FEMALE PELVIC SURGERY VIDEO ATLAS SERIES

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Vaginal Surgery for the Urologist

Victor Nitti

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Vaginal Surgery for the Urologist

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Victor W. Nitti

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Nirit Rosenblum

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Preface

The field of female pelvic medicine and reconstructive surgery has evolved since the early 1990s, melding specialists and techniques from urology with those from obstetrics and gynecology. This has provided comprehensive management of women with pelvic floor disorders, including urinary incontinence and lower urinary tract disorders, pelvic organ prolapse, and childbirth-related injuries. Although laparoscopic and robotic surgery have evolved to provide less invasive abdominal approaches, vaginal surgery remains a large component of the surgical treatment of such disorders. In fact, many of the conditions that are treated surgically are optimally handled via a vaginal approach.

Vaginal surgery requires a unique skill set and understanding of anatomy because it is approached through the vagina. We believe that it is essential that surgeons caring for women with pelvic floor and genitourinary disorders be skilled in vaginal surgery. This video atlas and text is designed to be a how-to guide for various vaginal procedures and techniques. Each chapter contains a description of the relevant anatomy for the procedures to be described, followed by a step-by-step description of the individual procedures, with an emphasis on special techniques and "surgical pearls" that we find to be useful. We fully realize that for many of the procedures described there are alternative vaginal (and nonvaginal) approaches. We have chosen to describe procedures and techniques that we commonly use and have evolved during more than 20 years of surgical practice. The anatomy and procedures are further described through the beautiful illustrations of Joe Chovan, as well as in more than 70 videos. Many of the videos are accompanied by case presentations.

We wanted to make certain that all major areas and types of vaginal surgery for the urologist caring for female pelvic floor disorders were covered. The book starts with a chapter on how to perform a focused physical exam on women with pelvic floor disorders. Many of the commonly seen conditions, as well as normal and abnormal anatomy, are demonstrated in video clips. The second chapter sets the stage for the rest of the book by describing the most common vaginal incisions and dissection techniques. Seven chapters are dedicated to the surgical treatment of pelvic organ prolapse, including chapters on anterior, apical, and posterior repairs, as well as hysterectomy for prolapse, colpocleisis, and the use of graft augmentation. The three chapters dedicated to female urethral surgery, including a chapter on various techniques of urethral reconstruction, provide a unique aspect to this atlas. Finally, there are chapters on anterior vaginal wall masses, vesicovaginal and urethrovaginal fistulae, and vaginal surgery complications.

It is our hope that this video atlas will serve as a useful supplement for urologists and female pelvic surgeons who are actively involved with the surgical treatment of female pelvic disorders. We thank Dr. Mickey Karram, the Female Pelvic Surgery Video Atlas series editor, for allowing us to produce this atlas and for his many contributions to this book.

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How to Perform a Focused Pelvic Examination of a Woman With Pelvic Floor Dysfunction

Eva Fong, MD
Mickey Karram, MD
Victor W. Nitti, MD

Videos

1-1 Principles and Highlights of the Pelvic Examination
1-2 Examples of a Variety of Cases of Advanced Prolapse
1-3 Focused Pelvic Examination (Example 1)
1-4 Focused Pelvic Examination (Example 2)
1-5 Focused Pelvic Examination (Example 3)
1-6 Focused Pelvic Examination (Example 4)

Nearly 24% of U.S. women are affected by one or more pelvic floor disorders (urinary incontinence, fecal incontinence, pelvic organ prolapse [POP]), and these disorders increase in frequency with age, affecting more than 40% of women aged 60 to 79 years and about 50% of women aged 80 years and older. According to the 2008 U.S. Census Bureau projections, the number of American women older than age 65 will more than double in the next 30 years to more than 44 million by 2040. Furthermore, Luber et al project that the demand for health care services related to pelvic floor disorders will increase at a rate twice that of the growth in this older population group.

Female pelvic floor dysfunction can be broadly categorized into five therapeutic areas:

1. Lower urinary tract symptoms (including incontinence, overactive bladder, and emptying problems)
2. Pelvic support defects (resulting in POP)
3. Defecatory dysfunction (including anal-fecal incontinence, constipation, outlet obstruction)

4. Sexual dysfunction (including dyspareunia, orgasmic dysfunction, and decreased libido)
5. Pelvic pain, which can originate from the bladder, the uterus, the vagina, or the lower gastrointestinal tract

Women commonly have more than one set of these symptoms, which makes evaluations more complex. History taking should be focused and should provide an understanding of the impact of the presenting symptom(s) on the patient's quality of life.

All women with any of the aforementioned conditions should undergo a focused examination of the pelvic floor (Videos 1-1 and 1-2). The goal of the examination is to attempt to correlate the functional abnormality of which the patient complains with the anatomical abnormalities present on examination. It is also important to view the pelvis as a whole and not to focus on one specific area. For example, if a woman complains of stress incontinence, not only should the anterior vaginal compartment be examined, but also the entire pelvic floor should be checked for functional integrity and associated anatomical abnormalities. A systematic pelvic examination can be facilitated by dividing the pelvic floor into six specific anatomical areas:

1. Distal anterior vaginal wall
2. Proximal anterior vaginal wall
3. Vaginal apex or cervix
4. Distal posterior vaginal wall
5. Proximal posterior vaginal wall
6. Perineum and external anal sphincter

Assessment in each area should focus on level of support, sensation, and tone.

The physical examination begins with visual inspection of the vulva, external urethral meatus, perineum, and vaginal tissues. This inspection may identify specific abnormalities such as excoriation, atrophic vaginitis, urethral prolapse or caruncle, obvious prolapse beyond the hymen, or perineal scarring or bulging. A bimanual examination assesses for any pelvic, vaginal, bladder, or urethral masses or tenderness. If the patient still has her uterus, the bimanual examination should document the position and size of the uterus as well as the presence or absence of any palpable adnexal mass.

Assessment of Support and Stress Incontinence

A speculum examination is performed with the posterior blade of a Graves or bivalved speculum (split-speculum technique) in a systematic manner so that the anterior, apical, and posterior compartments of the vagina can be assessed. First the posterior vaginal wall is retracted and assessment is performed for anterior prolapse (cystocele), apical prolapse (prolapse of the cervix or vaginal cuff), and urethral masses (Fig. 1-1). Scarring from previous surgery and the extent of prolapse can be seen during straining (Fig. 1-2). The effect of straining on the external urethral meatus can also be seen. For inspection of the vaginal cuff and apex, two blades can be inserted individually, one anteriorly and one posteriorly, to assess the support of these structures and differentiate apical from anterior defects (Fig. 1-3). In cases in which there appears to be cervical or uterine descent, it is important to differentiate between cervical elongation and true uterine descent (Figs. 1-4 and 1-5).

Figure 1-1 Half of a bivalve speculum is used to displace the posterior vaginal wall to allow inspection of the anterior vaginal wall.

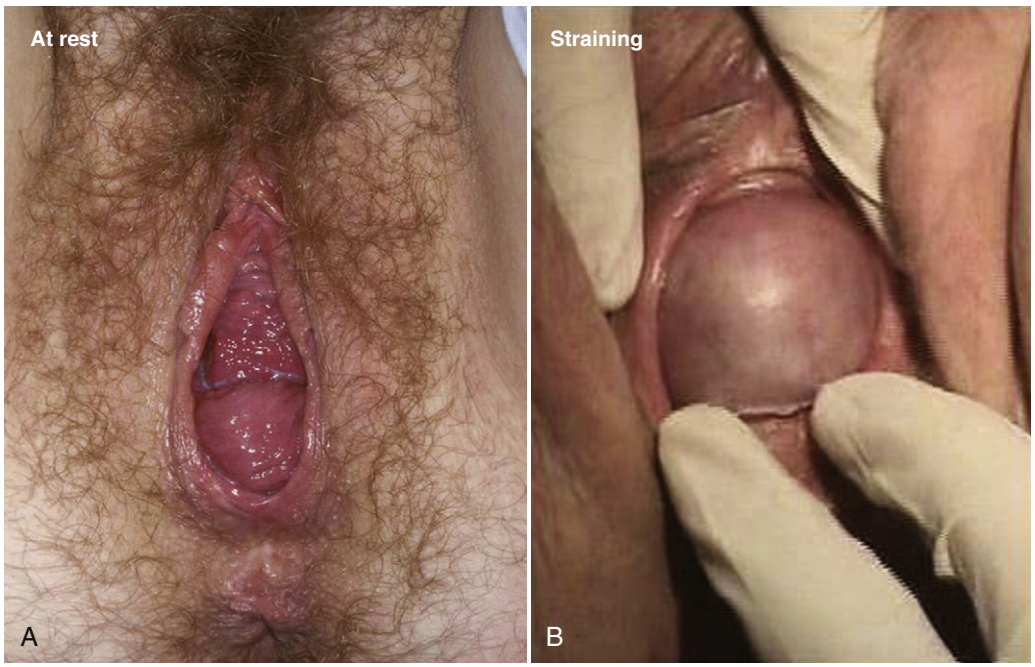

Figure 1-2 Inspection of the vaginal introitus in a patient with anterior vaginal wall prolapse at rest (**A**) and while straining (**B**).

After the support of the proximal anterior vagina and the apex is assessed, attention can be turned to the support of the distal anterior vagina, including the urethra. This assessment can be done first without retraction of the posterior vaginal wall and then again with retraction by a speculum. First, the position of the urethra at rest is noted. The patient is then asked to perform a Valsalva maneuver and/or cough so urethral mobility can be assessed. In a

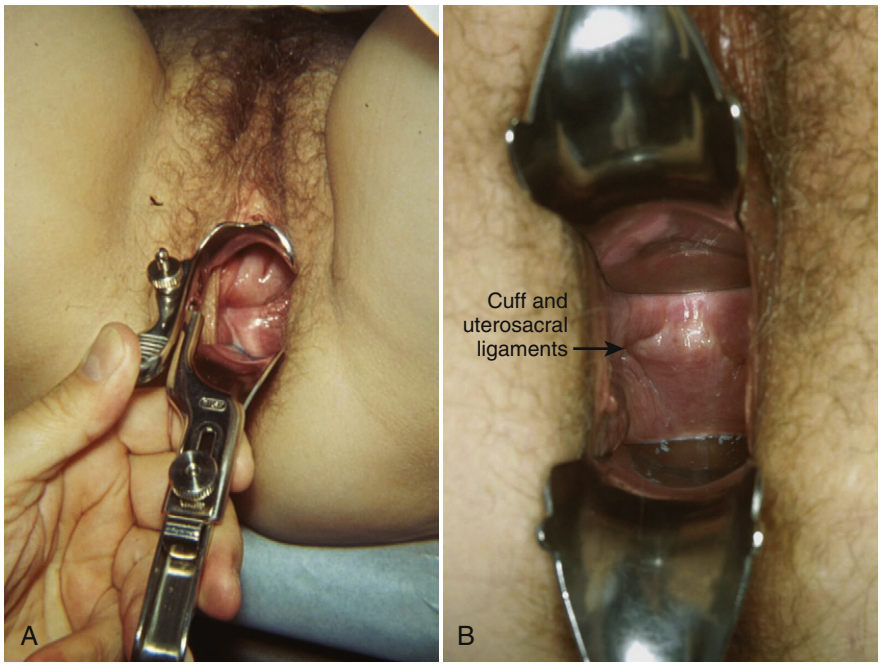

Figure 1-3 **A,** Bivalve speculum is used to inspect the cervix or vaginal cuff. **B,** Two halves of a bivalve speculum are used to inspect the vaginal apex.

Figure 1-4 Uterine prolapse secondary to an elongated cervix.

healthy nulliparous female the urethra should not move much, but in cases of compromised support (often seen after vaginal delivery) there may be a posterior rotational descent of the urethra (hypermobility). As the patient increases abdominal pressure, the examiner should also observe whether any leakage of urine occurs out the urethral meatus (stress incontinence). If so, then it is important to note whether the leakage is associated with hypermobility of the urethra. In cases of obvious hypermobility with stress loss, often no further assessment is needed. If there is little or no mobility, however, then further testing can be done to determine the degree of urethral hypermobility, if any (because this may affect treatment of stress incontinence). This is best assessed by a Q-Tip test. A sterile cotton swab is inserted in the urethra until the cotton tip is just inside the bladder. The end of the swab should be lubricated with sterile jelly. (Placing a sterile finger cot over the cotton tip has been shown to reduce discomfort.) Once the swab is in place, the resting angle of the urethra

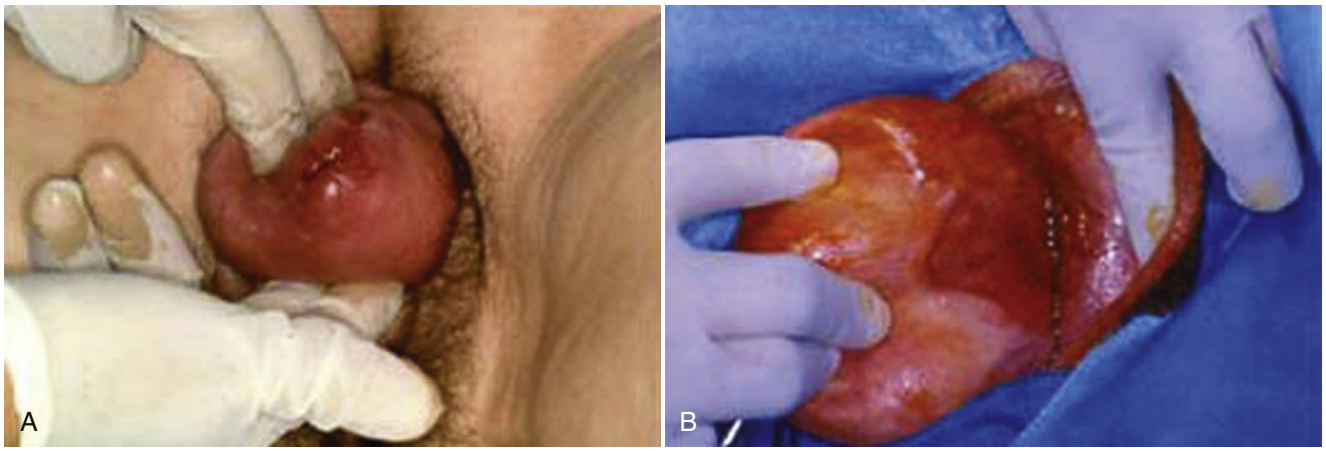

Figure 1-5 **A,** Complete uterine procidentia. Note that palpation of the cervix through the anterior and posterior vaginal wall confirms that this is a case of uterine prolapse, not an elongated cervix. **B,** Complete uterine procidentia with large vaginal ulcer.

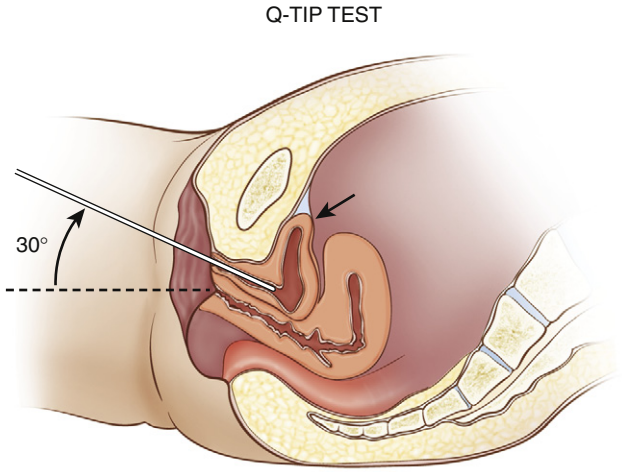

Figure 1-6 The Q Tip test. As the patient bears down, the cotton swab moves and the angle of deflection can be measured (*arrow*). In this example, it is 30 degrees, indicating urethral hypermobility. Thirty degrees or more from baseline (which in this case is 0 degrees from the horizontal) is considered to signify hypermobility. The *curved arrow* indicates the deflection or movement of the cotton swab with abdominal straining.

(compared with the horizontal) is noted. In a healthy nulliparous woman the angle is close to 0 degrees. The patient is then asked to bear down and the point of maximal urethral deflection from the horizontal is noted. The angle can be eyeballed or a protractor can be used for accuracy. An angle of 30 degrees or more is considered to indicate hypermobility (Fig. 1-6). We reserve the Q-Tip test for women with documented stress incontinence who do not have obvious urethral hypermobility and are considering surgical intervention as the presence and degree of mobility may affect the choice of procedure. If the patient has prolapse of any compartment, it should be reduced with a speculum, ring forceps, or sponge stick, and stress incontinence should be assessed by having the patient bear down and also cough. If the patient has no clinical stress urinary incontinence and no stress urinary incontinence on examination without prolapse reduction, but has it only with reduction, then it is known as *occult* or *potential stress incontinence* (Fig. 1-7).

Next the posterior vagina is examined—first proximally, then distally. The posterior speculum blade is rotated to retract the anterior vaginal wall, and the support of the posterior vaginal wall is assessed at rest and with straining. If proximal posterior prolapse is seen, it is important to differentiate between a high rectocele and an enterocele. This distinction can be aided by performing

a simultaneous rectal and vaginal examination with the index finger in the rectum and the thumb in the vagina. In cases of enterocele, the small intestine can often be felt sliding between the two fingers. A rectal examination can also aid in the assessment of the distal posterior vagina and a more distal rectocele (Fig. 1-8). The vaginal caliber should always be assessed by placing two or three fingers in the vagina, because it is important to determine the size of the genital hiatus before any prolapse procedure is performed (Fig. 1-9).

In cases of POP, particularly when examination of the patient in lithotomy position does not reveal a prolapse of the size that would be expected based on the patent's history, the examination should be repeated with the patient in the standing position. One of the patient's feet can be placed on a step stool and the other on the floor. The patient's legs are spread and the vagina and prolapse are examined at rest and with straining. The points of maximal anterior, apical, and posterior prolapse should be noted. Stress incontinence can also be assessed with the patient in the standing position with and without reduction.

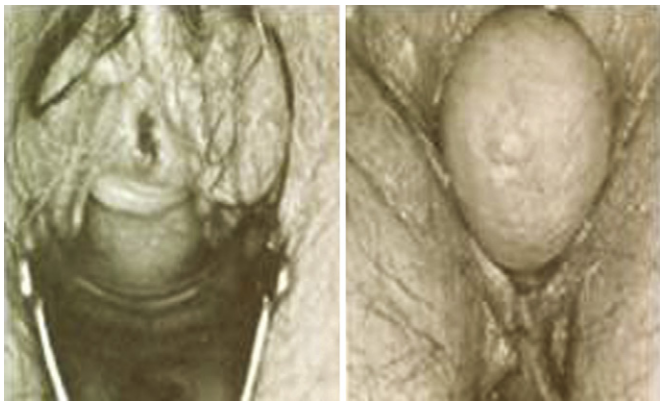

Figure 1-7 Advanced prolapse (*right*) appropriately reduced to test for occult or potential stress incontinence (*left*).

Figure 1-8 Examination of posterior vaginal wall. Rectal finger notes distal rectocele.

Figure 1-9 Gynecological pelvimetry. Two fingers are placed in the vaginal lumen to approximate the size of the genital hiatus.

Staging of Pelvic Organ Prolapse

A number of staging systems for POP have been developed, but two are most commonly used. The older of the two, the Baden-Walker Halfway System, is practical for use in everyday clinical practice (Table 1-1, Fig. 1-10). The more comprehensive Pelvic Organ Prolapse Quantification (POP-Q) system is currently recognized as the international standard for describing pelvic organ support. However, it has still not gained universal acceptance because many find it cumbersome and time consuming to apply. The POP-Q system is the most useful staging system for clinical research because it allows a quantification of multiple important measurable parameters (Fig. 1-11). Some have used an abbreviated POP-Q system for everyday practice. There are eight different points that should be measured (Tables 1-2 and 1-3). For an abbreviated version, some clinicians measure points Aa, Ba, C, Ap, and Bp (Fig. 1-12).

Examination of Pelvic Floor Muscles

Digital examination with two fingers is used to determine vaginal caliber and assess tone at rest and with muscle contraction. After resting tone is assessed, the patient is asked to contract the pelvic floor or tighten the vagina around the examiner's fingers. From this it can be determined if the patient has the ability to appropriately isolate the pelvic floor muscles. If the patient is able to isolate them, the strength and endurance of the contraction should be subjectively quantified. If she is unable to isolate the muscles or is tightening the abdominal muscles or lifting the buttocks off the table, she would benefit from pelvic floor physical therapy. The levator muscles should also be palpated from the rectum to the pubic bone to look for areas of tenderness or tension.

Perineal, Anal Sphincter, and Rectal Examination

The perineum is assessed first by looking at its length. In cases of perineal body destruction the vaginal epithelium and anal sphincter are in close proximity (Fig. 1-13). The perineal body (strong fibromuscular tissue between the vagina and rectum) is assessed for integrity. This assessment is often aided by a digital rectal examination, which also helps to further identify the presence of a rectocele or posterior enterocele. While the examiner's finger is in the anal canal, the patient is asked to contract the sphincter. The tone and integrity of the anal sphincter is assessed, and it should be palpable for the entire 360 degrees. Sometimes in cases of anal sphincter injury a decrease in muscle tone is appreciated and a gap can be felt anteriorly. During straining, perineal descent can also be assessed with the finger in the rectum.

Table 1-1. Baden-Walker Halfway Staging System for pelvic organ prolapse

Grade	Anterior	Apical	Posterior
1	Extends halfway to the hymen	Extends halfway to the hymen	Extends halfway to the hymen
2	Extends to the hymen	Extends to or over the perineal body	Extends to the hymen
3	Extends outside hymen	Extends beyond the hymen	Extends beyond the hymen

Each vaginal compartment can be staged separately: for example, the anterior compartment (cystocele), the apical compartment (uterine prolapse or enterocele), and the posterior compartment (rectocele).

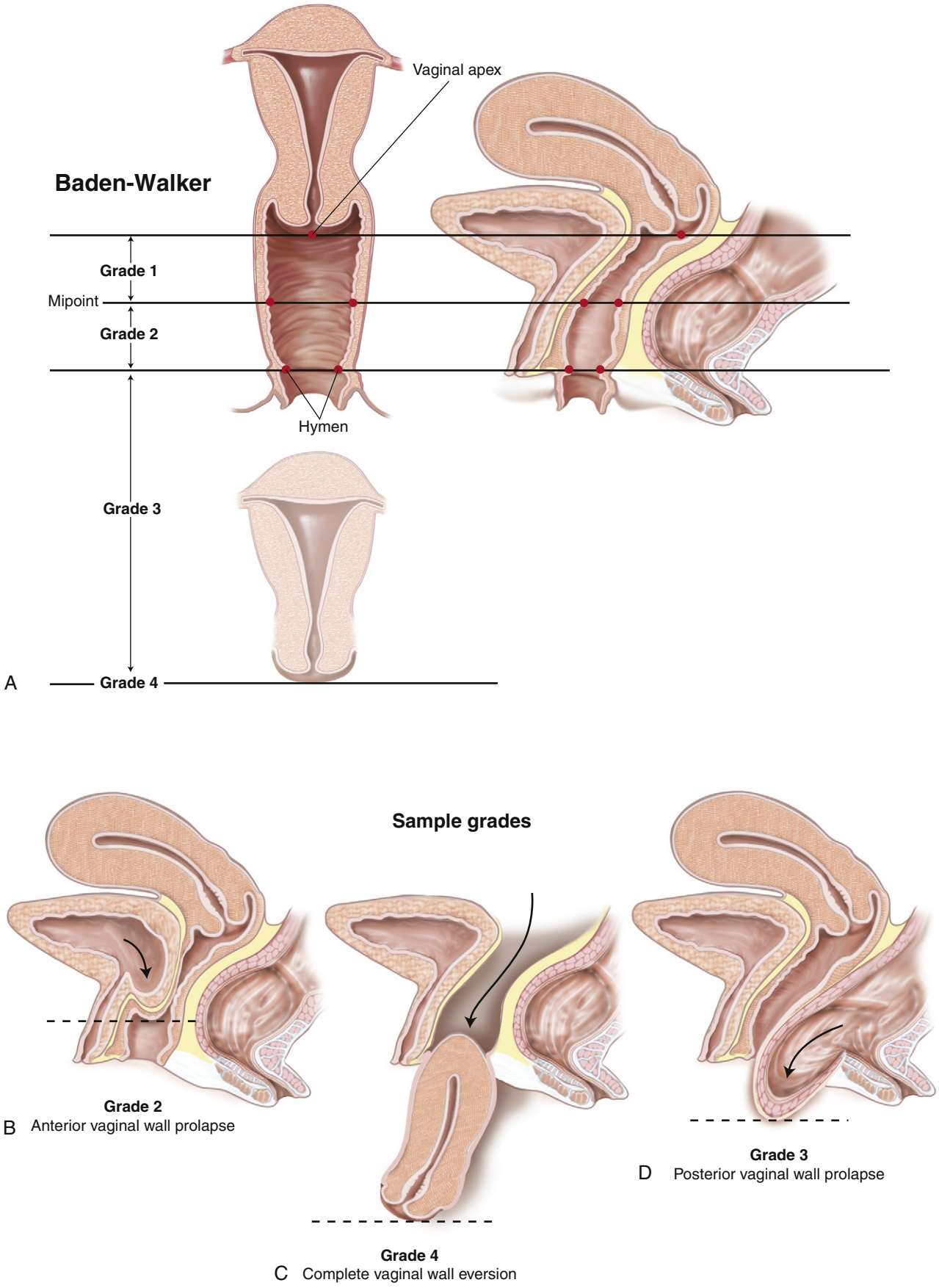

Figure 1-10 Baden-Walker Halfway Staging System for pelvic organ prolapse.

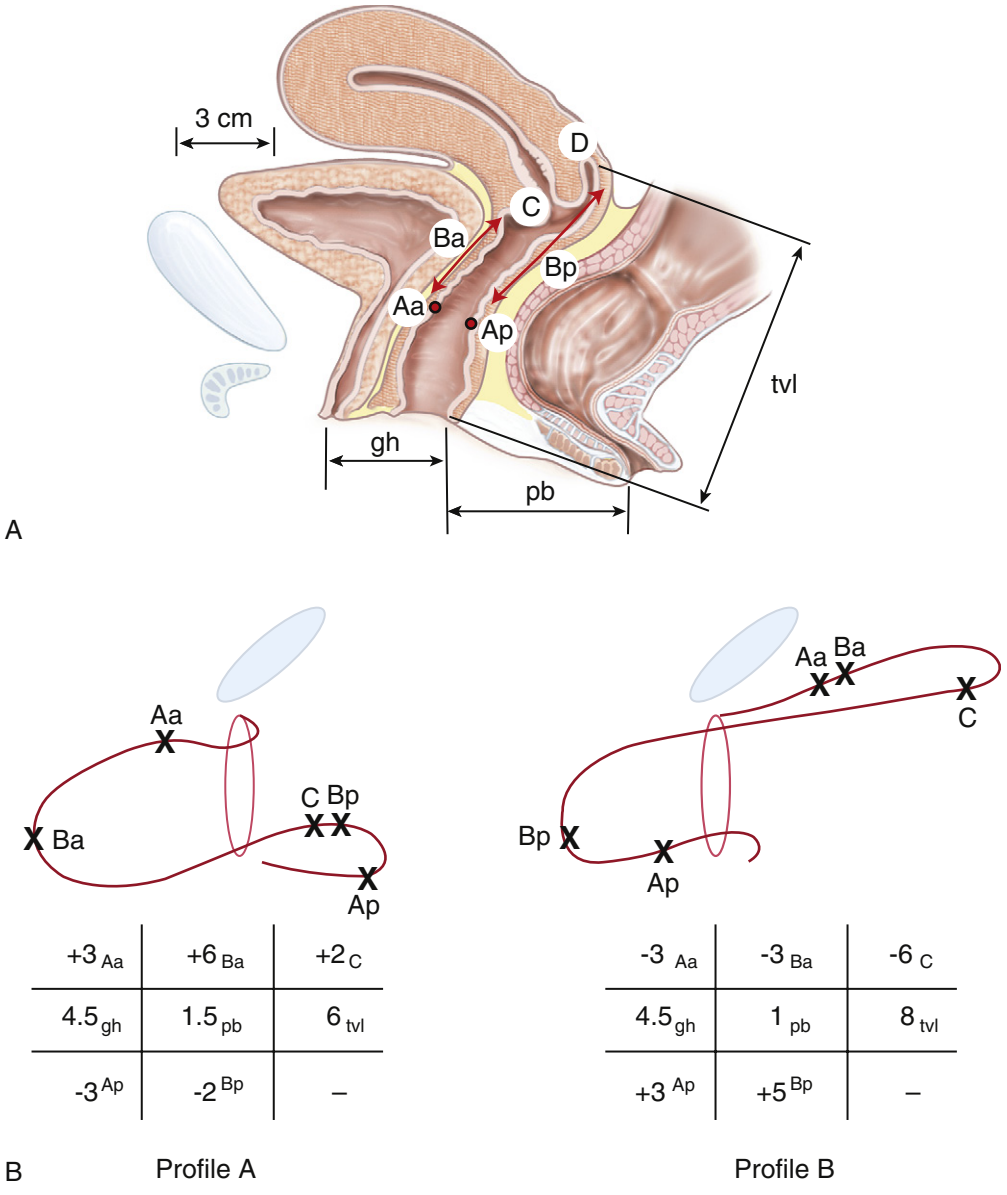

Figure 1-11 Pelvic Organ Prolapse Quantification (POP-Q) system for staging pelvic organ prolapse. *Aa,* Point A anterior; *Ap,* point A posterior; *Ba,* point B anterior; *Bp,* point B posterior; *C,* cervix or vaginal cuff; *D,* posterior fornix (if cervix is present); *gh,* genital hiatus; *pb,* perineal body; *tvl,* total vaginal length.

Table 1-2. Points of measurement in the Pelvic Organ Prolapse Quantification (POP-Q) system

Point	Description
Aa (A anterior)	A point located in the middle of the anterior vaginal wall 3 cm proximal to the urethral meatus. By definition the range of position of this point relative to the hymen is –3 to +3 cm.
Ba (B anterior)	A point that represents the most dependent or distal position of the upper portion of the anterior vaginal wall from the vaginal cuff or anterior vaginal fornix to point Aa.
C	A point that represents the most dependent or distal edge of the cervix or the leading edge of the vaginal cuff if the patient has undergone hysterectomy.
Ap (A posterior)	A point located in the middle of the posterior vaginal wall 3 cm proximal to the hymen. By definition the range of position of this point relative to the hymen is –3 to +3 cm.
Bp (B posterior)	A point that represents the most dependent or distal position of the upper portion of the posterior vaginal wall from the vaginal cuff or posterior vaginal fornix to point Ap.
D	A point that represents the location of the posterior fornix (pouch of Douglas). It is omitted if the patient has undergone hysterectomy.
gh (genital hiatus)	Measured from the middle of the external urethral meatus to the posterior midline hymen.
pb (perineal body)	Measured from the posterior margin of the genital hiatus to the middle of the anal opening.
tvl (total vaginal length)	The greatest depth of the vagina in centimeters when point C or D is reduced to its normal position.

Table 1-3. Staging of prolapse according to the Pelvic Organ Prolapse Quantification (POP-Q) system

Stage	Description
0	No descent of pelvic structures during straining. Points Aa, Ap, Ba, and Bp (see Table 1-2) are all at −3 cm.
I	The leading edge of the prolapse is more than 1 cm above the hymenal ring.
II	The leading edge of the prolapse is from 1 cm above to 1 cm below the hymen.
III	The leading edge of the prolapse extends more than 1 cm beyond the hymen, but less than the total vaginal length minus 2 cm.
IV	The leading edge of the prolapse protrudes more than the total vaginal length minus 2 cm.

Staging can also be subgrouped for individual points or compartments.

Focal Neurological Examination

A simple focal neurological examination can be conducted rapidly. The neurological examination begins by observing the patient's gait and demeanor as the patient first enters the examination room. A slight limp or lack of coordination, an abnormal speech pattern, facial asymmetry, or other abnormalities may be subtle signs of a neurological condition. Sacral innervation (predominantly S2, S3, and S4) is evaluated by assessing anal sphincter tone and control, genital sensation, and the bulbocavernosus reflex. With the physician's finger in the patient's rectum, the patient is asked to squeeze as if in the middle of urinating and trying to stop. A lax or weakened anal sphincter or the inability to contract and relax voluntarily can be subtle signs of neurological damage, but some patients simply do not know or do not understand how to isolate these muscles, whereas others may be too embarrassed to comply with the instructions. Perineal and perianal sensation can be assessed by gently scratching the area with a blunt instrument like a cotton swab. Anal wink and bulbocavernosus reflexes can be checked when indicated. To assess anal wink, the examiner gently stimulates the perianal region with a cotton swab and observes contraction of the external anal sphincter. The bulbocavernosus reflex can be assessed by placing gentle pressure on the clitoris and then observing for contraction of the anal sphincter and perineal muscles. Alternatively, in patients with a Foley catheter in place, the reflex may be initiated by suddenly pulling the balloon of the catheter against the bladder neck. This reflex is not detectable in up to 30% of otherwise healthy women. In addition pedal and Achilles deep tendon reflexes may be checked with a reflex hammer when indicated.

Special Focal Examinations

Depending on the patient's history and complaints, a more specific focal examination can be carried out on a particular part of the vagina or pelvis. For example, if a urethral or periurethral abnormality is suspected, careful and repeated palpation of the suburethral area of the anterior vaginal wall may be performed. Areas of consistent tenderness, a firm or cystic mass, and expression of discharge from a Skene gland may all confirm a diagnosis or lead to further testing. In cases of pelvic or vaginal pain, palpation of the vestibule with a cotton swab can help to diagnose vestibulitis.

In cases in which a fistula is suspected, the anterior vaginal wall and vaginal apex must be examined carefully. This is best accomplished initially with the bivalved speculum left intact so that the anterior and posterior vaginal walls can be retracted simultaneously. If a fistula is not immediately seen, then the bladder can be filled with saline or a methylene blue solution.

Figure 1-12 Anterior vaginal wall prolapse. Note that point Aa would be 3 cm proximal to the external urethral meatus, whereas point Ba would be the point representing the most dependent or distal position of the upper portion of the anterior vaginal wall from the vaginal cuff or anterior vaginal fornix to point Aa.

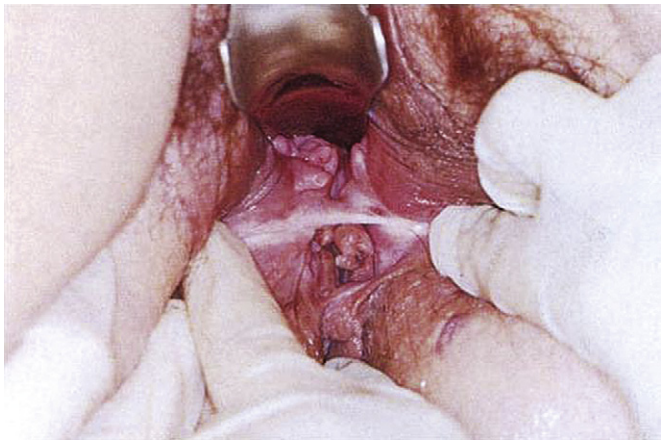

Figure 1-13 Patient with complete perineal breakdown. Note that the posterior vaginal wall and anterior wall of the rectum are in direct proximity with no intervening sphincter or perineal muscles.

Case #1

View Video 1-3

Video 1-3 demonstrates a focused pelvic examination of a woman with POP and lower urinary tract symptoms of frequency, urgency, and nocturia. The essentials of examining such a patient include a visual inspection of the vulva, perineum, and vaginal tissues and an assessment of the anterior, apical, and posterior vagina using the split-speculum technique.

Case #2

View Video 1-4

Video 1-4 demonstrates a focused pelvic examination of a woman with POP, urinary frequency, urinary urgency, urgency incontinence, and defecatory dysfunction, including fecal incontinence. With retraction of the anterior vaginal wall a significant posterior compartment prolapse, likely rectocele and enterocele, is seen. The external anal sphincter is then inspected with the patient performing a Valsalva maneuver, and prolapse of the rectal mucosa is seen.

Case #3

View Video 1-5

Video 1-5 demonstrates a focused pelvic examination of a woman with severe mixed urinary incontinence who also previously underwent anterior colporrhaphy. In this case a nonmobile anterior vaginal wall is seen. The Q-Tip test is also used to assess urethral mobility.

Case #4

View Video 1-6

Video 1-6 demonstrates a focused pelvic examination of a woman with POP and difficulty voiding. Descent of the anterior segment at rest is noted. Significant apical prolapse is demonstrated using the split-speculum technique.

Suggested Readings

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Vaginal Incisions and Dissection

2

Victor W. Nitti, MD
Benjamin M. Brucker, MD

Videos

2-1 Hydrodissection of the Vaginal Wall
2-2 Dissection of the Distal Anterior Vaginal Wall
2-3 Dissection of the Proximal Anterior Vaginal Wall
2-4 Inverted-U Anterior Vaginal Wall Incision
2-5 Vaginal Closure of Cystotomy
2-6 Dissection of the Distal Posterior Vaginal Wall
2-7 Dissection of the Proximal Posterior Vaginal Wall

An understanding of proper dissection planes and a thoughtful approach to the type and location of the surgical incision enhance the art of vaginal surgery. Establishing proper dissection planes helps to minimize blood loss and injury to adjacent structures. These planes may vary depending on whether the surgeon will interpose autologous or synthetic implant material or flaps. Incisions should be designed to provide maximal exposure to the area of interest while causing the least amount of trauma. In addition, the orientation of the incision is often important—for example, when one wants to close multiple suture lines in a nonoverlapping fashion (e.g., in fistula repair or urethral diverticulectomy) or provide minimal exposure of a synthetic implant to the suture line.

This chapter provides a brief description of the anatomy of the anterior and posterior vaginal walls as well as a description of several common incisions used in vaginal surgery. How best to identify appropriate dissection planes leading into a variety of avascular spaces in the pelvis is also discussed.

Anatomy of the Anterior and Posterior Vaginal Walls

The anterior and posterior vaginal walls have similar but slightly different features and composition. The vaginal wall consists of several layers. Most superficial is the vaginal epithelium, which comprises multilayered noncornified squamous epithelial cells and ranges in thickness from 0.15 to 0.3 mm. Beneath this is a stromal layer (lamina propria) composed mostly of collagen with some intermixed elastin. Beneath the stroma is a fibromuscular layer consisting of smooth muscle and collagen with some elastin. The total thickness of the vaginal

wall is 2 to 3 mm. Between the vaginal wall and the underlying structures (i.e., bladder, rectum, cervix) and their supportive tissues is an adventitial layer, which varies in thickness and becomes more prominent as one moves laterally or cephalad toward the cervix. The adventitia contains discontinuous layers of collagen and elastin fibers as well as adipose tissue, nerve fibers, and blood vessels.

The vaginal wall is most densely connected to underlying structures at its most distal aspects. The distal anterior vaginal wall is firmly adherent to the posterior urethra. As one proceeds proximally, the vaginal wall is more easily separated from the bladder. Similarly, the vagina and rectum are densely fused in the distal one third of the vagina. Surgically there is no clear plane of dissection between the very distal vagina and the rectum. As one proceeds 3 to 4 cm proximally, as the adventitial layer becomes more prominent, the plane between the vagina and rectum becomes more easily identifiable.

As the dissection extends toward the proximal vagina or cervix, the preperitoneal space between the base of the bladder and anterior cul-de-sac or the anterior wall of the rectum and posterior cul-de-sac is encountered. Identifying these spaces greatly facilitates identification and entrance into an enterocele sac in patients with enterocele or apical prolapse.

The vagina is highly vascularized and becomes more so as one dissects laterally. Large venous plexus and sinuses account for this vascularity. Thus it is vital to attempt to dissect just below the fibromuscular layer when such a plane is identifiable. The lateral dissection anteriorly should extend to the inferior pubic ramus on each side and posteriorly to the pararectal gutter on each side.

Vaginal Dissection and Incisions

Hydrodissection

Some surgeons find that the dissection of the vaginal wall is enhanced by the use of hydrodissection or the injection of a liquid into the plane between the vaginal wall and the underlying structures (Video 2-1 ). This can be done with saline, a local anesthetic agent, a vasoconstrictive agent such as epinephrine or vasopressin (Pitressin), or a combination of the latter two. Ideally hydrodissection should create a plane in the potential space between the vaginal wall and the underlying structures. It should facilitate dissection in the relatively avascular surgical plane just under the fibromuscular layer of the vagina. The injection of a vasoconstricting agent can further minimize bleeding. A caveat regarding hydrodissection is that it can distort the anatomy, particularly when the injection is in the wrong plane. Even when the injection is placed properly, large collections of injected fluid or bleeding from the injection can sometimes make the dissection more difficult. There are some areas where hydrodissection is less desirable. For example, in the dissection of the posterior vaginal wall off of the rectovaginal septum, we have found that hydrodissection makes the torn septum difficult to define when a site-specific repair is being considered (see Chapter 7). Thus hydrodissection is a technique that is often useful but at times can alter anatomical landmarks of importance, and therefore its application is left to the discretion of the surgeon.

Anterior Vaginal Wall

The most common incision made in the anterior vaginal wall is the midline incision. This can be used to gain exposure to the urethra, bladder, and supportive structures like the periurethral and pubocervical fascia. Depending on the

surgery to be performed, the length of the incision will vary from 1 cm to the entire length of the anterior vaginal wall.

As mentioned previously, the distal anterior vaginal wall is densely adherent to the urethra. Thus the separation of the vaginal wall off of the periurethral fascia requires careful dissection, and great care must be taken to stay in the proper plane. After the initial incision is made, the plane just beneath the vaginal wall is created with sharp dissection using Metzenbaum scissors. We prefer to use a spreading rather than a cutting technique (Video 2-2). If one stays just on top of the glistening surface of the periurethral fascia, there should be minimal bleeding. As one proceeds laterally, at the level of the urethra, the tips of the scissors should be pointed toward the inside of the vaginal wall. With force directed against the urethra and the tips of the scissors directed away from the urethra, the plane is usually easily established and dissection can proceed all the way to the endopelvic fascia or obturator internus muscle. Several consequences are associated with dissection in a plane that is too deep. First and most commonly, significant bleeding can be encountered, especially as dissection heads laterally, because large periurethral veins and sinuses can be encountered. Also, careless deep dissection can result in injury to the urethra, particularly in cases in which prior surgery has distorted the periurethral fascia. Finally, in some cases it is necessary to sharply perforate the endopelvic fascia and enter the retropubic space. If the dissection plane is too deep, a bladder injury is more likely to occur.

For more proximal incisions, the vaginal wall usually separates more effortlessly from the underlying pubocervical (perivesical) fascia and the bladder. In this case we prefer to grasp the edge of the vaginal wall with an Allis clamp after the incision is made. An index finger from the same hand that is holding the Allis clamp can be placed behind the vaginal epithelium and the vaginal wall can be sharply dissected by placing the tips of the Metzenbaum scissors toward the vaginal wall and applying inward pressure on the vaginal wall with the surgeon's nondominant index finger. This is done mostly with a spreading maneuver, with attachments cut loose as the plane is established (Video 2-3). Here the plane of dissection can vary a bit. The most avascular plane is just below the fibromuscular plane of the vaginal wall, and this is the preferred plane when no synthetic or biological material is to be placed vaginally. When an implant will be used, the dissection plane can be deeper, with the adventitial layer kept with the vaginal wall (see Video 2-3). In many cases, when the proper plane is entered, the dissection can be done bluntly with a moist gauze pad on the finger.

Sometimes an inverted-U anterior vaginal wall incision is desired. This is done most commonly when urethral surgery is to be performed or when access to the urethra is needed. It allows excellent exposure of the entire urethra all the way to the bladder neck. The incision is usually made with the apex of the U at the level of the midurethra and the sides extending to just proximal to the bladder neck. (See Video 2-4 for a demonstration of the inverted-U incision.) Countertraction from an Allis clamp placed near the apex of the incision is helpful. After the initial incision is made, lateral flaps are raised on each side using the technique described earlier for the distal midline incision. Here dissection is just on top of the periurethral fascia and is continued laterally toward the endopelvic fascia. When this step is completed, the proximally based U flap can be created. The distal end of the U is grasped with an Allis clamp and the index finger of the same hand that holds the Allis clamp is placed against the vaginal epithelium. The tips of the Metzenbaum scissors are placed toward the epithelium while pressure is exerted on the finger and the scissors are spread. The correct plane of dissection is the relatively avascular plane just beneath the fibromuscular layer of the vaginal wall. The dissection is usually continued until the bladder neck is exposed

(it can be identified by palpating the balloon of a Foley catheter routinely inserted at the beginning of surgery). This should be a relatively avascular plane.

In certain circumstances (e.g., when excising a vaginal wall cyst during repair of a fistula or when performing a vaginal hysterectomy) one may elect to make a transverse, circular, or elliptical incision. These incisions are discussed in Chapters 5, 11, and 14; however, certain basic considerations apply, including whether hydrodissection will facilitate or hinder the establishment of appropriate dissection planes. In addition it is helpful to remember that for vaginal surgery, exposure is key, so lateral-medial and/or anterior-posterior flaps should be large enough to give optimal exposure to the area being operated on.

If the bladder is inadvertently entered during the dissection of the anterior vaginal wall, it should be repaired primarily. The surgeon should confirm that the ureteral orifices are not injured and care should be taken to avoid injury during the repair. We recommend a two-layer bladder closure. The first layer is a full-thickness running closure with 2-0 delayed absorbable suture. If the cystotomy is small, a single suture may be all that is necessary. A second layer with the same suture can be done as an interrupted Lembert closure of the seromuscular layer. (See Video 2-5 for a demonstration of closure of a cystotomy.) The pubocervical fascia can be closed over the bladder as a third layer. A Foley catheter is left in place for 3 to 7 days depending on the size and location of the cystotomy. We strongly discourage the placement of synthetic mesh in the setting of a cystotomy.

Posterior Vaginal Wall

Most incisions in the posterior vaginal wall are midline or paramedian (e.g., for a relaxing incision when the introitus is narrow). For the perineum, a midline or V incision can be used to access the perineal body. The distal vaginal wall is densely adherent to the perineal body, levator muscles, and distal rectum. Because of this, sharp dissection is generally required, often with the need to cut with the scissors to establish a plane of dissection. (See Video 2-6 for a demonstration of distal posterior vaginal wall dissection.) As one proceeds proximally, it is much easier to separate the vaginal wall from the rectum and the rectovaginal septum, and this can usually be done with a spreading motion or blunt dissection using a most gauze pad. (See Video 2-7 for a demonstration of proximal posterior vaginal wall dissection.) That said, establishing an avascular plane of dissection is much more challenging on the posterior vagina than it is anteriorly. It is not unusual to stop the dissection to cauterize large veins. The lateral extent of the dissection is variable depending on the surgery. It is often necessary to extend the dissection out laterally to the levator fascia. When there has been prior posterior vaginal surgery, dissection of the posterior vaginal wall off the anterior wall of the rectum can be challenging. In such cases placing a finger of the nondominant hand in the rectum can facilitate dissection and help to avoid a rectal injury. Having an assistant surgeon apply countertraction to the vaginal wall and adjacent tissues is very helpful.

If the rectum is injured during the dissection, it can be closed in two layers. The mucosa is closed with a 3-0 delayed absorbable suture (polyglycolic acid suture).* This is followed by an imbricating suture closure of the seromuscular layer of the rectum. We strongly discourage the placement of synthetic mesh in the setting of a rectal injury.

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

3

Pelvic Organ Prolapse: Introduction, Nonsurgical Management, and Planning of Surgical Repair

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Mickey Karram, MD

Pelvic organ prolapse (POP) is a common condition affecting almost a quarter of the adult female population. However, the mere presence of prolapse of one or more organs or compartments does not necessarily mean that a problem or abnormality exists. As surgeons, we typically think in terms of normal and abnormal *anatomy,* considering "normal" to be a perfectly supported pelvis. However, various degrees of POP occur with aging, childbearing, and so on. POP may be totally asymptomatic or may create symptoms of prolapse such as heaviness or the feeling of tissue protrusion. These symptoms may or may not be associated with functional derangements, whether they be visceral or sexual. Our current understanding of the correlation between anatomical descent and functional derangements is very poor. Therefore, the decision to intervene surgically to correct POP should be based more on the presence or absence of outright symptoms of prolapse than on a functional derangement that is felt to be due to anatomical descent.

Historically, POP has been classified in terms of organs or structures; for example, cystocele, enterocele, rectocele, and uterine prolapse. Although these terms are descriptive, they are often not accurate in describing POP. In this book the discussion of POP is divided into chapters on anterior vaginal wall prolapse, posterior vaginal wall prolapse, and enterocele and apical prolapse. There is a separate chapter on vaginal hysterectomy for uterovaginal prolapse. Although each compartment is described separately, it is important to remember that most patients with POP have loss of support in more than one compartment. Consequently, the surgeon commonly must use techniques applicable to multiple compartments in repairing POP.

Epidemiology and Pathophysiology

POP is a common worldwide problem, but data are conflicting on whether differences in prevalence exist based on race and culture. Most reports suggest a higher incidence in white and Hispanic women than in black or Asian populations, but no good comparison studies exist.

The multifactorial etiology of POP makes the prevention of its occurrence difficult. Bump and Norton categorized risk factors for the development of POP as predisposing (genetics, race, gender), inciting (pregnancy, delivery, surgery, myopathy, neuropathy), promoting (obesity, smoking, chronic cough, constipation, repetitive occupational or recreational activities), and decompensating (aging, menopause, debilitation, and medications). Physiologically and anatomically, loss of the integrity and the support of the pelvic organs that causes herniation resulting in prolapse of the vaginal compartments singly or in combination.

Most women with POP have a combination of pelvic floor support defects affecting multiple compartments (anterior, apical, and posterior). Very commonly, anterior vaginal wall prolapse that is significant enough to require repair will be accompanied by apical or vault prolapse. In addition, many recurrences after POP repair may in part be due to failure to adequately address support of the vaginal apex during the original procedure.

The apical portion of the vagina is supported by sheetlike extensions of the endopelvic fascia that attach it to the pelvic sidewall and levator ani fascia, referred to as the *paracolpium.* The paracolpium provides two levels of support. Level I, or upper support, suspends the vagina, attaching it to the pelvic sidewall. Level II, or midvaginal support, which includes the pubocervical fascia, attaches the midvagina more directly to the pelvic walls, including the levator fascia and arcus tendineus fasciae pelvis. Damage to midlevel support usually results in anterior and posterior defects, whereas damage to upper-level support results in apical prolapse, including enterocele and/or vault or uterine prolapse (Fig. 3-1).

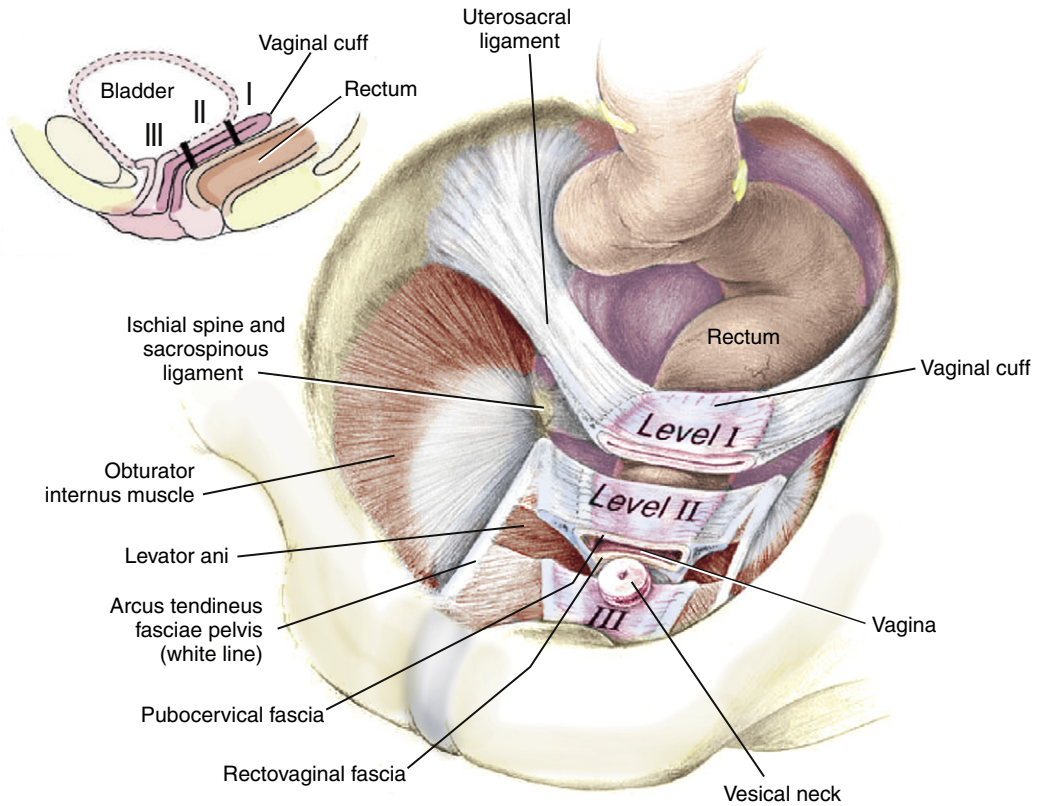

Figure 3-1 Level I (suspension) and level II (attachment) support of the vagina. In level I the paracolpium (uterosacral ligaments) suspends the vagina from the lateral pelvic walls. Fibers of level I extend both vertically and posteriorly toward the sacrum. In level II support the vagina is attached to the arcus tendineus fasciae pelvis and superior fascia of the levator ani by condensations of the levator fascia (e.g., endopelvic and pubocervical fascia). In level III support the vaginal wall is attached directly to adjacent structures without intervening paracolpium (i.e., urethra anteriorly, perineal body posteriorly, and levator ani muscles laterally). (From DeLancey JOL. Anatomic aspects of vaginal eversion after hysterectomy. *Am J Obstet Gynecol.* 1992;166:1717.)

Diagnosis of Pelvic Organ Prolapse

Most prolapse is multicompartmental, and the support of one pelvic structure is dependent on the support of other structures. It is sometimes difficult to tell on physical examination exactly what organs are prolapsed. An enterocele may present as anterior prolapse (usually in conjunction with a cystocele), apical prolapse, posterior prolapse, or a combination, depending on where the break in support is located. It is important to ascertain whether the vaginal vault is prolapsed, because this will affect the type of repair performed. A detailed description of the physical examination and staging of POP is provided in Chapter 1. Briefly, the extent of prolapse is first evaluated with the patient in the lithotomy position. The presence of urethral mobility, stress incontinence, and anterior, apical, and posterior prolapse should be assessed. The patient should be instructed to cough and perform a Valsalva maneuver so the effect of increased abdominal pressure on the prolapse can be determined. The examiner should reduce the prolapse (manually or with a ring forceps, packing, or pessary) and then ask the patient to cough and perform a Valsalva maneuver to evaluate for occult stress incontinence. So that the full extent of the prolapse can be ascertained, the patient should also be examined while in the standing position with one foot elevated on a stool. The degree of prolapse of each compartment may be quantified using a variety of staging systems (see Chapter 1). Imaging studies, including cystography, defecography, ultrasonography, computed tomography, and magnetic resonance imaging, may also be used if necessary to help define pelvic anatomy.

Nonsurgical Management of Prolapse

Although the majority of treatment options for advanced POP (Pelvic Organ Prolapse Quantification [POP-Q] stages III and IV) are surgical, conservative therapies are available for those patients who are not appropriate surgical candidates or those who do not desire corrective surgery. The American College of Obstetricians and Gynecologists has released practice bulletins recommending a trial of pessary use before surgical management in patients with POP. Pessaries come in a range of shapes and sizes, and with a variety functional modifications (Fig. 3-2). Many patients find pessaries nonintrusive to use and simple to maintain. Some types of pessary, such as the ring or ring with support, can be managed independently

Figure 3-2 A variety of commercially available pessaries.

if the patient's daily functionality is adequate. Other pessaries, such as the cube, doughnut, and inflatable pessaries, require frequent visits to a health care provider to prevent vaginal ulceration and infection.

Pessaries may be used both for long-term management and for initial treatment and symptom trouble shooting. If a patient does not appear to have significant prolapse on examination, a ring pessary that elevates the vaginal tissue can be inserted as a trial to see whether it relieves the symptoms of pressure or bulging. In addition, placement of a pessary may elicit occult stress incontinence after reduction of the prolapse, which indicates the need for an antiincontinence procedure at the time of surgery.

Proper fitting is often a trial-and-error process, and the goal of sizing is to find a pessary large enough to remain in the vagina during daily activities, including straining and lifting, yet not so big as to be bothersome to the patient. Most patients, especially those with early-stage prolapse, can be treated successfully using a ring pessary with support. For patients with POP-Q stage III and IV prolapse, use of a ring is still a possibility, but a space-occupying pessary such as a Gellhorn may be more efficacious. Other types of pessaries such as a Gehrung pessary can be helpful in cases requiring predominantly cystocele or rectocele support. Regardless of the type of pessary used, patients should be examined at a minimum of every 3 months to evaluate for vaginal erosions or infection.

It is important to recognize that about 20% of women will be revealed to have occult stress incontinence after proper placement of a pessary due to restoration of a more normal vaginal axis. These patients may require use of an incontinence knob or a bulk-enhancing agent or even placement of a midurethral sling if the incontinence becomes bothersome.

In mild cases of prolapse, estrogen cream and the estrogen vaginal ring, with or without physical therapy, are also options. Estrogen cream is also used as adjunctive therapy to pessary use to prevent vaginal thinning and ulceration from the foreign body.

Planning of the Surgical Repair

Surgery is the only known way to reverse the structural damage that has allowed prolapse to develop. Once prolapse is present, spontaneous regression will not occur. If the prolapse significantly affects quality of life, surgery should be strongly considered. Preoperative preparation may include the administration of vaginal estrogen in patients with urogenital atrophy, when appropriate. Lower urinary tract symptoms and pelvic pressure associated with POP will improve with appropriate hormonal therapy; therefore, we recommend optimizing urogenital tissue health in all patients with POP. Estrogen replacement therapy has been shown to promote the maturation of atrophic vaginal epithelium and relieve the symptoms of urogenital atrophy. The major routes of administration of estrogen are the oral, transdermal, and vaginal routes. A typical regimen is 0.5 g of vaginal estrogen cream nightly for 4 to 6 weeks , followed by a maintenance dosage of 0.5 g two to three times per week thereafter. This dosing can be used even if the patient still has her uterus in place without significant concern of endometrial proliferation. The estrogen rings and tablets have standardized recommended regimens.

As previously mentioned, the goal of any pelvic reconstructive procedure should be to restore anatomy and maintain or restore visceral and sexual function if appropriate. For patients who wish to maintain a functional vagina, the

goals of the reconstructive surgeon should be to provide durable apical support that results in maximal vaginal length and a vaginal axis that is not distorted. The normal vaginal axis sits on the levator plate. It is well known that the vagina is extremely sensitive to its position. Historically, procedures such as Burch colposuspension that antivert the vagina resulted in significant posterior vaginal wall defects secondary to rectoceles and enteroceles, whereas procedures such as sacrospinous suspension that may retrovert the vagina resulted in prolapse of the anterior vaginal wall in 20% to 40% of patients (Fig. 3-3).

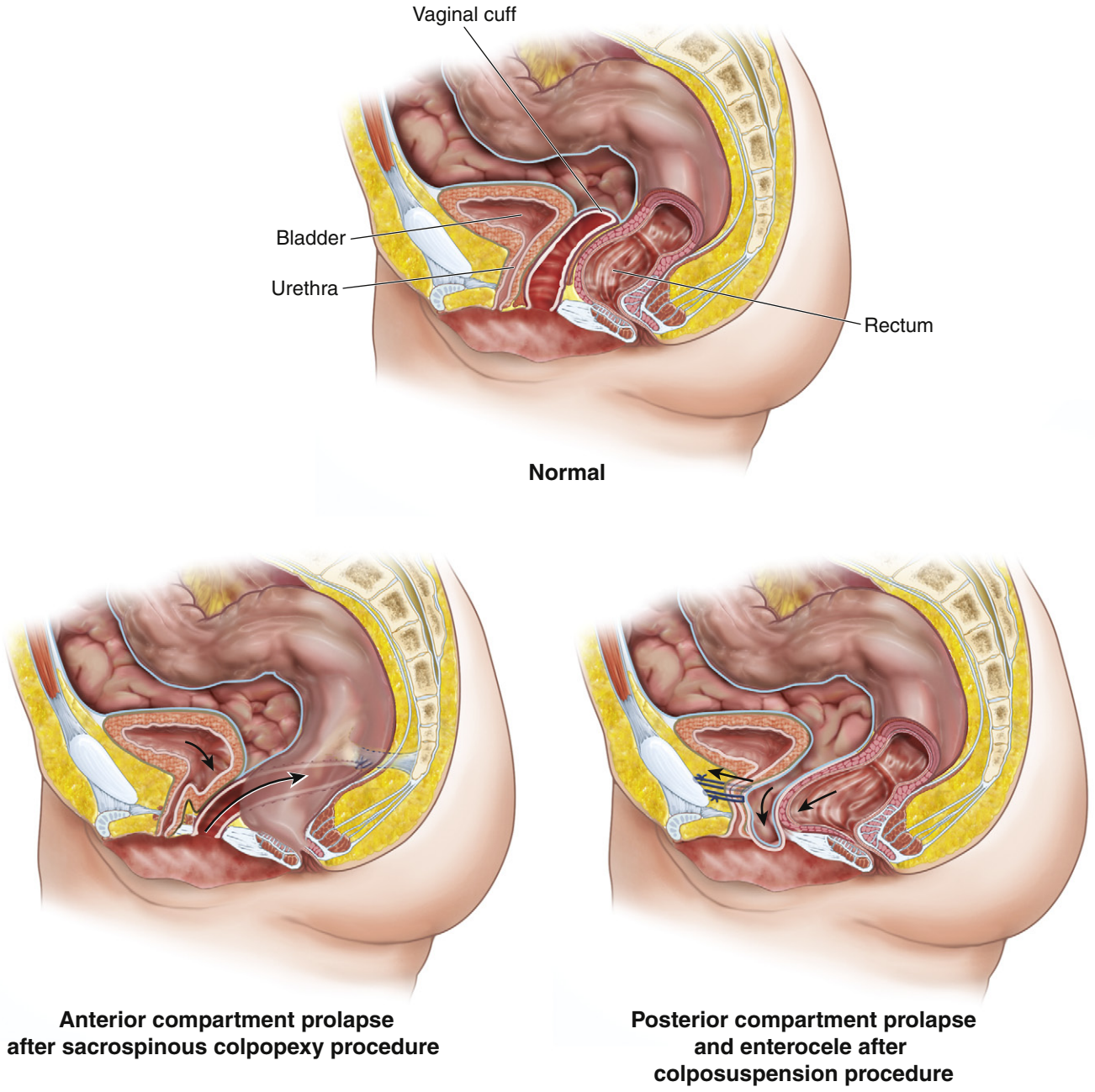

Figure 3-3 Illustrations demonstrating how distortion of the vaginal axis after either Burch colposuspension or sacrospinous colpopexy can result in iatrogenic prolapse.

Prior pelvic surgery may also be a risk factor for subsequent POP depending on the indications. Women who have previously undergone a hysterectomy have been shown to be at higher risk of developing subsequent prolapse. The risk of persistent or recurrent compartment prolapse is 5.5 times higher in women whose primary indication for hysterectomy was prolapse. Similarly, Dallenbach et al showed that the risk that women undergoing hysterectomy would require subsequent prolapse surgery was 4.7 times higher in those whose initial hysterectomy was for prolapse and 8 times higher in those who had prolapse of POP-Q stage II or higher before hysterectomy.

Over the years hundreds of techniques for surgical correction of POP have been described. Most descriptions and published data are based on individual experiences providing anecdotal information, and in general the level of science to support a certain approach or procedure over another has been poor.

In conclusion, surgeons who undertake surgical correction of POP should go to great lengths to ensure that de novo significant functional derangements are avoided, even at the expense of reduced long-term durability of the repair. Although the goal of this text is certainly not to dictate which procedures should be performed on which patients, the hope is that surgeons will be comfortable in addressing patient problems via multiple approaches with the goal of fitting the treatment to the patient's needs. Subsequent chapters discuss the vaginal approaches to management of POP. We do not attempt to describe all techniques, but rather have chosen those that have worked well for us and others. Also, the reader is reminded that this book describes only vaginal approaches to POP, and for some women an abdominal approach (open, laparoscopic, or robotic surgery) may be more appropriate. For more detailed discussion of surgery for POP, the reader is referred to the book entitled *Pelvic Organ Prolapse* in this Female Pelvic Surgery Video Atlas Series.

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Repair of Anterior Vaginal Prolapse

4

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Videos

4-1 Anterior Colporrhaphy With Midline Plication
4-2 Anterior Colporrhaphy With Midline Plication and PGA Mesh
4-3 Anterior Repair With Paravaginal Repair
4-4 Anterior Repair in Conjunction With Apical Suspension

White stated in 1909 that the only problem in plastic gynecology left unresolved was the permanent cure of cystocele. Today the surgical management of anterior compartment prolapse remains problematic and controversial. The anterior compartment is the most common site of prolapse and the site of prolapse with the highest anatomical failure rate, and a plethora of surgical options are available to the clinician. This chapter provides an overview of the current literature and describes various approaches to the surgical management of anterior compartment prolapse.

Anterior vaginal wall prolapse, commonly termed *cystocele,* is defined as pathological descent of the anterior vaginal wall overlying the bladder base. Cystoceles frequently coexist with a variety of micturition disorders. The current understanding of the anatomy and support of this segment of the pelvic floor stems from concepts proposed by Richardson et al., who described transverse, midline, and paravaginal defects. Transverse defects are said to occur when the pubocervical fascia separates from its insertion around the cervix, whereas midline defects represent an anterior-posterior separation of the fascia between the bladder and the vagina, and paravaginal defects are characterized by detachment of the lateral connective tissue attachments at the arcus tendineus fasciae pelvis (ATFP). A conceptual representation of these various defects is shown in Figure 4-1. All types of micturition disorders can be seen with anterior vaginal wall prolapse, and to date, there is no clear scientific explanation to help in understanding the correlation between anatomical descent of the anterior vaginal wall and functional derangements of the urinary tract. When conducting evaluation and planning for surgical treatment of patients with anterior vaginal wall descent, the surgeon must go to great lengths to determine how the surgical intervention will affect any potential functional derangements that the patient may be experiencing. This aspect of the preoperative discussion with the patient and the patient consent process is extremely important.

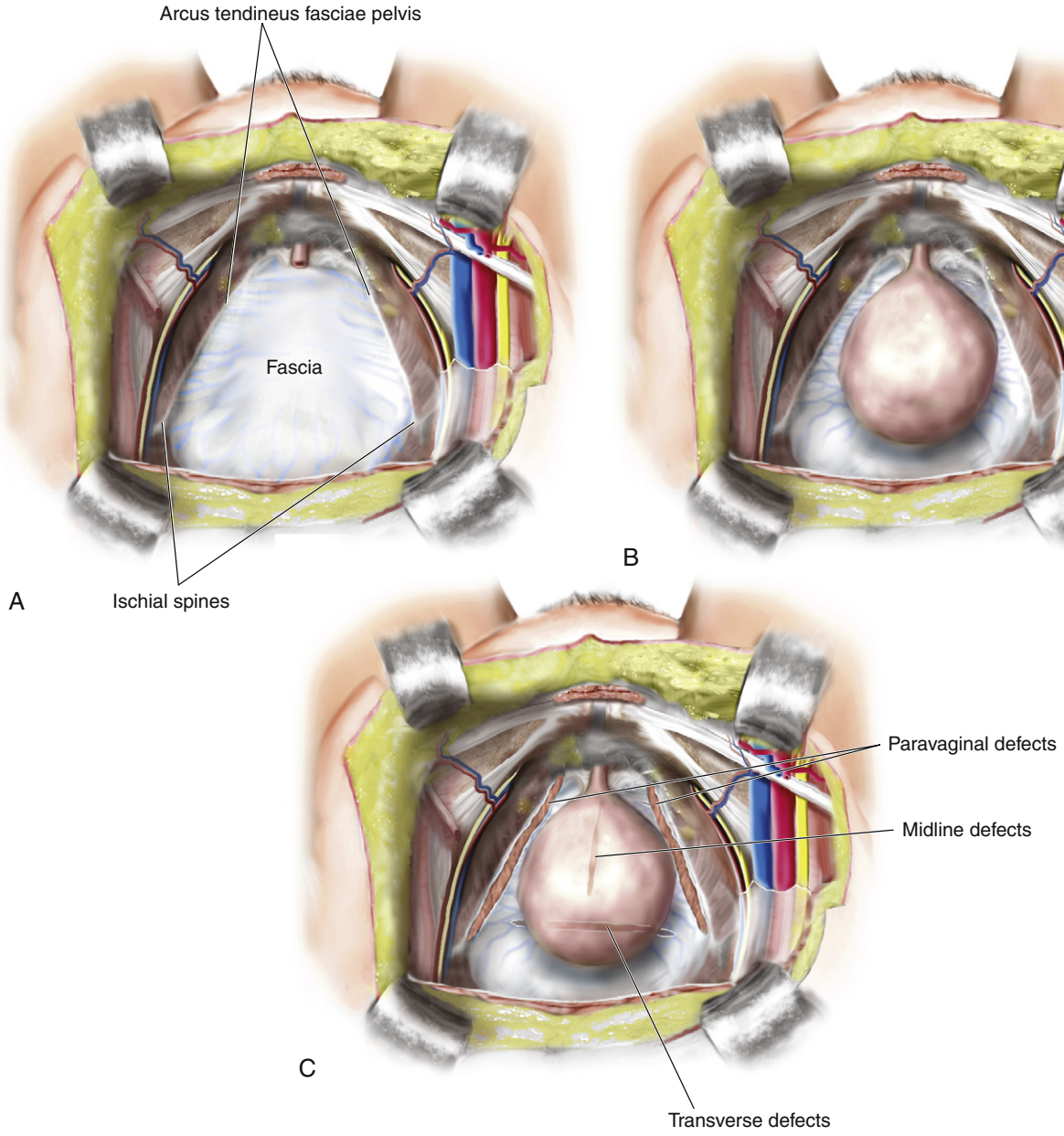

Figure 4-1 **A,** Normal support of the anterior vaginal wall viewed retropubically (bladder removed). The trapezoidal *blue area* depicts the fascial support that extends from the arcus tendineus fasciae pelvis on one side to the opposite side. This support continues to the level of the ischial spines laterally and the apex of the cervix transversely. **B,** Same view as in **A** but with the bladder in place. **C,** Three different fascial defects: central (midline), lateral (paravaginal), and transverse (apical).

Although many surgeons make a great effort to predict preoperatively what types of defects exist when patients have symptomatic anterior wall descent, the literature indicates that this is very difficult to do, and in our opinion determination of the various defects is best done intraoperatively. Thus it is critically important that the surgeon be able to customize the repair to meet the needs of a particular patient's anatomy. Although numerous types of repairs are discussed and demonstrated here, the ultimate goal of any anterior vaginal wall support procedure is to re-create a trapezoid of support that runs from below the proximal urethra to the cervix or apex and laterally to the ATFP or fascia of the internal obturator muscle. Finally, the long-term success of the anterior vaginal wall repair is directly correlated with the ability to suspend the apex in a high, durable position without creating any significant distortion of the vaginal axis.

It is well known that pelvic organ prolapse (POP) and stress urinary incontinence (SUI) can coexist. In addition, prolapse can actually mask or protect against SUI. Anterior and apical prolapse can cause a kinking of the urethra. Similarly, apical or posterior prolapse can compress the urethra and do the same. Although it is not a perfect test, reduction of the prolapse manually, with a pessary, or with packing may uncover incontinence on physical examination or urodynamic testing. SUI demonstrated by reduction of POP in a patient without clinical SUI is known as *occult* or *latent incontinence.* Although how (and whether) to treat occult incontinence remains debatable, based on the current literature we recommend at least giving consideration to performing a simultaneous antiincontinence procedure (usually placement of a synthetic midurethral sling) in patients with occult or clinical SUI who are undergoing surgery to treat prolapse. We prefer to place the midurethural sling through a separate incision after completion of the anterior vaginal wall repair.

