Techniques in Urogynecology and Pelvic Reconstructive Surgery

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Our fastest growing population is the elderly, and the incidence and prevalence of uterovaginal prolapse and urinary incontinence increase with age. Because of the significant impact on quality of life, patients continue to seek surgical management for treatment of these disorders. While there are three approaches to surgery that exist for pelvic floor disorders, laparoscopy has emerged as a minimally invasive option for appropriate candidates. Many perioperative considerations must be examined before performing laparoscopic operations, including patient positioning, trocar placement, and prevention of infectious and venous thrombotic events.

Patients who have undergone prior hysterectomy and suffer from vaginal vault prolapse may be good candidates for laparoscopic uterosacral ligament suspension of the vagina, which has yielded favorable results. However, sacrocolpopexy remains the gold standard for vaginal vault suspension, as patients attain very high cure rates. Successful outcomes have been shown with the laparoscopic approach to this procedure. For patients who have not undergone previous hysterectomy, there is the option for hysterectomy at the time of vault suspension. For patients without risk factors for cervical dysplasia or malignancy, the option for uterine preservation exists, and this can be achieved either with laparoscopic uterosacral hysteropexy or sacrohysteropexy. These operations have also yielded excellent results for management of pelvic organ prolapse. Patients with stress urinary incontinence may also be candidates for laparoscopic surgery, as the Burch colposuspension is a procedure that continues to be performed in certain patients.

There are many advantages to laparoscopic surgery; however, there are perioperative complications that are related to this surgical approach. Most complications are the result of trocar entry or instrument-related injury involving the pelvic and abdominal vasculature, the small and large bowels, the ureters, and the bladder. Complications involving synthetic mesh placement also exist, and these include infection at the site of mesh attachment as well as mesh erosion.

As advances in minimally invasive surgery are made, more surgeons will perform laparoscopic procedures to treat pelvic floor disorders and urinary incontinence. And as the population continues to age, the need for surgical management of these disorders will increase. Reconstructive surgeons should strive to learn the important principles of laparoscopy, avoid the complications that can be associated with certain procedures, and determine which operations are appropriate for their patients.

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7.1 Introduction

Pelvic organ prolapse and urinary incontinence are common problems in women that can cause substantial morbidity and negatively affect quality of life. The management of pelvic organ prolapse and incontinence can be challenging, as several support defects often coexist. To achieve the goals of pelvic reconstruction, the surgeon must understand normal anatomic support as well as physiologic function of the organs involved. The goals of surgery are to reconstruct anatomy, maintain or restore normal bowel and bladder function, and preserve vaginal length.

Three modes of surgery exist in pelvic reconstructive surgery: vaginal, open abdominal, and laparoscopic (conventional and robot-assisted). Advances in minimally invasive surgery have led to the widespread adoption of laparoscopic techniques in pelvic reconstruction. Laparoscopy has many practical and economic advantages compared with traditional open procedures. These advantages include improved visualization of pelvic anatomy, decreased postoperative pain, less operative blood loss, shortened hospital stay, rapid recovery rate and return to daily activities by patients [1].

7.2 Perioperative Considerations

Selecting appropriate patients for laparoscopic procedures is very important. The pneumoperitoneum needed during these cases causes important systemic changes in the body, including decreased venous return, increased systemic and pulmonary vascular pressures, and increased ventilation pressures [2]. These changes are amplified in the setting of the Trendelenburg position, which is often used in gynecologic procedures. These physiologic changes are not tolerated by patients with pre-existing cardiopulmonary disease. Therefore, appropriate preoperative tests, such as chest x-ray, pulmonary function tests, electrocardiogram and echocardiogram, may be necessary in patients with suspected cardiac and pulmonary comorbidities. These procedures should be avoided in patients with known and severe disease.

Visualization of all pelvic structures up to the level of the sacrum is very important for urogynecologic procedures, and therefore proper patient positioning before commencing surgery is essential. The patient should be positioned in the low lithotomy position using Allen stirrups with care to avoid hyperflexion or extension at the level of the hips and knees. All bony prominences should be padded. Placing an anti-slip device such as an egg crate underneath the patient to limit movement when the operating table is moved is very helpful. Additionally, positioning the patient so that the buttocks are slightly beyond the end of the table will help facilitate placement of vaginal and rectal manipulators. The arms should be tucked and padded adequately to relieve any pressure on the elbows, and the hands should be left in the proper anatomic position.

Patients should receive intravenous prophylactic antibiotics within 60 min of incision to reduce the risk of perioperative infection. The antibiotic of choice in all gynecologic surgery is a first-generation cephalosporin, usually cefazolin, or an alternative combination regimen such as ciprofloxacin and metronidazole if a patient has a documented allergy to penicillin [3].

All patients undergoing prolapse and/or incontinence surgery are at moderate risk for venous thromboembolic events (VTE) and require perioperative prophylaxis. A systematic review of VTE prophylaxis in gynecologic surgery concluded that application of intermittent pneumatic compression devices to the lower extremities before induction of anesthesia is sufficient for VTE prophylaxis [4]. Patients at higher risk for VTE (those with significant comorbidities, cancer history, morbid obesity, or history of prior VTE) should have intermittent pneumatic compression devices and low-dose unfractionated heparin or low-molecular-weight heparin administered before surgery [5].

