8 Laparoscopic and Robotic Assisted Laparoscopic Sacrocolpopexy

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Introduction

Many studies have shown the prevalence of female pelvic floor disorders, including pelvic organ prolapse (POP), increases with age. Given the anticipated increase in the aging population, it is estimated that the number of women with POP will increase from 3.3 million in 2010 to 4.9 million in 2050, creating a need for safe, durable, and cost-effective procedures.

Over the last 15 years there has been a movement away from invasive, open surgery towards more minimally invasive laparoscopic and more recently robotic procedures in many urologic specialties including female pelvic reconstruction. Robotic assisted laparoscopy has allowed surgeons to offer the "gold standard" treatment for post-hysterectomy vault prolapse, abdominal sacrocolpopexy (ASC), with a less invasive, less morbid approach with similar anatomical outcomes. This chapter will review in detail the technique, outcomes, and complications of laparoscopic sacrocolpopexy (LSC) and robotic assisted laparoscopic sacrocolpopexy (RASC).

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Background

Many studies have shown the prevalence of female pelvic floor disorders, including POP, increases with age [1]. It is estimated that the number of women with POP will increase by 46 %, from 3.3 million in 2010 to 4.9 million in 2050, creating a need for safe, durable, and cost-effective procedures [1]. Based on level 1 evidence, the ASC has long been considered the gold standard for vaginal vault prolapse given its long term anatomic success rates [2]. While ASC has demonstrated higher success rates than vaginal approaches, it is more invasive, has a longer recovery time, and has a higher complication rate.

With the advent of laparoscopic techniques in the 1990s, interest in laparoscopic approaches to prolapse repairs surged. Since its introduction by Nezhat in 1994, LSC has undergone several modifications [3]. In the original report, a single piece of gortex mesh was attached to the posterior vaginal apex and sutured or stapled to the anterior longitudinal ligaments of the sacrum. Since its inception, modifications to the procedure have been made including the use of anterior and posterior pieces of synthetic polypropylene mesh. In addition the procedure has been modified for patients desirous of preserving the uterus using a single piece of synthetic polypropylene mesh posteriorly or an anterior Y-shaped piece of synthetic mesh and a

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posterior synthetic mesh. The laparoscopic approach offers the success, versatility, and durability of the traditional abdominal repairs with a minimally invasive approach and shortened recovery.

However, widespread application of laparoscopic techniques has been limited by a steep learning curve and specialty training requirements. As technology has continued to advance, robotic surgery has been integrated into the treatment of female pelvic floor disorders. The RASC was first described in 2004 and subsequently in 2005 the Food and Drug Administration (FDA) approved Da Vinci® (Intuitive Surgical, Sunnyvale, CA) robotic technology for gynecologic applications. The advantages of robot assisted laparoscopy are that it provides the advantages of laparoscopic surgery while easing the technical challenges of traditional laparoscopic surgery. For instance, the 7 degrees of freedom provided by Da Vinci technology mimic the motions of the human hand and greatly facilitate surgical challenges such as intracorporeal suturing. Therefore, use of robotic technology may allow non-laparoscopic trained surgeons to bring the advantages of laparoscopic surgery to their patients.

In this chapter, we review laparoscopic and robotic approaches to the management of apical and uterine POP.

Evaluation and Work-Up

The management of POP depends on symptom bother, the goals of the patient, and comorbidities. If a patient is older or does not wish to preserve sexual function, observation, a pessary or an obliterative procedure may be more appropriate. In women that have symptomatic vaginal vault POP and desire surgical correction, the surgeon should discuss the various operative repairs, techniques, complications, and recovery time.

Indications for RASC include recurrent apical prolapse, failed previous transvaginal repairs, and apical prolapse in women with foreshortened vaginal length. Additional factors that should be taken into account are the patient's previous abdominal surgeries, which can lead to abdomino-pelvic adhesions, the patient's pulmonary status, and ability to tolerate steep trendelenburg.

Patients should also be assessed for stress urinary incontinence (SUI) to determine if a concomitant anti-incontinence procedure should be performed. The role of anti-incontinence in patients without documented pre-operative SUI remains controversial.

In 2006, the Colpopexy and Urinary Reduction Efforts (CARE) trial showed the addition of a Burch colposuspension in women without preoperative stress undergoing an ASC significantly reduced the risk of postoperative stress urinary incontinence (23.8 %, vs. 44.1 % in the control group, $P<0.001$) [2].

Recently, JAMA published the long term outcomes of the CARE trial, which shows by year 7 women who underwent prophylactic Burch at the time of ASC had a longer time to recurrence of SUI than women who did not undergo a Burch. The estimated probabilities of developing SUI by year 7 were 0.62 in the Burch and 0.77 in the no Burch arm (treatment difference of −0.153; 95 % CI, −0.268 to 0.030) [4].