Historically, anterior vaginal wall prolapse has been treated surgically using suture repairs designed to correct the various defects. In the early 2000s, there was a move toward the use of implant material to augment native tissue repair in reconstructive pelvic surgery. Although theoretically it would appear that augmentation with a strong material would improve outcomes and durability, the potential benefits of synthetic mesh and biological materials must be weighed against their known complications and negative outcomes, which include extrusion, erosion, dyspareunia, and host-implant reactions. After these factors are considered, in some patients it may be advantageous to augment the repair. The literature contains minimal data supporting the use of biological materials to augment prolapse repair. Many more data are available on synthetic implant materials, which have been commonly used since early 2000. The literature suggests that for some patients mesh augmentation may produce better anatomical (although not necessarily functional) results. However, permanent synthetic mesh implants are associated with unique complications, including vaginal extrusion, urinary tract erosion, infection, dyspareunia, and pain. These risks must be carefully weighed against the potential benefits. In July 2011, the U.S. Food and Drug Administration (FDA) issued a notification regarding the transvaginal placement of synthetic mesh for the repair of POP. It is recommended that any surgeon implanting mesh transvaginally read the warning and share it with his or her patient. Specifically, the FDA made the following recommendations:

- Surgeons should undergo rigorous training covering the principles of pelvic anatomy and pelvic surgery as well as proper patient selection for POP reconstructive procedures. Such training must be completed *before* implantation of surgical mesh is attempted for the treatment of prolapse.
- Before using mesh in pelvic floor repair, surgeons should be properly trained in specific mesh implantation techniques.
- Before implantation of mesh, surgeons should be competent in recognizing intraoperative and postoperative complications as well as comfortably and completely managing these adverse events. Such adverse events include those involving the urinary and gastrointestinal tracts.
- Before implantation of surgical mesh for the treatment of POP, the surgeon and patient *must* have a proper informed consent discussion regarding the risks, benefits, alternatives, and indications for the use of mesh.

This chapter describes techniques that can be performed without implants but can be adapted to tissue augmentation with a material if the surgeon so desires. The use of commercially available prolapse mesh kits is discussed in Chapter 8.

In many cases of anterior prolapse, other compartments, especially the apex, need to be corrected. The techniques described here can be used to correct an isolated anterior defect and can also be combined with procedures to restore apical support (see Chapter 6).

Native Tissue Anterior Colporrhaphy

Anterior colporrhaphy is used to repair a central or midline defect. It is essentially a plication of the pubocervical fascia (vaginal muscularis and the vaginal side of the endopelvic fascia). This in effect repairs the central defect and reduces the prolapsed bladder. Anterior colporrhaphy can be combined with a paravaginal repair as well as an apical repair.

Case #1

View Video 4-1

A 55-year-old woman complained of pelvic pressure, a vaginal bulge, and SUI. Physical examination showed Pelvic Organ Prolapse Quantification (POP-Q) stage II anterior prolapse with the leading edge of the prolapse about 0.5 cm beyond the hymen with straining (POP-Q point Ba = –0.5). The uterus and cervix were relatively well supported with the leading edge of the cervix 4 cm above the hymen with straining (point C = –4). The patient was sexually active and concerned about the consequences of implantation of permanent mesh. The defect was found to be predominantly a central defect. An anterior colporrhaphy was performed before placement of a synthetic midurethral sling (Video 4-1).

Surgical Technique for Native Tissue Anterior Colporrhaphy

1. After insertion of a Foley catheter, a midline incision is made in the anterior vaginal wall. The incision usually extends from the bladder neck (if simultaneous placement of a midurethral sling is planned) or from the midurethra (if no sling placement is planned) to the vaginal cuff (in cases of prior hysterectomy) or to just above the cervix (Fig. 4-2, *A* and *B*). (*Note:* In cases of apical prolapse, the incision may extend through the apex and even to the posterior vaginal wall.)
2. The vaginal wall is dissected off of the attenuated pubocervical fascia and bladder laterally to the inferior pubic ramus on each side. Once the initial dissection is done, countertraction (medially) on the remaining vaginal muscularis and bladder by an assistant can be helpful. The thickness of the vaginal flaps depends on whether or not an implant will be placed. If no implant is to be placed, the best plane is the avascular plane just underneath the vaginal wall. In many cases this dissection is quite easy and can often be done with a moist sponge once the proper plane is developed. If an implant is to be placed, we prefer a thicker flap, with some of the vaginal muscularis left behind.
3. The dissection is continued proximally to the vaginal cuff or cervix. It is important to fully mobilize the bladder off of the vaginal cuff. This usually requires sharp dissection (see Fig. 4-2, *C* and *D;* Fig. 4-3).
4. When an antiincontinence procedure will not be performed, Kelly plication sutures can be placed plicating the pubocervical fascia across the midline, under the urethra. 2-0 polyglycolic acid (PGA)* sutures may be used for this

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

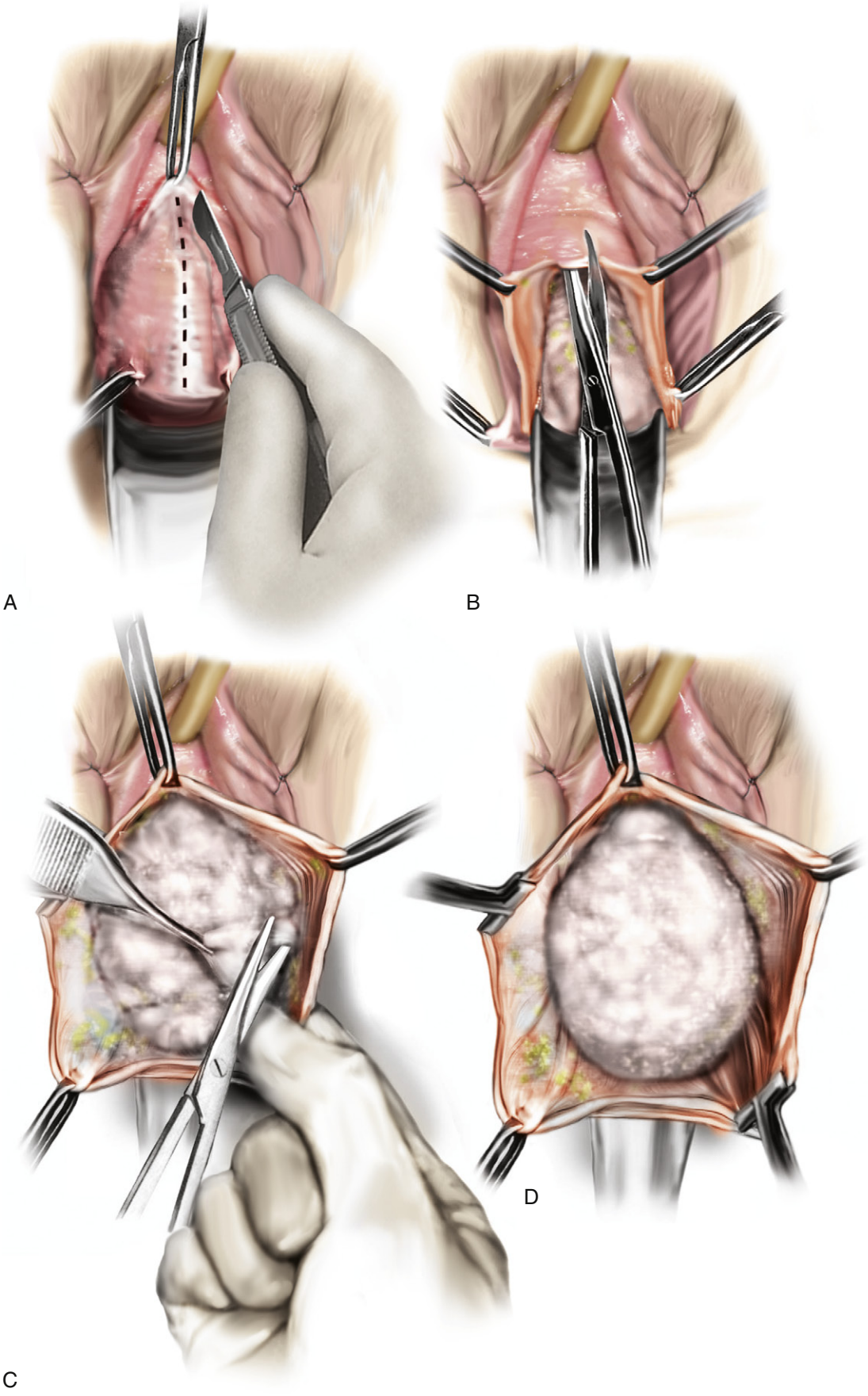

Figure 4-2 Anterior repair. **A,** A midline incision is made in the anterior vaginal wall. **B,** The incision is extended to the bladder neck (if a sling is to be placed) or to the midurethra (if no sling is to be placed). **C,** The dissection is continued laterally to the endopelvic fascia. **D,** Mobilization has been completed to the vaginal cuff.

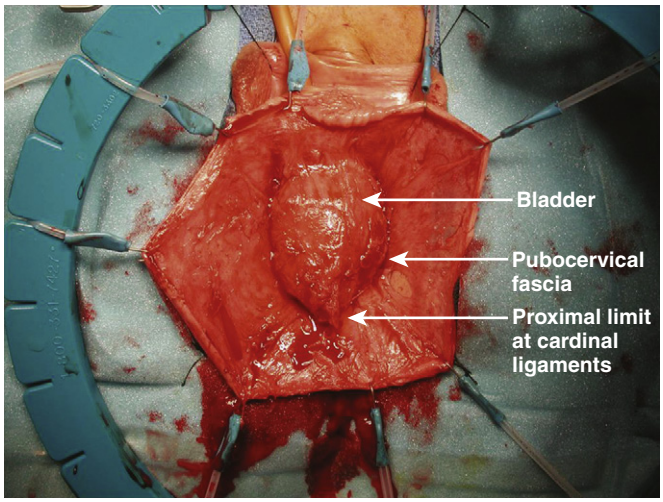

Figure 4-3 Completed dissection.

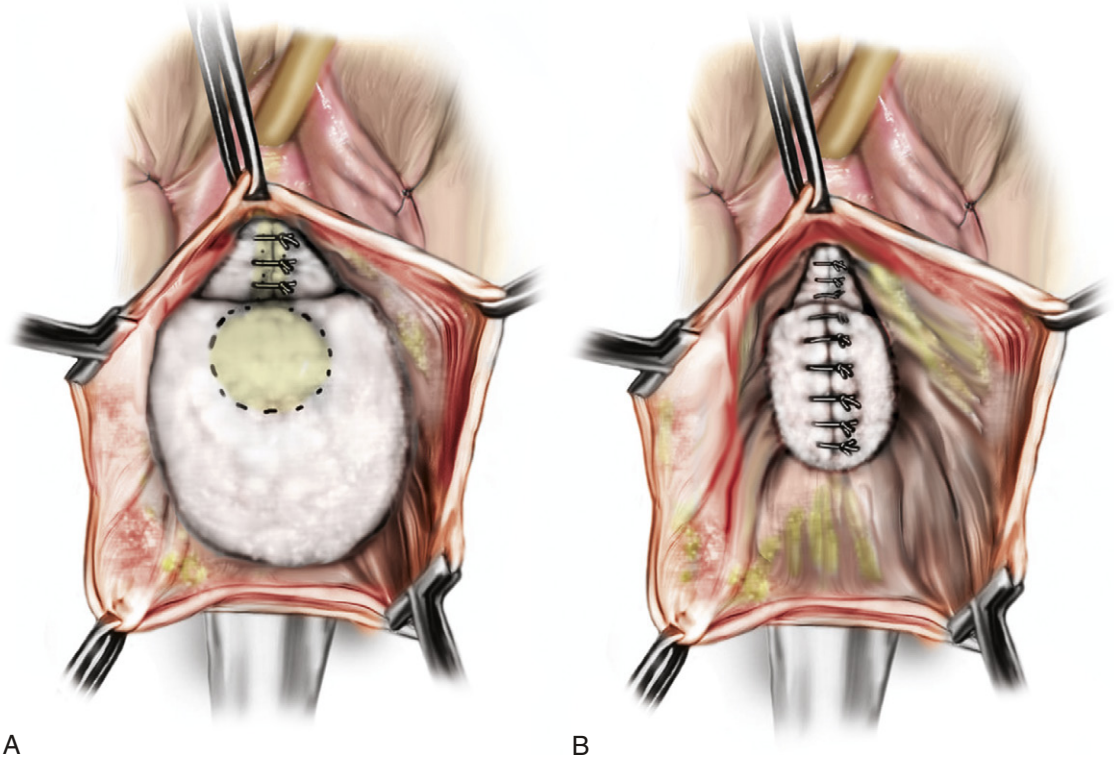

Figure 4-4 Continuation of anterior repair. **A,** Kelly plication sutures have been placed plicating the pubocervical fascia across the midline at the level of the bladder neck. (*Note:* We do not recommend this as a procedure to treat stress incontinence.) **B,** Anterior colporrhaphy has been completed from the cardinal ligaments to the bladder neck.

(Fig. 4-4, *A*). This method does not carry with it the risks associated with permanent synthetic mesh placement.

5. When an antiincontinence procedure will be performed (i.e., placement of a midurethral sling) or after Kelly plication, the anterior colporrhaphy begins at the bladder neck.
6. The repair is usually started proximally, with the cardinal ligaments (or their remnants) first brought together with 2-0 PGA sutures.
7. The pubocervical fascia is plicated across the midline for the length of the defect. The 2-0 PGA sutures are placed individually and then tied after all have

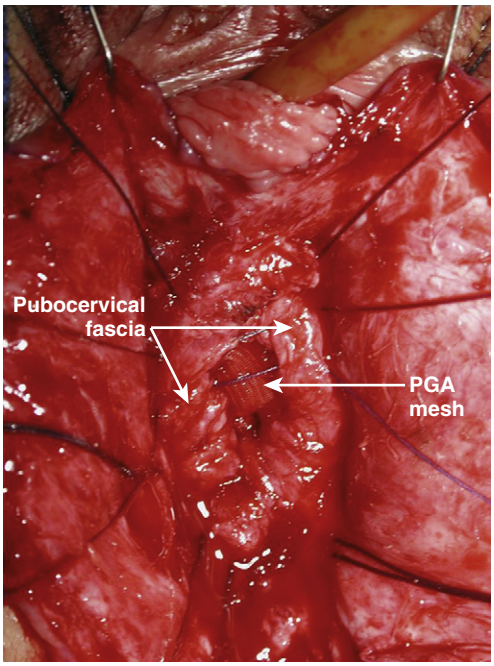

Figure 4-5 Bladder is reduced with a polyglycolic acid (PGA) mesh and the anterior repair is performed.

been placed. In cases of a transverse defect, the proximal extent of the colporrhaphy can be sutured to the plicated cardinal ligaments (see Fig. 4-4, *B*). It should be noted that if significant transverse defects with apical prolapse exist, a more extensive repair involving suspension of the vaginal apex is necessary (see Chapter 6 and Video 4-4).

8. We have also found it useful, especially in cases of a large cystocele, to pack the bladder into its normal anatomical position with a piece of PGA mesh, which will be absorbed in several weeks. This facilitates the repair by keeping the bladder reduced (Fig. 4-5). It was reported in one randomized controlled trial that this may reduce the risk of recurrence. Cystoscopy is performed after intravenous administration of indigo carmine to rule out ureteral, bladder, or urethral injury.
9. After completion of the anterior repair, the anterior vaginal wall is closed with interrupted 2-0 PGA sutures. Although the vaginal wall may be trimmed as necessary, we avoid excessive trimming to prevent vaginal shortening.
10. If a synthetic midurethral sling procedure is to be performed, it is done at this time in standard fashion through a separate distal anterior vaginal wall incision. (See Videos 4-1 and 4-2 for demonstrations of anterior colporrhaphy.)

Anterior Colporrhaphy With Implant Interposition

In cases in which the pubocervical fascia is attenuated, a piece of synthetic mesh or biological material can be interposed. After anterior repair the implant can be fixed to the upper portion of the anterior vaginal wall on each side (incorporating the levator fascia) and to the lining of the vaginal wall at the level of the cuff (Fig. 4-6). In cases where tissue augmentation is used, we prefer to use implant material in combination with a more extensive anterior or apical repair in which the implant can be secured to strong structures such as the ATFP and sacrospinous ligaments. In a randomized controlled trial of anterior colporrhaphy versus mesh repair of the anterior compartment recently described by

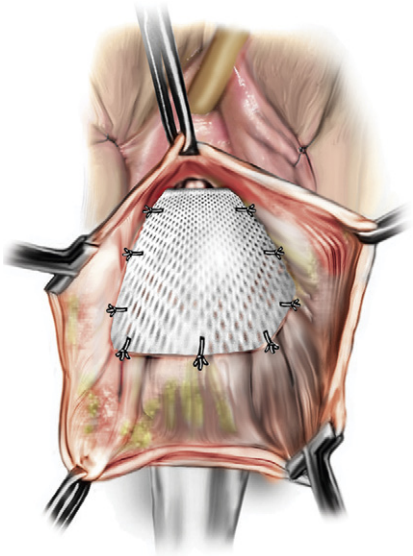

Figure 4-6 After completion of the anterior repair, a mesh (or biological) implant may be fixed laterally to the levator fascia and proximally to the inside lining of the vaginal wall at the level of the apex.

Hiltunen et al, mesh repair was found to produce superior anatomical outcomes at 1 year but was associated with a higher complication rate.

Combined Anterior Colporrhaphy and Paravaginal Repair

Case #2

View Video 4-3

A 62-year-old woman had pelvic heaviness and a vaginal bulge. She also complained secondarily of urinary frequency and urgency, but had no stress incontinence. Physical examination revealed a predominantly anterior prolapse with the leading edge of the anterior vaginal wall extending 1 cm beyond the hymen with straining (point Ba = +1). The cervix was 3 cm above the hymen (point C = –3). The patient wished to preserve her uterus. At surgery a significant central defect and a paravaginal defect were discovered. Both defects were repaired. (See Video 4-3 for a demonstration of anterior repair with paravaginal defect repair.)

Surgical Technique for Combined Anterior Colporrhaphy and Paravaginal Repair

When a paravaginal defect exists alone or, more commonly, with a central defect, it can be repaired vaginally. The technique for simultaneous paravaginal and midline plication is described here. The technique is modified slightly if no central defect is present.

1. The initial dissection is identical to that described previously for anterior colporrhaphy; however, the lateral dissection is extended to the pubic ramus. If a paravaginal defect is present, either the muscular lining of the vaginal wall will be completely detached from the ATFP or simple palpation will note a very weak attachment. For this repair to be performed appropriately, any attenuated lateral attachment should be taken down from the bladder neck to the ischial spine. This is usually done with blunt dissection.
2. At this point the bladder can be retracted medially with a Breisky-Navratil or similar retractor, and the arcus tendineus and/or obturator fascia are seen.
3. When a central defect exists, it is repaired as previously described.

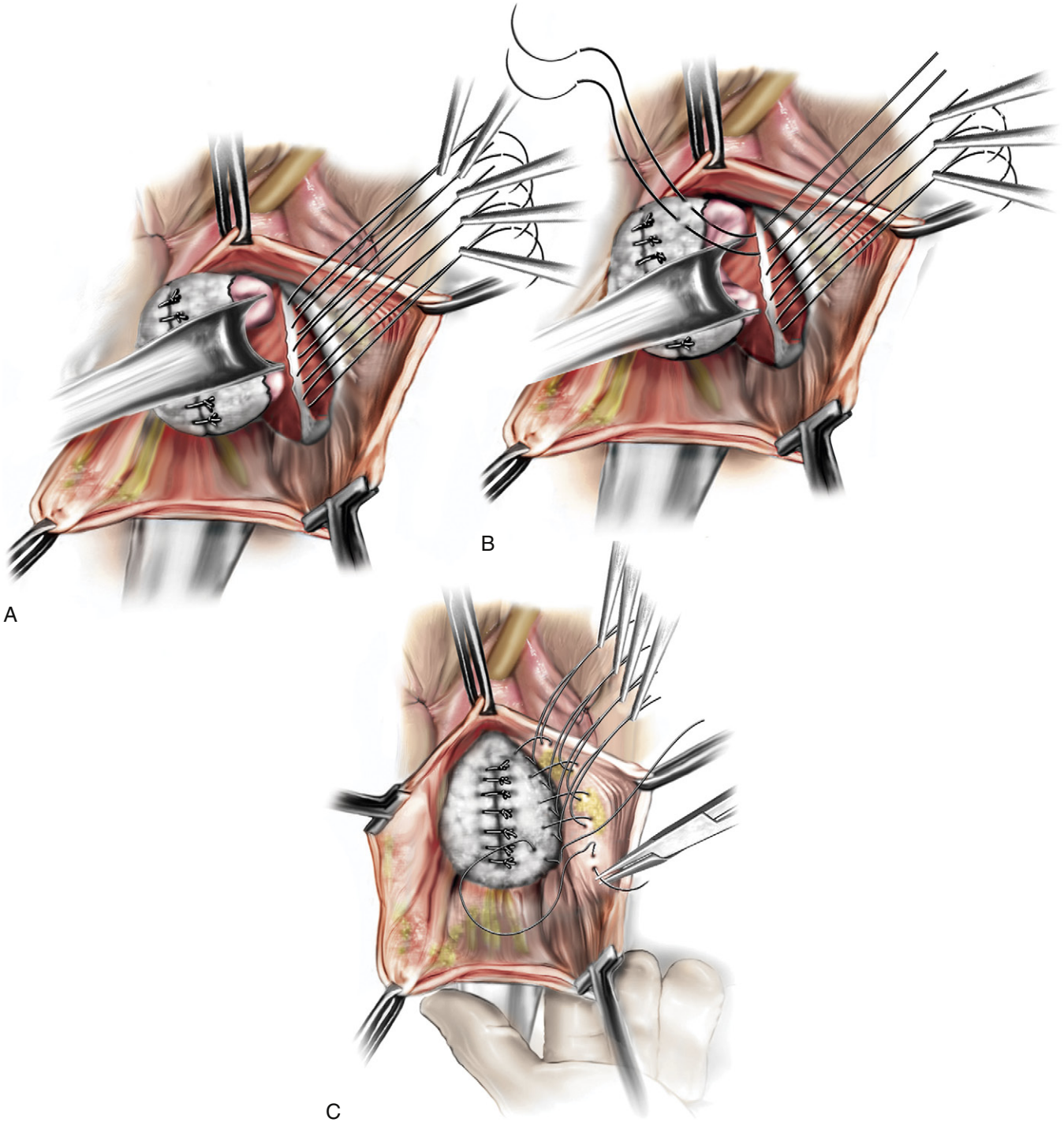

Figure 4-7 After midline repair (if necessary) the arcus tendineus fasciae pelvis is identified and sutures can be placed in it under direct vision or with use of a Capio needle driver (**A**) (see Video 4-3). These sutures can then be placed into the pubocervical fascia (**B**) and through the lateral vaginal wall (**C**).

4. Sutures are then placed into the arcus tendineus or, if it is attenuated or not identifiable, into the obturator fascia. This can be done under direct vision or, as we prefer, with a Capio needle driver (Boston Scientific, Natick, MA). Three to five sutures are placed on each side, starting at the level of the bladder neck and continuing proximally to just above the ischial spine. We prefer to use a permanent suture such as 2-0 Ethibond (Fig. 4-7, *A*).
5. The paravaginal sutures are placed into the lateral aspect of the colporrhaphy on each side (two-point repair). A small amount of lateral vaginal wall

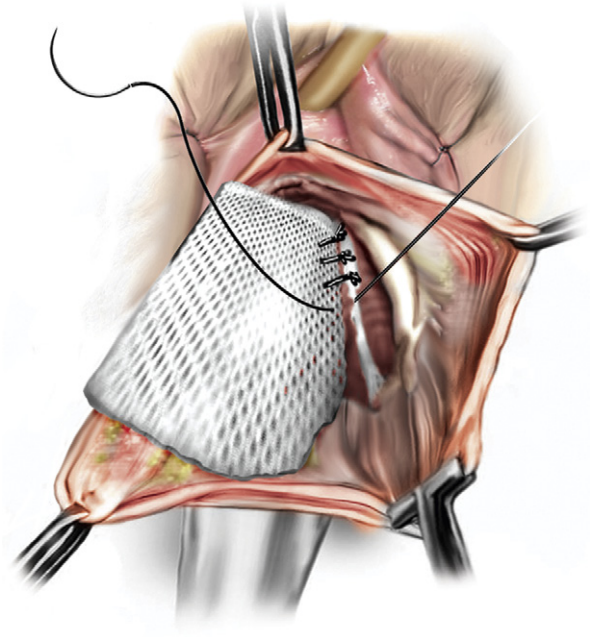

Figure 4-8 Paravaginal defect repair with implant sutured into the arcus tendineus fasciae pelvis.

(excluding the epithelium) can also be incorporated (three-point repair). The sutures are then tied distal to proximal, with the corresponding suture on each side tied before advancing (see Fig. 4-7, *B* and *C*).

6. When there is no central defect, the inside of the vaginal wall is sutured to the arcus tendineus as in the traditionally described paravaginal repair.
7. Cystoscopy is performed at completion of the repair after intravenous administration of indigo carmine to rule out ureteral, bladder, or urethral injury.
8. The vaginal wall is trimmed (if necessary) and closed with 2-0 PGA sutures.
9. Implant interposition can be done here as well by securing a trapezoidal implant to the arcus tendineus or obturator fascia bilaterally (Fig. 4-8).

Case #3

View Video 4-4

A 68-year-old woman who had undergone vaginal hysterectomy with repairs 2 years earlier came for treatment of recurrent advanced prolapse. She complained of significant tissue protrusion as well as voiding dysfunction requiring that she manually reduce the prolapse to empty her bladder. The leading edge of the prolapse was point D, descending 6 cm beyond the hymen with complete eversion of the anterior vaginal wall. The procedure performed was an intraperitoneal suspension of the vaginal apex to the uterosacral ligaments in conjunction with an anterior colporrhaphy augmented with placement of a biological mesh. (See Video 4-4 for a demonstration of anterior colporrhaphy in conjunction with vaginal vault suspension.)

Outcomes

Since anterior repair is often performed in conjunction with more extensive POP repairs (i.e., apical and/or posterior repairs), few studies have adequately addressed the long-term results of isolated anterior repairs. Most series are uncontrolled, and definitions of recurrence vary. Recurrence rates range from 7% to 50% depending on how recurrence is defined and what patient population

is chosen. Weber et al examined three variations of anterior colporrhaphy in a prospective study. Very strict anatomical criteria were used to determine success, and only 30% of patients undergoing standard anterior colporrhaphy, 42% of those undergoing standard repair plus PGA mesh overlay, and 46% of those undergoing ultralateral plication under tension were judged to have experienced an optimal or satisfactory anatomical result. However, most patients reported satisfaction with symptom improvement. This raises the question of how relevant are strict anatomical definitions of success. In almost all cases of POP repair, the indications for repair are subjective symptoms. It would thus seem that symptomatic improvement with maintenance or restoration of vaginal function is a more appropriate end point.

Two small randomized controlled trials reported lower anatomical recurrence with polypropylene mesh–reinforced repair than with traditional anterior vaginal prolapse repair. Hiltunen et al randomly assigned 97 women to undergo anterior colporrhaphy alone and 104 to undergo repair reinforced with low-weight polypropylene mesh. Seventeen patients (38.5%) in the no-mesh group and seven (6.7%) in the mesh group experienced recurrent anterior wall prolapse ($P < .001$) at 12 months. In another randomized controlled trial comparing low-weight polypropylene transobturator mesh-reinforced repair with site-specific repair of anterior vaginal prolapse, Sivaslioglu et al noted anatomical cure rates of 91% (39 of 43 patients) in those undergoing mesh repair and 72% (30 of 42 patients) in those undergoing site-specific repair ($P < .05$). However, mesh exposure (extrusion) rates for these two studies were 17.3% and 6.9%, respectively. Therefore better anatomical results may not translate into better overall outcomes.

Recently Altman et al reported on a large multicenter study of 389 women who were randomly assigned to a study treatment: 200 underwent anterior prolapse repair with a transvaginal mesh kit and 189 underwent traditional colporrhaphy. At 1 year, the primary outcome of POP-Q stage 0 or I anterior prolapse (anatomical result) was significantly more common in the women treated with the mesh procedure (60.8%) than in those who underwent colporrhaphy (34.5%) (absolute difference, 26.3%; 95% confidence interval, 15.6 to 37.0). The surgery took longer and the rates of intraoperative hemorrhage were higher in the mesh-repair group than in the colporrhaphy group ($P < .001$ for both comparisons). Rates of bladder perforation were 3.5% in the mesh-repair group and 0.5% in the colporrhaphy group ($P = .07$), and the respective rates of new SUI after surgery were 12.3% and 6.3% ($P = .05$). Surgical reintervention was required to correct mesh exposure during follow-up in 3.2% of 186 patients in the mesh-repair group.

Potential complications of anterior repair include bladder or urethral injury, ureteral injury, and excessive intraoperative bleeding. If indigo carmine is administered and cystoscopy performed after the repair is completed, bladder, urethral, and ureteral injuries should be recognized and repaired intraoperatively. If a permanent suture is seen in the bladder or urethra, it should be removed. If a ureteral injury is suspected, the colporrhaphy should be taken down. This usually results in prompt efflux of urine from the ureteral orifices. If not, consideration can be given to ureteral stent placement.

Voiding dysfunction is another possible longer-term complication of anterior repair. Difficult emptying can occur even if a simultaneous sling procedure is not done, but usually resolves over time and can be managed with an indwelling catheter or intermittent catheterization. Urgency and urgency incontinence may persist or occur de novo in a small percentage of patients. Sexual function may improve or worsen after anterior repair. The most common reasons for

the development of dyspareunia are vaginal shortening and the formation of a vaginal constriction. The use of synthetic mesh may also result in a higher incidence of dyspareunia.

Suggested Readings

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Indications and Techniques for Vaginal Hysterectomy for Uterine Prolapse

5

Nirit Rosenblum, MD
Victor W. Nitti, MD

Videos

5-1 Vaginal Hysterectomy for a Large Uterus Requiring Morcellation Techniques
5-2 Use of the LigaSure Device During Simple Vaginal Hysterectomy
5-3 Bilateral Oophorectomy at the Time of Vaginal Hysterectomy
5-4 McCall Culdoplasty After Vaginal Hysterectomy
5-5 Simple Vaginal Hysterectomy for POP-Q Stage III Uterine Prolapse
5-6 Simple Vaginal Hysterectomy for POP-Q Stage II Uterine Prolapse
5-7 Simple Vaginal Hysterectomy for Uterine Procidentia With an Elongated Cervix

Although the role of hysterectomy in the treatment of benign gynecological conditions has come into question since the early 2000s, with increasing emphasis on medical therapy for fibroid tumors, endometriosis, and benign uterine bleeding, there remains an important role for vaginal hysterectomy in the treatment of advanced pelvic organ prolapse (POP). Specifically, symptomatic uterine prolapse is ideally corrected vaginally with simple hysterectomy, usually in conjunction with enterocele repair, vault suspension, and appropriate repairs of the anterior and posterior vaginal wall. Uterine size, surgeon preference, obesity, age, and the need for concurrent prolapse repair or incontinence procedures are all important factors in the decision to choose a vaginal route for hysterectomy. Benefits of a vaginal approach to hysterectomy compared with an abdominal approach include a shorter hospital stay, more rapid return to normal activities, and fewer postoperative complications. A high level of patient satisfaction following vaginal hysterectomy for POP has been reported in several studies. Vaginal hysterectomy offers a safe, efficient, and effective method of surgically correcting advanced uterine prolapse.

Uterine prolapse is multifactorial in most women, some of whom may be predisposed genetically. Direct damage to the uterosacral-cardinal ligament complex as well as the levator ani muscular complex leads to loss of uterine and apical vaginal support. These defects can occur following pregnancy and

childbirth or can develop in certain types of connective tissue disorders. Conditions associated with chronically elevated intraabdominal pressures may also contribute to POP, especially in cases of recurrence following prior surgical repair. These conditions include chronic constipation, a common symptom complex in aging patients; chronic obstructive pulmonary disease; obesity; and occupations or situations associated with heavy lifting, such as caring for a disabled family member or spouse. Aging causes loss of muscular tone and dynamic function, decreased collagen quality, and endocrine abnormalities, which may play a role in POP.

Preoperative Evaluation

Patients being considered for vaginal hysterectomy as a definitive surgical therapy for symptomatic uterine or pelvic organ prolapse should be screened preoperatively for uterine fibroids, endometrial abnormalities, occult uterine or adnexal masses, and cervical dysplasia or carcinoma. Before vaginal hysterectomy is undertaken, a Papanicolaou test should be performed as indicated. In addition, if the patient has a history of abnormal uterine bleeding or if the surgeon desires to determine the size of the uterus and check for the presence and size of any fibroids, transvaginal pelvic ultrasonography should be done. Pelvic magnetic resonance imaging is an alternative option if further detailed imaging is warranted.

The presence of an enlarged uterus or sizable fibroids may preclude a vaginal route for hysterectomy if the uterus cannot be delivered vaginally after division of the pedicles. Endometrial thickening in a postmenopausal woman or the presence of endometrial polyps or masses requires preoperative biopsy to rule out dysplasia or carcinoma. The findings may lead to a change in operative planning. In addition, visualization of adnexal masses on pelvic ultrasonography could necessitate oophorectomy via abdominal or laparoscopically assisted hysterectomy. The patient's family history, specifically a familial risk of breast and ovarian cancer, or a prior positive screening result for the BRCA gene should also be taken into account and may guide decision making regarding the advisability of concurrent oophorectomy.

As mentioned earlier, a preoperative Papanicolaou test is another essential component of evaluation before vaginal hysterectomy. Cervical dysplasia or carcinoma in situ should be identified before surgery so that enough surrounding vaginal tissue can be resected to ensure margins free of neoplastic disease. This is especially important in any woman who has had high-risk human papillomavirus disease that has previously been associated with the appearance of atypical or dysplastic endocervical cells.

Patient Selection

Simple vaginal hysterectomy is an ideal option for the postmenopausal woman with symptomatic uterine prolapse who desires definitive treatment and is not interested in uterine preservation. Concurrent apical suspension with anterior and/or posterior repair as well as antiincontinence procedures can also be performed if indicated. Sexual function can be maintained by giving careful attention to preservation of vaginal length, depth, and caliber. The vaginal approach is implemented more readily than the abdominal approach in obese patients as well as in patients who have undergone prior abdominal or pelvic surgery.

Furthermore, vaginal hysterectomy with or without concurrent prolapse repair can be achieved under regional anesthesia, which may be ideal for any patient with compromised pulmonary function or cognitive dysfunction for whom general anesthesia is best avoided.

Surgical Anatomy

The uterus is composed of two main parts: the uterine corpus (or body) and the cervix. The corpus consists of the endometrial cavity surrounded by the myometrium and the serosa. The cervix, attached to the lateral fornices of the vagina, leads from the vagina to the endometrial cavity via the cervical canal (Fig. 5-1). The main support of the uterus comes from the uterosacral and cardinal ligaments. These two integrated connective tissue structures extend from their origin at the cervix and upper vagina to the pelvic sidewall (cardinal ligament) and to the sacrum (uterosacral ligament) and provide level I support for the uterus. Above these support structures lies the broad ligament composed of anterior and posterior leaves of visceral and parietal peritoneum that connect the uterus to the adnexa (Fig. 5-2). The blood supply to the uterus comes from branches of the internal iliac artery (Fig. 5-3). The uterine artery travels through the cardinal ligament and crosses over the ureter 1 to 2 cm lateral to the cervix.

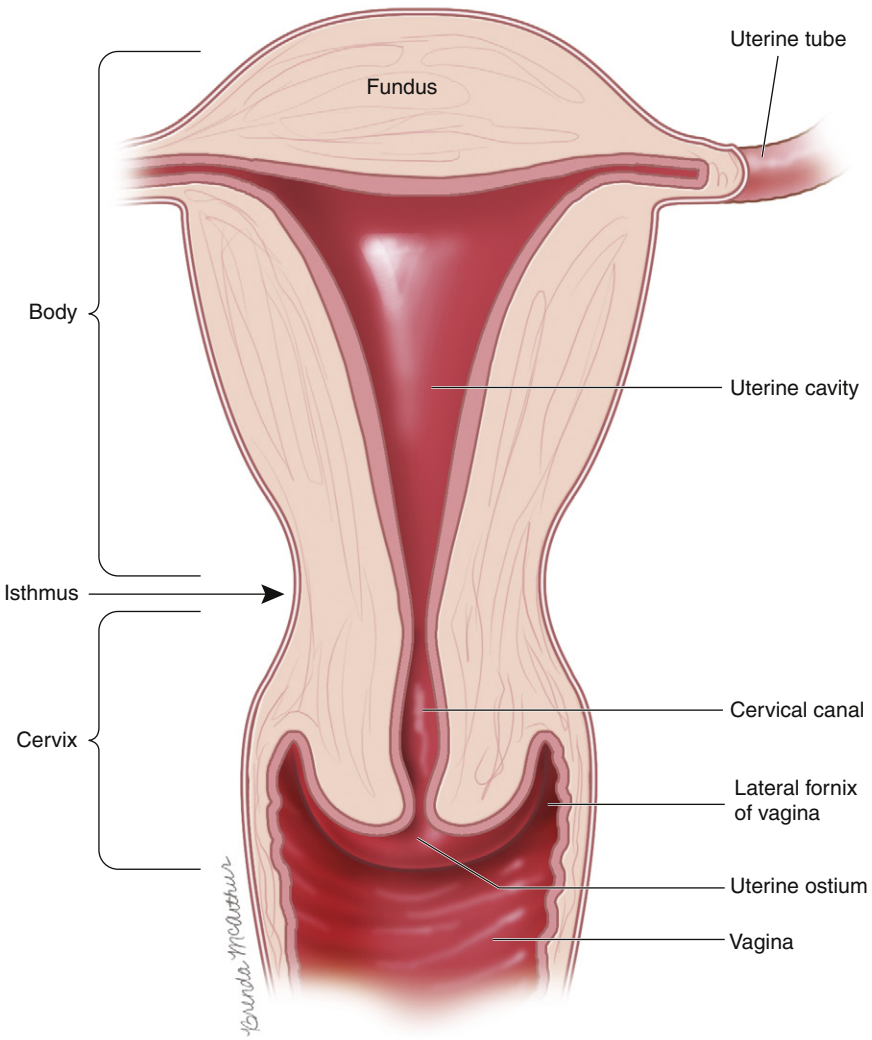
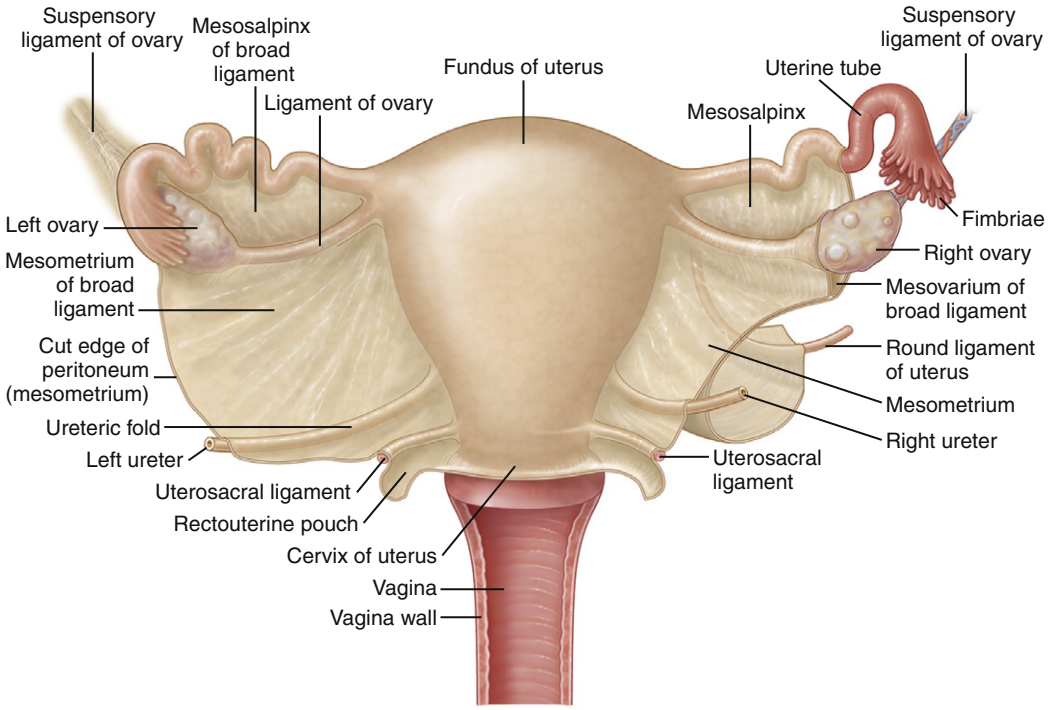


Figure 5-1 Sagittal view of the uterus, cervix, and vagina. (From Walters MD, Barber MD. *Hysterectomy for Benign Disease*. Philadelphia: Saunders; 2010. *Female Pelvic Surgery Video Atlas Series*.)



Uterus and broad ligament (posterior view)

Figure 5-2 Closer view of the uterus, cervix, ovaries, fallopian tubes, and the broad ligament. (From Drake RL, Vogl AW, Mitchell AWM, et al. *Gray's Atlas of Anatomy.* Philadelphia: Churchill Livingstone; 2008:229.)

Before it enters into the uterus near the junction of the corpus and the cervix, the uterine artery sends off the vaginal artery, which supplies the upper portion of the vagina (see Fig. 5-3). The ovarian arteries are direct branches of the aorta.

Surgical Technique for Simple Vaginal Hysterectomy

In this section we limit our discussion to vaginal hysterectomy for the treatment of POP. This technique (with some modifications) can be applied to uterine prolapse of varying degrees (Pelvic Organ Prolapse Quantification [POP-Q] stages II to IV) and uteri of different sizes. In addition the technique can be combined with vaginal oophorectomy when desired. In all cases in which vaginal hysterectomy is performed for the repair of POP, a procedure to address the cul-de-sac and restore and/or maintain apical support is necessary. (See Chapter 6 for discussion and demonstration of vaginal repair of enterocele and apical prolapse.)

1. After anesthesia is induced, lower-extremity sequential compression devices are applied, and the patient is placed in the exaggerated dorsal lithotomy position. Surgical preparation and draping are performed in the usual sterile fashion. We prefer to use an "all-in-one" lithotomy drape that includes leg covers and a midline subvaginal pouch to drain blood and fluids intraoperatively. The drape may be sutured to the perineum with silk sutures to avoid exposure of the anus in the operative field.
2. To optimize vaginal exposure, we place a Lone Star ring retractor (Cooper-Surgical, Trumbull, CT) with sharp hooks at the beginning of the procedure: two hooks along the anterior vaginal wall adjacent to the urethral meatus, two hooks at the lateral vaginal wall, and two hooks posteriorly along the posterior fourchette. This rectractor may be placed at the beginning of the procedure or after the uterus has been removed, depending on anatomy and surgeon preference. A Foley catheter is inserted into the bladder and all

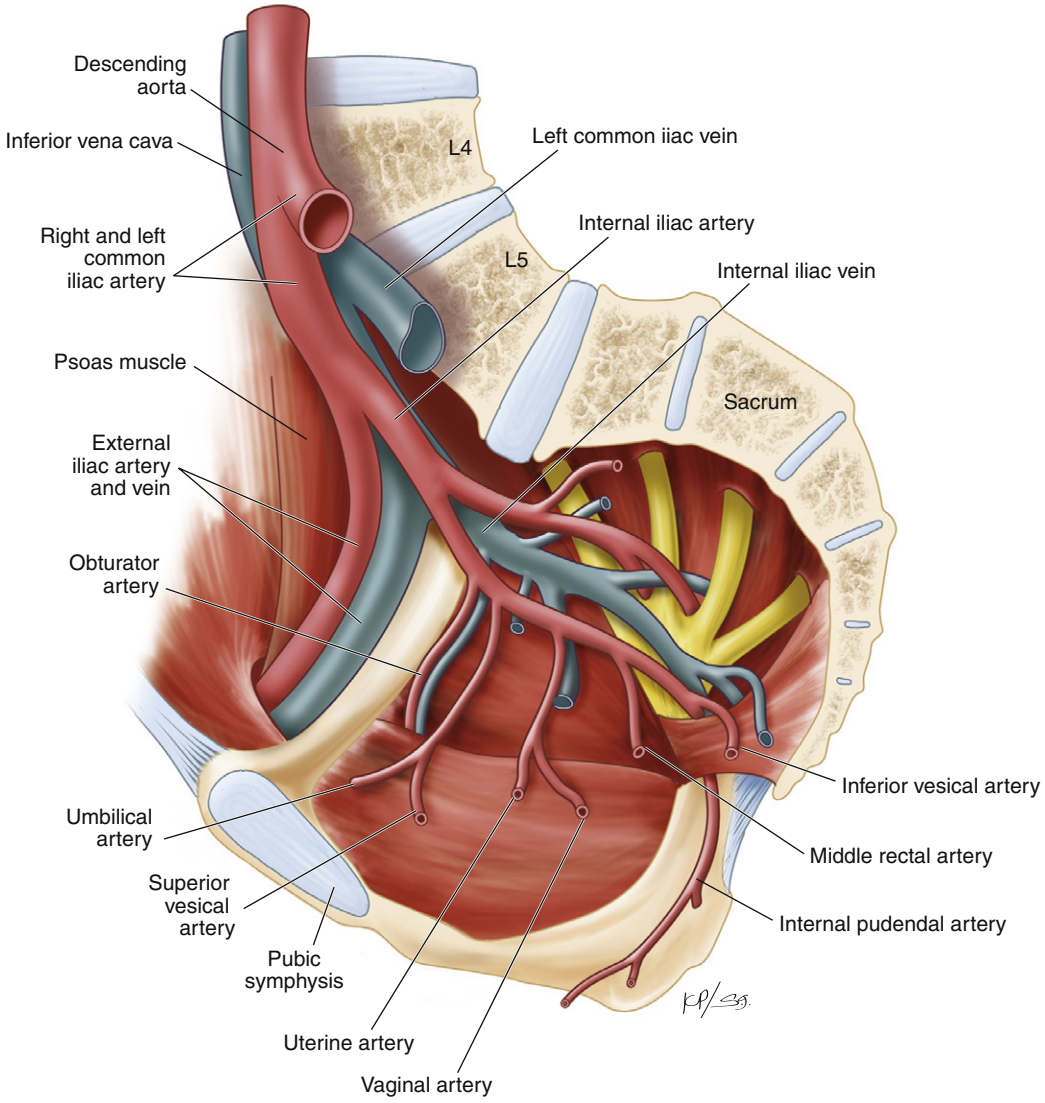


Figure 5-3 The aorta provides the blood supply to the pelvic structures. It bifurcates at approximately L4 and L5 into the right and left common iliac arteries. The inferior vena cava, into which the right and left common iliac veins return their blood flow, is located to the right of the aortic bifurcation. The left common iliac vein travels anterior to the sacrum medial to the aortic bifurcation and joins the right common iliac vein posterior to the right common iliac artery. The common iliac arteries then divide into the external iliac and internal iliac (hypogastric) arteries. The external iliac artery is located medial to the psoas muscle, and the external iliac vein is much larger and lies posterior and medial to the artery. The external iliac vein also covers the obturator fossa, where the obturator neurovascular bundle and lymph nodes are located medial to the obturator internus muscle. The internal iliac, or hypogastric, artery branches into the anterior and posterior divisions. The posterior division travels toward the ischial spine branching into the lateral sacral, iliolumbar, and superior gluteal arteries. The anterior division of the internal iliac artery branches into the obliterated umbilical, uterine, superior vesical, obturator, vaginal, and inferior gluteal and pudendal arteries. (From Walters MD, Barber MD. *Hysterectomy for Benign Disease*. Philadelphia: Saunders; 2010. *Female Pelvic Surgery Video Atlas Series*.)

urine evacuated before hysterectomy to allow delivery of the uterus while minimizing the risk of bladder injury.

3. Using Sims, Breisky-Navratil, or Heaney retractors, the cervix is identified and grasped with two long, single-tooth tenacula at the 12 o'clock and 6 o'clock positions. The use of two tenacula helps maintain the proper orientation. Traction on these clamps allows delivery of the uterus to the introitus or beyond, depending on how advanced the prolapse is. The pericervical tissue is then infiltrated with a diluted solution of 1% lidocaine

with epinephrine in a circumferential manner to cause vasoconstriction and aid in hydrodissection.

4. With a scalpel or Bovie cautery, a circumscribing incision is made in the cervicovaginal junction while countertraction is applied with the tenacula to maximize tissue separation. The incision should be made approximately 0.5 to 1.0 cm from the cervical os to maximize preservation of vaginal tissue, which is important in maintaining vaginal length and depth. Continued dissection in the midline both anteriorly and posteriorly can be achieved either with a Bovie cautery or with scissors, with the tips always pointed toward the cervix. Anteriorly the plane between the bladder and the cervix is identified and dissected to the anterior peritoneal fold to allow cephalad mobilization of the bladder away from the cervix and uterus. The anterior peritoneal fold may be identified by placing a narrow Deaver retractor between the cervix and the bladder. Posteriorly, a similar dissection is carried out to identify the plane between cervix and uterus and rectovaginal septum along with the overlying peritoneum (Fig. 5-4).
5. Following posterior dissection, the posterior peritoneum is identified and sharply entered with scissors (with tips pointed towards the cervix and uterus). A small amount of amber or yellow fluid is sometimes encountered, which confirms entry into the peritoneal cavity. Finger palpation is then used to confirm entrance into the peritoneal cavity and to palpate the uterine fundus, to ensure that there are no significant adhesions between the uterus and surrounding viscera as well as to confirm the size of the uterus.
6. Attention is then turned to the anterior compartment, where a Heaney or Breisky-Navratil retractor can be placed to assist in cephalad mobilization of the bladder. The uterosacral and cardinal ligament complex is identified on each side by placing a finger posteriorly through the posterior colpotomy and sweeping anteriorly beneath the ligament complex to reach the midline distal to the bladder base. This can also be done carefully using a

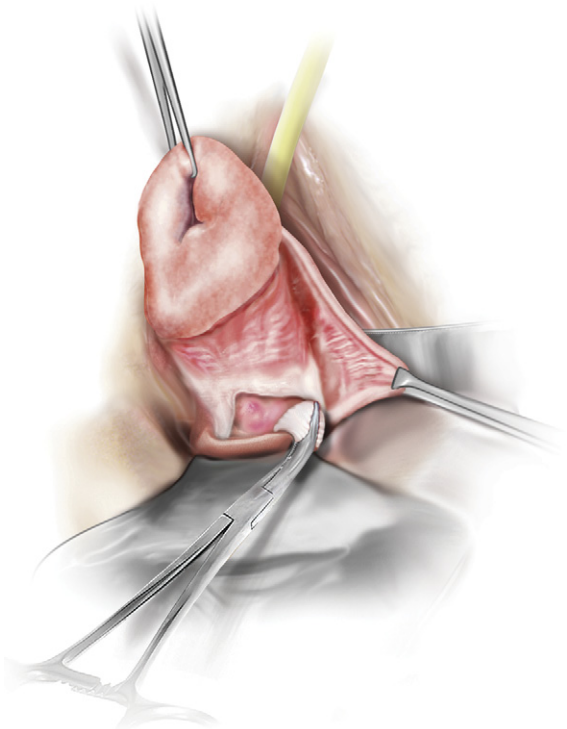


Figure 5-4 Dissection of the posterior cervix to the posterior peritoneal reflection (peanut retractor). Note the uterosacral ligaments on each side. Once identified, the peritoneum is sharply opened and the peritoneal cavity is entered.

large, curved vascular or right-angle clamp. Heaney clamps are then used to clamp the uterosacral ligaments bilaterally, with care taken to stay distal and adjacent to the cervix and thereby avoid potential ureteral injury (see Fig. 5-4). The ligament is divided sharply and suture-ligated with size 0 polyglycolic acid suture.* The uterosacral sutures are clamped and tagged with hemostats for later identification

7. Alternatively, depending on the thickness of the structures and the length of the cervix, the uterosacral and cardinal ligaments may be identified and divided separately. In cases of cervical elongation, it is often necessary to take several separate bites of tissue extraperitoneally before entering the posterior cul-de-sac.
8. The uterine pedicles are then clamped and divided, followed by suture ligation (Fig. 5-5). Many surgeons prefer also to tag these sutures to allow inspection for bleeding after delivery of the cervix and uterus.
9. The uterus is then delivered outside of the vagina by placing a finger posteriorly into the peritoneal cavity and palpating the fundus. The anterior peritoneum is then opened (if this has not already been done), and the fundus of the uterus is delivered posteriorly, so that the uterus is everted out through the introitus. If this maneuver proves difficult due to uterine size or adhesions, a tenaculum can be placed carefully on the fundus to aid in delivering the uterus. Adhesions can be sharply divided if necessary. In rare cases, if the uterus is unexpectedly large, various maneuvers to morcellate or core out the uterus can be employed (Video 5-1 ).
10. The remaining broad and round ligaments are clamped and divided sharply, then suture-ligated with absorbable size 0 sutures (Fig. 5-6). Depending on the thickness of the broad ligament, this can be done with a single clamp or with two clamps. These pedicles are usually also tagged for later identification.
11. As an alternative to clamping, division, and ligation of the various pedicles, one may use a tissue fusion or cauterizing device such as the LigaSure (Covidien, Mansfield, MA) to ligate the pedicles (Video 5-2 ).
12. When oophorectomy is to be performed, the ovaries can be identified by traction on the broad ligaments. Once they are identified, gentle traction on each ovary with an Allis or Babcock clamp will allow identification of the infundibulopelvic ligament. The ligament, along with the ovarian vessels, can be clamped and double-ligated. Alternatively a stapling or tissue fusion device (e.g., LigaSure) can be used (Fig. 5-7). (See Video 5-3 for a demonstration of vaginal oophorectomy. )
13. After the specimen is removed, the operative field is carefully inspected for hemostasis with the aid of the tagged sutures. Once the surgeon is satisfied that hemostasis has been achieved, the sutures marking the cardinal and broad ligaments are cut. The uterosacral sutures are held to assist in the appropriate positioning of culdoplasty sutures.
14. Closure of the cul-de-sac is next addressed to prevent enterocele as well as to support the cuff. If the patient has advanced prolapse (the cuff descends to or beyond the hymen), then a formal vaginal vault suspension such as a sacrospinous ligament fixation, high uterosacral ligament suspension, or iliococcygeus suspension (see Chapter 6) is usually required. However, if the cuff is relatively well supported or descends only into the lower third of

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

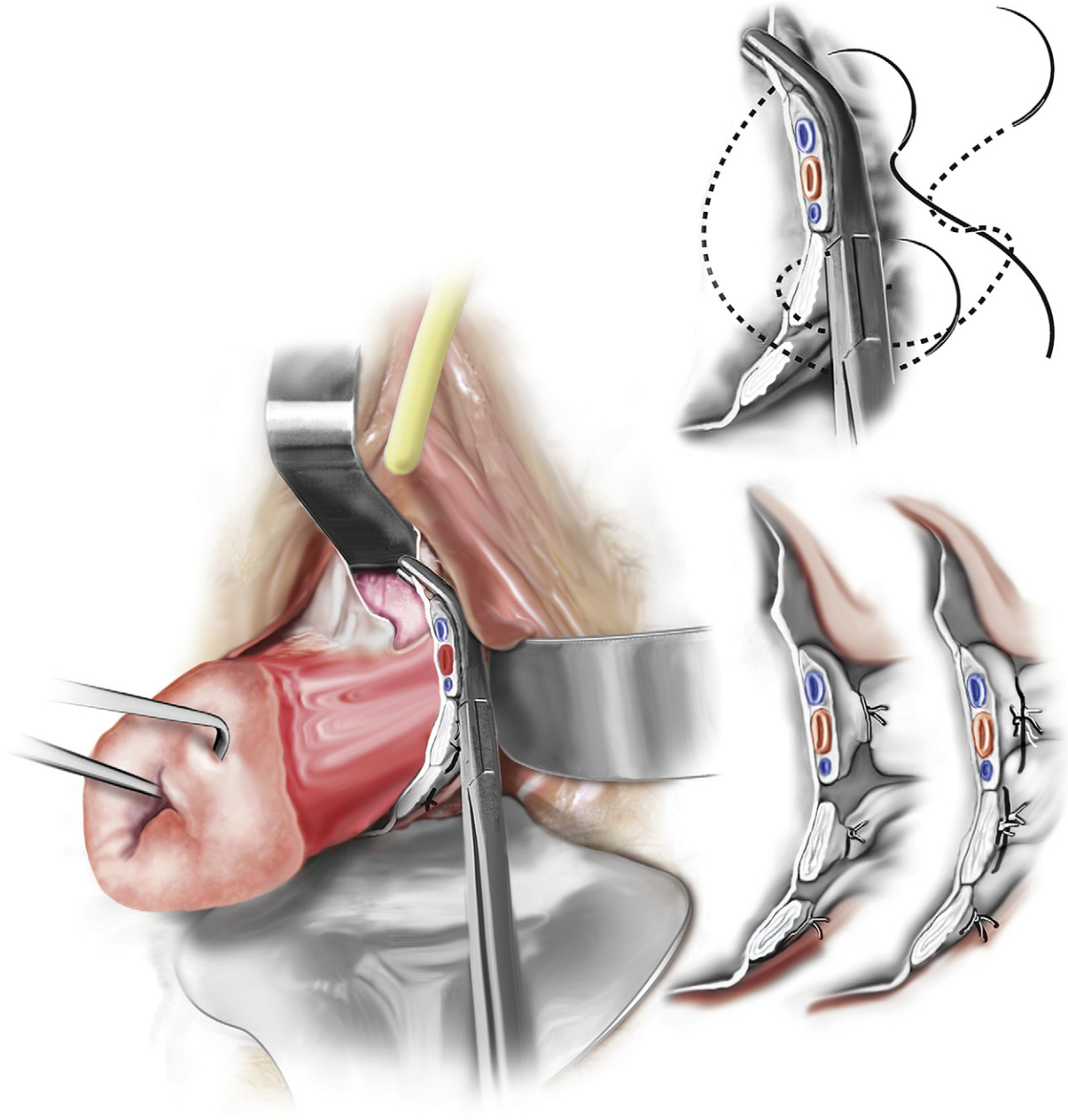


Figure 5-5 The uterine vessels are clamped, divided, and ligated with a hemostatic size 0 polyglycolic acid suture ligature. Care is taken to stay close to the cervix to avoid injury to the ureter.

the vagina, a McCall culdoplasty can be used. The advantage of the McCall culdoplasty is that it not only closes the redundant cul-de-sac and associated enterocele but also provides apical support and lengthening of the vagina. Many authors advocate using this procedure as part of every vaginal hysterectomy, even in the absence of enterocele, to minimize future hernia formation and vaginal vault prolapse. The technique for performing a McCall culdoplasty involves the following steps (Fig. 5-8):

a. After the vaginal hysterectomy is completed, the surgeon places a finger into the posterior cul-de-sac to evaluate the depth and extent of enterocele. Lateral traction is placed on the previously tagged uterosacral ligaments.

b. With the patient in the Trendelenburg position, a large pack is placed intraperitoneally to prevent descent of the omentum or bowel into the

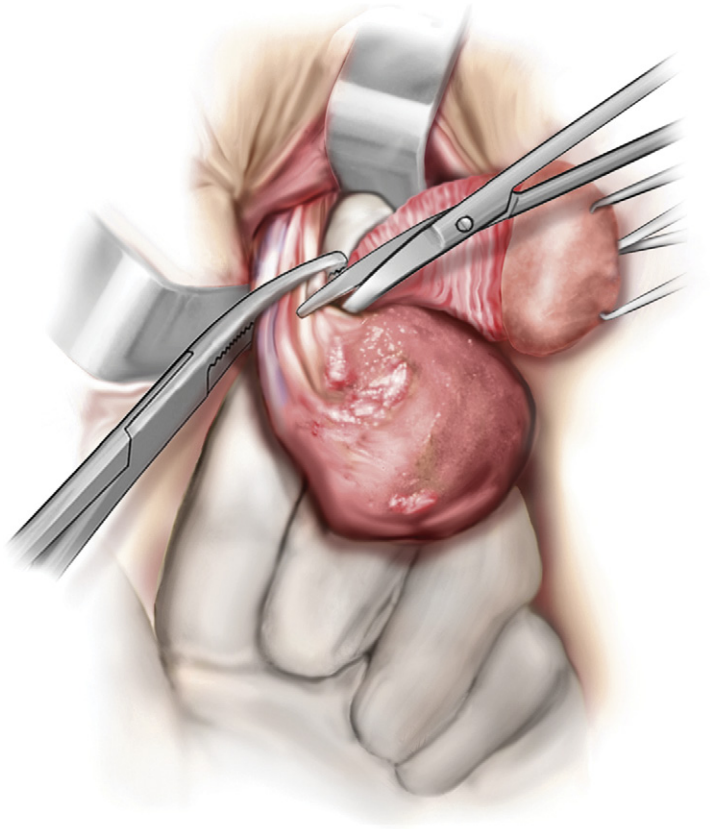


Figure 5-6 After the uterus is delivered, the broad ligament is isolated and then clamped, divided, and ligated. In the illustration, the ligament has been ligated as a single structure, but several "bites" may be required depending on its width.

field. Depending on the size and depth of the enterocele, internal McCall sutures are at times required. These sutures are passed intraperitoneally with the aim of plicating the uterosacral ligaments in the midline. They are left untied and successive identical sutures are placed as needed, in progression toward the posterior vaginal cuff. The goal is obliteration of the entire dependent portion of the cul-de-sac. We prefer to use permanent suture such as Ethibond polypropylene (Prolene) for this.

c. After all of the internal permanent sutures have been placed and their ends held laterally without tying, one or two sutures of delayed absorbable size 0 suture are placed (external McCall sutures). These are inserted from the vaginal lumen just below the middle of the cut edge of the posterior vaginal cuff, through the peritoneum, and through the right uterosacral ligament. Successive bites are taken across the cul-de-sac and into the left uterosacral ligament. This suture is then passed back into the vaginal lumen through the peritoneum and vaginal epithelium, adjacent to the point of entry.

d. The permanent sutures are tied in sequence. If an anterior colporrhaphy is to be performed, a midline vaginal incision is made from the cuff incision to the bladder neck, and the anterior vaginal wall prolapse is corrected (see Chapter 4). The anterior vaginal wall and the vaginal cuff are then closed.

e. The delayed absorbable sutures are tied in such a manner as to bring the posterior vagina up to the level of the plicated uterosacral ligaments. When there is excessive redundancy of the posterior vaginal wall and peritoneum, a modification of the McCall procedure in which a wedge of posterior vaginal wall and peritoneum is excised can be considered. (See Video 5-4 for a demonstration of McCall culdoplasty.)

15. Ureteral patency should be assessed following vaginal hysterectomy and culdoplasty. All sutures are therefore left tagged with clamps to allow for

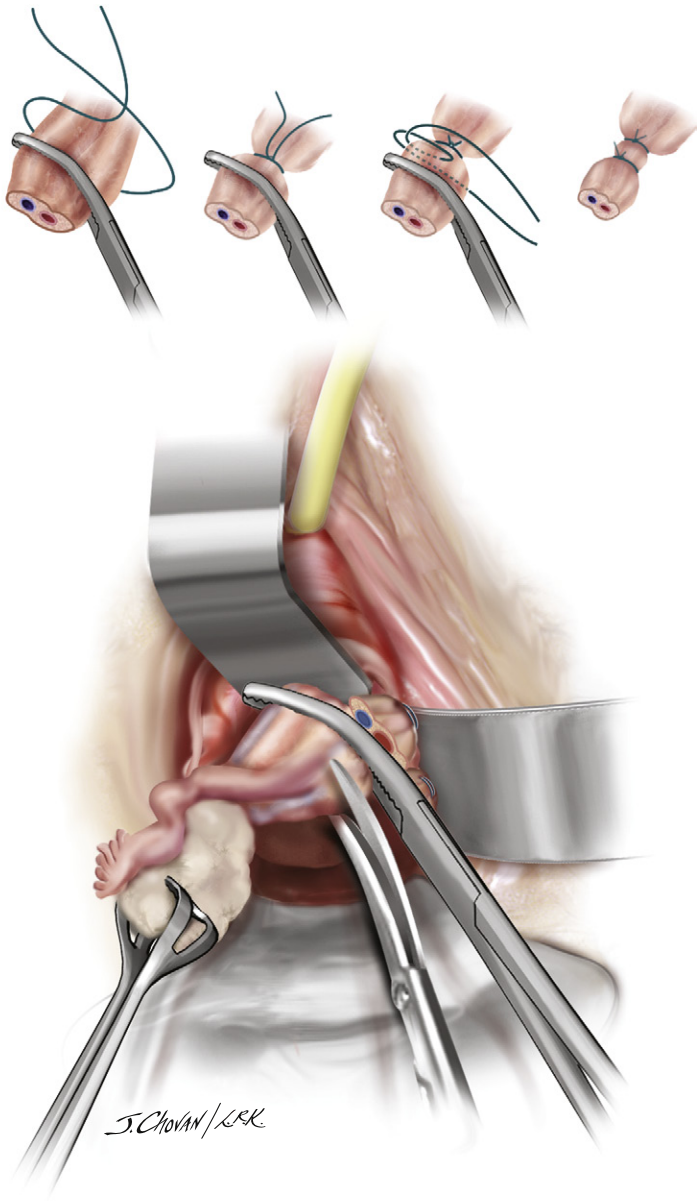


Figure 5-7 Technique of vaginal approach to salpingo-oophorectomy. After the uterus is removed, the ovary is grasped with a Babcock clamp and gentle traction is placed on the ovary, tube, and infundibulopelvic ligament. The vessels are clamped, the ovary and tube are removed, and the vessels are ligated. (From Walters MD, Barber MD. *Hysterectomy for Benign Disease*. Philadelphia: Saunders; 2010. *Female Pelvic Surgery Video Atlas Series*.)

easy suture removal if one or both ureters appear to be obstructed. Indigo carmine is administered intravenously followed by cystoscopy to observe directly for brisk efflux of blue-tinged urine from each ureteral orifice. If efflux is not visualized or appears to be slow from one ureteral orifice compared with the contralateral one, a wire or ureteral stent can be passed into the orifice and up the ureter to ensure patency. If resistance is met, then the ureter is likely obstructed, either by the sutures placed during the vaginal hysterectomy or, more commonly, by one of the culdoplasty sutures. Once the obstructing suture is cut, brisk efflux should be visualized or a wire or stent should pass easily beyond the point of obstruction.

16. A midurethral sling can be placed at the completion of the prolapse repair to correct clinical or occult stress incontinence if desired. A vaginal packing impregnated with antibiotic ointment is generally left in place until the morning of postoperative day 1. The Foley catheter is generally left in place postoperatively until the patient is ambulatory with adequate pain management before a voiding trial is attempted.

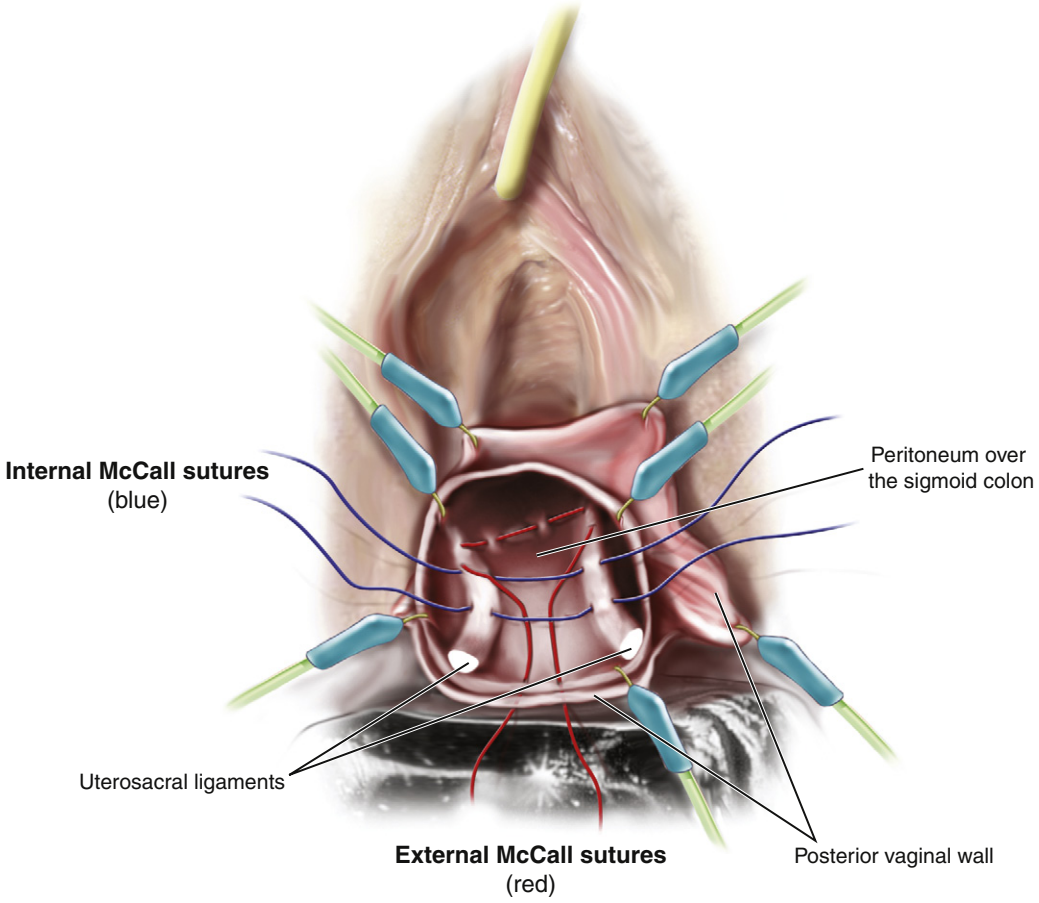


Figure 5-8 McCall culdoplasty. Placement of internal (*blue*) and external (*red*) McCall sutures. The permanent internal sutures do not go through the vaginal wall and are placed through each uterosacral ligament, incorporating some posterior peritoneum in between. These are tied first on the inside of the vaginal wall. The external suture of delayed absorbable material is brought from the vaginal lumen, through the vaginal wall, and then through the uterosacral ligaments on each side, incorporating the posterior peritoneum in between. Finally the suture is brought back through the vaginal wall so that when it is tied (after completion of the repair and closure of the vaginal cuff) the knot is on the outside of the vaginal wall.

Case #1

View Video 5-5

A 66-year-old woman (gravida 4, para 4) had a symptomatic vaginal bulge that was especially bothersome during long periods of standing upright or walking. She also complained of urinary frequency, a decreased force of stream, and a sensation of incomplete emptying. She had a history of stress urinary incontinence some years earlier that had resolved in the past few years when she noticed a vaginal bulge. Physical examination was notable for a finding of POP-Q stage III uterine and anterior prolapse with the cervix reaching 3 cm beyond the introitus during Valsalva maneuvers. Reduction of the prolapse revealed moderate urethral hypermobility and stress incontinence with cough maneuvers. Results of a Papanicolaou test performed within the past year were normal, and transvaginal ultrasonography revealed an atrophic uterus with an estimated volume of 37 mL, normal endometrium of 5 mm, no uterine fibroids, and normal atrophic ovaries. This patient desired definitive therapy and was not interested in trying a pessary. She gave consent for a vaginal hysterectomy, vaginal vault suspension, appropriate repairs of the anterior and posterior vaginal wall, and placement of a synthetic midurethral sling. (See Video 5-5 for a demonstration of a simple vaginal hysterectomy for POP-Q stage III uterine prolapse.)

Case #2

View Videos 5-4 and 5-6

A 61-year-old woman was experiencing bothersome pelvic pressure and a feeling of a bulge. Physical examination showed anterior descent to 1 cm beyond the hymen (POP-Q point Ba = +1), and the cervix came to 1 cm above the hymen (point C = –1). The patient elected to have a vaginal hysterectomy. The uterus was less prolapsed in this case than in case #1, and the surgical technique can be a bit more challenging. Although the technique is similar to that used in case #1, the lesser mobility of the uterus makes its removal more difficult. In cases such as this, the vaginal hysterectomy can be followed by a McCall culdoplasty. (See Video 5-6 for a demonstration of vaginal hysterectomy for POP-Q stage II uterine prolapse and Video 5-4 for McCall culdoplasty after vaginal hysterectomy.)

Case #3

View Video 5-7

A 75-year-old woman who wanted to preserve sexual function came for treatment of POP-Q stage IV POP (procidentia). Vaginal hysterectomy and reconstruction were recommended. Video 5-7 illustrating this case demonstrates how to handle a completely prolapsed uterus with a markedly elongated cervix. Hysterectomy was followed by a vaginal vault suspension procedure to suspend the prolapsed apex.

Case #4

View Videos 5-1 and 5-4

A 56-year-old woman had symptomatic prolapse mostly secondary to anterior vaginal wall prolapse (point Ba = +1) with some mild uterine descent. The patient desired definitive therapy, and consent was obtained for vaginal hysterectomy and repair of the anterior vaginal wall prolapse with possible vaginal vault suspension or McCall culdoplasty. At the time of vaginal hysterectomy it became apparent that the uterus was enlarged to a size comparable to that of a 10- to 12-week pregnancy secondary to asymptomatic uterine fibroids. Morcellation techniques were required to remove the uterus. (See Video 5-1 for a demonstration of vaginal hysterectomy for an enlarged uterus and Video 5-4 for the technique of McCall culdoplasty performed at time of vaginal hysterectomy.)

