

"Methods for enhancing surgical results in the current care of pelvic organ prolapse"

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INTRODUCTION

The descent of one or more of the uterus, the anterior or posterior vaginal walls, or the apex of the vagina (vaginal vault following hysterectomy) is known as pelvic organ prolapse (POP) [1]. POP is discovered during vaginal examinations in 40% to 60% of pregnant women; the anterior and posterior compartments are the most often repaired areas [2]. A POP repair is thought to have a lifetime risk for women of 12.6% [3]. Current POP surgery research suggests that in addition to evaluating composite success by objective results, one should also include subjective symptomatic outcomes, reoperation rates, and comorbidities. Given the characteristics of POP and concerns about native tissue healing and consequences, it is more crucial to increase patient satisfaction and decrease problems than to achieve anatomic success. and Food and Drug Administration (FDA) cautions. The utilisation of laparoscopic and robotic techniques for POP repair has expanded with the acceptance of less invasive surgery. This article's goal is to examine the current state of the art in POP surgery.

ANTERIOR COMPARTMENT PROLAPSE SURGERY

There are various treatment of options for anterior compartment prolapse, including conservative

management, pessaries, or surgical reconstruction. Unfortunately, there is no standard surgical treatment for anterior prolapse and it is crucial to discuss the risks and benefits of different surgical options with each patient. Generally, reconstruction of the anterior vaginal wall is performed by placing sutures further indigenous approaches have been used to further augment tissue and boost durability. that plicate and lessen the weaker tissues. Native tissue healing has undergone extensive research, despite having lower success rates than mesh-augmented repair. Native repair is helpful for minimising prolapse inside the vagina and treating symptoms of vaginal bulge, according to the most recent composite criteria of success.

Depending on how one defines therapeutic success, the success rate of POP surgery might range from 19.2% to 97.2%. As a result, it is challenging to compare outcomes due to differences in patient characteristics, surgical methods, and success criteria. During the past 15 years, the pelvic organ prolapse quantification (POPQ) method has been demonstrated to be an important measuring instrument that has enhanced our understanding of POP and permitted trustworthy evaluations of the anatomical success of POP procedures. The definition of "optimal anatomic outcome" was determined to require perfect anatomic support (POPQ stage 0) at a 2001 NIH workshop for the standardised terminology among pelvic floor disorder researchers, and the definition of "satisfactory anatomic outcome" required support higher than 1 cm proximal to the hymen. The term "cure" was defined as a successful or ideal anatomic result.

However, it has been argued that these anatomic categories are overly restrictive because more than 75% of women who have yearly exams do not exhibit POP symptoms.

over 40% of patients would not satisfy the standards for "acceptable anatomic result," and approximately 60% of patients would not meet the standards for "ideal anatomic outcome" [4]. Stage 2 has also been split into stage 2a (hymen to -1 cm) and stage 2b (hymen to 1 cm). While less strict criteria for defining "cure" are increasingly being discussed, several studies recently defined Ba point 0 as anatomical success.

Barber et al. [5] found that the highest correlation between patient ratings of overall improvement and treatment effectiveness and the absence of vaginal bulge symptoms.

Moreover, definitions based on patient assessments of outcomes and anatomic success revealed weak or no connections. Maximizing

patient happiness while restoring the pelvic organs to their original placements are the two objectives of surgical repair [6].

1. Anatomical success

A randomised controlled research comparing the outcomes of anterior colporrhaphy (AC) and mesh repair over the previous 10 years is summarised in Table 1 [7-23].

Results for AC varied from 39.5% to 75% when anatomic success was determined as obtaining a POPQ stage 0 or 1.

while mesh repair had superior results at a 1-year follow-up, ranging from 81.0% to 95% [7,8,10,13,15-18]. The findings of the mid-term follow-up (24–36 months) showed that mesh repair outperformed AC in the majority of trials [9,12,14,20,22], with outcomes ranging from 39.5% to 86% for AC and 39.5% to 91.4% for mesh repair.

Different outcomes are obtained when anatomic success is defined as “No descent beyond the hymen (Ba 0)”. According to certain studies, AC had anatomic success rates as high as 86% to 89%, which was comparable to the mesh repair success rates of 84% to 96% [11,21,23]. Nevertheless, the success rate for mesh repair (86.4%) was higher than that for AC repair (70.4%) in patients with severe POP (POPQ stages 3-4) ($p=0.019$) [19].