The value of a mechanical bowel preparation for prevention of infectious complications or an

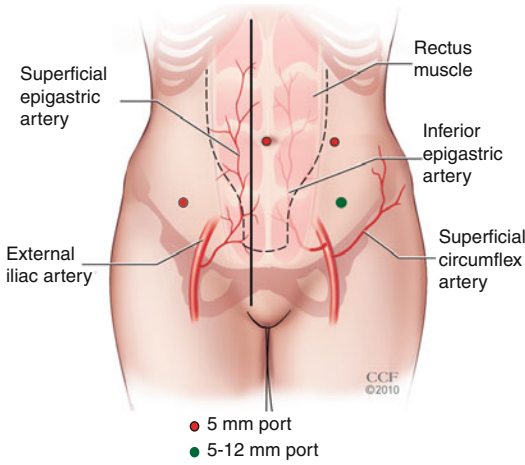


Fig. 7.1 Laparoscopic trocar placement. Trocar placement plays a key role in facilitating laparoscopic procedures performed for pelvic prolapse and incontinence. Proper positioning of each trocar allows reach of the laparoscopic instruments from the deep pelvis up to the level of the sacrum as well as adequate articulation for suturing and knot-tying. Sufficient distance between trocars is necessary to prevent instrument crossing. For surgeries such as laparoscopic sacrocolpopexy, which involves dissection over the sacrum and lower pelvis as well as extensive suturing of graft material to both regions, placement of at least four ports is usually necessary. Multiple port configurations are described in the literature. Placement of a 5- mm trocar is recommended in the umbilicus for the laparoscope, two ports placed 2 cm superior and medial to the anterior iliac spine on each side (typically a 10-mm port on the left and a 5- mm port on the right), and a 5-mm port placed in the midclavicular line at the level of the umbilicus on the side from which the surgeon will suture. The inferior epigastric vessels are the most commonly injured vessels at the time of lateral trocar placement [2]. Although these vessels are not easily visualized, placing the ports lateral to the rectus abdominis muscles usually ensures their avoidance. All trocars should be placed under direct visualization to avoid injury to the internal vasculature and surrounding soft tissues. When placing the initial port through the umbilicus, the table should be level to avoid injury to the greater vessels, and entry should be gained in the manner with which the surgeon is most comfortable. If the patient has a history of midline laparotomy or adhesions are expected, a left upper quadrant approach is recommended. After the entry site is inspected and the upper abdomen is surveyed, the patient should be placed in a steep Trendelenburg position to move the bowels cephalad for good visualization of the pelvis and for placement of the subsequent trocars (From Cleveland Clinic Center for Medical Art & Photography. Copyright © 2010–2013, with permission.)

intraoperative bowel leak or for reducing the rates of anastomotic leak if bowel surgery is performed has been challenged in a recent meta-analysis [6]. Therefore, it does not seem necessary to complete bowel preparation for all patients undergoing operations to treat prolapse or incontinence [6].

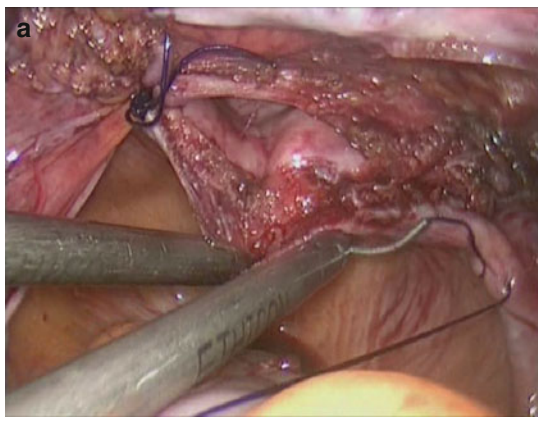
7.3 Uterovaginal Prolapse Procedures

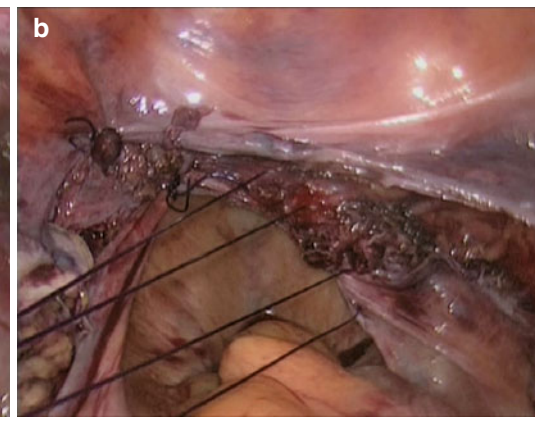
While there is sparse literature on outcomes from laparoscopic uterosacral ligament suspension because most studies do not follow patients beyond 2 years, the reported cure rate ranges from 76 to 90 % [8, 9]. Additionally, the laparoscopic approach has also been shown to have a lower risk of ureteral injury than transvaginal uterosacral suspension [7] and therefore may be a safe alternative to transvaginal surgery.

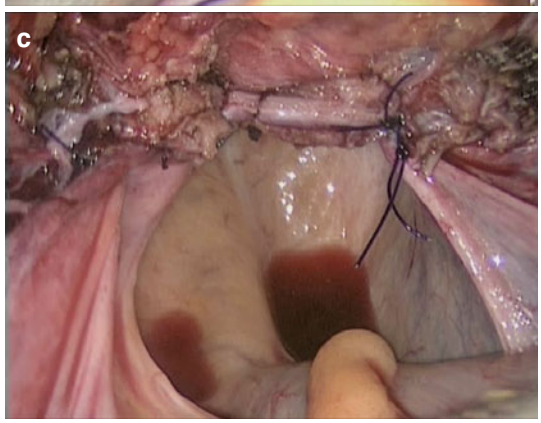
The most commonly used material is a large-pore polypropylene mesh, which has proven to have fewer complications because of its favorable synthetic properties [11]. The technique of laparoscopic sacrocolpopexy using graft placement begins with proper positioning of the patient in the low lithotomy position using Allen stirrups so that there is access to the vagina during the operation. A sponge stick or end-to-end anastomosis (EEA) sizer should be placed in the vagina for manipulation of the apex. A Foley catheter is placed in the bladder for continuous drainage throughout the operation. After intraperitoneal access is gained and laparoscopic trocars are placed, the small bowel should be gently placed into the upper abdomen and the sigmoid colon deviated to the left pelvis as much as possible. If manual retraction of the sigmoid colon is not adequate, a temporary suture can be placed through the epiploica of the colon, passed through a trocar on the left side of the patient, and clamped to the drapes, with removal of the suture at the end of the procedure. The ureters are identified bilaterally; it is important to note their location throughout the duration of the case. Attention is then turned to the sacrum, and the sacral

promontory is identified so that the presacral space may be entered.