Case #5

View Video 5-3

A 72-year-old woman who had used a pessary for 5 years to manage her POP-Q stage IV uterovaginal prolapse developed significant vaginal ulcerations that prompted her to seek a definitive surgical repair. After she was counseled on the risks and benefits of oophorectomy at the time of hysterectomy, she elected to have her ovaries removed if possible when the vaginal hysterectomy was performed. (See Video 5-3 for a demonstration of vaginal oophorectomy at the time of vaginal hysterectomy.)

Laparoscopically Assisted Vaginal Hysterectomy

Laparoscopically assisted vaginal hysterectomy was introduced as an alternative to abdominal hysterectomy in cases in which either vaginal hysterectomy alone might prove to be technically difficult because of the possible presence of intraperitoneal lesions such as pelvic adhesions, or the patient has benign adnexal abnormalities that would be difficult to address vaginally. Generally, dissection and ligation down to the level of the uterine vessels is carried out laparoscopically. Once the surgeon feels that vaginal hysterectomy is achievable, the procedure is completed vaginally.

Postoperative Care and Complications

Common complications following vaginal hysterectomy for uterine prolapse include urinary tract infection, vaginal bleeding, urinary retention, ureteral obstruction, and implant extrusion into the vagina. Most complications are self-limited and can be managed conservatively. The exception is ureteral obstruction, which necessitates prompt intervention with either retrograde ureteral stent placement or percutaneous placement of a nephrostomy tube. Ureteral obstruction most commonly

occurs due to kinking of the ureters caused by placement of sutures too close to the cul-de-sac or suspension of the vagina. However, the ureter can also be cut or ligated along with the uterine pedicles. Ideally, ureteral obstruction should be recognized in the operating room during cystoscopic assessment of ureteral patency. Usually removal of the clamped ipsilateral suture alleviates the obstruction except in cases in which the ureter has been cut and reimplantation is necessary.

SUMMARY: The vaginal approach, when technically feasible, remains the preferred route for hysterectomy to treat prolapse and benign pathologic conditions of the uterus. It can be accomplished safely and efficiently by adhering to anatomical surgical planes and by carefully ligating the vascular pedicles as close to the uterus and cervix as possible. This helps to prevent lateral and deep deviation during dissection and suturing, which can lead to pelvic bleeding and ureteral injury. In addition, attention is paid to preservation of vaginal tissue, especially vaginal length, when one dissects circumferentially around the cervix. This helps to preserve vaginal depth, which is important to sexual function. Whether culdoplasty or a formal vaginal vault suspension is performed depends on the extent of the prolapse and the patient's desires regarding future sexual function. Anterior compartment repair can be readily accomplished at the same time as vaginal hysterectomy and vault suspension. If desired, various implant materials such as synthetic mesh or biological materials can be added to the repair for additional support, particularly in the anterior compartment. Furthermore, antiincontinence procedures can be offered to women with occult or clinical stress urinary incontinence.

Suggested Readings

Fine PM, Johnson D. Vaginal hysterectomy and other operations for uterine prolapse. In: Appell R, Sand P, Raz S, eds. *Female Urology, Urogynecology and Voiding Dysfunction*. New York: Marcel Dekker; 2005:545-560.

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Rooney CM, Karram MM. Vaginal hysterectomy in the treatment of vaginal prolapse. In: Raz S, Rodriguez L, eds. *Female Urology*. 3rd ed. Philadelphia: Saunders; 2008:705-718.

Vaginal Repair of Enterocele and Apical Prolapse

6

Victor W. Nitti, MD
Mickey Karram, MD

Videos

6-1 Anatomy of the Uterosacral Ligament
6-2 Vaginal Dissection of an Enterocele Sac (Example 1)
6-3 Vaginal Dissection of an Enterocele Sac (Example 2)
6-4 High Uterosacral Suspension in a Patient With Complete Uterine Procidentia
6-5 Sacrospinous Ligament Fixation
6-6 Mesh-Augmented Anterior and Apical Repair

Vaginal vault prolapse can be repaired using a vaginal, abdominal, laparoscopic, and/or robotic approach. Although the focus of this chapter is on transvaginal repair, there are situations in which we feel abdominal sacral colpopexy (open, laparoscopic, or robotic) is preferred. Such cases would include but are not necessarily limited to young women with vaginal vault prolapse, certain women for whom transvaginal procedures have failed, and women with a foreshortened prolapsed vagina. In frail elderly women who are not and do not intend to be sexually active, obliterative procedures, in which the entire vagina is closed, should be considered (see Chapter 9).

Apical prolapse may present as uterovaginal prolapse or posthysterectomy vault prolapse. In the latter an enterocele is usually present. The treatment of uterine prolapse by vaginal hysterectomy is discussed in Chapter 5. Options for apical support are discussed in this chapter. It is also important to remember that apical prolapse frequently occurs in conjunction with anterior and/or posterior prolapse; thus repair of all affected compartments may be necessary. This chapter discusses and demonstrates the various procedures that can be performed transvaginally to correct an enterocele and vaginal vault prolapse.

Anatomy of Apical Support

The apex (proximal one third) of the vagina and the uterus are suspended from the pelvic sidewall and sacrum (level I support) by the cardinal ligaments and uterosacral ligaments, respectively (see Fig. 3-1). When these supporting structures become stretched and weakened, apical prolapse occurs. These are thus

structures that can be used to repair apical prolapse (e.g., uterosacral ligament suspension or plication, or McCall culdoplasty). Alternatively, other structures such as the sacrospinous ligament may be used as the anchoring point for apical support in a prolapse repair. When these structures are used for repair of pelvic organ prolapse, it is important to understand the anatomy and relationship of other critical structures such as the rectum and ureters as well as nerves and blood vessels that come in close proximity to these structures. Apical repairs are associated with about a 1% to 2% incidence of ureteral injury. Often this is due not to direct injury to the ureter (such as ligation) but rather to kinking of the ureter caused by incorporation of paraureteral connective tissue.

The uterosacral ligaments are fascial condensations that suspend and support the upper vagina and uterus through attachment to the anterior sacrum. They are continuous at points with the cardinal ligaments, which extend to the pelvic sidewall and arcus tendineus fasciae pelvis (ATFP) and also with the paravesical, pararectal, and paravaginal fascia (Fig. 6-1 and Video 6-1). High uterosacral ligament suspension for repair of apical prolapse is based on the concept that these ligaments do not significantly attenuate in cases of uterovaginal or posthysterectomy vaginal vault prolapse but instead "break" at certain points. The sacrospinous ligament extends from the ischial spine to the sacrum and is covered by the coccygeus muscle. Although it is not normally involved in apical support, it makes a strong anchoring point when an extraperitoneal vault suspension is desired (Fig. 6-2).

Transvaginal Enterocele Repair

In posthysterectomy apical prolapse an enterocele is often present. Depending on the size of the enterocele and other components of pelvic organ prolapse as well as the type of repair to be done, the surgeon will have to choose between a formal enterocele repair in which the peritoneum is entered or a simple reduction of the enterocele. The approach selected will depend on surgeon preference, the degree of prolapse, and other anatomical factors. The surgeon may elect to open the enterocele sac and perform an intraperitoneal apical repair (e.g., uterosacral suspension). In other cases in which an extraperitoneal apical repair is performed, the surgeon will choose between reducing the enterocele or opening the sac and repairing the enterocele before proceeding with the restoration of apical support (e.g., a sacrospinous ligament repair with reduction or formal repair). In general, when we decide to do an extraperitoneal apical suspension, it is our preference to perform a formal repair of large enteroceles, whereas smaller enteroceles and those that are located high in the pelvis are often treated with simple reduction.

Surgical Technique for Transvaginal Intraperitoneal Enterocele Repair

1. The patient is placed in the dorsal lithotomy position. The first step in an intraperitoneal repair is to isolate the enterocele sac. The prolapsed vaginal wall is grasped with two Allis clamps and brought toward the surgeon. The vaginal wall may be infiltrated with a lidocaine-epinephrine or vasopressin (Pitressin) solution before a longitudinal incision is made in the vaginal wall along the entire length of the enterocele (Fig. 6-3).
2. The vaginal wall is then carefully dissected away from the underlying peritoneal sac. Care is taken to stay very superficial and develop the proper plane with the curve of the Metzenbaum scissors against the vaginal wall. A finger can be placed on the outside of the vaginal wall to stabilize the initial dissection.

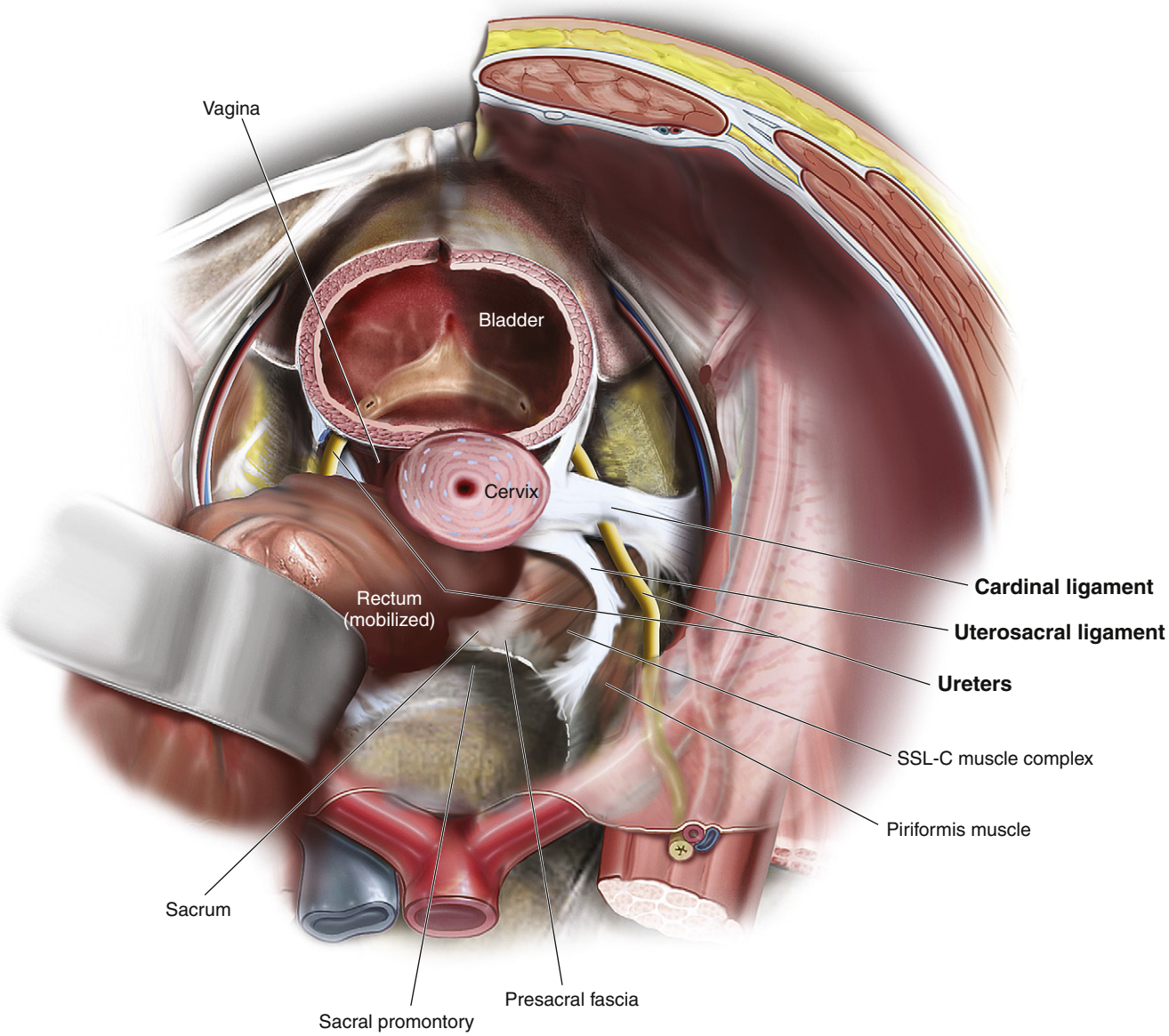

Figure 6-1 The fundus of the uterus has been excised and the uterosacral and cardinal ligaments can be seen. These fascial condensations suspend and support the upper vagina and uterus by attachment to the pelvic sidewall and arcus tendineus fasciae pelvis (cardinal ligaments), and the sacrum (uterosacral ligaments). The two are continuous with each other and the paravesical, pararectal, and paravaginal fascia. Note the course of the ureters as they penetrate the cardinal ligaments and their proximity to the uterosacral ligaments. *SSL-C,* Sacrospinous ligament–coccygeus.

3. Once the proper plane is entered, it is usually easy to dissect the vaginal wall away from the underlying sac. Often this can be done with blunt dissection using a moist sponge. However, when the enterocele sac is densely adherent to the vaginal wall, sharp dissection may be required. Care taken here will prevent early entry into the peritoneal cavity. (*Note:* In cases in which the surgeon plans to augment the anterior repair with a synthetic mesh, extra care must be taken to stay in the proper plane and not to thin the vaginal wall.)
4. The dissection of the enterocele is continued all the way to the neck of the sac anteriorly and posteriorly. A finger can be placed in the rectum to facilitate dissection of the sac off the anterior wall of the rectum (Fig. 6-4, *A*). After the enterocele has been completely isolated, the sac is opened and the peritoneal cavity is entered (see Figs. 6-4, *B* and 6-5). At this time, small bowel, omentum,

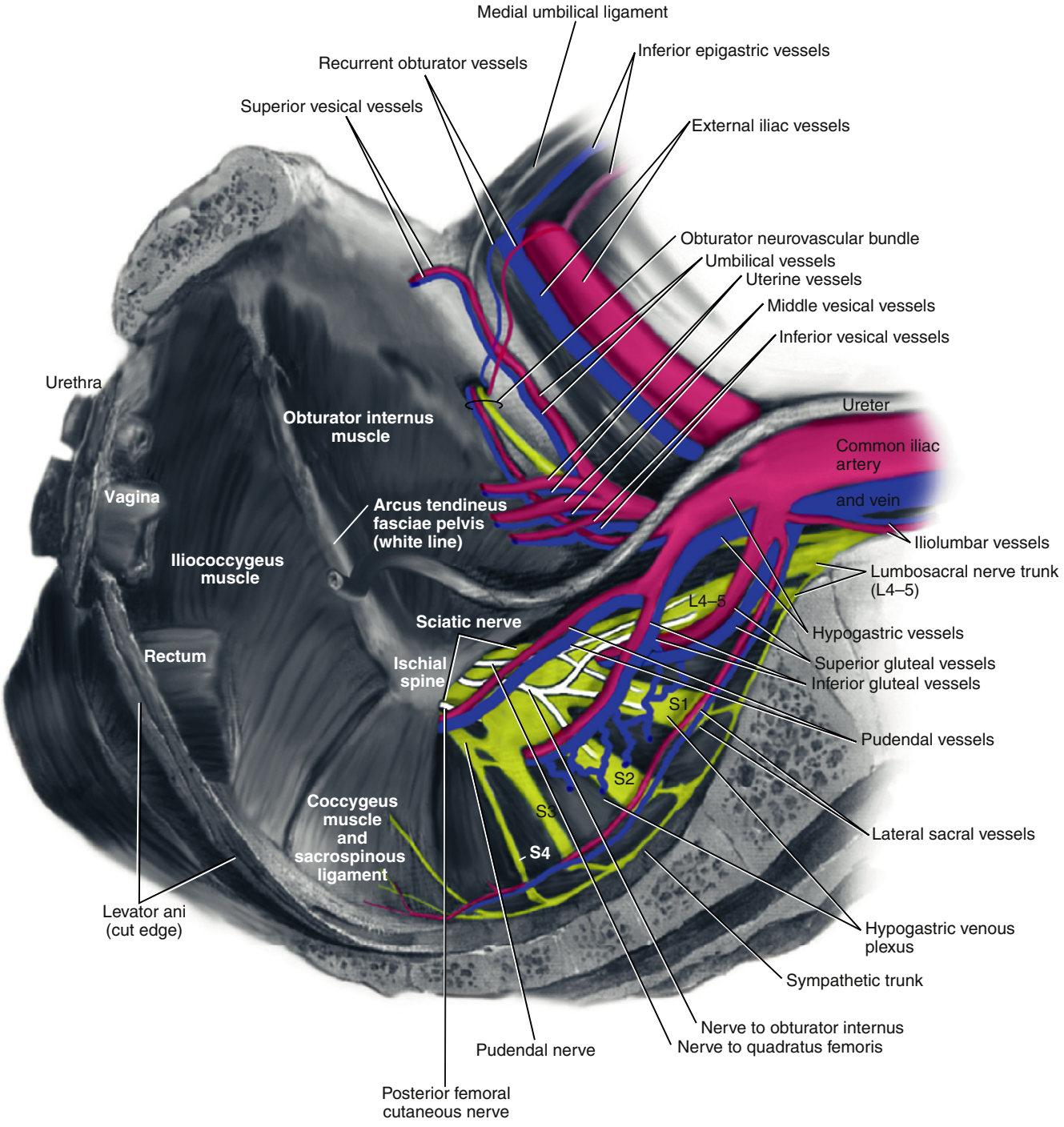

Figure 6-2 Anatomy surrounding the coccygeus muscle–sacrospinous ligament complex. (From Baggish MS, Karram MM. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

or ovary and fallopian tube may be seen in cases in which previous hysterectomy without oophorectomy has been performed (see Fig. 6-4, *C*). (See Videos 6-2 and 6-3 for a demonstration of vaginal dissection of an enterocele sac.)

5. The next step is closure of the enterocele defect or Douglas pouch unless a formal high uterosacral suspension is planned, because that procedure itself will obliterate the enterocele as well as suspend the vaginal apex. Retraction of the peritoneal contents is best performed using one or more moist

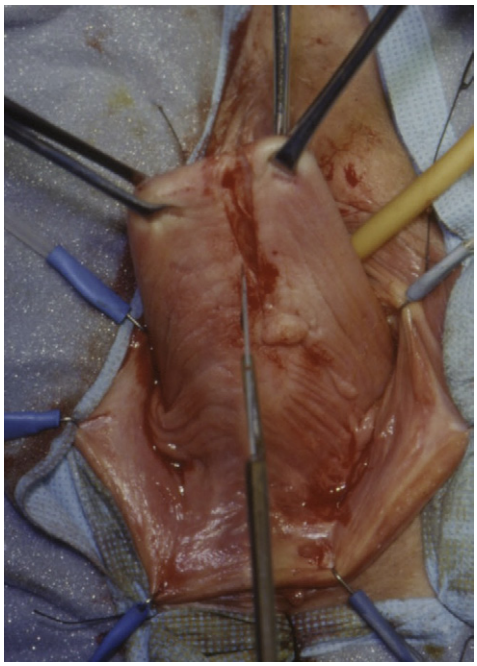

Figure 6-3 The apex of the vagina is grasped and the vaginal wall is incised for the length of the enterocele.

laparotomy pads and a narrow Deaver or Heaney retractor (Fig. 6-6). Placing the patient in the Trendelenburg position so that abdominal organs fall slightly cephalad assists in this step. The enterocele repair begins posteriorly while the abdominal contents are retracted anteriorly using the retractor.

6. A size 0 or 1 polyglycolic acid (PGA)* or polydioxanone (PDS) suture is first placed through the posterior peritoneum and into the prerectal fascia overlying the rectum. A circumferential closure of the defect is then performed by placing the purse-string suture laterally in the right uterosacral-cardinal ligament complex, anteriorly in the peritoneum overlying the base of the bladder, laterally on the left in the uterosacral-cardinal ligament complex, and finally again posteriorly in the peritoneum and prerectal fascia (see Fig. 6-4, *D*). After this purse-string suture has been placed, a second one may be placed in the identical structures in close proximity to the first. If no further apical repair or suspension will be performed, it is especially important to incorporate the uterosacral-cardinal ligament complex into the closure, because this will be the main support of the vaginal apex. In addition, care should be taken to place these sutures deep enough to ensure that adequate vaginal depth can be achieved. When an additional apical support procedure is performed, the main purpose of the purse-string suture is simply to close the peritoneum.
7. After all sutures are placed, the assistant cinches down and places tension on one of the purse strings while the surgeon ties the other. After the first purse string has been tied, the second purse string (if placed) is tied in a similar manner. The excess enterocele sac may be excised and the ends oversewn with 2-0 PGA suture.
8. Cystoscopy is performed to document that there has been no injury to the bladder. Ureteral injury is ruled out by intravenously administering indigo carmine and observing efflux of blue-tinged urine from the ureteral orifices.

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

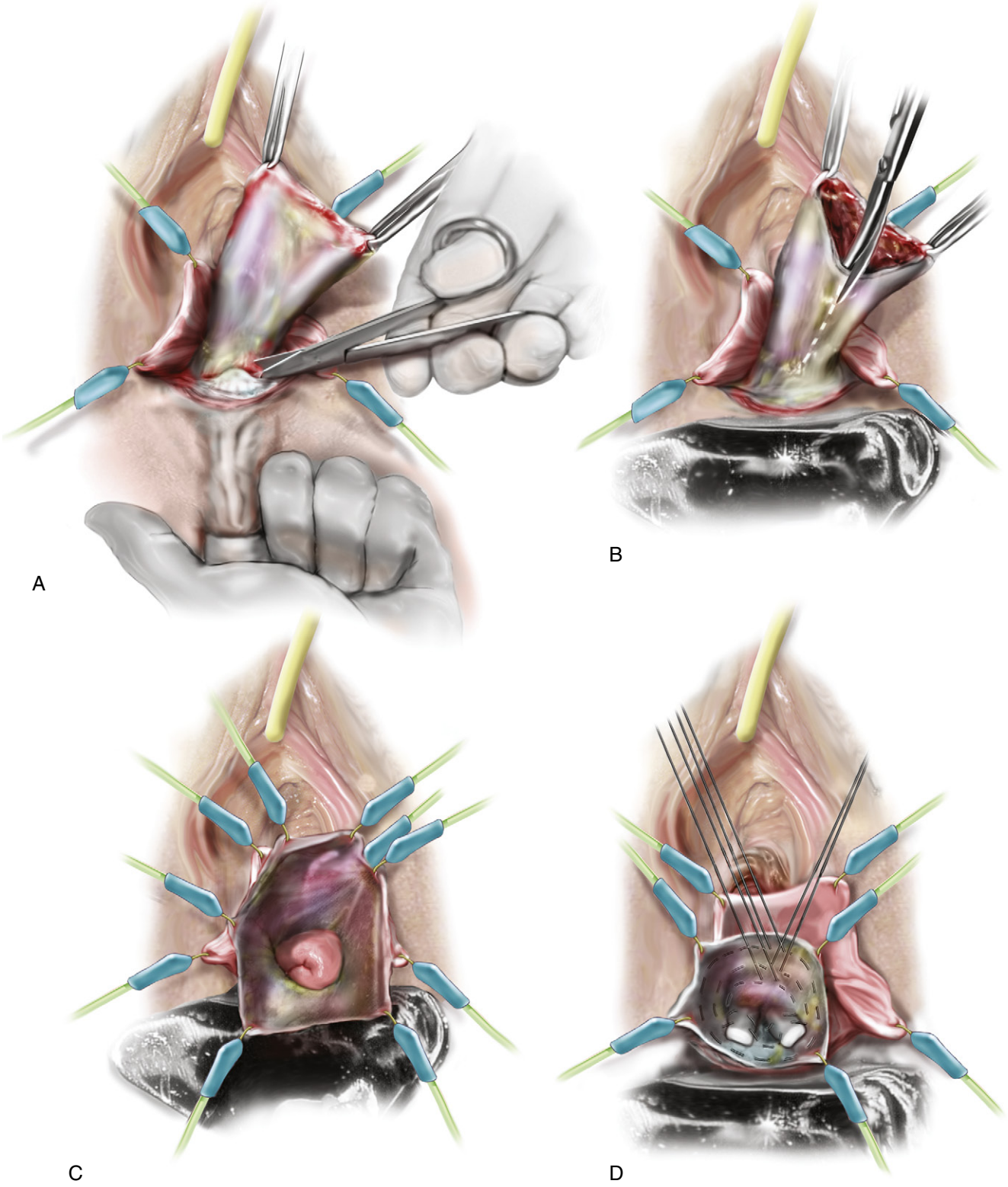

Figure 6-4 Repair of an enterocele. **A,** The enterocele sac is completely mobilized from the vaginal wall. During posterior dissection, placing a finger in the rectum helps to facilitate sharp dissection of the enterocele sac. **B,** The enterocele sac is sharply opened. **C,** Peritoneal contents can be observed and need to be reduced with moist laparotomy pads and a Deaver or Heaney retractor. **D,** Two sutures of size 0 or 1 polyglycolic acid or polydioxanone sutures are placed in a purse-string fashion incorporating the posterior peritoneum and prerectal fascia, uterosacral ligaments (cut ends or remnants), and anterior peritoneum overlying the base of the bladder.

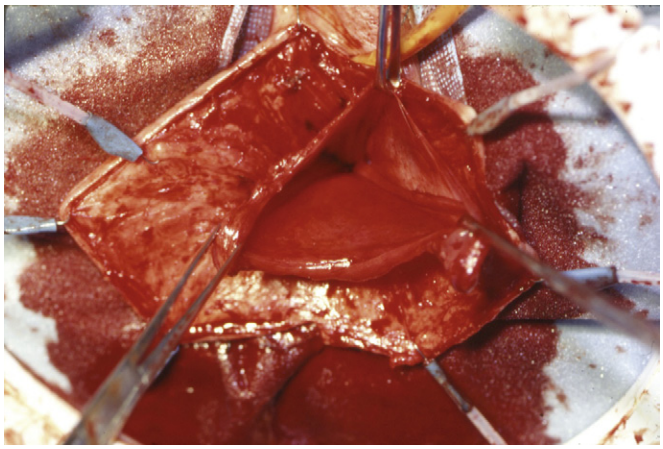

Figure 6-5 Opened enterocele sac after complete mobilization.

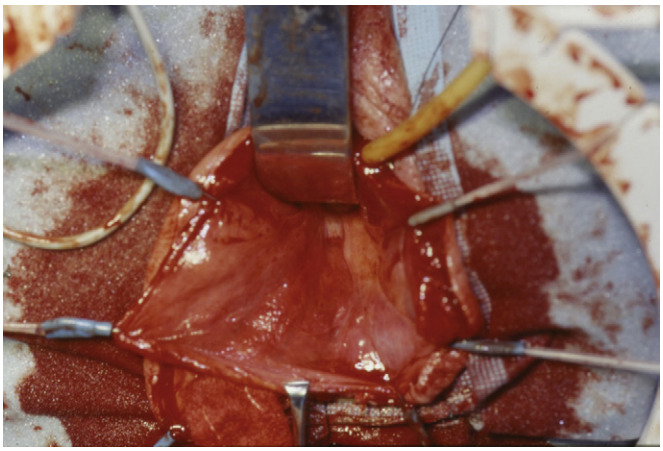

Figure 6-6 Peritoneal contents have been packed and retracted.

9. If no further apical support or repair of other compartments is to be performed, the vaginal wall may be closed with 2-0 PGA suture. The purse-string sutures can be placed through the apex of the vaginal cuff. If anterior repair and/or apical suspension is to be done, it may be performed at this time.

Video 6-1 demonstrates an enterocele repair in a woman with symptomatic Pelvic Organ Prolapse Quantification (POP-Q) stage III apical prolapse. After this repair is completed, the surgeon has the option of securing the apex of the vaginal cuff to the repair or performing a sacrospinous or mesh-augmented repair.

In most cases of enterocele, the vaginal apex is also prolapsed and requires a separate procedure to support it. It is also common for concomitant anterior and posterior defects to be present, and therefore repair of more than one compartment is typically necessary. Several techniques are commonly used to accomplish transvaginal vault suspension, and which technique is best is still debated. Here we review nonaugmented repairs, including uterosacral ligament suspension, sacrospinous ligament fixation, and iliococcygeus fixation, as well as augmented repairs, including sacrospinous ligament fixation with mesh. McCall culdoplasty is described and demonstrated in Chapter 5.

High Uterosacral Vaginal Vault Suspension

Suspension of the vaginal vault to the uterosacral ligaments as initially described by Shull provides a more natural vaginal axis than sacrospinous ligament fixation. The procedure provides good apical support without significantly distorting the vaginal axis, and passage of sutures intraperitoneally can be cleaner and simpler than passage through retroperitoneal structures. A disadvantage of the procedure is that the uterosacral ligament may at times lie in close proximity to the ureter. Studies have shown that the ureter can become kinked when sutures are passed too far laterally. When we first began performing high uterosacral vaginal vault suspension as described by Shull and colleagues, we mobilized the tunica muscularis vaginae off the epithelium and suspended the epithelium and tunica muscularis separately, making sure that sutures were passed through the anterior and posterior vaginal walls. Figure 6-7 illustrates intraperitoneal suture placement for the McCall culdoplasty, the traditional uterosacral suspension, and the modified high uterosacral suspension.

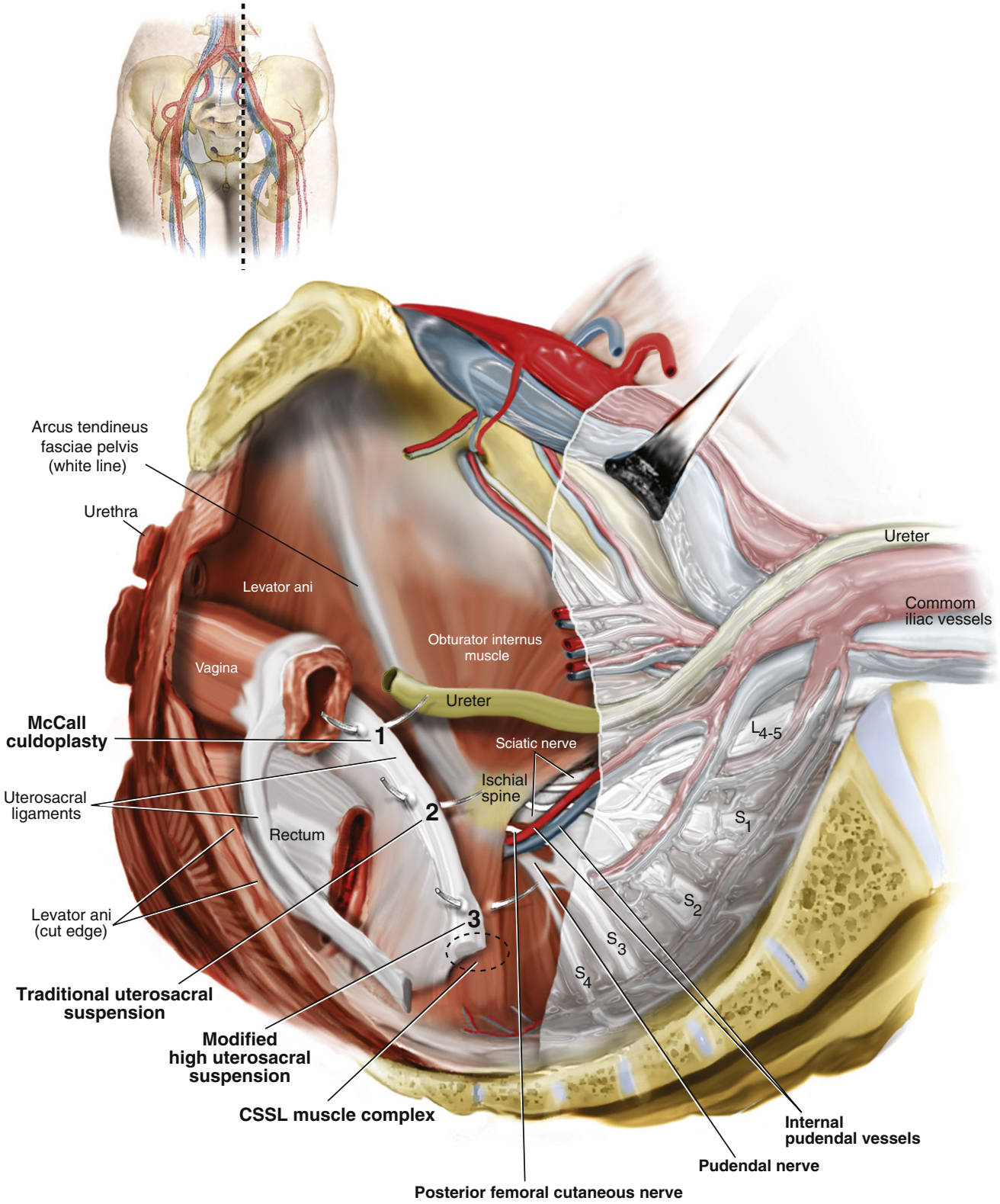

Figure 6-7 Cross section of the pelvic floor demonstrating intraperitoneal placement of sutures for (1) McCall culdoplasty, (2) traditional uterosacral suspension, and (3) modified high uterosacral suspension. Note that high uterosacral suspension may involve passage of the suture through the coccygeus muscle–sacrospinous ligament (CSSL) complex, because a portion of the uterosacral ligament inserts into this structure. (From Baggish MS, Karram MM. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

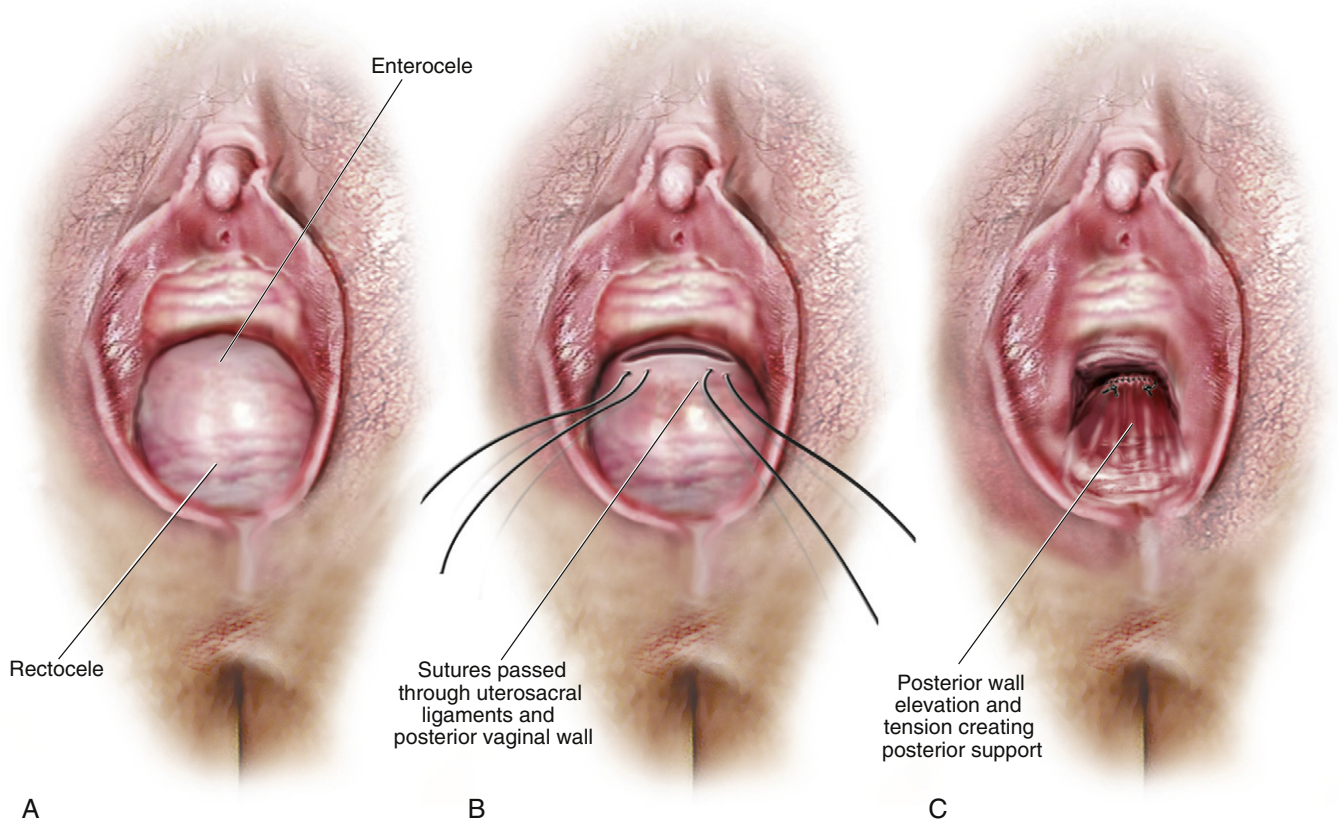

Figure 6-8 **A,** Posterior vaginal wall defect secondary to an enterocele and rectocele. **B,** After entry into the enterocele sac, intraperitoneal suspension sutures are brought out through the full thickness of the vaginal wall at the level of the apex. **C,** Tying of these sutures after closure of the vaginal incision at the apex not only results in an increase in vaginal length but also contributes to the overall support of the entire posterior vaginal wall. (From Baggish MS, Karram MM. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

Over time, we realized that this practice led to a shorter vagina—one that, in some cases, was less than ideal for the patient. We began, therefore, to pass sutures through the full thickness of the posterior vaginal wall only. With this change in technique, we have been able to create a longer vagina—and this has not been at the expense of any increase in the incidence of cystocele or anterior enterocele. Our experience directly contradicts the notion that fascial continuity is necessary for apical prolapse repair to be successful over the long term. This change in technique has also facilitated posterior vaginal wall support (Fig. 6-8). Also we initially thought that a large cul-de-sac needed to be obliterated in the midline with internal McCall-type stitches that are separate and distinct from the uterosacral suspension sutures. We no longer do this routinely because we believe that the numerous sutures that are passed through the full thickness of the posterior vaginal wall, including the peritoneum, effectively obliterate the enterocele and keep down the incidence of recurrent enterocele and high rectocele. Finally, we have come to realize that sutures placed medial and cephalad to the ischial spine are often passed through a portion of the coccygeus muscle–sacrospinous ligament complex (see Fig. 6-7).

Surgical Technique for High Uterosacral Vaginal Vault Suspension

The following is a description of how we currently perform high uterosacral vaginal vault suspension (Fig. 6-9):

1. Incise the vaginal wall. The most prominent portion of the prolapse is grasped with Allis clamps and a T incision is made. Alternatively a midline incision

can be made if an anterior repair is to be done or the T can be extended later (see Fig. 6-9, *A*).

2. Enter the peritoneum. It is our opinion that, even though extraperitoneal uterosacral suspension procedures have been described, the pertinent anatomical structures are not easily identifiable unless suspension is undertaken intraperitoneally. Entering the peritoneum obviously is not a concern if the patient is undergoing vaginal hysterectomy. If the patient has posthysterectomy prolapse, however, the surgeon must be able to isolate an enterocele and enter the peritoneum. Once the peritoneum is entered, the cul-de-sac must be relatively free of adhesive disease to allow access to the highest part of the ligament (see Fig. 6-9, B).
3. Pack the bowel to expose the uterosacral ligaments. Next, pack the small bowel out of the cul-de-sac to allow easy access to and visualization of the uppermost portions of the uterosacral ligament. This is best accomplished by passing large, moistened laparotomy sponges intraperitoneally and elevating them with a large retractor (e.g., Deaver, Heaney, Breisky-Navratil, or sweetheart). When the bowel is appropriately packed, the retractor lifts the intestinal contents out of the pelvis, which usually allows easy access to the proximal or uppermost portion of the uterosacral ligaments (see Fig. 6-9, C).
4. Palpate the ischial spines bilaterally. It is important that the surgeon palpate the ischial spines. Often, the ureter can be palpated lateral to the ischial spine against the pelvic sidewall. If one palpates the ischial spines and continues to palpate medially and cephalad, one can usually palpate the coccygeus muscle–sacrospinous ligament complex transperitoneally, because a portion of the uterosacral ligament inserts into the sacrospinous ligament. If sutures can be passed at this level, the ureter should be out of harm's way, and the result will (usually) be a vagina that is, at a minimum, approximately 9 cm long.
5. Pass the sutures. We prefer to pass two or three sutures on each side, using a long, straight needle holder. Because we eventually pass the sutures through the full thickness of the posterior vaginal wall, we have opted for a delayed absorbable suture—preferably, size 0 PGA/polyglactin 910 (Vicryl) on a CT-2 needle. A Breisky-Navratil retractor is used to retract the sigmoid colon in the opposite direction from the ligament into which the sutures are being passed. At times, attaching a light to a suction device or a retractor is also helpful to visualize this area. Then an Allis clamp is applied on the distal uterosacral ligament to elevate and apply traction to it; this facilitates palpation and visualization of the appropriate site for placement of the sutures. The exact area for suture passage is best identified by palpation (see Fig. 6-9, C and D). In early descriptions of this procedure, use of permanent sutures was reported; we use delayed absorbable sutures, because all sutures are brought out through the full thickness of the posterior vaginal wall. Using permanent sutures in our approach would be unacceptable, because the sutures are tied in the lumen of the vagina. In some other modifications of this procedure, sutures are passed through the muscular layer of the vagina to exclude epithelium; under those circumstances, permanent sutures can be used. In addition, sometimes it may be appropriate to pass one or two nonabsorbable sutures in the distal portion of the cul-de-sac (similar to internal McCall sutures) to plicate it, which helps to obliterate the cul-de-sac in the midline (see Fig. 5-8). Once the sutures are brought through the full thickness of the posterior vaginal wall, including the peritoneum, the sutures are individually tagged (see Fig. 6-9, E).

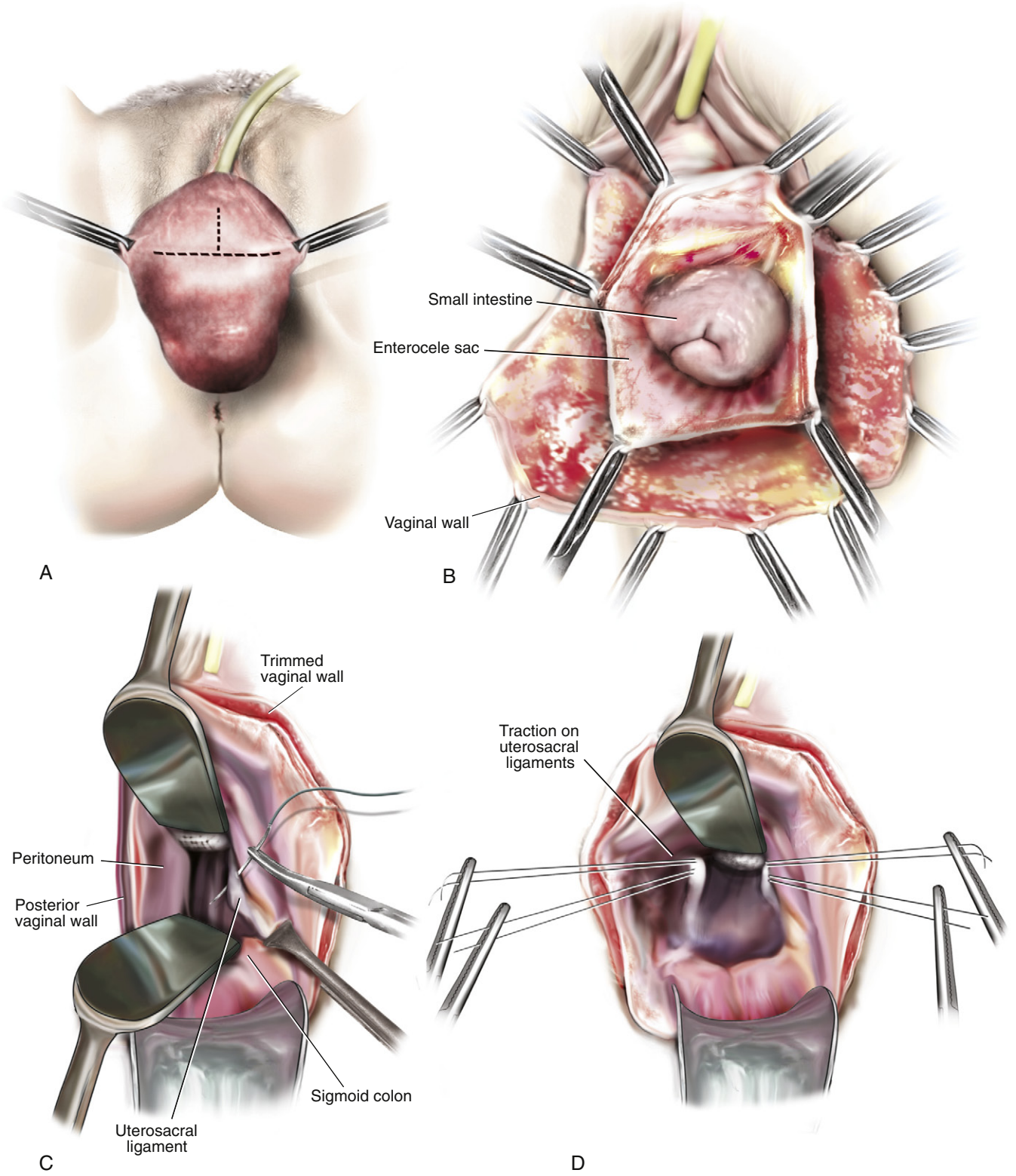

Figure 6-9 Technique for high uterosacral vaginal vault suspension. **A,** The most prominent portion of the prolapsed vaginal vault is grasped with Allis clamps. **B,** The vaginal wall is opened, and the enterocele sac is identified and entered. **C,** The bowel is packed high up into the pelvis using laparotomy sponges. The retractor lifts the sponges up out of the lower pelvis, thus completely exposing the cul-de-sac. When appropriate downward traction is applied on the uterosacral ligaments with an Allis clamp, the uterosacral ligaments are easily palpated bilaterally. **D,** Delayed absorbable sutures are passed through the uppermost portion of the uterosacral ligaments on each side and are individually tagged.

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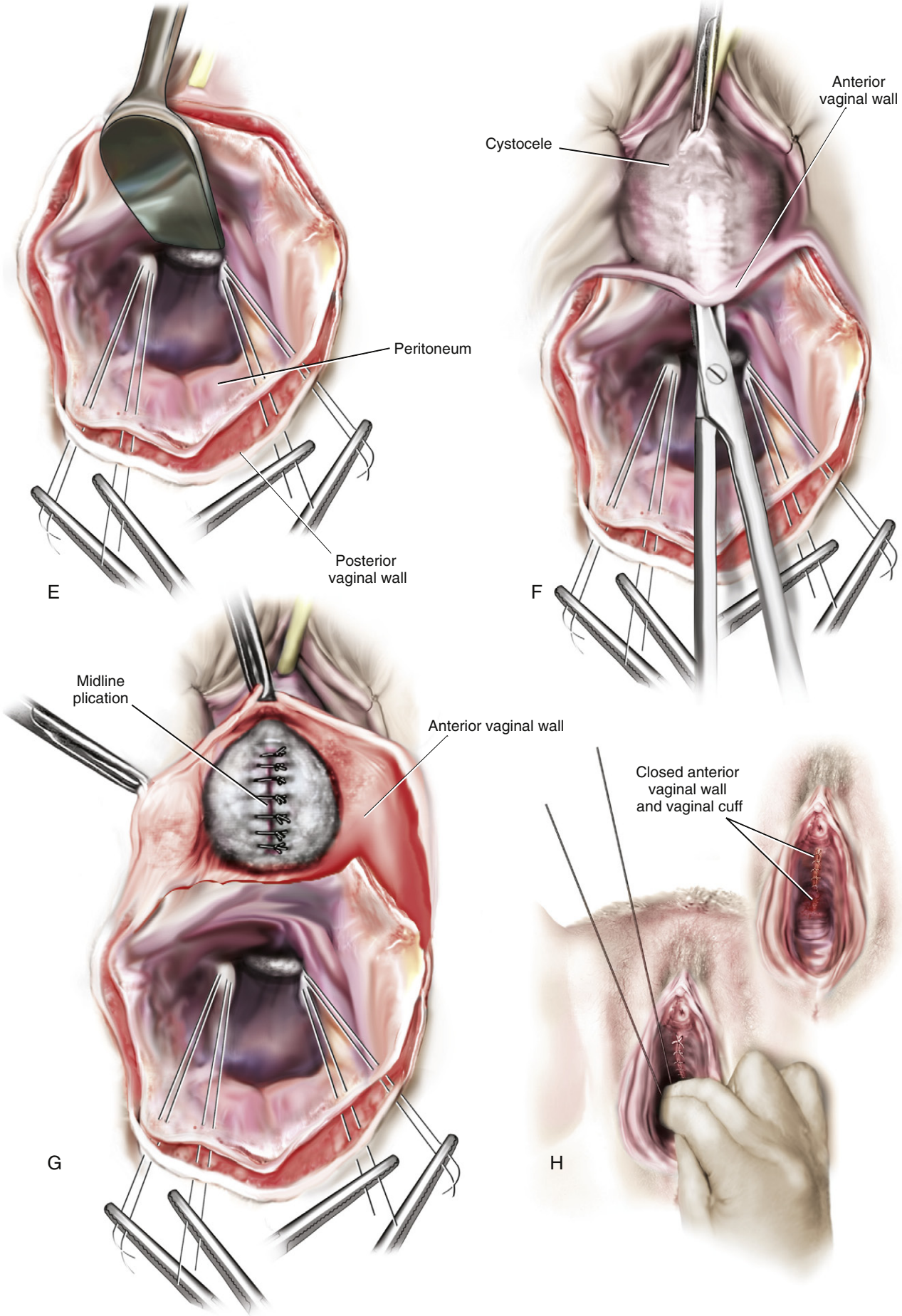
Peritoneum
Posterior vaginal wall
E
Cystocele
Anterior vaginal wall
F
Midline plication
Anterior vaginal wall
G
Closed anterior vaginal wall and vaginal cuff
H

Figure 6-9, cont'd **E,** Each end of the previously passed sutures is brought out through the posterior peritoneum and the posterior vaginal wall. (A free needle is used to pass both ends of these delayed absorbable sutures through the full thickness of the vaginal wall.) **F,** The anterior colporrhaphy is begun by initiating a dissection between the prolapsed bladder and the anterior vaginal wall. **G,** The anterior colporrhaphy is completed. **H,** The vagina is appropriately trimmed, if necessary, and closed with interrupted or continuous delayed absorbable sutures. After closure of the vagina, the delayed absorbable sutures that were previously brought out through the full thickness of the posterior vaginal wall are tied, which elevates the prolapsed vaginal vault high up into the hollow of the sacrum. (From Baggish MS, Karram MM. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

If the anterior segment is well-supported, close the vaginal incision with a continuous delayed absorbable suture, then tie the suspension sutures, elevating the apex into the hollow of the sacrum (see Fig. 6-8). If an anterior colporrhaphy is needed, perform that repair, then close the anterior vaginal wall as well as the vaginal cuff before tying off the suspension sutures (see Fig. 6-9 *F, G,* and *H*).

6. Ensure that the ureters are patent. Shortly before the uterosacral sutures are tied, instruct the anesthesiologist to administer 5 mL of indigo carmine dye intravenously. If there is no renal compromise, blue dye should be seen in the bladder 5 to 10 minutes later. If the patient is elderly or if one wishes to expedite this step, furosemide 5 to 10 mg can be given by intravenous push.

   Next, perform cystoscopy to ensure ureteral patency. Efflux of blue-tinged urine should be observed out of both ureteral orifices. If dye does *not* efflux from one or the other orifice after a reasonable wait (usually 20 minutes), one should assume that the ureter on that side is obstructed and take down the repair on that side.

7. Completely reconstruct the vagina. The remainder of the steps required to complete the procedure usually involve posterior colporrhaphy and perineoplasty. We also reserve placement of a synthetic midurethral sling (if one is needed) until after the vault procedure has been completed.

Case #1

View Video 6-4

A 72-year-old para 6 woman had complete uterine prolapse and complete extrusion of the anterior and posterior vaginal wall (POP-Q stage III with point C = +9). She was sexually active and desired definitive therapy. She did not want any mesh to be used to augment the repair. She thus gave consent for a vaginal hysterectomy with a vaginal vault suspension (modified high uterosacral vaginal vault suspension) in conjunction with vaginal repair of her anterior and posterior vaginal wall prolapse. Because she was noted to have a history of subjective complaints of stress incontinence some years earlier before developing the prolapse, consent was also obtained for placement of a transobturator sling. (See Video 6-4 for a demonstration of high uterosacral suspension with complete vaginal reconstruction.)

Sacrospinous Ligament Fixation—Posterior (Classic) Approach

Sacrospinous ligament fixation is also a popular procedure commonly used to correct apical prolapse. It is best suited for patients who have a well-supported anterior vaginal wall, because the procedure tends to deflect the apex in a posterior direction, which predisposes patients to subsequent anterior vaginal wall prolapse. Vaginal depth and axis are restored by posterior fixation of the vaginal vault to the sacrospinous ligaments. The sacrospinous ligament stretches from the ischial spine to the sacrum and is covered by the coccygeus muscle

(Fig. 6-10). The fixation can be done unilaterally or bilaterally. The sacrospinous ligament may be approached anteriorly or posteriorly. To perform a proper sacrospinous ligament fixation, the surgeon must be familiar with the anatomy surrounding the ligament (see Fig. 6-2).

Surgical Technique for Sacrospinous Ligament Fixation—Posterior Approach

1. Once the enterocele repair or reduction is complete (see earlier), the posterior vaginal wall must be opened far enough distally to facilitate dissection to the sacrospinous ligament. When a simultaneous rectocele repair is to be performed, the entire posterior vaginal wall may be opened through the perineum, and the sacrospinous ligament can be accessed through a posterior approach.
2. After the posterior vaginal wall is incised in the midline, it is gently dissected laterally from the underlying prerectal fascia for a short distance. Next, the sacrospinous ligament must be identified. This is done by retracting the rectum medially with a Breisky-Navratil retractor and entering the perirectal space. If a unilateral fixation is to be done, the right sacrospinous ligament is chosen to avoid the left colon. The perirectal space is entered by penetrating the rectal pillar (pararectal alveolar tissue that extends from the rectum to the ATFP). This can be done bluntly or sharply with Metzenbaum scissors. Blunt dissection of the pararectal space can be performed with a combination of finger dissection and the use of deep Breisky-Navratil retractors. This dissection is continued until the ischial

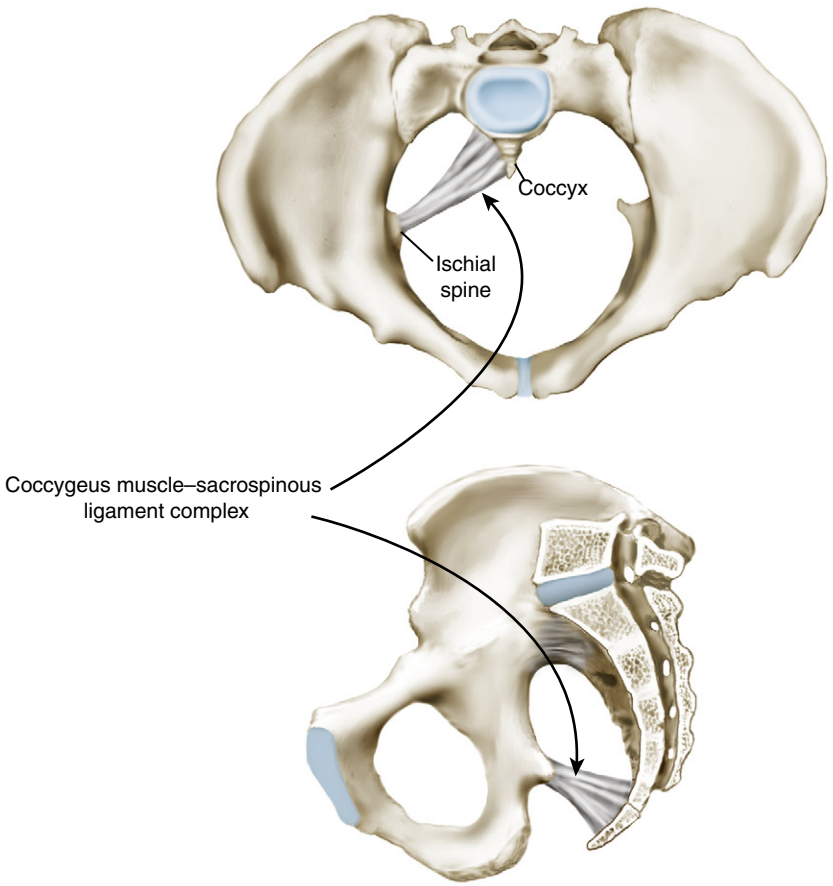

Figure 6-10 Coccygeus muscle–sacrospinous ligament complex.

spine is palpated, and then the sacrospinous ligament and overlying coccygeus muscle are palpated and visualized (Fig. 6-11, *A*).

3. Once the ligament is identified, a nonabsorbable or delayed absorbable suture (see later) is placed through the ligament and coccygeus muscle complex 2 cm medial to the ischial spine, which is also identified by palpation. It is important to place the suture in this position to avoid injury to the pudendal nerve and vessels, which run just below the ischial spine (see Fig. 6-11, *B*). It is also important to include the strong ligament in addition to the overlying coccygeus muscle. These tasks can be made easier by carefully dissecting over the ligament with a spreading motion of the Metzenbaum scissors and/or with the aid of a Kittner dissector. Visualization of the ligament itself helps avoid incorrect placement of the sutures. A number of techniques and devices have been described to aid in the placement of the sacrospinous ligament fixation sutures, including a Deschamps ligature carrier, a Miya hook, and an automatic suture-capturing device. We prefer to use automatic suture-capturing devices like the Capio device (Boston Scientific, Natick, MA). This tool allows for placement of the suture and retrieval of the needle in this deep and narrow space with just the depression of a lever on the instrument's end (Fig. 6-12). It has greatly simplified suture placement in our procedures. Tension should be placed on the suture to make certain that it is in the strong ligament. A second suture should be placed adjacent to the first.
4. If a rectocele is present, it is repaired at this time.
5. Fixation of the apex is performed next.
   a. If a nonabsorbable suture is used, the vaginal apex can be brought to the sacrospinous ligament with a pulley stitch. After placement in the ligament, the suture is rethreaded onto a free needle and sewn into the full thickness of the vaginal wall minus the epithelium at the vaginal apex. It is then tied by a single half-stitch while the free end is left long. Traction on the free end pulls the vagina to the ligament and a square knot fixes it in place, below the epithelium (see Fig. 6-11, *C*).
   b. If a delayed absorbable suture is used, both ends of the suture are passed through the full thickness of the vaginal wall including the apex, and the sutures are tied in the lumen of the vagina (see Fig. 6-11, *C*).
6. The vaginal wall is then closed with a running interlocking 2-0 PGA suture, and the previously placed sacrospinous ligament fixation sutures are individually tied. Antibiotic-impregnated vaginal packing is then placed.

Case #2

View Video 6-5

A 62-year-old woman had posthysterectomy apical prolapse with a large posterior enterocele and rectocele. A pertinent element in her medical history was an abdominal hysterectomy for uterine fibroids in conjunction with a Burch colposuspension for stress incontinence. On examination her anterior vaginal wall was found to be foreshortened with a very well-supported bladder neck. The patient reported no lower urinary tract symptoms but did complain of significant defecatory dysfunction in the form of difficulty evacuating her bowels and the need to splint on a regular basis. Because this patient had apical and posterior segment prolapse with a well-supported anterior vaginal wall, she was an excellent candidate for sacrospinous ligament vaginal vault suspension in conjunction with vaginal enterocele repair and posterior colpoperineorrhaphy (Video 6-5).

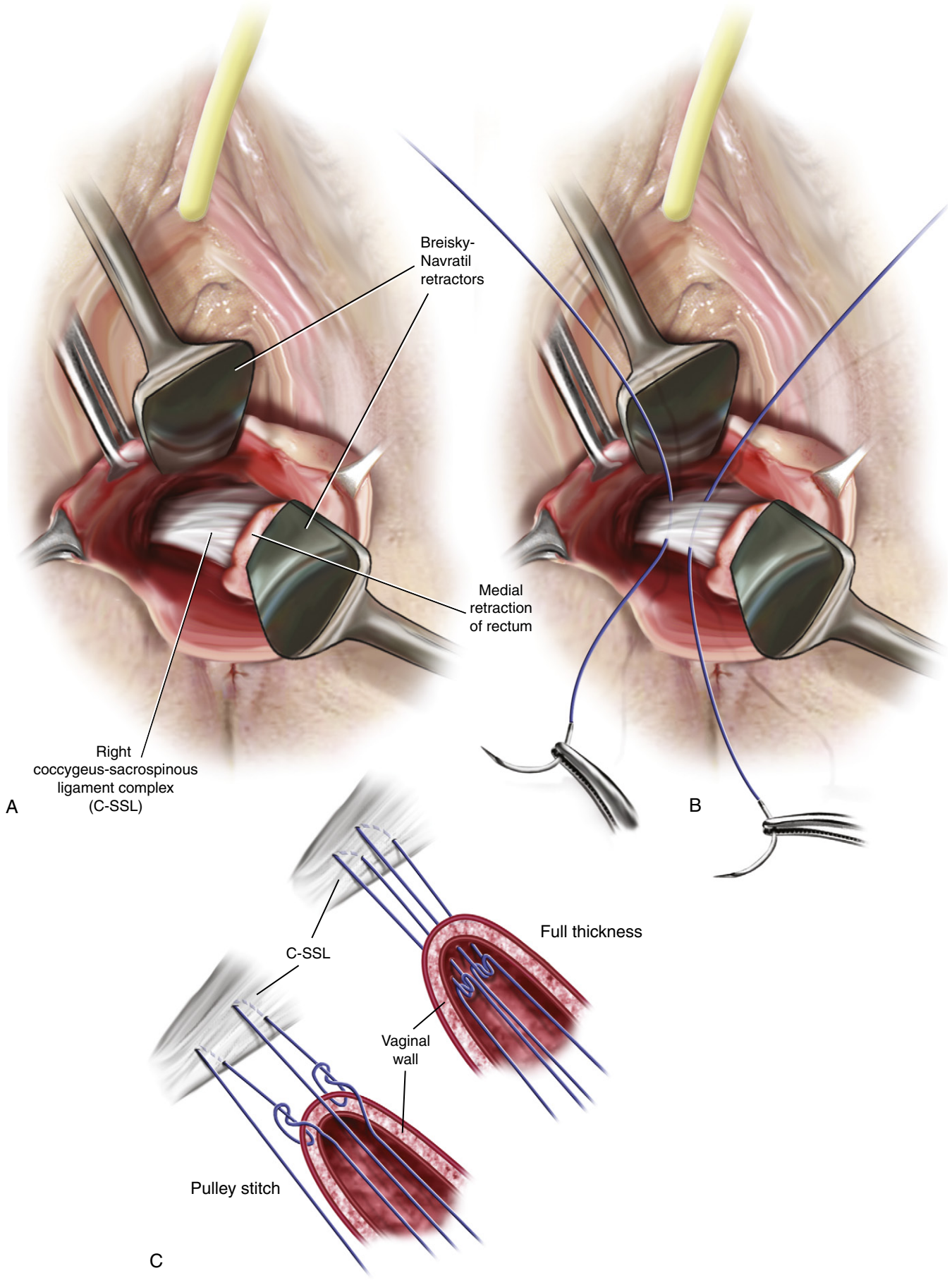

Figure 6-11 Sacrospinous ligament fixation. **A,** After the rectal pillar is perforated, retractors are used to help identify the coccygeus muscle–sacrospinous ligament complex. **B,** Two sutures are placed in the sacrospinous ligament 2 cm medial to the ischial spine. **C,** The vaginal apex can be fixed to the sacrospinous ligament using a pulley-stitch technique for nonabsorbable suture or a full-thickness technique for delayed absorbable suture.

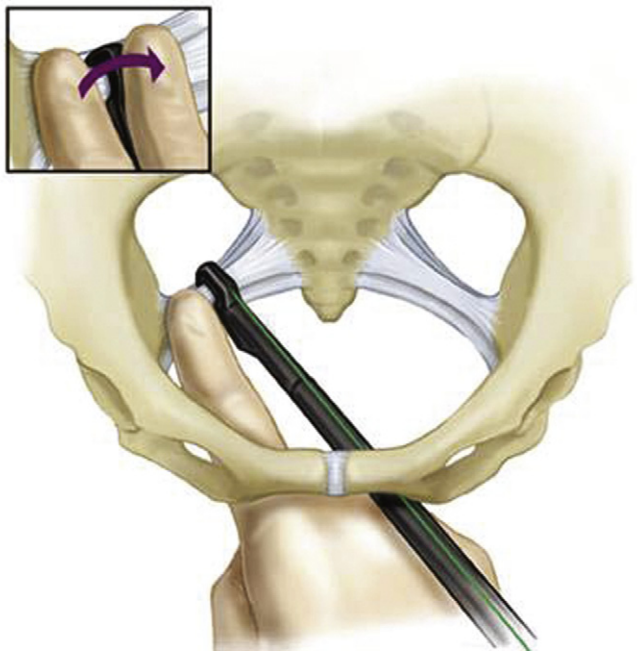

Figure 6-12 Capio suture-capturing device is used to place a suture into the sacrospinous ligament.

7. As with all vault suspension procedures in which there is a potential for ureteral injury, cystourethroscopy after intravenous administration of indigo carmine is recommended to evaluate ureteral patency.

Surgical Technique for Sacrospinous Ligament Fixation—Anterior Approach

Because posterior sacrospinous ligament fixation seems to predispose patients to anterior vaginal wall prolapse, an anterior approach to accessing this structure has been described. This approach can be easily combined with a vaginal-paravaginal repair. We find this to be extremely useful for women with anterior prolapse and a small to modest degree of apical prolapse. We use the same approach for an implant-augmented repair (see later).

1. The anterior approach to sacrospinous ligament fixation accesses the ligament from the retropubic space and dissection of the ipsilateral paravaginal space from the level of the bladder neck to the ischial spine. Theoretically this approach should reduce postoperative vaginal narrowing and posterolateral deviation of the upper vagina, resulting in improved functional outcome. When this approach is used, visualization of the ligament is difficult, and the suture is placed mostly by palpation. Here again use of a suture-capturing device like the Capio is extremely helpful (the technique can be seen in Video 6-4, which shows an implant-augmented repair, but the approach is the same). When this approach is used, the suspension is always bilateral. Bilateral fixation may provide additional support and longevity compared with single-point fixation and may also increase the area of the vagina over the pelvic floor, improving its ability to withstand increases in intraabdominal pressure. A limitation of this technique is that not all women have enough vaginal wall to stretch to both ligaments without leaving a suture bridge, which should always be avoided when performing a sacrospinous vaginal vault suspension.
2. After the ligament is exposed and a delayed absorbable suture is placed, an anterior repair with or without paravaginal repair as described in Chapter 4 can be performed.
3. After the anterior repair is completed, the sacrospinous ligament sutures are passed through the full thickness of the vaginal wall at the apex.

4. The anterior vaginal wall is closed for about half its length in a proximal to distal direction.
5. The sacrospinous ligament sutures are then tied down and the distal half of the vaginal wall is closed.

Iliococcygeus Fixation

Iliococcygeus or prespinous fixation for vaginal vault prolapse is yet another method of suspending the vaginal vault developed to address what was considered to be a high rate of anterior compartment prolapse after sacrospinous ligament fixation and damage to the pudendal neurovascular bundle. In iliococcygeus fixation, the vaginal apex is fixed bilaterally to the iliococcygeus fascia using a single size 1 PDS suture on each side. The incision and dissection are carried out posteriorly on both sides. The rectovaginal fascia is dissected off the posterior vaginal wall laterally all the way to the pelvic sidewall. The ischial spine and sacrospinous ligament are identified as a landmark for the iliococcygeus fascia, which will be found anterior to them (see Fig. 6-1). A disadvantage of this procedure compared with sacrospinous suspension is that vaginal length can be significantly compromised.

Implant-Augmented Repairs

As mentioned previously, the use of implant material (biological or synthetic mesh) at the time of pelvic organ prolapse repair has become increasingly popular due in part to the presumed reduction in the incidence of anatomical recurrence following primary repair. Some short- and intermediate-term data suggest an anatomical advantage of synthetic mesh–augmented repairs over suture repairs for anterior and apical prolapse. However, minimal data are available on the long-term efficacy and safety of implant use in pelvic reconstruction, and support for improved functional outcomes with mesh is also lacking. The significance of "anatomical" versus "functional" success also needs further clarification as implant-augmented repairs become more popular. In our opinion the high short- and intermediate-term anatomical success rates must be weighed against the increased risk of complications associated with the use of synthetic mesh. These include pain, dyspareunia, and the unique complications of mesh extrusion (into the vagina) and erosion (into the urinary or gastrointestinal tract). The risks and benefits of using mesh (or a biological graft) should be discussed in detail with the patient before a final decision is made (please refer to the discussion of informed consent by patients receiving transvaginal mesh implants in Chapters 5 and 8). In our opinion there are select circumstances in which the use of vaginal mesh can be helpful, but we recommend limiting the use of transvaginal mesh to cases of recurrent prolapse in which native tissue repairs have been tried and have failed and to special circumstances in which the surgeon feels that mesh offers a distinct advantage in a particular case.

Synthetic mesh–augmented repair can be performed using a custom-made implant or a predesigned mesh kit. All mesh today is made from soft, lightweight polypropylene with large bores. This material has been shown to be associated with low rates of infection. Some of the newer meshes incorporate an absorbable component. In this section, we describe a technique of custom-made mesh augmentation for anterior and apical prolapse repair. The use of mesh kits is described in Chapter 8.

Surgical Technique for Implant-Augmented Repair

Our current mesh–augmented repair for patients with apical and anterior prolapse includes a simultaneous paravaginal and apical repair using soft polypropylene mesh and involves bilateral sacrospinous ligament fixation through an anterior approach. This technique can be used to incorporate a biological graft as well.

1. When vaginal hysterectomy is to be performed, that procedure is done first. In women with prior hysterectomy (which is most often the case when this technique is used) we first perform any required enterocele repair or reduction as described earlier. After this has been completed, the anterior vaginal wall is infiltrated with 1% lidocaine with epinephrine and a vertical midline incision is made from the area of the bladder neck to the vaginal apex.
2. The vaginal wall is dissected off the bladder and pubocervical fascia to the endopelvic fascia on both sides.
3. The endopelvic fascia is perforated and the space of Retzius entered bilaterally. The ATFP/obturator fascia, ischial spine, and sacrospinous ligament are identified.
4. A Capio needle driver is then used to place a 2-0 PGA suture into the arcus tendineus at the level of the bladder neck and 1 cm above the ischial spine on each side. In addition a third suture (PGA or PDS) is placed into the sacrospinous ligament 1 to 2 cm lateral to the ischial spine (Fig. 6-13). If a distinct arcus cannot be identified, the sutures are placed into the obturator fascia.
5. An anterior colporrhaphy is performed by suturing the lateral edge of the pubocervical fascia to its counterpart on the opposite side using 2-0 PGA suture. Usually four to six sutures are placed from just below the bladder neck to the cardinal ligaments.
6. A piece of soft polypropylene mesh is then configured in the shape of a trapezoid approximately 5 cm wide at the top, 12 cm wide at the bottom, and 10 cm long. The previously placed sacrospinous ligament sutures are passed through the base of the mesh on each side. The sutures in the arcus tendineus just above the ischial spine are placed through the mesh about 3 cm from the base. When placing sutures through the mesh, it is important to pass both ends through, not too close to the edge to prevent tearing (Fig. 6-14).
7. The sacrospinous ligament sutures are tied down first and left long. Then the next set of sutures is tied down and cut.
8. The top of the mesh can then be trimmed, if necessary, to accommodate a particular patient's anatomy. Care should be taken not to trim the mesh too much, because this may result in excess tension. Also, it should be kept in mind that mesh will contract over time. What may appear to be a slight excess of mesh is acceptable.
9. After the appropriate mesh size is established, the most distal arcus tendineus sutures are placed through the distal end of the implant and then tied down.
10. The wound is irrigated with antibiotic solution. Cystoscopy is then performed after intravenous administration of indigo carmine to ensure ureteral patency and rule out bladder injury.
11. The sacrospinous ligament sutures are then passed through the vaginal wall bilaterally at the vaginal apex, about 2 cm from the midline. The proximal two thirds of vaginal wall is closed, and then the sacrospinous ligament sutures are tied down to elevate the vaginal cuff.

