# Surgical Treatment of Vaginal Vault Prolapse: A Historic Summary and Review of Outcomes

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**Objectives:** This study aimed to review the history of surgical treatment of vaginal vault prolapse, its current treatments, and its outcomes.
**Methods:** A PubMed search was conducted using the following terms: *vaginal vault prolapse*, *apical prolapse*, *surgical treatments*, *culdoplasty*, *uterosacral ligament fixation*, and *sacral colpopexy.*
**Results:** Vaginal vault prolapse is a common condition with many surgical treatment options. Surgical principles and treatment of this condition dates back to the 19th century. Native tissue repairs such as McCall culdoplasty, uterosacral ligament fixation, and sacrospinous fixation have high overall success rates with restoring apical anatomy. Sacral colpopexy also has excellent success rates when mesh is needed to augment repairs.
**Conclusions:** There are many options for the treatment of vaginal vault prolapse. Modifications have been made to the original procedures; however, the basic principles are still applicable and include attaching the vaginal apex to level 1 support.

**Key Words:** vaginal vault prolapse, surgical treatment, McCall culdoplasty, uterosacral ligament suspension, sacrospinous fixation

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## EVOLUTION OF POSTHYSTERECTOMY VAGINAL VAULT PROLAPSE

True estimates of the prevalence of pelvic organ prolapse (POP) are difficult to obtain, but the lifetime risk of needing surgery due to a pelvic floor disorder is around 11%.[1] The incidence of POP is expected to increase as the population ages.[2] Pelvic organ prolapse is present when 1 or more of the vaginal compartments are out of anatomic position. Nerve, muscle, and connective tissue damages are known to contribute to the development of POP. Increasing age, pregnancy, childbirth, obesity, and genetics also play an important role in the development of POP.[3]

DeLancy described the various levels of vaginal support, which helped clinicians understand the anatomic defect that is present in a patient with POP. The 3 levels of support are as follows: (1) uterosacral and cardinal ligament complex; (2) pubocervical and pubourethral fascia, with paravaginal attachment; and (3) perineal body complex.[4] Patients may develop prolapse from isolated defects or may have multiple defects at any level. Defects at level 1 are primarily responsible for apical vaginal vault prolapse (VVP) and uterovaginal prolapse.

When the levator plate is in normal position, the pelvic organs are supported, and the genital hiatus remains small even under forces of increased abdominal pressure. After parturition, the muscles, nerves, and connective tissue are altered. Porges and Porges[5] introduced the concept of the pelvic valve, whereby there is a hypertrophy of the endopelvic connective tissue along the anterior vaginal wall overlying the genital hiatus. This connective tissue forms the superior leaf of the pelvic valve with the inferior leaf being the levator plate. With increased abdominal forces, the 2 leaves interpose, thereby preventing descent of the pelvic organs. However, when the genital hiatus becomes too large for the pelvic valve because of loss of normal anatomic levator plate position, POP occurs. Prolapse affecting the proximal vagina (at the fornix) can lead to vaginal apex descent and enterocele formation.

The focus of this review will be on level 1 anatomic defects that contribute to VVP and enterocele formation. This article will discuss the history of VVP repair and compare current surgical techniques and outcomes.

## GOALS OF TREATMENT OF PROLAPSE

When patients are symptomatic from VVP, treatment is recommended. Treatment options include both medical and surgical therapies; however, for the purpose of this review, surgical treatments will be discussed. Patient goals are focused on relief of symptoms. Physician goals include improved quality of life, restoration of anatomy, function, and prevention of recurrent prolapse. Physicians must consider potential complications, de novo symptoms that may arise after anatomy is restored, and ultimately choose a procedure that is most appropriate for an individual patient.

## HISTORIC OVERVIEW OF SURGICAL REPAIR

The principles of the surgical techniques used today were originally developed and studied in the 19th and 20th centuries. Vaginal vault prolapse and enterocele formation (with and without uterus intact) were known conditions that were described as early as the 1700s.[6] However, it was not until the 1900s that Marion[7] and Moschcowitz[8] described the abdominal approach to cul-de-sac obliteration and repair of enterocele. The vaginal approach was advocated by Ward[9] in 1922. The road map for the correction of VVP and enterocele repair was complete by 1927, when Miller[10] described bilateral suspension of the vaginal vault to the uterosacral ligaments. The uterosacral ligaments had been identified as strong fibromuscular tissue and served as anchor points for the apex of the vagina. Obliteration of the cul-de-sac was additionally advocated to prevent recurrence of the enterocele and provide a "base" of support for the vagina.[6]

Much of the early work by physicians in the 20th century focused on enterocele repair and prevention of vault prolapse at the time of hysterectomy. Waters[11] (1956) and McCall[6] (1957) published articles describing their techniques for correction and prevention of enterocele and vault prolapse. Both authors emphasized key principles of their technique: (1) exposure of enterocele, (2) opening the hernia sac, (3) reduction of contents, (4) ligation of the base of the sac, (5) removal of excessive peritoneum, and (6) incorporation of the uterosacral ligaments with attachment to the vaginal cuff.