A review of abdominal sacrocolpopexy reported the success rate when defined as lack of apical vaginal prolapse postoperatively from 78 to 100 % [12]. The median reoperation rates for pelvic organ prolapse and for stress urinary incontinence in the studies that reported these outcomes were 4.4 % (range, 0–18.2 %) and 4.9 % (range, 1.2–30.9 %), respectively. A randomized, controlled trial of sacrocolpopexy with and without concomitant Burch colposuspension at 2-year follow-up had reassuring anatomic outcomes, with 95 % of subjects having excellent objective outcomes for the vaginal apex (within 2 cm of total vaginal length), with 2 % of subjects demonstrating stage III prolapse, and 3 % of subjects undergoing reoperation for prolapse [13]. These subjects also demonstrated improved urinary, defecatory, and sexual function based on validated questionnaires. Although most of the literature has been focused on abdominal sacrocolpopexy, there are emerging data on the laparoscopic approach. A comprehensive review looking at over 1,000 patients in 11 series who underwent laparoscopic sacrocolpopexy revealed that the conversion rates and operative times had decreased substantially with increased experience in performing this procedure [10]. The mean follow-up for these series was 24.6 months with an average patient satisfaction rate of 94.4 % and a 6.2 % prolapse reoperation rate [10]. From this review, the authors concluded that a laparoscopic approach to sacrocolpopexy upholds the outcomes of the gold standard of abdominal sacrocolpopexy and is a very good minimally invasive option for patients with vaginal vault prolapse [10].







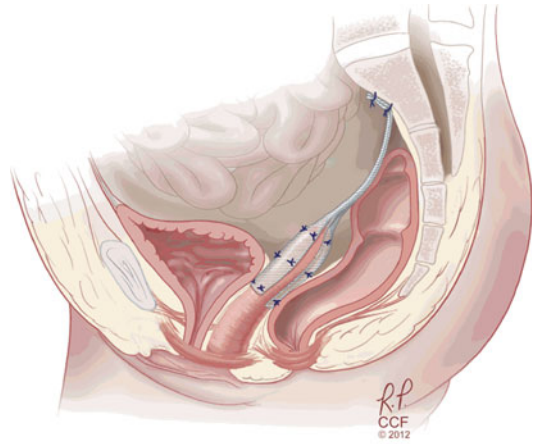


Fig. 7.3 Laparoscopic sacrocolpopexy. Laparoscopic sacrocolpopexy has become an alternative to open abdominal sacrocolpopexy for repair of vaginal vault prolapse. Abdominal sacrocolpopexy is considered the gold standard for vault prolapse and has demonstrated superior anatomic outcomes compared to transvaginal suspension procedures [10]; however, the operation is associated with a higher complication rate. A laparoscopic approach aims at bridging the gap between the advantages of vaginal surgery, namely, decreased morbidity and faster patient recovery, and the surgical success rates of abdominal sacrocolpopexy [10]. For young women who are sexually active with symptomatic pelvic organ prolapse, reconstruction with a sacrocolpopexy procedure is beneficial because the success rates are high because the procedure adequately restores normal pelvic anatomy and maintains vaginal length [11]. Laparoscopic sacrocolpopexy involves suspension of the vagina to the sacral promontory using a bridging graft that can be made of biologic or synthetic materials. The graft is sutured to the anterior as well as the posterior vagina and then to the anterior longitudinal ligament of the sacrum. We strongly believe that the minimally invasive approach to sacrocolpopexy should not have alterations from the open approach. The exact same steps, suture type and number, and graft should be used with open or laparoscopic surgery (From Cleveland Clinic Center for Medical Art & Photography. Copyright © 2012–2013, with permission)

Fig. 7.2 Laparoscopic uterosacral ligament vaginal vault suspension. Uterosacral ligament suspension is a procedure that is commonly performed at the time of hysterectomy for treatment of vaginal vault prolapse. The procedure involves attaching the vaginal vault to the midportion of the uterosacral ligament, which serves to restore the apical support of the vagina. When compared with the transvaginal approach, this type of suspension may decrease the risk of rectal and ureteral injury at the time of placement of the suspension sutures because these structures are easily identified in laparoscopic surgery [7]. Although laparoscopic uterosacral suspension after transvaginal hysterectomy is not very common, these benefits should be considered, especially if concomitant laparoscopic procedures are necessary. A laparoscopic approach can be taken at the time of laparoscopic hysterectomy, especially if no further vaginal reconstruction is needed at the end of the procedure. An Allis clamp can be used to elevate the vaginal cuff to delineate the uterosacral ligaments. Alternatively, a vaginal probe can be used to elevate the vagina, demarcating the uterosacral ligaments. Care is taken to avoid tenting the peritoneum close to the ureter on the ipsilateral side so as to not obstruct the ureter when the suspension sutures are tied down. A releasing peritoneal incision between the ligament and the ureter can be made in order to reduce peritoneal tension and subsequent ureteral kinking from suture placement. (**a**) A permanent or delayed absorbable suture is placed through the midportion of the uterosacral ligament (at the level of the ischial spine) with lateral to medial needle placement and then secured to the ipsilateral posterior and anterior vaginal cuffs. (**b**) One or two sutures can be placed on each side of the vagina, extracorporeal or intracorporeal knot-tying technique can be employed to suspend the vagina, (**c**) and the cuff is closed in an uninterrupted fashion

Table 7.1 Tips for performing minimally invasive sacrocolpopexy [11]