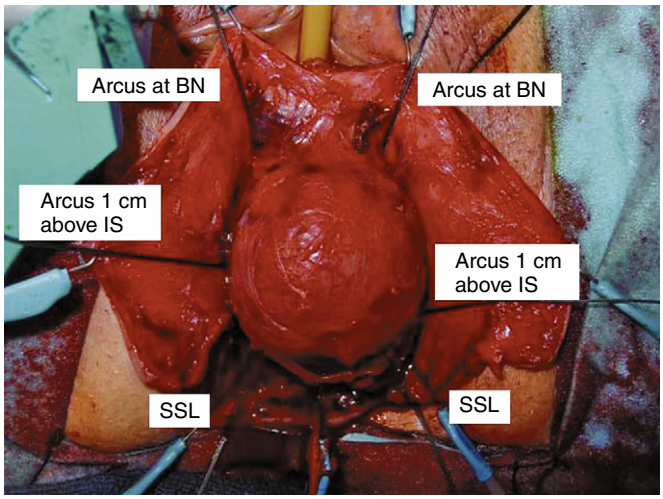

Figure 6-13 Before mesh insertion, sutures are placed in the arcus tendineus fasciae pelvis at the level of the bladder neck and just above the ischial spine on each side. A third set of sutures is placed in the sacrospinous ligament on both sides. *BN,* Bladder neck; *IS,* ischial spine; *SSL,* sacrospinous ligament.

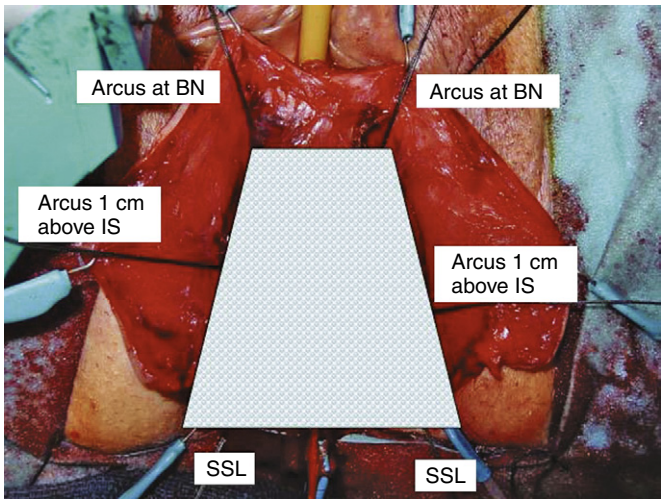

Figure 6-14 After anterior colporrhaphy is performed, the trapezoidal implant can be placed and secured with the preplaced sutures. The most proximal sacrospinous sutures are tied first, followed by the sutures above the ischial spine (IS). If necessary, the implant can be trimmed and then secured with the distal sutures. *BN,* Bladder neck; *SSL,* sacrospinous ligament.

12. The remainder of the anterior vaginal wall is closed. If any trimming of the vaginal wall is to be done, it is performed at this time before the distal closure. We usually do not trim or trim only a small amount of anterior vaginal wall to avoid vaginal shortening.
13. If a midurethral sling is to be placed, the procedure can be performed at this time, followed by posterior repair as indicated.

Case #3

View Video 6-6

A 78-year-old woman with recurrent POP-Q stage III anterior and apical prolapse was treated with a mesh-augmented anterior and apical repair procedure. In this case a prior transvaginal repair had failed. The patient had had multiple abdominal surgeries. She was not sexually active, but preferred to preserve vaginal function. Options for a case like this include abdominal sacrocolpopexy, repeat transvaginal repair with or without mesh augmentation, and colpocleisis. After understanding all of the risks and benefits of each method, the patient opted for mesh augmentation. We believe that morbidity can be minimized by using a customized piece of mesh rather than a trocar-based mesh kit system (Video 6-6).

Complications

In all the procedures described earlier, the major risks are bleeding due to vascular injury, nerve entrapment, ureteral injury or kinking, bowel injury, wound infection, and persistent or recurrent prolapse. During placement of the purse-string sutures of an enterocele repair, the surgeon must take care to not disturb the ovarian vessels, which lie near the uterosacral-cardinal complexes. The pudendal vessels and nerve, which lie beneath the sacrospinous ligament, are at high risk of injury during sacrospinous ligament fixation. Pudendal entrapment may occur if sutures are placed too laterally, whereas the sciatic nerve is at risk if the sutures are placed too cephalad. Injury to either of these nerves will result in significant vaginal pain (pudendal nerve) or thigh and leg pain (sciatic nerve or its roots) Often these injuries are also associated with sensory changes in this area. Approximately 15% of the time, significant genital pain occurs after sacrospinous ligament fixation due to injury to the nerve to the levator ani, which runs through the complex. This pain is always self-limiting, requiring only antiinflammatory medications, and should subside within 2 to 3 weeks. The intrapelvic ureter is intimately associated with the uterosacral ligaments but can be injured or kinked during any intraperitoneal vaginal vault suspension procedure. Ureteral injury or kinking in association with vault suspension has a reported incidence of 1% to 11%. The anterior vaginal compartment is at highest risk for persistent or recurrent prolapse, but in many cases this prolapse is asymptomatic and does not require reoperation.

Mesh-augmented repairs are associated with the additional complications of mesh extrusion and erosion as well as a higher incidence of pain and dyspareunia. The reported rates of vaginal mesh extrusion (exposure) range from 5% to as high as 20%.

Outcomes

The results of apical prolapse repair are difficult to evaluate because the definition of success varies across studies and few studies report long-term follow-up. Colombo and Milani found no statistical difference in recurrence of vault prolapse in a 1998 retrospective study comparing sacrospinous ligament fixation and McCall culdoplasty (8% vs. 3%, respectively). Shull, Bachofen, et al reported "optimal anatomical outcomes" in 87% of patients undergoing uterosacral fixation, whereas Karram et al reported that 89% of women expressed satisfaction with the outcome following the procedure. Success rates ranging from 8% to 97% have been reported for traditional sacrospinous ligament fixation by Holley et al and by Nichols. Shull, Capen, et al and Meeks et al reported 95% and 96% cure rates following iliococcygeus fixation, whereas more recently, Maher et al reported equal efficacy for iliococcygeus fixation and sacrospinous ligament fixation when the two methods were compared.

With regard to mesh augmentation, there are few data on mesh-augmented repairs using custom-cut implants rather than mesh kits. Amrute et al, in a study of single-mesh repair of total pelvic organ prolapse, reported a 5.2% recurrence rate and a 2.1% rate of vaginal erosion after a mean follow-up of 31 months. In a systematic review, Sung et al found limited existing evidence to guide decisions regarding the use of implant materials in transvaginal prolapse surgery. They reported the rates of adverse events associated with implant use to be as follows: bleeding, 0% to 3%; visceral injury, 1% to 4%; implant erosion, 0% to 30%; and fistula, 1%. Recent comparative studies of mesh-augmented versus

nonaugmented repairs have consistently shown better anatomical success rates with mesh (81% to 91%) than without mesh (55% to 72%) at 12 to 24 months. But these higher anatomical success rates must be viewed with caution and weighed against the functional success rates and increased complications with vaginal mesh repair. The specific outcomes of prolapse repair using vaginal mesh kits are reported in Chapter 8.

Suggested Readings

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Repair of the Posterior Vaginal Compartment

7

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Videos

7-1 Defect-Specific Rectocele Repair
7-2 Rectocele Repair in Conjunction With Repair of Posterior Enterocele
7-3 Biological Mesh Augmentation of Repair of Recurrent High Rectocele
7-4 Site-Specific Rectocele Repair in Conjunction With Overlapping Sphincteroplasty
7-5 End-to-End Anal Sphincter Repair in Conjunction With Extensive Perineoplasty

Posterior compartment prolapse involves herniation of the small intestine and/or rectum into the posterior vaginal compartment, which extends from the cervix or vaginal cuff to the perineal body and includes the anal sphincter. Symptomatic isolated posterior compartment defects are relatively unusual and are seen most often in women who sustained severe posterior tears in association with vaginal delivery or in women who have previously undergone repair of the anterior or apical compartment. More frequently, posterior compartment defects are associated with more global pelvic floor dysfunction and vaginal prolapse. Many factors, including childbirth, aging, estrogen withdrawal, habitual abdominal straining, and heavy labor, weaken the pelvic floor and its associated support structures. Childbirth can cause stretching of the prerectal and pararectal fasciae with detachment of the prerectal fascia from the perineal body, which allows rectocele formation. In addition, vaginal childbirth damages and weakens the levator musculature and its fascia, which attenuates the decussating prerectal levator fibers and the attachment of the levator ani to the central tendon of the perineum. The result is a convex sagging of the levator plate with a loss of the normal horizontal vaginal axis. The vagina becomes rotated downward and posteriorly, no longer providing horizontal support. These anatomical changes allow downward herniation of the pelvic organs along this new vaginal axis. Enterocele formation is caused by transmission of intraabdominal pressure to the pouch of Douglas, with herniation of small intestine along the rectovaginal septum. Widening of the anogenital hiatus and damage to the urogenital diaphragm and central tendon further facilitate pelvic prolapse by preventing the normal compensatory narrowing of the vaginal opening. Varying degrees of perineal trauma and tears contribute to widening of the vaginal introitus. The repair of the relaxed or disrupted perineum and the repair of a rectocele are two distinct operative procedures, although they are often performed together.

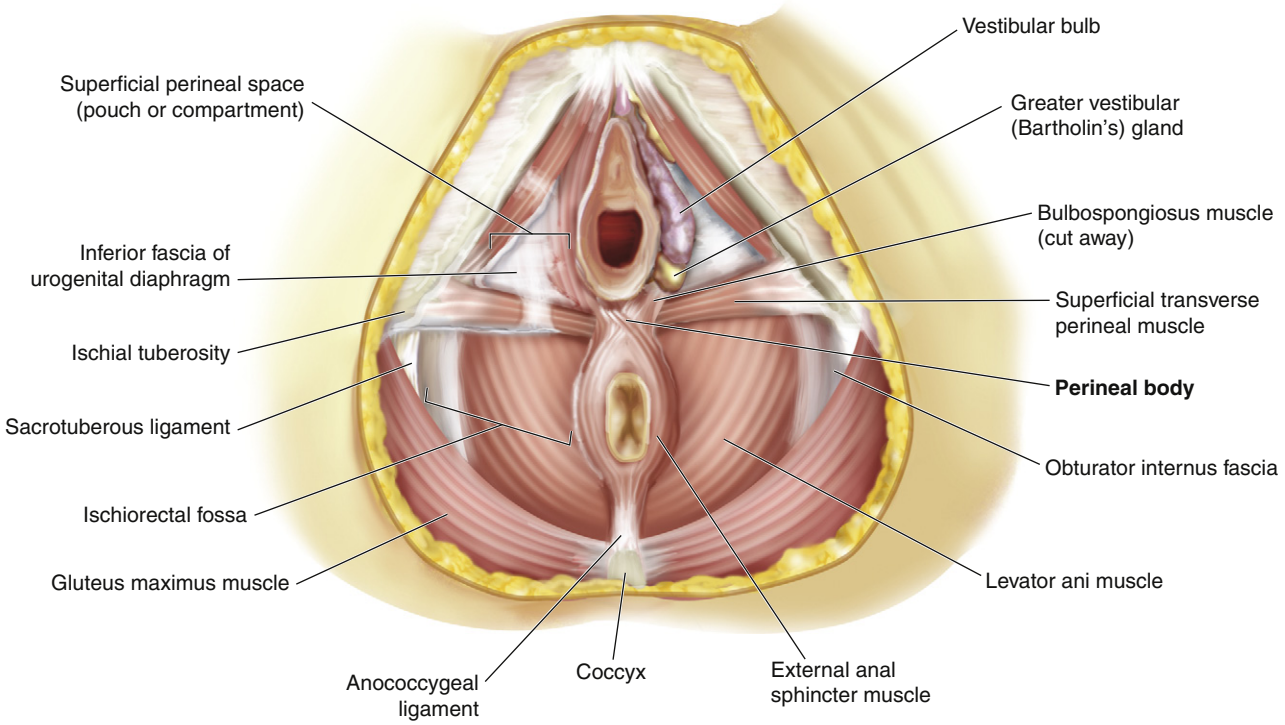

Figure 7-1 The perineal body is the central point between the urogenital and anal triangles. It consists mainly of interlacing muscle fibers from the bulbospongiosus muscle, the superficial transverse perineal muscle, and the external anal sphincter. There are also contributions from the longitudinal rectal muscle and the medial fibers of the puborectalis muscle.

Surgical Anatomy

Several structures provide support for the posterior vagina and rectum:

1. The rectovaginal septum lies between the rectum and the vagina. It extends caudad from the posterior cervix and the uterosacral-cardinal complex to the perineal body centrally and the levator fascia laterally on each side. The rectovaginal septum is densest distally where it is composed of dense connective tissue. Its midportion contains fibrous tissue, fat, and neurovascular tissue. Proximally it is mostly composed of fat cells.
2. The pararectal "fascia" lies between the rectovaginal septum and the rectum. It originates from the pelvic sidewalls and divides into fibrous anterior and posterior sheaths, which envelop the rectum. It also contains blood vessels, nerves, and lymph nodes that supply the rectum.
3. The levator ani consists of the paired ileococcygeus, puborectalis, and pubococcygeus muscles. These function to maintain constant basal tone and a closed urogenital hiatus. They also provide a reflex contraction in response to increases in intraabdominal pressure. The puborectalis muscle acts as a sort of sling that causes the posterior vaginal wall to angulate about 45 degrees from the vertical.
4. The perineal body is the central point between the urogenital and anal triangles (Fig. 7-1). It contains interlacing muscle fibers from the bulbospongiosus and superficial transverse perineal muscles and the anterior portion of the external anal sphincter. There is also a contribution from the longitudinal rectal muscle and the medial fibers of the puborectalis muscle.

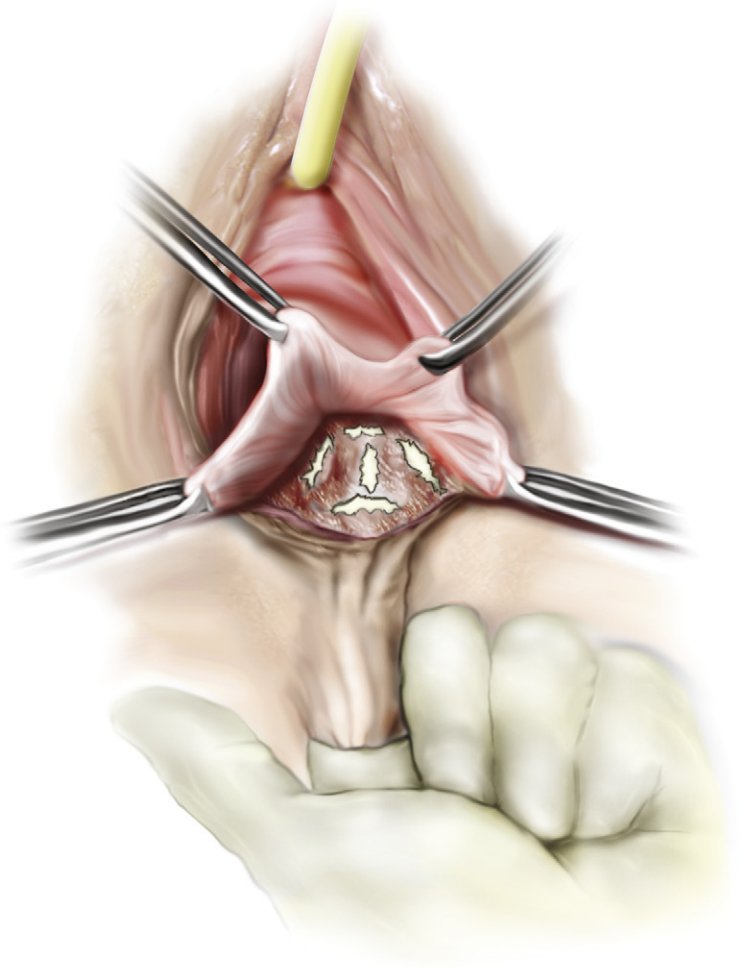

Figure 7-2 Illustration of the various sites where the rectovaginal septum can become disrupted. Shown are midline, lateral, and transverse (proximal and distal) breaks. More than one break in the septum can be present, and multiple breaks can be continuous with each other.

Several critical components of pelvic floor relaxation are associated with rectocele formation. Loss of the normal horizontal axis of the levator plate and vagina, weakness of the urogenital and pelvic floor diaphragms, detachment of the levator ani from the central tendon of the perineum, and widening of the anogenital hiatus allow intraabdominal forces to be transmitted directly to pelvic organs without counteraction by normal underlying compensatory mechanisms. In addition, the rectovaginal septum becomes attenuated or disrupted, which allows intravaginal herniation of the rectum. Isolated breaks in the rectovaginal septum facilitate rectocele formation. There are several areas along the rectovaginal septum where breaks are commonly found (Fig. 7-2). The most common is a transverse separation immediately above the attachment of this septum to the perineal body, which results in a low or distal rectocele (seen just inside the introitus). A midline vertical defect is also very common and most likely represents a poorly repaired or poorly healed episiotomy. Rarely, one can see lateral separation on one side. Defects can occur in isolation or in combination. Identification of specific defects is important when one is considering performing a site-specific posterior repair. Therefore, each of these components of pelvic floor relaxation must be addressed at the time of rectocele or posterior vaginal wall repair. Identification of the specific pathophysiological features is critical when one is evaluating female patients with symptoms or signs of pelvic floor relaxation, including stress incontinence, cystocele, and/or uterine prolapse. Maintenance of the normal horizontal vaginal axis to allow compensatory

mechanisms to be reestablished is an important goal of surgical repair of pelvic floor relaxation. Corrective surgery for posterior vaginal wall prolapse may include correction of the rectocele by reinforcement of the rectovaginal septum and prerectal and pararectal fasciae, repair of the levator muscle defect to restore the levator hiatus, restoration of the horizontal supporting plate of the proximal vagina, and repair of the perineum.

The indications for repair of the posterior compartment are not clearly defined for a patient with no symptoms attributable to the rectocele who is being evaluated for correction of apical and/or anterior compartment prolapse. Some surgeons advocate posterior compartment repair in all patients undergoing vaginal prolapse surgery, so that all areas of pelvic floor weakening are addressed. Other surgeons selectively repair the posterior compartment only in cases of defecatory dysfunction, most commonly outlet obstruction that is felt to be attributable to the rectocele or to posterior compartment prolapse extending beyond the hymen. These surgeons feel that the potential for morbidity associated with the repair of asymptomatic posterior prolapse (pain and dyspareunia) outweighs the benefit of complete "anatomical correction." Furthermore, in selected cases of fecal incontinence secondary to an anal sphincter defect, transperineal anal sphincter repair may be combined with posterior compartment repair.

Preoperative Evaluation

History

Numerous symptoms related to bowel and sexual function have been attributed to posterior compartment prolapse, although few studies have adequately correlated surgical repair with definitive symptom improvement. Symptoms include sensation of a vaginal bulge or lump, incomplete evacuation of the bowel, constipation, fecal straining, the need for vaginal digitalization to facilitate defecation (splinting), and dyspareunia. Despite the association between constipation and the presence of a rectocele, many other factors can contribute to constipation. Furthermore, rectocele size does not directly correlate with symptoms.

Physical Examination

Assessment of the posterior vaginal compartment should be a routine component of the examination of any patient with incontinence or pelvic organ prolapse (see Chapter 1). This includes inspection for the presence of enterocele, rectocele, and perineal weakness. Generally, the posterior compartment is evaluated by displacing the anterior vaginal wall with half of a Graves speculum to allow complete visualization of the posterior wall during straining. Digital examination with one of the examiner's fingers in the vagina and one finger in the rectum allows assessment of the rectovaginal septum, which is often quite attenuated with Pelvic Organ Prolapse Quantification (POP-Q) stage II and III rectoceles and may contain an enterocele sac. Physical examination may not reliably distinguish an enterocele from a high rectocele. Inspection of the rectovaginal septum for isolated breaks, typically found near its attachment to the perineal body or in the midline, is performed by placing a finger in the rectum and lifting up the posterior vaginal wall. Finally, inspection of the perineal body is performed to identify any defect associated with a widened introitus and a decreased distance between the anus and posterior vaginal fourchette. In cases of severe prolapse, combined defects of posterior vaginal wall support at the level of the pelvic floor and the perineum are often present.

The vaginal axis is assessed by digital examination. In a nulliparous woman with a well-supported pelvic floor, the proximal vagina will show a posterior curvature. In a patient with pelvic floor relaxation, the vaginal axis will be horizontal in the lithotomy position. Restoration of this important vaginal axis prevents further development or recurrence of pelvic organ prolapse. Increases in abdominal pressure will cause vaginal coaptation when the normal vaginal axis has been restored.

The final portion of the posterior compartment examination involves assessment of the anal sphincter, including resting tone, voluntary activity, and reflex activity. Defects in the external anal sphincter may be associated with symptoms of fecal incontinence. Digital examination is performed with the patient at rest, straining or coughing, and voluntarily contracting.

Identification of Perineal Laxity

In addition to posterior vaginal wall prolapse, perineocele (or perineal laxity) is an important component of pelvic floor dysfunction. The urogenital diaphragm, made up of the bulbocavernosus muscle, superficial and deep transverse perineal muscles, and external anal sphincter musculature, joins with the levator ani to form the central tendon of the perineum. Attenuation of these structures, along with detachment from the central tendon, results in perineal laxity. On physical examination, an outward convexity of the perineum with straining is noted, and the distance between the posterior vaginal fourchette and the anus is increased. Often, this defect is present in association with rectocele. Specific symptoms associated with perineal laxity include severe constipation and the need to apply perineal pressure to evacuate the rectum. In addition, the patient may notice a bulging of the perineum during straining or increases in abdominal pressure.

Radiographic Evaluation

Magnetic resonance imaging (MRI) can be an adjunct in identifying and quantifying the presence of a rectocele as well as associated pelvic floor dysfunction, pelvic organ abnormality, pelvic organ prolapse, and rectal prolapse and/or intusseption. Specifically, dynamic pelvic MRI can provide objective quantification of prolapse in all three vaginal compartments while also assessing for any underlying urological or gynecological pathological condition. Static images are obtained in both sagittal and parasagittal planes from left to right across the pelvis. Then a set of dynamic images in the midsagittal plane is acquired during the resting and straining states. This particular set of dynamic images is helpful in identifying pelvic floor descent and pelvic organ prolapse. The pubococcygeal line and posterior puborectalis muscle sling are fixed anatomical reference points used to quantify organ prolapse and pelvic floor dysfunction. *Organ prolapse* is defined as any protrusion beyond the pubococcygeal line during the dynamic phase with Valsalva maneuvers. A rectocele is easily identified when the rectum is filled with gas, fluid, or gel. Furthermore, gel can be instilled rectally to perform magnetic resonance (MR) defecography and identify specific areas of rectovaginal septum attenuation, rectal mucosal prolapse or intussusception, and defects of the anal sphincter and perineal body. Dynamic pelvic MRI in conjunction with MR defecography can be especially useful in evaluating for rectocele, enterocele, and internal or external rectal prolapse. The findings can help in surgical planning by both the female pelvic reconstructive surgeon and the colorectal surgeon.

Patient Selection for Posterior Compartment Repair

In general, the repair of posterior vaginal prolapse is undertaken together with associated anterior or apical compartment prolapse repair, except in cases of an isolated symptomatic rectocele following prior anterior and/or apical compartment repair. Surgical correction of the anterior compartment (cystocele) and/or the apical compartment (uterine prolapse or enterocele) can include rectocele repair, because pelvic floor laxity often affects all vaginal compartments. Rectocele repair during prolapse surgery helps to restore a normal vaginal axis and introital diameter, which prevents prolapse recurrence.

The decision to pursue posterior compartment repair depends on both surgeon and patient preference. When posterior compartment repair is undertaken to correct or alleviate specific defecatory symptoms, the goal is generally to improve rectal evacuation, decrease the need for fecal straining and/or manual splinting, and improve constipation overall. The decision to perform posterior compartment repair in a patient without specific defecatory symptoms during antiincontinence and/or prolapse surgery is somewhat controversial. Indications for repair of asymptomatic posterior compartment prolapse are less well defined than are those for repair of anterior compartment and uterine prolapse. Part of the controversy surrounding posterior compartment repair is based on the known adverse effect of dyspareunia that occurs in a proportion of patients postoperatively. Reported rates of pain with sexual activity vary widely in the literature depending on how the symptom was assessed and which type of repair was performed. On the other hand, posterior compartment repair may be undertaken in those women who complain of vaginal laxity following childbirth, which may be bothersome to both the patient and her partner and thereby affect sexual function. Typically this repair is combined with levator myorrhaphy and perineorrhaphy.

Patient Selection for Perineorrhaphy

Generally, repair of the perineal body is performed at the time of posterior compartment repair to restore a normal vaginal axis, re-create the anchoring of the levator ani muscle to the central tendon of the perineum, and restore the normal urogenital diaphragm, which decreases the size of the genital hiatus. Occasionally one may find a rectocele in a patient with an intact perineal body, but this is less common. When specific herniation of the perineum is associated with symptomatic bowel dysfunction, a formal perineorrhaphy should be undertaken. Indications for this type of repair are based on the patient's symptoms, such as difficulty in evacuation and the need to provide manual perineal pressure to defecate effectively.

Patient Selection for Anal Sphincter Repair

Disruption of the anal sphincter and/or perineal body may occur during vaginal delivery and is associated with third- and fourth-degree lacerations. Often these injuries are repaired at the time of delivery; however, it may be difficult to clearly identify the internal and external anal sphincter, severed perineal body, and rectovaginal septum due to tissue edema and bleeding at the time of the acute injury. Chronic separation of these perineal structures can lead to fecal incontinence, incontinence of flatus, and poor overall support of the vaginal compartments. Patients with this constellation of symptoms are candidates for surgical repair. It is critical that the posterior vaginal compartment, including the rectovaginal septum, the internal and external anal sphincters, and the

perineal body, be individually assessed for defects and/or fistulae to optimize surgical planning. Endoanal ultrasonography is a useful tool in assessing these anatomical structures. More complex cases involving multiple defects and/or fistulae may require consultation with a colorectal surgeon.

Surgical Technique for Posterior Compartment Repair

The surgical repair of the posterior compartment has three goals: rectocele reduction by plication of prerectal and pararectal fascia or site-specific repair of the rectovaginal septum, reconstruction of the levator hiatus by reapproximation of the prerectal levator fibers, and repair of the perineal body. These steps result in reconstruction of the rectovaginal septum as well as restoration of the horizontal levator plate. The perineal body repair allows anchoring of the muscles of the lower vagina and perineum, which restores the urogenital diaphragm and prevents future distal rectocele formation. Repair of a rectocele can be achieved by several methods, including traditional posterior colporrhaphy and site-specific (or defect-specific) repair.

Traditional Posterior Colporrhaphy

1. Following induction of anesthesia, lower-extremity sequential compression devices are applied, and the patient is placed in the exaggerated dorsal lithotomy position. Preparing and draping are performed in the usual sterile fashion. A sterile adhesive plastic drape may be placed over the anus just below the perineum to improve sterility yet allow the surgeon to place a gloved finger beneath the drapes into the rectum. The draping should be done so that the surgeon has access to the rectal vault during surgical repair. If the anterior and/or apical compartments are to be repaired, this is done before the posterior repair.
2. To optimize vaginal exposure, a ring retractor with sharp hooks may be placed at the beginning of the procedure: two hooks along the anterior vaginal wall adjacent to the urethral meatus, two hooks at the lateral vaginal wall, and two hooks posteriorly along the posterior fourchette. Upward retraction of the anterior vaginal wall with a Heaney retractor improves visualization and prevents inadvertent narrowing of the vagina by excessive excision of vaginal wall tissue.
3. The posterior vaginal wall is typically infiltrated with hemostatic solution such as 1% lidocaine with epinephrine or vasopressin (Pitressin), both to minimize bleeding during dissection and to facilitate hydrodissection between the vaginal epithelium and the rectovaginal fascia.
4. Two Allis clamps are placed along the posterior fourchette, usually at the 5 o'clock and 7 o'clock positions. A V-shaped incision is made, creating a triangular flap of skin that is subsequently excised to expose the attenuated perineal body.
5. Two Allis clamps, placed approximately 3 cm apart, are then used to grasp the cut edge of the posterior vaginal wall overlying the perineal body. A midline incision (or alternatively two longitudinal incisions that start on the lateral border of the rectocele and meet at the vaginal apex) is made in the posterior vaginal epithelium overlying the rectocele and can be extended from the vaginal cuff or cervix to the perineum depending on the extent of the rectovaginal septal defect.

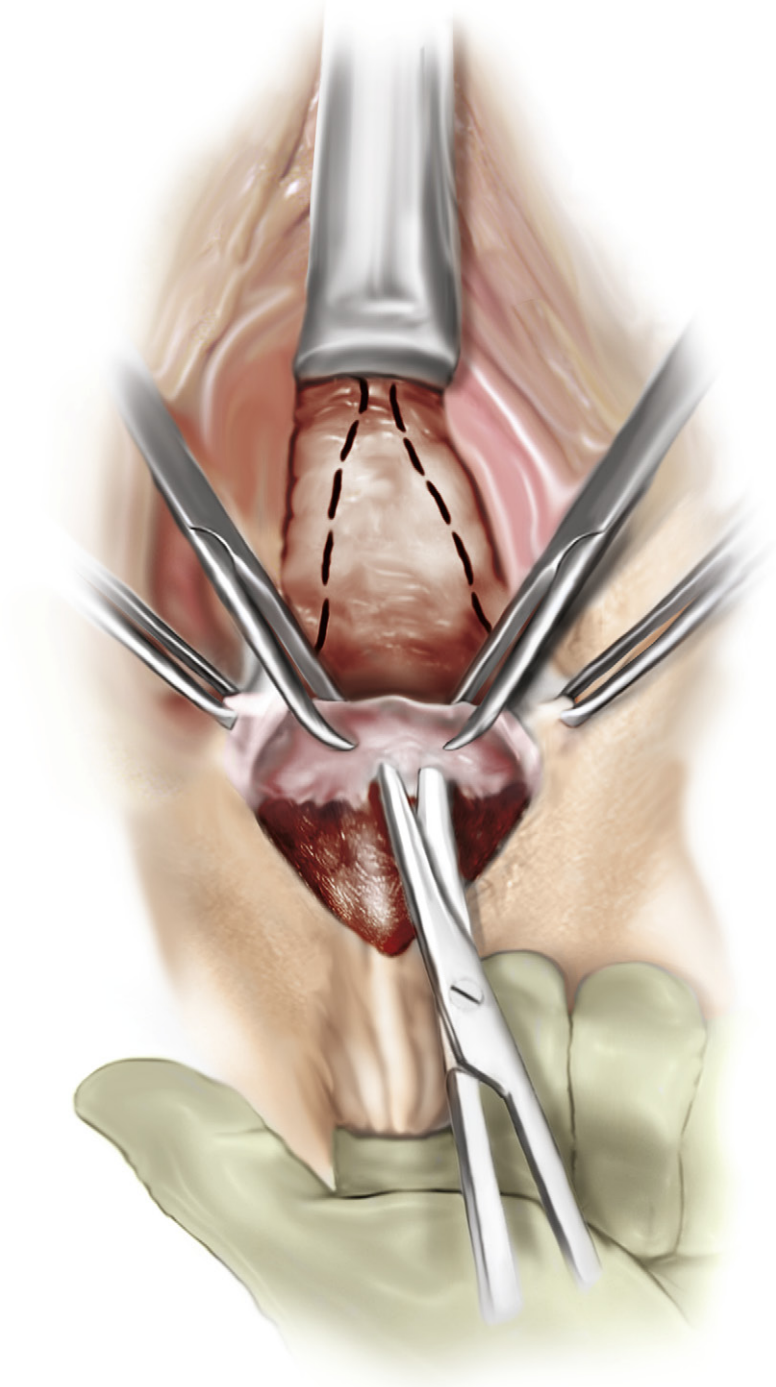

Figure 7-3 Sharp dissection is performed to separate the posterior vaginal wall from the rectovaginal septum. The incision of the vaginal wall can then be continued in the midline or along the *dotted lines* shown in the figure.

6. Sharp dissection with Metzenbaum scissors aids in developing the plane between the posterior vaginal wall and the herniated anterior rectal wall, which exposes the attenuated rectovaginal fascia (Fig. 7-3). This dissection is generally carried out for the length of the defect and should extend cephalad to beyond the extraperitoneal portion of the rectum to allow detection of a posterior enterocele (see Chapter 6). It is important to maintain dissection along the vaginal wall (with scissor tips pointed upward) to avoid injury to the rectum. The hooks are then used to retract the posterior vaginal epithelial flaps and widely expose the rectovaginal septum.

7. At this point, a gloved finger may be placed into the rectum to assess the size of the defect and identify discrete defects in the rectovaginal septum or areas of generalized weakness. Either a running, interlocking 2-0 polyglycolic acid (PGA) suture* or interrupted sutures are placed to approximate the pararectal fascia and the edge of the rectovaginal septum. In a traditional posterior colporrhaphy, the rectovaginal septum is repaired with interrupted 2-0 PGA sutures that plicate the fascia across the midline. This is commonly followed by a second layer of interrupted sutures that in the most distal portion of the repair should include the puborectalis portion of the levator ani muscle laterally on each side. Aggressive levator plication should be avoided, because it can narrow the vagina and lead to dyspareunia.
8. Distal levator plication, if desired, is accomplished by placing horizontal or figure-of-eight 2-0 or 0 PGA suture in the levator fascia distally near the vaginal introitus. This technique is commonly used in patients with a large prolapse to appropriately narrow the genital hiatus.
9. Very frequently the perineal body is repaired at the time of posterior repair. The superficial and deep perineal muscles are reapproximated to the central tendon with one or two U stitches of 2-0 PGA going from the vaginal side of the perineal body to the central tendon. When the defect is wide, transverse sutures can also be placed.
10. Generally, at the completion of the rectovaginal septal repair, the most distal aspect of the rectovaginal septum should be reapproximated to the perineal body, again with 2-0 PGA sutures. This will often correct a transverse distal defect that may contribute to a distal rectocele.
11. At the completion of the posterior colpoperineorrhaphy, the vaginal epithelium is reapproximated with one or more fine running or interrupted 3-0 delayed absorbable sutures. Only when the prolapse is very large is it necessary to excise excess posterior vaginal wall. Aggressive excision can lead to vaginal narrowing and dyspareunia.
12. If the perineal skin was incised, it is closed with interrupted 4-0 PGA sutures.
13. An antibiotic-impregnated vaginal packing is placed at the completion of the procedure to aid in hemostasis. The packing is commonly removed on postoperative day 1, and patients are routinely discharged home, with stool softeners prescribed to prevent constipation and straining.

Site-Specific Posterior Colporrhaphy

1. If a perineal repair is to be performed, a triangular portion of perineal skin is excised. This excision may be preceded by injection of hemostatic solution into the perineum.
2. The distal end of the vagina is grasped with an Allis clamp on either side of the midline, and the posterior vaginal wall is opened. We prefer not to infiltrate the posterior vaginal wall with hemostatic solution for site-specific repair, because this can make identification of the rectovaginal septum difficult. To preserve the rectovaginal septum, the vaginal wall is separated from the septum with sharp dissection before it is cut in the midline.
3. The Allis clamps can be advanced proximally as the vaginal wall is cut to facilitate dissection (Video 7-1 ).

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

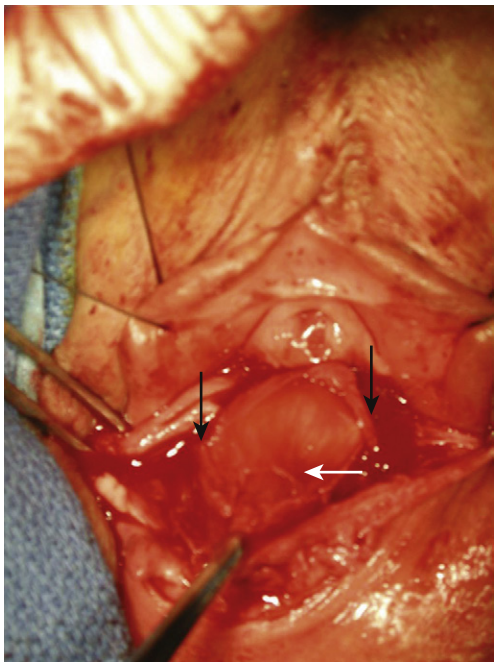

Figure 7-4 A finger in the rectum reveals the defect in the rectovaginal septum. Here there are continuous midline and distal transverse defects where the septum is torn completely off of the perineal body. The *black arrows* show the edges of the septum; the *white arrow* points to the defect and the exposed muscularis of the rectal wall.

4. Once the posterior vaginal wall is fully opened, a finger of the surgeon's nondominant hand is placed in the rectum and the edges of the rectovaginal septum and the defects are identified. This can be aided by upward traction of the finger in the rectum so that the muscularis of the rectal wall (where the defect is present) can be distinguished from the rectovaginal septum (Fig. 7-4). Sometimes the rectovaginal septum must be mobilized off of the vaginal wall.
5. Allis clamps can be placed on the fascial septum and the defect fully appreciated. The septum is then repaired with interrupted 2-0 PGA sutures. The configuration and number of sutures is dependent on the type of defect. Thus sutures can be placed horizontally or vertically.
6. If necessary, in women with a widened levator hiatus, another set of horizontal sutures can be placed to narrow the hiatus.
7. Perineal repair is performed as described earlier, and when the rectovaginal septum is separated from the perineal body, it is reapproximated.
8. The vaginal wall is closed with a running 2-0 PGA suture.
9. The perineal skin is closed with interrupted 4-0 PGA sutures.

Case #1

View Video 7-1

A 56-year-old woman had a vaginal bulge and needed to splint manually to defecate. The bulge was uncomfortable, and she sometimes felt as if she were "sitting on a sponge." The bulge sometimes interfered with intercourse. On physical examination the patient was found to have good anterior and apical support and a POP-Q stage III rectocele that descended about 2 cm beyond the hymen with straining. The patient was very concerned about sexual function and potential side effects of a posterior repair, but she was bothered enough to want to do something to correct the defect. A site-specific repair was performed with care taken not to affect the size of the vaginal introitus (it was not widened). (See Video 7-1 for a demonstration of defect-specific rectocele repair.)

Case #2

View Video 7-2

The case was similar to case #1, but at the time of surgical correction a posterior enterocele was encountered. (See Video 7-2 for demonstration of rectocele repair in conjunction with repair of a posterior enterocele.)

Tissue Augmentation in Posterior Colpoperineorrhaphy

The addition of implant material to the posterior compartment has been advocated by some pelvic surgeons to strengthen the repair of the rectovaginal septum and reduce the risk of rectocele recurrence. Data on the use of mesh in the posterior compartment do not support its routine use, and therefore graft augmentation should probably be reserved for the very rare cases in which the rectovaginal septum is completely obliterated. Numerous types of materials are commercially available for this purpose, including xenografts, allografts, and synthetic mesh. Historically the use of polypropylene mesh in the posterior compartment has been largely avoided due to fears of mesh erosion into the rectum and rectovaginal fistula formation. However, with the advent of prolapse repair kits that allow polypropylene mesh to be tunneled into various vaginal compartments by different methods, increasing numbers of patients have undergone procedures in which synthetic mesh is placed over the rectovaginal fascia. If such a kit is used, the risks of mesh augmentation, including specifically those related to placement in the posterior compartment, should be thoroughly explained to the patient (see Chapter 8). As an alternative to synthetic mesh, some surgeons have used biological grafts such as dermal or collagen allografts to augment site-specific or traditional colpoperineorrhaphies. Currently, there is no level I evidence regarding posterior compartment repair with or without the addition of implant materials, and conclusions regarding outcomes cannot be drawn. For the most part, the decision regarding whether or not to use implant materials in the posterior compartment depends on the specific surgeon and reflects the surgeon's experience, outcomes, and philosophy. In specific cases in which prior posterior compartment repair has failed, the addition of an implant material may be beneficial, although we do not advocate the use of synthetic mesh.

Surgical Technique for Implant Augmentation in Posterior Colpoperineorrhaphy (Video 7-3)

1. The steps for traditional posterior repair described earlier are carried out to step 8. The implant material can then be used as a broad sheet spanning the entire rectovaginal septum from the vaginal apex or cervix to the perineal body or as a discrete patch to reinforce a site-specific repair. The implant is sutured laterally to the pararectal fascia and proximally and distally to the rectovaginal fascia itself using 2-0 absorbable suture.
2. If the implant is placed along the entire rectovaginal septum, it can be sutured apically to the cervix, to the uterosacral ligaments, or to the sacrospinous ligaments. Distally it is anchored to the distal rectovaginal septum, if available, or to the perineal body just inside the vaginal introitus (Fig. 7-5). In addition, if an apical repair has been performed concurrently, the apex of the implant can be secured to the vaginal suspension sutures (i.e., sacrospinous ligament, iliococcygeus, or high uterosacral sutures).

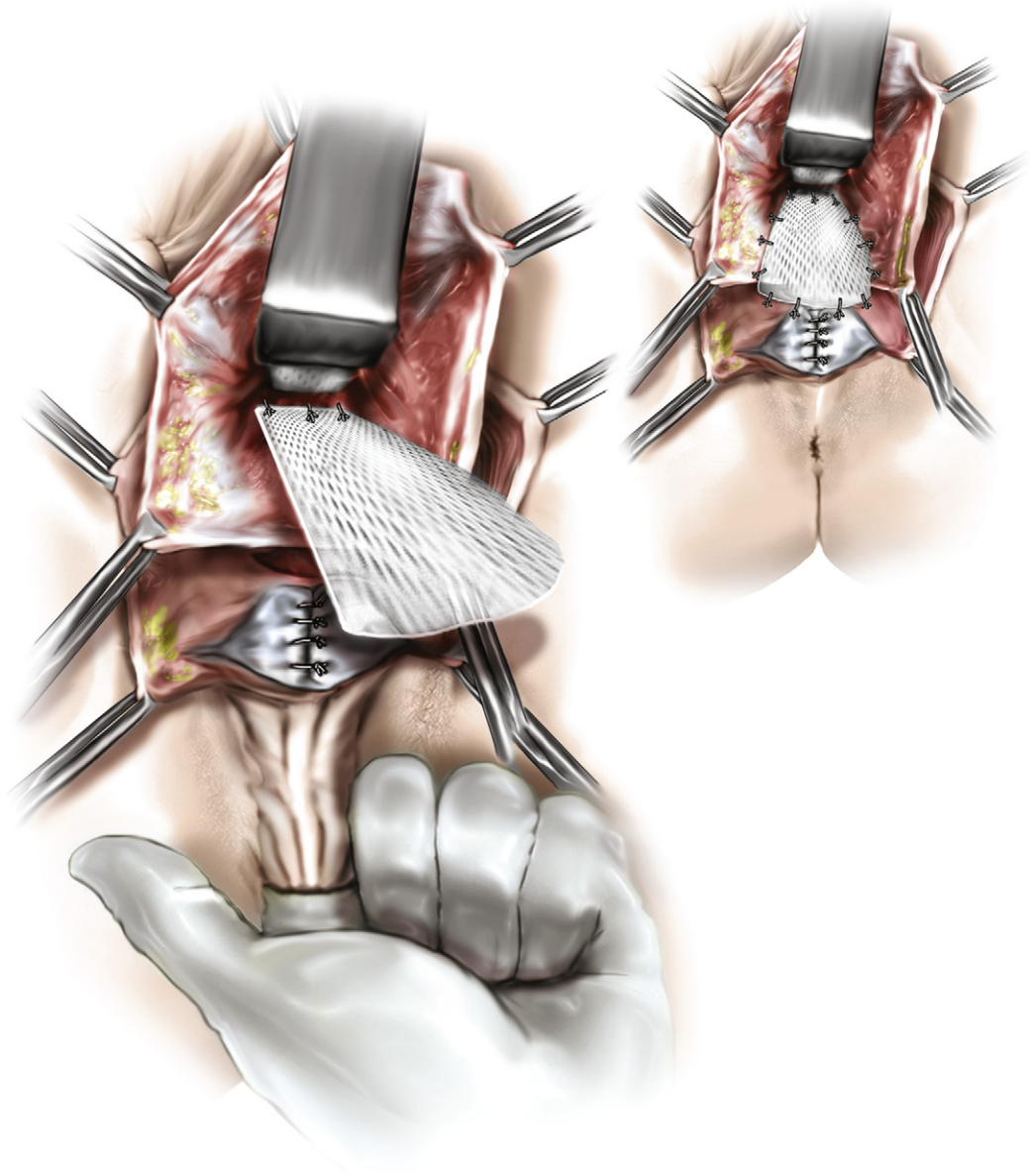

Figure 7-5 Placement of a graft over the rectum to re-create the rectovaginal septum. Proximally it is attached to the uterosacral ligaments (alternatively it can be sutured to the sacrospinous ligaments), and distally it is attached to the edge of the rectovaginal septum (shown here) or to the perineal body, depending on the availability of native tissue.

3. After copious irrigation of the posterior compartment repair (including the overlying implant) with saline or water, the posterior vaginal epithelium is then reapproximated with absorbable sutures to completely cover the implant as previously described.

Surgical Technique for Anal Sphincter Repair

Repair of the external and internal anal sphincter is undertaken specifically when an isolated defect in the anal sphincter complex is identifiable by physical examination and/or transanal ultrasonography, pelvic MRI, or MR defecography and is associated with fecal incontinence. In addition, separation of the perineal body may need to be addressed concurrently and any rectovaginal fistula present repaired. Generally, these defects result from obstetric trauma at vaginal delivery and are associated with fourth-degree lacerations or episiotomy and incomplete repair at the time of delivery. The external anal sphincter can be accessed through the perineum quite readily or can be accessed through the anus itself. Bowel preparation is advocated to allow a clean operative field and

to delay passage of a bowel movement through the repair postoperatively. To enable dissection and identification of the anal sphincter complex, the patient should not be given paralytic medications during anesthesia. Thus, general anesthesia is preferable to spinal anesthesia.

1. The perineum and vagina are prepared and draped as described previously for posterior colpoperineorrhaphy, with adhesive draping across the anus.
2. An inverted U–shaped or semicircular incision is made in the perineum, approximately 2 cm from the anus and midway between the posterior vaginal fourchette and anus. Skin flaps are dissected both anteriorly and posteriorly to expose the superficial transverse perineal muscles and the central tendon of the perineum or perineal body, which may be disrupted with lateral retraction of the two segments. A ring retractor can be placed with sharp hooks to improve exposure.
3. A gloved finger can be placed in the rectum throughout the surgery to aid in identification of the external and internal anal sphincters, rectovaginal septum, and perineal body.
4. The posterior vaginal wall is typically infiltrated with a hemostatic solution such as 1% lidocaine with epinephrine, both to minimize bleeding during dissection and to facilitate hydrodissection between the vaginal epithelium and the rectovaginal fascia.
5. Two Allis clamps, placed approximately 3 cm apart, are then used to grasp the cut edge of the posterior vaginal wall overlying the perineal body. Dissection of the rectovaginal space is carried out sharply with Metzenbaum scissors to expose the distal rectum, rectovaginal fascia, and perineal body.
6. The external anal sphincter is identified at the junction of the perianal skin creases and the perineal body. A nerve stimulator or monopolar cautery can be used intraoperatively to identify the two viable ends of the sphincter muscle. The ischiorectal fat lies lateral to the sphincter, and the anal canal lies medial to it. Allis clamps are placed on either end of the disrupted external anal sphincter.
7. The rectal wall is then reapproximated with absorbable suture material. If there is disruption of the internal anal sphincter, a gloved finger in the rectum can help to identify this rubbery structure, which can then be reapproximated with monofilament delayed absorbable suture such as PGA or polydioxanone (PDS).
8. The ends of the external anal sphincter must be dissected laterally to allow a tension-free repair. The ends of the external sphincter are joined to one another again, either directly (end to end) or in an overlapping fashion, using PDS (Figs. 7-6 and 7-7).
9. The perineal body is then reapproximated in the midline with absorbable sutures to reestablish the central tendon of the perineum. At the completion of the repair, there should once again be a circumferential pattern of distribution of the perianal creases.
10. After copious irrigation of the operative field with saline or water, the perineal skin is reapproximated, typically with a monofilament absorbable suture such as PGA or Monocryl, in a subcuticular or interrupted fashion. In addition, skin glue can be applied to the wound to further seal the skin.
11. Ice packs can be applied to the perineum immediately after surgery to reduce edema and pain. In addition, the patient should take a stool softener such as mineral oil daily to maintain soft, regular bowel movements that are easy to pass.

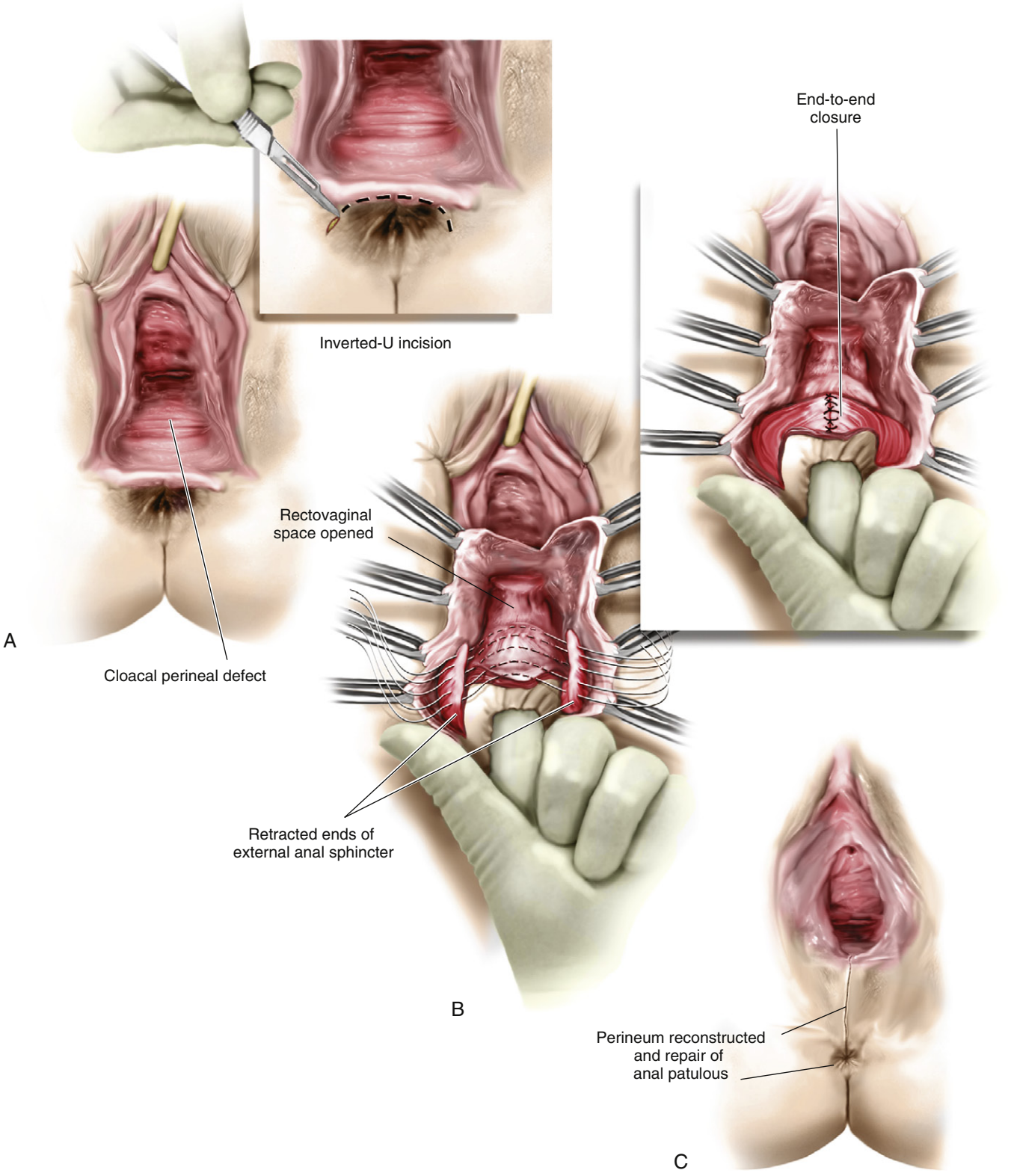

Figure 7-6 End-to-end anal sphincteroplasty. **A,** The external anal sphincter is approached through an inverted U–shaped perineal incision. **B,** Dissection is carried out laterally to identify the retracted ends of the anal sphincter. **C,** Several interrupted sutures are used to reapproximate the sphincter in a nonoverlapping fashion.

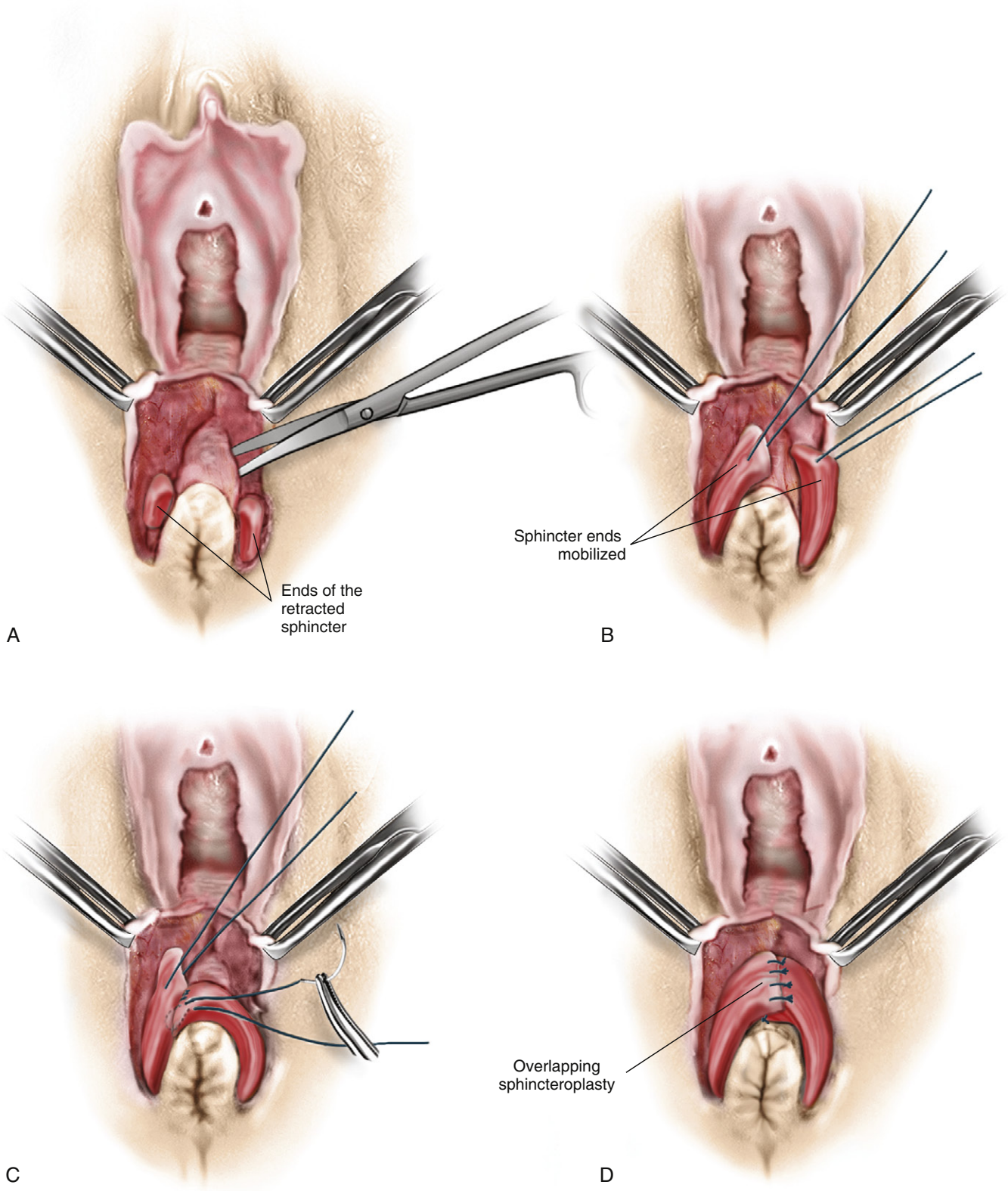

Figure 7-7 Overlapping anal sphincteroplasty. **A,** As in end-to-end sphincteroplasty, the retracted ends of the external anal sphincter are further mobilized laterally. **B,** Lateral mobilization is continued further to allow the ends on each side to be overlapped. **C,** The two ends of the sphincter are overlapped on one another and sutured to each other and to the perineal body. **D,** Completed sphincteroplasty.

Case #3

View Video 7-4

A 57-year-old woman (gravida 5, para 4) with a history of uterine prolapse who previously underwent supracervical hysterectomy and sacrocolpopexy complained of a symptomatic vaginal bulge, difficulty with rectal evacuation, and occasional fecal incontinence, especially when her bowel movements were soft or loose. She often manually pushed the bulge into the vagina to improve rectal evacuation during times of constipation. Physical examination revealed normal vaginal depth and length, good apical and cervical support, POP-Q stage I anterior prolapse, and a large posterior rectocele (POP-Q stage IV) protruding approximately 2.5 to 3.0 cm beyond the introitus with laxity of the perineal body in the midline. Rectal examination revealed a discrete defect in the external anal sphincter from the 10 o'clock to the 2 o'clock position that was especially notable on voluntary contraction of the pelvic floor. The perianal skin lacked any creasing between the 10 o'clock and 2 o'clock positions, consistent with a sphincter defect. The vaginal axis was flattened, and the vaginal introitus had a gaping appearance. The patient was offered a site-specific rectocele repair (without implant augmentation), overlapping anal sphincter repair, and perineorrhaphy (Video 7-4).

Case #4

View Video 7-5

A 28-year-old woman (gravida 1, para 1) came for treatment 6 months after a vaginal delivery with complaints of incontinence of gas and liquid stool. At the time of her delivery she sustained a third-degree tear, which was repaired, but the repair subsequently broke down. On examination an obvious defect was seen in the external anal sphincter anteriorly from approximately the 10 o'clock to the 2 o'clock position. There was also complete breakdown of the perineal body with minimal tissue present between the posterior vaginal wall and the anterior wall of the rectum. The patient had excellent pelvic muscle strength and control and could satisfactorily contract the remainder of her anal sphincter on command. She made a series of visits to a physical therapist who specialized in pelvic floor rehabilitation but experienced no significant improvement in her incontinence. Surgical repair of the sphincter defect in conjunction with extensive reconstruction of the perineum was discussed with the patient, and it was emphasized that, if the surgery were successful, she would have to undergo cesarean section with any future deliveries. The patient decided to proceed with surgery, which included end-to-end anal sphincter repair with extensive perineoplasty (Video 7-5).

Postoperative Care and Complications

Short-Term Care and Complications

Following repair of the posterior compartment, the most common complication is constipation. It is crucial that patients take stool softeners and laxatives, if needed, during the period immediately after surgery. Mineral oil is the most effective in maintaining soft bowel movements that are readily evacuated. Obstipation or rectal impaction can directly influence the outcome of any rectocele, anal sphincter, and perineal body repair. Breakdown or separation of the perineal wound can occur simply due to tension and pressure effects or can be confounded by local cellulitis. Broad-spectrum antibiotics are administered in cases of cellulitis to cover for enteric flora. Local wound care with antibiotic ointments or barrier creams can be used when deemed necessary. Vaginal penetration (e.g., sexual intercourse, use of tampons) should be avoided for a minimum of 4 to 6 weeks to allow healing.

Long-Term Complications

Rectocele repair can be associated with prolonged defecatory pain and pain during sexual intercourse. Anal sphincter repair and perineorrhaphy can cause constipation-obstipation or difficulty with rectal evacuation if there is overnarrowing of the anal canal or if bowel movements are too large and firm to pass comfortably. Rarely, rectovaginal fistula can result from posterior compartment or perineal repair. Tissue ischemia, postoperative constipation, and prior radiation therapy are risk factors.

SUMMARY: Posterior vaginal compartment prolapse may be associated with a number of symptoms, including a vaginal and/or perineal bulge, dyspareunia, defecatory dysfunction, and fecal incontinence. Isolated tears of the rectovaginal septum can lead to symptomatic rectocele alone, without injury to the perineal body and anal sphincter. In addition, prior anterior or apical compartment surgery for correction of prolapse can lead to further weakening of the posterior compartment and progression of rectocele. Generally, we advocate discrete repair of the various anatomical defects without the use of implant augmentation in most cases. Correct identification of defects of the rectovaginal fascia, anal sphincter complex, and perineal body is critical to allow proper surgical planning and to improve outcomes related to defecatory function and fecal continence. Patients should be counseled preoperatively regarding appropriate long-term bowel management regimens to avoid chronic constipation and improve outcomes.

Suggested Readings

DeLancey JO, Miller NF, Berger MB. Surgical approaches to postobstetrical perineal body defects (rectovaginal fistula and chronic third- and fourth-degree lacerations). *Clin Obstet Gynecol*. 2010;53:134-144.

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Kohli N, Miklos JR. Dermal graft–augmented rectocele repair. *Int Urogynecol J*. 2003;14:146-149.

Noci JM, Bradley CS, Mahmoud NN, et al. Sexual function in women after rectocele repair with acellular porcine dermis graft vs site-specific rectovaginal fascia repair. *Int Urogynecol J*. 2007;18:1163-1169.

Zutshi M, Hull T, Bast J, et al. Ten-year outcome after anal sphincter repair for fecal incontinence. *Dis Colon Rectum*. 2009;52:1089-1094.

8

Repair of Pelvic Organ Prolapse Using Synthetic Mesh Kits

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Mickey Karram, MD

Videos

8-1 Technique for Using the Anterior Gynecare Prolift Mesh Kit
8-2 Technique for Using the Uphold Mesh Kit
8-3 Technique for Using the Anterior Elevate Mesh Kit

Since the mid-1990s, much discussion has taken place regarding the use of synthetic and biological materials to increase the durability of pelvic organ prolapse repair. There has also been considerable dialogue about whether the use of nonnative materials carries excess risk for patients. This has led to research and development of a variety of synthetic and biological implant kits specifically marketed for repair of pelvic organ prolapse in the hope of providing improved long-term anatomical durability compared with native tissue suture repairs.

Level I literature, such as the 2008 review by Maher et al, supports the use of synthetic mesh for applications like open abdominal and laparoscopic sacral colpopexy. This has led surgeons to begin using synthetic implants in transvaginal procedures in the hope of duplicating the long-term outcomes achieved with sacral colpopexy. Although long-term level I data are still unavailable, transvaginal placement of mesh to repair prolapse has become increasingly popular.

In their 2010 Cochrane review of treatment modalities for pelvic organ prolapse, Maher et al examined mesh augmentation procedures performed via both abdominal and vaginal approaches. The review supported the use of mesh in the anterior compartment based on findings of decreased recurrence of anterior wall prolapse after surgery as determined by objective examination, but it was noted that general reviews addressing specific complications were lacking. In addition, Maher et al found a lack of evidence to support the use of mesh in the posterior compartment to improve repair durability.

In this chapter, we discuss the mesh kits currently approved by the U.S. Food and Drug Administration (FDA) for use in prolapse repair. These include mesh overlay kits containing customizable sheets of mesh that the surgeon fashions

intraoperatively into implants of the appropriate shape and size and places over the prolapsed tissue; trocar-based anterior and posterior synthetic mesh kits; and trocarless, or direct-access, synthetic mesh kits. In general, mesh kits aim to provide apical support as well as anterior and posterior vault support through anchoring to structures such as the coccygeus muscle–sacrospinous ligament (C-SSL) complex, the obturator membrane, and levator and inner thigh muscles. It is critical to thoroughly understand the anatomy and the proper sites for anchoring these mesh implants to ensure a safe and successful anatomical and functional repair. Because of this, we also discuss the appropriate anatomical landmarks, proper placement of anchoring devices or sutures, proper tensioning of the synthetic materials, and potential complications associated with these products.

Editor's note: Permanent synthetic mesh grafts have unique complications, including vaginal extrusion, urinary tract erosion, and infection. These risks must be carefully weighed against the potential benefits. In July 2011, the FDA issued a notification regarding the use of transvaginal synthetic mesh for the repair of POP.*

Finding the Ideal Mesh

Certain properties make synthetic materials desirable for use in the pelvis. Ideally, surgical foreign bodies should be nontoxic and noncarcinogenic, and should have minimal potential for infectious or expulsive rejection. In addition, mesh should be strong but macroporous to allow fibroblast integration, as well as be pliable to allow the natural flexibility of the vaginal walls to be maintained. It should be inexpensive and easy to obtain, and made of material that is not greatly altered by the native tissues before a durable and well-incorporated repair is achieved.

Both absorbable and nonabsorbable synthetic mesh implants are currently available on the market, although as of 2012 macroporous polypropylene derivatives (nonabsorbable) dominated the industry. In general, it is not acceptable for intrafiber pores to be smaller than 50 μm because of risk of infection and difficulty with collagen integration. Microporous meshes tend to become encapsulated rather than integrated into the surrounding native tissues, which leads to higher rates of infection-associated morbidity.

Although the suitability of synthetic mesh for sacral colpopexy has been well established in the literature, studies report variable rates of erosion at the apex, most often noted as being in the range of 3% to 5%. Vaginal mesh procedures are associated with a considerably higher rate of vaginal extrusion, in the range of 8% to 20%, and higher rates of dyspareunia are also reported in patients undergoing transvaginal mesh placement.

Surgeons must also keep in mind the ideal characteristics of candidates for synthetic mesh placement. Generally, patients who have risk factors associated with poor healing or who have had complications after previous mesh procedures should not be offered augmentation with a mesh kit. Patients with severe genital atrophy, a history of radiation therapy, or baseline chronic pelvic pain may experience more postoperative complications after mesh placement. In addition, patients who desire to maintain sexual function should be informed that mesh augmentation may cause some loss of elasticity, which can lead to dyspareunia in

*See U.S. Food and Drug Administration. *FDA Safety Communication: UPDATE on Serious Complications Associated with Transvaginal Placement of Surgical Mesh for Pelvic Organ Prolapse.* < http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm262435.htm. > Accessed 13.02.12.

either partner. Ensuring that the patient thoroughly understands the benefits and potential risks of synthetic mesh–augmented pelvic organ prolapse procedures is an essential part of the consent process. The potential risks must be weighed against the perceived advantage of better durability with mesh augmentation.

In July 2011, the FDA released the safety alert "Update on Serious Complications Associated with Transvaginal Placement of Surgical Mesh for Pelvic Organ Prolapse" to inform providers and patients that "serious complications associated with synthetic mesh for transvaginal repair of POP [pelvic organ prolapse] are not rare." The FDA had issued its initial public health notification regarding the urogynecological use of surgical mesh in 2008, and after continued surveillance of adverse event postings to the Manufacturer and User Facility Device Experience (MAUDE) database, the 2011 update stated that complications with mesh had been reported in over 2800 cases, in approximately 1500 of which the mesh was placed to repair pelvic organ prolapse. In addition, the FDA cited a review of the literature indicating that 10% of women implanted with mesh during pelvic organ prolapse surgery experienced vaginal erosion within 1 year of surgery and that dyspareunia was increasingly reported. The type of mesh or mesh kit used was not further categorized. In addition, the FDA did not report the total denominator of mesh procedures in determining the rate of serious complications. It is recommended that any surgeon implanting mesh transvaginally read the FDA warning and share it with his or her patient. Specifically, the FDA made the following recommendations:

- Surgeons should undergo rigorous training covering the principles of pelvic anatomy and pelvic surgery as well as instruction on proper patient selection for pelvic organ prolapse reconstructive procedures. Such training must be completed *before* implantation of surgical mesh is attempted for the treatment of prolapse.
- Before using mesh in pelvic floor repair, surgeons should be properly trained in specific mesh implantation techniques.
- Before implantation of mesh, surgeons should be competent in recognizing intraoperative and postoperative complications as well as comfortably and completely managing these adverse events. Such adverse events include those involving the urinary and gastrointestinal tracts.
- Before implantation of surgical mesh for the treatment of pelvic organ prolapse, the surgeon and patient *must* have a proper informed consent discussion regarding the risks, benefits, alternatives, and indications for the use of mesh.

Trocar-Based Mesh Kits

Several FDA-approved trocar-based kits are available for both anterior and posterior approaches to repair of pelvic organ prolapse (Fig. 8-1, Box 8-1, and Table 8-1). All of the available trocar-based devices use the C-SSL complex for apical support. The obturator membrane is used as a distal anchor by the majority of anterior kits, with the superior arms placed in much the same way as a transobturator midurethral sling and the inferior arms passed through an avascular portion of the obturator membrane and through the ischiococcygeus complex overlying the sacrospinous ligament.

Posterior approach devices are designed to correct apical and posterior vaginal wall defects. They also use the C-SSL complex for apical suspension via a posterior and extraperitoneal approach with the trocars introduced pararectally in the gluteal fossae.

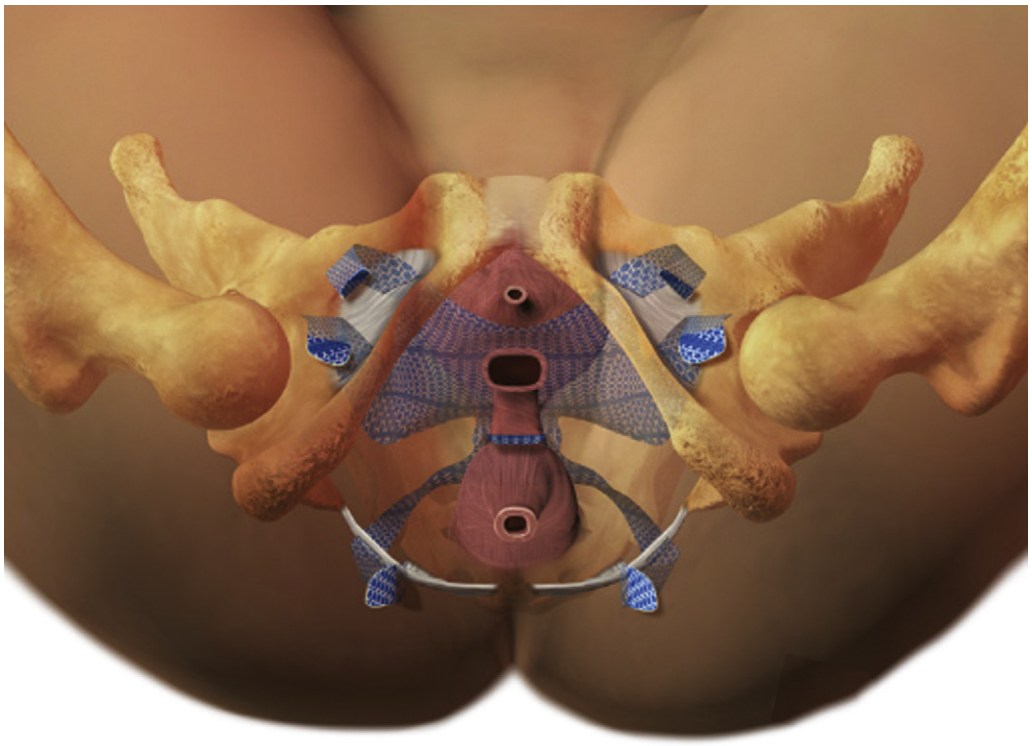

Figure 8-1 Gynecare Prolift total repair system. (Courtesy Ethicon Women's Health and Urology, Somerville, NJ.)

Box 8-1: Elements Necessary for Appropriate Use of Pelvic Mesh Kits

- Full-thickness dissection of the anterior or posterior vault to prevent erosion after surgery
- Tension-free placement and adjustment of all mesh materials to account for up to 25% contraction occurs over time
- Adequate distancing of mesh arms to avoid rolling or bunching of synthetic materials
- Cystoscopy and rectal examination before closure to ensure that no mesh or arms are in the urethra, bladder, or rectum
- Minimal or no trimming of the vaginal epithelium to allow for contraction of the mesh without potential shortening or narrowing of the vagina

The design of these devices is such that a sheet of mesh will cover the anterior and posterior vaginal wall in a tension-free fashion with minimal bunching or excess. Theoretically, this sheet of support, along with apical suspension of the vaginal cuff or cervix to the C-SSL complex, achieves restoration of the vaginal axis and provides additional durability to protect against anterior and posterior vaginal wall prolapse.

Surgical Technique for Anterior Trocar-Based Mesh Kits

All patients should receive antibiotics perioperatively, have a Foley catheter inserted, and be placed in the dorsal lithotomy position. Thromboembolic precautions should also be taken during and after anesthesia. We recommend that the vaginal epithelium be well estrogenized before these procedures when possible and routinely prescribe the use of vaginal estrogen cream before and after surgery to optimize tissue condition. Procedures for using several of the available mesh kits are described; however, we stress again that surgeons should be appropriately trained in the specific procedure they are performing in keeping with the FDA recommendations cited previously.

