Key Concepts

- Multi-compartment pelvic floor disorders are common and require a multi-disciplinary team approach to evaluation and management.
- The levator ani muscles and connective tissue structures of the pelvis provide the main supports to the pelvic floor and pelvic organs.
- Transvaginal repair of pelvic organ prolapse is commonly performed at the time of transperineal repair of rectal intussusception or prolapse.
- The most commonly performed abdominal procedure for pelvic organ prolapse is the sacral colpopexy, which can be performed concomitantly with ventral or other types of rectopexy.
- A transvaginal or transanal approach can be taken to repair a rectocele, but the transvaginal approach is more common and seems to have better outcomes with less morbidity.

Introduction

Many patients who complain of descensus in a single pelvic compartment may be affected by prolapse in multiple pelvic compartments [1] and several publications have described coexistence of rectal and pelvic organ prolapse [2-9]. In addition, there is a high incidence of anorectal dysfunction in women with genital prolapse. As a result, multi-compartment pelvic floor disorders are now increasingly being evaluated and managed together by female pelvic medicine and reconstructive surgery (FPMRS) surgeons and colorectal surgeons [10, 11].

It is imperative for specialists to recognize when consultation with the one another is indicated, as joint management may significantly improve patient outcomes. For instance, defecatory symptoms may not improve with transvaginal rectocele repair alone [12], as obstructive symptoms may be related to more extensive posterior compartment dysfunction.

Anatomy of the Pelvic Floor

The levator ani muscles (puborectalis, iliococcygeus, and pubococcygeus) contribute to the main support of the pelvic organs and play an important role in the pelvic floor (Fig. 63-1). [18]. In their normal state, the levators maintain constant tone, which helps support the pelvic organs against fluctuating changes in intraabdominal pressures, and also keeps the urogenital hiatus closed, drawing the distal urethra, vagina and rectum up toward the pubic bone [19]. The muscles can also be voluntarily contracted (performance of a Kegel exercise) but can also be lengthened and relaxed, which is important for micturition and defecation.

For example, studies have shown that an enterocele is not an uncommon finding in patients presenting with a rectocele, and may occur in up to 42% of patients [13], and rectal intussusception may occur in up to 68% of patients undergoing defecography for symptomatic rectocele [14].

The other posterior compartment conditions that may occur with anterior and middle compartment rectocele include sigmoidocele, anismus, perineal descent, and/or rectal prolapse. Peters et al. [15] showed that in 55 patients evaluated with rectal prolapse, 52 of the patients had other pelvic floor defects, and 39 were found to have occult rectal prolapse that simulated a rectocele or enterocele. Patients with the above-mentioned posterior defects often require radiographic evaluation for accurate diagnosis, as well as a multi-disciplinary team approach to management [16, 17].

In this chapter, we review the anatomy of the pelvic floor and the important relationships between its compartments, we describe the FPMRS surgeon’s approach to the evaluation and management of pelvic organ prolapse, we provide an overview of the transvaginal and abdominal approaches to apical prolapse procedures that can be performed concomitantly with colorectal procedures, and we describe and compare the different approaches to the rectocele repair.
The puborectalis originates from the each side of the pubic bone and forms a U-shaped sling that courses above the external sphincter muscle and around the anorectal junction [19]. The iliococcygeus is the least bulky of the levator ani muscles and is located posteriorly, arising from the ischial spines and the arcus tendineus levator ani with its fibers meeting in the midline and inserting into the coccyx. The iliococcygeal raphe forms as a result of the converging iliococcygeal muscle fibers, and forms the levator plate, an anatomic shelf on which the rectum, proximal vagina, and uterus rest. In a woman with normal support, the levator plate lies almost parallel to the horizontal plane in the standing position [20]. The pubococcygeus originates from the inner surface of the pubic bone and contains three divisions that are named according to the attachments of the muscle fibers [21]. The pubovaginalis inserts into the lateral walls of the vagina and helps to maintain para-vaginal and urethral support and plays a role in urinary continence [22]. The pubococcygeus muscle fibers that attach to the perineal body are termed the puboperinealis, and in its contracted state, the muscle draws the perineal body toward the pubis. The puboanalis is comprised of muscle attachments to the anus at the level of the intersphincteric groove, and along with the puborectalis muscle, this muscle helps to elevate the anus, which also keeps the urogenital hiatus closed [23].

The perineal membrane (also referred to as the urogenital membrane) spans the opening of the ventral pelvic outlet [24] and is continuous with the arcus tendineus fascia pelvis, attaching the distal vagina and urethra to the distal pelvis, while the dorsal outlet is made up of dense connective tissue that attaches to the ischiopubic rami as well as the distal vagina and perineal body [23]. The perineal body is located between (and attaches to) the distal third of the posterior vagina and the external sphincter of the anus and is made up of a portion of the bulbospongiosus and superficial transverse perineal muscles as well as dense connective tissue [25]. This muscular structure supports the distal vagina and rectum, and these attachments can easily be disrupted during childbirth, necessitating proper reattachment and repair after delivery in order to restore the proper distal pelvic floor supports.