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Given the etiology of apical or VVP, regardless of the presence or absence of a uterus, the fundamentals of repair that were established by the early work of these gynecologists are still relevant and used today.

## COMPARISON OF SURGICAL TECHNIQUES FOR VVP REPAIR

There are many different surgical techniques used to correct VVP. Restoring level 1 support at the cardinal and uterosacral ligament level has provided the best clinical and surgical outcomes for this defect. However, given that there are different etiologies of this problem, the ideal surgical approach and technique are controversial. On the basis of the original historical principles, the vaginal apex should be reattached to the intact fibromuscular tissue with the vaginal axis aimed toward the sacrum to optimize anatomic position and function. Level 1 support depends significantly on uterosacral ligaments, and therefore, many of the surgical procedures such as the modified McCall culdoplasty and traditional uterosacral ligament suspension use the uterosacral (US) ligaments as attachment points for the apex of the vagina. If the US ligaments are weakened or attenuated, as sometimes may be the case with significant prolapse, then one should consider other possible points of attachment. Other native tissue repairs include sacrospinous ligament fixation and iliococcygeus fixation. The anatomic location of these structures provides restoration of level 1 support similar to that of the US ligaments and does not require intraperitoneal access. If native tissue repair is not optimal, synthetic mesh can be used to attach the vaginal apex to the sacrum, which is best done with a sacral colpopexy.

## DESCRIPTION OF PROCEDURES

The McCall culdoplasty is a technique used at the time of hysterectomy or after hysterectomy to treat apical prolapse. It uses the original principles outlined by Milton McCall in 1957. This procedure can be used for patients with intact uterosacral ligaments having apical defects with or without enterocele. This technique usually requires intraperitoneal access that can be achieved vaginally. During vaginal hysterectomy and for subsequent prolapse repairs, visualization and retraction are key to a successful operation. For vaginal procedures, patients are placed in a dorsal lithotomy position using Allen Stirrups (Allen Medical Systems, Acton, Mass). A Magrina-bookwalter (Codman & Shurtliff, Inc, Raynham, Mass) is used to obtain adequate visualization during the procedure. The advantage of this self-retaining retractor is that of increased surgeon independence, and it allows the assistants to focus on other tasks while not having to retract the vaginal sidewalls during the entire case. For apical suspension procedures, we have found it helpful to have extra long needle drivers, pickups with teeth, and side wall retractors such as extra long Deaver or Briesky-Navratil. Additional light sources are often needed to visualize the deeper structures. Options for additional light include surgeon headlamps, lighted suction devices, or use of the cystoscopic light source attached to a Babcock. Packing abdominal contents is also necessary to optimally visualize structures and to minimize the inadvertent risk of injury to adjacent organs. An extra long laparotomy sponge can be placed intraperitoneally to pack away the small and large bowel. We also ask the anesthesia colleagues to ensure the patient is totally relaxed before any suspension procedures because this will help keep abdominal contents from entering the field.

The traditional McCall culdoplasty is performed using a 0 or a no. 1 permanent suture for the "internal McCall culdoplasty" and a 0 or no. 1 delayed absorbable suture for the "external McCall culdoplasty." Once intraperitoneal access and proper visualization have been achieved, it is important to palpate the ureters before proceeding. Palpation can be done by placing a retractor inside the vagina along the sidewall at the 2- to 3-o'clock position. Using the index finger, the ischial spine (IS) can be palpated and located. The ureter can then be found 2 to 5 cm ventral and lateral to the IS. Use a sweeping motion with the finger from a superior to inferior direction against the retractor to identify the location of the ureter.

Once the ureter has been palpated, the uterosacral ligament is identified. This can be accomplished in several ways. At our institution, the vaginal cuff tissue and US ligament is grasped at the 5-o'clock position, and traction is applied superiorly and medially. This causes the US ligament to flatten. Other techniques include placing Allis clamps on the peritoneal tissue at the 5- and 7-o'clock positions where the US ligaments are located.

Once the pertinent anatomy has been identified, a long Deaver or a Heaney retractor is placed inside the peritoneum posteriorly with downward lateral traction applied to displace and protect the rectum. A second long Deaver or Heaney is then placed vaginally inside the peritoneal cavity along the lateral wall of the pelvis applying gentle lateral traction to elevate the cardinal ligament and protect the ureter.