Patient positioning is critical
Place egg crate or other anti-slip device directly below patient to prevent movement during operation.
Position buttocks slightly beyond end of table so that vaginal manipulation is possible.
Both arms are tucked and protected.
Once intra-abdominal access is gained, steep Trendelenburg positioning helps move the small bowel into the upper abdomen,
Two knowledgeable assistants are necessary
One works intra-abdominally and helps with retraction.
One works vaginally and manipulates the vagina and rectum to optimize visualization.
Side dock the robot, either parallel or at a 45-degree angle, to the table.
Placement of ports is integral to procedure success.
Ensure there is enough space between the robot arms to prevent collision.
If the colon is redundant, an epiploica can be sutured temporarily to the left anterior abdominal wall to improve visualization.
If hysterectomy is planned, a supracervical hysterectomy should be considered because the cervix may help to decrease future mesh erosions. Alternatively, a vaginal hysterectomy can be performed prior to a laparoscopic repair.
Given the lack of tactile feedback in robotic surgery, identification of the sacral promontory can be challenging. Using laparoscopy initially, this area can be identified and marked with a cautery before docking the robot.
Care should be taken to avoid the intervertebral disc while placing the sacral sutures. Deep stitches through the disc and periosteum should be avoided because cases of osteomyelitis have been reported after robotic sacrocolpopexy.
A barbed suture can be used to close the peritoneum.
Convert to laparotomy when necessary. Patient safety is of utmost importance

From Walters and Ridgeway [11]; with permission

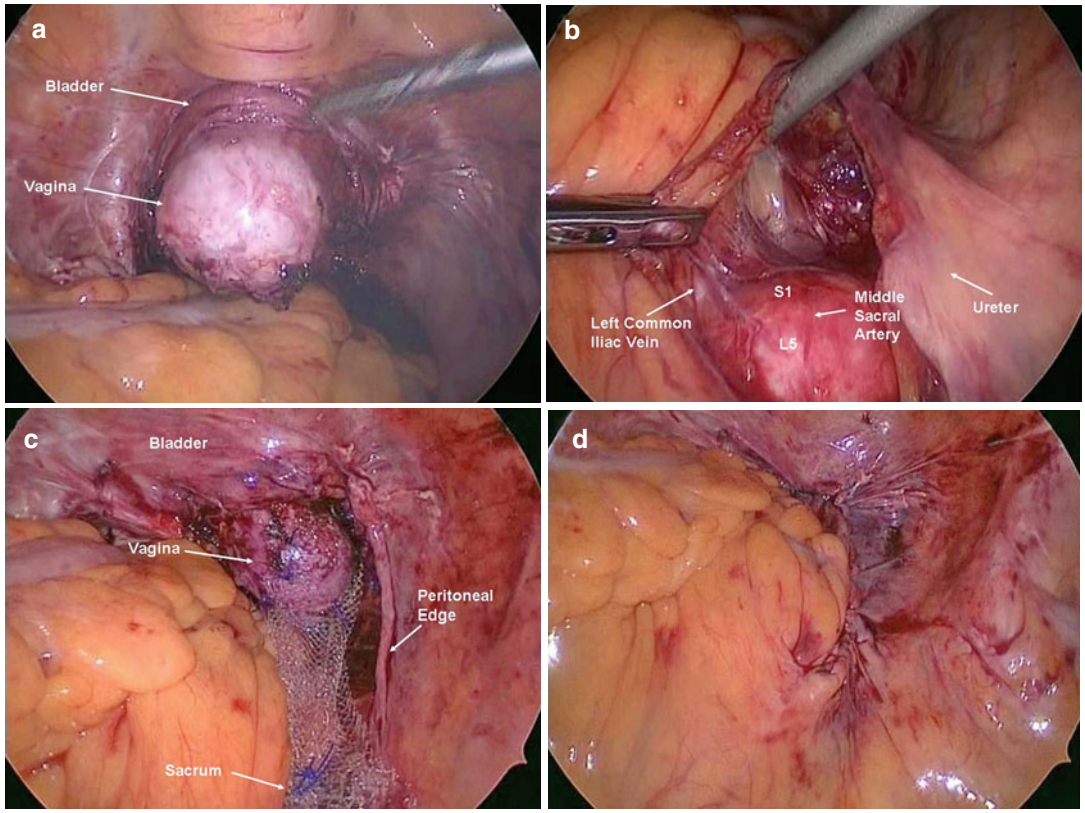


Fig. 7.4 (**a**) The important landmarks of the presacral space include the aortic bifurcation, the common and internal iliac vessels, the sigmoid colon, and the right ureter. Notably, the left common iliac vessel is located medial to the iliac artery and is particularly vulnerable to injury during this procedure, as are the internal iliac vessels, the right ureter, and the middle sacral artery. Once all structures are identified, a longitudinal peritoneal incision is made over the sacral promontory. Dissection is done carefully to reveal the bony promontory as well as the anterior longitudinal ligament, which will later serve as the attachment point for the graft. Approximately 4 cm of exposure is necessary, and this is achieved by using blunt dissection or electrocauterization of the subperitoneal fat. Caution should be taken to avoid the presacral venous plexus as well as the middle sacral vein and artery, which are often encountered during this dissection. Dissection caudally through the peritoneum and subperitoneal fat is carried down to the level of the posterior culde-sac. The rectum and right ureter are visualized at all times during this part of the procedure as the course of the dissection is located between these two structures. (**b**) The vagina is elevated cephalad using a sponge stick or EEA sizer, the peritoneum overlying the anterior vaginal apex is incised transversely, and the bladder is dissected off the anterior vagina using sharp dissection, creating a 4- to 5-cm pocket. If this plane is difficult to establish, the bladder can be filled in a retrograde fashion to find the correct dissection plane. Similarly, the peritoneum overlying the posterior vagina is incised, and dissection is done overlying the vagina and extending into the posterior cul-de-sac, creating a 4- to 5-cm pocket. Care must be taken to avoid injury to the rectum during this part of the surgery. If the rectum is hard to delineate, a second EEA sizer should be introduced into the rectum, and with manipulation of the vaginal and rectal EEA sizers, the correct dissection plane is identified. If the patient has concomitant defecatory dysfunction and/or rectal prolapse, the posterior dissection is sometimes carried down to the level of the perineal body. In most cases, however, the 4- to 5-cm pocket is sufficient. Once dissection is complete, the graft is prepared. A lightweight polypropylene mesh is currently most commonly used. The mesh is fashioned into two arms that are approximately 4 Å~ 15 cm in size. The graft is first attached to the posterior vaginal wall using 4–6 permanent or delayed-absorbable No. 0 or 2-0 sutures in an interrupted fashion, 1–2 cm apart from each other. Sutures are placed through the fibromuscular tissue of the vagina but not through the underlying epithelium. *S1* 1st sacral vertebral body, *L5* 5th lumbar vertebral body. (**c**) The graft extends approximately half-way down the posterior vaginal wall. The second arm of the graft is then attached to the anterior vaginal wall in a similar fashion. Delayed absorbable sutures should be used for the most distal stitches close to the bladder to avoid suture erosion and fistulization. The vagina is then elevated with the sponge stick or EEA sizer toward the sacral promontory. The graft is trimmed to the appropriate length and then sutured to the anterior longitudinal ligament using a stiff but small half-curved tapered needle with two to three permanent No. 0 monofilament sutures. (**d**) The peritoneum is then closed over the exposed graft with absorbable suture. After cystoscopy, a vaginal examination is performed, and a posterior colporrhaphy and perineorrhaphy are performed if needed