There are important relationships between the levator ani muscles and the connective tissue structures that attach the uterus, cervix, vagina, and rectum to the pelvic walls, and these interactions are also responsible for structural support in the pelvis. The supporting or endopelvic fascia is a more complex and controversial structure than the levator ani. Located between the visceral peritoneum and parietal fascia of the levator ani is fibroareolar tissue containing neurovascular bundles, smooth muscles, collagen, and elastin, which is often called the endopelvic or endovisceral fascia [26]. This structure fans out to envelop the pelvic organs and anchors them to the surrounding pelvic sidewall structures. DeLancey calls the endopelvic fascia the viscero-fascial layer because it is a combination of the pelvic viscera and endopelvic fascia and plays a key role in the support of the vagina and uterus [27, 28]. Norton [29] has described the interaction between levator ani and endopelvic fascia as the “boat in the dry dock.” The levator ani is like the water in a dry dock that floats the boat, and the ligaments are like the mooring that holds the boat in place. When the water in the dock begins to recede, the moorings are strained to hold the boat in place. The term “ligament” is commonly used to describe pelvic floor connective tissue structures; however, it is important to recognize that these structures do not really meet the true definition of the term. In fact, there is great variation in the composition and function of these structures. Some consist of dense connective tissue bands that connect portions of the bony pelvis and are responsible for pelvic stability. These “ligaments” are often used as anchoring sites in pelvic organ prolapse surgery, and examples include the sacrospinous ligaments, uterosacral ligaments, and the anterior longitudinal ligament of the sacrum. Smooth muscle, fibrous, and areolar tissue also make up some of these connective tissue structures, and are more likely to play a role in the orientation and support of the pelvic organs inside the pelvis. Examples of these structures include the round and broad ligaments of the uterus.

The rectovaginal septum is a condensation of tissue that extends approximately 3 cm proximal to the perineal body but is not present above the rectovaginal pouch [30] and it is attached to the pelvic sidewalls by the arcus tendineus fascia rectovaginalis [31]. Surgically and histologically, it is hard to delineate this layer of tissue between the vagina and rectum, and the same has been described for the layers of tissue between the vagina and bladder in the anterior compartment [32]. These tissues have previously been referred to as the pubocervicovesical (anterior) and rectovaginal (posterior) fascial layers; however, histological studies cast doubt over the “fascial” nature of these layers [28], and surgically, the layer that can be separated between
the vagina and the rectum and the vagina and the bladder appears to predominantly be made of vaginal muscularis. Therefore, when we describe repair of a cystocele and/or rectocele, we commonly refer to plication of the muscularis layer, rather than a separate fascial layer between the two structures.

DeLancey [33] has described three levels of vaginal connective tissue support that help us understand how and why pelvic floor support defects occur (Fig. 63–2). The parametria are the lateral supports to the uterus and cervix and are made up of perivascular connective tissue that contains the uterosacral and cardinal ligaments. These structures are known as Level I support and provide the apical support of the vagina to the pelvic sidewalls, keeping the vagina suspended vertically over the pelvic floor. Women with Level I support defects present with either uterine/cervical or posthysterectomy vaginal apex prolapse. The mid portion of the vagina is suspended to the pelvic sidewalls via lateral connective tissue attachments to either the arcus tendineus fascia pelvis or the medial aspect of the levator ani muscles. These attachments are important for anterior vaginal wall and bladder neck support. Defects in these supports can manifest as anterior vaginal wall prolapse (a cystocele) or stress urinary incontinence symptoms. As previously mentioned, the distal vagina attaches to the perineal body posteriorly, and these attachments contribute to Level III support. Defects in these structures can present as distal posterior vaginal wall prolapse (a rectocele) as well as perineal detachment and descent.

The etiology of pelvic organ dysfunction is multifactorial but appreciating the relationships between the above-mentioned anatomic structures is an important part of understanding how pelvic floor dysfunction occurs. For example, mechanical disruption of the connective tissues or neuromuscular injury of the pelvic floor can lead to anatomic changes such as lengthening or widening of the genital hiatus as well as a change in the incline of the levator plate [34]. If the axis of the vagina becomes more vertical, the pelvic organs can become oriented directly over the larger hiatal opening, which can lead to descensus of the pelvic organs through the hiatus [35]. We also believe that there may be a genetic component to pelvic floor disorders. Recent histologic studies have demonstrated that the elastin and collagen content in the vaginal walls of women with pelvic organ prolapse and incontinence differs from women who do not suffer from these conditions [36]. It is not completely clear whether these women have a genetic predisposition to changes in collagen and elastin homeostasis, placing them at risk for pelvic floor dysfunction over time, whether the distension and mechanical disruption caused by the prolapse is responsible for the histologic changes reported, or if a combination of these factors are at play. There is currently

ongoing research examining these questions, but what remains clear is that the underlying etiology of pelvic floor disorders is complicated and likely involves multiple factors.