Internal McCall sutures are then placed using permanent suture material. The first internal McCall suture is placed in the distal part of the left uterosacral ligament (closest to the vaginal cuff). Several bites of the posterior peritoneum are then taken as progress is made to the opposite side. The retractors are repositioned and placed on the patient's right side such that the surgeon can safely and effectively visualize the right US ligament. The suture is then placed in the right US ligament at the same level as the suture on the left side. This suture is then tagged so that 1 to 2 more additional sutures can be placed. Additional sutures are placed in the US ligaments and incorporate posterior peritoneum to achieve obliteration of the cul-de-sac. These sutures are placed more cephalad to the first, usually leaving 0.5 to 1 cm between each suture. Care should be taken to avoid placing sutures higher than the IS because this area is rich in vascular and nerve supply. These sutures are all tagged and tied at a later point.

External McCall sutures are placed using absorbable suture. These sutures function to attach the vaginal apex to the remnants of the US ligaments. Suture is inserted through the posterior vaginal mucosa at the vaginal apex, thereby entering the peritoneal cavity. The suture is then placed through the US ligament and then exits through the anterior vaginal epithelium at the corner of the apex. External sutures are placed more cephalad than those of the internal sutures.[6] This is done bilaterally to suspend the vaginal apex (Fig. 1).

The combination of internal McCall sutures and external McCall sutures both obliterates the cul-de-sac and serves as a vaginal apical suspension procedure. Modifications of the McCall procedure have been made during the years including the Mayo culdoplasty and the modified McCall culdoplasty.[12]

Enterocele is a common finding when patients have an apical vaginal defect. The enterocele should be reduced to minimize the risk of inadvertently injuring the contents. The enterocele sac is grasped with an Allis clamp and elevated away from the posterior vaginal mucosa. Using metzenbaum scissors, the enterocele sac is dissected away from the posterior vaginal mucosa and rectovaginal septum. The excess peritoneum and sac can then be excised (Fig. 2). When there is significant redundancy

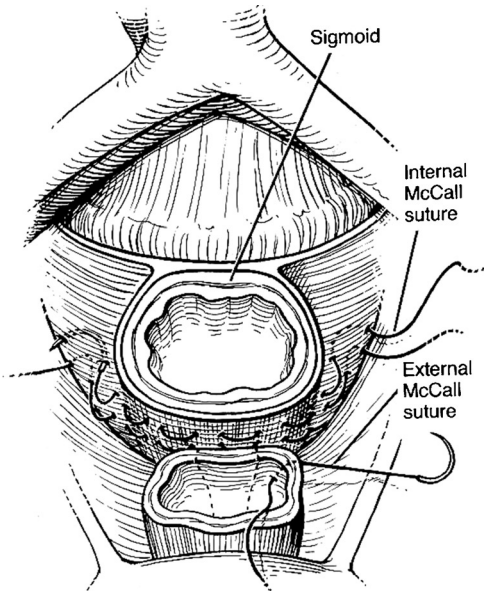


**FIGURE 1.** McCall culdoplasty. From: Lee RA. *Atlas of Gynecologic Surgery*. Philadelphia, PA: WB Saunders; 1992.

of the posterior vaginal mucosa, a wedge of mucosa can also be excised to decrease the width of the vaginal apex.

Some surgeons choose not to remove the enterocele sac and instead leave the redundant peritoneum in place. The excess peritoneum in the cul-de-sac can be reefed during the placement of the internal McCall sutures to obliterate that space as the suture is taken from one corner of the vaginal apex to the other.

Uterosacral ligament suspension is also an intraperitoneal procedure that can be performed at the time of hysterectomy or after. Patient's positioning, lighting, and retraction are performed in a similar manner to that described for the McCall culdoplasty. The abdominal contents are packed away using a moist laparotomy sponge. Knowledge of the location of the ureter is crucial before beginning the procedure as well. The ureter should be palpated before beginning this procedure as described above.

About 1 to 3 sutures are placed through the US ligament and then attached to the vaginal cuff on the ipsilateral side. The number of sutures placed varies depending on the desired length of the vagina, the degree of prolapse, and the ability to safely place sutures without compromising surrounding structures. This technique traditionally uses permanent suture, but modifications have used absorbable suture as well.[13] Permanent sutures should be monofilament. Delayed absorbable suture with the same thickness such as polydioxanone can also be used. Some surgeons use Vicryl. This suture is reabsorbed more quickly, but ultimately scar formation at the site of the repair will overtake the strength of the suture and maintain integrity of the repair.

To attach the vaginal wall to the US ligament for suspension, the delayed absorbable sutures are then placed through the lateral portion posterior vaginal wall, the US ligament, and exits through the lateral anterior vaginal wall. About 1 to 2 of these sutures are placed. This accomplishes reapproximating the pubocervical and rectovaginal fascia.[14] This is done bilaterally so that each corner of the vagina is suspended, mimicking the normal anatomic attachment of the vagina to the pelvic sidewall and US ligaments.[15]

The most common complication with both McCall culdoplasty and US ligament suspension is ureteral obstruction. The ureter is near the US ligaments and can be inadvertently injured. Palpation of the ureter and knowledge of this anatomy before suture placement can minimize this risk. All patients undergoing pelvic reconstruction surgery should have a cystoscopy performed after completion of the procedure to ensure ureteral patency. Significant hemorrhage is less likely with these procedures, but if high US suspension is performed, major blood vessels and nerves are at higher risk than if sutures are placed below the IS.