Table 8-1. Comparison of trocar-based mesh systems

Device	Manufacturer	Material	Posterior Approach Landmarks	Delivery System
Apogee Vaginal Vault Prolapse Repair System	American Medical Systems	Polypropylene + biological coating	Transgluteal to 1-2 cm distal to ischial spine	Transgluteal trocar
Perigee Transobturator Anterior Prolapse Repair System	American Medical Systems	Polypropylene + biological coating	ATFP and 1-2 cm medial to ischial spine in C-SSL, arms through two points in obturator membrane	Helix for transobturator placement
Avaulta Plus Biosynthetic Support System—Posterior	Bard Medical Division	Polypropylene + biological coating	C-SSL, ischiorectal fossae, obturator membrane	Transobturator helix and transgluteal curved trocar
Avaulta Plus Biosynthetic Support System—Anterior	Bard Medical Division	Polypropylene + biological coating	ATFP and 1-2 cm medial to ischial spine in C-SSL, arms through obturator and gluteal fossae	Transobturator helix and transgluteal curved trocar
Gynecare Prolift Anterior Pelvic Floor Repair System	Ethicon Women's Health and Urology	Polypropylene (+ poliglecaprone)	ATFP and obturator membrane	Transobturator trocars
Gynecare Prolift Posterior Pelvic Floor Repair System	Ethicon Women's Health and Urology	Polypropylene (+ poliglecaprone)	C-SSL, ischiorectal fossae, ATFP	Transgluteal trocar

ATFP, Arcus tendineus fasciae pelvis; *C-SSL,* coccygeus muscle–sacrospinous ligament (complex).

Anterior Gynecare Prolift System

1. For repair using the Gynecare Prolift Anterior Pelvic Floor Repair System (Ethicon Women's Health and Urology, Somerville, NJ), the procedure begins with hydrodissection of the anterior vaginal wall using anesthetic and epinephrine to a level of 1 to 2 cm above the cuff or cervix.
2. A vertical incision is made full thickness through the epithelium and underlying vesicovaginal fascia and into the true vesicovaginal space. Use of this dissection plane allows the mesh to be placed with a thicker layer of tissue (generally 5 to 7 mm) between the mesh and vaginal vault. The desired plane is often described as a glossy, gray, gelatinous-appearing area that may have some perivesical adipose tissue within it. Anatomically, proper hydrodissection and careful identification of the vesicovaginal plane are essential for repair.
3. Dissection with Metzenbaum scissors to the superior pubic rami can be accomplished by keeping the scissors parallel to the vaginal epithelium and pointing toward the ipsilateral shoulder.
4. Once this level of lateral dissection is obtained, blunt dissection of the paravaginal space until all areolar connective tissue is freed allows excellent palpation of the ischial spines and palpation medially to the C-SSL complex.
5. The Prolift kit uses two anchoring arms that pass through two sites in the inferior portion of the obturator foramen to avoid the neurovascular supply in the superior portion of the membrane. Before the trocars are passed, the proposed entry sites are marked and infiltrated with the surgeon's choice of local anesthetic. The superior incision in the groin

is identical to that used in transobturator sling procedures and can be marked in the superior medial notch just below the adductor longus tendon in the midclitoral line.

6. The inferior incision is made 1 cm lateral and 2 cm inferior to the superior incision to allow passage of a second trocar through the inferolateral portion of the membrane. The inferior trocar with cannula is placed in a trajectory that penetrates the obturator membrane toward the ischial spine.
7. Once the spine is reached, the trocar handle is elevated and advanced into the iliococcygeal fascia and then into the dissected paravaginal space. The cannula is then left in place as the trocar is removed.
8. The superior trocar is passed in an out-to-in fashion following the curve of the pelvis after initial penetration of the obturator membrane. The cannula is similarly left in the dissected paravaginal space, and the trocar is removed.
9. Once the cannulae are in place, it is important to confirm that the distance between them is great enough to avoid bunching of a properly sized piece of mesh. Generally, this distance is estimated to be 5 cm or greater.
10. The mesh is appropriately trimmed to the specific size of material needed by measuring the distance from the junction of the bladder neck and the apex, whether it is the cervix or the vaginal cuff. The mesh is tacked in place with 2-0 delayed absorbable suture at the level of the bladder neck and the cuff or cervical stroma.
11. The mesh arms are then fed through the cannulae and appropriately adjusted to achieve good apical suspension that does not cause bunching or excessive tension on the mesh.

Cystoscopy and copious irrigation should always be part of the procedure after mesh placement to ensure that no bladder, ureteral, or urethral injury has occurred and to decrease the risk of infection from vaginal flora.

Other Systems

The Perigee Transobturator Anterior Prolapse Repair System system (Fig. 8-2) from American Medical Systems (Minnetonka, MN) requires dissection in the same planes as described previously. A suture plication of the cystocele may be completed before placement of the fixating mesh arms. Proper needle entry point for the superior trocar is in midclitoral line at the lateral edge of the ischiopubic ramus (the same as the incision for transobturator sling placement). The inferior trocar should enter 2 cm lateral to and 3 cm below that point. The superior needle is angled at 45 degrees from the midline and curved into the place of dissection, with care taken to ensure that there are no buttonholes. The arms are tensioned so that the body of the mesh extends to the lateral edge of the cystocele. The inferior needle is inserted medially with the tip pointed at the ischial spine and exits approximately 2 cm from the ischial spine. Redundant mesh is trimmed, and edges are fixated with suture proximally and distally.

The Avaulta support system (Bard Medical Division, Covington, GA) is similar to the Prolift system except for slight differences in trocar size and shape. The Avaulta system is available in several different materials, including mesh with biological coatings, collagen matrices, and purely biological materials.

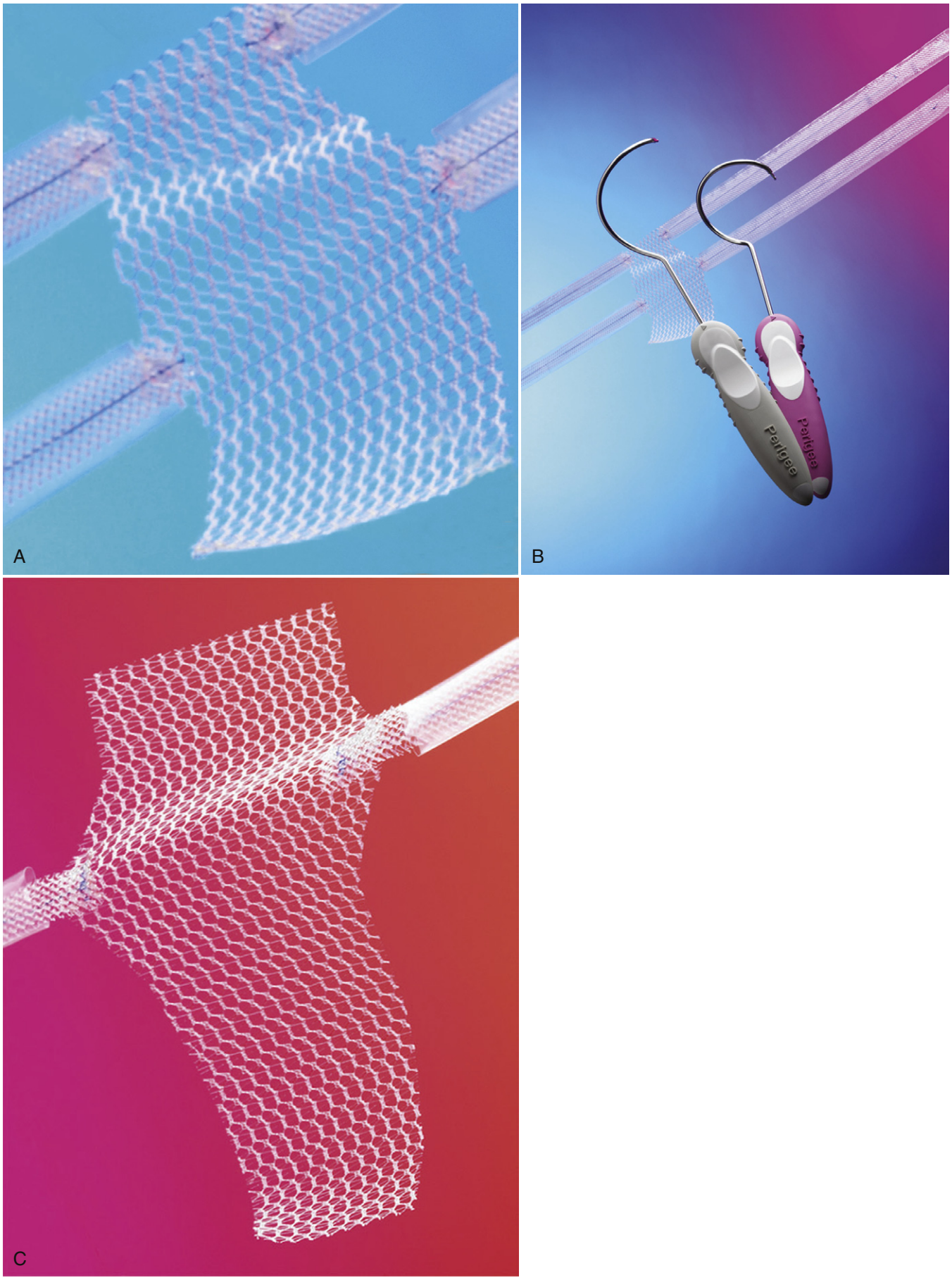

Figure 8-2 **A,** Mesh implant for the Perigee system. **B,** Custom superior and inferior needles used to place the arms of the Perigee mesh implant. **C,** Mesh implant for the Apogee system. (Courtesy American Medical Systems, Minnetonka, MN.)

Case #1

View Video 8-1

A 49-year-old para 4 woman had complaints of recurrent posthysterectomy prolapse. She had undergone a total vaginal hysterectomy and anterior repair about 10 years earlier and had noticed a recurrent sensation of pressure and a visible bulge for the previous 9 months. She complained of some urinary frequency and irritation as well as the need to splint with bowel movements. Given her occupation as a horse breeder, which required frequently lifting bags of feed, the patient was concerned about the recurrence and desired surgical correction.

On examination, the patient exhibited a Pelvic Organ Prolapse Quantification (POP-Q) stage III recurrent cystocele with points Aa and Ba at +2, a POP-Q stage I rectocele with points Ap and Bp at −2, and a POP-Q stage II vault prolapse with point C at −1 with respect to the hymen. The patient underwent urodynamic evaluation and was noted to have occult stress urinary incontinence and a normal bladder capacity.

After appropriate counseling regarding the risks and benefits of prolapse repair with mesh augmentation and a full discussion of surgical options, including native tissue repair, sacral colpopexy, and mesh kit repair, the patient opted for an anterior mesh kit repair and placement of a retropubic midurethral sling. Her rectocele was plicated with a native tissue suture repair. The surgery was performed without major complication with a total blood loss of less than 200 mL and no identifiable injury to the bladder, urethra, or ureters on cystoscopy.

Postoperatively, the patient did well. She did experience some dyspareunia in the first few months after surgery, but this resolved with the use of vaginal estrogen cream. (See Video 8-1 for a demonstration of the anterior Prolift procedure.)

Surgical Technique for Posterior Trocar-Based Mesh Kits

All patients undergoing gynecological procedures should receive antibiotics perioperatively. A Foley catheter should be inserted, and the patient should be placed in the dorsal lithotomy position with the knees at approximately 90 degrees. Thromboembolic precautions should also be taken during and after anesthesia. Many surgeons routinely prescribe vaginal estrogen cream before and after surgery to optimize the condition of the vaginal tissue.

Posterior Gynecare Prolift System

1. For repair using the Gynecare Prolift Posterior Pelvic Floor Repair System (Ethicon Women's Health and Urology), the posterior vaginal epithelium is grasped with Allis clamps at each end of the proposed colporrhaphy. Hydrodissection is accomplished with local anesthetic and epinephrine injected along this entire region.
2. A scalpel is used to enter the posterior vaginal epithelium and Allis clamps are placed along the periphery of the incision. Full-thickness dissection is performed to the level of the inferior rami bilaterally, which is similar to the dissection in a traditional posterior colporrhaphy but in a deeper plane. The dissection is ideally extended to the posterior cervix or cuff to allow full dissection of the rectovaginal space.
3. The pararectal space is then entered sharply using Mayo or Metzenbaum scissors and is developed to allow palpation of the ischial spine laterally and the C-SSL complex medially.
4. Gluteal stab wounds are made with a #15-blade scalpel at the level of 3 cm lateral and 3 cm posterior to the anal verge bilaterally.
5. For the posterior Prolift system, the trocar and cannula are guided through the gluteal incision at approximately a 15-degree angle away from the midline

to avoid the rectum. The trocar follows the curve superiorly to the level of the C-SSL and is gently pushed through the complex. Remaining 1 to 2 cm from the ischial spine provides a safe distance to avoid the neurovasculature of the pudendal structures as they pass through the Alcock canal.

6. After the trocar is removed, the retrieval suture is delivered through the cannula to pull the mesh arm through the dissected path, as with the anterior Prolift device.

Other Systems

In the Avaulta system, the needle is designed to penetrate the iliococcygeus musculature just inferior to the sacrospinous ligament before deploying a snare that locks the mesh arm in place. However, a major difference in the Apogee Vaginal Vault Prolapse Repair System is the presence of two additional arms, which are placed through the same gluteal incisions at an angle so as to exit the rectovaginal dissection just proximal to the bulbocavernosus and transverse perineal musculature. It is essential to avoid the neurovasculature in this region, such as the inferior rectal artery and vein, as well as the rectum. A rectal examination is essential at every juncture in these procedures to rule out injury.

The Apogee Vaginal Vault Prolapse Repair System system by American Medical Systems (see Fig. 8-2) requires the same posterior dissection for mesh placement, with the proposed trocar entry points at 3 cm below and 3 cm lateral to the anal verge. The mesh arms are sewn to the body of the mesh after the trocars are placed and appropriate tension-free positioning is obtained. A posterior suture plication may also be done concomitantly.

After passage of all trocars, it is essential to tack the mesh into place distally and proximally to allow the material to lie flat across the rectovaginal dissection plane. Delayed absorbable sutures are placed in the posterior cervical stroma or partial thickness of the cuff and also at the level of the most distal portion of the dissection. The mesh is appropriately tensioned and trimmed before closure.

Case #2

A 65-year-old para 3 woman complained of a recurrent bulge, urinary frequency, and a sensation of incomplete bladder emptying. Upon further questioning, she also reported a sensation of incomplete emptying of her bowels and noted that she sometimes had to splint to fully evacuate. One year earlier she had undergone vaginal hysterectomy for prolapse and menorrhagia as well as McCall culdoplasty and native tissue anterior repair.

On physical examination, the patient was noted to have recurrent prolapse with POP-Q point Aa at +2, point Ba at +3, point C at 0, and points Ap and Bp at +1. On urodynamic testing, the patient did not exhibit stress urinary incontinence with or without prolapse reduction. It was noted, however, that the vaginal tissue was very atrophic, and the patient was treated with vaginal estrogen cream for 6 weeks before the surgery date.

The patient was currently not sexually active but desired to maintain a functional vagina. After all surgical options were discussed with her in detail, she decided to undergo repair with a trocar-based total (anterior and posterior) vaginal mesh kit (Fig. 8-3). A rectal examination was performed during placement of the posterior mesh arms to ensure that the trocars had caused no rectal perforation. A minimal amount of vaginal trimming was performed to allow for mesh and tissue retraction and shrinkage postoperatively.

After surgery the patient did well overall. She did not initially pass a voiding test on postoperative day 1 but was able to self-catheterize for several days until her postvoid residuals were below 100 mL.

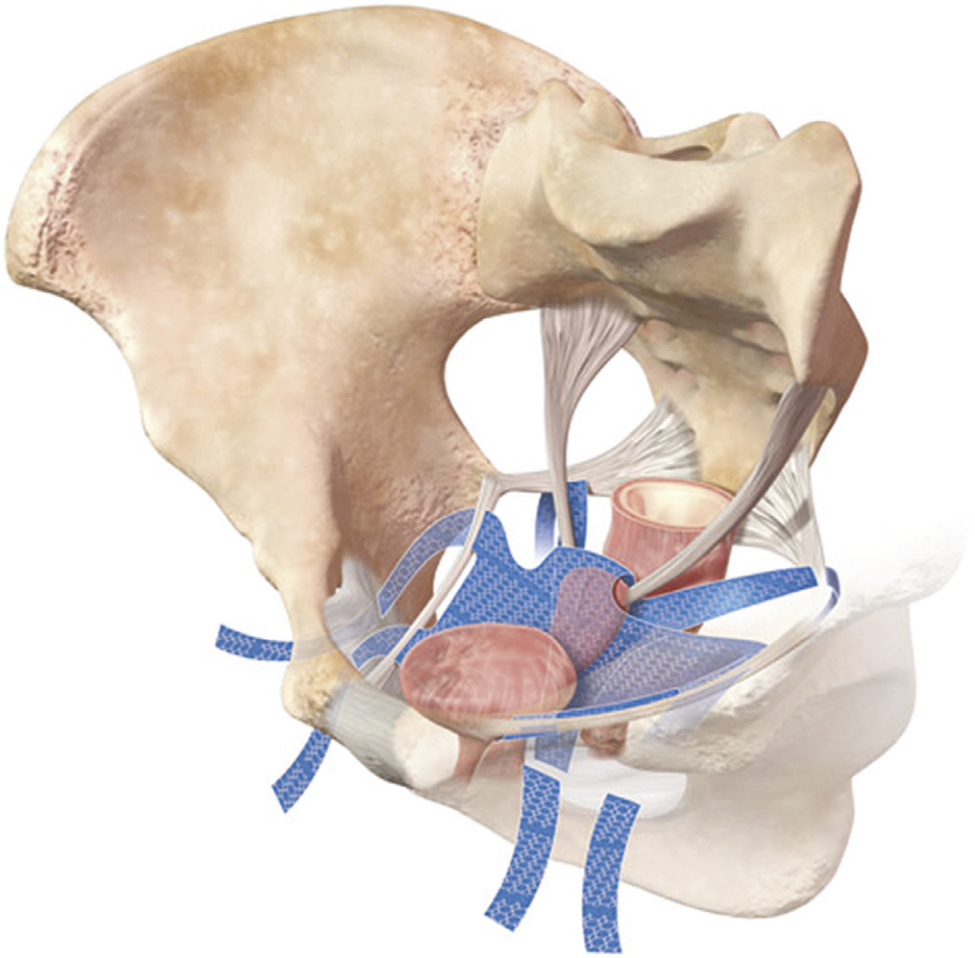

Figure 8-3 Placement of the Gynecare Prolift total repair system as it relates to the bony pelvis. (Courtesy Ethicon Women's Health and Urology, Somerville, NJ.)

Trocarless or Direct-Access Mesh Kits

Because of growing concerns about trocar-related complications with the use of mesh kits, as well as a desire to further simplify and standardize pelvic mesh procedures, four direct-access mesh kits were developed (Fig. 8-4 and Table 8-2). These systems do not require the passage of trocars through the obturator membrane or the ischiorectal fossae. The Uphold Vaginal Support System and Pinnacle Pelvic Floor Repair Kit family (Boston Scientific, Natick, MA), the Elevate Prolapse Repair System (American Medical Systems), and the Gynecare Prosima Pelvic Floor Repair Systems (Ethicon Women's Health and Urology) use smaller pieces of mesh that have fixation points at the C-SSL complex and the vaginal vault but do not incorporate mesh arms or trocars for placement in the anterior and posterior compartments. All of these kits aim to increase level I support of the apex and level II support of either a cystocele or rectocele repair.

In the case of the Uphold system, a Capio needle device (Boston Scientific) is anchored into the sacrospinous ligaments bilaterally. The potential benefit of this device is the ease of making multiple attempts at obtaining adequate purchase on the C-SSL complex. The mesh arms are anchored at the level of the C-SSL, and the excess suture is trimmed after appropriate tensioning. The mesh is then tacked down to the bladder neck and the cervical stroma or vagina cuff with several delayed absorbable sutures. The Uphold system does not require any obturator or arcus tendineus fasciae pelvis (ATFP) attachments to lie flat and provide apical suspension.

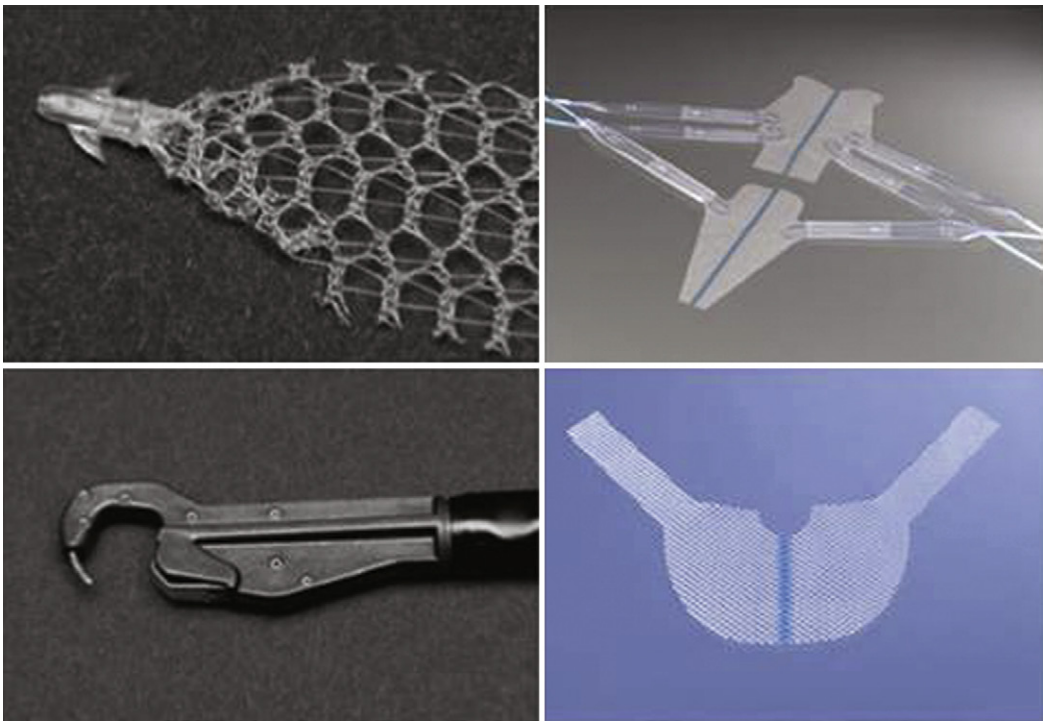

Figure 8-4 Trocarless Mesh Delivery Systems. Upper left, Elevate tined delivery system by American Medical Systems. **Lower left,** Capio needle driver for Boston Scientific products. **Upper right,** Pinnacle mesh system by Boston Scientific. **Lower right,** Uphold anterior mesh system by Boston Scientific.

Table 8-2. Trocarless or direct-access FDA-approved devices

Device	Manufacturer	Material	Placement	Delivery System
Elevate Prolapse Repair System	American Medical Systems	Polypropylene	C-SSL, obturator internus muscle/ATFP	Trocarless with self-fixating polypropylene barbs
Pinnacle Pelvic Floor Repair Kit	Boston Scientific	Polypropylene	C-SSL, ATFP	Trocarless using Capio device for SSL sutures, additional side arms anchor to ATFP
Uphold Vaginal Support System	Boston Scientific	Polypropylene	C-SSL	Capio device for C-SSL sutures

ATFP, Arcus tendineus fasciae pelvis; *C-SSL,* coccygeus muscle–sacrospinous ligament (complex); *FDA,* Food and Drug Administration.

The Pinnacle Anterior-Apical Pelvic Floor Repair Kit, on the other hand, uses the Capio needle driver for C-SSL placement but has two additional distal arms that are anchored to the ATFP. The posterior Pinnacle system, designed for a posterior approach, uses the Capio needle driver for C-SSL suture placement, and the distal mesh is sutured to the arcus tendineus.

The Elevate Anterior and Apical Prolapse Repair System requires dissection to the C-SSL complex using an anterior approach. Anchoring to the ligament complex is accomplished with a self-fixating anchoring needle and fixating arms, which are introduced through a 2.4-mm needle 1 to 2 cm medial to the ischial spine. There are two additional self-fixating arms laterally, which are placed along the ATFP. Stay sutures are placed proximally at the cervical stroma or cuff and distally at the bladder neck to avoid folding or bunching of the mesh. The arms are then locked into place onto the mesh body using a set of locking polypropylene eyelets and an eyelet applicator to push the anchoring arms in the C-SSL complex through the mesh body. The Elevate Apical and Posterior Prolapse Repair System similarly anchors to the C-SSL complex from a posterior dissection approach and uses the self-fixating lateral tips to secure the mesh at the arcus tendineus.

The Gynecare Prosima system, on the other hand, does not use anchors to fasten the mesh to the C-SSL complex. Anteriorly, dissection pockets are created

bilaterally over the obturator internus fascia and the mesh is pushed into place with the anterior applicator. Plication of the underlying cystocele is not necessary. Posteriorly, channels are created with sharp and blunt dissection pararectally to the level of the C-SSL complex and the mesh is pushed into position with a posterior introducer. An adjustable balloon is then inflated to the appropriate vaginal caliber and is left in place for 3 to 4 weeks after surgery.

Given the relatively recent introduction of these devices, there are no long-term data regarding durability, efficacy, and overall complications. Initial reports in the literature providing 1-year data appear promising. In 2011 a 20-patient case series was reported by Alcalay et al, using a mesh kit similar to those described earlier that does not have FDA approval. At 1 year the anatomical success rate (defined as prolapse of less than POP-Q stage II) was 85%, and scores on a quality-of-life questionnaire showed improvement. One mesh exposure occurred and was treated conservatively.

In a short-term prospective study by Zyczynski et al reported in 2010, 136 women underwent prolapse repair surgery using the Prosima kit. In 86% of patients, support was maintained above the hymenal ring, and in 76.9% prolapse was evaluated as less than POP-Q stage II. The authors reported improvement in all subjective measures, including sexual function. There was an 8% erosion rate. Unfortunately, these data may not be applicable to other kits, since the Prosima anchoring system varies from other products and healing is assisted by placement of an inflatable vaginal device that must remain in place for 3 to 4 weeks.

Surgical Technique for Trocarless Mesh Kits

Procedures using trocarless kits begin similarly to those using trocar-based systems. Patients should receive antibiotics perioperatively, and a Foley catheter should be inserted. Proper placement of the patient in dorsal lithotomy position with the knees at approximately 90 degrees should be ensured to prevent nerve injury and provide good surgical field visualization. Thromboembolic precautions should also be taken during and after anesthesia. Vaginal estrogen cream is used preoperatively when appropriate after any comorbid conditions in the patient's history are considered.

Elevate System

1. When the Elevate system is used, the procedure begins with hydrodissection of the anterior vaginal wall using anesthetic and epinephrine to a level 1 to 2 cm above the cuff or cervix.
2. The incision is made full thickness through the epithelium and underlying vesicovaginal fascia and into the vesicovaginal space as previously described.
3. When the proper plane has been established, dissection to the superior pubic rami can be accomplished with Metzenbaum scissors, with the scissors kept parallel to the vaginal epithelium and pointed toward the ipsilateral shoulder.
4. Once this level of lateral dissection is obtained, blunt dissection of the paravaginal space until all areolar connective tissue is freed allows excellent tactile palpation of the ischial spines and C-SSL complex.
5. A needle applicator with sheath is used to place self-fixating mesh arms 1 to 2 cm medial to the ischial spine in the C-SSL complex. The operator's finger is used to depress the introducer over the proposed location for fixation, and a toggle on the handle of the introducer is pressed while the operator advances the tip of the device.
6. Lateral self-fixating tips are depressed into the ATFP bilaterally with a separate introducer to ensure lateral spread of the mesh.

7. The C-SSL–anchored mesh arms are directed through prefabricated holes in the proximal mesh, and the mesh is secured using polypropylene locking eyelets, which are pushed onto the arm with a device called a *locking eyelet introducer.*
8. Once the mesh is positioned with appropriate apical support, the excess mesh arm is cut above the locking eyelet.

Uphold and Pinnacle Systems

1. In our practice, when the Uphold or Pinnacle system is used, a horizontal initial incision is made across the anterior vaginal wall 1 to 2 cm proximal to the bladder neck (whose location is judged by gently tugging on the Foley catheter).
2. After the remaining dissection is completed as described earlier, the Capio needle driver device is passed through the dissected paravaginal space to a level of 1 to 2 cm medial to the ischial spine along the C-SSL complex. Placing a finger on top of the Capio device provides pressure adequate to obtain good purchase on the ligament complex.
3. The suture is then brought out through the incision and held with a hemostat until it is time to suspend the apex.
4. An anterior colporrhaphy is completed with 2-0 polydioxanone suture before the mesh is positioned.
5. Stay sutures are placed at the most distal and proximal portions of the mesh and attached to the bladder neck and cervical stroma or vaginal cuff with delayed absorbable suture.
6. The C-SSL fixation sutures are then pulled to suspend the vaginal apex to an acceptable length, and the excess suture is trimmed before closure. A minimal amount of vaginal epithelium should be trimmed.

Anterior Gynecare Prosima System

1. When the Gynecare Prosima Anterior Pelvic Floor Repair System is used, hydrodissection of the anterior vaginal epithelium is accomplished as described previously.
2. The anterior vaginal epithelium is dissected off the bladder at full thickness.
3. Laterally, the dissection is continued toward the pelvic sidewall and to the ischial spine.
4. Channels are created to place the mesh implant so that the distal sections of the straps lie flush against the pelvic sidewall and parietal fascia of the obturator internus muscle.
5. To place these straps, dissection is begun by palpating and identifying the ischial spine on both sides. Once contact is made with the ischial spine, the index finger is swept to create a space anterior and superior to the ischial spine. *Note:* Unlike with the other kits described, with the anterior Prosima kit the anterior dissection does not involve dissection onto the sacrospinous ligaments.
6. Plication of the prevesical tissue is not required. If plication is performed, however, only the central portion of the tissue is plicated. This avoids too great a narrowing of the dissected area. The mesh is placed over the prevesical tissue with the strap pockets facing upward. The mesh may be tacked with suture to the apex and bladder neck at this time.
7. With the anterior inserter provided, the mesh implant straps are placed into both spaces created by the dissection, with the straps loaded into the previously created tissue channels until the handle of the inserter comes in contact with the labia majora on the contralateral side.
8. All incisions are closed.

Case #3

View Video 8-2

A 62-year-old woman had primary complaints of stress urinary incontinence and symptomatic anterior and apical uterovaginal prolapse. She was insistent on uterine preservation. She had a body mass index of 45. She desired sexual activity following any intervention. On physical examination, the patient was found to have a POP-Q stage II uterovaginal prolapse, with the anterior vaginal wall forming the leading edge of the prolapse. Point C was at −1 and point Aa was at 0. The patient easily demonstrated stress incontinence on simple office cystometry and had a maximum bladder capacity of 350 mL. After discussion of all uterine-preserving options, including abdominal sacral colpohysteropexy, as well as a detailed discussion regarding the risks and benefits of mesh augmentation versus native tissue repair, the patient decided to proceed with a repair using a direct-access vaginal apical and anterior suspension system. The surgery was uncomplicated, and a retropubic midurethral sling was also placed at the time of the repair. A posterior repair and perineorrhaphy were performed as well. (See Video 8-2 for a demonstration of repair using the Uphold system.)

Postoperatively, the patient reported some symptoms of irritation on voiding, which resolved by 6 weeks after surgery. She had no other complications during short-term follow-up. At 1 year after surgery, she had no residual stress urinary incontinence and reported no discomfort with intercourse. Her uterus was well supported, with a POP-Q stage I anterior prolapse.

Case #4

View Video 8-3

A 72-year-old woman with advanced, longstanding pelvic organ prolapse developed urinary retention and renal failure. At presentation she had bilateral double-J ureteral stents and a Foley catheter in place. On examination she was found to have complete uterine procidentia with POP-Q point C at +15 and complete aversion of the anterior and posterior vaginal wall. Her body mass index was 48. To obtain a durable repair it was felt that mesh augmentation would be needed. So that the procedure could be performed in the least invasive way possible, the patient was scheduled for vaginal hysterectomy with prolapse repair using an anterior Elevate kit and a sacrospinous ligament vaginal vault suspension. (See Video 8-3 for demonstration of prolapse repair using the anterior Elevate kit.) The surgery was completed without complication. Over time the patient began to void spontaneously, she was able to have the ureteral stents removed, and her renal function normalized.

Outcomes

Although the use of mesh implant kits for the transvaginal repair of pelvic organ prolapse remains controversial, promising short-term results have been reported. In 2009 Elmér et al published findings of a prospective multicenter trial in which subjective and objective measures were used to evaluate the success of transvaginal mesh repair of prolapse. Anatomical cure (defined as prolapse of less than POP-Q stage II) was achieved in 79% of women undergoing anterior-apical repair and in 82% of those undergoing posterior-apical repair. Mesh erosions of all severities were seen in 11% of patients, with 2.8% requiring surgical intervention. Altman et al, in a separate analysis carried out by the same research group, found that overall sexual function scores were decreased after trocar-guided transvaginal mesh surgery.

In 2011 Withagen et al published the results of a randomized controlled trial comparing trocar-guided mesh repair (Prolift system) with native tissue repair in 190 patients undergoing surgery for recurrent prolapse. At 1 year, subjective improvement was noted in more than 80% of patients in both groups, whereas

anatomical success (defined as prolapse of less than POP-Q stage II) was seen in 93% of patients in the mesh repair group and 56% of those in the native repair group. The rate of mesh erosion was 16.9%.

Altman et al also conducted a randomized controlled trial that compared prolapse repair using the Prolift mesh kit with nonmesh anterior colporrhaphy and described their results in the *New England Journal of Medicine* in 2011. Although they did report higher rates of objective success in the short term with mesh augmentation, they also found mesh repair to be associated with higher complication rates, a higher incidence of bladder perforation, increased blood loss, and longer operating time. In addition, a higher rate of de novo stress incontinence was noted in the mesh repair group.

Discussion

Although level I evidence is still needed to establish the role of vaginal mesh implants in pelvic organ prolapse repair, the number of surgeons performing these procedures may continue to grow. Initial evidence indicates that good anatomical outcomes can be achieved with mesh kit repairs; however, there are potential concerns regarding mesh-specific complications and dyspareunia. As the body of literature develops, surgeons should exercise proper caution and provide appropriate counseling when selecting candidates for mesh repair. In addition, all postoperative complications should be evaluated promptly and managed on an individual basis with conservative treatment or surgical revision as appropriate.

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9

Obliterative Procedures for the Correction of Pelvic Organ Prolapse

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Videos

9-1 Le Fort Partial Colpocleisis
9-2 Complete Colpectomy and Colpocleisis
9-3 Complete Colpectomy and Colpocleisis After Failed Previous Colpocleisis

Public health data indicate that the number of patients 60 years of age and older can be expected to double in the next 30 years from 11% to 22%. In addition, the life expectancy of women is longer than that of men. As a result there is a global trend toward aging and feminization of the population. Specific attention needs to be paid to disorders that affect this ever-growing elderly female population. Pelvic organ prolapse is extremely common in older women, and age is one of the most important risk factors for this disorder, which has a substantial negative impact on a woman's quality of life.

When conservative treatment with a pessary has failed, surgical intervention is the only way to address the bothersome symptoms of prolapse. Geriatric patients with pelvic organ prolapse often have multiple comorbid conditions that make them less than ideal candidates for complex, time-consuming reconstructive procedures.

Obliterative procedures may be considered as an alternative in the appropriate setting, because they represent a safe, durable, and effective surgical option for frail elderly woman who do not wish to preserve sexual function and desire a rapid recovery. The term *colpocleisis* comes from the Greek root *kolpos,* which means "hollow," and *cleisis,* which means "closure." The technique has been described both in patients with an intact uterus and in patients who have previously undergone hysterectomy, and is termed a *Le Fort partial colpocleisis* (uterus present) or a *complete colpectomy and colpocleisis* (after hysterectomy).

Preoperative Evaluation

At the preoperative discussion, it is imperative to select a procedure that will achieve the following:

- Effectively treat the patient's condition
- Minimize the patient's perioperative risk
- Allow the patient to attain her treatment goals and expectations

The preoperative evaluation should begin with taking a thorough history and performing a physical examination. Specific questions should be asked about symptoms related to the pelvic floor, including prolapse symptoms, vaginal irritation, voiding problems, defecatory problems, lower urinary tract symptoms, and urinary incontinence. The use of validated symptom questionnaires can be very helpful.

It is also important to take a complete sexual history. The patient should fully understand that the procedure is aimed at closing the vagina and thus vaginal intercourse will no longer be possible. Sexual activity does decrease with increasing age, but nothing should be assumed, because very commonly elderly women remain sexually active into their eighth decade and beyond.

The vagina should be examined with the patient in both the supine and standing positions, if possible. The patient should be asked to strain during the examination so the extent of the prolapse can be determined. The position of the anterior wall, posterior wall, and apex of the vagina should be recorded. Use of a standardized measuring and recording system, such as the Pelvic Organ Prolapse Quantification (POP-Q) system or the Baden-Walker system (see Chapter 1), can be helpful.

An assessment of the patient's continence is also recommended, because stress urinary incontinence commonly affects this population. Stress incontinence on prolapse reduction (also know as occult or latent stress incontinence) may be discovered preoperatively, which allows the patient and the physician to make a more informed decision about preforming a contaminant antiincontinence procedure. One way of assessing continence status is a "cough stress test." The patient performs maneuvers that increase intraabdominal pressure with a relatively full bladder while the examiner observes for leakage of urine. If no incontinence is demonstrated, the prolapse should be reduced and the provocative maneuvers repeated. Another option is urodynamic testing. We find this helpful especially if the stress test result does not correlate with the patient history or if there are mixed incontinence symptoms, urinary retention, or other lower urinary tract complaints.

The preoperative assessment should also include measurement of a postvoid residual, since elderly women with pelvic organ prolapse are at risk for urinary retention. Ureteral obstruction from kinking of the distal ureter has also been described in this population, especially in patients with Pelvic Organ Prolapse Quantification (POP-Q) stage IV prolapse. Renal ultrasonography can be useful to rule out hydronephrosis or at least to provide a baseline so that the degree of hydronephrosis can be followed after surgery. Urinalysis is also recommended as part of the initial evaluation to ensure that the patient does not have a urinary tract infection or hematuria that may require treatment or further evaluation.

Once a Le Fort partial colpocleisis is carried out, the cervix and uterus can no longer be accessed vaginally. Thus, it is mandatory that any premalignant or malignant conditions of the cervix or endometrium be ruled out. The surgeon should document that cervical cytological analysis yields normal findings and that either the endometrial stripe is less than 5 mm by transvaginal

ultrasonography or histological examination of an endometrial biopsy specimen shows no pathological changes.

Based on the patient's age and potential comorbid conditions, medical or geriatric preoperative evaluation should be considered. Cardiology or pulmonary consultation can help in risk assessment and may be valuable in the event that additional expertise are needed postoperatively. Obliterative procedures can be done using general anesthesia, regional anesthesia, or even local anesthesia with intravenous sedation if the patient is very medically fragile.

Surgical Technique for Le Fort Partial Colpocleisis

1. After a Foley catheter is inserted into the bladder, two tenaculum or allis clamps are placed on the cervix to fully evert the vagina. A marking pen is used to outline two rectangles on the anterior and posterior surfaces of the vagina. This leaves a 2- to 3-cm strip of epithelium down each side of the everted vagina. The markings should be extended to approximately 2 cm from the tip of the cervix and approximately 3 to 4 cm below the urethral meatus. This will ultimately permit creation of a channel to allow egress of drainage from the cervix or uterus, should it occur, after the procedure is completed.
2. Lidocaine (0.5%) with 1:100,000 epinephrine is used to infiltrate underneath the epithelium. Hydrodissection helps in finding the correct plane and allows for a relatively bloodless dissection.
3. The anterior vaginal wall rectangle is incised with a scalpel. Sharp dissection is carried out with Metzenbaum or Mayo scissors (Fig. 9-1, *A*). Blunt dissection is also very useful when the correct plane is achieved. The goal is to completely remove the vaginal epithelium leaving the subepithelial fibromuscular tissue intact. Bleeding is controlled with electrocautery to prevent hematoma in the vaginal canal. Some surgeons routinely perform a Kelly plication (also referred to as a Kelly-Kennedy plication) at the bladder neck if an antiincontinence procedure such as a midurethral sling is not being performed (see Fig. 9-1, *B*).
4. A similar dissection is carried out posteriorly, with the posterior vaginal wall excised to about 2 to 3 cm from the introitus. If the peritoneum is inadvertently entered, it should be closed with interrupted sutures.
5. A 14F or 16F red rubber catheter is used to create the drainage tract. This catheter is affixed to the drapes with hemostats at the level of the cervix. A 2-0 polyglycolic acid suture* is used to imbricate the edges of this epithelial tract starting over the cervix and working outward. This creates an epithelium-lined tunnel around the red rubber catheter. Multiple interrupted sutures are used to perform this imbrication (see Fig. 9-1, *C*).
6. After the first layer is closed, interrupted sutures are placed that include the anterior and posterior aspects. Tying down the interrupted sutures gradually pushes the uterus and vaginal apex upward and inward (see Fig. 9-1, *D*).
7. After multiple layers are closed, the vagina will be inverted and the potential space obliterated.
8. If additional posterior support is desired, a levator plication is carried out at this time. This also serves to decrease the size of the genital hiatus. (In some cases this step may be performed before the colpocleisis is completed.)

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

9. At this point, if a procedure to treat stress incontinence is desired, a synthetic midurethral sling (or other antiincontinence procedure) may be placed. Alternatively, as previously mentioned, a Kelly plication can be performed if placement of a midurethral sling is not desired (see Fig. 9-1, *B*).
10. Now, with complete obliteration of the potential space, the anterior and posterior vaginal epithelium edges are reapproximated.
11. The red rubber catheter is removed.
12. Indigo carmine is administered intravenously and cystoscopy is performed to confirm that efflux of blue-tinged urine can be seen from each ureteral orifice.

Surgical Technique for Complete Colpectomy and Colpocleisis

1. Hydrodissection may be used to guide dissection and facilitate hemostasis. Lidocaine (0.5%) with 1:100,000 epinephrine is used to infiltrate underneath the vaginal epithelium.

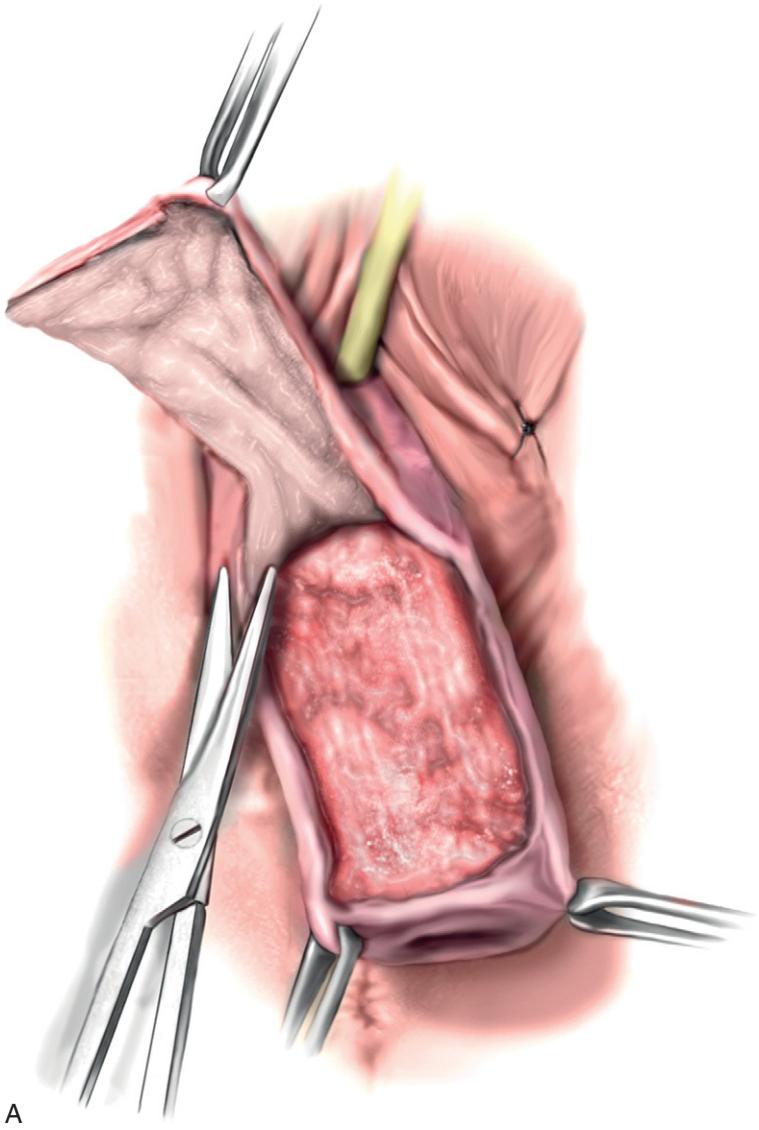
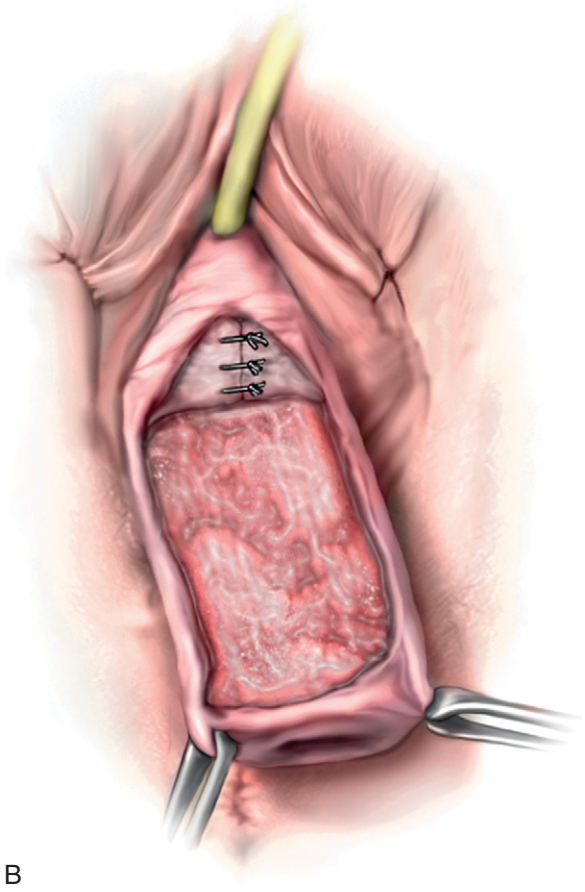


Figure 9-1 Le Fort partial colpocleisis. **A,** A rectangular piece of the epithelium of the anterior vaginal wall is dissected free.

Figure 9-1, cont'd **B,** The rectangle is removed. When no midurethral sling is to be inserted, Kelly plication sutures (shown here) are often placed to help support the bladder neck. **C,** The cut edge of the cervix is sewn to the distal cut edge of the posterior incision over a red rubber catheter using 2-0 polyglycolic acid sutures.



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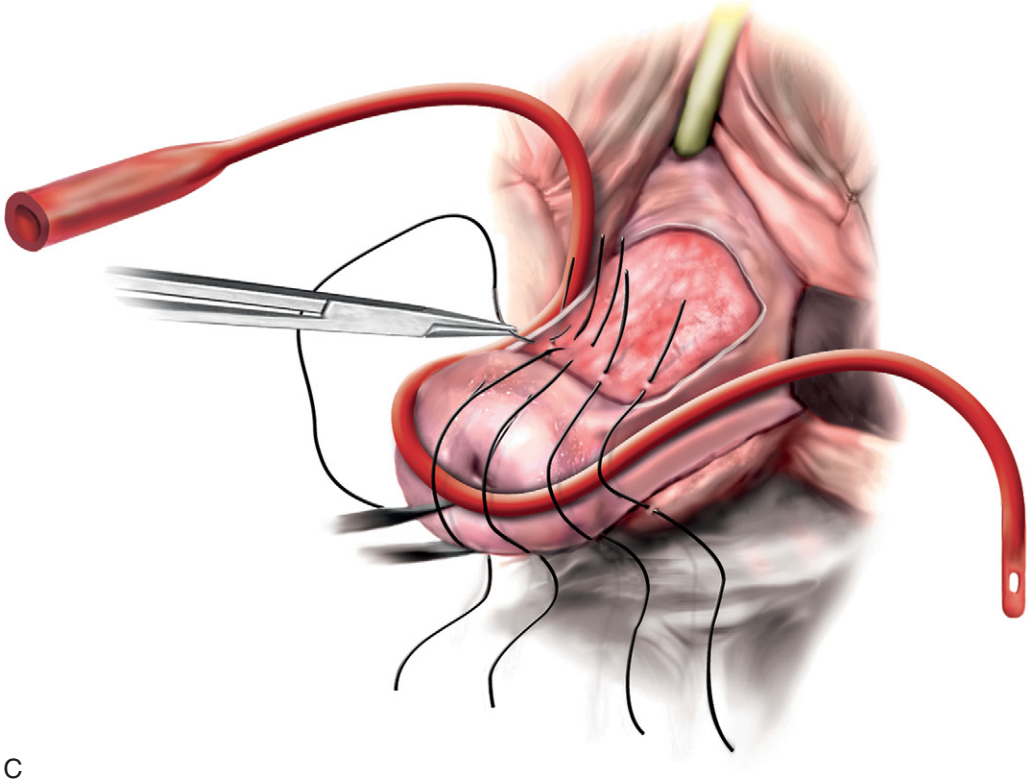

C

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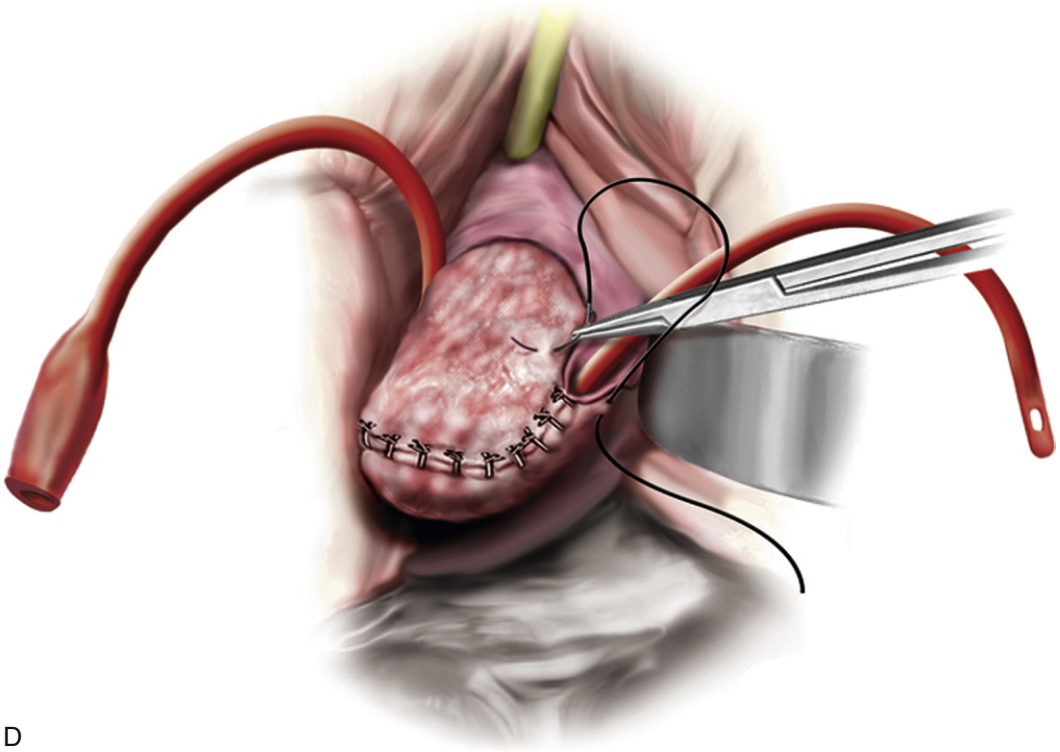


D

Figure 9-1, cont'd D, The suturing creates an epithelialized tunnel around the catheter. The vagina above and below the channel is progressively imbricated to close the vagina. Several rows may be needed to completely invert the vagina. Eventually the catheter is removed after the colpoclesis is completed. (**A** and **B,** From Baggish MS, Karram MM, eds. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

2. Next, the vaginal epithelium is excised. We prefer to perform a four-quadrant, systematic removal of the vaginal epithelium. Each section is incised using a scalpel. The vaginal epithelium is removed using a combination of blunt and sharp dissection. The epithelium is removed to within 2 to 3 cm of the hymeneal ring proximally, which allows anterior and posterior closure of the vagina (Fig. 9-2, *A*).
3. Purse-string sutures are placed using 2-0 polyglycolic acid sutures with the leading edge inverted sequentially down toward the base of the prolapse. As each successive purse-sting suture is tied down, there is complete inversion of the vagina (see Fig. 9-2, *B* and *C*).
4. A posterior repair, which reapproximates the distal levator complex, is carried out as interrupted sutures are placed to strengthen the repair and close the urogenital hiatus.
5. Perineorrhaphy is carried out together with the colpocleisis. The vaginal epithelium is closed with interrupted absorbable sutures.
6. Indigo carmine is administered intravenously and cystoscopy is performed to confirm that efflux of blue-tinged urine can be seen from each ureteral orifice.

Perioperative Management

A single prophylactic dose of a broad-spectrum antibiotic is routinely given. Because of the age, living arrangements, and comorbid conditions of women undergoing obliterative procedures we often admit patients overnight for observation. Most patients are discharged on postoperative day 1. Routine perioperative and postoperative prophylactic measures are also critical in this population. These include perioperative administration of subcutaneous heparin to prevent deep vein thrombosis, use of sequential compression devices, early ambulation, and incentive spirometry. Diets are advanced as tolerated. The bladder is drained overnight,

Case #1

View Video 9-1

An 87-year-old woman with pelvic organ prolapse was bothered by a feeling of pelvic pressure and reported that she limited her daily activity because of the prolapse. She had no history of urinary tract infection or hematuria. She reported no loss of urine with coughing or sneezing or in association with urgency. She did have some constipation but had done well with laxatives recently. She stated that she had not been sexually active for over 25 years since her husband died and did not plan on resuming sexual activity. She had a normal result on a Papanicolaou test 2 months earlier and reported no abnormal uterine bleeding. Pelvic ultrasonography revealed a postmenopausal uterus with an endometrial stripe of 3 mm. The ovaries were noted to be small without any cysts. Pelvic examination revealed an atrophic vagina with POP-Q point Aa at −1, point Ba at −1, point C at +2, point Ap at −1, and point Bp at −1. Urodynamic testing showed a stable detrusor to a maximum capacity of 400 mL. No stress incontinence was demonstrated even with reduction of the prolapse.

Because of the patient's symptoms and her lack of interest in resuming sexual activity, a Le Fort partial colpocleisis was performed (Video 9-1).

Case #2

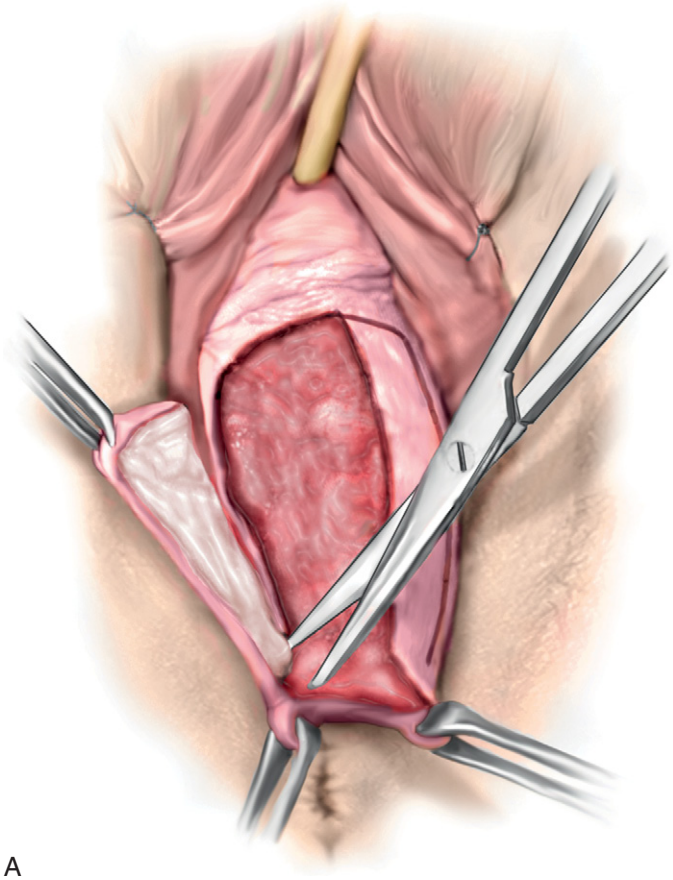
View Video 9-2

An 85-year-old woman (gravida 2, para 2) with an extensive history of chronic obstructive pulmonary disease came for treatment of vaginal vault prolapse. She was bothered by a bulge, pelvic pressure, and vaginal irritation. She described her level of discomfort as "severe." She had undergone hysterectomy for excessive vaginal bleeding in her 30s. She had no history of urinary incontinence and stated that she had no problems emptying her bladder. She had not been sexually active in the previous 15 years and was widowed. She had no plans or wish to resume sexual activity. After an unsuccessful attempt at using a pessary, she desired surgical correction. She was concerned about undergoing a lengthy procedure, given her pulmonary status. She was evaluated by her pulmonologist, who recommended that the procedure be done without general anesthesia if possible. Physical examination findings were consistent with complete eversion of the vagina (POP-Q stage IV). She also demonstrated stress incontinence on urodynamic testing. Because of her age, medical status, and lack of interest in maintaining a functional vagina, consent was obtained for a complete colpectomy and colpocleisis with a concomitant transobturator sling procedure under regional anesthesia. (See Video 9-2 for a demonstration of complete colpectomy and colpocleisis.)

Case #3

View Video 9-3

An 81-year-old woman had recurrent pelvic organ prolapse after undergoing two previous attempts at colpocleisis. She had a hysterectomy many years earlier for gynecological reasons. More recently she was diagnosed with invasive vulvar carcinoma, which required a radical vulvectomy. After the radical vulvectomy she became totally incontinent because of the removal of a portion of her urethra. She opted for a urinary diversion in the form of an ileal conduit because it was felt that not enough urethra remained for sling placement to be attempted. She then developed significant prolapse that became very symptomatic. Because she was not sexually active, colpectomy with colpocleisis was attempted. She experienced an almost immediate recurrence of prolapse after the first attempt, and a second attempt was made. At presentation she had an obvious apical enterocele with small bowel firmly adherent to the prolapsed vagina. The plan was to release the small bowel from the vagina, aggressively close off the enterocele sac, and perform a third colpectomy and colpocleisis (Video 9-3).



A

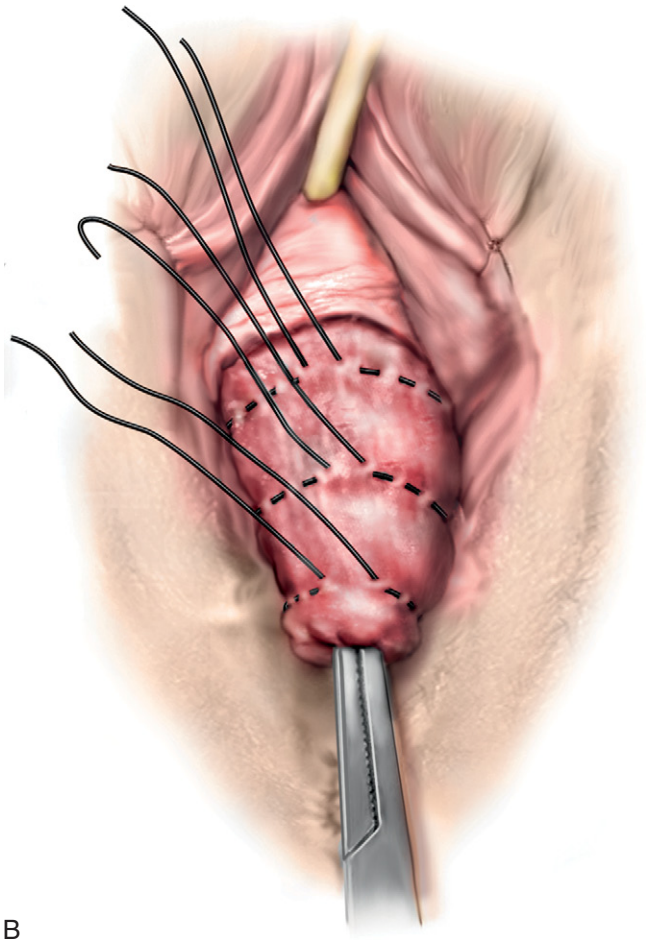
Figure 9-2 Colpectomy and colpocleisis. **A,** The vagina is circumscribed by an incision at the site of the hymen and marked into quadrants. Each quadrant of vaginal epithelium is then removed.

and a voiding trial is performed on the day of discharge. If the patient cannot void spontaneously, a Foley catheter is inserted and left in place for approximately 1 week, and the patient is seen in the office for a second voiding trial.

Outcomes

Most of the surgical outcome data for colpocleisis come from retrospective case series. Studies have looked at patient satisfaction, anatomical success, and symptomatic improvement. The proportion of patients who report being "satisfied" or "very satisfied" with the outcome at least 1 year after surgery is in the 90% to 95% range. Depending on the anatomical definition of repair success, the objective success rate for colpocleisis is between 70% and 100% at 1-year follow-up. Finally, studies that have looked at scores on validated outcome measures such as the Pelvic Floor Distress Inventory and Pelvic Floor Impact Questionnaire note significant improvement in quality of life.

Concomitant hysterectomy and colpocleisis has also been described as a viable repair for pelvic organ prolapse. This approach has not been shown to be superior and may subject patients to increased blood loss and longer operative times. However, a combined procedure does prevent any complications that may be experienced from leaving the uterus and cervix intact. Placement of a synthetic midurethral sling at the time of colpocleisis has also been described and appears to be a safe way of treating stress urinary incontinence without increasing risk of urinary retention.



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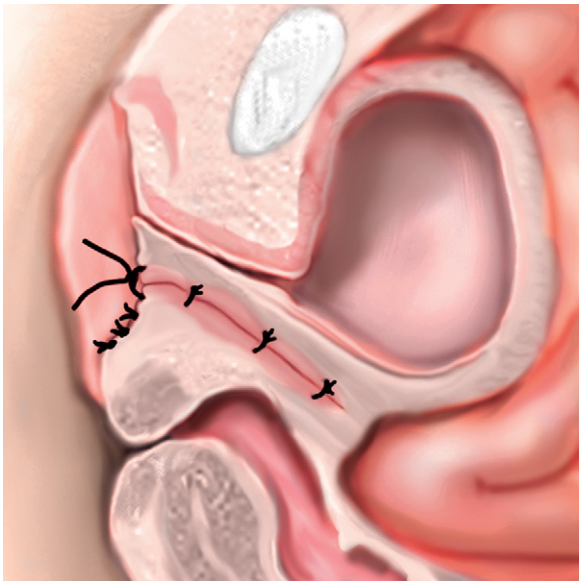


C

Figure 9-2, cont'd B, After removal of the vaginal epithelium, purse-string sutures are placed using delayed absorbable suture (2-0 polyglycolic acid). The lead end of the deepithelialized vagina is inverted with the tip of a clamp in this illustration. **C,** The relationship of the sutures in sagittal section. A perineorrhaphy is commonly performed as well, as indicated by the additional sutures. (From Baggish MS, Karram MM, eds. *Atlas of Pelvic Anatomy and Gynecologic Surgery.* 3rd ed. St Louis: Saunders; 2011.)

About 5% of patients experience postoperative events related to cardiac, thromboembolic, pulmonary, and cerebrovascular complications. Minor complications (e.g., urinary tract infection, vaginal hematoma, cystotomy, fever, thrombophlebitis) have been noted in review articles to occur in approximately 15% of cases. The most commonly reported complication is the need for blood transfusion. New urinary symptoms are another commonly encountered postoperative problem. One published study reported that 11% of women had a

new symptom of mixed incontinence and another noted that 7% of women had worsening of stress urinary incontinence. Certainly a careful preoperative workup and attention to surgical technique may reduce these rates and/or help in managing expectations, but there is no way to prevent voiding complaints entirely.

Suggested Readings

Abbasy S, Kenton K. Obliterative procedures for pelvic organ prolapse. *Clin Obstet Gynecol*. 2010;53:86-98.

FitzGerald MP, Richter HE, Bradley CS, et al. Pelvic support, pelvic symptoms, and patient satisfaction after colpocleisis. *Int Urogynecol J Pelvic Floor Dysfunct*. 2008;19:1603-1609.

FitzGerald MP, Richter HE, Siddique S, et al. Colpocleisis: a review. *Int Urogynecol J Pelvic Floor Dysfunct*. 2006;17:261-271.

Ghezzi F, Uccella S, Cromi A, et al. Surgical treatment for pelvic floor disorders in women 75 years or older: a single-center experience. *Menopause*. 2011;18:314-318.

Karram MM. Vaginal operations for prolapse. In: Baggish MS, Karram MM, eds. *Atlas of Pelvic Anatomy and Gynecologic Surgery*. 2nd ed. Philadelphia: Saunders; 2006:674-684.

Von Pechmann WS, Mutone M, Fyffe J, Hale DS. Total colpocleisis with high levator plication for the treatment of advanced pelvic organ prolapse. *Am J Obstet Gynecol*. 2003;189:121-126.

Urethral Diverticulectomy

10

Victor W. Nitti, MD

Videos

10-1 Urethral Diverticulectomy With Urethral Reconstruction
10-2 Urethral Diverticulectomy With Simultaneous Pubovaginal Sling Placement
10-3 Urethral Diverticulectomy With Takedown of a Midurethral Synthetic Sling

The true incidence of female urethral diverticulum is not known. It has been estimated to occur in 0.6% to 6% of females. Some have argued that urethral diverticulum is underdiagnosed and that with a higher level of clinical suspicion the incidence might be greater; however, this has yet to be proved. Urethral diverticulum may occur as a result of infection of the periurethral glands with obstruction and local abscess formation, or due to trauma from childbirth or instrumentation. A congenital origin has also been proposed; however, the absence of urethral diverticulum in children and adolescents makes this a less likely etiology.

There are a myriad of symptoms that are thought to be caused by a urethral diverticulum. The classic triad of dysuria, dyspareunia, and dribbling is present in fewer than half of diagnosed cases. Other symptoms include frequency, urgency, recurrent urinary tract infections, urethral pain, tender mass, stress or urge incontinence, hematuria, urethral discharge, difficulty voiding, and urinary retention.

In many cases the diagnosis of urethral diverticulum is made (or suspected) on physical examination. The presence of a suburethral mass, often tender, with expression of discharge by urethra when the anterior vaginal wall is massaged is a typical finding. The differential diagnosis includes cystocele, anterior vaginal wall cyst, adenoma, and ectopic ureter. In these cases there is no expression of urethral discharge on palpation. The diagnosis can be confirmed by a number of imaging tests, including voiding cystourethrography (VCUG), ultrasonography, and magnetic resonance imaging (MRI). We prefer to obtain an MRI scan in all cases of known or suspected urethral diverticulum because it precisely defines the anatomy (size, location, shape, and number of diverticula) and aids in surgical dissection and removal (Figs. 10-1 through 10-3). A diverticular ostium is seen on urethroscopy in

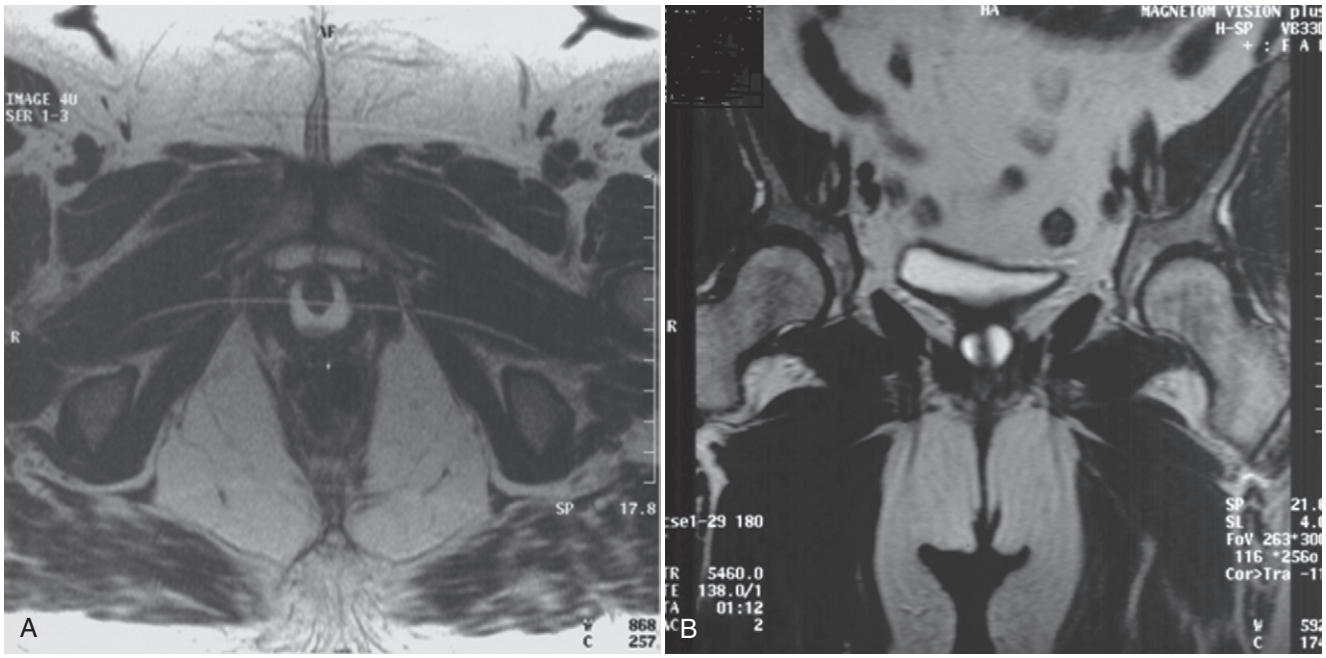


Figure 10-1 Large "saddlebag" urethral diverticulum that extends ventrally and laterally. The dorsal part of the urethra is not surrounded by the diverticulum. **A,** Axial image. **B,** Coronal image.

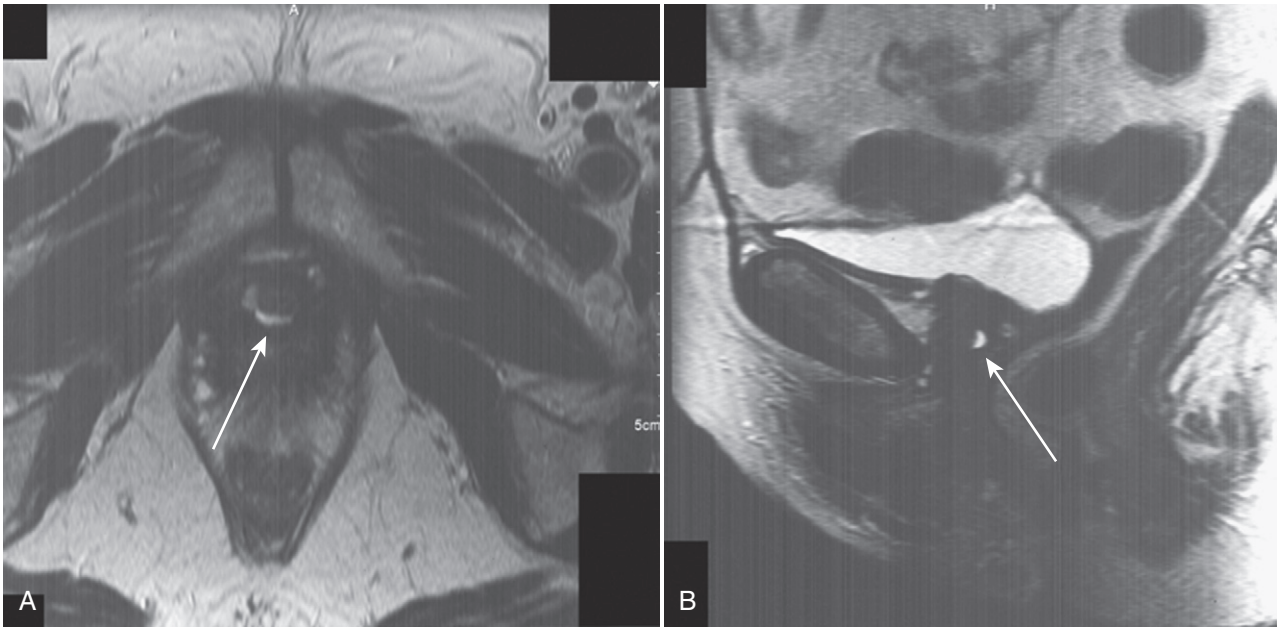


Figure 10-2 Small urethral diverticulum in a highly symptomatic woman with urethral pain and tenderness. Voiding cystourethrography and cystoscopy yielded normal findings. **A,** Axial image. **B,** Sagittal image.

most, but not all, cases. Although urethroscopy can identify the location of the urethral communication, it tells nothing about the size, location, and anatomy of the diverticulum itself. Also, in cases of urethral pain, urethroscopy can be painful and at times even impossible with only local anesthesia. In those cases we reserve urethroscopy for the operating room at the time of surgical excision.