Evaluation of Pelvic Organ Prolapse

The diagnosis of pelvic organ prolapse is made using a combination of history and physical examination. Patients with symptomatic prolapse usually describe vaginal bulge, pressure, discomfort, as well as functional symptoms such as difficulty voiding or defecating, and sexual dysfunction. The physical examination for prolapse includes a general gynecology examination and should be conducted with the patient in the dorsal lithotomy position. If physical findings do not correspond with symptoms, or if the maximum extent of prolapse cannot be confirmed, the woman can be reexamined in the standing position.

The pelvic organ prolapse quantification (POP-Q) examination is a validated tool that is used to measure and report prolapse [37]. Using the hymen as a reference point, the POP-Q measures the genital hiatus length, the perineal body length, the total vaginal length, the amount of cervical or vaginal apex prolapse, and the presence/extent of prolapse of the anterior and posterior vaginal walls. All measurements are taken while the patient is performing a Valsalva maneuver with the exception of total vaginal length. The maximal amount of prolapse noted is used to assign a stage to the prolapse (Table 63-1).

Many women with pelvic organ prolapse also have urinary incontinence. Women who do not have symptoms of incontinence are at risk for de novo stress urinary incontinence when their prolapse is corrected because the previously obstructed urethrovaginal junction is straightened by elevating the vaginal apex and anterior vaginal wall [38]. Adding an anti-incontinence procedure at the time of prolapse repair significantly reduces the incidence of stress urinary incontinence [39, 40], and as a result, it is important to screen patients for incontinence symptoms at the time of evaluation, and also to evaluate patients for occult incontinence before proceeding with surgery. During the pelvic examination, if the patient has a full bladder, she may be asked to cough or Valsalva, and her urethra is examined for leakage of urine. Alternatively, simple cystometry can be performed with placement of a catheter attached to a 60 cc syringe with the plunger removed placed approximately 15 cm above the level of the pubic symphysis. The bladder is filled with normal saline and the patient is then asked to cough, and the urethra is observed for any degree of leakage of urine. Otherwise, urodynamic testing is performed, and an overview of this office procedure is described below.

Based on current evidence, there is no role for routine imaging in the evaluation of pelvic organ prolapse, but it may be useful for diagnosis and management when rectal intussusception, occult rectal prolapse, sigmoidocele, or enterocele is suspected as the underlying cause of a patient’s defecatory symptoms. For example, rectal prolapse frequently coexists with other pelvic floor defects and internal rectal prolapse may simulate a rectoceles or enterocele and requires defecography to establish the diagnosis [15]. Anal manometry, defecating proctogram, dynamic MRI, and endoanal ultrasound may also have an important adjunctive role in assessing obstructive defecatory symptoms and/or fecal incontinence in patients presenting with pelvic floor disorders, and are often ordered and/or performed by the colorectal surgeon to help with assessment and treatment planning. Indications and interpretation of these tests has already been discussed in previous chapters, and not within the scope of this chapter.

Overview of Urodynamics

Urodynamic testing is an office-based procedure that is used to evaluate the function of the lower urinary tract system. Pelvic floor surgeons rely on urodynamic testing for several different indications; however, there are no agreed upon guidelines for when to perform the procedure, and testing is often based upon clinical history, presenting symptoms, previous pelvic floor surgeries, and upcoming planned procedures [41]. Table 63-2 lists common indications for urodynamic testing used by most FPMRS surgeons.

Urodynamics evaluates the pressures at which the detrusor muscle of the bladder is able to accommodate during bladder filling, how well a patient is able to suppress micturition at

<table>
<thead>
<tr>
<th>Table 63-2. Indications for urodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complicated lower urinary symptoms history</td>
</tr>
<tr>
<td>Pre-operative evaluation of stress incontinence</td>
</tr>
<tr>
<td>Urgency incontinence refractory to medical therapy</td>
</tr>
<tr>
<td>Recurrent urinary incontinence after anti-incontinence surgery</td>
</tr>
<tr>
<td>Frequency, urgency, and pain syndromes unresponsive to therapy</td>
</tr>
<tr>
<td>Nocturnal enuresis</td>
</tr>
<tr>
<td>Lower urinary tract dysfunction after pelvic radiation or radical pelvic surgery</td>
</tr>
<tr>
<td>Neurologic disorders</td>
</tr>
<tr>
<td>Continuous incontinence</td>
</tr>
<tr>
<td>Voiding dysfunction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 63-1. Pelvic organ prolapse stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 0</td>
</tr>
<tr>
<td>Stage 1</td>
</tr>
<tr>
<td>Stage 2</td>
</tr>
<tr>
<td>Stage 3</td>
</tr>
<tr>
<td>Stage 4</td>
</tr>
</tbody>
</table>
various volumes, and how well the patient is able to initiate voiding which requires adequate detrusor muscle contraction with simultaneous relaxation of the urethra. The procedure is performed and recorded in a standard fashion in order to facilitate clear communication between providers, and the terminology used to report urodynamic findings is based on published guidelines by the International Continence Society (ICS). Figure 63-3 depicts the set-up and catheter placement for multi-channel urodynamics, which is the method most commonly used by practitioners. Patients are positioned comfortably on a urodynamics chair and disposable microtransducer catheters are used. A catheter is placed inside of the bladder and measures vesical pressures ($P_{ves}$) and a catheter is placed inside of either the rectum or vagina and measures abdominal pressures ($P_{abd}$). Detrusor pressure ($P_{det}$) is determined by subtracting the abdominal and vesical pressures ($P_{abd} - P_{ves} = P_{det}$).