Sacrospinous fixation and iliococcygeus fixation are performed through an extraperitoneal technique. These procedures are indicated if the US ligament is attenuated or if intraperitoneal access cannot be obtained. The sacrospinous ligament can be reached via sharp dissection starting from the posterior vaginal wall. The rectovaginal fascia is freed from the vagina, and the dissection is continued to the pelvic sidewall until the IS is identified.[15] Entry into the perirectal space is accomplished by creating a window through the rectal pillar with sharp dissection. The sacrospinous ligament (SSL) can then be palpated. The sacrospinous ligament is attached laterally to the IS and runs medially to the sacrum and coccyx.

A retractor such as Briesky-Navratil is used to displace the rectum medially. On the patient's right side, the surgeon places the left index and middle finger over the medial surface of the IS. Care is taken to place sutures 4 cm medial to the IS because there are major blood vessels and nerve supply in this area. Suture choice is also surgeon dependent. A thicker permanent suture such as a 0 or no. 1 are most often used to perform SSL suspension. A long-handled ligature carrier is helpful for delivering the sutures into this tight space. Several types of ligature carriers are available such as the Miya hook, long-handled Deschamps ligature carriers, Laurus needle driver (Microvasive-Boston Scientific Corporation, Watertown, Mass), Nichols-Voronikis ligature carrier (BEI Medical systems, Chatsworth, Calif), and the Capio device (Boston Scientific, Natick, Mass; Fig. 3).[16] Instrumentation is generally chosen based on comfort level and prior training. Using the ligature carrier, the suture is passed through the SSL avoiding the superior margin of the ligament; it is retrieved and a second suture is placed 1 cm medial to the first. There should be considerable resistance against traction placed on the suture if it properly located. Once the 2 sutures are placed through the SSL, they are attached to the vaginal vault. One way of accomplishing this is by the use of a pulley stitch. The free end of the suture is placed through a free needle and sutured to the fibromuscular layer on the undersurface of the vagina. Traction on the free end of the suture will pull the vagina toward

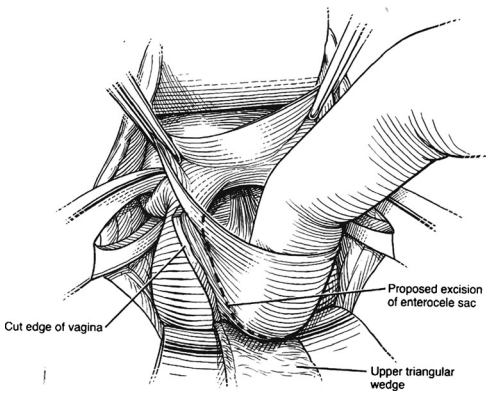


**FIGURE 2.** Isolation of enterocele sac. From: Lee RA. *Atlas of Gynecologic Surgery*. Philadelphia, PA: WB Saunders; 1992.

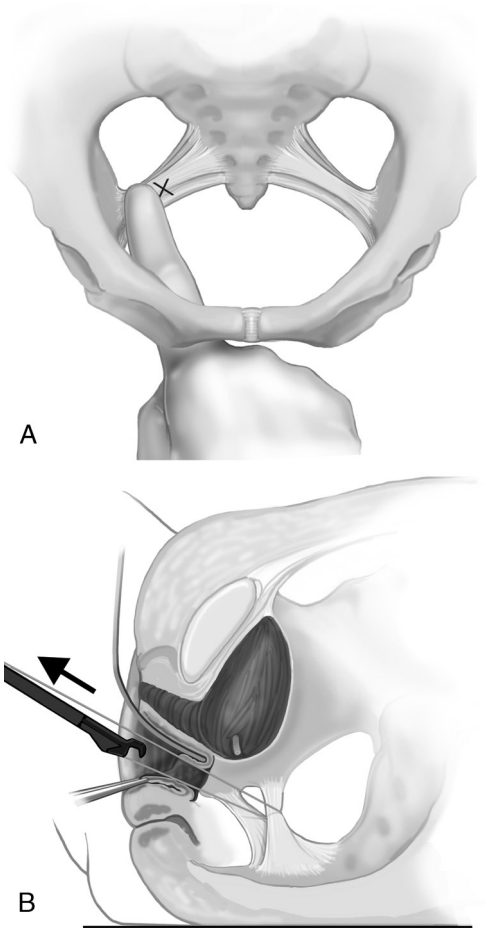


**FIGURE 3.** Sacrospinous fixation. Images courtesy of Boston Scientific Corporation. Information herein is the opinions of the author and not of Boston Scientific. A, Palpation of SSL. B, Capio Device is used to deliver and anchor sutures to the SSL.

the SSL, and further throws with square knots will secure the suture.[17]