Ancillary testing can be performed in certain circumstances. For example, when stress incontinence is suspected, urodynamic testing can confirm the diagnosis. This could lead the surgeon to decide to perform an antiincontinence procedure at the same time the diverticulum is repaired.

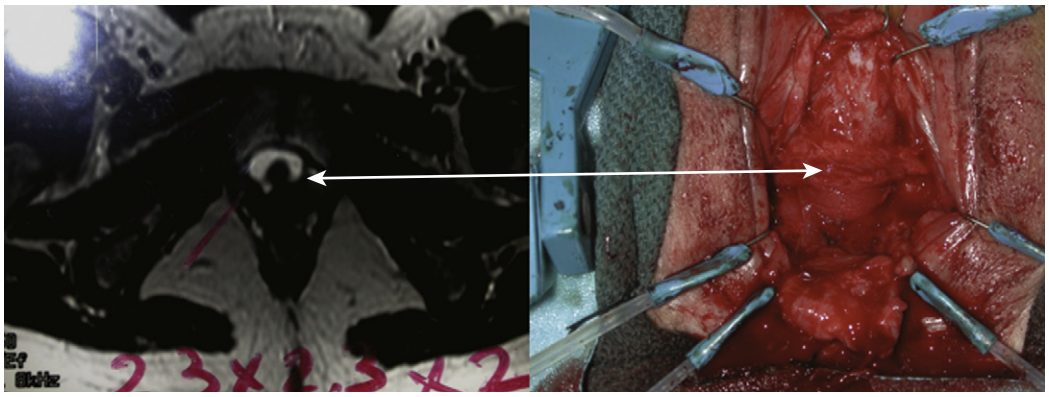


Figure 10-3 Axial magnetic resonance image (**left**) reveals a large circular diverticulum that is deficient ventrally. This information was invaluable at surgery, when a fibrous band of tissue was found and the diverticulum was identified laterally on both sides (**right**). (See Case #3.)

Surgical Repair of Urethral Diverticulum

The decision to treat urethral diverticulum is often based on the severity of the presenting symptoms. In cases of an asymptomatic urethral diverticulum, treatment is not mandated. Often an asymptomatic diverticulum is discovered on a routine physical examination or an imaging study done for another reason. Little is known about the natural history of an asymptomatic diverticulum and whether it will increase in size or become symptomatic in the future. The occurrence of carcinoma within a urethral diverticulum is well recognized, because cases of squamous cell carcinoma, transitional cell carcinoma, and adenocarcinoma have been reported. Thus, patients with an asymptomatic urethral diverticulum must at least be warned of this risk.

Symptomatic patients will often opt for treatment. A variety of surgical techniques have been described, but we adhere to the principle of excision and urethral reconstruction. Other techniques of treatment include marsupialization by a transurethral or open approach, fulguration, and endoscopic unroofing. We believe that excision and urethral reconstruction gives the best long-term results with maximal preservation of urethral function. In addition, it allows the surgeon to simultaneously treat stress urinary incontinence when present. Before surgical repair we attempt to treat any active infection. In addition to the techniques described later, a urethral excision with end-to-end urethroplasty for correction of a large circumferential diverticulum has been described by Rovner and Wein.

As mentioned previously, it is a great help to the surgeon to know the exact location, the shape, the approximate size, and the number of diverticula before the surgery is begun. This will help the surgeon plan the dissection once the diverticulum is encountered to allow complete excision of the diverticulum without excision of normal urethra.

There are several important principles to which the surgeon should adhere in performing urethral diverticulectomy:

1. Create well-vascularized flaps.
2. Know and identify all appropriate anatomical layers and structures.
3. Identify normal urethra before excising the diverticulum.
4. Excise the entire diverticulum (preferable) or the entire mucosal portion along with the communication to the urethra.
5. Avoid excision of normal urethra.
6. Ensure a watertight reconstruction of the urethra.

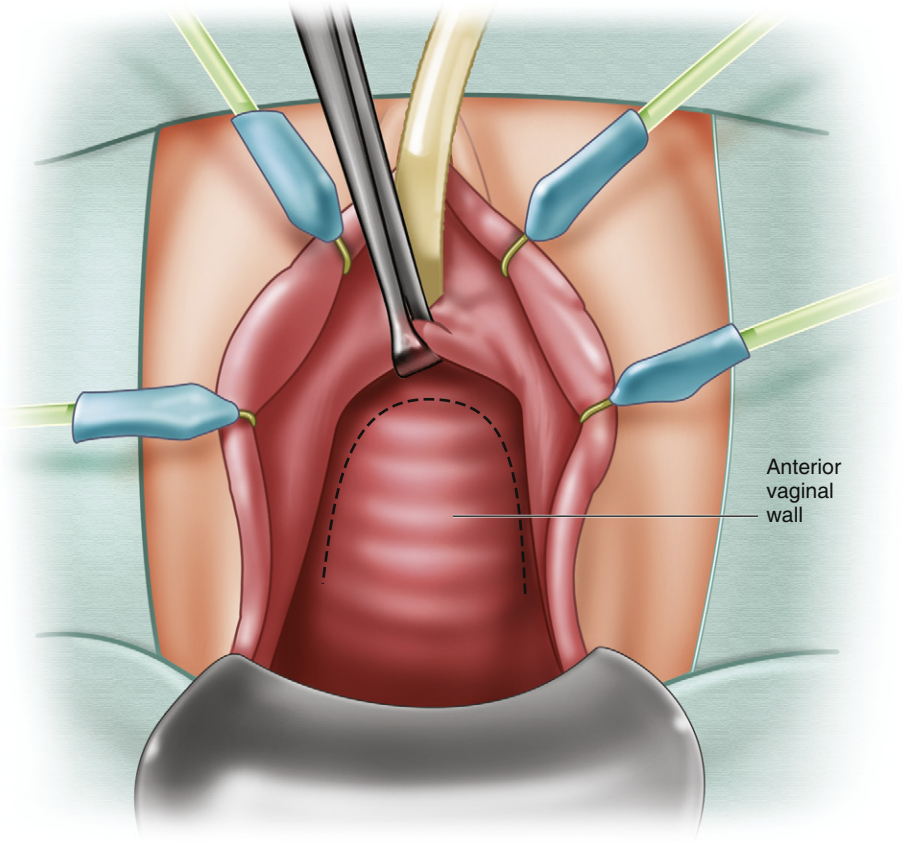


Figure 10-4 An inverted-U incision is made in the anterior vaginal wall.

7. Perform multilayered, nonoverlapping closure of the urethra.
8. Provide adequate postoperative drainage.

Surgical Technique for Urethral Diverticulectomy

1. Create a well-vascularized vaginal flap. We prefer an inverted-U incision, because it creates excellent exposure and allows for nonoverlapping suture lines at closure (Fig. 10-4). When extended, the inverted-U incision allows visualization of the entire urethra and bladder neck and gives the surgeon the ability to dissect a large diverticulum from under the bladder neck.
2. Identify and preserve the periurethral fascia. This is the first important layer beneath the vaginal wall (Fig. 10-5). This step is often skipped as the surgeon tries to immediately access the diverticulum. Identification of this layer prevents dissection in the wrong plane. Preservation of the periurethral fascia provides an extra layer of closure.
3. Sharply open the periurethral fascia. A transverse incision across the fascia for the width of the diverticulum should be made. This incision can be extended laterally on either side to facilitate dissection (Fig. 10-6).
4. Sharply dissect the periurethral fascia off of the diverticulum (Fig. 10-7). This step should be done carefully and gently, because the diverticulum is often quite adherent to the fascia. Since it is preferable to keep the diverticulum distended, it is useful to have a suture ready (4-0 polyglycolic acid [PGA]),* so that if a small opening is made in the diverticulum, it can be quickly closed.

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

Figure 10-5 A proximally based vaginal flap is created to the level of the bladder neck, leaving the periurethral fascia intact.

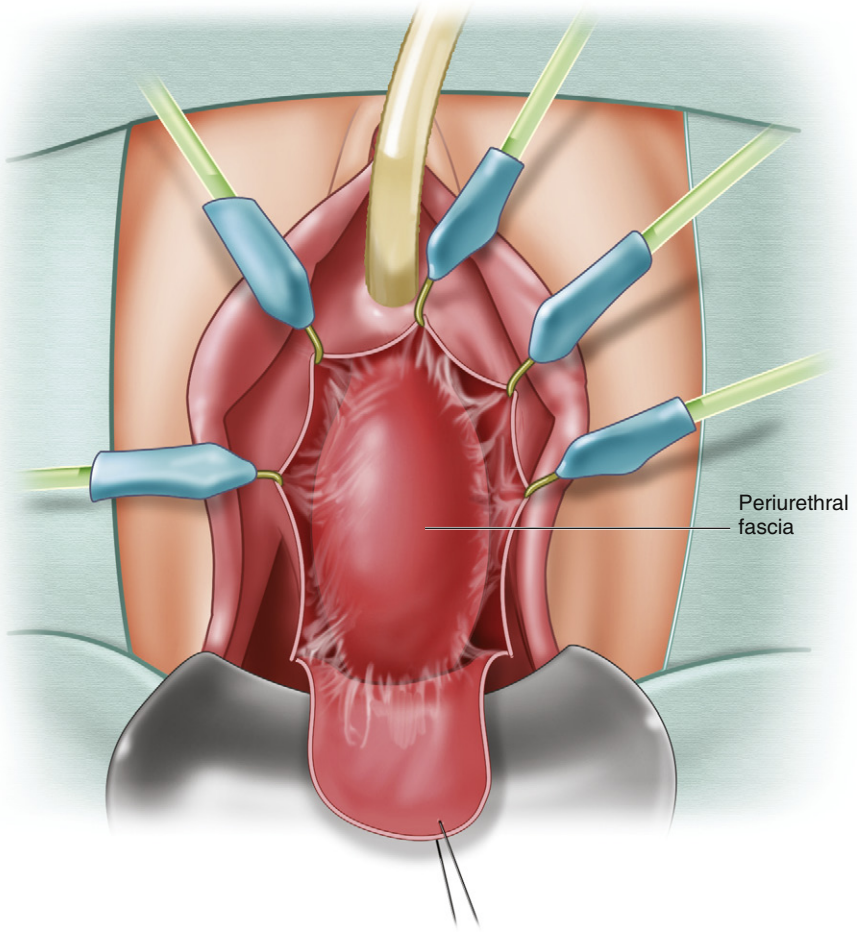
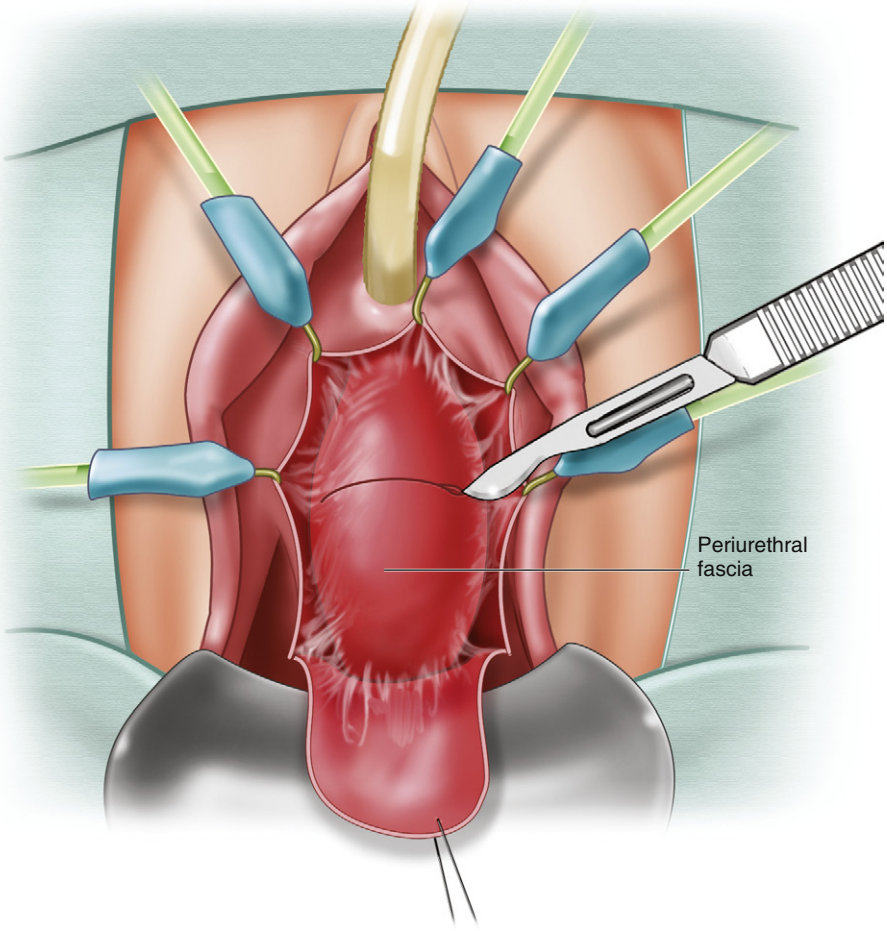


Figure 10-6 The periurethral fascia is incised horizontally.



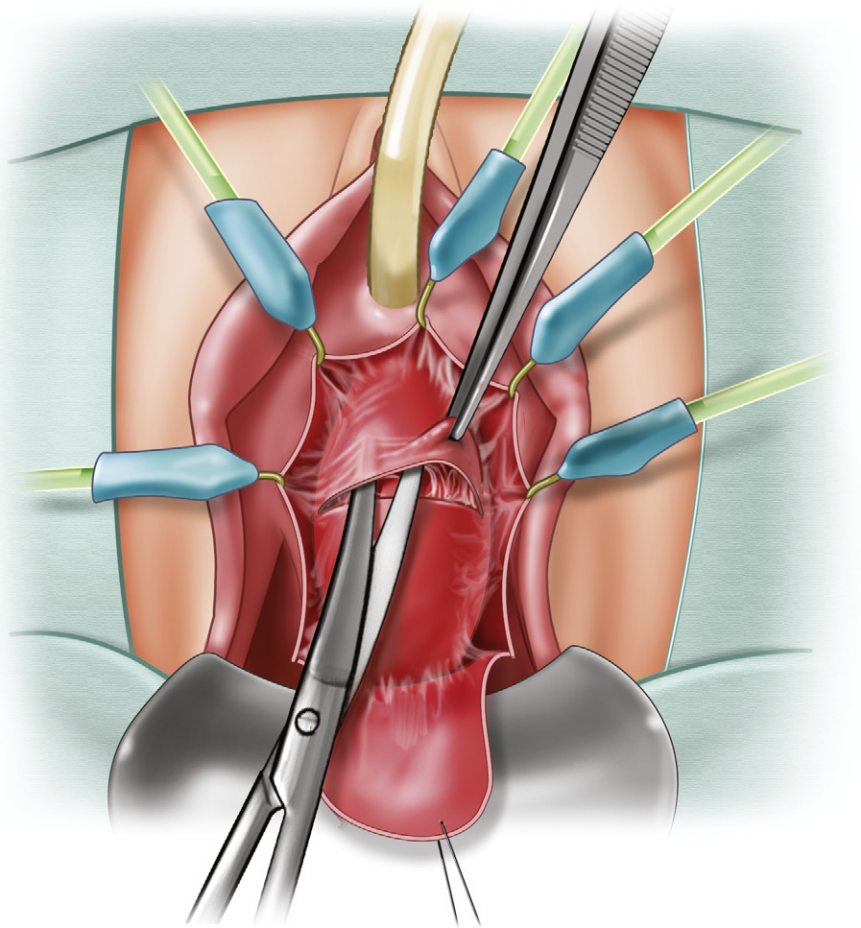


Figure 10-7 The periurethral fascia is dissected off the underlying diverticulum both distally (shown here) and proximally.

5. Continue the dissection proximally, distally, and laterally until the normal urethra is identified (Fig. 10-8), because this will allow a clear excision of the entire diverticulum. When the diverticulum is very large, this may not be possible.
6. Remove the diverticulum (Fig. 10-9). Complete dissection to the neck of the diverticulum is optimal. However, in cases of a large or complex diverticulum it may be necessary to open the diverticulum and excise it from the inside. If the communication to the urethra can be clearly identified without opening the urethra, dissect the diverticulum off of the urethra.
7. Reconstruct the urethra (Fig. 10-10). Often the urethral opening is larger than expected, because it expands as the diverticulum is taken off the urethra. Repair the urethra in a single-layer, longitudinal, running closure of 4-0 PGA suture over a Foley catheter. We prefer a 14F catheter, but a smaller catheter may be used, especially when part of the urethra has been excised. It can be helpful to place one suture at the proximal end and one at the distal end to facilitate closure. After the closure is completed, place a 5F feeding tube or similar catheter alongside the Foley catheter and irrigate, checking for watertightness. If there are any leaks, reinforce the closure with an interrupted 4-0 PGA suture.
8. Close the periurethral fascia transversely with interrupted 3-0 PGA suture (Fig. 10-11).
9. Close the vaginal flap with two separate running 2-0 PGA sutures (Fig. 10-12).

The preceding technique is suitable for removal of most urethral diverticula. However, more complex cases (complete circular diverticulum, concomitant stress urinary incontinence) require certain modifications that are

Figure 10-8 With the periurethral fascia opened, the diverticulum is completely exposed.

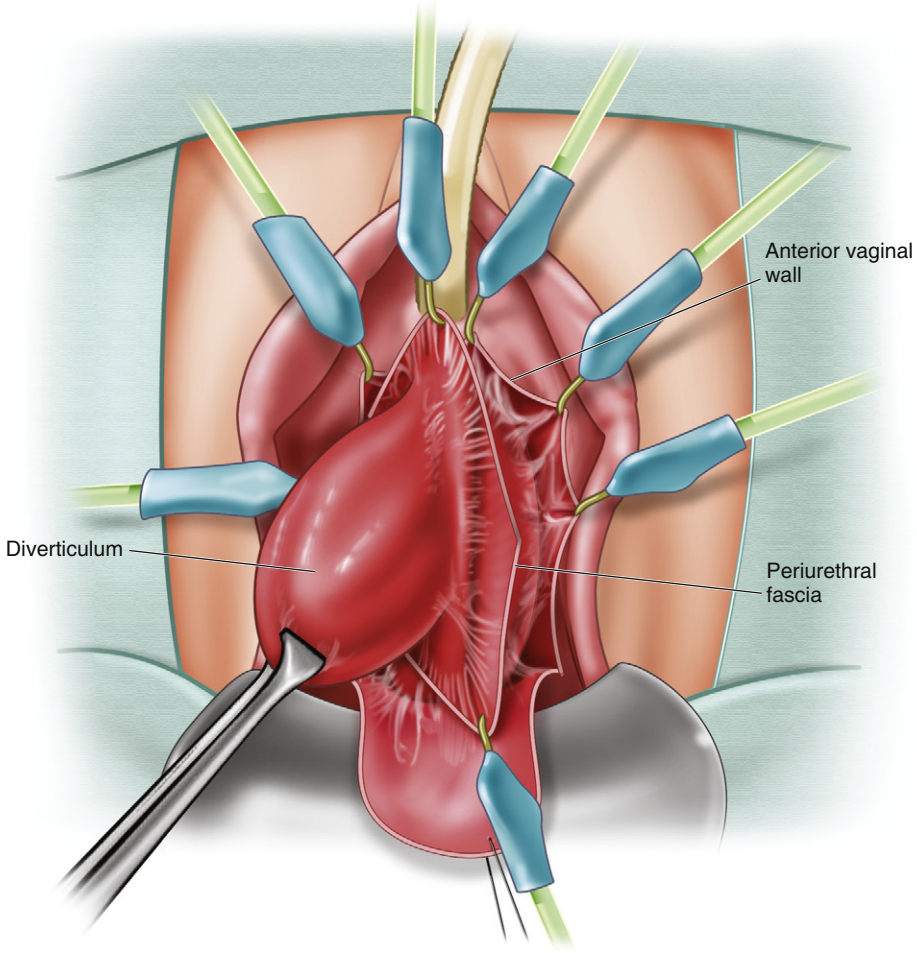


Figure 10-9 The diverticulum has been completely excised and the urethral defect is seen.

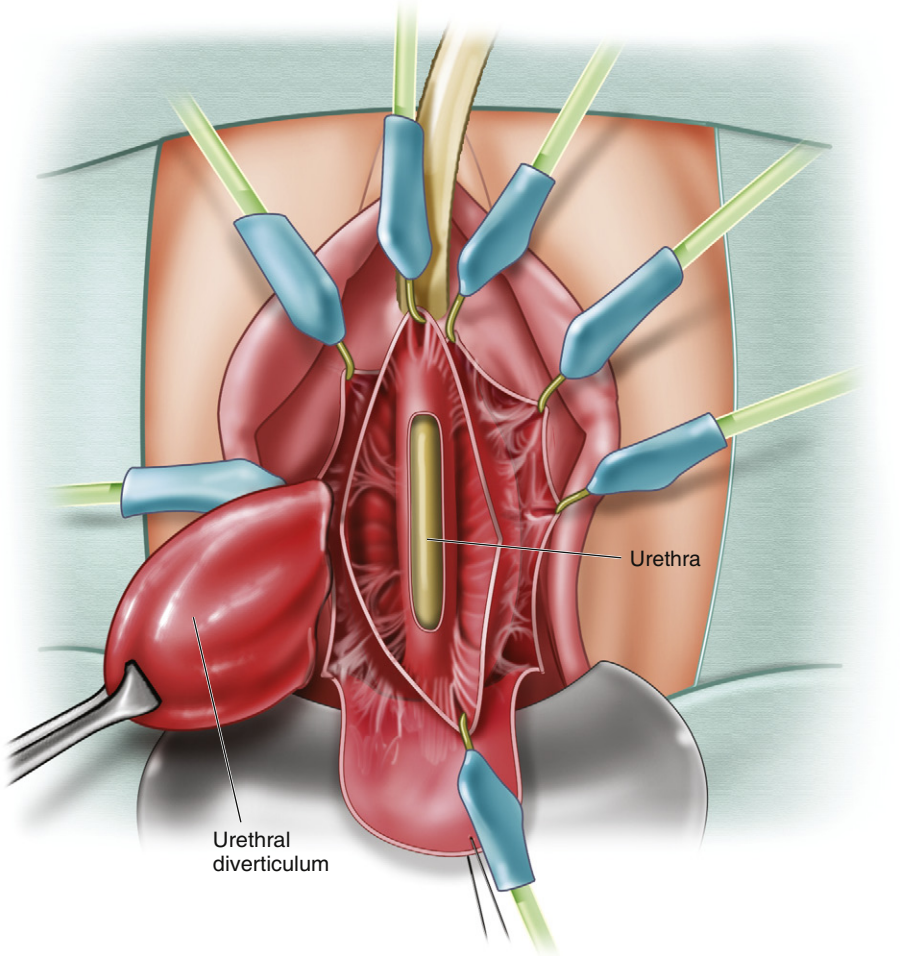


Figure 10-10 The urethra has been closed longitudinally with a full-thickness running 4-0 PGA suture.

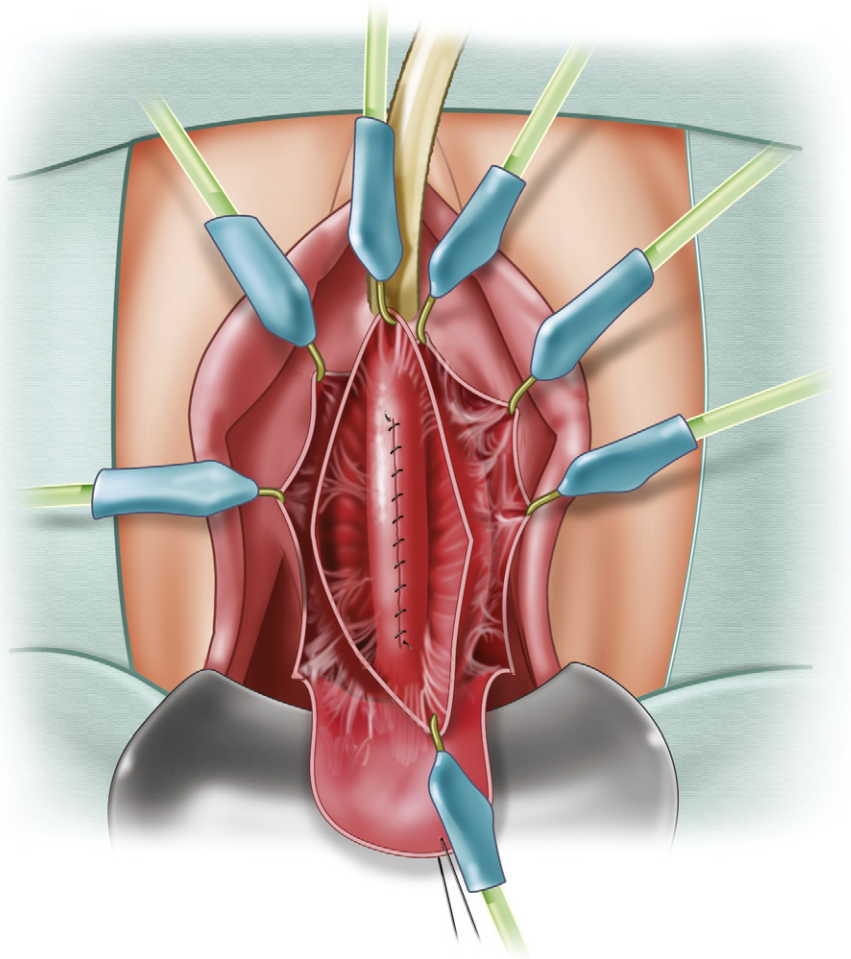
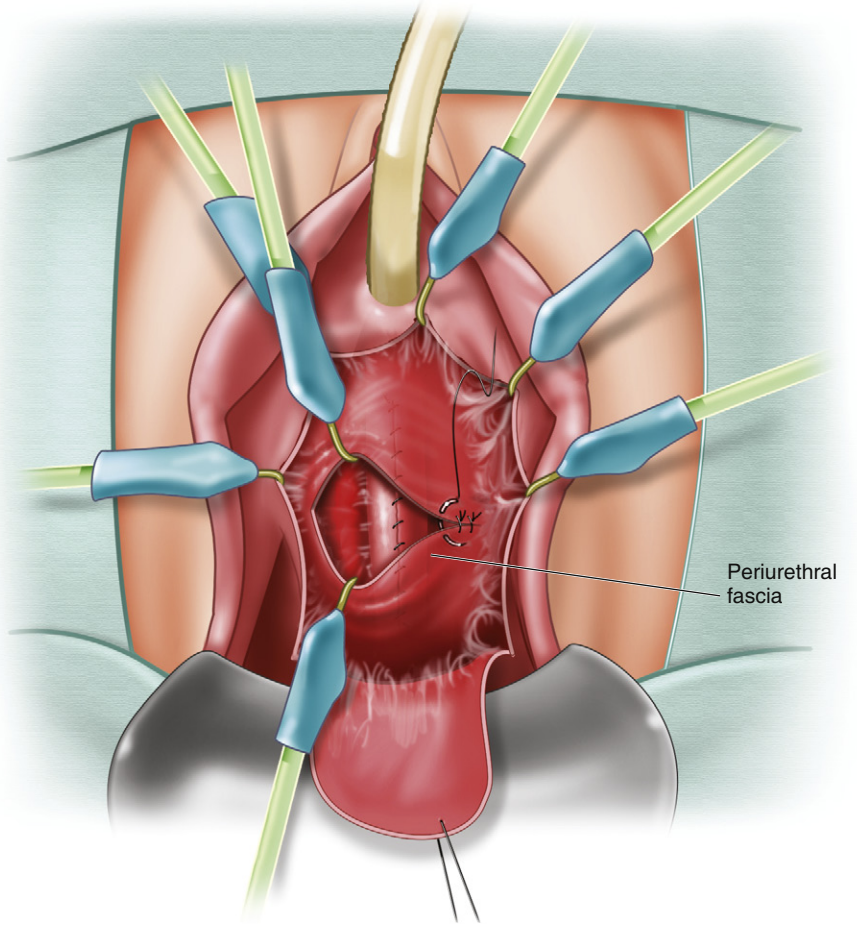


Figure 10-11 The periurethral fascia is closed transversely with interrupted 3-0 PGA sutures.



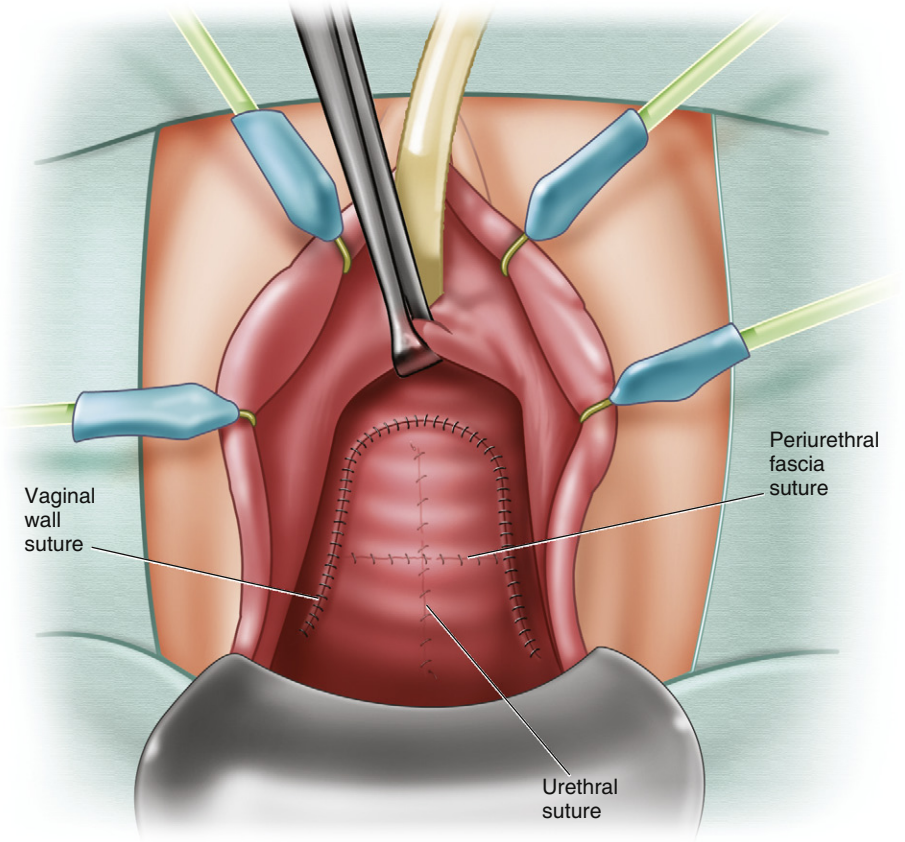


Figure 10-12 The vaginal flap is advanced and closed. Note the three non-overlapping suture lines.

Case #1

View Video 10-1

A 40-year-old woman sought treatment because of recurrent urinary tract infections (about five per year over the previous 3 years). When she did not have an active urinary tract infection, she often had dysuria. She reported no stress- or urgency-related incontinence. Physical examination suggested a suburethral mass; there was mild urethral hypermobility, and stress incontinence could be demonstrated. MRI confirmed the presence of a 3-cm urethral diverticulum, predominately on the patient's right side. Because of her symptoms, excision was recommended. No antiincontinence procedure was performed; however, great care was taken to preserve the patient's continence mechanism (Video 10-1).

Case #2

View Video 10-2

A 44-year-old woman had urethral pain and dyspareunia of 2 years' duration. She had had two urinary tract infections in the previous 18 months. Physical examination revealed a large anterior vaginal wall mass that, when palpated, expressed urine via the urethra. She also had significant urethral hypermobility, and stress incontinence was seen with coughing and a Valsalva maneuver. MRI revealed a 4-cm ventral urethral diverticulum. Videourodynamic testing showed stress incontinence with an abdominal leak point pressure of 70 cm H_2O. The diverticulum filled with voiding, and there was no paradoxical incontinence after voiding. Because of the presence of stress incontinence and the large size of the diverticulum, a pubovaginal sling fashioned of autologous rectus fascia was placed at the time of urethral diverticulectomy (Video 10-2).

Case #3

A 38-year-old woman had a 3-year history of urethral pain and recurrent urinary tract infections (five or six per year). She was unable to engage in intercourse because of the pain. She reported no stress or urge incontinence. Physical examination revealed severe suburethral tenderness, but no mass was felt and no fluid was expressed. The urethra was fixed, and there was no objective evidence of stress incontinence. MRI showed a dorsal circular urethral diverticulum (see Fig. 10-3, *left*). Surgery was performed. A fibrous band was encountered ventrally (see Fig. 10-3, *right*) and was transected.

During surgery, the urethra was retracted to the left as the right side of the diverticulum was mobilized off the urethra (Fig. 10-13, *A*).

Both the right and left sides of the diverticulum were then completely mobilized off the urethra. The right side was transferred dorsally to the left side. Only the dorsal part of the diverticulum remained attached between the urethra (which was retracted to the right) and the pubic bone (Fig. 10-13, *B*).

A large urethral defect on the right side (Fig. 10-13, *C*) was repaired as previously described.

A Martius flap was mobilized from the left labia and was split lengthwise; half was wrapped dorsally and half ventrally around the urethra to fill the large dorsal dead space (Fig. 10-13, *D*). The excess fat was trimmed (Fig. 10-13, *E*).

Case #4

View Video 10-3

A 56-year-old woman came for treatment of symptomatic stress incontinence. The diagnosis of urodynamic stress incontinence was made. The patient underwent surgery to place a transobturator synthetic midurethral sling. Postoperatively she continued to complain of stress incontinence as well as some de novo voiding dysfunction and urgency. Cystourethroscopy revealed a large midurethral diverticulum. There was no objective evidence of stress incontinence. Because the urgency and voiding dysfunction developed after the sling procedure, the decision was made to take down the transobturator sling at the time of repair of the large diverticulum (Video 10-3).

discussed and demonstrated in the case presented. If a patient has concurrent stress incontinence or if excision is extensive and urethral support is greatly compromised, an antiincontinence procedure can be performed simultaneously with the diverticulectomy. In these cases we prefer to use autologous fascia (rectus fascia or fascia lata). Biological material (allograft, xenograft) may be considered in circumstances in which harvesting of autologous fascia is associated with a particularly high morbidity. Synthetics should be avoided.

Postoperative Care

In most cases, the urethra is reconstructed over a 14F Foley catheter, which is left in place for 10 to 14 days, depending on the size and complexity of the reconstruction. When a single suture is used to close the urethra (pinhole communication), the drainage time can be reduced to 7 days. We often prescribe anticholinergic medications to be taken during the period of catheterization to prevent involuntary detrusor contractions. We do not routinely place a suprapubic tube, but in cases of significant bleeding in which there is concern about the adequacy of catheter drainage, one can be inserted. When patients are admitted to the hospital after surgery, we often leave a vaginal packing in overnight; however, if the surgery is done as an outpatient procedure, the packing is either

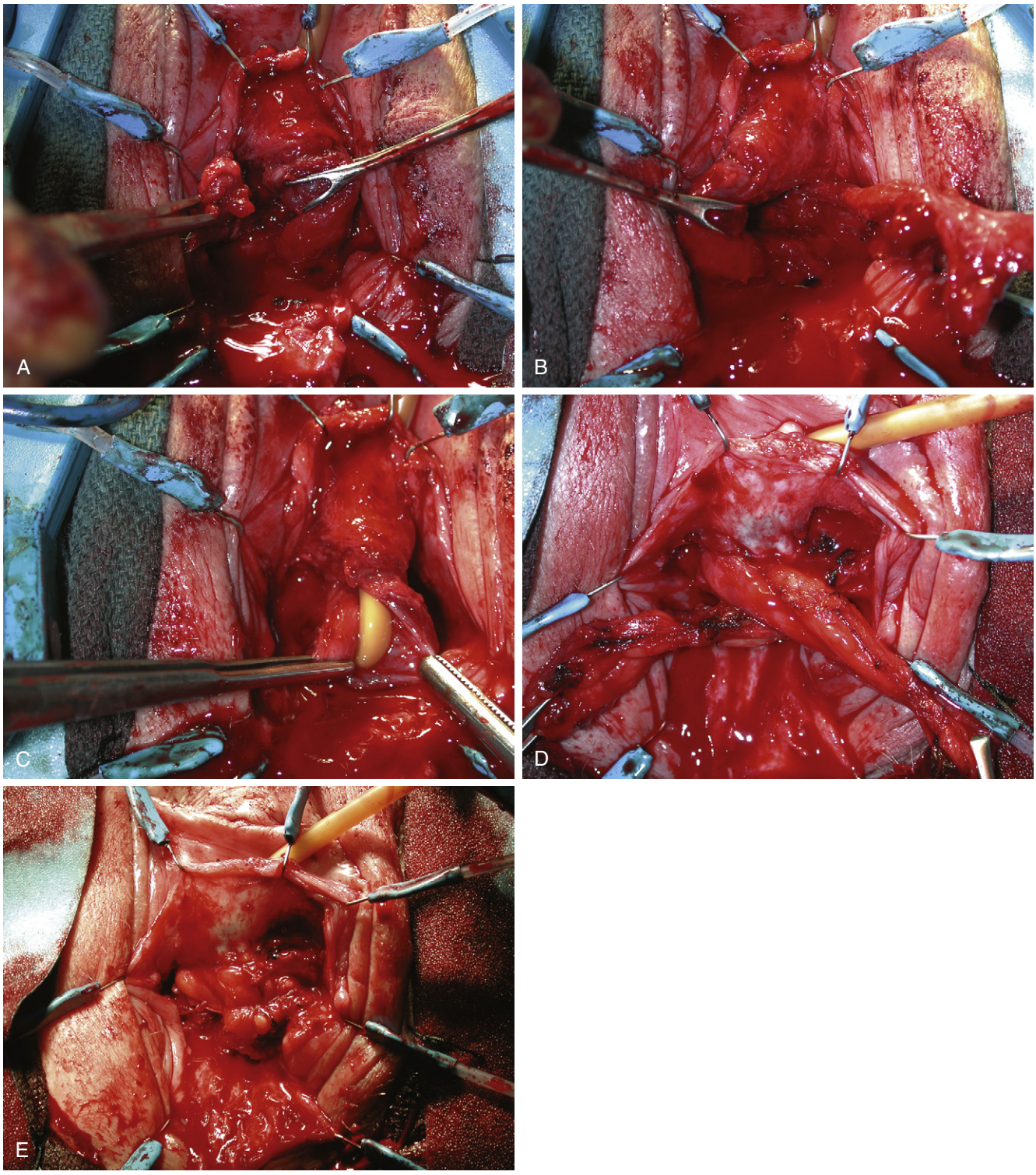


Figure 10-13 **A,** A 38-year-old woman with dorsal circular diverticulum. The urethra is retracted to the left as the right side of the diverticulum is mobilized. **B,** The right side of the diverticulum has been transferred to the left from the dorsal side of the urethra. **C,** The urethral defect is seen after complete excision of the diverticulum. **D,** After closure of the urethra, the Martius flap was mobilized from the left labia and split lengthwise and then wrapped around the urethra. **E,** The excess fat from the flap was trimmed prior to vaginal wall closure.

removed before discharge or not placed at all. Prophylactic antibiotics are continued for as long as the catheter is in place.

When the patient returns for catheter removal, VCUG is performed to confirm healing. If there is any extravasation, the catheter is reinserted and remains in place for another 7 days, at which time VCUG is repeated.

Outcomes

Reported recurrence rates after urethral diverticulectomy are in the range of 4% to 17%. In many cases the recurrence is probably due to incomplete resection and repair, and thus is really a persistence of the diverticulum rather than a recurrence. With the use of modern imaging techniques such as MRI, we believe these rates have been reduced. Incontinence has been reported in 20% to 25% of women postoperatively. These rates include data from long-term studies in which the incontinence was not necessarily related to the diverticulectomy. Treating existing stress incontinence when appropriate with a simultaneous pubovaginal sling procedure should significantly decrease the potential for development of stress incontinence. Persistent or de novo detrusor overactivity occurs in 3% to 5% of women. Fortunately, structural complications like urethral stricture and urethrovaginal fistula are rare, occurring in only 1% of cases.

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Benign Vaginal Wall Masses and Paraurethral Lesions

11

Sagar R. Shah, MD
Victor W. Nitti, MD

Videos

11-1 Excision of an Infected Skene Gland
11-2 Marsupialization of a Gartner Duct Cyst
11-3 Excision of a Vaginal Inclusion Cyst
11-4 Excision of a Urethral Caruncle

This chapter discusses benign lesions and masses of the vagina and urethra (excluding urethral diverticula). Although the exact prevalence of these conditions is unknown, they seem to be relatively common and can present with symptoms that are quite distressing to the patient.

Infected Skene Glands and Cysts

The Skene glands, or paraurethral glands, are found on both sides of the urethra. They are the female homologues of the prostate in the male and arise from the urogenital sinus. Ailments of the Skene glands are relatively rare but include infection or abscess, cyst, and neoplasm. The exact incidence of these conditions is unknown. Cysts or abscesses of the Skene glands most commonly present in the third to fourth decades. However, Skene gland cysts have been reported in neonates, and recently a Skene gland abscess has been reported in a prepubertal girl. The incidence of Skene gland abscess in neonates was reported to be 1 in 2074 in one study.

The differential diagnosis of any anterior vaginal wall mass includes urethrocele, cystocele, urethral diverticulum, ectopic ureterocele, urethral prolapse, malignancy, Skene gland abscess or infection, Skene gland cyst, Bartholin gland cyst or infection, and Gartner duct cyst or infection. Presenting symptoms of Skene gland abscess, infection, or cyst include urethral pain, dysuria, dyspareunia, presence of an asymptomatic mass, recurrent urinary tract infections (UTIs), urethral drainage, and voiding symptoms. Clues that point to Skene gland involvement are a mass located distally and lateral along the urethra, point tenderness along the lateral and distal aspect of the urethra, and expression of pus. In our practice we consider the diagnosis of Skene gland abscess or infection not only in patients with a palpable anterior vaginal wall lesion but also in

patients with chronic urethral pain, recurrent UTIs, or unexplained dyspareunia and an otherwise unremarkable workup. The diagnosis of Skene gland abscess, infection, or cyst can generally be made by history and physical examination. When the diagnosis is in doubt, further workup with magnetic resonance imaging (MRI), voiding cystourethrography, transvaginal ultrasonography, or cystourethroscopy may be warranted. A combination of the symptoms described earlier and physical examination findings demonstrating reproducible point tenderness (re-creating the patient's complaints) distally and laterally along the urethra, palpable cystic mass, or purulent discharge on aggressive milking of the urethra is usually required to diagnose a Skene gland abscess or infection. In the absence of these symptoms or physical findings, imaging results consistent with the diagnosis are required before any treatment is offered.

Skene gland infections may present in several ways. In some cases, the duct is visible and may appear inflamed or express a purulent discharge when palpated, but there is no discrete mass (Fig. 11-1). More commonly, there is an associated cystic mass caused by a relative closure of the duct and collection of fluid. These cysts can become quite large and displace the urethral meatus (Fig. 11-2). They may drain spontaneously through the duct or rupture into the anterior vaginal wall.

Because of the relatively infrequent occurrence of Skene gland abscess or infection, very little information has been published regarding its management. Conservative management may include providing antibiotic therapy or

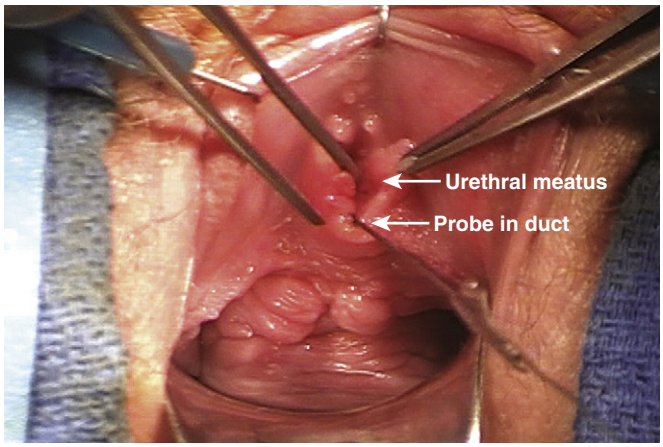

Figure 11-1 Probe placed in an infected Skene gland duct before excision.

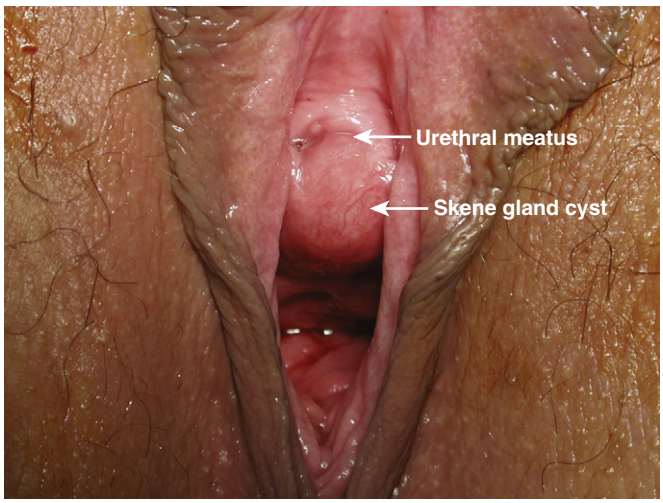

Figure 11-2 Infected Skene gland cyst displacing the urethral meatus toward the patient's right side.

waiting for spontaneous rupture. No guidance is available in the literature regarding the length of time for which conservative management should be tried. We usually treat patients initially with a 2-week course of antibiotics (culture specific if possible). It is felt that the initiation, progression, and propagation of urethral diverticula is secondary to an infection of the periurethral glands. Bacteria associated with a Skene duct abscess include *Escherichia coli*, other coliform bacteria, *Neisseria gonorrhoeae*, and vaginal flora. If culture results are not available, antibiotic therapy is aimed at covering these common pathogens. If there is no response, then surgical therapy is offered. If a response is seen to antibiotic therapy but symptoms recur, then a repeat course is given. In an era of increasing antibiotic resistance and other complications associated with prolonged antibiotic therapy, it is reasonable to consider surgical intervention after a failure or recurrence of symptoms following one or two courses of antibiotics if the patient is symptomatic and appropriately counseled.

There is a paucity of literature regarding the surgical management of Skene gland abscess or infection. A few small series examining the surgical management of paraurethral gland cysts may have included some infected cysts or abscesses, but no studies have looked specifically at noncystic lesions. Surgical excision, marsupialization, and simple needle aspiration have all been described for the surgical management of Skene gland or paraurethral cysts. An argument for surgical excision rather than marsupialization or needle aspiration is the fact that malignancy has been reported to occur in paraurethral cysts, and so pathological examination of these lesions seems most prudent. For this reason we prefer surgical excision whenever possible.

Surgical Technique for Excision of a Skene Gland Lesion

Before excision, cystourethroscopy is performed on all patients in the operative theater. In cases in which there is no obvious mass, every attempt is made to cannulate the opening of the duct with a lacrimal probe or similar tool if possible (see Fig. 11-1). We use two different surgical techniques based on the size of the lesion.

For smaller, noncystic lesions the following technique is used:

1. A small transverse or gently curved inverted-U incision is made just below the urethral meatus.
2. A proximally based vaginal flap is raised.
3. A wedge of distal urethra and periurethral fascia is excised that includes the entire duct and gland.
4. After excision, the urethral mucosa is advanced to the vaginal flaps, with care taken to ensure that there is good apposition of urethral mucosa to vaginal epithelium.

For larger, cystic lesions (see Fig. 11-2) a technique similar to that used for urethral diverticulectomy is performed (see Chapter 10).

1. An inverted-U incision is made in the vagina with the apex over the lesion.
2. If the periurethral fascia is identifiable, it is incised perpendicular to the vaginal incision and flaps are raised.
3. The Skene gland cyst or abscess and duct are excised.
4. The urethra is closed or, if the communication is very distal, the distal urethral mucosa is excised to the level of the lesion.
5. The periurethral fascia is closed followed by closure of the vaginal wall.

Postoperative Care

All procedures are performed on an outpatient basis. In most cases the patient is sent home without a urethral catheter. For larger reconstructions of the urethral meatus a catheter may be kept in place for several days. Patients are sent home with a 3-day supply of oral narcotic pain medication.

Case #1

View Video 11-1

A 40-year-old woman experienced recurrent UTIs and postvoid urethral pain. She had been recently treated with a course of antibiotics, which only temporarily improved her symptoms. Physical examination showed a prominent Skene gland duct, and palpation of the urethra expressed a purulent discharge. A culture of the discharge grew enterococcus, and the patient was again treated with another culture-specific antibiotic, without resolution of symptoms. The decision was made to excise the infected gland. The patient experienced complete resolution of her UTIs after surgery. (See Video 11-1 for a demonstration of excision of an infected Skene gland.)

Outcomes

Very little literature is available on outcomes following surgical excision of an infected Skene gland. We recently reported our experience in treating 34 women who underwent Skene gland excision for various indications, including dysuria, distal and lateral urethral pain, purulent discharge, recurrent UTIs, pain, and symptomatic vaginal mass. After the initial excision 88.2% of patients had resolution of symptoms. However, symptoms recurred in 9 of 30 women (30%) who were initially cured, with a mean time to recurrence of 24 months. Of these nine women, eight were cured with either further conservative management or repeat surgical treatment, for a total cure rate of 85% after two interventions. Four patients with recurrent symptoms improved with conservative therapy (antibiotics, topical estrogen cream or local anesthetics to the affected area), whereas five required a second operation for an overall reoperation rate of 14.7%. All except one of the surgical failures were in women with urethral pain as the primary indication for surgery. These patients had the highest rate of failure at 23.5%. It is our belief that such patients should be counseled thoroughly regarding the increased risk of failure.

Other Benign Paraurethral and Vaginal Masses

Several types of masses can occur in the vagina and the periurethral area. Cystic masses include Gartner duct cysts, Bartholin gland cysts, and epithelial inclusion cysts. The most common solid lesion is leiomyoma. These lesions often are asymptomatic and do not require treatment; however, sometimes they become large and create a vaginal bulge, interfere with intercourse, or cause dyspareunia. These masses must be differentiated from a urethral diverticulum. In cases of uncertainty, MRI may be performed to distinguish these masses from a urethral diverticulum before any surgical intervention is attempted.

A Gartner duct cyst is a remnant of the distal end of the mesonephric (wolffian) duct in females. These cysts may be associated with other developmental anomalies related to the mesonephric duct, such as an ectopic ureter and ipsilateral renal agenesis. Usually the cysts are solitary and small, but they can be large enough to bulge from the vaginal introitus (Fig. 11-3). When they are symptomatic, these cysts, like any periurethral cyst, can usually be excised. However, at times the cyst may track up toward the ureter. In such situations

Figure 11-3 Gartner duct cyst that presented as a large anterior vaginal wall mass. On palpation the mass felt cystic and was freely movable.

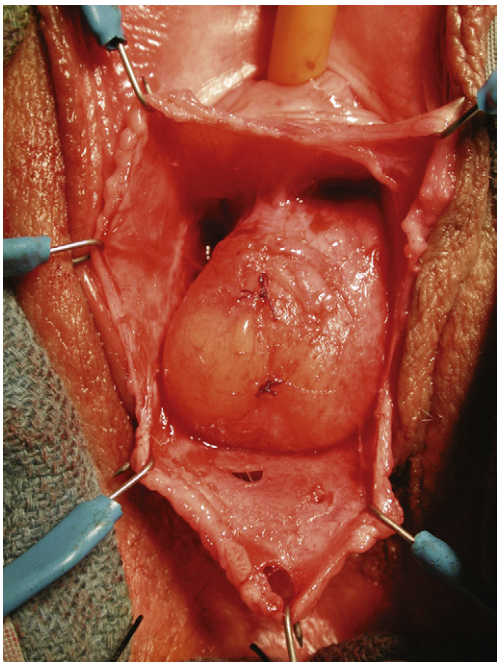

Figure 11-4 For excision of the Gartner duct cyst, an inverted-U incision was made and the cyst was encountered just below the vaginal wall.

marsupialization of the cyst instead of complete excision should be considered (Video 11-2). The initial surgical approach is similar to that for a diverticulectomy, and either an inverted-U or midline incision is made. In cases in which the diagnosis is uncertain, we prefer an inverted-U incision for maximal exposure and optimal closure if there is a communication with the urethra. Vaginal cysts are located superficial to the periurethral fascia and can often be enucleated without opening the fascia (Figs. 11-4 and 11-5). (See Videos 11-2 and 11-3 for a demonstration of marsupialization of a Gartner duct cyst and complete excision of a vaginal inclusion cyst.)

Bartholin glands are pea-sized glands that lie beneath the bulbospongiosus muscle on each side of the vagina. When the ducts are obstructed, cysts may form, which can become infected. Symptomatic Bartholin cysts can be treated

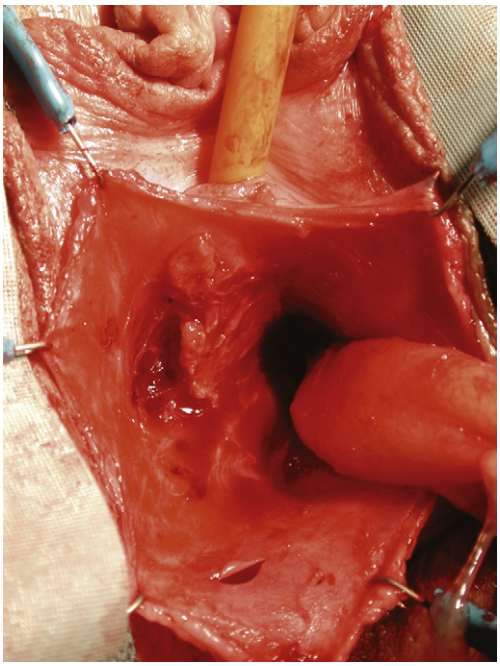

Figure 11-5 After the Gartner duct cyst was excised, the periurethral fascia remained intact.

in a variety of ways, including excision, marsupialization, silver nitrate or laser ablation, cyst or abscess fenestration or needle aspiration with or without alcohol sclerotherapy, or incision and drainage followed by primary suture closure. A recent systematic review of surgical treatments noted that many of these interventions had similar outcomes. The reported frequency of recurrence after surgery varied from 0% to 38%.

Leiomyomas may present as a periurethral mass. The typical presentation is one of a nontender, nonpainful vaginal mass. Leiomyomas may arise from smooth muscle of the bladder, urethra, periurethral tissue, or vagina. On examination they may be pedunculated and are nontender. Paravaginal leiomyomas have a typical appearance on MRI and may often be diagnosed preoperatively. MRI usually shows a well-circumscribed shape with uniform enhancement and a homogeneous signal that is hypointense or isointense to muscle on both T1- and T2-weighted images. Leiomyomas may become large enough to affect vaginal function, requiring excision (Fig. 11-6). These masses can often be enucleated once the proper plane is entered (Fig. 11-7).

Urethral Caruncle and Prolapse

Urethral caruncle is the most common benign tumor of the female urethra, occurring frequently after menopause. It presents as a reddish, sometimes tender, polypoid protrusion of the posterior lip of the urethral meatus (Fig. 11-8). The differential diagnosis of urethral caruncle includes urethral prolapse (see later), carcinoma of the urethra, thrombosis of a urethral vein, and a prolapsing urethral polyp. Caruncles are almost always benign, with only 2% found to be malignant. Biopsy is recommended when the presentation is atypical or the diagnosis is uncertain. Urethral caruncles often are asymptomatic and do not require treatment. However, they can sometimes cause bleeding, pain, or obstruction of voiding. In such cases treatment may be initiated. Topical estrogen can be used to reduce inflammation and relieve symptoms. In cases of a large and/or highly symptomatic caruncle, excision is recommended. Surgical excision consists of removal of the entire caruncle and approximation of the ventral urethral meatal

Figure 11-6 Vaginal leiomyoma that presented as a very large anterior vaginal wall mass. On palpation the mass felt solid and was freely movable.

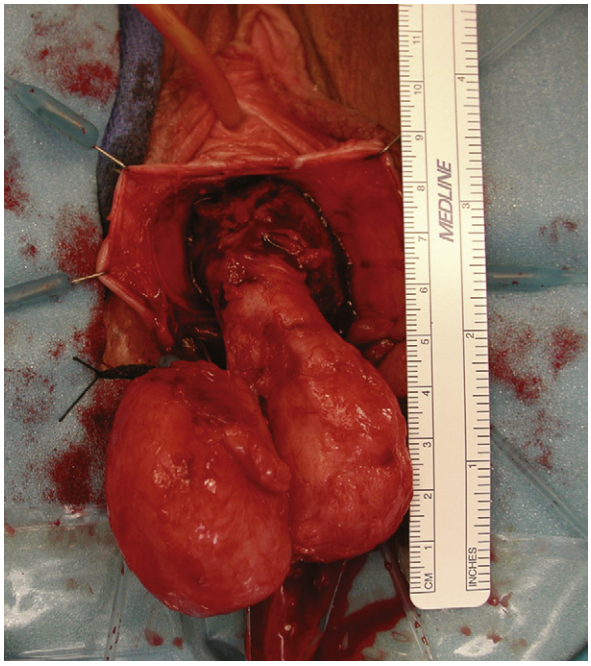

Figure 11-7 For excision of the leiomyoma, an inverted-U incision was made and the leiomyoma was exposed just under the vaginal wall, superficial to the periurethral fascia. The 6 × 7 cm solid mass was easily enucleated.

mucosa to the vaginal epithelium. Care must be taken to ensure good mucosal approximation to prevent stricture or meatal stenosis. (See Video 11-4 for a demonstration of surgical excision of a urethral caruncle.)

Case #2

View Video 11-4

A 78-year-old woman had progressive bloody vaginal staining and discharge. She was found to have a friable, bleeding urethral caruncle. The rest of her urological and gynecological workup showed no abnormalities. She was initially treated with topical estrogen cream; however, it failed to relieve her symptoms. The patient ultimately underwent excision of the caruncle (see Video 11-4).

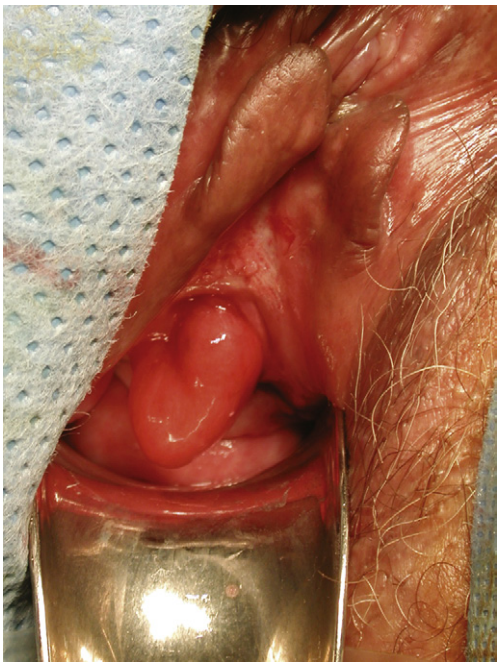

Figure 11-8 Urethral caruncle arising from the ventral aspect of the urethral meatus.

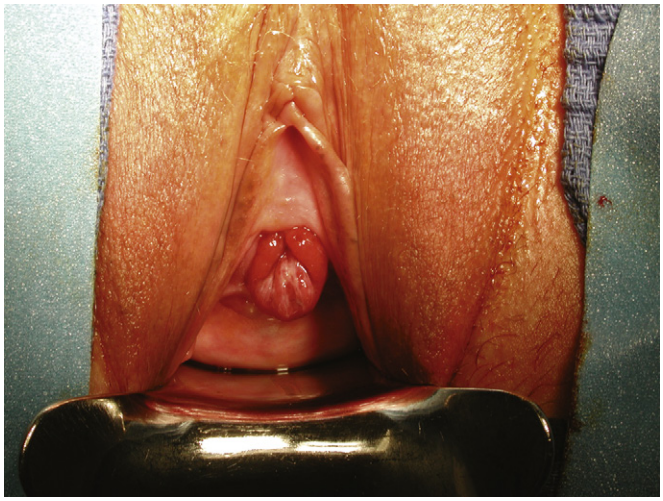

Figure 11-9 Urethral prolapse. Note the circumferential prolapse of the urethra, which distinguishes it from the urethral caruncle in Figure 11-8.

Urethral prolapse (Fig. 11-9) is a condition commonly seen in children, but it may also occur in adulthood. It is often asymptomatic but may present with bleeding and in rare cases edema causing urethral obstruction. The cause of urethral prolapse has not been fully elucidated, but it is thought to be related to chronic straining to void and/or defecate. Like urethral caruncle, urethral prolapse often does not require treatment and can be treated initially with topical estrogen cream. However, in some cases surgical excision of the prolapse is required because of bleeding or urethral obstruction.

Surgical Technique for Excision of Urethral Prolapse

1. The extent of the prolapse is identified. If desired, interrupted absorbable sutures can be placed in the more proximal, nonprolapsed urethra (at least 2 mm proximal to the prolapsed segment) at the 6 and 12 o'clock positions so that the mucosa does not retract inward.
2. A circumferential incision is made around the urethra at the mucosal–vaginal epithelial junction, and the nonprolapsed urethra is dissected off the periurethral fascia for approximately 5 mm.

3. The prolapsed urethral mucosa is excised.
4. Healthy nonprolapsed urethral mucosa is then advanced and circumferentially sutured to the vaginal epithelium in an interrupted fashion with 4-0 polyglycolic acid* or poliglecaprone 25 (Monocryl) sutures. This creates a neomeatus with well-vascularized, nondiseased mucosa.
5. Depending on the degree of inflammation, a urethral catheter may be left in place for 1 to 3 days postoperatively. This is particularly useful because postoperative swelling can cause urinary retention.

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*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

Female Urethral Reconstruction

12

Victor W. Nitti, MD
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Videos

12-1 Distal Urethrectomy With Meatal Advancement
12-2 Proximally Based Vaginal Pedicle Flap (Blandy) Urethroplasty
12-3 Buccal Mucosal Dorsal Onlay Graft Urethroplasty
12-4 Autologous Fascial Sling Placement After Bladder Neck Reconstruction for Eroded Synthetic Sling
12-5 Transvaginal Bladder Neck Closure

Knowledge of urethral anatomy is essential to fully understand the options for urethral reconstruction. The female urethra is relatively short compared with its male counterpart and is generally between 2 and 4 cm long. It has an inner layer of mucosal epithelium with numerous infoldings, which creates an effective seal against the passive loss of urine. Beneath the mucosa lies a rich network of elastic vascular tissue much like the corpus spongiosum. Finally, surrounding the spongy vascular tube is a collagen-rich fibromuscular envelope comprising the periurethral fascia. These three components of a normal urethra are crucial in maintaining continence and enabling dynamic function during increases in abdominal pressure as well as during normal micturition.

Two primary fascial attachments provide support to the urethra: the pubourethral ligaments and the periurethral fascia that makes up the suburethral hammock, which attaches to the arcus tendineus fasciae pelvis on each side. The pubourethral ligaments are a band of fascia that supports the urethra dorsally between the vagina and pubic symphysis. These ligaments often serve as a point of anatomical demarcation of the midurethra. The suburethral hammock is comprised of two layers of fascial condensation, the endopelvic fascia and the pubocervical fascia, which provide lateral attachment to the arcus tendineus. The midurethra is thought to be the center of continence where the striated sphincter complex maintains both active and passive tone.

Urethral reconstruction is most commonly performed to treat urethral stricture disease, urethral prolapse, urethral ablation, and urethrovaginal fistula. Female urethral stricture disease is relatively rare and can be caused by radiation exposure, inflammatory processes, difficult catheterization with subsequent fibrosis, prior dilation, urethral surgery, or trauma. Rarely strictures may be a consequence

of estrogen deficiency. Urethral ablation usually results from urethral trauma, from long-term use of an indwelling urethral catheter (usually in a patient with decreased or absent sensation), or as a complication of urethral surgery.

The treatment algorithm for female urethral stricture is not as well defined as that for stricture in the male. Perhaps this discrepancy is attributable to the relative rarity of stricture disease in women, especially in cases of blunt pelvic trauma. Because of the short length of the female urethra, its anatomical position behind the pubic arch, and its relative mobility, the incidence of stricture following trauma in females is low (0% to 6%). More commonly, stricture disease in women is seen after endoscopic or open urethral surgery, urethral dilation, or pelvic radiation therapy for gynecological malignancies. Generally, repair of stricture disease is divided into endoscopic and open repairs, with the use of local tissue flaps or graft interposition. Because of the relatively short length of the female urethra (approximately 4 cm), stricture excision and end-to-end urethroplasty is not a feasible option. Distal and midurethral strictures may be treated with dilation or enlarged endoscopically with a cold knife or holmium laser. Treatment with dilation is usually a long-term commitment, and dilation can be done by the urologist or by the patient using intermittent self-catheterization. Endoscopic treatment, generally used for midurethral strictures, can be attempted for short strictures (< 1 cm), although the failure rate is quite high. In most cases we prefer urethral reconstruction as the primary treatment.

This chapter describes urethral reconstructive options based on the anatomical location of the urethral lesion: distal, middle, or proximal urethra or bladder neck. Distal lesions are usually caused by strictures (including meatal stenosis) and urethral prolapse. Midurethral lesions generally result from strictures or distal urethral ablation. Proximal urethral or bladder neck lesions are due to complete bladder neck incompetence (usually as a result of trauma or prior surgery), extensive urethral ablation, or rarely stricture disease.

Distal Urethral Reconstruction

Stenosis or stricture of the distal urethra in women often presents with lower urinary tract voiding and storage symptoms (decreased force of stream, prolonged or incomplete emptying, and frequency and/or urgency). Distal stricture can be seen following traumatic urethral instrumentation and endoscopic procedures or radiation therapy to the pelvis or vulva for gynecological malignancy; it also occurs in postmenopausal women with significant vaginal atrophy from estrogen deficiency or with vulvar dystrophy. The diagnosis of a functional urethral stricture can be made using a combination of patient history (symptoms), physical examination findings (obvious scarring and/or the inability to pass a urethral catheter), endoscopy, radiography (voiding cystourethrography), and urine flow evaluation (decreased or abnormal flow). In cases of uncertainty videourodynamic testing can be helpful (Fig. 12-1). The two most common types of urethral reconstruction that we perform are distal urethrectomy with advancement meatoplasty, used for very distal strictures (generally involving the distal 1 cm of the urethra), and Blandy urethroplasty, used for lesions up to 1.5 to 2.0 cm proximal to the urethral meatus.

Surgical Technique for Distal Urethrectomy With Advancement Meatoplasty

Meatotomy can be performed to treat distal stenosis by simple ventral incision of the meatus and suturing of the cut end of the meatus to the vaginal wall.

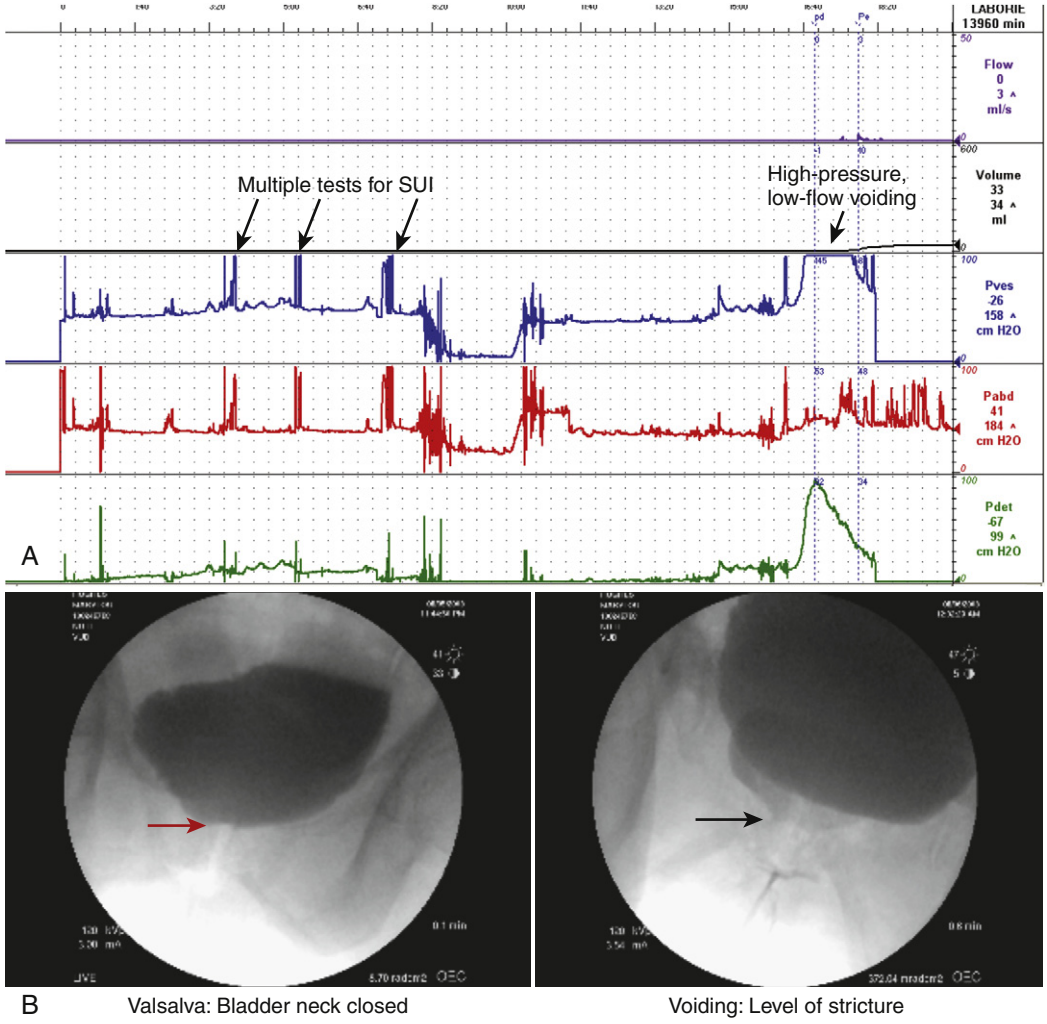


Figure 12-1 Videourodynamic study for a woman with frequency, urgency, and incomplete bladder emptying with poor flow. **A,** Pressure-flow study shows a stable, compliant bladder with high-pressure, low-flow voiding consistent with obstruction. Note that the patient was tested multiple times for stress urinary incontinence (SUI), which she did not have. **B,** Fluoroscopic image taken during a stress maneuver shows the level of continence at the bladder neck. This is important for determining the type of reconstruction. Fluoroscopic image taken during voiding shows an extremely dilated proximal and mid-urethra narrowing in the more distal urethra (*arrow*). Endoscopy confirmed the stricture to involve the distal 1.5 cm of the urethra.

However, in our experience, circumferential distal urethrectomy and advancement meatoplasty works best for distal strictures and urethral prolapse. The technique can be applied to meatal stenosis and strictures within approximately 7.5 mm of the meatus (Video 12-1).

1. The extent of the stricture is identified. If desired, interrupted absorbable sutures can be placed in the more proximal, healthy urethral mucosa (at least 2 mm proximal to the strictured segment) at the 6 and 12 o'clock positions so that the mucosa does not retract inward. A nasal speculum can assist in identifying healthy mucosa. When the urethral meatus is severely narrowed, an initial ventral incision may be necessary to determine the extent of the stricture.
2. A circumferential incision is made around the urethra at the mucosal-epithelial junction, and the urethra is dissected off the periurethral fascia for the extent of the stricture.
3. The distal urethra and meatus are excised.
4. Healthy urethral mucosa is then advanced and circumferentially sutured to the vaginal epithelium in an interrupted fashion with 4-0 polyglycolic acid (PGA)* or poliglecaprone 25 (Monocryl) sutures. This creates a neomeatus with well-vascularized, nondiseased mucosa.

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

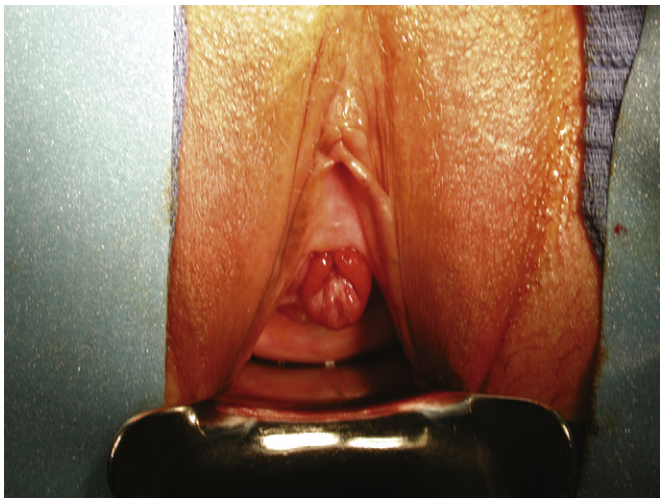


Figure 12-2 Urethral prolapse. Note the circumferential protrusion of the urethral mucosa.