The first stage of urodynamics is referred to filling cystometry, which assesses the relationship between volume and detrusor pressure during bladder filling, also known as the storage phase. The bladder is then filled with normal saline and the patient is asked about bladder sensations: first sensation of filling, first desire to void, strong desire to void, symptoms of urge, and pain. The bladder is filled until cystometric capacity is reached and this volume is recorded. Detrusor contractions are also recorded during filling and are defined by rises in $P_{det}$, which represent detrusor overactivity, an abnormal finding on urodynamics that is indicative of overactive bladder disorder. Bladder compliance can be calculated by dividing the volume change by the change in $P_{det}$, which should remain low and constant during filling. Rises in $P_{det}$ not associated with a detrusor contractions are a sign of poor bladder compliance and can be associated with neurogenic bladder disorders. In order to assess ability to suppress micturition during filling, patients are asked to perform provocative measures (Valsalva, cough, jumping) to simulate stresses on the bladder, and episodes of leakage with these maneuvers are indicative of stress urinary incontinence. Under normal physiologic conditions, as the bladder fills, urethral resistance should generate enough pressure to compensate for any abdominal or detrusor pressure that is experienced during normal activities. The leak point pressure measures the urethra’s ability to prevent involuntary leakage of urine, and is defined as the lowest $P_{det}$ or $P_{ves}$ at which urine is expelled through the urethra. Abdominal leak point pressure is most commonly used to assess stress urinary incontinence as it assesses the ability of the urethra to resist increased abdominal pressure. This information is sometimes helpful to assess the severity of stress urinary incontinence.

The second stage of urodynamics is uroflowmetry and it involves assessment of bladder emptying, known as the voiding phase. After they undergo filling during the first phase of the study, patients are asked to void into an electronic volume detector and a graphical representation, or flow pattern, of the weight of the urine over time is created. Conditions that alter the uroflowmetric parameters include bladder neck obstruction, urethral resistance, and detrusor contractility. In addition to urine flow, post-void residual (PVR) is also assessed after passive or active filling of the bladder. Techniques to determine PVR include ultrasonographic assessment as well as catheterization.
Surgical Management of Middle and Anterior Compartment

Women presenting with bothersome pelvic organ prolapse have a number of treatment options, including observation, conservative treatment with a pessary and/or pelvic muscle exercises, and surgery [42]. Surgical management should be chosen after careful counseling, and if the patient no longer is improved by or does not desire conservative therapies. Surgical management should aim to address all of the segments of the vagina that are involved in the prolapse and an attempt should be made to improve related visceral function of the lower urinary tract, vagina, and anorectum [38].

There are important considerations to review with the patient before proceeding with prolapse surgery. These discussion points often help the surgeon and patient make a decision about appropriate route and approach to the surgery, and these important factors are listed in Table 63-3.

Transvaginal Repair

Transvaginal repair of pelvic organ prolapse is commonly performed at the time of transperineal repair of rectal intussusception or prolapse. In most cases, the FPMRS surgeon first performs the transvaginal prolapse repair, in order to operate in a clean-contaminated field, and the colorectal surgeon follows and performs his or her transperineal repair after the vaginal repair has been completed. However, the order of surgery can be coordinated based on surgeon preference and availability. Below we provide a brief overview of the surgeries performed.

Anterior compartment prolapse refers to prolapse of the bladder due to defects in the anterior vagina and is called a cystocele. This can be repaired performing a native tissue repair (anterior colporrhaphy) or with placement of a biologic or mesh graft. Cystocele repair is commonly performed at the time of transvaginal apical repair and confers very little additional morbidity to the overall procedure. The overall rate of anterior compartment recurrence has been estimated to be as high as 55 % [43], but depends on definitions used for recurrence. The rate of recurrence also appears to be higher in native tissue groups compared to mesh or graft augmentation groups: RR 1.39 (95 % CI 1.02–1.90) with a polyglactin mesh inlay and RR 2.72 (95 % CI 1.20–6.14) with a porcine dermis mesh inlay [44]. While the recurrence rate is higher after native tissue repair, it remains unclear if the higher adverse event rates associated with mesh augmentation (i.e., mesh erosion rate ~10 %) for repair of the anterior compartment outweigh the risk of recurrence, and at this time, most surgeons would argue that it does not.