2. Manifested success

Improvements in quality of life and patient satisfaction are increasingly viewed as more crucial variables than morphological achievement alone when redefining the success of POP surgery. While morphological success alone does not guarantee that vaginal bulge symptoms remain a meaningful outcome evaluation tool following POP surgery, it does show a substantial correlation between patient assessments of overall improvement and improvement in quality of life after surgery [5]. With the help of several indicators, including the lack of vaginal bulge symptoms and other forms of validated questionnaires, multiple randomised trials have looked at symptomatic success (Table 1). When vaginal bulge symptoms were used as the measure of symptomatic success, symptoms persisted in 0% to 37.9% of patients following AC, and superior to that in the mesh repair group, while the remaining tests revealed no evidence of bulging problems.

There are considerable variations between mesh repair and AC. According to a 2016 Cochrane analysis of anterior compartment prolapse, mesh repair significantly reduced the likelihood of prolapse awareness compared to AC (risk ratio [RR], 0.56; 95% confidence interval [CI], 0.43-0.73) [24]. The majority of quality-of-life surveys did, however, significantly improve following both procedures, with no discernible difference between AC

and mesh repair in terms of improvement [7,12,13,19,20,23]. Despite mesh repair having a higher anatomic success rate, AC provides some benefits for quality of life. Therefore, while treating anterior compartment prolapse, mesh should be taken into consideration in order to 3. Concerns with mesh: Is synthetic mesh actually harmful? For the past ten years, there has been scholarly discussion over the use of transvaginal mesh. kits for vaginal mesh were Following receiving FDA approval in 2001 for POP repair, the product was initially made available in the USA in 2005. The vaginal mesh-kit is a simple tool used in POP to supplement natural tissue.

The mesh typically has four arms and a main body and may successfully cover both paravaginal and central abnormalities. These standardised kits mark a change from patient anatomy assessments that are done on an individual basis [10]. Meshkits have shown a meteoric rise in clinical use since their release into the market, outpacing the accumulation of assessments of their long-term safety. Sung et al. [25] examined studies in 2008.

There is inadequate data to support the claim that transvaginal mesh improves POP outcomes as compared to native tissue for POP repair. The evaluation of mesh-related adverse events included looking at fistula development (1%), visceral damage (1%–4%), urinary tract infection (0%–19%), and erosion (0%–30%). Overall, the outcomes showed that carefully planned and Randomized studies that are appropriately powered are required. Apical augmentation using transvaginal mesh had positive surgical results, with mesh erosion being the most frequent consequence, occurring in 4.6% to 10.7% of patients, according to Feiner et al [26]. 's assessment of success and problems in all trials to date that employed transvaginal mesh. The FDA initially alerted the public about potential health risks connected with transvaginal mesh for POP repair in 2008. Mesh degradation rates of 2% to 25% for anterior POP surgery and mesh-related infection rates of up to 8% were reported by Bako and Dhar [27] in 2009. The FDA updated the 2008 notice with the following safety statement in 2011 [28]. Understand that POP can typically be properly treated without mesh, therefore preventing mesh-related issues. Only choose for mesh surgery after assessing its risks and advantages against all other surgical and nonsurgical options.

3. Before to putting mesh, take into account the following

A mesh procedure may put the patient at risk for needing additional surgery or for the emergence of new complications. Removal of mesh may require multiple surgeries and significantly reduce the patient's quality of life. Surgical mesh is a

permanent implant that may make future repairs more difficult. Full removal might not be feasible and might not resolve issues like discomfort. Mesh positioned abdominally might lead to decreased risks of infection. Compared to transvaginal mesh installation, mesh problems exist.

Explain to the patient the advantages and hazards of nonsurgical procedures, non-mesh surgery, abdominally inserted mesh, and their likelihood of success in comparison to transvaginal mesh implantation. Inform the patient if mesh will be utilised during her POP procedure and offer details on the precise product that will be used. Make sure the patient is aware of the postoperative dangers and problems of mesh surgery as well as the scant information on long-term outcomes.