Many pelvic surgeons have extrapolated the data from the CARE trial data to justify prophylactic concomitant mid-urethral slings in all continent women undergoing ASC or LSC/RASC. Recently, the Outcomes Following Vaginal Prolapse Repair and Midurethral Sling (OPUS), a randomized, multi-center trial involving women with stage 2 or greater anterior vaginal wall POP without symptoms of SUI undergoing vaginal prolapse surgery found urinary incontinence present in 27.3 % and 43.0 % of patients in the sling and sham groups, respectively ($P=0.002$), at 12 month follow-up [5]. The number needed to treat with a sling to prevent one case of urinary incontinence at 12 months was 6.3 [5]. In summary, a prophylactic midurethral sling inserted during vaginal prolapse surgery resulted in a lower rate of urinary incontinence at 12 months but an overall higher rate of adverse events. It is important to remember that only vaginal surgeries were included in this study, not ASC or LSC/RASC, and therefore these conclusions must be applied to these procedures with care.

Surgical Procedure

Laparoscopic Sacrocolpopexy

The initial steps involving patient positioning are the same for both LSC/RASC. The patient is placed in the dorsal lithotomy position using Yellowfin® (Allen Medical Systems, Acton, MA) stirrups. The arms are tucked at the side. All pressure points are padded. The patient's breasts should be padded and the patient secured to the table using surgical tape (Fig. 8.1). The patient's abdomen and vagina should be prepped and draped in standard surgical fashion. Based on surgeon preference, four or five ports are used (Fig. 8.2a, b). An intra- or infra-umbilical incision can be made. Access can be obtained using either the Hassan open technique or a Veress needle. If the Hassan technique is used, a 10–12 mm port is placed into the abdominal cavity. The port or Veress needle should be connected to the CO_2 insufflation tubing and the abdomen insufflated. Intra-abdominal pressures should be monitored, if they exceed 8 mm Hg; the port or needle should be adjusted to ensure that it is not adherent to bowel or omentum and not outside the peritoneal cavity.

Fig. 8.1 Patient positioning for both LSC/RASC: the patient is placed in the dorsal lithotomy position using Yellowfin® (Allen Medical Systems, Acton, MA) stirrups. The arms are tucked at the side. All pressure points are padded. The patient's breasts should be padded and the patient secured to the table using surgical tape

Two additional 10–12 mm ports are placed lateral to the rectus muscle. One or two additional 5 mm ports are placed 2–3 cm cephalad and 2–3 cm medial to the anterior superior iliac spines, avoiding ilioinguinal and iliohypogastric nerve injury or entrapment. The left lower port is utilized to retract the sigmoid colon to the left and cephalad. This port can be eliminated by using a suture to retract the sigmoid. A 1-0 monofilament suture on a large (CT-X) needle can be passed into the left lower quadrant, through an epiploic appendage of the sigmoid colon, back out through the left lower quadrant, and clamped at the skin level to retract the sigmoid colon (Fig. 8.3).

After the sigmoid is retracted, the sacral promontory, right common iliac artery, and right ureter are identified. The posterior peritoneum over the sacral promontory is incised longitudinally to the level of the vaginal apex. An endoanal sizer (Fig. 8.4) is placed in the vagina, thereby reducing the prolapse and elevating the vagina for exposure (Figs. 8.5 and 8.6). The peritoneum over the vaginal apex is then incised, and this dissection is continued anteriorly along the vaginal wall in an attempt to dissect the plane between the bladder and vagina (Figs. 8.7, 8.8, and 8.9). The bladder can be filled to help demarcate this plane. This can also be accomplished with the introduction of a cystoscope light in the bladder. This plane is dissected at least 3 cm distal to the vaginal apex to allow space for placement of the anchoring sutures. The lack of direct tactile feedback makes this dissection challenging; in a recent study of this technique, cystotomy or sutures thrown into the bladder were noted in 10.7 % of cases [6]. Similar dissection is performed on the posterior vaginal wall to de-peritonealize this area and separate the vagina from the rectum posteriorly. The mesh, either in two separate strips (size varies depending on surgeon preference: 2–4 cm × 12–15 cm) or prefashioned in a Y-configuration, is passed into the field and sutured with nonabsorbable suture to the posterior and then the anterior vaginal wall (Fig. 8.10). At least four sutures are required on either side to fully anchor the mesh (Fig. 8.11).

The next step involves suturing the mesh to the longitudinal ligament of the sacral promontory.