Middle compartment prolapse refers to apical prolapse and includes post-hysterectomy vaginal apex prolapse as well as uterovaginal prolapse. Uterine-sparing techniques, namely hysteropexy, exist for the repair of apical prolapse in patients who desire uterine preservation. In other patients, vaginal hysterectomy with apical suspension or post-hysterectomy apical suspension, are commonly performed procedures. Apical suspension can be performed through an extra or intraperitoneal approach. Intraperitoneal bilateral uterosacral colpopexy is often performed at the time of vaginal hysterectomy and is a popular surgery in the USA. It is most commonly performed vaginally, but can also be done abdominally or laparoscopically, with or without robotic assistance. Its biggest advantage is that it suspends the vaginal apex in such a way that it maintains the normal axis of the vagina [38]. During this procedure, the uterosacral ligaments are exposed bilaterally and two to three delayed absorbable and/or permanent sutures are placed through the ligament 1–2 cm above the level of the ischial spines. These sutures are then passed through the vaginal cuff, suspending the apex of the vagina to the ligaments once the sutures are tied down. Studies have shown that success rates after uterosacral colpopexy are high. In a systematic review by Margulies et al. [45] the pool rates for anatomic success by compartment (anterior, apical, posterior) were 81.2 %, 98.3 %, and 87.4 %, respectively. Interestingly, patients with more severe prolapse had significantly worse cure rates, which has been reported in other studies as well [46].

Extraperitoneal suspensions are usually performed for post-hysterectomy vaginal vault prolapse, but can also be done after hysterectomy once the peritoneum is closed. The vaginal apex can be suspended unilaterally to the sacrosinous ligament for moderate-to-severe prolapse, or to the bilateral iliococcygeus fascia just below the ischial spines, in cases of minor apical prolapse or if the vagina is not long enough to reach the sacrosinous ligament. A sacrosinous suspension can be performed via an anterior, apical, or posterior approach and requires careful extraperitoneal dissection of the pararectal space down to the ischial spine and the sacrosinous ligament. Suspension sutures made of either delayed absorbable and/or permanent material are then placed through the ligament with care taken to avoid the pudendal neurovascular structures through direct visualization using a standard needle driver, or through specialized ligature carrier instrument such as the Deschamps or the Miya hook. The Capio™ (Boston Scientific, Inc., Natick, MA) is a suture-carrier device that was developed in the last decade and is also commonly used by surgeons to perform this

<table>
<thead>
<tr>
<th>Table 63-3. Preoperative considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is hysterectomy indicated? Does the patient desire uterine preservation?</td>
</tr>
<tr>
<td>Is the patient sexually active? Does she desire to maintain sexual function?</td>
</tr>
<tr>
<td>Through which route should the surgery be performed—vaginally, abdominally, laparoscopically, robotically?</td>
</tr>
<tr>
<td>Should a native tissue repair be performed or is graft augmentation necessary?</td>
</tr>
<tr>
<td>Is the patient undergoing a concomitant colorectal procedure, and which route is best for that procedure?</td>
</tr>
<tr>
<td>Should a concomitant anti-incontinence procedure be performed, and if so, which one?</td>
</tr>
</tbody>
</table>
procedure. Once two to four suspension sutures are placed through the ligament, the sutures are passed through the vagina, suspending the apex to the ligament once the sutures are tied down. Studies have shown that the sacrospinous colpopexy is effective in treating apical prolapse with recurrence rates as low as 8%; however, anterior compartment recurrence is more common after sacrospinous suspension, with rates as high as 37% 6–15 years after surgery [47]. The sacrospinous ligament suspension remains a popular approach for post-hysterectomy prolapse and concomitant cystocele repair at the time of suspension is recommended.

If patients are older and no longer desire sexual activity, a vaginal obliterator procedure can be performed instead of a reconstructive procedure. This is commonly performed at the time of transperineal colorectal procedures when patients present with concomitant advanced stage pelvic organ and rectal prolapse, especially if they are older and frailer and are determined to not be good candidates for a transabdominal repair. Obliterator procedures can be performed for post-hysterectomy vaginal prolapse as well as for urorectal prolapse, in which case either the uterus is left in situ (a Lefort procedure), or a vaginal hysterectomy is performed followed by a colpectomy and obliteration of the vagina (colpocleisis). The major advantage of the obliterator procedure is that is associated with a quick operative time and low morbidity, but most importantly, these procedures are associated with the lowest rates of recurrence and very high patient satisfaction [48].

Abdominal Repair

The most commonly performed abdominal procedure for pelvic organ prolapse is the sacral colpopexy, which can be performed through a laparotomy or by laparoscopy or robot-assisted laparoscopy. The procedure involves suspension of the vaginal apex to the anterior longitudinal ligament of the sacrum using a bridging synthetic or biologic graft. Synthetic grafts that have been used in the past include polypropylene mesh, polyester fiber mesh, polytetrafluoroethylene mesh, Dacron mesh, and silastic silicone rubber. Large-pore, lightweight polypropylene mesh is currently the most common type of synthetic mesh used, and we recommend using this mesh over the others, as it is associated with the least amount of complications. Biologic materials that have been used for this procedure include fascia lata, rectus fascia, dura mater, porcine dermis, and porcine small intestinal submucosa. The data that exist comparing synthetic mesh and biologic materials have shown that anatomic outcomes with biologic materials such as fascia lata are inferior to those when synthetic mesh is used [49, 50]. We prefer to use mesh for routine sacral colpopexy procedures; however, we recommend using biologic materials, and most often use cadaveric fascia lata, for combined ventral rectopexy procedures when a sigmoid resection is performed. This recommendation is based on the theory that infection resulting from anastomotic leak would necessitate removal of the implanted prosthesis. The data supporting this recommendation are sparse.