7.3.1 Laparoscopic Hysteropexy

Hysterectomy is often done at the time of surgical repair for uterine and uterovaginal prolapse. Uterine preservation techniques have largely been employed in women with uterovaginal prolapse desiring future fertility. However, there has been a small shift in this practice as more women are requesting uterine preservation for other important reasons, including issues of sexuality, body image, cultural preferences, and the concern for earlier-onset menopause after hysterectomy [11]. The risk of unanticipated pathology in asymptomatic women remains low [14]; however, it is important to determine which patients are appropriate candidates for uterine-preserving surgery. Uterine-preserving surgery is contraindicated in women with a history of cervical dysplasia, dysfunctional uterine bleeding, postmenopausal bleeding, and risk factors for endometrial carcinoma. Additionally, women who choose to undergo hysteropexy should be counseled about the need for continued cancer surveillance and potential risks associated with future pregnancies [15].

Most procedures that aim to suspend the vaginal apex are performed in a similar fashion to those performed with hysterectomy, with some necessary modifications [11]. The minimally invasive abdominal procedures most commonly described in the literature include laparoscopic uterosacral ligament suspension and laparoscopic sacrohysteropexy. Laparoscopic uterosacral ligament suspension is performed similarly to vaginal vault suspension to the uterosacral ligaments. The uterus is suspended to a portion of the ligament on each side, preferably using permanent suture. Additionally, the uterosacral ligaments can be shortened with sutures, providing additional support. This procedure is favorable because it restores normal anatomy while preserving the uterus. Furthermore, it carries little risk for subsequent pregnancy and delivery. The only study to compare laparoscopic hysteropexy via uterosacral ligament suspension to vaginal hysterectomy with subsequent vaginal vault suspension is a retrospective cohort study of 50 patients [16]. The authors found that hysteropexy patients had better vault suspension as measured by the Pelvic Organ Prolapse Quantification examination postoperatively and experienced fewer failures as measured by reoperation rates when compared to the vaginal vault suspension group [16].