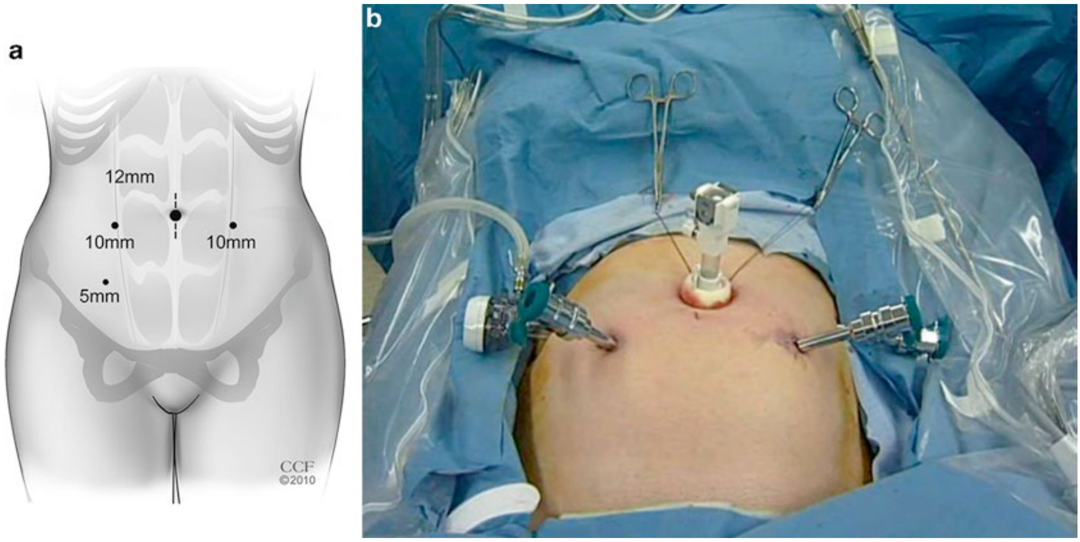

Fig. 8.2 (**a**) Port placements for laparoscopic pelvic organ prolapse surgery. A fifth port (5 mm) may be placed in the left lower quadrant, or a suture may be used to retract the sigmoid colon. (**b**) Laparoscopic port placement for robotic pelvic organ prolapse surgery. (**a**: Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2006–2014. All Rights Reserved)

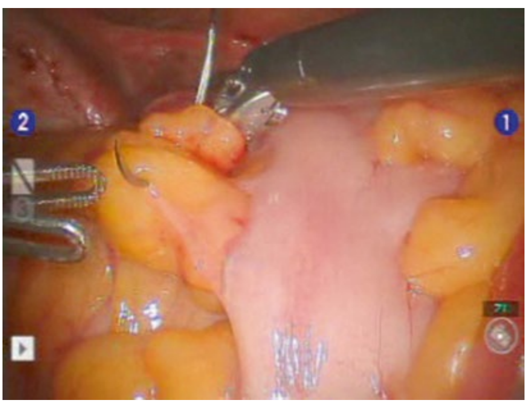

Fig. 8.3 Retraction of the sigmoid colon with a CT-X needle through an epiploic appendage. The needle can be placed though the abdominal wall and clamped at the skin level to retract the sigmoid colon allowing exposure of the sacral promontory

Fig. 8.4 Endoanal sizers (EEA)

Using the third robotic arm the sigmoid colon is retracted to the left pelvic side wall using a bowel grasper or Prograsp™ (Intuitive Surgical, Sunnyvale, CA) exposing the sacral promontory. The peritoneum overlying the promontory is incised using monopolars scissors or hook. Care should be taken to identify the right ureter, iliac bifurcation, and presacral vessels. With careful blunt dissection the fat overlying the promontory is cleared identifying the anterior longitudinal ligament at the S1 or S2 level (Fig. 8.12). This maneuver is frequently done with a laparoscopic Kittner introduced through the 12 mm accessory port which allows tactile feedback of the bone (Fig. 8.13). Should bleeding occur from the presacral space, one can increase insufflation and intrababominal pressure while introducing lap pads to apply direct pressure. In addition sutures, surgical clips, and hemostatic agents can be used. If conversion to open is required, orthopedic thumbtacks can also be used.

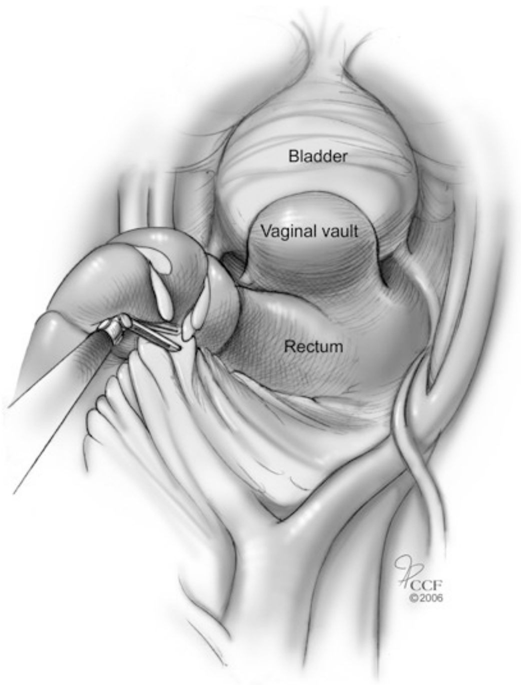

Fig. 8.5 Retraction of the small bowel and sigmoid colon allowing exposure of the sacral promontory. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2006–2014. All Rights Reserved)

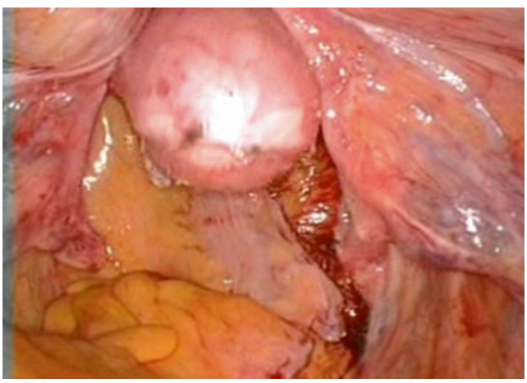

Fig. 8.6 Placement of EEA sizer in the vagina reducing the prolapse and elevating the vagina for exposure

With the prolapse reduced using the endoanal sizer, the proximal end of the mesh is anchored to the anterior longitudinal ligament of the sacrum with two No. 0 nonabsorbable sutures (Figs. 8.14 and 8.15). The excess mesh is trimmed and the posterior peritoneum is then closed over the mesh (Fig. 8.16). Cystoscopy should be performed at the end of procedure to ensure ureteral patency and that none of the sutures have passed into the bladder.