To perform the procedure, the patient should be positioned in dorsal supine low lithotomy position. The bladder is drained continuously with a Foley catheter. A sponge stick or end-to-end anastomosis (EEA) sizers can be placed in the vagina and rectum for manipulation of the vaginal apex and delineation of the rectovaginal septum. A laparotomy is performed, or intraperitoneal access is gained laparoscopically with or without robotic assistance. The patient is positioned in deep Trendelenberg and the small bowel is placed or packed into the upper abdomen, and the sigmoid colon is deviated to the left pelvis as much as possible. Pertinent anatomy is identified, including the bilateral ureters, the bifurcation of the aorta, and the iliac vessels. A longitudinal incision is made in the peritoneum over the sacral promontory and the anterior longitudinal ligament is exposed. Care must be taken here to avoid injury to the presacral venous plexus and middle sacral artery. Next, either a subperitoneal tunnel is created or the peritoneum is opened from the sacrum down to the posterior cul-de-sac in order to cover the graft with peritoneum after it is attached to the sacrum. The vaginal EEA sizer or alternate probe is then used to elevate the vagina and the peritoneum over the anterior vagina is dissected sharply in order to create a 4 cm pocket between the vagina and bladder. The mesh is then secured to the anterior and posterior vagina in a “Y” configuration using 0 or 2-0 suture (our preference is monofilament delayed absorbable suture) and with the vagina placed in the right pararectal space, the stem of the mesh is secured to the sacrum using 0 or 2-0 suture (our preference is monofilament permanent). The peritoneum is then closed over the mesh with absorbable suture.

Sacral colpopexy or colpoperineopexy can also be performed in conjunction with ventral or other rectopexy and requires a multi-disciplinary team approach to the surgery (Fig. 63-4a, b). During the peritoneal dissection, the colorectal surgeon mobilizes the sigmoid and rectum and either the FPMRS surgeon or colorectal surgeon performs the posterior dissection of the rectovaginal septum down to the level of the perineum (in the case of perineopexy) so that the posterior mesh may be attached as caudal as possible. This is especially important for patients with outlet defecatory dysfunction and/or a perineocele on examination. As mentioned in the chapter on rectal prolapse, in cases of redundant sigmoid colon suspected on defecography or other preoperative studies and confirmed intraoperatively, the colorectal surgeon may choose to perform a partial sigmoid resection with EEA in conjunction with the prolapse repair. If this is the case, as we previously mentioned, we advocate for biologic graft placement to avoid the need for removal if postoperative
anastomotic leak occurs. In our practice, we use porcine small intestinal submucosa (6 or 8 ply) for this portion of the procedure. Instead of posterior vaginal placement, the posterior graft is attached to the fascia of the pubococcygeus and iliococcygeus muscles laterally, to the distal rectum, lateral rectal attachments, and to the perineum distally. The mesh is then secured to the sacrum by one of the surgeons while the other confirms that there is adequate suspension without too much tension of both the rectum and vagina. Restoration of normal anatomy is key during this portion of the surgery.

Pooled data show that sacral colpopexy has superior outcomes to a variety of vaginal procedures including sacrospinous colpopexy, uterosacral colpopexy, and transvaginal mesh [44]. However, the procedure is associated with longer operating time, longer time to return to daily activities of living, and increased cost if the open abdominal approach is performed. Therefore, care should be taken in choosing the appropriate patients for the procedure, and the risks and benefits of the procedure versus the other approaches should be discussed.

With regard to combined rectopexy and sacral colpopexy procedures, there are many published reports of successful outcomes showing that a multi-disciplinary transabdominal approach is both safe and effective with good symptomatic improvement for patients with combined genital and rectal prolapse [17, 51–58]. Review of the literature also reveals that adverse events related to combined rectopexy with sacral colpopexy appear to be low, and there does not seem to be significant added morbidity to performing the procedures together. In a single institution retrospective analysis, VanderPas et al. [59] looked at 133 patients who underwent sacral colpopexy alone, suture rectopexy alone with sigmoid resection, or combined sacral colpopexy with suture rectopexy with and without sigmoid resection. The authors found that the only difference in perioperative adverse events between the groups was the rate of postoperative ileus: the rate was much higher in the rectopexy alone group compared to the two sacral colpopexy groups (22.2 % vs. 3.8 % vs. 5.9 %, \( p = 0.004 \)). Otherwise, they reported that concomitant sacral colpopexy at the time of rectopexy did not increase the rate of intra- or postoperative complications.