Figure 12-3 Urethral caruncle. The inflammatory tissue occupies the left side of the urethral meatus.

5. Depending on the degree of reconstruction, a urethral catheter may be left in place for 1 to 3 days postoperatively. This is particularly useful because postoperative swelling may cause urinary retention.

In adult women urethral prolapse can occur as a result of habitual straining to defecate or void but sometimes may have no clear cause. Urethral prolapse is characterized by a circumferential protrusion of the urethral mucosa (Fig. 12-2); in contrast, an inflammatory urethral caruncle usually occupies one or two quadrants of the urethra (Fig. 12-3). Urethral prolapse often is asymptomatic and requires no treatment. However, sometimes it can bleed or cause obstructive voiding symptoms requiring intervention. Surgery for urethral prolapse is similar to the procedure described earlier for distal urethrectomy with advancement meatatoplasty, except that the prolapsed urethra needs to be mobilized only to the mucosal-epithelial junction. After the prolapsed urethra is excised, a circumferential reapproximation as described previously is performed at the site of the original urethral meatus. In the case of a urethral caruncle, simple excision of the inflammatory mass with reapproximation of the cut mucosal edge to the epithelium is usually all that is necessary.

Case #1

View Video 12-1

A 59-year-old women presents with decreased force of stream and incomplete bladder emptying. She has had these symptoms for about 5 years and was previously diagnosed with urethral meatal stenosis (etiology unclear). She has been managed with periodic urethral dilations and topical estrogen. Initially, dilations relieved symptoms for about 6 months, but now they only last about 3 weeks. She is not interested in doing self-catheterization to keep the stricture open. Cystourethroscopy shows a scarred distal urethra (about 0.5 cm), and the rest appears normal. She elected to have definitive treatment with excision of the scarred distal urethra and an advancement meatoplasty, which is feasible due to the distal location of the stricture (see Video 12-1).

Surgical Technique for Blandy Urethroplasty

For strictures longer than 1 cm and those that originate in the mid-distal urethra, we prefer to perform Blandy urethroplasty. This procedure, which uses a proximally based vaginal pedicle flap, was originally described by Blandy but not reported in the literature. A description was subsequently published by Bath Schwender et al. The procedure (Video 12-2) is applicable to strictures that extend up to 2 cm from the urethral meatus. Blandy urethroplasty re-creates the ventral portion of the urethral meatus and replaces the distal ventral urethra with a flap of vaginal wall. The surgical steps are as follows:

1. The urethra is catheterized with a 14F catheter if possible, but a smaller catheter may be used if necessary.
2. An inverted-U incision is made in the anterior vaginal wall with the apex of the U at the urethral meatus (Fig. 12-4, *A*).
3. With sharp dissection, a proximally based vaginal flap is raised that is the approximate length of the stricture (2 to 3 cm) (see Fig. 12-4, *B*).
4. The proximal limit of the stricture is identified, which can be done by inserting a nasal speculum into the urethral meatus. The stricture is incised ventrally at the 6 o'clock position (see Fig. 12-4, *C*). Cystoscopy can also be used to aid in determining the limit of the stricture.
5. The apex of the vaginal flap is advanced to the apex of the incised urethra and is sutured in place with 4-0 PGA sutures (see Fig. 12-4, *D*). The edges of the vaginal flap are approximated to the urethral mucosal edges using interrupted 4-0 PGA or poliglecaprone 25 sutures (see Fig. 12-4, *E*).
6. A 14F to 16F Foley catheter is left indwelling for several days.

Case #2

View Video 12-2

A 65-year-old woman experienced difficulty voiding and was found to have a residual of 700 mL with bilateral hydronephrosis. Her urological history included recurrent urinary tract infections in her 20s that were treated with urethral dilation. About 5 years ago she began to have difficulty emptying her bladder. She was diagnosed with a urethral stricture and underwent multiple urethral dilations and one endoscopic urethrotomy, all under anesthesia. Cystoscopy showed a midurethral stricture. Videourodynamic testing was performed to assess anatomy and urethral function. The patient was found to have a closed bladder neck at rest and with a Valsalva maneuver. She voided with high-pressure, low-flow voiding dynamics, and obstruction was seen at the level of the midurethra. The stricture was too proximal for a distal urethra excision, but it was felt that because her level of continence was proximal to the stricture, the ventral urethra could be opened through the stricture. A proximally based vaginal flap (Blandy) urethroplasty was performed, and continence was maintained (see Video 12-2).

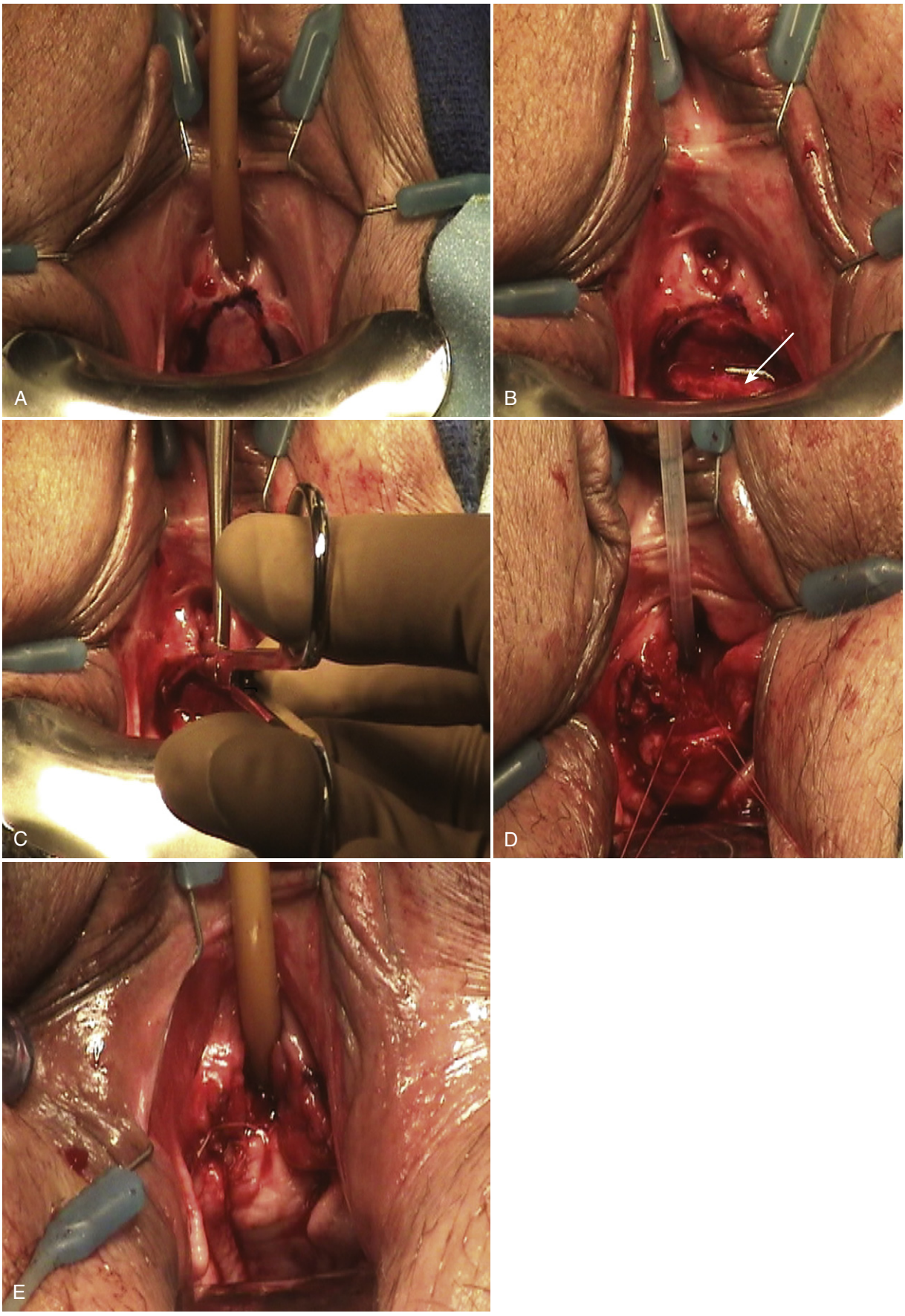


Figure 12-4 Blandy urethroplasty. **A,** The vaginal flap is outlined with a marker. **B,** The proximally raised flap is created (*arrow* shows distal end of the flap). **C,** The entire stricture is cut ventrally at the 6 o'clock position. **D,** The apex of the flap is sutured to the proximal cut edge of the stricture. **E,** Completed urethroplasty.

Outcomes

Postoperative complications after distal urethral reconstruction are generally self-limiting and include bleeding, transient urinary retention secondary to swelling, and urinary tract infection. We have seen one case of recurrent urethral prolapse in a patient who had chronic constipation and strained to void. In such patients, we recommend leaving in a catheter.

There is little in the literature regarding the outcomes for distal urethral reconstruction. Bath Schwender et al reported an 89% success rate (no further treatment necessary) in eight women who underwent Blandy urethroplasty. Montorsi et al, who used a similar vestibular pedicle flap for urethroplasty, reported that 88% of 17 women experienced relief of obstruction. We would expect similar success rates for distal urethrectomy and advancement meatoplasty. When this procedure occasionally fails, it is usually due to the re-formation of scar tissue caused by inadequate resection during the initial procedure.

Midurethral Reconstruction

The middle or proximal segment of the female urethra, between the true bladder neck and the pubourethral ligaments, contains the striated sphincter complex and levator ani insertion. Currently, we believe the most critical components of both active and passive continence are located in this important segment of the urethra. Thus, sling surgery for stress incontinence has now been targeted at the midurethra rather than the bladder neck, where pubovaginal slings were traditionally placed. Intrinsic damage to the midurethra can lead to stress incontinence, total incontinence, or stricture with resultant obstruction. The treatment of stress and total incontinence is addressed elsewhere. A discussion of reconstruction of the urethra to treat urethrovaginal fistula can be found in Chapter 14. However, some of the techniques described here can be used in urethrovaginal fistula repair. The discussion in this section focuses on reconstruction of the female midurethra in cases of stricture and urethral ablation. In general, lesions of this type in the midurethra are caused by iatrogenic injury associated with urethral diverticulectomy, incontinence surgery, or urethral instrumentation or endoscopy; radiation therapy for pelvic malignancies; trauma; or a longstanding indwelling urethral catheter (associated with loss of the middle to distal urethra).

Blandy proximally based vaginal flap urethroplasty (described earlier) can be used to treat some midurethral strictures, particularly those that are in the more distal portion of the midurethra. It is important to assess the level of continence in such patients (see Fig. 12-1). When strictures are isolated to the midurethra and do not include the distal urethra, a free graft of autologous tissue, such as buccal or lingual mucosa, may also be considered.

Surgical Technique for Urethral Reconstruction Using a Vaginal Flap

Vaginal flap urethroplasty can be used to re-create a functional urethra using local healthy tissues. This technique can also be applied in cases of a shortened urethra associated with vaginal voiding to increase urethral length. There are two variations of this technique.

In the first, a U-shaped flap of full-thickness vaginal wall, including the epithelium, is used as a patch or ventral plate of neourethra.

1. In cases of urethral stricture, a longitudinal incision is made in the anterior vaginal wall directly beneath the urethra. The urethra is exposed, and a longitudinal incision is made in the ventral urethra exposing the entire segment of

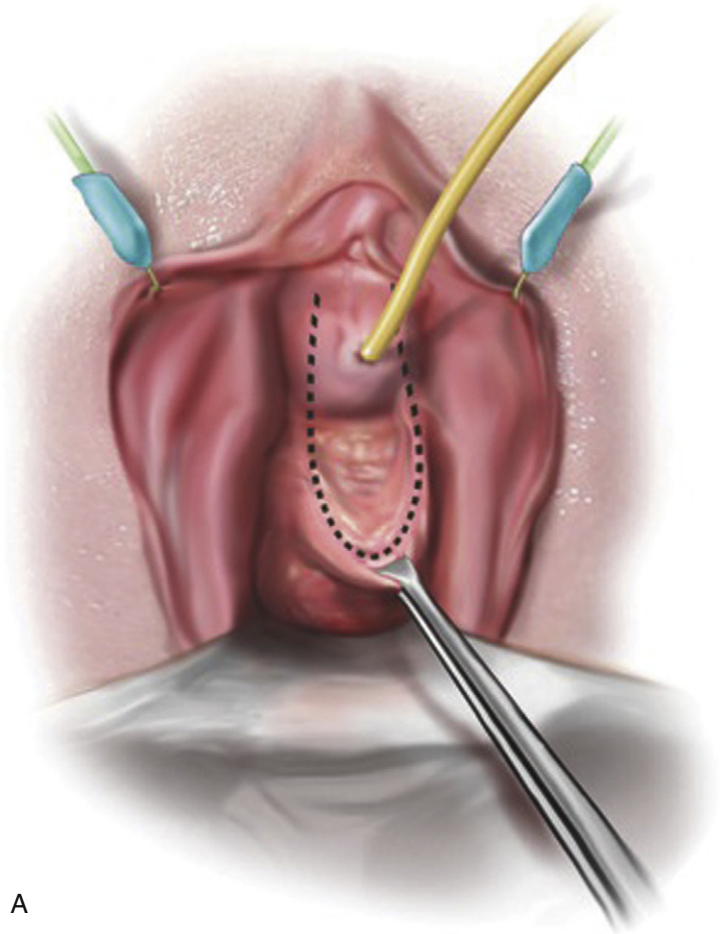


Figure 12-5 Vaginal flap urethroplasty. **A,** A U-shaped incision is made in the anterior vaginal wall. In cases of stricture, when the opened urethra will be used as the dorsal plate of the neourethra, the top of the U is at the level of the proximal part of the opened urethra. In cases of urethral ablation (shown here), the top of the U extends to the point where the neomeatus will be located.

strictured or diseased urethra until more proximal, viable tissue is identified. This will become the dorsal plate of the urethra.

2. The vaginal flap is then harvested by incising the more proximal, anterior vaginal wall in a U-shaped configuration, approximately 1.0 to 1.5 cm wide and 2 to 3 cm long (Fig. 12-5, *A*). When there is no viable middle to distal urethra, the vaginal wall distal to the urethra will serve as the dorsal wall of the neourethra and the flap as the ventral wall.
3. The flap is then flipped up and sutured to the edges of the open distal urethra (stricture) or proximal vaginal wall (ablation) using a running 4-0 PGA suture on each side (see Fig. 12-5, *B*).
4. Lateral vaginal wall flaps are made so that the anterior vaginal wall can be closed primarily, with creation of a second layer of tissue above the newly constructed urethra.
5. If desired, a pubovaginal sling fashioned of autologous fascia or biological material can be placed at the bladder neck (see later).
6. A Foley catheter is left in place for 10 to 14 days.

In cases of urethral ablation in which the anterior vaginal wall tissue proximal to the urethra is compromised, medially based flaps can be created from the vaginal wall distal to the urethra.

1. A rectangular or square island of vaginal wall is created by making lateral vertical incisions on each side and proximal and distal horizontal incisions around the urethral meatus (Fig. 12-6, *A*).

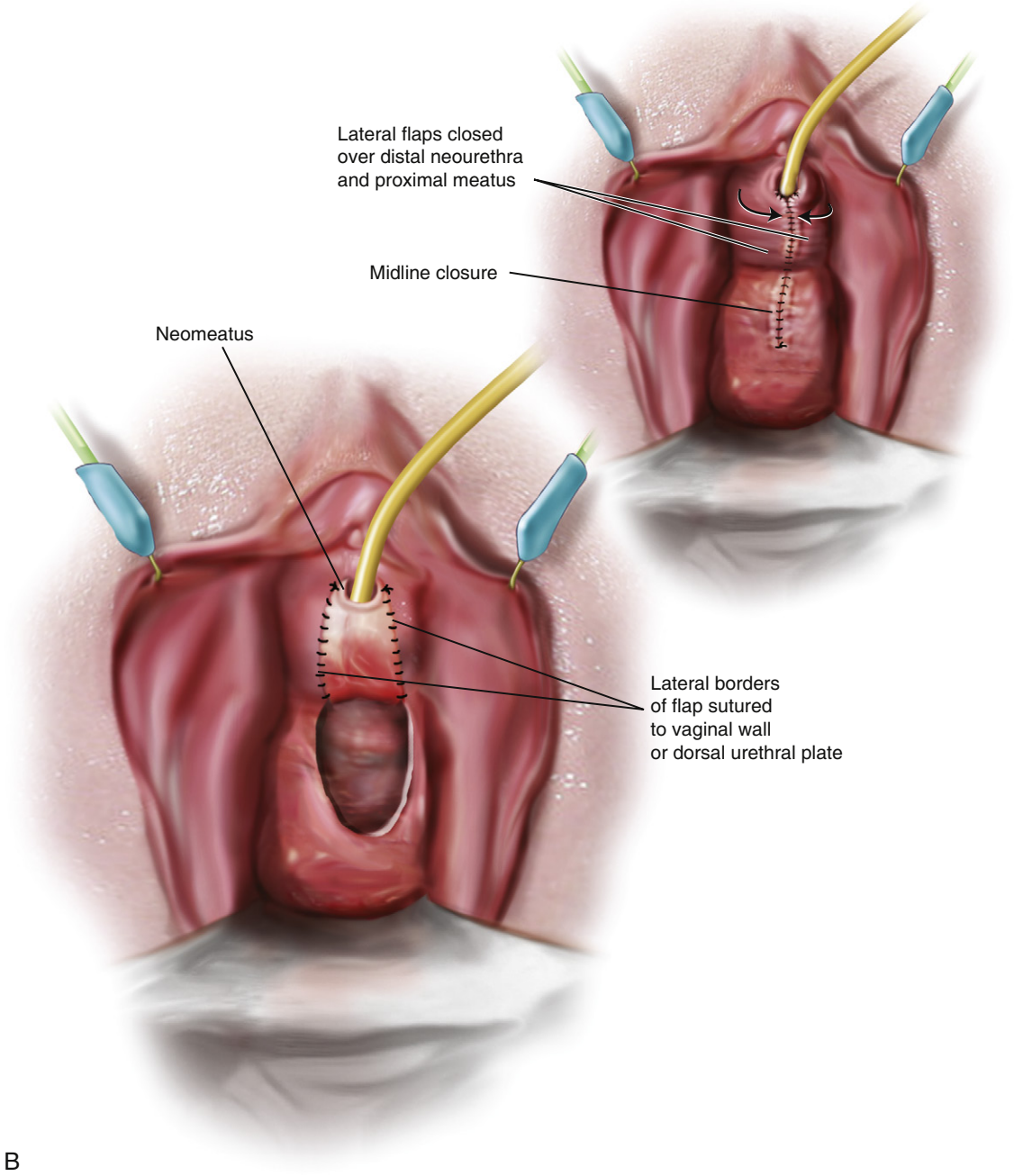
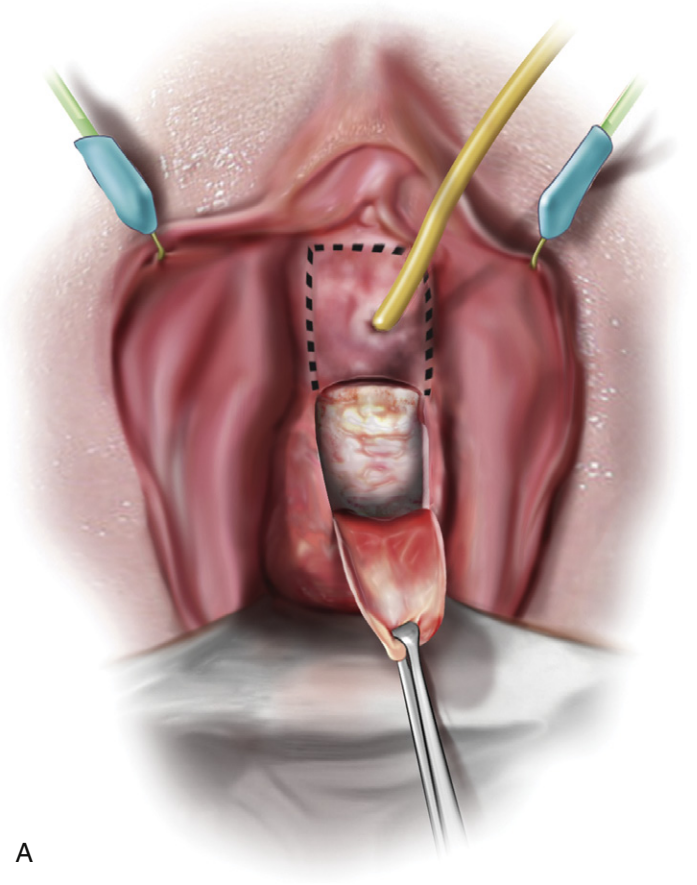
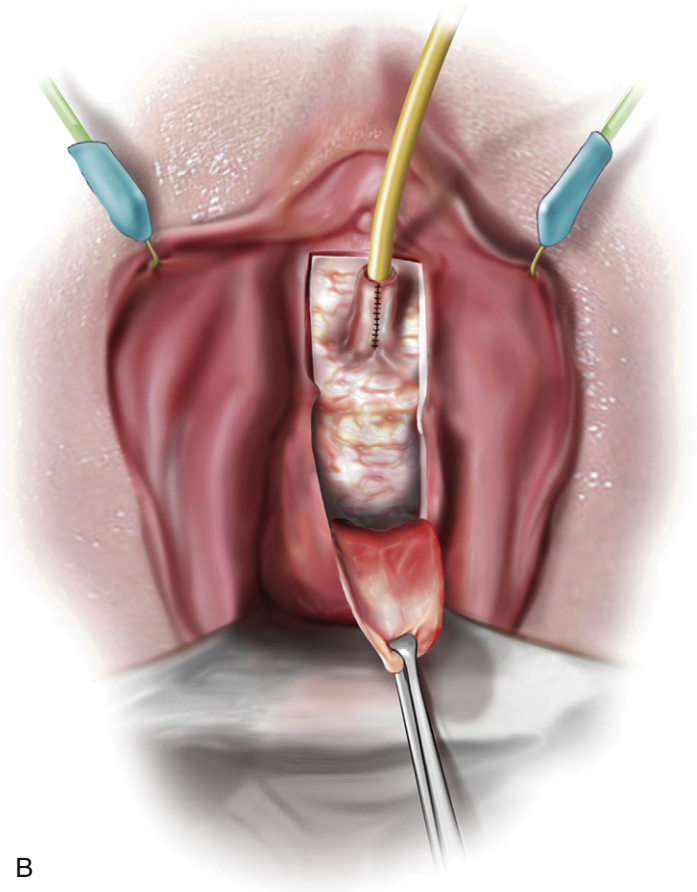


Figure 12-5, cont'd **B,** The vaginal wall flap is then transposed to the urethra or proximal vaginal wall as the ventral plate of tissue.

2. In addition an inverted-U incision is made with the apex of the U at the level of the lower border of the rectangular flap (see Fig. 12-6, *A*).
3. The rectangular flap is then mobilized by medial dissection on each side so the lateral edges can be sutured to each other in the midline, which tubularizes the flap (see Fig. 12-6, *B*). This is usually done over a 14F Foley catheter, which is left in place for 10 to 14 days.
4. The lateral vaginal flaps are sutured in the midline over the neourethra.
5. The proximal portion of the inverted-U flap is then advanced over the neourethra and closed to the lateral edges of vaginal wall, where the rectangular flap was taken to provide an additional layer of tissue (Fig. 12-6, *C*).



A



B

Figure 12-6 Vaginal wall urethroplasty. **A,** A rectangular or square island of vaginal wall is created by making lateral vertical incisions and proximal and distal horizontal incisions around the urethral meatus. In addition an inverted-U incision is made with the apex of the U at the level of the lower border of the rectangular flap. **B,** The rectangular flap is then dissected medially on both sides so that the vaginal wall can be tubularized over a catheter to create a neourethra.

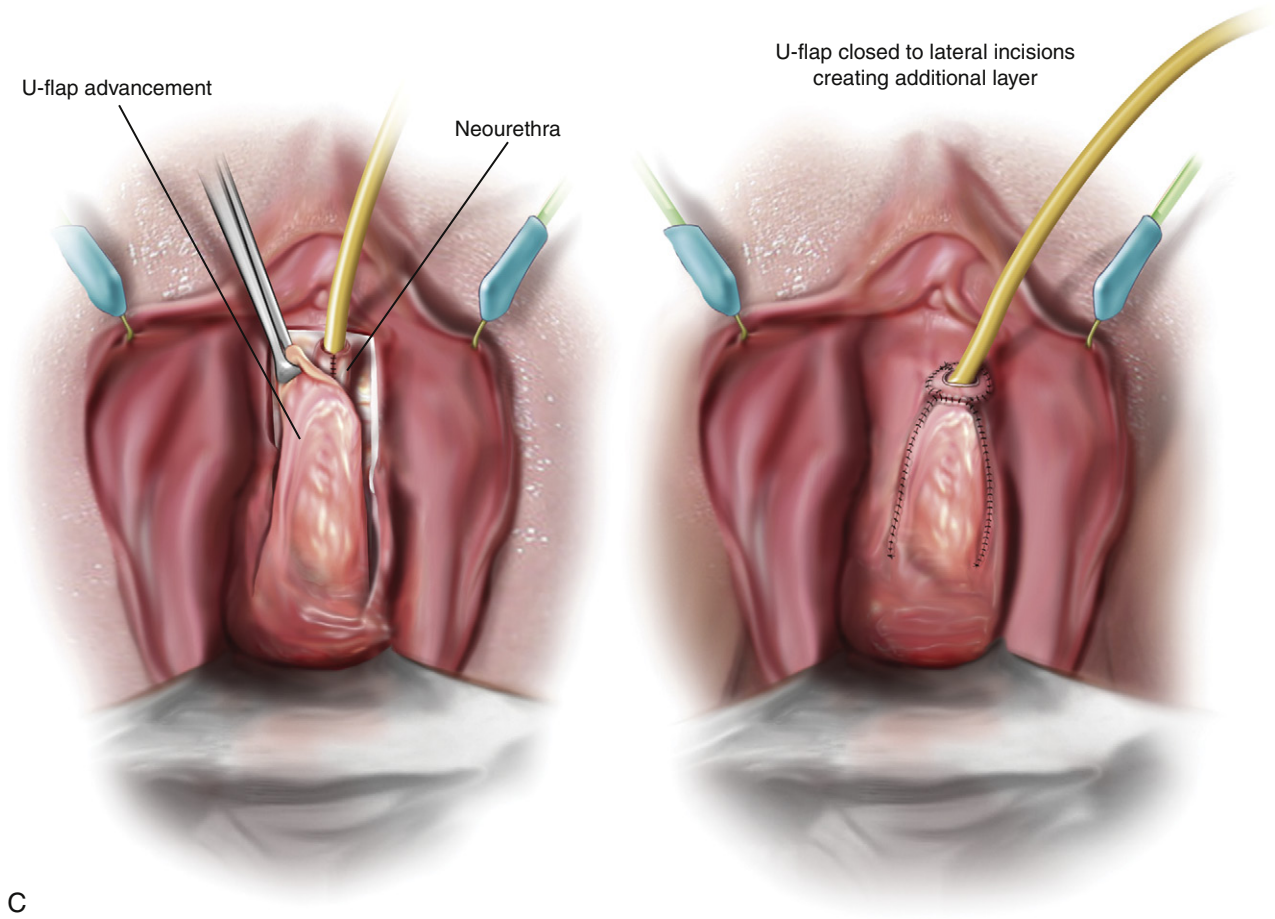


Figure 12-6, cont'd C, The proximal portion of the inverted-U flap is then advanced over the neourethra and closed to the lateral edges of vaginal wall where the rectangular flap was taken to provide an additional layer of tissue.

6. If a pubovaginal sling is desired, it can be placed before advancement of the inverted-U flap (see later).

As mentioned in the previous descriptions, in patients with preexisting intrinsic sphincter deficiency and urethral incompetence, a simultaneous pubovaginal sling procedure can be performed. In general, the use of synthetics is not advocated in the setting of urethral reconstruction, and most surgeons use autologous fascia when available. Although biologic materials such as allografts or xenografts can be used, there is little published experience with the placement of such grafts in conjunction with urethral reconstruction. Thus we prefer to use autologous fascia for this purpose. The autologous fascial sling is placed overlying the grafted tissue; when a Martius flap is also used, it is placed over the sling. A vaginal packing is kept in place for 24 hours postoperatively, and voiding cystourethrography is performed to ensure urethral patency and exclude extravasation when the catheter is removed at 10 to 14 days.

Surgical Technique for Dorsal Onlay Urethroplasty Using a Free Graft

When suitable vaginal tissue is not available for urethral reconstruction, the surgeon may consider using a free graft to patch the urethra. Buccal mucosa, which has been used extensively in male urethral reconstruction, has also

been used to reconstruct the female urethra. Lingual mucosa removed from the ventrolateral aspect of the tongue has also been used, because it is easy to harvest and has many of the same properties as buccal mucosa, and potential injury to the parotid duct and mental nerve is avoided. When a free graft is used, it is recommended that the graft be placed on the dorsal aspect of the urethra primarily because the graft will be well supported mechanically and will rest on a well-vascularized bed. Also sacculation and the risk of urethrovaginal fistula can be eliminated. The following are the steps in the procedure:

1. The urethra is cannulated with a small catheter (5F or 6F).
2. A suprameatal inverted-U incision is made to expose the dorsal urethra. Traction sutures may be placed in the urethral mucosa at the meatus at the 3 and 9 o'clock positions.
3. The urethra is sharply dissected from the vulvar mucosa, and a plane is developed between the urethra and clitoral cavernosal tissue, with care taken not to damage the bulb, clitoral body, crura, or anterior portion of the striated sphincter, which should be reflected upward.
4. The urethra is incised dorsally at the 12 o'clock position from the urethral meatus through the stricture to normal unscarred urethral mucosa (Fig. 12-7, *A*). A stay suture of 4-0 or 5-0 PGA can be placed at this point.
5. The stricture is measured so that an appropriately sized piece of buccal or lingual mucosa approximately 1.5 to 2.0 cm wide can be harvested.
6. The graft is fixed to the apex of the stricture with the previously placed stay suture.
7. The sides of the graft are sutured to the urethra with 4-0 or 5-0 PGA over an 18F Foley catheter (see Fig. 12-7, *B*). The graft can be fixed dorsally with one suture, and the augmented dorsal urethra is quilted to the clitoral body to cover the new urethral roof.
8. The vulvar mucosa is closed.

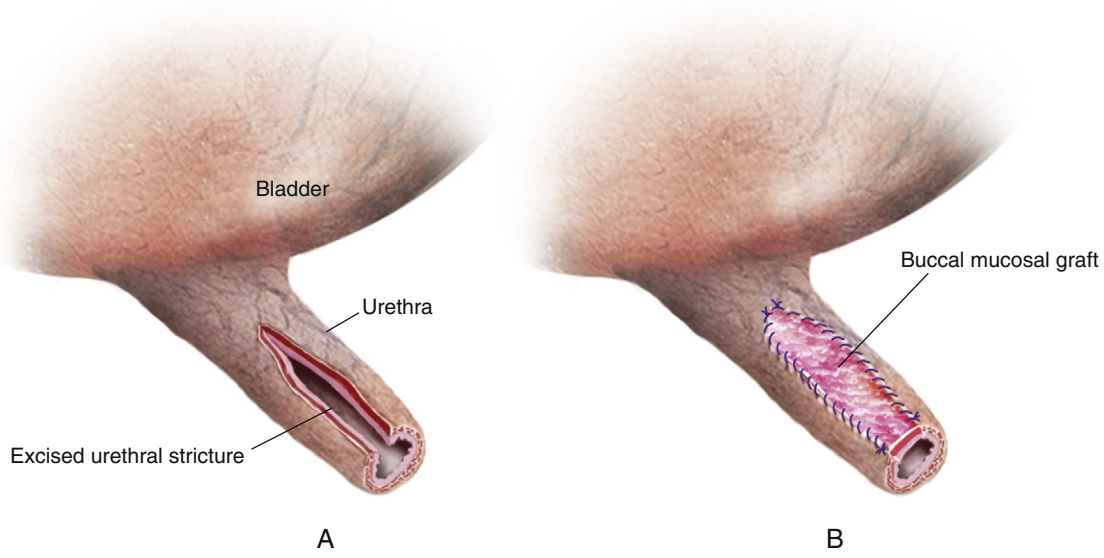


Figure 12-7 Dorsal onlay urethroplasty using buccal or lingual mucosa. **A,** The urethra is incised at 12 o'clock through the entire length of the stricture. **B,** The mucosal surface of the graft is placed into the urethral lumen and the graft is sutured to the open urethral edges with running 4-0 or 5-0 polyglycolic acid suture.

Case #3

View Video 12-3

A 73-year-old woman had a long history of urethral stricture disease with chronic decreased force of stream and incomplete bladder emptying. The cause of the stricture was thought to be inflammatory. A previous distal urethroplasty had failed to correct her symptoms. Videourodynamic testing showed a closed bladder neck at rest and with straining and a dense stricture in the proximal urethra. Cystoscopy revealed the entire length of the urethra to be strictured. The patient underwent buccal mucosal dorsal onlay graft urethroplasty (Video 12-3).

Outcomes

Success rates for vaginal flap urethroplasty are quite high. In a study by Flisser and Blaivas, the largest series reported in the literature, successful anatomical repair was achieved in 93% of 72 women. Many of these women (62 patients) were incontinent and underwent a simultaneous pubovaginal sling procedure, for which the success rate was 87%. Incontinence occurred postoperatively in 25% of the women who were continent before surgery. Potential complications of vaginal flap urethral reconstruction include recurrent urethral stricture or meatal stenosis, vaginal flap necrosis, de novo stress or urgency incontinence, vaginal shortening, and dyspareunia.

Outcome data for buccal and lingual mucosal onlay graft procedures come from relatively small series. Outcomes are reported to be quite good at short-term follow-up (1 year or less for most patients), with success, defined as unobstructed voiding, reported in 93% to 100% of patients. Meatal stenosis requiring urethral dilation occurred in one patient.

Surgical Treatment for Lesions of the Bladder Neck and Proximal Urethra

The bladder neck and proximal urethra are made up primarily of smooth muscle oriented in a circular fashion. This intrinsic involuntary sphincter maintains passive continence. This intrinsic involuntary sphincter maintains passive continenced, supplementing the action of the striated urethral sphincter. Failure of the bladder neck sphincter mechanism can be related to age, childbirth, neurological disease, congenital anomalies, or pelvic surgery. Mild bladder neck insufficiency can often be overcome by an intact urethral sphincter; however, more severe bladder neck incompetence (often associated with complete urethral sphincter failure) can require bladder neck reconstruction. Reconstruction of the bladder neck to restore continence can be accomplished in several ways depending on the severity of incontinence, its underlying cause and associated anatomical defects, and the goals of surgical correction. In adults the two most common antiincontinence procedures are pubovaginal sling placement, for cases in which an adequate urethra is present, and surgical closure of the bladder neck, for cases in which pubovaginal sling placement with or without distal urethral reconstruction is not feasible or desired.

Surgical Technique for Pubovaginal Sling Placement

Traditionally, pubovaginal sling surgery has been used to treat intrinsic sphincter deficiency and stress urinary incontinence, with concomitant correction of hypermobility and restoration of posterior urethral support. Because a pubovaginal

sling procedure is often performed in conjunction with urethral reconstruction, the technique is briefly described here. Sling materials include autologous fascia, allografts, xenografts, and synthetic implants. The most common pubovaginal sling technique involves harvesting a graft of autologous fascia, generally rectus abdominis fascia or fascia lata, fashioned into a strip 2 cm by 8 to 12 cm.

1. A Foley catheter is inserted. With the patient in the dorsal lithotomy position, an inverted-U or longitudinal midline incision is made in the anterior vaginal wall at the level of the bladder neck, which can be identified by palpation of the balloon of the Foley catheter.
2. The vaginal wall is dissected off the periurethral fascia to the endopelvic fascia laterally on both sides.
3. The endopelvic fascia is perforated on each side with Metzenbaum scissors (aimed toward the ipsilateral shoulder), and the retropubic space is entered.
4. An autologous fascial sling may be harvested from the anterior rectus abdominis fascia (from a separate incision) or from the fascia lata before the vaginal incision is made. Alternatively, a sling made of a biological material can be used. Nonabsorbable sutures are placed at either end. The sling is positioned under the bladder neck by passing an instrument (Raz-Pereyra or Stamey needle or long clamp) through the rectus fascia and retropubic space on each side (under finger guidance) and grasping the suture on either end of the sling. The bladder should be relatively nondistended to avoid inadvertent cystotomy.
5. Cystoscopy should be performed after sling suture passage to ensure bladder integrity and assess for the presence of suture material within the bladder lumen.
6. The sling is secured proximally to the perivesical fascia at the level of the bladder neck and distally to the periurethral fascia at the level of the midurethra with 3-0 PGA sutures. The sling sutures are then tied across the midline, above the rectus abdominis fascia, to avoid excessive tension on the bladder neck. The Foley catheter is left in place postoperatively until normal voiding ensues, generally from several days to weeks.

Case #4

View Video 12-4

A 64-year-old woman experienced severe stress incontinence 4 months after an obstructing transobturator synthetic sling was removed because it had eroded at the bladder neck. Bladder neck reconstruction was done at the time of excision. In a second surgery, an autologous fascial pubovaginal sling was placed to treat her incontinence without the use of mesh because of the prior complication (Video 12-4).

Surgical Technique for Transvaginal Bladder Neck Closure

Surgical closure of the bladder neck in women is indicated in cases of extensive urethral destruction, usually caused by long-term use of an indwelling urethral catheter in cases of neurogenic bladder or severe trauma. Progressive urethral dilatation leads to chronic, intractable incontinence around an indwelling catheter, with associated perineal excoriation and chronic urinary tract infection. Bladder neck closure can be readily accomplished via a transvaginal approach and is combined with creation of a continent catheterizable stoma or incontinent ostomy (ileovesicostomy), or placement of an indwelling suprapubic catheter.

Transvaginal bladder neck closure is performed with the patient in the dorsal lithotomy position. Initially, the surgeon may perform a suprapubic cystotomy unless another form of bladder drainage has been established, such as a continent stoma (e.g., Mitrofanoff stoma) or an incontinent stoma (e.g., ileal bladder chimney). A simple percutaneous suprapubic cystotomy or cystotomy by open technique can be used as indicated. The technique for transvaginal bladder neck closure is as follows:

1. An incision is made in the anterior vaginal wall that circumscribes the damaged urethra and extends onto the anterior vaginal wall in an inverted-U configuration (Fig. 12-8, *A*). This allows creation of an anterior vaginal wall flap by dissection from the underlying perivesical and periurethral fascia.
2. The inverted-U flap is taken down as a proximally based vaginal flap.

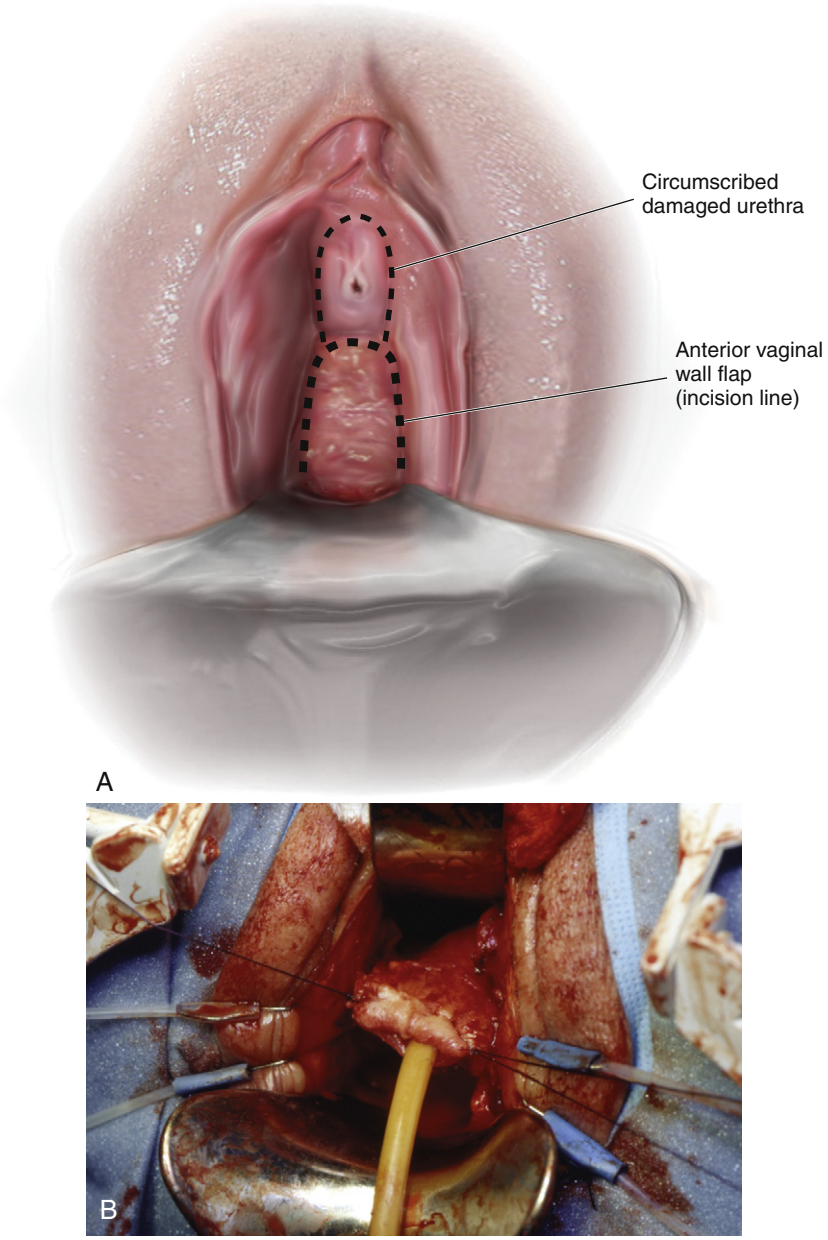
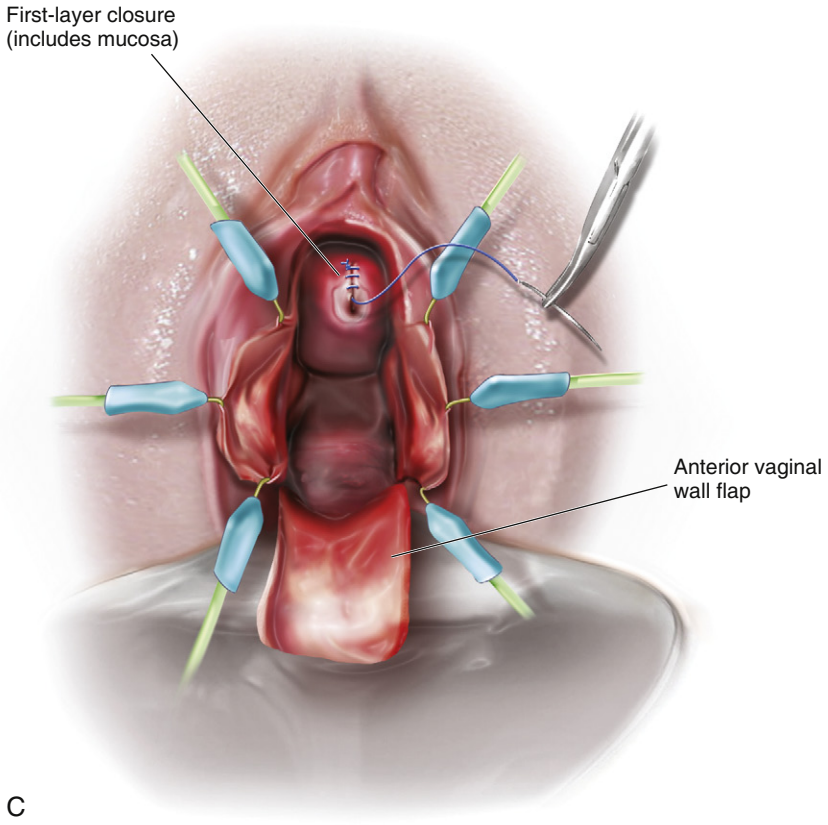


Figure 12-8 Bladder neck closure. **A,** A circumscribing incision is made around the urethral meatus or remnant and an inverted-U incision is made on the anterior vaginal wall. **B,** After the endopelvic fascia is perforated, the urethra is mobilized to the bladder neck, with the pubourethral ligaments cut during this mobilization. Here the urethra is almost of normal length, but often the urethral remnant is 1 cm or less.

Continued

Figure 12-8, cont'd **C,** After the urethra is excised, a longitudinal closure of the bladder neck incorporating the mucosa and muscle is carried out with 2-0 polyglycolic acid suture (PGA). **D,** A second-layer transverse closure of the seromuscular layer is performed using interrupted Lembert sutures of 2-0 PGA. This suture line should be positioned behind the symphysis pubis.



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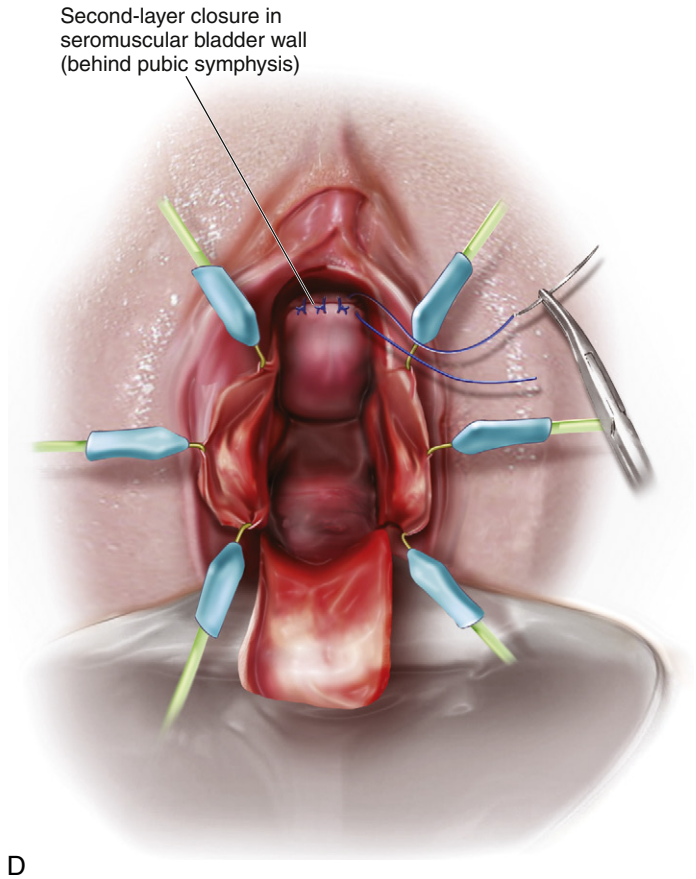

D

3. The vaginal wall is dissected laterally off the periurethral fascia. The endopelvic fascia is perforated on each side, and the retropubic space is entered.
4. The urethra is mobilized from the meatus to the bladder neck (see Fig. 12-8, *B*). The pubourethral ligaments are cut during this mobilization. Traction sutures can be placed at the 3 and 9 o'clock positions depending on the length of the urethra. In cases of bladder neck closure, the remaining urethra is often 1 cm or less.
5. Indigo carmine may be administered intravenously to allow cystoscopic visualization of the ureteral orifices and their proximity to the bladder neck.
6. The remaining damaged urethra is excised.
7. The bladder neck is closed in two layers. The first layer is a running suture of 2-0 PGA that includes the mucosa (see Fig. 12-8, *C*).
8. The second layer is interrupted 2-0 PGA sutures placed in the seromuscular bladder wall (see Fig. 12-8, *D*). The second suture line extends from the bladder neck to the anterior bladder wall behind the pubic symphysis, so that the closed bladder neck is placed in the retropubic space. This avoids direct apposition of suture lines, which may lead to fistula development.
9. If the vaginal and perivesical tissues are compromised because of chronic infection or prior radiation therapy, additional tissue interposition can be accomplished by placing a Martius labial fat pad flap between the bladder neck and vaginal wall.
10. The anterior vaginal wall flap is advanced and closed.
11. A vaginal packing impregnated with antibiotic cream is left in place for 24 hours postoperatively.

Outcomes

The number of published reports on bladder neck closure is not large, but success rates are high. Zimmern et al reported a 100% success rate in six women undergoing the surgery. One potential complication of this procedure is bleeding from retropubic vessels, which can be difficult to control. When this happens, the procedure should be completed expeditiously. Other complications include ureteral injury (which can be minimized by giving indigo carmine and clearly visualizing the ureteral orifices and vesicovaginal fistula formation.

Case #5

View Video 12-5

A 48-year-old paraplegic woman with an L1 spinal cord injury had severe urinary incontinence. Her injury occurred 20 years ago and for 18 years she was managed, by choice, with an indwelling urethral catheter. Over the years she began to experience increasing incontinence around the catheter, so it was progressively upsized. Eventually she could not hold the catheter in anymore, even with the balloon maximally inflated. The catheter was replaced by a suprapubic tube, but she still had significant leakage via the urethra. On physical examination the patient was found to have a patulous, short urethra (a finger could be placed into the bladder) with continuous leakage. Much of the urethra (and all of the functional urethra) was eroded. The urethra was felt to be too short for placement of a tight pubovaginal sling, and the patient did not want to catheterize herself through the urethra. Bladder neck closure became a viable option. The patient was offered simultaneous bladder augmentation with creation of a continent, catheterizable stoma but opted to keep the suprapubic tube after bladder neck closure (Video 12-5).

Suggesting Readings

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Treatment of Obstruction Following Stress Incontinence Surgery

13

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Victor W. Nitti, MD

Videos

13-1 Incision of a Pubovaginal Sling
13-2 Isolation and Incision of a Synthetic Midurethral Sling
13-3 Transvaginal Urethrolysis

Because of greater public awareness, more and more women are actively seeking treatment for stress urinary incontinence (SUI). This increase, combined with the availability of newer surgical techniques associated with less morbidity, has led to a rise in the use of surgery to treat SUI and a concomitant increase in the number of patients with postoperative voiding problems. The true incidence of voiding dysfunction and iatrogenic obstruction after SUI surgery is likely unknown and probably underestimated because of underdiagnosis, misdiagnosis, variations in definition, and underreporting. Reported rates of obstruction vary depending on the type of surgery performed (Table 13-1). Urinary obstruction requiring intervention will occur in at least 1% to 2% of patients after any SUI surgery, even when performed by an experienced surgeon.

Voiding dysfunction following SUI surgery is related to obstruction, detrusor overactivity, or impaired contractility. Iatrogenic obstruction is most commonly the result of technical factors. With sling procedures, obstruction is usually caused by excessive tension on the sling around or under the urethra. The sling can also become dislodged and displaced from the intended position, producing obstruction. During retropubic urethropexy, sutures placed medially can lead to urethral deviation or periurethral scarring resulting in obstruction. Sutures placed distally can cause kinking of the urethra with resultant obstruction and an inadequately supported bladder neck or proximal urethra, and potentially lead to continued SUI. "Hypersuspension" or overcorrection of the urethrovesical angle can also result from excessive tightening of the periurethral sutures. Vaginal prolapse that is not recognized and corrected at the time of sling surgery can also lead to obstruction via kinking or external compression. Learned voiding dysfunction with

Table 13-1. Reported rates of obstruction after various sling procedures

	TVT (%)	Trans-obturator Tape (%)	TVT-O (%)	TVT-Secur (%)	Pubovaginal Sling (%)	SPARC (%)	Retropubic Suspension (%)	Transvaginal Needle Suspension (%)
Urinary retention (including transient obstruction that may not be clinically relevant)	0-43	0-7.8	0-10.3	2-8	2-47	0-18.1	3-7	4-8
Retention requiring CIC >1 wk	8.0-17.6	0-10	N/A	N/A	N/A	31.3	N/A	N/A
Obstruction >4-6 wk	11.2	0-2.9	N/A	N/A	6-28	N/A	3-7	4-8
Obstruction requiring intervention	0-14.8	0-2.1	N/A	0-2	2-10	6.5-18.8	N/A	N/A

CIC, Clean intermittent catheterization; *N/A,* not available; *SPARC,* SPARC Self-Fixating Sting System (American Medical Systems, Minnetonka, MN); *TVT,* GYNECARE TVT Retropubic System (Ethicon Women's Health and Urology, Sommerville, NJ); *TVT-O,* Gynecare TVT Obturator System Tension-Free Support for Incontinence (Ethicon Women's Health and Urology); *TVT-Secur,* Gynecare TVT Secur System (Ethicon Women's Health and Urology).

failure of external sphincter relaxation after surgery can produce functional obstruction. Finally, impaired contractility can be responsible for a relative obstruction.

Patients with iatrogenic obstruction following SUI surgery may have a variety of signs and symptoms. The most obvious are complete or partial urinary retention, the inability to void continuously, or a slow stream with or without intermittency. However, many women do not have obstructive voiding symptoms and experience mainly the storage symptoms of frequency, urgency, and urgency incontinence. It is believed by some that storage symptoms associated with obstruction develop as a result of either acquired parasympathetic denervation or alterations in cholinergic and purinergic afferent pathways. Women may also have a combination of voiding and storage symptoms. Thus, in any case of de novo voiding and/or storage symptoms, the diagnosis of obstruction should be entertained.

Transient voiding dysfunction and urinary retention are common after certain SUI surgeries (e.g., traditional procedures like pubovaginal sling). Because of this, it is difficult to determine the appropriate timing of evaluation and intervention for suspected obstruction following such SUI procedures. Traditionally evaluation was delayed for at least 3 months after surgery. This practice was based on the literature on pubovaginal sling placement, colposuspension, and needle suspension, which indicated that recurrent SUI following intervention could be minimized by waiting at least 90 days before evaluation of obstructive symptoms because spontaneous resolution of symptoms commonly takes 3 months. However, the waiting period that was advocated after these traditional procedures has largely been abandoned for retropubic, transobturator, and single-incision synthetic midurethral sling procedures. Because of the immobility and contraction of the mesh as well as in-growth of fibroblastic tissue at 1 to 2 weeks, patients with retention or severe symptoms are less likely to improve beyond this period. After retropubic and transobturator tape procedures, temporary voiding dysfunction has been reported to resolve in 25% to 66% of patients in 1 to 2 weeks and in 66% to 100% of patients by 6 weeks. Based on these data and our experience, waiting beyond 6 weeks for workup and intervention seems unwarranted. Some would also argue that because up to 66% of patients can be expected to experience resolution of their symptoms within 2 weeks, workup and possible

intervention are warranted at the 2-week mark or earlier (in cases of complete inability to void) after discussion with the patient about her symptoms, level of bother, and willingness to risk possible intervention. In our practice, if a patient is unable to void spontaneously (i.e., has urinary retention) within 1 week after a retropubic or transobturator tape procedure, we will consider and discuss loosening the sling in cases in which simultaneous pelvic organ prolapse repair was not done.

For a patient with suspected obstruction, the workup should include a focused history taking, physical examination, and measurement of postvoid residual. The workup may include uroflowmetry, cystourethroscopy, and urodynamic testing in selected cases. Key points to address in the history taking are the patient's preoperative voiding status and symptoms, and the temporal relationship of new symptoms to the SUI surgery. The type of procedure and relative risk of obstruction associated with that procedure should be considered and the risk of obstruction determined. If the patient is straining to void, she should be instructed to stop this behavior, because SUI surgeries are designed to stop the flow of urine with abdominal straining. Physical examination should focus on determining the angulation of the urethra and detecting any signs that it may be kinked or hypersuspended. However, most patients will not appear to be overcorrected after a midurethral sling procedure. Patients should be examined for prolapse, urethral hypermobility, and recurrent stress incontinence. Cystourethroscopy may be performed to rule out the presence of any sling material in the urethra or bladder as well as to evaluate for any scarring, narrowing, occlusion, kinking, or deviation. Urodynamic evaluation can be performed if there is doubt regarding the diagnosis based on the history, physical examination, and noninvasive testing (measurement of urine flow and postvoid residual). Unfortunately, no universally accepted urodynamic criteria exist for bladder outlet obstruction. A finding of classic high-pressure, low-flow voiding dynamics confirms the diagnosis, but this is not always present even with significant obstruction because of the differing voiding dynamics in women and men. For patients with complete or significant retention who emptied normally before surgery, urodynamic testing is of minimal diagnostic benefit, and often the results do not affect treatment. The usefulness of urodynamic testing for patients with retention is limited and should not be used to exclude patients from an intervention, even if detrusor contraction or high-pressure, low-flow voiding dynamics are absent. For patients with predominately de novo storage symptoms who have normal emptying, urodynamic testing can help identify or rule out obstruction. Videourodynamic testing is preferable to standard urodynamic testing because it allows the site of obstruction to be identified by fluoroscopy regardless of pressure-flow dynamics.

Loosening of a Synthetic Midurethral Sling

In women with postoperative urinary retention following synthetic midurethral sling procedures, some surgeons advocate early intervention within 7 to 14 days after surgery. After placement of synthetic midurethral slings (retropubic, transobturator, and single-incision slings) the vast majority of patients should be able to void spontaneously within 72 hours. Early sling loosening can be performed in a minimally invasive procedure under local anesthesia in the office setting or operating room. Early sling loosening is recommended only for women who are dependent on catheterization to empty the bladder.

Surgical Technique for Synthetic Sling Loosening in the Acute Setting (7 to 14 Days After Surgery)

1. Place the patient in the lithotomy position and prepare the vagina in a sterile fashion.
2. Infiltrate the anterior vaginal wall with local anesthetic.
3. Cut the suture used to close the vaginal wall and open the prior incision.
4. Identify the sling and hook it with a right-angle or other small clamp.
5. Spread the clamp or apply downward traction to loosen the tape 1 to 2 cm.
6. If the sling cannot be loosened, cut it in the midline.
7. Close the incision with running absorbable suture.

The described procedure can be performed in the office if the patient is cooperative. However, if the patient is anxious or unwilling, it can be done in the operating room with intravenous sedation and local anesthesia. It is best to perform the procedure within 10 to 14 days of surgery, because after this time tissue ingrowth may prevent loosening. In such a case we recommend cutting the sling in the midline.

Incision of a Biological or Synthetic Sling

Transvaginal sling incision can be used for traditional pubovaginal slings (autologous, xenograft, or allograft) as well as synthetic midurethral slings. Sling incision is the treatment of choice for treatment of obstruction caused by a pubovaginal sling or synthetic midurethral sling in the nonacute setting.

Important considerations include the following:

1. Confirm the type of sling in place. If a synthetic sling was used, the brand will determine the color of the sling, and this knowledge can help identify the sling type.
2. Obtain adequate exposure. An inverted-U incision provides the best exposure for a pubovaginal sling, but a midline incision can also be used. A retractor such as a Lone Star will aid exposure.
3. The sling should be identified and isolated. It may be encased in scar or may be under significant tension and difficult to identify. Careful dissection is required to identify the sling. A cystoscope or sound may be placed into the urethra with upward retraction to expose the sling by isolating the axis of tension and indention on the urethra. Some biological slings may not be identified because of autolysis. In such cases the surgeon may proceed to urethrolysis. *All synthetic slings must be definitively identified.*

Surgical Technique for Sling Incision

1. Cystoscopy is performed to assess the urethra and rule out erosion or urethral injury.
2. An inverted-U or midline incision is made to expose the area of the bladder neck and proximal urethra.
3. Careful dissection is performed to isolate the sling. Injury to the urethra can be avoided by beginning the dissection distally to identify normal urethra and then proceeding proximally to identify and isolate the sling. It should be kept in mind that when there is no urethral erosion, in most cases the sling will be superficial to the periurethral fascia.

4. Usually the sling is isolated in the midline. However, if the sling is extremely tight, it can be isolated lateral to the urethra to avoid urethral injury.
5. Once the sling is isolated, it should be separated off the underlying periurethral fascia with sharp or blunt dissection. Pubovaginal slings are usually wider than synthetic midurethral slings and usually require more dissection. The dissection can be facilitated by grasping the sling with an Allis clamp on either side of the midline and exerting downward pressure.
6. A right-angle clamp is placed between the sling and the urethra and is used to lift the sling off of the periurethral fascia (Fig. 13-1). If there is dense scarring between the sling and the urethra and the plane between the two cannot be easily developed, the sling can be isolated lateral to the midline.
7. For biological slings, after isolation the sling is cut in the midline or lateral to the midline.
8. In cases of a very tight synthetic sling, dissection can be more challenging because the sling may be ingrown with fibrotic tissue (Fig. 13-2). In some cases the sling may roll up and may be only 1 to 2 mm wide (Fig. 13-3). In these situations, it may be necessary to pull the urethra proximally and distally from the midline to find the buried sling. After isolation, the synthetic sling is clamped with two small clamps on either side of the midline, and the sling is then cut in the midline.
9. For both synthetic and biological slings the cut edges of the sling are mobilized off the periurethral fascia and to, but not through, the endopelvic fascia and are then excised. This will preserve the lateral support of the urethra, because the retropubic space is not entered. We recommend obtaining pathological confirmation of the identity of the excised portion of a synthetic sling. If the procedure is unsuccessful, then it is clear that the sling was cut.
10. The urethra is assessed for injury externally and internally with urethroscopy. In cases in which the sling is deep to the periurethral fascia, it can be ingrown into the wall of the urethra. In such cases a urethrotomy may occur, or may even be necessary to access the sling. In such cases, the urethra should be closed primarily with adsorbable sutures.
11. The vaginal incision is closed.

Case #1

View Video 13-1

A 45-year-old woman experienced urinary retention and urgency incontinence 3 months after a urethral diverticulectomy and placement of an autologous fascial pubovaginal sling. She was able to void only small amounts and needed to self-catheterize four times a day. Between catheterizations, she had episodes of urgency incontinence. Before her earlier surgery she voided and emptied normally but had recurrent urinary tract infections because of a 2-cm ventrally located midurethral diverticulum and wore two pads per day for her stress incontinence. Postoperatively her emptying had not improved after her catheter was removed, and she was instructed on self-catheterization. Current cystoscopic findings were unremarkable and MRI showed no persistent diverticulum. Exploration revealed the sling to be in proper position at the bladder neck, but it was clearly tight. Successful sling incision resulted in spontaneous and complete voiding with a recurrence of mild stress incontinence. (See Video 13-1 for a demonstration of pubovaginal sling incision.)

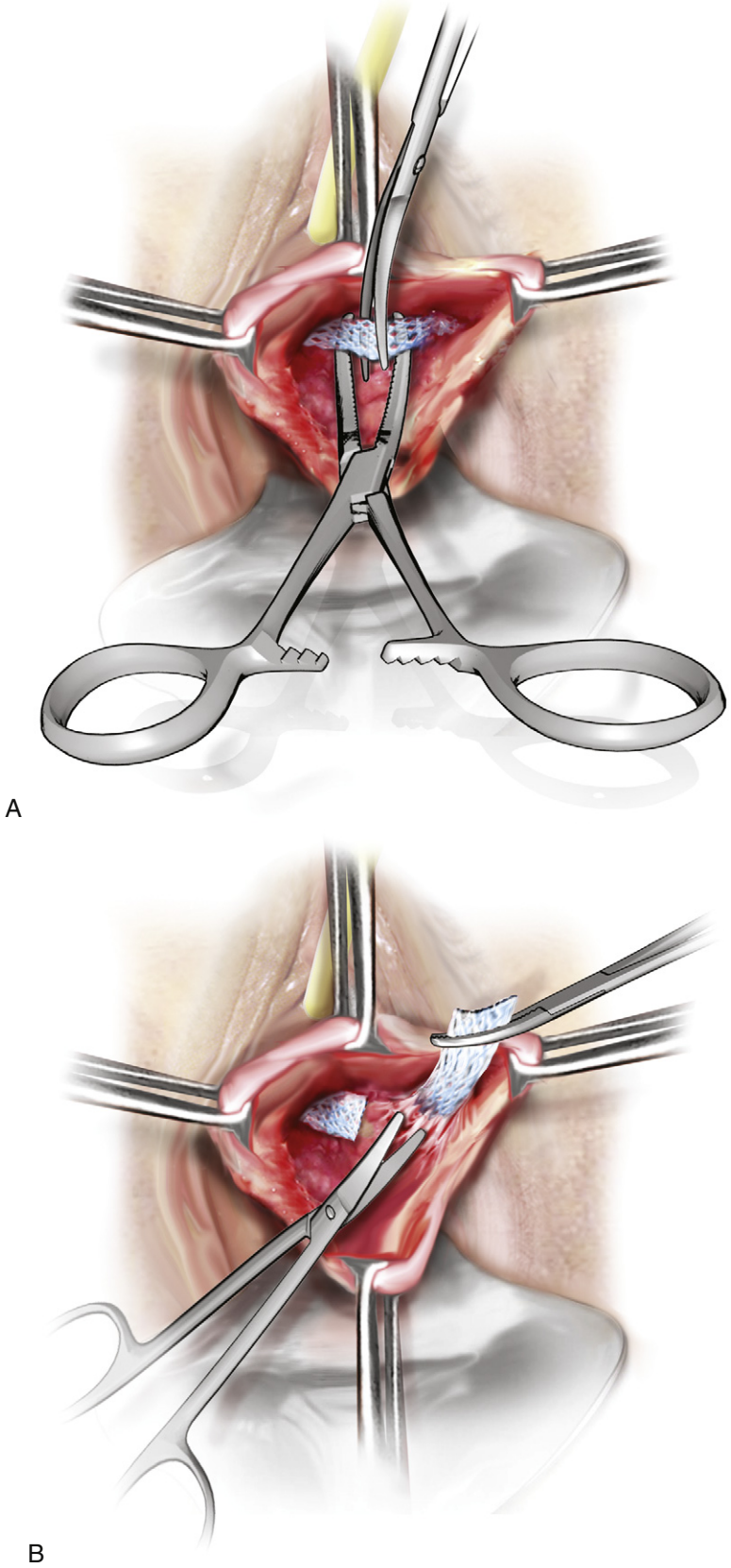

Figure 13-1 Sling incision. **A,** The sling is isolated in the midline superficial to the periurethral fascia and is cut in the midline. **B,** The sling is then mobilized laterally to the periurethral fascia on each side and the suburethral portion on each side is excised. Although a midurethral synthetic sling is shown here, the same technique applies to a biologic or autologous fascial sling at the bladder neck.

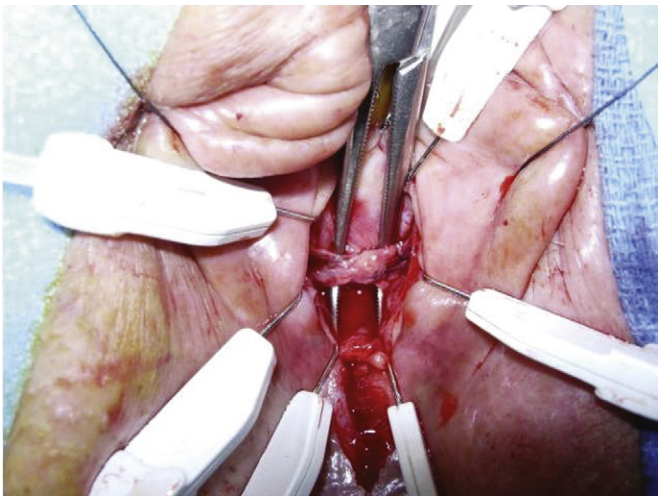

Figure 13-2 Obstructing midurethral sling 11 months after placement. Note the ingrowth of fibrous tissue.

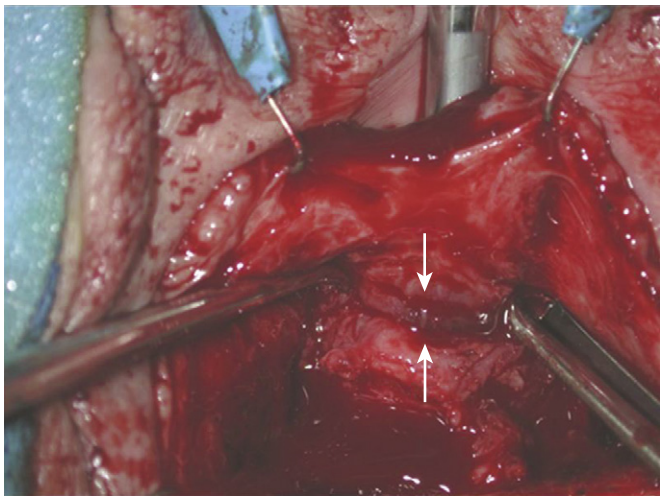

Figure 13-3 Obstructing midurethral synthetic sling that has rolled up into a tight band (*between arrows*).

Case #2

View Video 13-2

A 48-year-old woman came for treatment 4 months after undergoing a transvaginal pelvic organ prolapse repair (anterior and posterior repair with sacrospinous ligament fixation) and placement of a retropubic midurethral synthetic sling. After having an indwelling catheter for 6 weeks, she was placed on a regimen of self-catheterization because of her inability to void. Two months after the initial surgery she underwent a second procedure in which "vaginal scar tissue" was removed. There was no change in symptoms. One month later a third procedure was performed. The operative report stated that the sling was cut and the suburethral portion of the tape was excised. The excised tissue, which was sent to the pathology laboratory, was found to contain "fragments of granulation tissue with focal foreign-body giant cell reaction and chronic inflammation." No sling material was identified. There was again no change in symptoms, and the patient continued to experience urinary frequency, almost constant urgency, urgency incontinence, small-volume voids, and incomplete emptying. She needed to catheterize at least twice daily for volumes of 250 to 400 mL. Physical examination showed a healing vagina with good anterior, apical, and posterior support. Videourodynamic testing revealed a high-pressure voluntary detrusor contraction (over 150 cm H_2O) with minimal flow and no opening of the bladder neck or urethra. High-grade obstruction was confirmed, and further surgery to relieve obstruction was recommended. (See Video 13-2 for a demonstration of how to isolate and excise a synthetic sling.)

Transvaginal Urethrolysis

Formal urethrolysis is performed when it is necessary to completely free the urethra from the surrounding tissue and the pubic bone. It is most commonly done as a primary procedure in cases of obstruction caused by urethral suspension (e.g., Burch colposuspension, transvaginal urethral suspension) in which a sling is not used and in cases in which a biologic sling (autologous tissue, allograft, or xenograft) cannot be identified. It is most frequently used as a secondary procedure in cases in which sling incision provides the most successful primary treatment. When a synthetic sling has been placed, performing transvaginal urethrolysis without identifying the sling can result in failure to relieve obstruction, because the synthetic sling can roll up and be missed. In these cases it is critical to identify and incise a synthetic sling that has not been previously cut. In most cases, we prefer a transvaginal approach to urethrolysis because of its ease, relatively low morbidity, and shorter recovery time compared with an abdominal procedure. A retropubic approach may be best in selected cases; for example, when the original SUI surgery was associated with bladder perforation, fistula, significant retropubic hematoma, or another relevant complication. Retropubic urethrolysis also is preferred by some surgeons when obstruction is caused by retropubic incontinence surgery (Burch colposuspension or Marshall-Marchetti-Krantz procedure), when a synthetic sling needs to be removed because of infection or bladder erosion, and when prior transvaginal urethrolysis has failed. Retropubic urethrolysis is the preferred route when adequate transvaginal access is not possible.

In some patients undergoing transvaginal urethrolysis, the surgeon may choose to interpose tissue between the urethra and pubic bone to prevent rescarring. A Martius flap may be used for this purpose. We reserve the use of a Martius flap for select cases (e.g., repeat urethrolysis or extensive fibrosis) and divide the robust flap along its longitudinal axis and wrap it around the urethra, which effectively supports the undersurface and retropubic surface of the urethra. In very select cases it may also be desirable to resupport the urethra. Resuspension or sling placement is considered if the patient had SUI before urethrolysis or if support structures are severely compromised during urethrolysis and the patient desperately desires continence. In most patients, however, the obstruction causes the most bothersome symptoms and distress, and in these women it is our preference to deal with the recurrent SUI at a later time if the patient is agreeable.

Surgical Technique for Transvaginal Urethrolysis

1. A thorough endoscopic evaluation of the urethra and bladder to identify any eroded sutures, eroded slings, or fistula is performed first.
2. A midline or inverted-U incision is made that is approximately 3 cm long and extends from the midurethra to 1 to 2 cm proximal to the bladder neck. The apex of the inverted-U incision should be halfway between the bladder neck and the urethral meatus, and the flap should be raised 1 to 2 cm proximal to the bladder neck.
3. Lateral dissection is performed along the glistening surface of the periurethral fascia to the pubic bone.