In patients undergoing sacrouteropexy, the uterus can be suspended with a laparoscopic tenaculum or with a Keith needle placed though the fundus (Fig. 8.17). The posterior peritoneum is incised from the level of the sacral promontory, caudally to the level of the posterior vaginal cuff and cervix (Fig. 8.18). Depending on surgeon preference, a single piece of posterior mesh (3–5 cm × 12–15 cm) or an anterior Y-shaped piece of mesh and a posterior mesh are used. In cases using a single piece of mesh, the mesh is sutured to the posterior vaginal cuff and posterior cervix using 0-nonabsorbale sutures. When using two pieces of mesh the posterior mesh is placed as described, while each arm of the anterior Y-shaped mesh is passed through the broad ligament. The mesh/meshes are fixed to the sacrum as described above.

Robotic Laparoscopic Sacrocolpopexy and Sacrouteropexy

This modification of the LSC utilizes the robotic system to facilitate three-dimensional visualization of the operative field, placement of sutures, and tying of the sutures, thereby simplifying the execution of maneuvers and shortening the laparoscopic learning curve. Five ports are typically utilized: an umbilical port (intra-, infra-, or supraumbilical) 12 mm camera port; and two 8-mm robotic ports placed at the lateral edge of the rectus abdominal muscles (8–10 cm lateral to the camera port) at the level of the umbilicus or 1–2 cm caudal; traditionally two additional ports a 5 mm and a 10 mm or two 10 mm ports are placed bilaterally, 3 cm medial and cephalad to the anterior superior iliac spine to allow an assistant to retract the sigmoid colon and small bowel (Fig. 8.19). At least one of these ports should be 10 mm to allow passage of the mesh strips and needles as needed. In women with small pelvises, we place the accessory 10 mm port 8 cm lateral and 2–3 cm cephalad to the umbilical port.

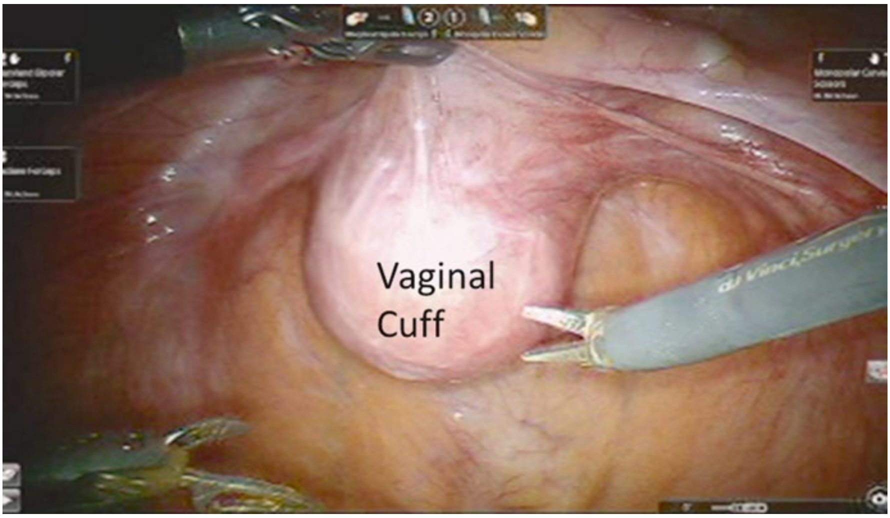

Fig. 8.7 The peritoneum over the vagina apex is incised longitudinally to the level of the sacral promontory. Using the third robotic arm to retract the bladder anteriorly, the peritoneum over the vaginal cuff is exposed. Note the grasper in the left hand and the endoshears in the right hand. (Used with permission of Springer Business + Business Media from McAchran S, Moore C. Robotic Abdominal Sacrocolpopexy. In Best SL, Nakada SY (eds): Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy (LESS), and Robotics. New York: Springer Science + Business Media; 2014)

