Transvaginal Suture-Based Repair

Ekene A. Enemchukwu, MD, MPH[a,b,*]

KEY POINTS

- An estimated 300,000 women undergo pelvic organ prolapse (POP) surgery in the United States every year at a cost of more than 1 billion dollars per year.
- Apical support is required to achieve successful prolapse repair.
- Transvaginal native tissue repairs have the advantage of providing minimally invasive surgical repairs without the added risk of abdominal, laparoscopic, or robotic surgery while avoiding the risk of mesh augmentation.

INTRODUCTION

An estimated 300,000 women undergo pelvic organ prolapse (POP) surgery in the United States every year at an annual cost of more than 1 billion dollars.[1–3] The prevalence of POP is approximately 2.9% to 8% and increases with age.[4–6] POP is often associated with urinary, anorectal, and/or sexual dysfunction, all of which can negatively affect a woman's quality of life. As the population ages and women live longer and more active lives, the search for safe, durable surgical repairs continues. The estimated lifetime risk of undergoing POP surgery is as high as 20% with reoperation rates up to 30%.[7–9]

Risk factors for POP are well-defined, including advanced age, parity, obesity, and postmenopausal status.[7,10] POP occurs as a result of pelvic floor support defects. Defects in the level 1 support (uterosacral and cardinal ligament) can cause uterine prolapse or, in the posthysterectomy woman, descent of the vaginal cuff with herniation of the small or large bowel, also known as an enterocele.

Apical support is required to achieve successful prolapse repair.[11–13] Chen and colleagues,[12] confirmed the importance of good apical support for successful POP repair surgery in a study involving dynamic MRI.[12] The investigators radiographically demonstrated the significance of apical support disruption on the magnitude of anterior wall prolapse.[14]

Surgical management options are divided into obliterative or restorative techniques. Obliterative repairs have high success rates; however, they are reserved for women who no longer wish to be sexually active. Restorative repairs aim to restore vaginal length, axis, and function. These repairs can be approached vaginally or abdominally, and performed with or without biological or synthetic mesh augmentation. The surgical approach should be individualized based on patient factors, including suitability for surgical approach, desire for future sexual function, and past surgical history. The goal is to relieve bothersome symptoms. Historically, success was defined based on anatomic outcomes. However, among the most important recent developments

---

in POP outcomes research is the realization that patient-reported outcomes are perhaps more important than anatomic outcomes.[15]

The open abdominal sacrocolpopexy is considered the gold standard approach for apical POP repair due to its superior anatomic outcomes, long-term durability, and lower rates of dyspareunia.[16] However, the open approach has largely been replaced by minimally invasive techniques using laparoscopic and robotic techniques. Diwadkar and colleagues[17] performed a systematic review and found that abdominal sacrocolpopexy and mesh-augmented repairs have superior outcomes. However, they also reported higher reoperation rates in mesh-augmented repairs than in native tissue transvaginal repairs. Transvaginal native tissue repairs have the advantage of providing minimally invasive surgical repairs without the added risk of abdominal, laparoscopic, or robotic surgery while avoiding the risk of mesh augmentation.[2] This article reviews transvaginal native tissue repairs for posthysterectomy vault prolapse.

TRANSVAGINAL NATIVE TISSUE TECHNIQUES

Historically, native tissue transvaginal techniques have involved suspension of the vaginal cuff to the sacrotuberous, sacrospinous, or uterosacral ligaments. Currently, the most commonly performed transvaginal vaginal vault repairs are the sacrospinous ligament fixation (SSLF) and the uterosacral ligament suspension (ULS). The iliococcygeus suspension is a modification of the SSLF that was originally developed to address the high rates of postoperative cystocele repair.[14] However, the procedure is typically performed bilaterally in the woman with a foreshortened vagina that fails to reach the sacrospinous ligament or with significant scarring that precludes safe exposure of the sacrospinous ligament.