Iliococcygeus suspension can be performed instead of sacrospinous fixation (SSF) if there is concern for hemorrhage or if it is difficult to palpate the SSL. The initial surgical dissection to perform an iliococcygeus suspension is the same as described previously for the SSL suspension. The iliococcygeus ligament is located lateral to the rectum and anterior to the IS (Fig. 4). Permanent or delayed suture materials may be used for this procedure and are usually 0 or no. 1. Because the iliococcygeus muscle is near the SSL, the same retraction techniques and ligature devices can be used to pass the suture. Two sutures are placed anterior to the IS directly into the muscle, whereas the rectum is retracted medially and downward with a long retractor such as Briesky-Navratil. The sutures are placed through the vaginal apex, and if permanent suture is used, a pulley stitch will best elevate the vagina. A delayed absorbable suture may also be placed through the vagina and tied to elevate the vaginal vault to the SSL. Suture material such as polydioxanone or polyglyconate (Maxon, Covidien, Mansfield, Mass) will provide sufficient strength and will be present for 3 to 5 months. This procedure is performed bilaterally. With both SSF and iliococcygeus suspension, the risk of ureteral injury is less. However, the risk of rectal injury, hemorrhage, and nerve injury is higher because of the close proximity of the sutures to major structures. Buttock pain has also been reported after iliococcygeus suspension and SSF.[15]

The procedures described previously use native tissue and suture to reattach the vaginal vault and restore anatomy. Sacral colpopexy is a technique that uses synthetic mesh that is placed abdominally to suspend the vagina. Indications for sacral colpopexy include significant apical defect, recurrent prolapse, limited vaginal access, scarring or anatomic abnormalities in the pararectal space, attenuated US ligaments, and adnexal masses or other intra-abdominal pathologic lesions that may require further exploration.

The sacral promontory is identified and the peritoneum overlying the promontory is incised, and the dissection is carried down to the anterior longitudinal ligament. Care is taken to avoid injury to the major vessels, ureter, and colon. The peritoneal incision is then extended in a caudad direction adjacent to the sigmoid colon until the vaginal apex is reached. A vaginal probe is inserted to reduce the prolapse and stretch the vagina to assist with identification of the vesicovaginal plane. Dissection begins at the vagina where the peritoneum overlying the vaginal apex is opened. The dissection is carried down the anterior vaginal wall, separating the peritoneum and bladder from the anterior vaginal wall. The length of the dissection is dependent on the degree of anterior vaginal wall relaxation. A longer dissection is performed on the posterior vaginal wall approaching the levator musculature. The rectum may be near the posterior vaginal wall, and care should be taken to avoid entering the rectum. A rectal probe can be used to identify the margins of the rectum and if needed can be use to move the rectum away from the operating field.

Polypropylene mesh is prepared by the surgeon in the shape of a "Y." The anterior and posterior segments of the mesh are trimmed in accordance with the amount of dissection that was performed. The tail of the Y-shaped mesh can be rolled and held in that shape with suture to keep the tail of the mesh out of the surgeon's field of view. The anterior portion of the mesh is then sutured to the anterior vaginal wall with 4 to 6 sutures placed along the anterior vaginal wall. Using a monofilament permanent suture can decrease the likelihood of bacterial adherence and possible suture erosion. The posterior segment of the mesh is attached to the posterior vaginal wall using 6 to 8 attachment points. No sutures are placed into the vaginal apex tissue to reduce the risk of erosion. The mesh is then secured to the anterior longitudinal ligament on the sacrum using permanent suture material in at least 2 fixation points. Reperitonealization is then performed using absorbable suture.[16] Uncommon complications of sacral colpopexy include infection, bleeding, ureteral obstruction, cystotomy, enterotomy, and mesh erosion.

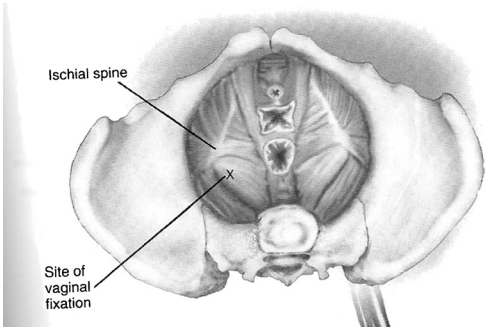


**FIGURE 4.** Iliococcygeus suspension sutures. From: Walters MD, Karram MM. *Urogynecology and Reconstructive Pelvic Surgery*. 3rd ed. Philadelphia, PA: Mosby Elsevier; 2007.