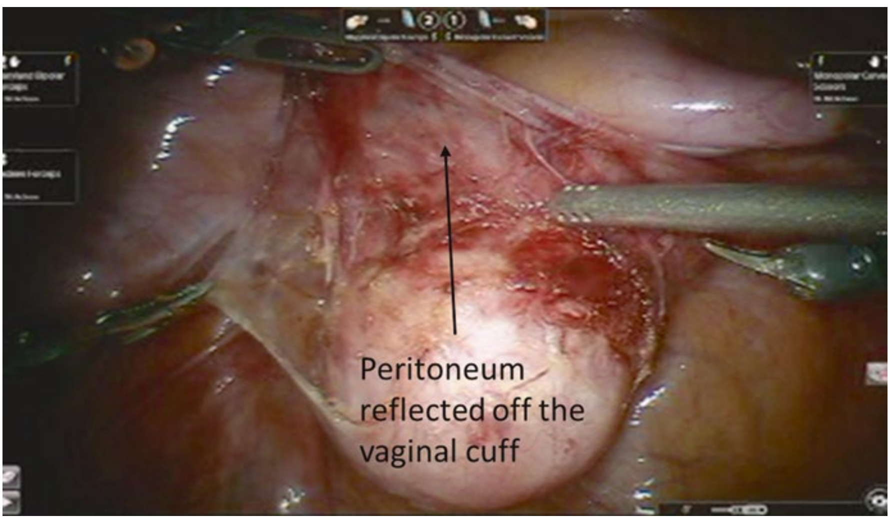

Fig. 8.8 The peritoneum overlying the anterior vagina has been dissected allowing a place to develop between the vagina and the bladder. This will be site for the anterior mesh attachment. (Used with permission of Springer Business + Business Media from McAchran S, Moore C. Robotic Abdominal Sacrocolpopexy. In Best SL, Nakada SY (eds): Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy (LESS), and Robotics. New York: Springer Science + Business Media; 2014)

Once access is obtained the patient is placed in steep Trendelenburg position. The robot can be docked between the legs or side docked (Figs. 8.20 and 8.21). The technique is identical to that described for laparoscopic sacrocolpopexy. As in the laparoscopic procedure the uterus can be spared by performing a robotic laparoscopic sacrouteropexy as described above.

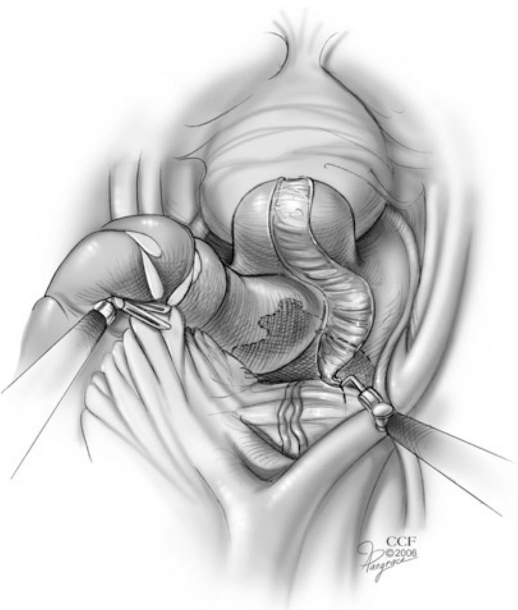

Fig. 8.9 The peritoneum over the vagina apex is incised longitudinally to the level of the sacral promontory. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2006–2014. All Rights Reserved)

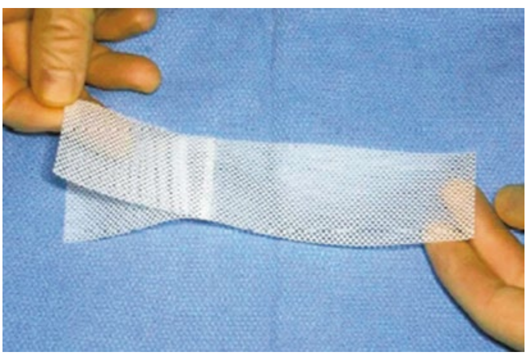

Fig. 8.10 Y-shaped mesh

Complications

In a comprehensive review of the published literature on ASC, Nygaard and colleagues from the Pelvic Floor Disorders Network reported the success rate, defined as lack of apical prolapse postoperatively, ranged from 78 % to 100 % and when defined as no postoperative prolapse, from 58 % to 100 % [7]. Median reoperation rates for POP and for stress urinary incontinence were 4.4 % (range 0–18.2 %) and 4.9 % (range 1.2–30.9 %), respectively [7]. The rate of mesh erosion was 3.4 % [6]. In the recently published JAMA article on long term complications of ASC, the estimated probabilities of treatment failure for anatomic POP was 0.27 in the urethropexy group and 0.22 in the no urethropexy group (treatment difference of 0.050; 95 % CI, −0.161 to 0.271), and 0.29 and 0.24, respectively for symptomatic POP (treatment difference of 0.049; 95 % CI, −0.060 to 0.162) [4]. The probability of mesh erosion was 10.5 % [4].

The Pelvic Floor Disorders Network found intraoperative complications of ASC to include cystotomy in 3.1 %, enterotomy or proctotomy in 1.6 %, ureteral injury in 1.0 %, and hemorrhage or transfusion or both occurred in 4.4 % [6]. Among postoperative complications urinary tract infections were the most common complication with a median range of 10.9 % (2.5–25.9 %) followed by wound infection, hematoma, or superficial separation ranging with a median of 4.6 % (0.4–19.8 %) [6]. Ileus was reported in 3.6 %, deep venous thrombus or pulmonary embolus 3.3 %, 1.1 % required reoperation for small bowel obstruction, and 5.0 % underwent incisional hernia repair [7].

Both the incidence of intraoperative and postoperative complications that occur after LSC and RASC are similar to ASC. Interestingly, the rate of cystotomy or sutures in the bladder is much higher, 10.7 % in RASC and LSC compared to ASC, which was 3.1 % [6, 8].