Sacrospinous Ligament Fixation

The sacrospinous ligament extends from the ischial spine to the lateral sacrum, dividing the sciatic notch into the greater and lesser sciatic foramen. Numerous vessels and nerves lie posterior and lateral to the sacrospinous ligament, including the inferior gluteal vessels, the hypogastric venous plexus, the sciatic nerve, and the pudendal nerve and vessels. The sciatic nerve courses superior and lateral to sacrospinous ligament, whereas the pudendal nerve and vessels lie directly posterior to the ischial spine.

The SSLF procedure was first described in 1958 by Sederl.[18] Indications include total procidentia, posthysterectomy vaginal vault prolapse,[19] and hysteropexy. Traditionally, the SSLF is approached posteriorly. The extraperitoneal approach provides the added advantage of avoiding the peritoneal cavity, particularly in women with prior abdominal surgery and risk of pelvic adhesions. In the posthysterectomy setting, an enterocele sac is often encountered and should be dissected off the vaginal wall. The enterocele sac can be entered and the abdominal contents reduced. The peritoneum is then closed in a purse-string fashion, incorporating the uterosacral ligaments and the anterior or posterior peritoneum. When the sacrospinous ligament is identified, 2 narrow retractors (eg, Breisky-Navratil) can be placed to protect the rectum and expose the ligament. The surgical technique then involves fixation of the vaginal vault using a combination of 2 to 4 nonabsorbable or delayed absorbable sutures and a Miya hook, Deschamps ligature carrier, Capio automatic suture capturing device (Boston Scientific, Marlborough, MA, USA), or (alternatively) suture passage under direct visualization. The sutures are placed 2 cm medial to the ischial spine and 0.5 cm below the superior edge of the sacrospinous ligament. Avoidance of an intervening suture bridge is important to allow adequate fibrosis and scarring. Therefore, vaginal length and the position of the vaginal apex should be assessed before attempting this approach to ensure the vaginal cuff is able to make direct contact with the sacrospinous ligament. If indicated, anterior colporrhaphy is performed and the SSLF sutures are subsequently passed through the posterior surface of the vaginal apex. The procedure can be performed either unilaterally or bilaterally. Bilateral placement has been reported in patients with recurrent vault prolapse or desire to maintain symmetry and a wide vaginal vault.[20] Jones and colleagues[21] performed a retrospective review of 103 women undergoing SSLF. Sixty-two women (60%) underwent bilateral suspension, whereas the remaining 41 (40%) underwent unilateral suspension. Although the follow-up was short (mean 4.6–8.6 months), the investigators observed no difference in anatomic cure rates in the unilateral and bilateral groups (90.2% and 85.5%, respectively) and did not observe increased morbidity or anterior prolapse recurrence in the bilateral group.

Alternatively, the sacrospinous ligament can be approached anteriorly using a paravaginal dissection. The Michigan 4-wall technique describes an apical approach that differs from the original technique by attaching both the anterior and posterior walls to the sacrospinous ligament. The investigators report that this allows proper selection of suspension points and reduces the risk of anterior vaginal wall recurrence.[22]

When the vaginal cuff does not reach the sacrospinous ligament, an iliococcygeus suspension can be performed. The dissection is performed in a similar fashion to the SSLF, with the dissection extending toward the ischial spine. Rather than exposing the SSLF, the tissue overlying the iliococcygeus muscle and fascia are mobilized bilaterally and a delayed absorbable suture is placed in the muscle and fascia.

Several retrospective cohort studies examine and report single-center SSLF safety and outcomes. Overall, success rates are high, except for an outlier that reports 8% success rate.[23] Sze and Karram[24] published a review in which surgical success varied widely depending on the definition used. They found success rates up to 94% (mean 75%) in more than 1000 subjects. Paraiso and colleagues[25] followed 243 women for a mean time of 73 months and observed apical recurrences in 8.2% of women and prolapse-free survival rates of 88.3%, 79.7%, and 51.9% at 1, 5, and 10 years, respectively. Maher and colleagues[26] compared the outcomes of SSLF and iliococcygeus suspension in a matched case controlled study and found no difference in recurrence or complication rates. For the SSLF group, the investigators reported a 94% success rate at a mean follow-up time of 19 months, with recurrence rates of 3%, 25%, and 6% for the apical, anterior, and posterior compartments, respectively. They observed similar rates of buttock pain, intraoperative hemorrhage, and subsequent cystocele in both groups.[26]