## Robotic and Laparoscopic Approaches

Minimally invasive surgery has many advantages for the patient undergoing reconstructive gynecologic procedures. The rates of postoperative infections and pain are less with a minimally invasive approach.[18] Return to daily activities and work is also faster for many patients, and cosmetic results are improved with this approach. The vaginal approach is considered to be the original type of minimally invasive surgery. Patients undergoing vaginal procedures often have no external incisions and pain is minimal because there is no disruption of the abdominal skin, fascia, and muscles. Procedures that use the uterosacral ligaments for suspension and abdominal sacral colpopexy (ASC) can be performed using laparoscopic or robotic techniques. Uterosacral ligament suspension has been performed laparoscopically and uses the same surgical principles described above. Steps to laparoscopic US suspension include (1) identifying vital structures including the ureters, (2) reducing the enterocele and assessing the cul-de-sac, (3) opening the peritoneum overlying the vaginal apex to expose the pubocervical (anteriorly) and rectovaginal fascia (posteriorly), and (4) approximation of the 2 fascias together, and (5) attachment to the uterosacral ligaments.[19] A 0 nonabsorbable suture is used for this procedure, and sutures are tied extracorporally. One of the major advantages of ASC is that it supports the vaginal apex using synthetic mesh, but it leaves the vaginal mucosa intact thereby potentially decreasing the rates of erosion.

Abdominal sacral colpopexy has also been studied both laparoscopically and robotically. The advantages of this route are increased visualization of pelvic anatomy and presacral space as well as the insufflation effects and improved hemostasis. The disadvantages, however, are mainly due to the technical difficulty that exists with laparoscopic suturing and precise dissection required in the presacral space. Robotic surgery principles are very similar to that of laparoscopy with the advantage of increased instrument dexterity and 3-dimensional vision. Both laparoscopic and robotic sacral colpopexy routes have been reported in the literature and have good success rates.[20]

## Vaginal Mesh to Augment Apical Suspension Procedures

All of the procedures described use native tissue and suture to complete the repair with the exception of sacral colpopexy, which requires synthetic mesh. In more recent years, vaginal mesh placement has been used to provide additional support. This is, however, not without potential significant consequences including vaginal immobility, scarring, mesh erosion, pain, and vaginal shortening. There are limited long-term data on vaginal mesh placement, and the optimal "kit" has yet to be established. Synthetic mesh that penetrates the levator muscle should be avoided because of risk of long-term pain. Careful patient selection and patient counseling regarding risks, benefits, and alternatives should be performed before any use of vaginal mesh.

# OVERVIEW OF EFFICACY

Evaluating surgical efficacy and outcomes in patients with VVP is challenging because of the wide variations of the definitions of success, failure, and recurrence. To complicate the matter further, often a physician's definition of success is different than the patient's. Level 1 evidence is limited, and therefore much of the evidence we use to guide our decisions is based on level 2 and level 3 evidence.[21]

## McCall

Level 1 evidence comparing McCall culdoplasty to other procedures is sparse. Cruikshank and Kovac[22] performed a randomized controlled trial comparing McCall culdoplasty, vaginal Moschcowitz, and peritoneal closure in preventing enterocele at the time of vaginal hysterectomy. Three years after surgery, patients who underwent McCall procedures had a significantly lower incidence of recurrent prolapse compared with the other groups.

Colombo and Milani[23] published a retrospective comparison of the McCall culdoplasty and SSF from which they concluded that SSF was not superior to McCall during vaginal hysterectomy for the treatment of advanced uterovaginal prolapse. Optimal vaginal support was noted in 73% of SSF group and 85% of the McCall group ($P = 0.14$). Recurrent VVP occurred in 8% of the SSF group and 5% of the McCall group ($P = 0.72$). Efficacy of McCall culdoplasty at the time of vaginal hysterectomy has also been reviewed by Montella and Morrill[24] who showed a 97% success rate at 1 year after surgery. Similar results were found by Webb et al[25] who reviewed 693 patients who underwent McCall culdoplasty for posthysterectomy VVP and noted a reoperation rate of 50 with a patient satisfaction greater than 82%. Of those dissatisfied in this study, the majority were dissatisfied because of problems with incontinence.

## Uterosacral Suspension

There is limited level 1 evidence comparing uterosacral suspension (USS) to other techniques, but there are several prospective nonrandomized trials and many retrospective reviews assessing the efficacy of this technique. High levator myorrhaphy was compared to USS in a prospective randomized trial conducted by Natale et al.[26] They defined cure as no evidence of prolapse in any compartment greater than stage 2. Patients who underwent high levator myorrhaphy had 96.6% cure rate, and patients in the USS group had 98.3% cure rate.

Wheeler et al[27] evaluated 32 patients who underwent bilateral USS with preoperative and postoperative pelvic organ quantification (POPQ) scores and found that the mean (SD) change in POPQ point C was 5.9 (4.7), with a mean follow-up of 2 years. None of the patients in this study had greater than stage 1 prolapse at their postoperative follow-up examination. Patient satisfaction was greater than 90%.

Barber et al[28] in 2000 reported on 46 patients who underwent bilateral USS with paravaginal defect repair and showed that 95% of patients had stage 2 prolapse or less at the apex, with a mean follow-up time of 15.5 months.