Outcomes

LSC appears to successfully recapitulate the open technique that has demonstrated durable results for several decades. Several studies have demonstrated the laparoscopic approach to be successful, 90–96 % cure rate, with a low mesh erosion rate, ranging from 1 % to 8 % [9]. The largest series of LSC is a retrospective cohort of 165 patients followed for a mean of 43 months [10]. Of the 165 patients, 27 were lost to

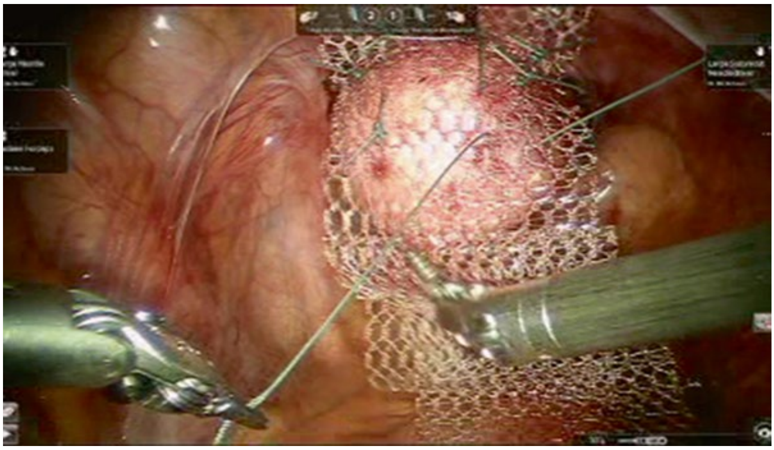

Fig. 8.11 With an EEA sizer in the vagina, the mesh is sutured to the anterior vaginal wall

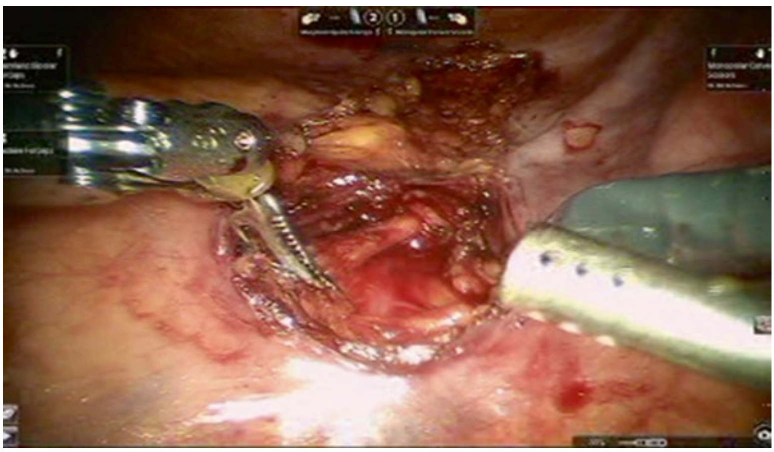

Fig. 8.12 Sacral dissection with the posterior peritoneum incised exposing the anterior longitudinal ligament. (Used with permission of Springer Business + Business Media from McAchran S, Moore C. Robotic Abdominal Sacrocolpopexy. In Best SL, Nakada SY (eds): Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy (LESS), and Robotics. New York: Springer Science + Business Media; 2014)

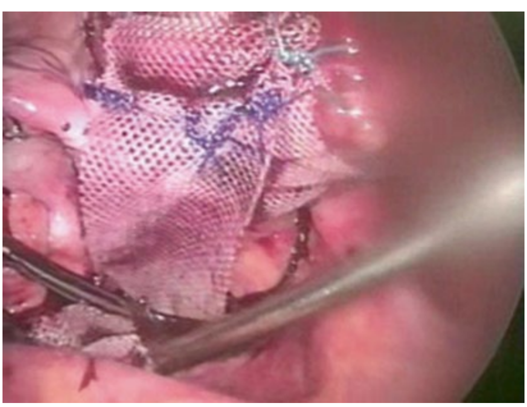

Fig. 8.13 Fat overlying sacral promontory blunted dissected using laparoscopic Kittner exposing the bone

follow-up. Success rate at mean follow-up was 94.9 %, with 5.07 % patients reporting recurrent vaginal vault prolapse. Only 3.62 % of patients reported a recurrent cystocele.

We reported a comparative cohort study from our institution of 61 patients treated with ASC and 56 treated with LSC with a mean follow-up of 16 and 14 months, respectively. The mean total operative time was longer for the laparoscopic group (269 min vs. 218 min), but hospital stay was shorter in the laparoscopic group (1.8 days vs. 4.0 days) [11]. Reoperation rates (11 % laparoscopic vs. 5 % open) and clinical outcomes rates were similar. The sample size was not

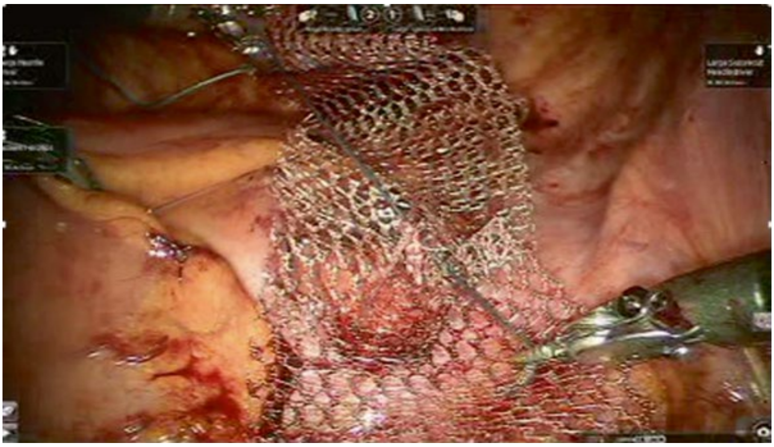

Fig. 8.14 The anchoring suture for the sacral portion of the mesh is placed through the anterior longitudinal ligament. (Used with permission of Springer Business+Business Media from McAchran S, Moore C. Robotic Abdominal Sacrocolpopexy. In Best SL, Nakada SY (eds): Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy (LESS), and Robotics. New York: Springer Science+Business Media; 2014)