Randomized controlled trials comparing SSLF to mesh techniques are lacking. Maher and colleagues[27] randomized 95 women to SSLF or abdominal sacral colpopexy (ASC). After 2 years, they found no statistically significant difference in subjective (94% ASC and 91% SSLF) or objective success rates (76% ASC and 69% SSLF). They reported higher cost, slower return to activity, and longer operating room time with ASC. The group did not report reoperation rates. In a multicenter randomized controlled trial, Halaska and colleagues[28] randomized 168 women with posthysterectomy vaginal vault prolapse to SSLF or vaginal mesh (VM) repair. At 1-year follow-up, prolapse recurrence was 16.9% in the VM group and 39.4% in the SSLF group (P = .003). They observed no difference in quality of life improvements but observed a 20.8% mesh exposure rate in the VM group. In a single-center randomized controlled trial, Svabik and colleagues[29] randomized 142 women with posthysterectomy vaginal vault prolapse and levator ani avulsion injury to VM or SSLF. At 1 year, they observed objective success rates of 97% in the VM group and 35% in the SSLF group on clinical examination and ultrasound ($P<.001$). However, they did not detect any difference in subjective outcomes, which they attributed to being under-powered. The mesh erosion rate was 8.3% in the VM group.

Marguiles and colleagues[30] performed a systematic review of vaginal SSLF and reported anatomic cure rates of 98.3% apically, and 81.2% and 87.4% in the anterior and posterior vaginal compartments, respectively. POP symptoms resolved in 82% to 100% of subjects in 5 of the 11 studies reviewed.

Complications

Serious intraoperative and postoperative complications, such as hemorrhage, nerve injury, and rectal injury, are uncommon. The most common complication reported is buttock pain (0.4%–9.3%), which can be caused by injury or entrapment of a small nerve that runs through the SSLF-iliococcygeus muscle complex.[31] Buttock pain should be self-limited with complete resolution within 6 weeks. The pain is often managed expectantly with reassurance, antiinflammatory medications, and donut pillows to relieve discomfort while sitting. Pain that radiates down the leg is more likely caused by sciatic nerve or root entrapment. This occurs as a result of suture placement cephalad to the SSLF and warrants immediate reoperation for suture removal. Vulvovaginal pain and/or numbness can occur as a result of pudendal nerve injury or entrapment. Immediate reoperation for suture removal should be performed. Persistent buttock pain and paresthesia suggest nerve injuries and warrant reoperation to remove the sutures.

Other complications are relatively rare. Risk of intraoperative hemorrhage requiring blood transfusions is low (~2%). Intraoperative hemorrhage can occur as a result of inferior gluteal vessel, hypogastric venous plexus, pudendal vessel injuries, and perirectal veins. These injuries can often be managed with tight vaginal packing and hemostatic agents. Given the location of the SSLF, bleeding in this area is difficult to manage abdominally or with selective embolization.[24,31] Due to the proximity of the sacrospinous ligament to the rectum, a rectal injury can occur during dissection of the perirectal space or dissection of the SSLF. Rectal examination should always be performed. Intraoperative recognition and repair using standard technique is imperative to avoid complications. Pelvic infections, urinary retention, and urinary tract infections are uncommon and short-lived, as long the issue is identified and treated in a timely fashion. Finally, sexual dysfunction and dyspareunia due to vaginal shortening or narrowing have been reported in case series.[32,33] Avoidance

of excessive vaginal wall trimming and prescribing postoperative estrogen cream can minimize this risk. Finally, although ureteral obstruction or injury is a rare complication of the SSLF procedure, intraoperative cystoscopy should always be performed if there is any concern for ureteral injury.