The FDA came to the conclusion that transvaginal mesh had a greater complication rate than transabdominal mesh in response to an increase in reports of adverse events. 2012 saw the FDA ordered mesh producers to carry out post-market surveillance tests to assess effectiveness and safety. Surgical mesh for POP was eventually reclassified by the FDA in 2014 as a class 3 (high-risk) device, and the reclassification was legally put into effect in January 2016. According to one study, rates of minimally invasive procedures like laparoscopic or robotic sacral colpopexy or native tissue repair increased while vaginal mesh repairs decreased from 27% of POP repairs before 2008 to 15% after the first FDA notification in 2008 and 5% after the second notification in 2011 [29]. Finally, in April 2019, the FDA prohibited the sale of transvaginal mesh for POP. Mesh items used to treat other diseases like hernias or incontinence are not covered by it. The state of things in Europe with relation to Meshes are still used in POP correction. The Medicines and Healthcare Products Regulatory Agency (MHRA) published an official statement on mesh for POP surgery in 2014, stating that mesh is safe and effective for the majority of patients and that further research should be done on implant kinds and surgical procedures. Mesh should be taken into consideration as a last resort for POP repair, according to the National Institute for Health and Care Excellence's (NICE) official release in April 2019. Moreover, it is advised that the patient be thoroughly informed of the results and the potential for mesh complications while utilising a mesh [30]. Is it harmful to use synthetic mesh? It's critical to not misinterpret the FDA's caution. Recent randomised controlled trials and singlearm studies both report mesh exposure rates ranging from 3.2% to 20.5% and 3.1% to 14.4%, respectively. The danger associated with utilising synthetic mesh for POP cannot be assessed since mesh degradation rates differ between investigations. The midurethral sling mesh degradation rates in SUI patients differ from study to study

as well. The mesh erosion rate of the retropubic method was 11.4% (24/210) and that of the transobturator approach was 25.7% (18/70) in a research that included 388 complications [31], which were somewhat higher than the average mesh erosion rate of midurethral slings (3%–5%) [32]. Midurethral slings are not regarded as dangerous, even though greater complication rates are documented. Moreover, the majority of cases of mesh exposure are asymptomatic, and conservative therapy is likely to alleviate symptoms. Only 50% of patients with mesh exposure required surgical intervention, ranging from 0% to 16.4% of patients in randomised controlled trials [7-10,12-23] and 1.7% to 8.9% in single-arm studies [33-37].

4. The significance of concomitant apical prolapse correction

After POP surgery, apical prolapse must be found and corrected in order to lower recurrence. Almost all instances of both anterior and posterior compartment prolapse have clinically substantial apical prolapse. 80% of vaginal apices prolapsed to at least 2 cm within the hymen and 55% of apices prolapsed >2 cm outside the hymen if the anterior vaginal wall was at least 2 cm outside the hymen [39]. Another study discovered that apical vaginal descent was clinically significant in nearly 60% of individuals with stage 2 or higher cystoceles. The prognostic significance of apical prolapse rises with cystocele stage [40]. A research comparing isolated anterior repair to combined anterior and apical repair in over 2,700 women revealed that 10-year reoperation was more common with the former.

The combined anterior and apical repair group had lower rates (11.6% vs. 20.2%) [41]. In addition to a basic association between apical support and anterior support, these findings serve as a foundation for reducing recurrences. For anterior compartment prolapse cases to be successfully treated, the vaginal apex must be suspended properly. There are surgeons who do anterior compartment repair without first carefully examining the vagina, despite the fact that contemporaneous apical repair is an evident modifiable factor that can lower the chance of recurrence. The percentage of anterior repairs without apical suspension declined from 77.7% in 2004 to 41.4% in 2012, according to US statistics (p0.001). There has been a decline since 2011

APICAL VAGINAL PROLAPSE SURGERY

Surgery for apical prolapse can be roughly divided into obliterative and restorative methods. Restorative methods might be used abdominally or transvaginally.