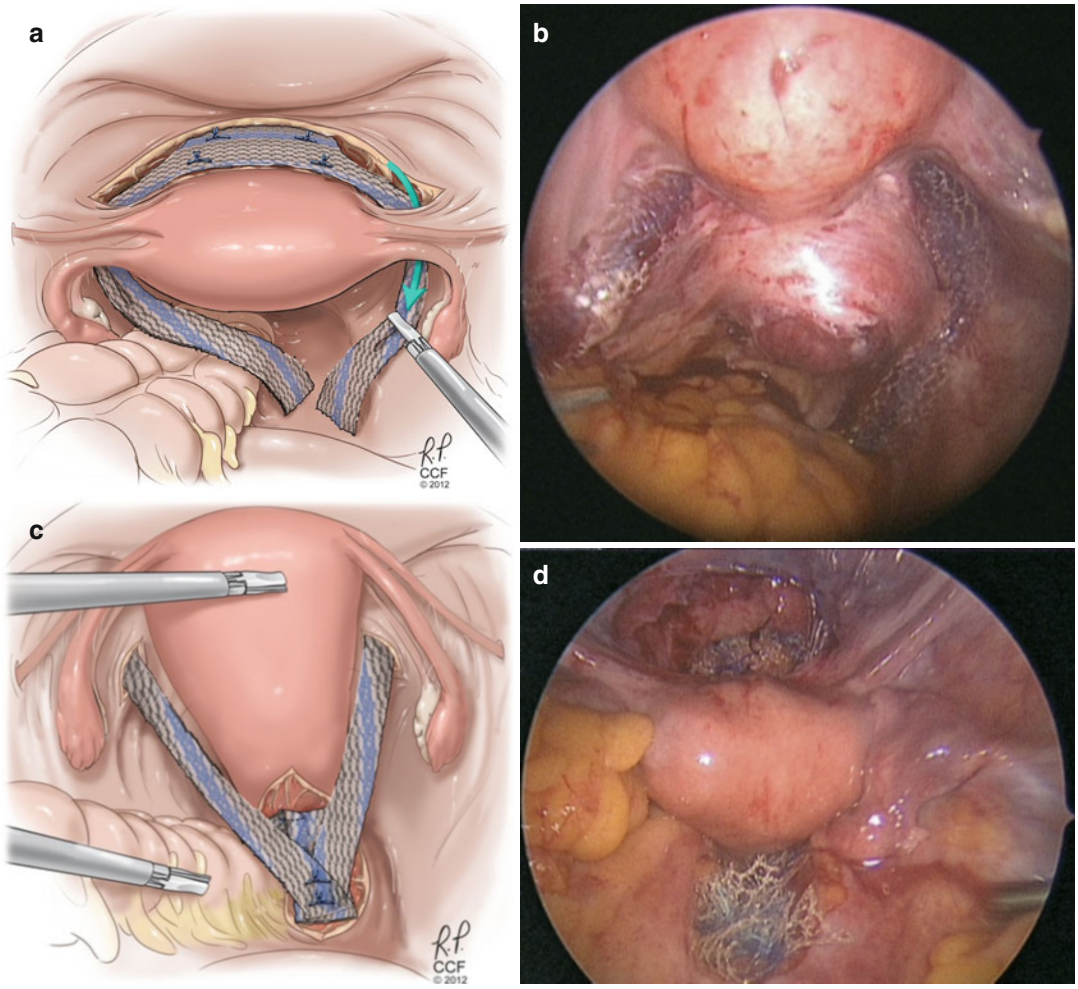


Fig. 7.5 Laparoscopic sacrohysteropexy. This can be done using different techniques but is similar to the technique used during sacrocolpopexy. Graft material can be sutured anteriorly and/or posteriorly, usually on the cervix, but can also be sutured to a portion of the proximal vagina. The graft is then suspended to the anterior longitudinal ligament of the sacrum using permanent sutures. (**a**–**b**) If anterior mesh is applied, windows are created through the broad ligament to allow the graft to pass through for attachment to the sacrum. (**c**–**d**) A posterior cervical graft has been placed, and this also has been sutured to the sacral promontory, thus suspending the uterus, cervix, and vagina to the sacrum. While outcomes data are sparse for laparoscopic sacrohysteropexy, results from abdominal sacrohysteropexy studies have shown similar high success rates when compared to open abdominal hysterectomy with subsequent sacrocolpopexy [17]. This procedure remains a viable option for patients with uterovaginal prolapse who desire uterine preservation. However, sacrohysteropexy with anterior mesh should not be offered to patients who desire future fertility. In these patients, placing a solitary posterior mesh can be considered (**a** and **c** from Cleveland Clinic Center for Medical Art & Photography. Copyright © 2012–2013, with permission)

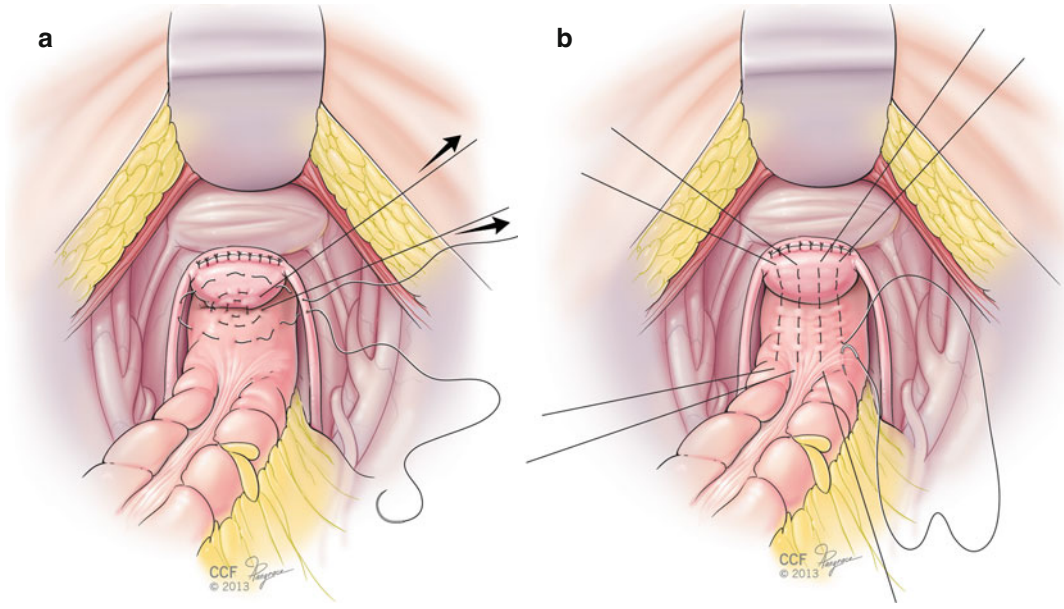


Fig. 7.6 Laparoscopic enterocele repair. An enterocele is a true hernia of the peritoneal pouch of Douglas and most often occurs in conjunction with additional uterovaginal prolapse or develops following vaginal or abdominal hysterectomy. The repair of an enterocele is traditionally done transvaginally or abdominally for larger enteroceles. However, there are times when laparoscopic repair is indicated, such as during concomitant surgery for other uterovaginal prolapse [18]. Two different laparoscopic techniques have been described to repair an enterocele: the Moschcowitz and Halban procedures. In both operations, a transvaginal manipulator or digital manipulation is necessary to apply transvaginal pressure for easy identification of the posterior vagina, rectum, and hernia sac. (**a**) In the Moschcowitz procedure, the enterocele sac is obliterated by reapproximating the pelvic peritoneum between the rectum and vagina, incorporating the uterosacral ligaments with a permanent No. 0 suture in a purse-string fashion (*arrows*). (**b**) The Halban culdoplasty is similar but involves placing permanent No. 0 sutures in an interrupted fashion, starting at the posterior vagina and proceeding longitudinally over the cul-de-sac peritoneum and then over the inferior sigmoid serosa; the sutures are tied as they are placed and should be approximately 1 cm apart [19]. Visualization of the ureters is important during both of these procedures to ensure that there is no obstruction or kinking of the overlying peritoneum when the cul-de-sac is closed (From Cleveland Clinic Center for Medical Art & Photography. Copyright © 2013, with permission)

7.4 Incontinence Procedures

The Burch colposuspension procedure remains an important technique for management of stress urinary incontinence in patients who have failed treatment with the midurethral sling, who decline synthetic mesh placement, or who are undergoing concomitant laparoscopic prolapse repair surgery and would prefer to have an abdominal approach for their incontinence procedure. Additionally, the paravaginal defect repair was once a routine procedure at the time of Burch colposuspension for treatment of stress urinary incontinence. While this procedure is no longer routinely performed, it remains indicated in certain patients.