Uterosacral Ligament Suspension

The uterosacral ligament and cardinal ligaments are fascial condensations that suspend the vaginal apex. In 1927, Miller[34] first described plication and suspension of vaginal vault using these ligaments. In 2000, Shull and colleagues[35] described a modification of the technique. Although the original technique described an intraperitoneal approach, an extraperitoneal approach can be taken. However, an intraperitoneal allows proper palpation and, in some cases, visualization of important structures and landmarks. If performed concomitantly with hysterectomy, the ligaments should be tagged for subsequent identification. In the posthysterectomy setting, an enterocele sac may be encountered. The sac should be dissected off the vaginal cuff, the peritoneum carefully entered, and the bowels reduced. The ischial spines are important landmarks. The uterosacral ligament is located posterior and medial to the ischial spines, whereas the ureter is located ventral and lateral to the ischial spines. Occasionally, the ureters can be palpated. Intraoperative ureteral catheters can also aid in identification of the ureters, if needed. 2 to 3 delayed absorbable sutures are placed through each ligament bilaterally, with or without the assistance of an Allis clamp. The sutures can then be passed through the layers of anterior and posterior vaginal walls. Nonabsorbable suture can be placed using a pulley-type stitch to avoid the presence of permanent suture in the vaginal lumen. The pulley stitch technique is performed by including the muscular layer of the vaginal wall while excluding the epithelial layer. Finally, cystoscopy should always be performed to ensure patency of bilateral ureters before and after tying the sutures.

Similar to the SSLF technique, numerous outcomes studies exist in the medical literature. Silva and colleagues[34] observed a recurrence rate of 15% in a single-center cohort study in which failure was defined as symptomatic prolapse of stage 2 or greater. Shull and colleagues[35] performed a retrospective review of 298 women undergoing ULS and reported a recurrence rate of 13% in 1 or more compartment.

In a cohort of 983 subjects, Unger and colleagues[36] observed that 14.4% of cases had

POP recurrences, 11% had recurrences beyond the hymen, 10.6% were symptomatic with bulge symptoms, and 3.4% required reoperation.

Complications

Serious complications are infrequent. Ureteral obstruction was the most commonly reported complication (4.8%) in 1 large cohort.[36] A metaanalysis by Marguiles and colleagues [30] reported a rate of 1.8%. In most cases, removal of the offending suture relieved the obstruction. In rare cases, ureteral reimplantation was required (0%–0.6%). Cystotomy (1%), small bowel obstruction (0.8%) and ileus (0.1%) were also reported.[36]

SACROSPINOUS LIGAMENT FIXATION VERSUS UTEROSACRAL LIGAMENT SUSPENSION

One randomized controlled trial comparing the efficacy and safety of the ULS and SSLF has been reported in the literature. In the randomized multicenter Operations and Pelvic Muscle Training in the Management of Apical Support Loss (OPTIMAL) trial, Barber and colleagues[37] randomized 374 women with stage 2 to 4 POP to ULS or SSLF. Success was defined as (1) no apical descent greater than one-third in the vaginal vault, (2) no bothersome vaginal bulge symptoms, and (3) no retreatment for POP. At 24 months, no significant differences were observed in anatomic outcomes, length of hospitalization, blood loss, and surgical time. Anatomic success rates were 59.2% and 60.5% for ULS and SSLF, respectively. Recently, the same group published a follow-up in which 285 (86%) women completed the 5-year extension of the OPTIMAL trial.[38] Overall, 5.1% required reoperation at 2 years. Combined, 18% developed bulge symptoms, and 17.5% developed anterior or posterior POP beyond the hymen.

Adverse events were unique to each repair. For SSLF, neurologic pain occurred more frequently, at a rate of 12.4% compared with 6.9% in the ULS group. Ureteral obstruction was more common in the ULS group, with a rate of 3.2%. Five cases (2.7%) resolved with suture removal, 1 (0.5%) required stent placement, and 1 (0.5%) was not recognized intraoperatively.