Abdominal sacrocolpopexy continues to be the gold standard

for patients seeking restorative results. Robot assisted-laparoscopic sacrocolpopexy (RALS) and standard laparoscopic sacrocolpopexy (LSC) are three ways to execute abdominal sacrocolpopexy (RSC). In a recent Cochrane review, [43] sacrocolpopexy, including open and laparoscopic approaches, was associated with a lower risk of prolapse awareness, recurrent prolapse, repeat surgery for prolapse, postoperative stress urinary incontinence, and dyspareunia than a variety of vaginal approaches (RR, 2.11; 95% CI, 1.06-4.21), recurrent prolapse (RR, 2.28; 95% CI,

1. Open sacrocolpopexy versus laparoscopic/robotic sacrocolpopexy

Although open sacrocolpopexy is an excellent alternative for treating apical prolapse repair and has long-term success rates of 78% to 100%, it is more expensive, requires more analgesics, and requires a longer hospital stay than transvaginal surgeries [44,45]. These restrictions have been solved by the development of new surgical methods including LSC and RSC. LSC or RSC had better anatomical durability and lower overall morbidity when compared to open sacrocolpopexy [46–52]. In a randomised research, Freeman et al. [47] compared open sacrocolpopexy with LSC in patients with vault prolapse and discovered that the procedures had clinically identical 1-year recurrence rates. The longest randomised follow-up research comparing open sacrocolpopexy with LSC was undertaken by Costantini et al. [52] in 2016 and concluded that No patients in their sample experienced apical recurrences, demonstrating the effectiveness of both procedures. For repeat surgery for prolapse, the 2016 Cochrane review [43] found that there might not be a difference in outcomes between LSC and open sacrocolpopexy (RR, 1.04; 95% CI, 0.16-6.80).

Although open sacrocolpopexy appears to be improved upon by LSC, LSC is technically more difficult for people who are not skilled in laparoscopy. Having RLC in place since 2004 has made it possible for surgeons with high dexterity and precision to do the surgery instead of LSC. Without the requirement for laparoscopic expertise, the learning curve is manageable. The anatomical success rate for one of the biggest prospective trials of RSC (n=120) was 89% after a year of follow-up [53]. A recent systematic study comparing LSC and RSC found that RSC was more expensive and was linked to lengthier operations with more postoperative discomfort. Nonetheless, both surgical procedures yielded comparable outcomes in terms of symptom relief [54].

2. Sacrohysteropexy to preserve the uterus

For patients with apical prolapse, there are three options: sacrohysteropexy, which preserves the uterus by securing the uterus and vagina with a mesh to the sacral promontory; supracervical hysterectomy with sacrocervicocolpopexy, which does not; and sacrocolpopexy following total hysterectomy with closure of the vaginal cuff. By conserving the uterus, hysteropexy provides the benefit of retaining fertility and natural menopausal timing. Assuming equal surgical effectiveness, 36% to 60% of female patients choose for uterine preservation. The uterosacral-cardinal ligaments may also be damaged as a result of the uterus being removed, further weakening the vaginal support. Sacrohysteropexy could be advantageous if uterine preservation is not contraindicated.

Sacrohysteropexy, however, has fewer surgical outcome data available, and The method necessitates ongoing monitoring of the endometrium and cervix.

There are no randomised trials contrasting hysteropexy with simultaneous sacrocolpopexy and hysterectomy. In prospective trials, Costantini et al. [55] compared abdominal sacrohysteropexy to complete hysterectomy and sacrocolpopexy.

In this study, 72 patients with grade 3 to 4 POP self-selected either sacrohysteropexy or complete hysterectomy and sacrocolpopexy as their procedure of choice. Both groups showed comparable, high success rates (100% and 100%, respectively), with no reoperations required owing to recurrence. As compared to the complete hysterectomy and sacrocolpopexy groups, the sacrohysteropexy group saw shorter average operation times (89 vs. 115 minutes) and significant improvements in sexual function. There are benefits to conducting total hysterectomy and sacrocolpopexy, according to a retrospective research that compared laparoscopic sacrohysteropexy (n=65) to total laparoscopic hysterectomy and sacrocolpopexy [56]. (92.3% vs. 100%, p=0.001) and the subjective satisfaction rating was much higher.

3. Sacrocolpopexy and a supracervical hysterectomy

The advantages of supracervical hysterectomy may lower the danger of mesh erosion, preventing cautery-induced vaginal thermal damage [61]. Compared to the complete hysterectomy group, which had a mesh exposure incidence of 4.9%, the supracervical hysterectomy group had zero mesh exposures (p=0.03). Unfortunately, there is currently a dearth of proof supporting the effectiveness of supracervical hysterectomy. A small study comparing laparoscopic sacrohysteropexy (n=15) to laparoscopic sacrocolpopexy with concurrent supracervical

hysterectomy revealed that while major complications and vaginal mesh erosions were not recorded, the overall success rate for laparoscopic supracervical hysterectomy with sacrocolpopexy was significantly higher (67% vs. 27%). Retrospective research revealed that compared to complete hysterectomy with sacrocolpopexy, supracervical hysterectomy with sacrocolpopexy was 2.8 times more likely to cause recurring prolapse.