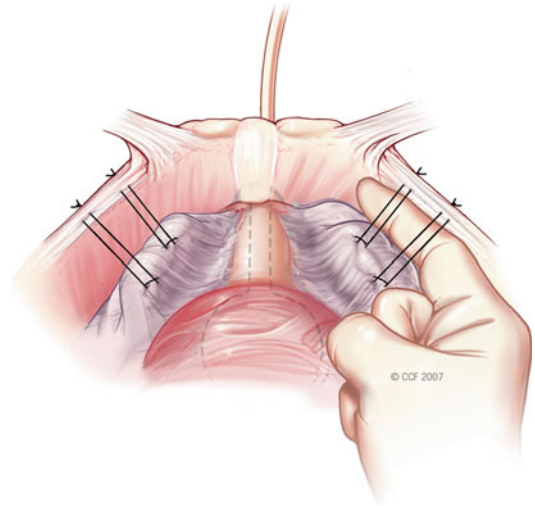


Fig. 7.7 Laparoscopic Burch colposuspension. Surgery for stress incontinence is recommended when conservative treatments fail. The open Burch colposuspension has been referred to as the gold standard for surgical management of urinary stress incontinence, with a reported cure rate higher than 80 % [20]. In recent years, the midurethral sling has become the most common method of surgical management of stress urinary incontinence owing to its minimally invasive approach and evidence that it has similar long-term efficacy to the Burch procedure [21]. However, the Burch colposuspension remains an important technique for management of stress urinary incontinence in patients who have failed treatment with the midurethral sling, who decline synthetic mesh placement, or who are undergoing concomitant laparoscopic prolapse repair surgery and would prefer to have an abdominal approach for their incontinence procedure. The laparoscopic Burch colposuspension was first described in the 1990s and while similar in technique to the open approach, has the same advantages as conventional laparoscopic surgery [20]. Miklos and Kohli provide a good description of how this procedure is performed [22]. The bladder is first filled in retrograde fashion to visualize the superior border of the bladder edge. The space of Retzius can be entered by creating a peritoneal incision above the bladder reflection, starting along the medial border of the right obliterated umbilical ligament. Confirmation of entry into the proper plane is made when the underlying loose alveolar tissue is encountered and the pubic rami are identified. The bladder is then drained and blunt dissection opens the space of Retzius until the bladder neck is identified. Important anatomic landmarks of this dissection include the pubic symphysis, Cooper's ligaments, and the arcus tendineus fascia pelvis. Once the bladder neck and midurethra are visualized, careful dissection exposes the underlying endopelvic fascia. A vaginal manipulator or digital manipulation elevates the vagina during placement of the sutures. Permanent No. 0 or 2-0 sutures are used, first placed lateral to and at the level of the midurethra, through the fibromuscular tissue of the vagina, with care not to incorporate the underlying epithelium. The suture is then passed through the Cooper's ligament on the ipsilateral side. A second suture is then placed at the level of the urethrovesical junction and again through the Cooper's ligament on the same side. The sutures are tied in an extracorporeal or intracorporeal fashion. The same procedure is repeated on the contralateral side. While the literature shows that midurethral sling procedures appear to offer greater benefits with better objective outcomes in the short term and similar subjective outcomes long term [23], the laparoscopic Burch procedure is still an important operation in pelvic reconstructive surgery and is appropriate for certain patients. Some studies have shown that that laparoscopic colposuspension is as efficacious as open colposuspension [20]; however, the 2010 Cochrane review on laparoscopic Burch colposuspension revealed that while women's subjective impression of cure was similar for both procedures, there was some evidence of poorer results for laparoscopic colposuspension on objective outcomes [23]. Additionally, while there were fewer postoperative complications and shorter hospital stays with laparoscopic Burch procedures when compared to open colposuspension, the laparoscopic approach was more costly (From Cleveland Clinic Center for Medical Art & Photography. Copyright © 2007–2013, with permission)

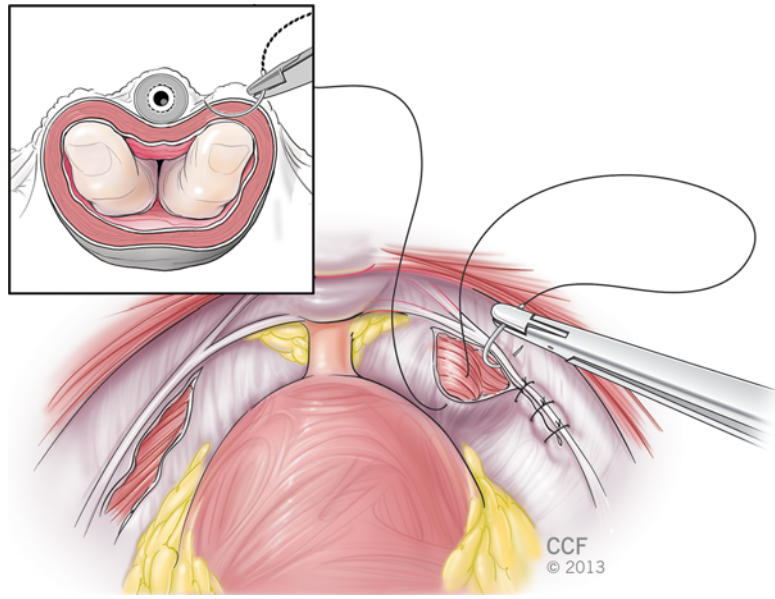


Fig. 7.8 Laparoscopic paravaginal defect repair. Lateral vaginal wall support defects may contribute to the development of stress urinary incontinence, and for this reason the paravaginal defect repair was once routine at the time of Burch colposuspension for treatment of stress urinary incontinence [22]. However, the rate of Burch colposuspension procedures continues to decrease with the increasing use of the midurethral sling. Additionally, the presence and degree of severity of paravaginal defects is challenging to diagnose as there is evidence that the clinical examination of these support defects displays poor interexaminer and intraexaminer agreement [24]. For these reasons, paravaginal defect repairs are performed much less frequently than in the past. However, a Cochrane review evaluating laparoscopic Burch colposuspension reported that paravaginal repair at the time of the Burch procedure appears to be beneficial with regard to postoperative outcomes. Therefore, understanding the steps of this procedure continues to be important [23]. These defects are identified when the space of Retzius is opened; the lateral attachments of the pubocervical fascia are detached from the side wall of the pelvis at the level of the arcus tendineus fascia pelvis. To repair these defects laparoscopically, a nonabsorbable suture can be used and passed through the fibromuscular layer of the vagina and then through the obturator internus muscle and its fascia around the arcus tendineus at its origin, approximately 2 cm from the ischial spine [22]. Several sutures are placed in an interrupted fashion from the ischial spine to the proximal portion of the vesicourethral junction until there is good restoration of vaginal anatomy. The procedure can be done unilaterally or bilaterally, depending on the nature of the defect (From Cleveland Clinic Center for Medical Art & Photography. Copyright © 2013, with permission)