SUMMARY

Transvaginal apical native tissue POP repairs are safe and effective. Although studies suggest transvaginal mesh-augmented repairs are more durable, the risk of mesh-related complications is not insignificant. The risk and benefits of each technique should be discussed with the patient and weighed against individual patient factors.

REFERENCES

1. Wu JM, Kawasaki A, Hundley AF, et al. Predicting the number of women who will undergo incontinence and prolapse surgery, 2010 to 2050. Am J Obstet Gynecol 2011;205(3):230.e1–5.

2. Boyles SH, Weber AM, Meyn L. Procedures for pelvic organ prolapse in the United States, 1979–1997. Am J Obstet Gynecol 2003;188:108–15.

3. Subak LL, Waetjen LE, van den Eden S, et al. Cost of pelvic organ prolapse surgery in the United States. Obstet Gynecol 2002;98:646–51.

4. Nygaard I, Barber MD, Burgio KL, et al. Prevalence of symptomatic pelvic floor disorders in US women. JAMA 2008;300:1311–6.

5. Rortveit G, Brown JS, Thom DH, et al. Symptomatic pelvic organ prolapse: prevalence and risk factors in a population-based, racially diverse cohort. Obstet Gynecol 2007;109:1396–403.

6. Tegerstedt G, Maehle-Schmidt M, Nyrén O, et al. Prevalence of symptomatic pelvic organ prolapse in a Swedish population. Int Urogynecol J Pelvic Floor Dysfunct 2005;16:497–503.

7. Olsen AL, Smith VJ, Bergstrom JO, et al. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 1997;89:501–6.

8. Wu JM, Matthews CA, Conover MM, et al. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. Obstet Gynecol 2014;123(6):1201–6.

9. Committee on Practice Bulletins-Gynecology, American Urogynecologic Society. Practice bulletin No. 185: pelvic organ prolapse. Obstet Gynecol 2017; 130(5):e234–50.

10. Jelovsek JE, Maher C, Barber MD. Pelvic organ prolapse. Lancet 2007;369:1027.

11. Marchionni M, Bracco GL, Checcucci V, et al. True incidence of vaginal vault prolapse. Thirteen years of experience. J Reprod Med 1999;44(8):679–84.

12. Chen L, Ashton-Miller JA, Hsu Y, et al. Interaction between apical supports and levator ani in anterior vaginal support: theoretical analysis. Obstet Gynecol 2006;108(2):324–32.

13. Summers A, Winkel LA, Hussain HK, et al. The relationship between anterior and apical compartment support. Am J Obstet Gynecol 2006;194(5):1438–43.

14. Shull BL. Pelvic organ prolapse. Am J Obstet Gynecol 1999;181(1):6–11.

15. Barber MD, Brubaker L, Nygaard I, et al. Defining success after surgery for pelvic organ prolapse. Obstet Gynecol 2009;114:600–9.

16. Maher C, Feiner B, Baessler K, et al. Surgery for women with apical vaginal prolapse. Cochrane Database Syst Rev 2016;(10):CD012376.

17. Diwadkar GB, Barber MD, Feiner B, et al. Complication and reoperation rates after apical vaginal prolapse surgical repair: a systematic review. Obstet Gynecol 2009;113(2 Pt 1):367–73.

18. Sederl J. Zur operation des prolapses der blind endigenden sheiden. Geburtshilfe Frauenheilkd 1958; 18:824–8.

19. Morley GW, DeLancey JOL. Sacrospinous ligament fixation for eversion of the vagina. Am J Obstet Gynecol 1988;158:872.

20. Pohl JF, Frattarelli JL. Bilateral transvaginal sacrospinous colpopexy: preliminary experience. Am J Obstet Gynecol 1997;177:1356.

21. Jones CM, Hatch K, Harrigill K. Unilateral and Bilateral Sacrospinous Ligament Fixation for Pelvic Prolapse: A Nonconcurrent Cohort Comparison. Female Pelvic Med Reconstr Surg 2001;7(1):27–33.