In a somewhat larger retrospective study done by Karram et al,[29] 99% of patients had no evidence of prolapse beyond grade 1 with a mean follow-up time of 21.6 months.

A recently published meta-analysis of USS showed successful anatomic outcomes defined as POPQ stage 0 or stage 1 with respect to apical support in 98% of patients. Pooled analysis of subjective outcomes showed that 82% to 100% of patients had relief in their symptoms.[30]

## Sacrospinous Fixation

Morgan et al[31] published a systematic review on sacrospinous fixation and noted a remarkable variation in reported failure rates across the literature. Objective findings were summarized as showing 73% to 97% success rates. This wide range in success rates from this review stems from the variation in definitions used to classify failures. Many of the studies did not separate specifically categorize at which sites failures occurred, and therefore, anterior and posterior compartment failures are included in the reported rates. A pooled analysis using the Baden-Walker grading system showed that only 6.3% of patients had grade 2 or higher failures of at the apex.

## Iliococcygeal Suspension

Iliococcygeal suspension also known as prespinous fixation has been used to treat VVP with a similar technique as SSF. Prespinous fixation was developed to avoid possible injury to the major blood and nerve supply that can occur with SSF. Sacrospinous fixation usually involves anchoring sutures at the level of the IS, whereas prespinous fixation as the name implies anchors sutures anterior to the IS in the dense fascia of the iliococcygeus muscle thereby decreasing the risk of injuring the major structures.

Overall success rates reported in case series have demonstrated good anatomic results.[32,33] Maher et al[15] performed a retrospective analysis of iliococcygeus and sacrospinous fixation on 128 patients. Comparison of these 2 procedures showed no statistically significant difference in vault prolapse greater than grade 1 at the apex (SSF 2.8% vs iliococcygeal 8.3%, $P = 0.38$). Mean follow-up time in this study was 21 months.

## Abdominal Sacral Colpopexy

There is little debate that ASC is a highly recommended procedure for apical prolapse because many studies have shown excellent efficacy of this procedure.[34,35] There have been several studies comparing the efficacy of ASC to SSF, which show mixed results. The overall trend, however, shows that ASC is more efficacious at preventing recurrent prolapse at the apex. Benson et al[36] performed a prospective randomized trial comparing these 2 procedures. The trial was discontinued early because of disparity in several clinical outcomes between the groups. The reported recurrence rate of vaginal vault inversion was 12% in the SSF group and 2.6% in the ASC group. Shortly after the study of Benson et al was published, Sze et al[37] published a retrospective study comparing ASC with Burch colposuspension to SSF with needle suspension for VVP and stress incontinence. This study also demonstrated a significant difference in the incidence of recurrent prolapse to the hymen (33% vs 19%, $P = 0.05$) in the SSF versus the ASC group, respectively. It should be noted, however, that this study did not specifically comment on outcomes at the apex. On the basis of these studies, it was concluded that the abdominal route was superior to the vaginal route with regard to better anatomic outcomes. In a more recent prospective randomized study on 95 patients by Maher et al,[38] ASC and SSF had similar anatomic outcomes for vault prolapse to the introitus with a mean follow-up time of 24 and 22 months, respectively (17% vs 4%, $P = 0.095$). They concluded that these procedures were equally effective in the treatment of VVP.

## Definitions of Success

After reviewing the pertinent literature published on the various surgical techniques for treatment of VVP, it was not surprising that there were mixed results reported across the literature. Barber et al[39] published an excellent article that addressed how we as surgeons and as a medical community define success. The most stringent criteria for success are outlined in the National Institutes of Health (NIH) consensus guidelines where cure is defined as stage 0 on the Pelvic Organ Prolapse Quantification system (POP-Q).[40] Studies in the past have also used different quantification systems to objectively report anatomic outcomes such as the Baden-Walker and POP-Q. Most of the previous studies have defined success using these systems as prolapse that is not greater than Baden-Walker grade 2 (no prolapse beyond the hymen) and POP-Q stage 1 (prolapse that is at 1 cm above the hymen). This definition of success has been largely adopted for several reasons: (1) symptoms of POP are not present in many patients until prolapse reaches the hymen or beyond[39] and (2) overall success and failure are sometimes based on prolapse being present in any compartment instead of quantifying success based on what the original procedure was intended to treat.