7.5 Complications

The overall complication rate of gynecologic laparoscopic procedures has been reported to be approximately 0.46 % with a mortality rate of 3.3 per 100,000 laparoscopies [25]. As procedures become more complex, the risk of complication increases. Up to one-third of complications can be attributed to trocar entry or placement [2]. Vascular injuries, while rare, are associated with the highest rate of mortality from a laparoscopic injury. The reported incidence of laparoscopic vascular injury ranges from 0.01 to 0.64 % [25]. Morbidity from a vascular injury varies and is dependent on the vessel that is injured and time of recognition of the injury. The vessels most commonly injured during operative laparoscopy are the aorta, inferior vena cava, and iliac vessels [2]. Laparoscopic sacrocolpopexy adds additional risk to the vasculature of the presacral space, including the left common iliac vein, middle sacral artery, and sacral venous plexus [11].

Bowel injuries can account for almost one-third of laparoscopic complications during gynecologic procedures [25]. Injuries that occur at entry are usually associated with small bowel injuries and are the most common. Once entry has been achieved, injury to the rectosigmoid colon is the second most common type of injury [2]. Operative injuries with laparoscopic instruments, especially those using electrocautery, can also occur and can be very severe, as recognition of the injury can be delayed in these cases. Factors that increase the rate of bowel injury include complexity of the case, the presence of intra-abdominal adhesions, and the experience of the operating surgeon. A study by Warner and colleagues reported on the intraoperative and postoperative gastrointestinal complications specific to laparoscopic sacrocolpopexy [26]. Their intraoperative bowel injury rate was 1.3 %, and injury was not found to be associated with prior abdominal surgery, age, or body mass index. Their postoperative gastrointestinal complications included ileus and small bowel obstruction with a reported rate of 1 % in their patient population.

The incidence of ureteral injury (including transection, obstruction, fistula formation, and necrosis from thermal injury) during gynecologic laparoscopy ranges from less than 1–2 % [27]. The bladder is at risk of injury during its dissection at the time of hysterectomy and also during sacrocolpopexy. Injuries to the ureter occur most commonly at the level of the infindibulopelvic ligament and at the cardinal ligament, where the ureter passes underneath the uterine artery. Ureteral injury can also occur at the time of suspension suture placement during uterosacral ligament suspension if the sutures are placed in such a way that the peritoneum overlying the ureter receives too much tension or if the ureter itself is incorporated into the suspension. Cystoscopy after administration of indigo carmine dye should always be performed after laparoscopic reconstructive pelvic surgery because studies show that there is a higher injury detection rate seen when intraoperative cystoscopy is done [27].

Postoperative infection is rare after laparoscopic surgery. Spondylodiscitis of the L5 to S1 disc space is the most morbid infection associated with sacrocolpopexy and is very rare; only case reports have been written about this complication. *Staphylococcus aureus* is the most commonly reported organism, and cases were most commonly associated with concomitant hysterectomy at the time of prolapse repair [28]. When sacrocolpopexy is being performed, care should be taken to avoid the intervertebral disc space while placing the sacral sutures because deep stitches through the disc and periosteum may be the precipitating factors in the development of osteomyelitis. Patients with these infections require aggressive therapy with intravenous antibiotics and often reoperation for pelvic wash-out and removal of the infected graft.

Mesh erosion is also a complication related to laparoscopic sacrocolpopexy. A randomized clinical trial evaluating the outcomes of abdominal sacrocolpopexy with and without Burch colposuspension also looked at the risk of mesh and suture exposure following abdominal sacrocolpopexy and found the exposure rate to be 6 % in 322 study participants [29]. Results from a retrospective study of 188 subjects demonstrated a higher rate of mesh erosion in patients who had undergone concurrent total laparoscopic hysterectomy compared to those who were posthysterectomy or underwent supracervical hysterectomy at the

time of surgery, with rates of 23, 5, and 5 %, respectively [30]. Performing a supracervical hysterectomy at the time of prolapse surgery rather than a total vaginal hysterectomy prior to sacrocolpopexy has become more common, and patients should be counseled regarding the risks and benefits of both options.

Conclusions

Currently, our fastest growing population is the elderly, and the incidence and prevalence of uterovaginal prolapse and urinary incontinence increase with age. Current data show that 23.7 % of women suffer from at least one pelvic floor disorder [31] and that the overall prevalence of these disorders is projected to increase by 56 % by 2050 [32]. While there are three approaches to surgery that exist for pelvic floor disorders, in this chapter we focused on the laparoscopic procedures that are used to treat prolapse and incontinence. There are many advantages to performing these surgeries in a minimally invasive fashion; however, the burden of postoperative complications remains. For this reason, it is imperative that the appropriate surgical candidates undergo the correct procedures for their surgical needs and that important perioperative precautions are taken. Surgical management of pelvic organ prolapse and incontinence remains complex. The principles for management of these disorders are not new, and the difference lies in the route by which the surgery is performed. Adequate training is necessary to perform these procedures laparoscopically; however, pelvic floor surgeons should strive to learn these techniques as the benefits of improved visualization of pelvic anatomy and easier recovery for patients remain very desirable.

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