22. Kearney R, DeLancey JO. Selecting suspension points and excising the vagina during Michigan four-wall sacrospinous suspension. Obstet Gynecol 2003;101:325–30.

23. Holley RJ, Varner RE, Gleason BP, et al. Recurrent pelvic support defects after sacrospinous ligament fixation for vaginal vault prolapse. J Am Coll Surg 1995;180:444–8.

24. Sze EH, Karram MM. Transvaginal repair of vault prolapse: a review. Obstet Gynecol 1997;89:466e75.

25. Paraiso MFR, Ballard LA, Walters MD, et al. Pelvic support defects and visceral and sexual function in women treated with sacrospinous ligament suspension and pelvic reconstruction. Am J Obstet Gynecol 1996;175:1423e30 [discussion: 1430e1].

26. Maher CF, Murray CJ, Carey MP, et al. Iliococcygeus or sacrospinous fixation for vaginal vault prolapse. Obstet Gynecol 2001;98:40e4.

27. Maher CF, Qatawneh AM, Dwyer PL, et al. Abdominal sacral colpopexy or vaginal sacrospinous colpopexy for vaginal vault prolapse: a prospective randomized study. Am J Obstet Gynecol 2004;190(1):20–6.

28. Halaska M, Maxova K, Sottner O, et al. A multicenter, randomized, prospective, controlled study comparing sacrospinous fixation and transvaginal mesh in the treatment of posthysterectomy vaginal vault prolapse. Am J Obstet Gynecol 2012;207(4):301.e1-7.

29. Svabik K, Martan A, Masata J, et al. Comparison of vaginal mesh repair with sacrospinous vaginal colpopexy in the management of vaginal vault prolapse after hysterectomy in patients with levator ani avulsion: a randomized controlled trial. Ultrasound Obstet Gynecol 2014;43(4):365–71.

30. Marguiles RU, Rogers MA, Morgan DM. Outcomes of transvaginal uterosacral ligament suspension: systematic review and metaanalysis. Am J Obstet Gynecol 2010;202:124.

31. Karram MM, Ridway BM, Walters MD. Surgical treatment of vaginal apex prolapse. In: Walters MD, Karram MM, editors. Urogynecology and female

pelvic reconstructive surgery. 4th edition. Philadelphia: Elsevier Saunders; 2015. p. 372–4.

32. Given FT Jr, Muhlendorf IK, Browning GM. Vaginal length and sexual function after colpopexy for complete uterovaginal eversion. Am J Obstet Gynecol 1993;169:284e7.

33. Holley RL, Varner RE, Gleason BP, et al. Sexual function after sacrospinous ligament fixation for vaginal vault prolapse. J Reprod Med 1996;41(5):355–8.

34. Silva WA, Pauls RN, Segal JL, et al. Uterosacral ligament vault suspension: five-year outcomes. Obstet Gynecol 2006;108:255–63.

35. Shull BL, Bachofen C, Coates KW, et al. A transvaginal approach to repair of apical and other associated sites of pelvic organ prolapse with uterosacral ligaments. Am J Obstet Gynecol 2000;183(6):1365–73.

36. Unger CA, Walters MD, Ridgeway B, et al. Incidence of adverse events after uterosacral colpopexy for uterovaginal and posthysterectomy vault prolapse. Am J Obstet Gynecol 2015;212(5):603.e1–7.

37. Barber MD, Brubaker L, Burgio KL, et al. Comparison of 2 transvaginal surgical approaches and perioperative behavioral therapy for apical vaginal prolapse: the OPTIMAL randomized trial. JAMA 2014;311(10):1023–34.

38. Jelovsek JE, Barber MD, Brubaker L, et al. Effect of uterosacral ligament suspension vs sacrospinous ligament fixation with or without perioperative behavioral therapy for pelvic organ vaginal prolapse on surgical outcomes and prolapse symptoms at 5 years in the OPTIMAL randomized clinical trial. JAMA 2018;319(15):1554–65.