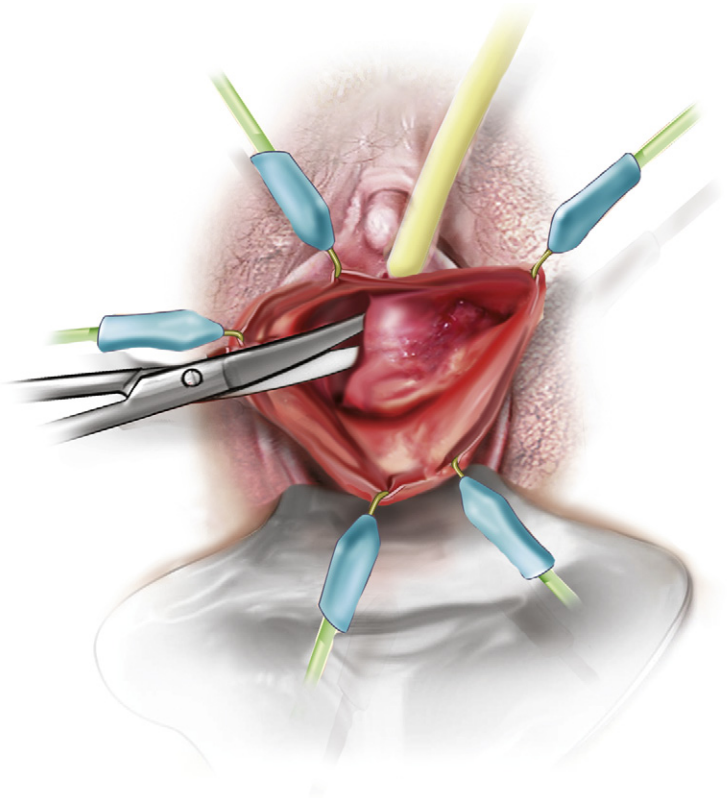

Figure 13-4 Transvaginal urethrolysis. After the endopelvic fascia is perforated and the retropubic space is entered on both sides of the urethra, sharp dissection is used to establish the plane between the urethra and the pubic bone. After that plane is established, a combination of sharp and blunt dissection is used to free the urethra from the undersurface of the pubic bone until a finger can be placed between the pubic bone and urethra.

4. The retropubic space is entered sharply by perforating the attachment of the endopelvic fascia to the obturator fascia.
5. The urethra is dissected bluntly and sharply off the undersurface of the pubic bone and is completely freed proximally up to the bladder neck so that an index finger can be placed between the urethra and symphysis pubis. Sharp dissection is usually required for the attachments to the undersurface of the pubic bone (Fig. 13-4).
6. After initial mobilization, a right-angle or Satinsky clamp is carefully placed between the urethra and pubic bone to start the urethrolysis.
7. A Penrose drain can be placed around the urethra to facilitate the urethrolysis. The drain can then be used to place downward traction on the urethra to aid in visualizing any remaining attachments that need to be dissected sharply under direct vision (Video 13-3).
8. Urethrolysis is complete once the urethra is fully mobile, which can be tested by moving an intraurethral sound or cystoscope up and down. A finger should be able to be placed between the urethra and the pubic bone.
9. Cystoscopy is done to rule out bladder or urethral injury. When urethrolysis is extensive, indigo carmine can be administered to rule out ureteral injury. If urethral or bladder injury is identified, it should be repaired primarily with delayed absorbable sutures.
10. A Martius flap may placed if desired. We reserve this for cases of recurrent obstruction after prior urethrolysis or extensive urethrotomy with reconstruction.
11. The vaginal wall is closed.

Case #3

View Video 13-3

A 75-year-old woman had urinary frequency, urgency, and urgency incontinence and a history of about three urinary tract infections per year. She had tried several anticholinergic medications for her overactive bladder symptoms with no improvement. She underwent a transvaginal bladder neck suspension procedure 10 years before presentation. Pelvic examination showed a fixed urethra with no prolapse. Several postvoid residual measurements were between 200 and 250 mL. Because of the refractory nature of her symptoms and incomplete emptying, videourodynamic testing was performed. Results showed detrusor overactivity and voluntary voiding pressures of 40 cm H_2O with a maximum flow rate of about 7 mL/sec. The proximal urethra was dilated, and there appeared to be a point of obstruction at the midurethra. Based on the diagnosis of refractory detrusor overactivity in the face of urethral obstruction and incomplete emptying, urethrolysis was recommended. (See Video 13-3 for a demonstration of a transvaginal urethrolysis.)

Postoperative Care

In most cases after sling loosening or incision, the patient is sent home without a catheter and is given only perioperative antibiotics. Patients should void before leaving the office or recovery room. A catheter is left indwelling if urethral repair was required during sling incision or loosening or if urethrolysis was extensive. The length of catheterization depends on the extent and complexity of injury or reconstruction and can range from 3 to 14 days. For patients who are hospitalized after transvaginal urethrolysis, a vaginal packing and Foley catheter are left in overnight. The catheter is left in place following transvaginal urethrolysis until the vaginal packing is removed or until discharge if the patient is hospitalized. If the patient is unable to void at the time of discharge, the patient is instructed to perform or resume clean intermittent catheterization.

Outcomes

Success rates of intervention for obstruction following antiincontinence surgery depend on the definition of success. Success can be defined as return to normal voiding, resolution of storage symptoms, or patient impression of global success. Many studies have attempted to identify factors that predict success, but no consistent predictors have been identified to date. The reported rates of resolution of voiding symptoms, relief of storage symptoms, and perceived global success following loosening of synthetic midurethral slings range from 80% to 100%. Rates of resolution of voiding symptoms, relief of storage symptoms, and perceived global success following sling incision have been reported to be 69.2% to 100%, 0% to 100%, and 84% to 100%, respectively, regardless of the type of sling used. Rates of resolution of voiding symptoms, relief of storage symptoms, and perceived global success following transvaginal urethrolysis have been reported to be 33% to 94%, 19% to 87%, and 43% to 92%, respectively. All of the intervention methods appear to be effective. It is impossible to determine which method is superior based on the reported results. Time to intervention was different in all of these series and may play a role, because permanent changes may take place in the bladder when the patient experiences obstruction for longer periods. Also, the type of sling materials and the sling placement methods used were different in the cases treated by the various techniques and likely play a role in success or failure of each technique. Therefore these reported

outcomes should not necessarily guide treatment modality; rather, the degree to which the patient is bothered by her symptoms, the morbidity associated with the procedure, the type of SUI surgery preformed, and the patient's willingness to risk recurrent SUI should determine timing and treatment options.

Stress incontinence following sling loosening, sling incision, and transvaginal urethrolysis is a complication that should be discussed with all patients before intervention. The reported rates of recurrent SUI vary greatly, and the true rates may be underestimated due to underreporting. Very little has been published on SUI after sling loosening, but an incidence of 0% was reported in two very small series with short follow-up. The reported incidence of SUI following sling incision ranges from 0% to 39% in studies with varying follow-up times. SUI after transvaginal urethrolysis is reported to occur in 0% to 19% of patients. Because many reported series are small and follow-up period varies, it is difficult to ascertain the true incidence of SUI following the various interventions for obstruction after SUI surgery. In general the incidence can be estimated to be approximately 15% based on larger series, and this should be what patients are told to expect following intervention.

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14

Vaginal Repair of Urethrovaginal and Vesicovaginal Fistulae

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Videos

14-1 Repair of Vesicovaginal Fistula Using a Peritoneal Flap Tissue Interposition
14-2 Repair of Vesicovaginal Fistula Using a Martius Flap Tissue Interposition
14-3 Repair of Urethrovaginal Fistula After Prior Synthetic Sling Excision With Concurrent Pubovaginal Sling Placement

Worldwide, genitourinary fistulae are most often a devastating consequence of prolonged or obstructed labor. In the industrialized world, however, this is rarely the situation, and fistulae generally occur as a result of gynecological surgery, most commonly hysterectomy, or radiation therapy to the pelvis. Vesicovaginal fistula (VVF) is much more common than urethrovaginal fistula. The latter more commonly occurs after urethral surgery, such as a midurethral sling procedure in which synthetic material was placed or eroded into the lumen of the urethra. Repair of both types of fistulae can almost always be addressed via a vaginal approach. The following important principles for a successful repair apply to both types of fistulae:

1. Perform adequate exposure and mobilization of the fistula track.
2. Reapproximate healthy tissue in several layers to ensure a watertight closure.
3. Ensure tension-free suture lines.
4. Interpose a healthy, well-vascularized tissue flap when necessary.
5. Provide adequate diversion of urine during the postoperative period to allow complete healing.

The vaginal approach is an ideal approach that allows exposure of the fistula and preparation of the tissue layers and a well-vascularized flap for interposition. This chapter reviews and demonstrates the technical steps required to successfully correct urethrovaginal and vesicovaginal fistulae via a vaginal approach.

Preoperative Evaluation

History

In industrialized countries, women with VVF usually have varying degrees of incontinence that began after recent hysterectomy or pelvic surgery. Typically, the incontinence is described as continuous, both day and night, and unrelated to activity or an urge to void. In some cases, however, the incontinence may be somewhat positional or gravity dependent. If the fistula is quite sizable, the patient rarely voids volitionally, because the bladder never fills to any significant volume. In other cases in which the fistula is small (i.e., several millimeters in diameter), incontinence may be intermittent and more difficult to characterize. An important symptom in most patients with VVF is incontinence that occurs in the supine position, even during sleep. If the patient had an indwelling urethral catheter following pelvic or gynecological surgery, she will often report sudden onset of incontinence when the catheter was removed postoperatively. The patient may also have experienced gross hematuria immediately following the surgery, such as after hysterectomy.

Less commonly, a fistulous tract can be present between the urethra and vagina causing total incontinence, sporadic incontinence, or vaginal voiding without incontinence depending on its location. A fistula in the proximal portion of the urethra, proximal to the external sphincter complex, may present with continuous incontinence (similar to a VVF), especially if the bladder neck is incompetent. If the fistula is located in the middle to distal urethra, distal to the sphincter complex, the incontinence can be sporadic and may present as postvoid dribbling. In addition, recurrent urinary tract infections are common in women with urethrovaginal fistula because of migration of vaginal bacteria through the fistulous tract. Today, urethrovaginal fistula may commonly occur following midurethral synthetic sling surgery because of unrecognized perforation of the urethra during dissection or sling passage, inadvertent dissection into the periurethral fascia resulting in sling placement in the urethral wall, unrecognized placement of a sling through the urethra, or late urethral erosion. In such cases fistula repair often involves excision of the eroded foreign material in addition to fistula closure. Urethrovaginal fistula may also result from other surgeries on the urethra, such as urethral diverticulectomy, or from urethral trauma.

It is also important to consider the timing of the presentation of incontinence relative to the event that may have caused a fistula, particularly for a VVF. When there is an unrecognized or inadequately repaired cystotomy at the time of pelvic surgery, urine leakage usually occurs immediately after surgery. After cautery or devascularization injuries (e.g., from suture placement), leakage usually becomes evident 7 to 10 days after surgery. However, in some cases a VVF may present weeks or months after pelvic surgery, particularly in a patient who has undergone pelvic irradiation.

Physical Examination

Vaginal speculum examination should be performed to visualize the fistula. For a VVF, when a full speculum is placed, the first observation is usually that of a urine-filled vaginal vault. Depending on the patient's anatomy, the fistula may best be seen by using a full speculum to retract both the anterior and posterior vaginal wall. This is particularly true when the fistula is located at the vaginal cuff, the most common site for a VVF occurring as a result of hysterectomy.

When the fistula is more distal, it is helpful to use the bottom blade of a Graves speculum to facilitate careful visualization of the anterior vaginal wall. The half-speculum is placed along the posterior vaginal wall with mild traction downward to expose the aforementioned compartments. The fistula is often surrounded by granulation tissue. Palpation of the vaginal cuff and anterior vaginal wall may reveal the opening as well as suture material at the vaginal cuff near a presumed fistula. In addition, a urethral catheter can be placed and the bladder filled with a solution of either indigo carmine or methylene blue diluted in sterile saline. This maneuver can help both to confirm and to identify fistula location. If extravasation of blue-tinged fluid is not seen during speculum examination, a tampon or gauze packing can be placed vaginally and the patient can ambulate or sit upright for 10 to 15 minutes. Subsequent inspection of the gauze revealing blue staining is indicative of a lower urinary tract fistula. If there is no blue staining of the vaginal gauze but the gauze appears saturated with yellow urine, a ureterovaginal fistula must be suspected. This possibility can be further investigated with computed tomographic (CT) urography (see later section on imaging).

To identify a urethrovaginal fistula, it may be necessary to place a urethral catheter to elongate the urethra and allow inspection of the entire vaginal epithelium overlying the urethra. If any portion of the catheter becomes visible on vaginal examination, a sizable fistula is present. The same thing can be accomplished by placing a lubricated cotton-tipped applicator (Q-tip) into the urethra.

Endoscopy

Preoperative cystourethroscopy is recommended in all cases of suspected urethrovaginal or vesicovaginal fistula. The fistula may be readily identifiable on cystourethroscopy as a pinpoint or larger, well-epithelialized mucosal hole, either in the bladder itself or in the urethra. It is important to note its proximity to the ureteral orifices to allow proper surgical planning and determine the potential need for ureteral stents. If a VVF is present and is quite large, it may be difficult to distend the bladder sufficiently during cystoscopy to enable visualization of the fistula because of constant extravasation of irrigant. In addition, vaginoscopy (using a standard flexible cystoscope) can be performed to identify any suspicious openings in the vaginal epithelium, particularly when the site of the fistula in the vagina cannot be adequately seen on physical examination.

Imaging

Imaging is not always mandatory to diagnose and treat a VVF, though it is important to rule out a ureterovaginal fistula in cases where such a finding is possible (e.g., after pelvic surgery such as hysterectomy). Standard cystography, CT cystography, or pelvic magnetic resonance imaging can allow identification and further characterization of a VVF. In cases in which the fistula is not obvious on physical examination or endoscopy, we prefer standard cystography as the simplest and most reliable initial method of diagnosis. A Foley catheter is placed via urethra and the bladder is filled under gravity drainage with a contrast solution. Standard radiographic or fluoroscopic images are obtained in both the anteroposterior and lateral orientations. A VVF is typically most readily identifiable in the lateral orientation as a wisp of contrast beyond the border of the bladder wall, with filling or pooling of the vaginal canal just beneath the bladder visible on the radiograph. The same applies to a urethrovaginal fistula located proximal to the external sphincter.

In any case of VVF following pelvic surgery, the possibility of a ureterovaginal fistula or even ureteral obstruction should be evaluated preoperatively with upper urinary tract imaging using CT or magnetic resonance urography. The radiologist should be given sufficient clinical information so that the distal ureters are properly opacified and evaluated on delayed images during the study, typically by administration of a diuretic following contrast-enhanced imaging. This is critical in evaluating for ureterovaginal fistula. Alternatively, and particularly in cases in which use of intravenous contrast is contraindicated, retrograde ureteropyelography can be done at the time of fistula repair.

Patient Selection and Surgical Planning

A transvaginal surgical route is the best approach in any patient with a urethrovaginal fistula. In patients in whom the fistula occurred secondary to synthetic sling placement it is critical to the procedure to completely excise the foreign sling material in and around the urethra to allow proper healing of the urethral mucosa and periurethral fascia. Accurate preoperative assessment of stress incontinence is often difficult, so patients are counseled regarding the possible need for a delayed, second-stage procedure to treat stress incontinence, such as injection of a urethral bulking agent, or even repeat sling placement, which is usually done with an autologous fascial sling in cases of prior synthetic sling complications. When the urethrovaginal fistula is proximal and stress incontinence can be assessed preoperatively, placement of a pubovaginal sling of autologous fascia can be performed at the time of fistula repair. The sling can provide both a backboard of support for the urethra and an additional tissue layer for the repair. We believe that concurrent placement of a synthetic sling is contraindicated in the setting of urethrovaginal fistula repair and/or urethral reconstruction.

The timing of VVF repair depends primarily on the surgeon's experience and preference. Our practice is to repair VVF upon presentation in most cases, but it is also reasonable to provide time for healing and wait for the tissues appear healthy and demonstrate a well-formed fistulous tract. Most patients come for treatment several weeks after the gynecological surgery and are therefore candidates for repair at the time of presentation. There is no objective evidence to indicate that waiting 3 to 6 months, as suggested by older published series, is truly beneficial.

Surgical Anatomy

When preparation is made for urethrovaginal fistula repair, it is important, whenever possible, to preserve the periurethral fascia as a separate and distinct layer from the underlying urethral mucosa. In some cases, the periurethral fascia is obliterated around the fistula and dissection proximally, distally, and laterally (Fig. 14-1). Often, one must dissect laterally on either side of the fistula to identify the retracted ends of the periurethral fascia. This layer is critical in achieving a successful repair.

When a VVF repair is performed, the location of the fistula should be assessed from the vaginal side as well as the bladder side. Examination of the vagina allows the surgeon to determine the quality of the tissues, assess the mobility of the vaginal cuff and anterior vaginal wall, and estimate the proximity of the peritoneum. It is critical to identify the fistula before the procedure is begun, and filling the bladder with a solution of indigo carmine or methylene blue can

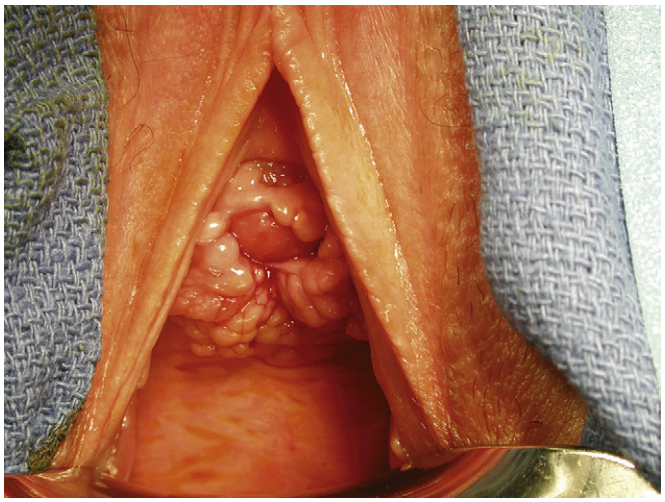

Figure 14-1 Urethrovaginal fistula associated with a midurethral synthetic sling. The urethra is exposed directly underneath the vaginal epithelium with no obvious periurethral fascia. The actual fistula (not seen) is located at the proximal border of the area where the vaginal epithelium meets the urethra.

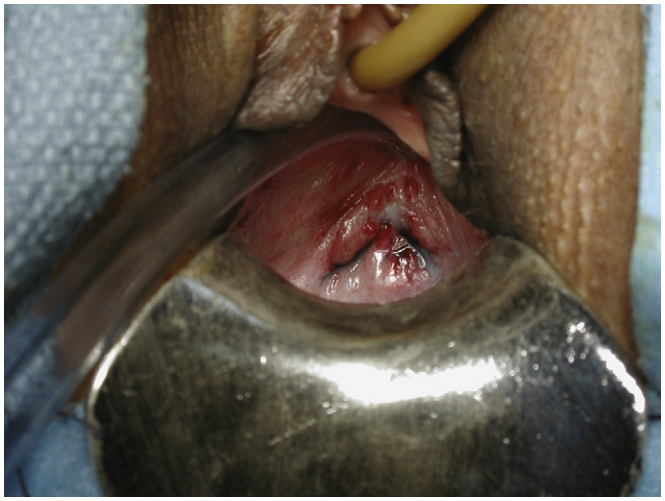

Figure 14-2 Instillation of indigo carmine in the bladder can help to locate the fistula.

facilitate this identification (Fig. 14-2). The bladder side of the VVF is assessed cystoscopically. Important elements are the estimated size of the fistula in the bladder compared with the vaginal opening (often the fistula is larger than it appears on vaginal examination), the appearance of the bladder mucosa surrounding the fistula, and the location of the ureters. The surgeon must keep in mind that mobilization of the bladder around the fistula may be necessary when assessing the proximity of the ureters. If the ureters are close to the fistula and the repair could compromise their patency, ureteral stenting should be considered. As a general rule, if the ureters are less than 1.0 to 1.5 cm from the fistula edge, we recommend that ureteral stents be placed. Most VVFs that occur after hysterectomy are located along the anterior vaginal wall or at the vaginal cuff. When preparing for dissection at the vaginal cuff, the surgeon should keep in mind a few important anatomical points. Because the patient will almost always have undergone hysterectomy, the peritoneum is often adherent to the vaginal wall at the cuff, and entrance into the peritoneum (whether intentional or inadvertent) may often occur. It is best to dissect the vaginal wall off the unopened peritoneum to avoid encountering peritoneal contents. However, often the peritoneum is entered, and the surgeon may encounter small bowel adhered to the vaginal cuff. The peritoneum can also serve as an excellent source of tissue for interposition, whether it is preserved unopened or opened and mobilized off the proximal vaginal flap. The peritoneum must sometimes be opened to gain adequate mobilization (Video 14-1 ).

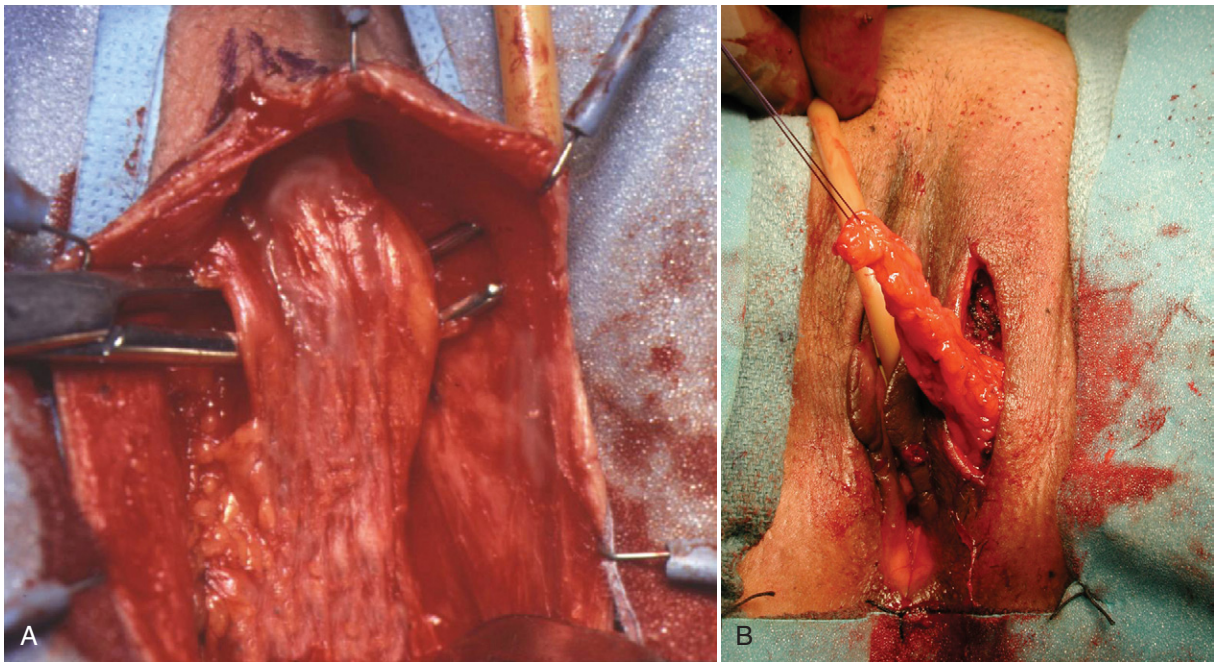

Figure 14-3 **A,** A Martius flap can be mobilized by making a longitudinal incision over the labia majora or in the crease between the labia minora and majora. Just underneath the skin is an avascular plane that sits between the skin and the underlying fat pad. **B,** In this case the flap is based on the blood supply from the inferior pudendal artery. The flap has been mobilized off the pubic bone and can now be tunneled under the labia minora and vaginal epithelium.

Tissue Interposition

Tissue interposition options in repair of vaginal fistulae include a fibrofatty, pedicled labial flap (Martius flap); a transvaginal peritoneal flap; a pedicled labial flap with skin; and a pedicled gluteal flap with skin. All of these options are available for repair of VVFs. For repair of urethrovaginal fistulae, a peritoneal flap is not practical because of the distal location, and a Martius flap is the most common interposition. The surgeon should consider the need for tissue interposition preoperatively, although the decision on whether and what to interpose is often made at the time of surgery. Nevertheless, the surgeon should know the available options before surgery and discuss these with the patient. As mentioned earlier, if an autologous fascial sling procedure is performed at the time of urethrovaginal fistula repair, it can serve as an extra layer of interposing tissue.

A Martius flap is a pedicled, labial fatty flap with a pudendal blood supply (Fig. 14-3 and Video 14-2). It can be based on an inferior pedicle derived from the internal pudendal artery or on a superior pedicle derived from the external pudendal artery. When a Martius flap is prepared, it is extremely important to estimate the distance between the harvest site and the fistula repair accurately, with the length required for tunneling taken into account, so that a flap of adequate length is dissected before division of one pedicle. If vaginal epithelial coverage is problematic because of prior failed procedures, extensive vaginal scarring or shortening, or radiation therapy, a full-thickness labial flap, including skin, can be used. Aesthetically, this may cause some asymmetry between the labia majora on opposite sides.

A peritoneal flap is the simplest tissue to use for interposition in the vast majority of cases of posthysterectomy fistulae, which are often located at the vaginal cuff along the posterior vaginal wall. This tissue is readily available and found posteriorly at the vaginal cuff, is easy to mobilize, and is well vascularized. When there is extensive scarring along the cuff and peritoneum is not

identifiable or the fistula is too distal along the anterior vaginal wall, a Martius flap is ideal (see Fig. 14-3). A Martius flap is quite versatile, because it can be made wider or longer based on the location and size of the fistula. In addition, the surgeon has the option of basing the pedicle either superiorly or inferiorly to allow the flap to be tunneled to its final destination.

Surgical Technique for Repair of Urethrovaginal Fistula

Although the surgical technique for urethrovaginal fistula repair will vary somewhat depending on the size and location of the fistula, the following basic technique applies to most cases.

1. After anesthesia is induced, lower-extremity sequential compression devices are applied and the patient is placed in the dorsal lithotomy position.
2. To optimize vaginal exposure, we often use a ring retractor with sharp hooks (Lone Star retractor [Cook Surgical, Bloomington, IN]). In addition, a weighted vaginal speculum or Sims retractor is placed to further optimize vaginal exposure.
3. The fistula site is identified along the anterior vaginal wall. Urethroscopy is performed to further define the anatomical location of the urethrovaginal fistula and its proximity to the sphincter complex in the midurethra. Following urethroscopy, a urethral Foley catheter is placed, generally 14F or 16F.
4. For optimal localization of the fistula, a small catheter (ureteral catheter or feeding tube) may be placed into the fistula. Because urethrovaginal fistulae are generally easy to identify, this is not always necessary.
5. The anterior vaginal wall surrounding the fistula site is infiltrated with a solution of 1% lidocaine and epinephrine to induce vasoconstriction and aid in hydrodissection. Although the shape of the incision may be tailored to the fistula, we most commonly make a circumferential incision around the fistula (Fig. 14-4, *A*). Vaginal epithelial flaps are carefully dissected laterally, proximally, and distally using sharp, fine scissors such as tenotomy scissors. Care is taken during this initial dissection to preserve the underlying periurethral fascia laterally, which is often retracted beneath the vaginal epithelium.
6. Once the vaginal epithelium is dissected widely, these flaps can be retracted using the hooks on the ring retractor. This allows visualization of the edges of the periurethral fascia for mobilization (see Fig. 14-4, *B*). Once the periurethral fascia is mobilized bilaterally and its edges can easily be brought together over the site of the fistula, the tissue layers involved in the repair can be approximated. We do not advocate routine excision of the fistula itself during the repair, because this technique only enlarges the caliber of the fistula and creates more friable tissue to suture.
7. The first layer of repair is the full thickness of the urethra, including the urethral mucosa at the edges of the fistula itself. This layer is reapproximated with absorbable 4-0 polyglycolic acid (PGA) suture* either in a running fashion or in a simple interrupted fashion (when the fistula is small) to achieve a tension-free, watertight closure (see Fig. 14-4, *C*). The periurethral fascial edges, prepared carefully during the fistula dissection, are brought together as the second layer of the repair using interrupted 3-0 PGA sutures

*Delayed absorbable sutures made primarily from polyglycolic acid (PGA) are commonly used in lower urinary tract and genitourinary reconstructive surgery. We most commonly use polygalactin 10 (Vicryl) because it is available in sizes and with needles that are particularly useful for these types of surgery.

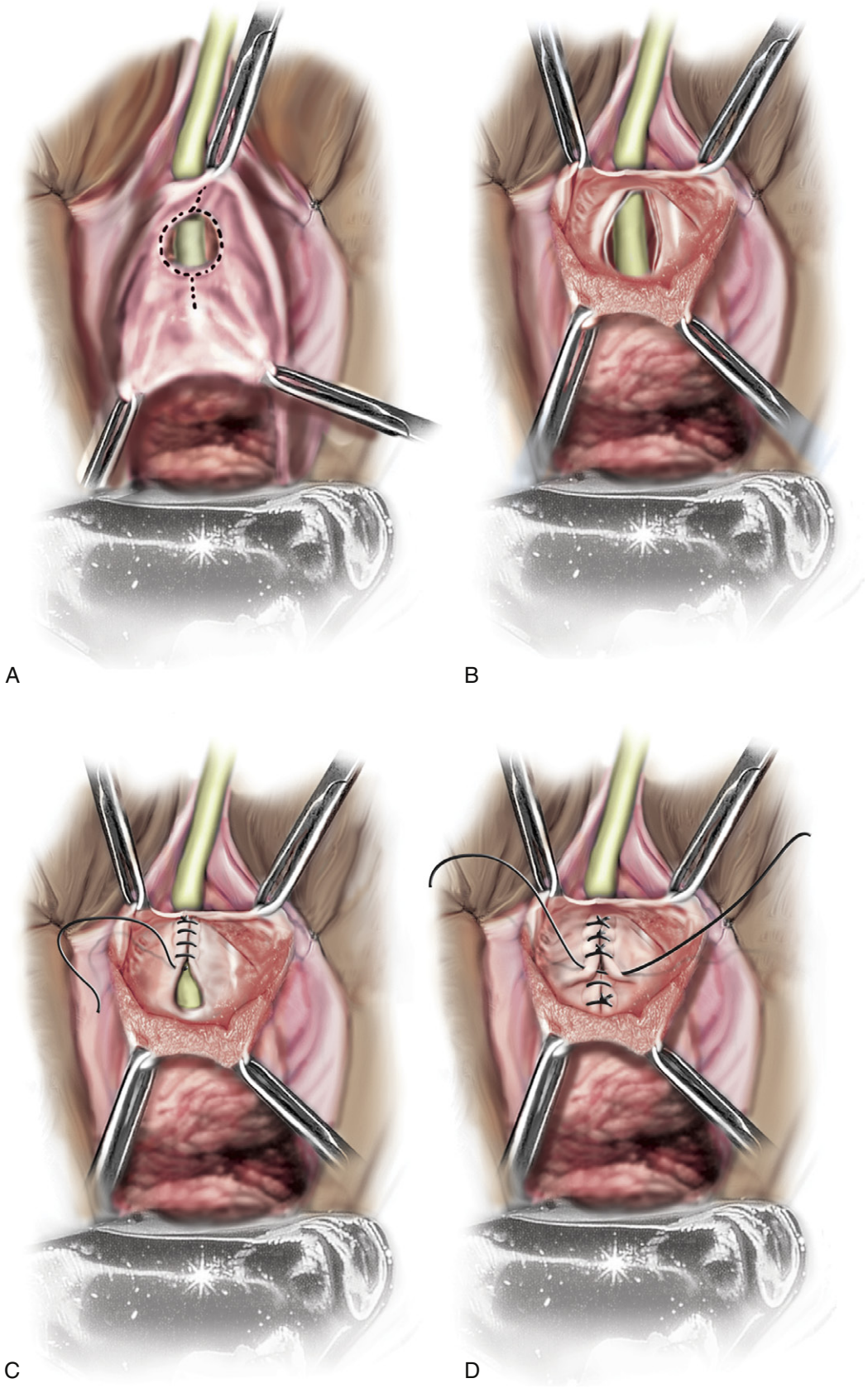

Figure 14-4 **A,** The fistula is circumscribed so that the vaginal wall can be mobilized off of it. **B,** The fistula is fully exposed. **C,** The full thickness of the urethra, including the mucosa, is closed with a continuous 4-0 polyglycolic acid (PGA) suture. **D,** The periurethral fascia is closed with interrupted 3-0 PGA sutures.

(see Fig. 14-4, *D*). This layer is critical to a successful repair, and the edges should reapproximate easily, without tension, to completely cover the initial mucosal suture line.

8. After suturing of these two layers, the integrity of the repair can be tested by injecting either saline or a solution of methylene blue or indigo carmine diluted in saline directly into the urethra via a feeding tube or 14- to 16-gauge angiocatheter placed alongside the Foley catheter. If extravasation from the suture line is noted, additional sutures can be placed to reinforce the repair.
9. If the fistula is located in the proximal urethra or bladder neck, an autologous fascial sling can be placed at the time of repair as an additional layer of tissue as well as a supportive hammock to improve any stress incontinence or intrinsic sphincter deficiency. The sling can be sutured over the periurethral fascial suture line as a third layer of tissue.
10. In cases of a larger urethrovaginal fistula or failed prior repair, a Martius flap is an ideal local, vascularized option for tissue interposition. This flap can be sutured over the periurethral fascia to further enhance the closure.
11. The final layer of repair is the closure of the overlying and surrounding vaginal epithelium. Again, this is often accomplished with interrupted 3-0 PGA sutures. The Foley catheter is generally left in place for 5 to 10 days postoperatively depending on the extent of the fistula and the surgeon's preference.

Case #1

View Video 14-3

A 50-year-old woman had urinary incontinence and a urethrovaginal fistula after prior excision of an eroded synthetic sling. Because the patient had both stress incontinence and a fistula, a decision was made to repair the fistula and perform a simultaneous autologous rectus fascial pubovaginal sling procedure. In addition to treating the stress incontinence, the sling also served as an additional tissue layer between the urethra and the vaginal wall (Video 14-3).

Surgical Techniques for Repair of Vesicovaginal Fistula

Vaginal Flap Repair

For transvaginal repair of VVF, the most important step is exposure and control of the fistula. Once this is done, repair of the fistula is greatly facilitated. Instilling a dye such as indigo carmine in the bladder can help to identify the fistula (see Fig. 14-2).

1. Patient positioning and vaginal exposure are as described earlier for urethrovaginal fistula repair. The first step in exposure of the fistula to allow dissection of tissue flaps is to cannulate the fistula with a small Foley catheter, 8F to 12F depending on the size of the VVF (Fig. 14-5). Sometimes it may be necessary to dilate the fistula to successfully insert a small catheter into it. If a catheter cannot be easily passed from the vagina into the bladder, two options are available. First, a wire can be passed from the vagina into the bladder and then retrieved cystoscopically. With control of both ends of the wire, the fistula can be easily dilated or catheterized by placing the catheter over the wire. Alternatively, a wire can be placed cystoscopically from the bladder into the vagina. Even a large fistula should be catheterized (Fig. 14-6).
2. Placing traction on the fistula catheter allows the surgeon to gain access to the surrounding vaginal epithelium and perivesical fascia for preparation of

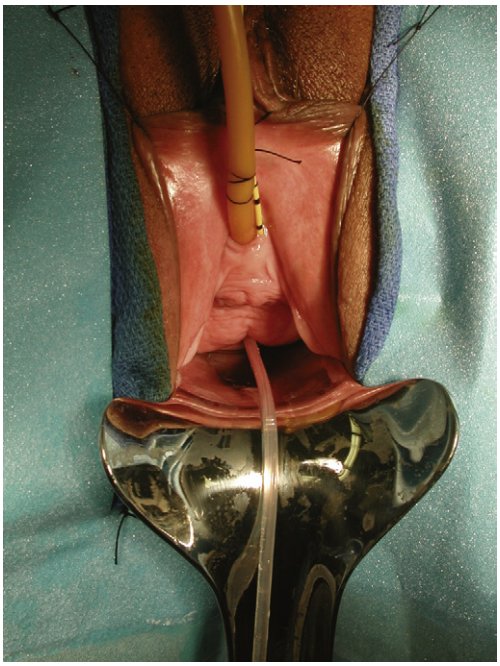

Figure 14-5 A vesicovaginal fistula located near the vaginal cuff has been catheterized with a small Foley catheter. Traction on the Foley catheter allows easy exposure and dissection.

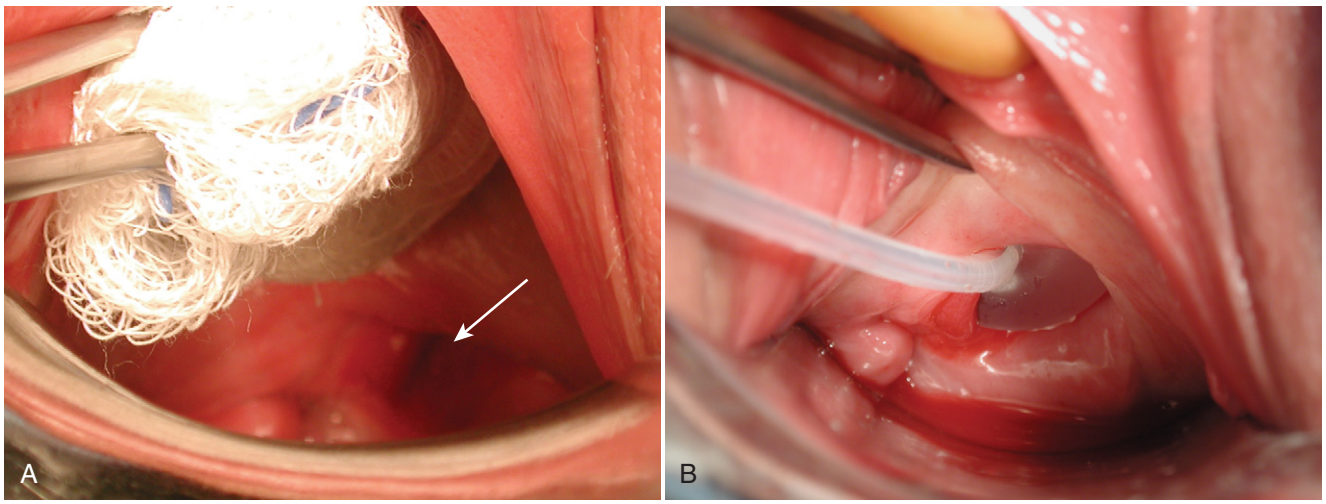

Figure 14-6 **A,** A fistula at the vaginal cuff seems difficult to access vaginally. **B,** After a Foley catheter is placed, however, exposure of the large fistula is much better.

flaps. This maneuver converts a deep VVF at the vaginal cuff into a readily accessible fistula within the operative field.

3. Following cannulization of the VVF, cystoscopy is performed to assess the proximity of the VVF to the ureteral orifices. If necessary, the ureters can be stented to avoid ligation or obstruction during VVF repair. Cystoscopy also helps to ensure that the VVF has been cannulated with the pediatric Foley and that only one VVF is present.
4. At this time a suprapubic tube can be placed if desired. We recommend this for the majority of VVF repairs. It is particularly useful when a transurethral Foley catheter will sit in the repair or when prolonged drainage is expected. Also, some patients will not tolerate the urethral catheter, and it can be removed leaving the suprapubic catheter as the sole drainage. The bladder is filled and the fistula Foley clamped in preparation for suprapubic cystotomy placement. Suprapubic cystotomy can be performed by a number of methods (percutaneous or open) depending on the situation. If the

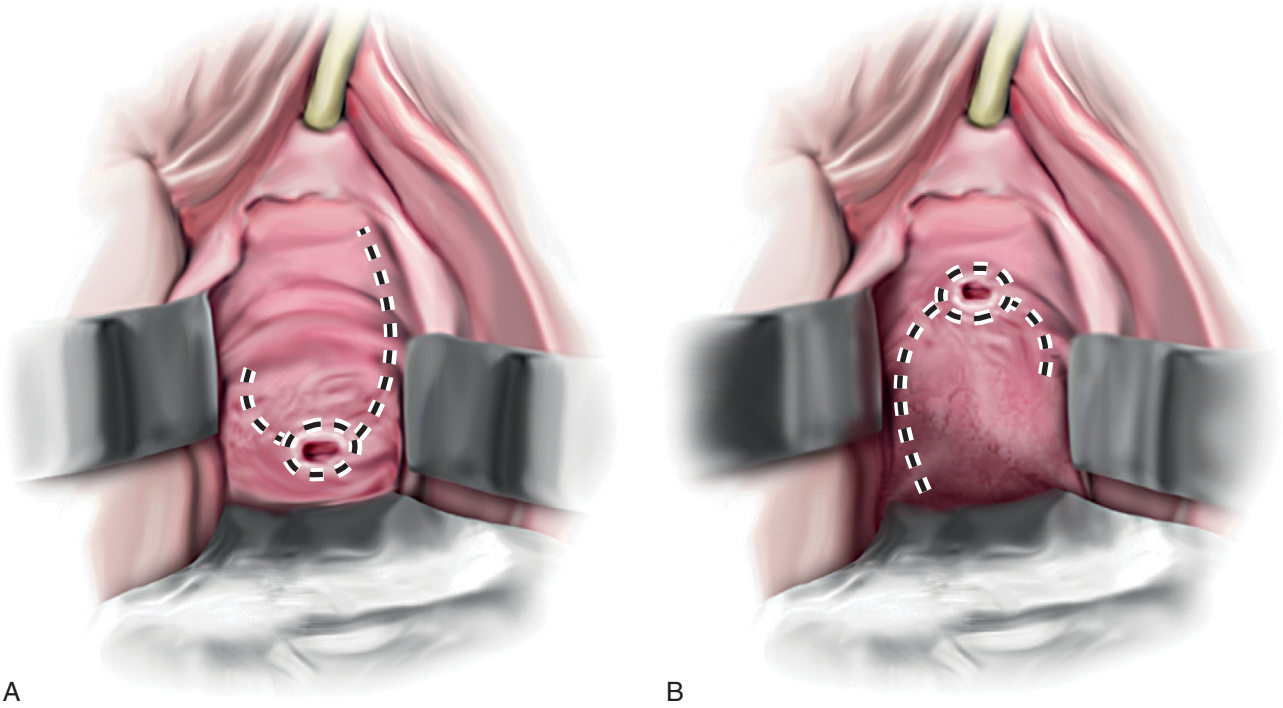

Figure 14-7 Incisions for vaginal flap repair of a vesicovaginal fistula. The configuration of the J incision will depend on the location of the fistula. **A,** For a more proximally located fistula, an anterior J is made. This allows for an anteriorly based flap. **B,** For a more distally located fistula, a posterior J is made to allow a posteriorly based flap to be mobilized.

bladder cannot be filled because the fistula is too large, then a suprapubic tube can be placed after the fistula is repaired.

5. The vaginal wall surrounding the fistula site is infiltrated circumferentially with a solution of 1% lidocaine with epinephrine to induce vasoconstriction and aid in hydrodissection. The vaginal wall incision is carried out by circumscribing the fistula and extending the incision either anteriorly or posteriorly in a J pattern. The configuration of the J incision will depend on the location of the fistula. For a more proximally located fistula, an anterior J is made (Fig. 14-7, *A*), whereas for a more distally located fistula, a posterior J is made (see Fig. 14-7, *B*).
6. Vaginal epithelial flaps are carefully dissected laterally, proximally, and distally using sharp Metzenbaum or tenotomy scissors. Along the posterior edge of the vaginal incision, a deeper dissection may be carried out to allow mobilization and dissection of a peritoneal flap for tissue interposition, if desired. This dissection produces a posteriorly based "tongue" of vascularized peritoneum that can be tailored in width and length to suit the size of the fistula.
7. After the vaginal epithelial flaps are dissected, the perivesical fascia surrounding the fistula is dissected and mobilized widely to allow complete imbrication of the first suture line (Fig. 14-8). As previously mentioned, we do not advocate excision of the fistula itself during the repair, because this technique only enlarges the caliber of the fistula and creates more friable tissue to suture. The fistula tract, which includes bladder mucosa, bladder wall, and residual vaginal tissue, serves as a well-developed fibrotic rim of tissue in which to anchor the first sutures.
8. Generally, we use 2-0 PGA sutures on a UR-6 needle for fistula closure. The initial suture line is placed around the fistula Foley in a simple interrupted pattern. Once the surgeon is ready to tie these sutures, the catheter is removed.

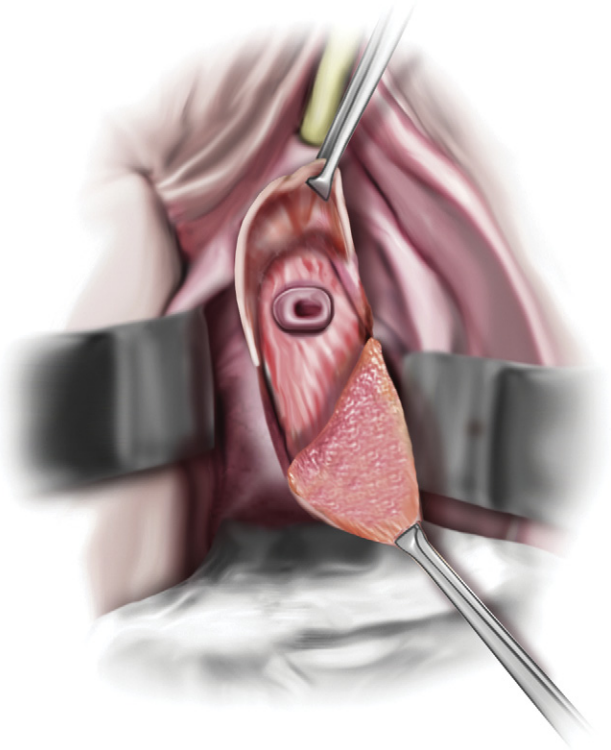

Figure 14-8 After mobilization of the vaginal wall, the fistula is fully exposed and ready for a two-layer closure. Ideally, there should be a distance of at least 1.0 to 1.5 cm from the fistula to the vaginal wall in all directions.

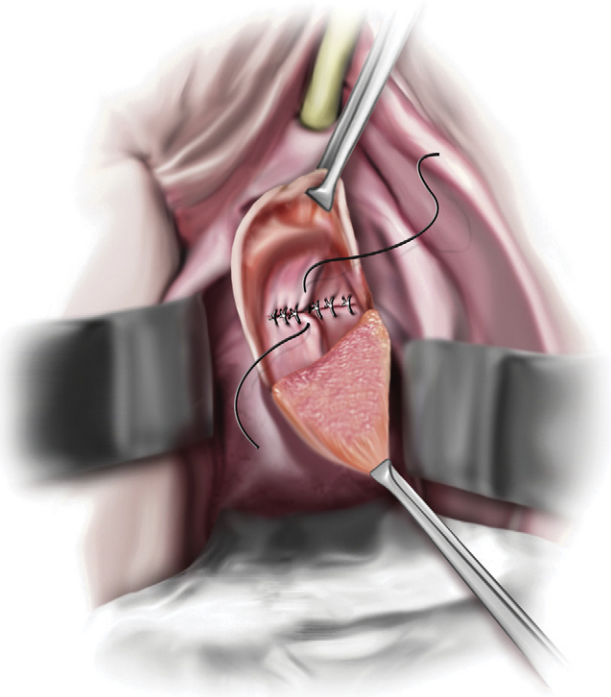

Figure 14-9 Two-layer closure of the fistula. The deep layer is full thickness, including the bladder mucosa. The more superficial layer is an imbrication of the seromuscular wall of the bladder.

9. The second layer of repair is completed by placing interrupted sutures in the surrounding perivesical fascia to completely imbricate the first suture line (Fig. 14-9). The integrity of these two layers can then be tested by distending the bladder with saline or a solution of methylene blue or indigo carmine. Additional sutures can be placed at any sites of fluid extravasation.
10. The third layer of VVF repair may be accomplished by interposition of well-vascularized tissue, either a local peritoneal flap or a Martius flap. A

peritoneal flap, generally harvested beneath the posterior vaginal flap, is sutured in place to cover the first two layers of VVF repair. A Martius flap must first be tunneled from the harvest site beneath the vaginal epithelium to the VVF site. This is generally accomplished by dissecting a tunnel beneath the ipsilateral vaginal wall and passing a right-angled or tonsil clamp beneath to pull the Martius flap in.

11. Finally, the vaginal epithelium is sutured over the entire VVF repair. If a J-type incision has been used, the suture line of the vaginal epithelium closure usually does not overlap that of the fistula closure.
12. Generally we advocate that two drainage catheters be placed in the postoperative period (urethral Foley and suprapubic cystotomy) to allow maximum bladder drainage in the event that one of the catheters becomes plugged. The catheters are usually left in place for 2 to 3 weeks, at the discretion of the surgeon. We also administer oral anticholinergic agents to prevent bladder spasms during the healing process. If the patient experiences severe bladder spasms despite the administration of anticholinergic medication, the urethral Foley catheter may be removed.

Case #2

View Video 14-1

A 45-year-old woman developed continuous drainage from the vagina about 1 week after undergoing an abdominal hysterectomy. On physical examination at 3 months after her hysterectomy there was an obvious fistula at the vaginal cuff. Because of the proximal location of the fistula, a peritoneal flap was used for repair (see Video 14-1).

Case #3

View Video 14-2

A 24-year-old woman developed continuous vaginal leakage after a cesarean delivery. At the time of the cesarean section, a laceration of the anterior bladder wall was noted and repaired. However, shortly after the catheter was removed, the patient experienced severe incontinence. Cystoscopy revealed a fistula just between and very close to both ureteral orifices. Physical examination showed the fistula to be close to the cervix. Because the patient had her uterus, there was no easy access to the peritoneum, and a Martius flap was used for tissue interposition (see Video 14-2).

Latzko Repair

The Latzko technique of partial colpocleisis is useful for the repair of small posthysterectomy fistulae, but vaginal length must be adequate because the vagina may be slightly shortened by this procedure. It is a relatively simple procedure with short operative times and low morbidity.

1. The fistula is identified as described earlier. We prefer to catheterize the fistula for optimal control.
2. An elliptical incision is made around the fistula tract, and the vaginal epithelium is excised. No attempt is made to raise wide flaps. Generally at least 1.0 to 1.5 cm of epithelium is excised in all directions around the fistula (Fig. 14-10, *A* and *B*).
3. The fistula is closed by inverting the bladder with interrupted PGA sutures. These are full thickness excluding the bladder mucosa (see Fig. 14-10, *C*).

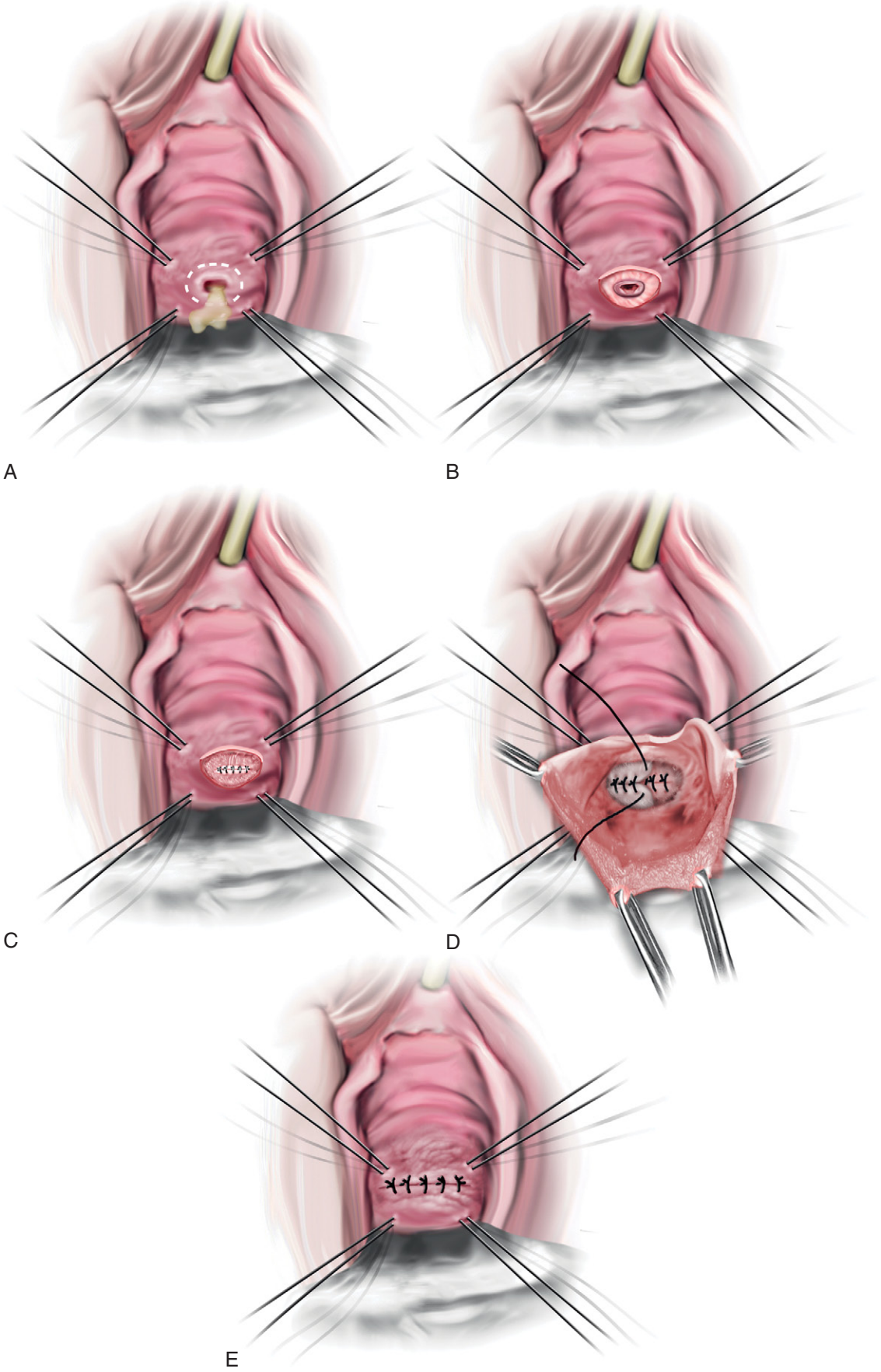

Figure 14-10 Latzko technique of partial colpocleisis. **A,** An elliptical incision is made around the fistula tract, and the vaginal epithelium is excised; at least 1.0 to 1.5 cm of epithelium is excised in all directions around the fistula. **B,** The fistula is prepared for closure. **C,** The fistula is closed by inverting the bladder with interrupted polyglycolic acid (PGA) sutures that are full thickness excluding the bladder mucosa. **D,** If possible a second layer of imbricating sutures is placed to further invert the bladder. **E,** The vaginal epithelium is closed with interrupted PGA sutures.

4. If possible, a second layer of imbricating sutures is placed to further invert the bladder (see Fig. 14-10, *D*).
5. The vaginal epithelium is closed with interrupted PGA sutures (see Fig. 14-10, *E*).
6. Because a small part of the vagina is excised and flaps are not raised, the vagina may be shortened by 2 to 3 cm.

Outcomes

The success rate for primary transvaginal closure of VVFs and urethrovaginal fistulae is quite high, averaging about 95% for all techniques when performed by experienced surgeons. This applies primarily to iatrogenic, non–radiation-induced fistulae. Success rates are lower for repair of large VVFs caused by birth trauma (mostly in developing countries) and those associated with significant radiation damage. The timing of the surgery does not appear to affect success in most cases, and for this reason we usually advocate immediate repair unless there are extenuating circumstances or a recent attempt at repair has failed. Although the first operation is always the best, the transvaginal approach can be successfully used for repeat repair, even if the first attempt was also transvaginal.

Suggested Readings

Cohen BL, Gousse AM. Current techniques for vesicovaginal fistula repair: surgical pearls to optimize cure rate. *Current Urol Rep*. 2007;8:413-418.

Dorairajan LN, Khattar N, Kumar S, et al. Latzko repair for vesicovaginal fistula revisited in the era of minimal-access surgery. *Int Urol Nephrol*. 2008;40:317-320.

Eilber KS, Kavaler E, Rodriguez LV, et al. Ten-year experience with vesicovaginal fistula repair using tissue interposition. *J Urol*. 2003;169:1033-1036.

Ockrim JL, Greenwell TJ, Foley CL, et al. A tertiary experience of vesico-vaginal and urethro-vaginal fistula repair: factors predicting success. *BJU Int*. 2009;103:1122-1126.

15

Avoiding and Managing Vaginal Surgery Complications—A Series of Case Discussions

Mickey Karram, MD

Videos

15-1 Intraoperative Management of Ureteral Kink During Vaginal Prolapse Repair
15-2 Postoperative Management of Ureteral Obstruction After Vaginal Prolapse Repair
15-3 Recurrent Prolapse With Mesh Erosion After Trocar-Based Vaginal Mesh Kit Repair
15-4 Removal of a Synthetic Sling From the Urethra With Simultaneous Placement of a Fascial Sling
15-5 Cystoscopy Showing Eroded Intraurethral Mesh
15-6 Complete Excision of Intraurethral Mesh and Left Arm of Retropubic Midurethral Sling With Urethral Reconstruction
15-7 Excision of Synthetic Mesh From the Rectum
15-8 Vaginal Repair of a Vesicovaginal Fistula With Removal of a Biological Graft From the Bladder Wall
15-9 Takedown of a Distal Iatrogenic Vaginal Constriction
15-10 Takedown of a Tight Vaginal Introitus
15-11 Vaginal Repair of Recurrent Vesicovaginal Fistula
15-12 Vaginal Removal of a Transobturator Sling for Persistent Granulation Tissue
15-13 Vaginal Excision of Mesh Causing Postoperative Vaginal Pain and Dyspareunia

This chapter reviews a variety of potential complications that can occur during or as a result of vaginal surgery. Most of the cases have an accompanying video clip demonstrating the technical aspects of managing the complications.

Case #1: Intraoperative Management of Ureteral Obstruction During a Vaginal Prolapse Repair

View Videos 15-1 and 15-2

A 56-year-old woman with symptomatic pelvic organ prolapse underwent a vaginal prolapse repair that involved anterior colporrhaphy as well as vaginal vault suspension to the uterosacral ligaments. After the anterior colporrhaphy was completed and the apical stitches were tied to suspend the vaginal vault, 5 mL of indigo carmine was administered intravenously and cystourethroscopy was performed to confirm ureteral patency. There was prompt efflux of dye from the right ureter; however, there was no efflux from the left ureter 15 minutes after dye administration. Close visualization of the ureter revealed peristalsis of the intravesical part of the ureter.

Discussion of Case

This is a typical example of a ureteral kink or obstruction occurring secondary to a prolapse repair. The obstruction is caused either by the stitches placed through the uterosacral ligament on the patient's left side or by one of the stitches placed for the anterior colporrhaphy. Although options to address this problem include attempting to pass a stent and performing a retrograde study, in our opinion the next step of management should be to identify the suture causing the obstruction, cut it, ensure ureteral patency, and then, if appropriate, replace the suture. In this particular case, the offending suture was from the anterior colporrhaphy, and once the suture was cut, dye was visualized immediately. The suture was replaced, ureteral patency was confiirmed, and the procedure was completed. (See Videos 15-1 and 15-2 for demonstrations of techniques for addressing ureteral obstruction during and after a vaginal prolapse repair.)

Case #2: Vaginal Mesh Erosion After Prolapse Repair Using a Trocar-Based Total Vaginal Mesh Kit

View Video 15-3

A 59-year-old woman had recurrent pelvic organ prolapse as well as erosion of a large piece of mesh into the upper part of the anterior vaginal wall. She had undergone prolapse repair using a trocar-based total vaginal mesh kit 6 months before presentation. Her current symptoms included a feeling of recurrent prolapse, significant dyspareunia related to the mesh erosion, and vaginal bleeding and discharge. Examination revealed apical prolapse with descent of Pelvic Organ Prolapse Quantification point C to +1 as well as recurrent prolapse of the upper part of the anterior vaginal wall (point Ba was at 0). The patient underwent vaginal surgery for excision of the eroded mesh and suture repair of her apical prolapse and cystocele.

Discussion of Case

This erosion most likely occurred due to bunching up of the mesh in the anterior vaginal wall (Video 15-3). The fact that a patient experiences erosion and failure of prolapse repair after a mesh kit procedure does not exclude the patient from undergoing a subsequent traditional suture repair. During dissection of the anterior vaginal wall the peritoneum was entered and a high uterosacral vaginal vault suspension was accomplished to adequately suspend the prolapsed cuff. The mesh was sharply excised, and the recurrent cystocele was corrected with an anterior colporrhaphy (see Video 15-3).

Case #3: Midurethral Sling in the Urethra

View Video 15-4

A 36-year-old woman had recurrent urinary stress incontinence. One year previously she had undergone a sling placement procedure using the Gynecare TVT Secur system (Ethicon Women's Health and Urology, Somerville, NJ), which resulted in minimal to no improvement in her stress incontinence. Subsequently she had two injections of a urethral bulking agent, which again failed to improve her incontinence. On physical examination she was noted to have urethral hypermobility (urethral angle of 60 degrees with straining on the Q-Tip test). Urodynamic studies confirmed recurrent urinary stress incontinence with leak-point pressure measurements of approximately 50 cm H_2O. Cystourethroscopy was undertaken, and the edge of the previously placed synthetic sling was seen transecting the lower left edge of the midurethra. The patient gave consent for exploration of the anterior vaginal wall with excision of the previously inserted sling and urethral reconstruction with placement of a fascial sling at the bladder neck.

Discussion of Case

This case most likely reflects a situation in which the original synthetic sling was placed in the wall of the urethra. The distal portion of the anterior vaginal wall is fused with the posterior urethra. Thus it is extremely important that a clear dissection plane be created between the posterior urethra and the anterior vaginal wall before any synthetic midurethral sling is placed. If this dissection is not done appropriately, then there is a potential risk of placing the sling in the wall of the urethra. (See Video 15-4 for a demonstration of excision of a synthetic sling from the urethra and placement of a fascial sling.)

Case #4: Persistent Eroded Mesh in the Urethra After Prior Mesh Excision

View Videos 15-5 and 15-6

A 58-year-old woman had recurrent urinary tract infections and pyelonephritis 10 years after placement of a retropubic midurethral sling for stress incontinence. Cystoscopy revealed a urethral stone, and after laser lithotripsy was performed to pulverize the stone, an eroded sling was discovered. Another surgeon approached the eroded sling through a vaginal incision but removed only the suburethral portion of the sling. The patient was referred for removal of the rest of the sling. At that time she had no complaints of stress incontinence but did complain of left-sided pelvic-vaginal pain. On physical examination no significant urethral hypermobility was noted and no stress incontinence was demonstrated. However, there was tenderness along what would have been the course of the sling on the left side. Cystoscopy revealed mesh material in the urethra at the left side dorsally, as well as a small amount of retained mesh ventrally. (See Video 15-5 for a cystoscopic examination of the urethra showing eroded mesh.) In this case it was important to remove all intraurethral mesh and then reconstruct the urethra. This required extensive mobilization of the urethra as well as urethral reconstruction. (See Video 15-6 for a demonstration of urethral mobilization, removal of mesh, and reconstruction.) In addition, because the left arm of the sling was felt to be responsible for the pain, it too was removed. Perforation of the endopelvic fascia and entrance into the retropubic space facilitated urethral mobilization and sling removal. Because the patient did not have stress incontinence, a simultaneous autologous tissue sling procedure was not done, although the patient was aware of the risk that stress incontinence might develop later and require treatment.

Discussion of Case

In this case, the sling was likely placed through the urethra. The fact that the patient was asymptomatic for almost 10 years is surprising. This case demonstrates the importance of removing all the mesh present in the lower urinary tract as well as any mesh thought to be responsible for symptoms.

Case #5: Rectal Injury Resulting From Trocar-Based Placement of Posterior Vaginal Mesh

View Video 15-7

A 62-year-old woman came for treatment approximately 18 months after undergoing a trocar-based procedure in which a mesh implant was placed in the posterior vaginal wall. Since the placement of this mesh, she had experienced significant vaginal pain as well as infection accompanied by intermittent foul-smelling discharge from the pararectal incisions that recurred approximately every 6 weeks. On rectal examination one of the arms of the mesh implant was noted to clearly transect the lumen of the rectum. The patient was also found to have a rectovaginal fistula with mesh eroding into the posterior vaginal wall. After a colorectal specialist was consulted and the situation was discussed in detail with the patient, the decision was made to attempt vaginal excision of the mesh without diversion of the bowel. Intravenous antibiotics were given and the patient underwent a full bowel preparation before the surgery. The decision to proceed without diversion was based on the fact that, at the time of the examination, the tissue was not extremely indurated and clinically there was no ongoing active infection. However, the patient did fully understand the possibility of repair breakdown and the need to undergo bowel diversion if the current attempt at mesh removal were unsuccessful. The mesh was successfully removed from the vagina and rectum, and the rectovaginal fistula was repaired. The patient healed with no breakdown of any portion of the repair. (See Video 15-7 for a demonstration of the removal of mesh from the rectum.)

Discussion of Case

This case clearly indicates a technical failure on the part of the surgeon who placed the mesh. An adequate rectal examination should have been performed at the time of surgery, and this would have allowed the surgeon to determine that the rectum had been perforated with the mesh arm. In such a situation the mesh that had transected the rectum should have been removed and the entire procedure aborted to allow proper healing of the rectal injury.

Case #6: Vesicovaginal Fistula After Cystocele Repair Augmented With a Biological Graft

View Video 15-8

A 76-year-old woman had an obvious vesicovaginal fistula arising from the midportion of the anterior vaginal wall. The patient had undergone a cystocele repair augmented with a biological material (Pelvicol Acellular Collagen Matrix, Bard Medical Division, Covington, GA) approximately 6 months earlier. Cystoscopic examination revealed the fistula to be in the middle trigone well below the ureteral orifices; however, there was obvious bunching up of the graft just under the mucosa of the bladder extending close to the right ureteral orifice. The plan was to place bilateral double-J stents and proceed with a vaginal repair of the vesicovaginal fistula with excision of the graft from the wall of the bladder. The procedure was accomplished without incident, and the patient experienced successful closure of the fistula after 2 weeks of continuous drainage postoperatively. (See Video 15-8 for a demonstration of vaginal repair of a vesicovaginal fistula with removal of a biological implant from the bladder wall.)

Discussion of Case

This case represents a situation in which an undiagnosed bladder injury occurred at the time of the initial repair because the surgeon was in a dissection plane that was most likely in the wall of the bladder. It illustrates the importance of fully mobilizing the vaginal wall in an appropriate plane away from the bladder before placement of any material to augment a prolapse repair.

Case #7: Vaginal Pain and Dyspareunia After Native Tissue Prolapse Repair

View Video 15-9

A 45-year-old woman came for treatment 6 months after a vaginal hysterectomy and anterior and posterior colporrhaphy. Her primary complaint was inability to have intercourse because her partner was not able to penetrate her vagina. Examination revealed a vaginal constriction ring, located approximately 2.5 cm inside the introitus, that was fairly tight and sensitive. The examiner was able to pass only one finger through the constriction ring. The vagina appeared to be of adequate length, and the vagina above the constriction seemed to be fairly normal. The plan was to proceed with a takedown of the constriction ring by making bilateral relaxing incisions completely through the constriction band and then allowing the vagina to heal by secondary intention. (See Video 15-9 for a demonstration of how to take down an iatrogenic vaginal constriction.)

Discussion of Case

This is a situation in which most likely too much vaginal wall was trimmed during the anterior and posterior colporrhaphy, which resulted in some scarring and constriction of the vaginal wall. Another possibility is that the patient was not examined in the postoperative period and that there was some inappropriate scarification which could have been prevented by early intervention with examinations and possibly the use of a vaginal dilator.

Case #8: Tight Vaginal Introitus After Rectovaginal Fistula Repair

View Video 15-10

A 29-year-old woman had complaints after repair of a rectovaginal fistula that occurred following childbirth. She had had a vaginal delivery that required the use of forceps and resulted in a fourth-degree tear, which was corrected at the time of the delivery. The repair subsequently broke down, and the patient developed a rectovaginal fistula. She was referred to a colorectal surgeon, who proceeded with transperineal repair of the fistula. The fistula was successfully repaired; however, during this process, the perineum was built up very aggressively, and the patient was left with a very tight introitus that allowed penetration of only one finger, which made it impossible for her to have intercourse. On examination an excessive buildup of the perineal skin and lowest portions of the labia minora was noted. The patient underwent a midline takedown of this buildup of tissue with mobilization of the distal posterior vaginal wall. The mobilized vaginal wall was then advanced distally, and this satisfactorily opened up the vaginal introitus. However, there was not enough vaginal tissue to completely cover the perineal defect. Thus a piece of Surgisis Biodesign repair material (Cook Medical, Bloomington, IN) was used to replace the perineal skin. This material was effectively converted into perineal skin over the 3-month period following surgery. (See Video 15-10 for a demonstration of surgical management of a tight vaginal introitus.)

Discussion of Case

This case illustrates the importance of appropriately assessing the caliber of the introitus at the time of any perineal or posterior vaginal wall surgery.

Case #9: Recurrent Vesicovaginal Fistula After a Latzko Procedure

View Video 15-11

A 46-year-old woman had undergone a laparoscopic hysterectomy for treatment of pelvic pain and pelvic endometritis approximately 1 year before presentation. Shortly after the hysterectomy she was diagnosed with a vesicovaginal fistula arising at the apex of the vagina. The fistula was repaired in an outpatient Latzko procedure. She came for treatment of a recurrence of the fistula approximately 6 weeks after the procedure. Upon examination she was noted to have a fistula in the area of the vaginal cuff with some granulation tissue. She underwent a vaginal procedure to correct the fistula, which involved excision of the tract and mobilization of some intraperitoneal omentum to facilitate closure of the fistula. (See Video 15-11 for a demonstration of vaginal repair of a recurrent vesicovaginal fistula.)

Discussion of Case

In this case, the Latzko operation most likely failed because the fistula was closed with avascular tissue that immediately began to break down after the surgery. In such procedures the surgeon must subjectively assess the state of the tissue that is used to close the fistula. If it is felt to be devitalized, then a vascular flap of some sort should be considered for placement between the bladder and the vagina.

Case #10: Recurrent Granulation Tissue in the Vaginal Side Wall After Transobturator Sling Placement

View Video 15-12

A 41-year-old woman had a history of placement of a transobturator sling (Ob tape, Mentor Urology, Santa Barbara, CA) approximately 2.5 years earlier. She subsequently began to have significant vaginal bleeding and recurrent granulation tissue. The suburethral part of the sling was removed, and later a second attempt was made to excise more sling granulation tissue because of persistent bleeding. When the patient came for treatment, it was obvious that large areas of granulation tissue were still present, which indicated that a fairly strong reaction was still occurring to the sling material remaining in the obturator space. The plan was to dissect into the space and if necessary even open up the inner thigh to remove the remaining mesh. The remainder of the sling was successfully removed via the vaginal route, and the vagina healed without incident. (See Video 15-12 for a demonstration of vaginal removal of a transobturator sling.)

Discussion of Case

A finding of persistent granulation tissue indicates the presence of an ongoing reaction between the foreign body and the surrounding tissue, and complete excision of the foreign body is usually required. This generally happens when non–type I macroporous mesh is used (as was the case with the Ob tape, Mentor Urology).

Case #11: Vaginal Mesh Implant Causing Significant Vaginal Pain and Dyspareunia

View Video 15-13

A 56-year-old woman experienced significant vaginal pain after a prolapse repair procedure in which a trocar-based mesh kit was used. Examination revealed no obvious excursion or erosion of the mesh; however, in the upper part of the anterior and posterior vaginal wall the mesh was easily palpated and the vagina extremely tender. The plan was to remove the mesh from these tender areas in the hope of releasing the tension on the arms of the mesh and thus relieving the patient's pain. When the vaginal wall was opened over the tender areas, the mesh was noted to be thickened and under significant tension. The mesh was sharply excised and the vagina closed. Although the patient did note improvement of her pain, she continued to have intermittent vaginal pain and some dyspareunia. (See Video 15-13 for a demonstration of excision of mesh from the vagina.)

Discussion of Case

In cases such as this, it is most likely that the trocar arms of the mesh implants were inappropriately passed and that this resulted in shrinkage and bunching up of the mesh. The surgeon must go to great lengths to appropriately trim the mesh and lay it flat, and to make sure that the arms are under no tension and are nicely separated from each other anteriorly. If the anterior arms are passed in close proximity to each other, the ultimate result will be bunching up of the mesh, which can be a precursor to vaginal pain.