Consider the patient with the following preoperative findings on POP-Q: uterovaginal prolapse stage 3 with the maximal point of prolapse being point C at +2, stage 2 prolapse anteriorly (Aa and Ba +1), and stage 1 prolapse posteriorly (Ap and Bp −2). In one scenario, the patient undergoes a SSF and has excellent resolution of prolapse at point C (−8), point Aa and Ba (−1), and point Ap and Bp (−3). The same patient might have undergone an ASC with the following findings: point C (−8), point Aa and Ba (−2), and point Ap and Bp (−1). Which of these 2 scenarios would we judge a successful outcome? After SSF, the greatest burden of prolapse is stage 2 in the anterior compartment. There is, however, excellent support of the apex. After ASC, this patient has stage 2 prolapse present in posterior compartment with resolution of apical prolapse. Neither of these patients would be considered "cured" nor in the satisfactory anatomic outcome category according to the NIH guidelines. Both ASC and SSF are primarily procedures for apical prolapse and are not first-line treatment of defects in the anterior and posterior compartment. Patients undergoing prolapse repairs often require more than 1 procedure to adequately address all the compartments affected by prolapse. The additional procedures further confounds the ability to classify as surgery as a success or failure. As in this example, both patients have resolution of their apical prolapse but still have anatomic evidence of prolapse in other compartments.

It has been postulated that some of these apical suspension procedures may put stress on other compartments. Sacrospinous fixation attaches the apex to a posterior location in the pelvis and therefore may predispose the anterior compartment to additional forces that might contribute to formation of anterior compartment defect. Abdominal sacral colpopexy places the vaginal axis more cephalad and anterior but may put the posterior compartment at risk for prolapse.[37]

Factors that should be considered in determining success or failure of a procedure are patient satisfaction and presence of symptoms. Swift et al[41] noted that many patients in the general population have baseline POP-Q examinations consistent with stage 1 to 2 prolapse but in fact are not seeking treatment. It has been concluded that any definition of success after POP surgery should include the absence of symptoms as well as anatomic criteria and/or the absence of retreatment.[39]

# CHOOSING THE PROCEDURE

On the basis of the review of the procedures here, it is evident that there is no clear answer as to which procedure will provide the best outcomes in a given patient. There are some trends that can be seen from the data that we do have to guide us in choosing the right procedure. It should be noted that because the focus of this review was on anatomic outcomes at the apex, consideration of other factors must be taken into account. There are inherent complications with each procedure and this must be considered. The risk of recurrence of POP or development of POP in a different location, incontinence and voiding issues, patient medical and surgical history, and surgeon expertise all factor into which procedure will give the best results. Patient and physician expectations should be discussed before surgery. Pelvic organ prolapse is a multifactorial disease, and despite our best efforts, recurrence with the need for surgery is not uncommon.[42,43]

# SUMMARY

Our understanding of the pathophysiology of POP and best surgical procedures continues to challenge those of us in the

field of female pelvic medicine and reconstructive surgery. The historic evidence reveals that VVP has long been recognized as a difficult surgical problem. The original principles for surgical correction are still valid today, but there is room for additional research to contribute to our knowledge of this problem and improve treatments for patients.

## QUESTIONS

1. Which of the following risk factors is not clearly associated with the development of pelvic organ prolapse?
   A. Age
   B. Vaginal childbirth
   C. Obesity
   D. Previous hysterectomy

Age, childbirth, and genetics all play an important role in the development of POP. However, previous hysterectomy as a risk factor continues to be debated. Disruption of the attachments and connective tissue is thought to predispose women to prolapse development. However, the incidence of prolapse after hysterectomy is similar to that in the general population in patients who still have their uterus.[3]

2. On the basis of DeLancy's description of levels of vaginal support, which level is primarily responsible for apical vaginal prolapse?
   A. Level 1
   B. Level 2
   C. Level 3
   D. All of the above

The cardinal and uterosacral complex are primarily responsible for support of the vaginal apex. These structures are defined by DeLancy as level 1 support. Level 2 support may also play a small role in support to the upper portion of the vagina because of the attachments to the pelvic sidewall. Level 3 support originates from the perineal body complex, and defects in this level lead to problems with the perineum, lower vagina, and distal urethra.[4]

3. Surgical cure of pelvic organ prolapse at the apex is defined by the NIH consensus guidelines as which of the following?
   A. Descent that is less than 1 cm from the hymen; POP-Q stage 1
   B. Descent that does not bother the patient or cause symptoms
   C. No prolapse of the vaginal apex correlating to POP-Q stage 0
   D. Any of the above

Anatomic cure is defined by evidence of no prolapse based on the NIH guidelines. However, many surgeons base success and cure on absence of patient symptoms, and anatomic cure as prolapse that is above the hymen. Many patients with mild degrees of prolapse do not have symptoms. Absence of symptoms is important in meeting patient expectations.[37,38]

4. Which of the following apical suspension procedures has a potentially higher risk of anterior compartment relaxation as a subsequent recurrence?
   A. Abdominal sacral colpopexy
   B. McCall culdoplasty
   C. Sacrospinous fixation
   D. Laparoscopic uterosacral ligament fixation

Sacrospinous fixation places the vaginal axis more posteriorly compared to the other procedures listed. This may predispose the anterior compartment to additional forces that could increase the risk for an anterior compartment defect. As with any prolapse repair procedure, recurrence risk in any compartment is possible and many patients will undergo more than 1 procedure to treat POP.[35]

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