractory cases the following options exist.

### ***Onabotulinumtoxin A to Bladder Detrusor***

Doses of 100 to 400 units are used, typically 100 units for those who void spontaneously and a starting dose of 200 units for those who self-catheterize. Urinary tract infection is the most common complication, followed by urinary retention requiring intermittent catheterization. Distant spread of toxin is a theoretic complication at these doses.



**Fig. 19.** Rectovaginal fistula. (A) Posterior mesh has eroded through the posterior vaginal wall and through the rectal wall, causing a rectovaginal fistula. (B) After removal of mesh, suction tip demonstrates rectovaginal fistula. (C) Vaginal side of fistulous tract is visible. (From Margulies RU, Lewicky-Gaup C, Fenner DE, et al. Complications requiring reoperation following vaginal mesh kit procedures for prolapse. *Am J Obstet Gynecol* 2008;199(6):678.e1-4; with permission.)

### ***Interstim Sacral Neuromodulation***

Interstim sacral neuromodulation is an option for those with nonneurogenic overactive bladder. A lead is placed along the S3 nerve route and a low-grade vibration raises the threshold for neural communication in the pelvis.<sup>44</sup> Indications include not only urgency, frequency, and urge urinary incontinence, but also idiopathic urinary retention and fecal incontinence.<sup>45</sup>

### ***Augmentation Cystoplasty***

Augmentation cystoplasty involves augmentation of the bladder using ileum or other sections of bowel, described elsewhere in this issue (See [Moritz Hansen, Matthew Hayn, Patrick Murray: The Use of Bowel in Urologic Reconstructive Surgery](#), in this issue). Electrolyte abnormalities, urinary retention, stones due to mucous build up, and perforation due to overdistension/delayed catheterization (a surgical emergency) are the most common complications.<sup>46</sup>

## **OBSTRUCTION**

### ***Urethral Diverticulum***

Urethral diverticulum is an outpouching of the urethra that can be dissected and repaired to address its resultant urinary tract infections, postvoid dribbling, bladder

outlet obstruction, and dyspareunia.<sup>47</sup> A Martius labial fat pad is often used for vascular interposition.

### ***Urethral Stricture***

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Urethral stricture is rare in women. Urethral dilation is commonly used as first intervention. Maintenance of patency can be helped by periodic self-catheterization. Formal repair can be undertaken with urethral reconstruction.

### ***Onabotulinumtoxin A to Sphincter or Bladder Neck***

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Onabotulinumtoxin A to sphincter or bladder neck can relax the internal or external urethral sphincter in a patient with primary (idiopathic) bladder neck obstruction or neurologic etiology for dyssynergia of either sphincter.

### ***Incision of Bladder Neck***

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Incision of the bladder neck is used only rarely for women with primary bladder neck obstruction who are refractory to alpha blocker medical therapy and onabotulinumtoxin A. Stress urinary incontinence is a predictable risk and self-catheterization may be a preferred mode of therapy.

### ***Levator Dysfunction***

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For levator dysfunction and behavioral dysfunction of the external urethral sphincter, pelvic floor physical therapy is an extremely useful intervention for incomplete emptying, urinary urgency frequency, incontinence, dyspareunia, and defecatory dysfunction related to a dysfunctional pelvic floor.<sup>48</sup> Onabotulinumtoxin A can be injected directly into the external urethral sphincter and levator muscles in cases refractory to physical therapy and oral muscle relaxants.<sup>49</sup>

Prolapse of the anterior vaginal wall can lead to obstruction, as discussed.

## **SUMMARY**

Surgery for female voiding dysfunction is varied and depends on the clinical picture at presentation. Review of the prior operative note, and a general understanding of the type of procedures performed, will typically shed light on the organs affected by complications or future surgical planning.

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