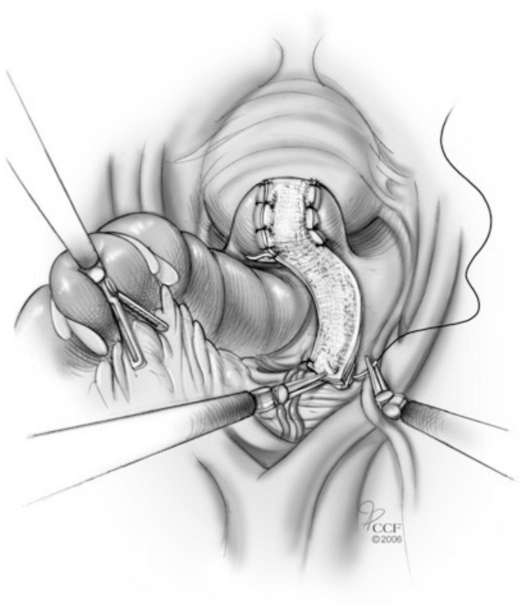

Fig. 8.15 Mesh is introduced and sutured to the vaginal apex anteriorly and posteriorly and sutured to the sacral promontory. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2006–2014. All Rights Reserved)

powered adequately to detect differences in complication rates.

Many studies have shown RASC to have anatomical cure rates similar to ASC and LSC [12]. Two more recent larger series by Akl et al. and Shariati et al. who followed 80 and 77 patients undergoing RASC reported recurrent prolapse in 3.7 % and 1.29 % patients, respectively [13].

In a retrospective study comparing 73 patients who underwent RASC with 10 patients who had ASC 6 weeks postoperatively, Geller et al. found the robotic group to have slightly better POP-Q "C" points, −9 compared with −8 ($P=.008$) [13]. All other anatomic outcomes were similar. Robotic procedures had statistically less blood loss (103 ± 96 mL vs. 255 ± 155 mL, $P<.001$), longer total operative time (328 ± 55 min vs. 225 ± 61 min, $P<.001$), shorter length of stay (1.3 ± 0.8 days vs. 2.7 ± 1.4 days, $P<.001$), and a higher incidence of postoperative fever (4.1 % compared vs. 0.0 %, $P=.04$). Recently the same group published their long term data. At a mean follow-up of 44.2 ± 6.4 months, there was still significant improvement in all POP-Q measurements from baseline. Cure rates for the Apex were 100 % while cure rates for the anterior and posterior compartments were lower 78.9 % for both. Secondary outcomes assessed using PFDI_20, PFIQ-&, PISQ-12 all showed significant improvement in pelvic floor function. At follow-up, there were two cases of mesh erosion in both open (7 %) and robotic group (8 %) [14].

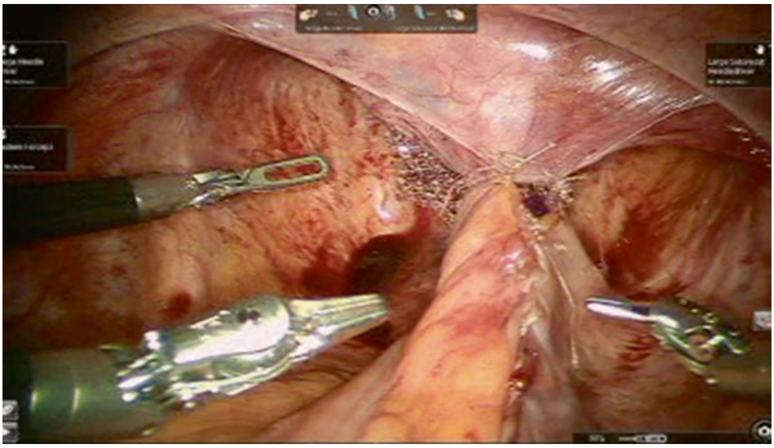

Fig. 8.16 The mesh is covered by the posterior peritoneum. The vagina is suspended to the sacral promontory, recreating normal vaginal anatomy. (Used with permission of Springer Business+Business Media from McAchran S, Moore C. Robotic Abdominal Sacrocolpopexy. In Best SL, Nakada SY (eds): Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy (LESS), and Robotics. New York: Springer Science+Business Media; 2014)