The main concern is for spondylodiscitis, a condition that includes a spectrum of spinal infections such as discitis, osteomyelitis, epidural abscess, meningitis, subdural empyema, and spinal cord abscesses [60]. Implanted prosthetic materials pose an ongoing risk during surgery and post-operatively because of the direct inoculation of bacteria at the time of graft and suture placement and because of the continued presence of a foreign body. As sacral colpopexy involves placement of a graft material over the sacrum, it represents a unique risk for spondylodiscitis, and there are reported case reports after this procedure [61, 62]. There are also reported cases of spondylodiscitis after combined rectopexy cases with and without sigmoid resection [63, 64]. More importantly, our group has found a significant increase in the risk of pelvic abscess formation after combined ventral rectopexy cases compared to sacral colpopexy alone (11.1 % vs. 0.8 %, \( p < 0.001 \)). In this cohort of patients, resection of the bowel did not seem to contribute to this increased risk, and rectopexy alone was sufficient for abscess formation.

Extra caution must be taken during these procedures to place the sacral sutures in the anterior longitudinal ligament of the sacrum and not inadvertently in the vertebral disc space, as this may increase the risk of bacterial inoculation.

**Figure 63-4.** Combined sacro-colpo-rectopexy procedure. (a) The graft is secured to the anterior rectum. (b) Sagittal view of the procedure showing suspension of the vagina and rectum to the sacrum using a graft.
into the space, especially when the graft has been attached to the rectum. While there are documented reports of favorable outcomes using synthetic mesh, even with sigmoid resection is performed [59], our group attempts to minimize the risk of infection of prosthetic synthetic material by using a biologic graft when a bowel resection is indicated and by always using monofilament delayed absorbable sutures on the rectum and vagina and monofilament permanent sutures on the sacrum. We also have a low threshold to evaluate postoperative patients with either a CT scan or an MRI who complain of malaise and/or lower back pain or who have ongoing nondescript symptoms that cannot be explained by another cause of infection.

Surgical Management of the Posterior Compartment: Approach to the Rectocele Repair

Symptoms associated with a rectocele can often be managed effectively without surgery. Conservative management includes the initiation of a routine bowel regimen in order to avoid constipation and straining with bowel movements. A good regimen usually includes a high fiber diet, adequate water intake, and an over-the-counter stool softener. Pelvic floor physical therapy with or without biofeedback is also a conservative management strategy that can be offered to patients who are noted to have dysfunction of the pelvic floor muscles on examination. In addition, rectoceles protruding into the middle and upper vagina may also benefit from pessary placement.

Surgical management is an option for patients who fail conservative management. Surgeons differ in their opinion regarding when surgical management is indicated. Some surgeons (many colorectal surgeons) believe that dysfunctional fecal evacuation alone is not an indication and that patients should complain of needing to splint to defecate, or have vaginal protrusion of the rectocele beyond the hymen. In our urogynecology practice, we offer patients surgical treatment if they fail conservative measures, have any emptying/evacuation complaints and/or vaginal bulge or protrusion symptoms. Surgical management and planning are done after a thorough pelvic floor examination as mentioned above. Prolapse of the posterior vaginal wall can be isolated or can occur in conjunction with prolapse of the other compartments, and surgical planning is done accordingly. Concomitant enterocele and sigmoidocele can also be present with a rectocele, but there are no data describing how often this occurs, and whether or not the presence of one of these conditions affects surgical outcomes after rectocele repair.

Before proceeding with surgical management, an important thing to always consider is that constipation symptoms may be related to underlying physiologic dysfunction [65], and not the rectocele itself. In addition, while posterior compartment prolapse is commonly associated with symptoms of bowel dysfunction, it is unclear how related they are to the presence or severity of prolapse [66], which can make the decision to proceed with surgical management a challenge.

There are data, however, that show significant improvement in anatomy of the posterior compartment as well as defecatory symptoms after rectocele repair [67], and therefore, there is reason to believe that posterior repair is beneficial for some patients. Patients should be well counseled about the possibility of persistent constipation or defecatory symptoms after rectocele repair, and conservative management of these symptoms may still be needed after surgery. Several approaches to rectocele repair exist. The transvaginal techniques used by pelvic floor surgeons will be discussed here. The transanal techniques will be discussed in Chap. 59.

Transvaginal Repair

Transvaginal repair is currently the most common approach to rectocele repair, and two techniques for transvaginal repair exist. The “traditional” or “midline plication” technique involves plication of the vaginal muscularis and rectovaginal tissues with or without the underlying levator muscles in the midline. A “site-specific” repair entails repair of discrete defects in the vaginal muscularis and rectovaginal tissues without plication of the levator muscles, usually with a finger inside of the rectum to discern repair of the defects.