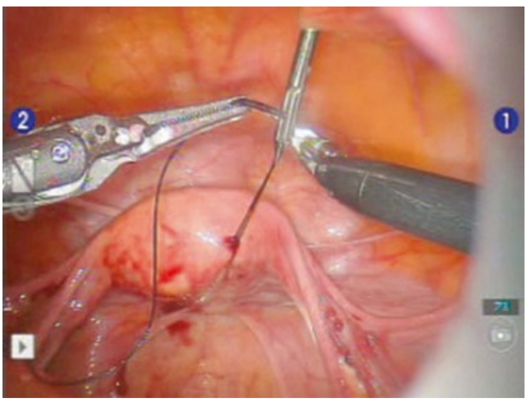

Fig. 8.17 In a sacrouteropexy, the uterus is retracted using a Keith needle

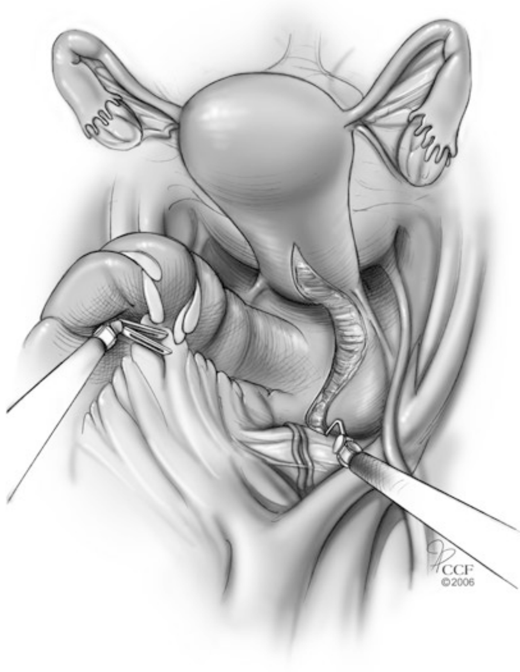

Fig. 8.18 In sacrouteropexy, the posterior peritoneum overlying the posterior vaginal cuff and cervix is incised longitudinally to the level of the sacral promontory. (Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2006–2014. All Rights Reserved)

Until recently, there were no randomized controlled trials comparing RASC to ASC or LSC. Paraiso et al. conducted a single center randomized trial comparing RASC to LSC [8]. In the RASC group, anesthesia time, total time in the operating room, total sacrocolpopexy time, and total suturing time were all significantly longer. Patients in the robotic group also had significantly higher pain at rest and with activity during weeks 3 through 5 after surgery and required longer use of nonsteroidal anti-inflammatory drugs.

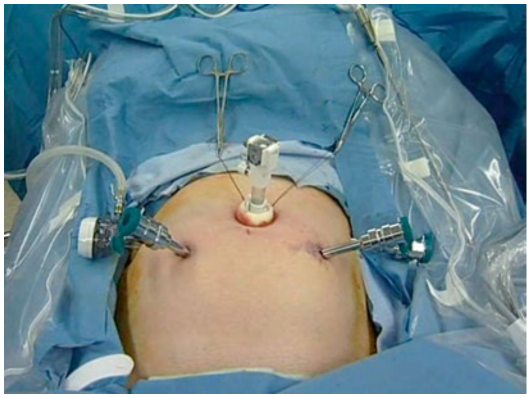

Fig. 8.19 Robotic port placement in W configuration

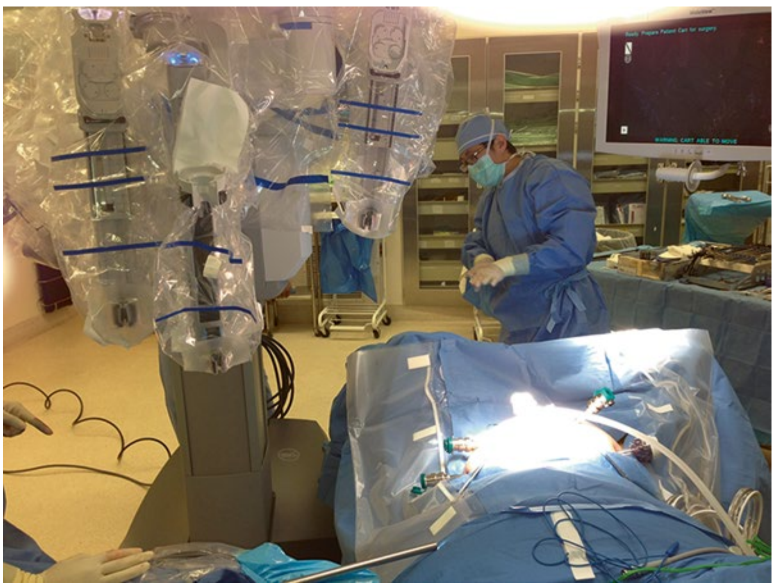

Fig. 8.20 Robot is docked laterally, abutting the base of the operating room table

Fig. 8.21 The patient is placed in steep trendelenburg with lateral docking of the robotic ports

In addition, the robotic surgery was significantly more expensive than laparoscopy (mean difference +$1,936; $P = .008$). At 1 year there was no difference in improvement in vaginal support or functional outcomes between groups.

Summary

Over the last decade new minimally invasive laparoscopic and robotic techniques have evolved for the correction POP. All of these techniques aim to achieve the same durable success of the traditional open abdominal techniques while minimizing recovery, pain, blood loss, and hospital stays. The limited, available data suggests that laparoscopic and robotic outcomes are comparable to the open ASC but more expensive.

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