Figure 63-5 provides an overview of how the transvaginal rectocele repair is performed. Patients are positioned in the dorsal lithotomy position. The posterior vaginal wall is injected with a local anesthetic with dilute epinephrine (our preference is 0.5% lidocaine with 1:200,000 units epinephrine) and then incised in the midline from the most dependent portion of the rectocele proximally, (easily identified on rectovaginal examination), to the hymen. If there is detachment of the rectovaginal septum from the perineum, a gaping genital hiatus, and/or a perineocele, a perineorrhaphy should also be performed, and the perineal epithelium should also be incised. Once incision is made, clamps are placed on the incised vaginal epithelial edges, gentle traction is applied, and the fibromuscular layer of the vagina is dissected off of the epithelium, creating bilateral epithelial flaps. If an enterocele sac is encountered, it is usually opened, the small bowel contents are reduced and the sac is purse-stringed shut with either permanent or delayed absorbable No. 0 or 2-0 suture. Next, plication is performed either in the midline, or in a site-specific manner using either No. 0 or 2-0 absorbable or delayed absorbable suture until the rectocele is completely reduced. If a perineorrhaphy is performed, a 0 absorbable suture is used to reconstruct the perineum by plicating the inferior portion of the bulbospongiosus muscles and the superficial transverse perianal muscles and reattaching this complex to the rectovaginal septum if indicated. The epithelial edges are then trimmed bilaterally and reapproximated with 2-0 absorbable suture.
The transvaginal rectocele repair can be further modified by augmenting the repair with either a synthetic or biologic graft. Synthetic graft materials can be either absorbable or permanent and are commonly made out of polyglactin or polypropylene, and the most commonly used biologic grafts are dermal or intestinal and are bovine or porcine in nature. The data that exist on posterior compartment repair with graft augmentation do not show significant benefit from its use. Altman et al. [68] prospectively looked at augmentation with a porcine dermal graft and reported a 40% anatomic recurrence at 3 years and less than 50% of patients had improvement in their defecatory symptoms. Sand et al. [69] compared rectocele repair with and without placement of a polyglactin mesh and found that recurrence was similar between the two groups.

In a review of posterior vaginal wall prolapse by Maher and Karram [70], midline plication and site-specific repair were found to both have a mean reported anatomic success
rate of 83%. The authors also found that of the patients undergoing midline repair, 18% complained of postoperative dyspareunia and 26% complained of defecatory dysfunction with need to perform vaginal digitation to defecate, compared to 18% for both problems in the site-specific groups. In their retrospective analysis, Abramov et al. [71] found that patients undergoing site-specific repair were more likely to experience recurrent rectocele compared to their midline plication cohort (32% vs. 13%, p = 0.015).

In a randomized trial by Paraiso et al. [72], patients with a stage II or greater rectocele were randomized to one of three rectocele repair arms: midline plication, site-specific repair, and augmented repair with porcine small intestinal submucosa graft. At 1 year, anatomic failure was found to be highest in the augmented group, followed by the site-specific repair group (46% vs. 22% vs. 14%, p = 0.02). Interestingly, there was no statistical difference in defecatory and dyspareunia symptoms between the three groups. In a multicenter randomized trial, Sung et al. [73] also found no statistical difference in postoperative dyspareunia and resolution of defecatory symptoms in patients undergoing any type of native tissue repair (midline plication and site-specific) compared to a porcine small intestinal submucosa graft augmented repair; however, contrary to the above-mentioned studies, the authors also did not find a difference in objective and subjective success rates between the two groups.

**Transanal Repair**

In 1967, Marks [74] described the transanal rectocele repair procedure. While less commonly performed (compared to the transvaginal approach), it is still performed by some colorectal surgeons (see Chap. 59).

Several trials exist comparing the transvaginal and transanal approaches to rectocele repair. Kahn and Stanton [75] looked at women with symptomatic rectoceles with and without defecatory dysfunction who had impaired rectal evacuation on defecography but normal anorectal compliance on anal manometry. Transvaginal repair involved midline and levator plication and was performed by FPMRS surgeon, while the transanal colorectal surgeons performed a transanal repair. Nieminen et al. [76] performed a trial with broader inclusion criteria and included all women with symptomatic isolated rectoceles and intact anal sphincter function who did not respond to conservative management. Transvaginal repair was performed by FPMRS surgeons and involved midline plication only without levator plication and transanal repair was performed by colorectal surgeons. Both trials reported significant alleviation of symptoms by both operative techniques, but the transanal approach seemed to be associated with more clinically diagnosed rectocele recurrences and decreased incidence of dyspareunia.

In general, the transvaginal approach seems to be the more commonly performed operation for symptomatic rectocele particularly by FPMRS. The anatomic outcomes seem to be better, and it may be associated with less morbidity. However, the procedure is associated with higher rates of postoperative dyspareunia, especially if levator plication is performed, and it does not always resolve all defecatory symptoms.

**Conclusions**

Pelvic floor disorders are mostly a continuum of a disease process resulting from the loss of pelvic floor support. It is not uncommon to have multi-compartmental dysfunction, often requiring a multi-disciplinary team approach to evaluation and management. FPMRS surgeons and colorectal surgeons must strive to work together to offer their patients treatment strategies that are associated with the best outcomes but also with the lowest risk of morbidity. Understanding the anatomic relationships of the pelvic floor is the first step in achieving this. Second, is having a good grasp of each specialist’s evaluation and management strategies, and working together to offer patients a comprehensive plan of care.

**References**