4. Mesh fixation techniques

when recurring prolapse was deemed to be prolapse greater than or equivalent to stage 2 and sacrocolpopexy was performed. With 7.5% in the whole hysterectomy with sacrocolpopexy group vs. 2.3% in the supracervical hysterectomy with sacrocolpopexy group ($p=0.35$), this research lacked the statistical power to detect differences in mesh exposure rates [61].

5. Non-absorbable sutures versus absorbable sutures

Nonabsorbable suture is used in traditional open sacrocolpopexy to keep the mesh attached to the vagina. www.icurology.org Ko and Lee used the sacral promontory to reduce the chance of mesh exposure and suture erosion (doi:10.4111/icu.2019.60.6.413). Porcine animals that had synthetic mesh implanted revealed that after 2 weeks, the mesh had attained 74% of its ultimate strength and reached its full strength after 3 months. Delayed absorbable monofilament suture totally absorbed after 6 to 8 months [65], lost 100% of its tensile strength after 2 to 3 months, and 50% of it after 4 weeks [65]. According to the danger of mesh problems, braided non-absorbable suture (2-0 Ethibond; Ethicon, Somerville, NJ, USA) exposure rate was 3.7% (6/161), but no difficulties were reported.

Monofilament delayed-absorbable sutures (2-0 polydioxanone sutures, Ethicon) caused erosions ($p=0.002$) [66]. The use of absorbable sutures for both vaginal and sacral mesh attachment was successful in a group of RSC patients with a median follow-up of 33 months, and the 3-year survival rate without repeat prolapse surgery was 93%. The benefit of the risk of mesh erosion, however, was not evaluated in this study [67]. It seems doubtful that absorbable sutures represent a risk factor for mesh separation, notwithstanding the absence of supporting data. Further research will be required to discover the ideal suture type to employ in POP repair, as well as the ideal suture position and quantity.

CONCLUSIONS

According to the surgeon's expertise, POP repair is accomplished in various situations utilising somewhat different approaches. It is challenging to come to consistent findings from the literature since study designs and criteria of therapeutic effectiveness vary widely. Yet according to all prior study, the aim of surgery is to increase patient happiness while also repositioning the pelvic organs. Whilst the FDA warning about vaginal mesh has led to a decline in mesh use, it is not an exaggeration to say that the outcome of POP repair is directly connected to the experience of the surgeon. Moreover, minimally invasive surgery has grown in acceptance and is progressively developing to be on par with conventional methods for POP correction.

REFERENCES

1. Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, et al.; International Urogynecological Association, International Continence Society. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010;29:4-20.
2. Handa VL, Garrett E, Hendrix S, Gold E, Robbins J. Progression and remission of pelvic organ prolapse: a longitudinal study of menopausal women. *Am J Obstet Gynecol* 2004;190:27-32.
3. Wu JM, Matthews CA, Conover MM, Pate V, Jonsson Funk M. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. *Obstet Gynecol* 2014;123:1201-6.
4. Swift S, Woodman P, O'Boyle A, Kahn M, Valley M, Bland D, et al. Pelvic Organ Support Study (POSST): the distribution, clinical definition, and epidemiologic condition of pelvic organ support defects. *Am J Obstet Gynecol* 2005;192:795-806.
5. Barber MD, Brubaker L, Nygaard I, Wheeler TL 2nd, Schaffer J, Chen Z, et al.; Pelvic Floor Disorders Network. Defining success after surgery for pelvic organ prolapse. *Obstet Gynecol* 2009;114:600-9.
6. Lee U, Raz S. Emerging concepts for pelvic organ prolapse surgery: what is cure? *Curr Urol Rep* 2011;12:62-7.

7. Nguyen JN, Burchette RJ. Outcome after anterior vaginal prolapse repair: a randomized controlled trial. *Obstet Gynecol* 2008;111:891-8.
8. Carey M, Higgs P, Goh J, Lim J, Leong A, Krause H, et al. Vaginal repair with mesh versus colporrhaphy for prolapse: a randomised controlled trial. *BJOG* 2009;116:1380-6.
9. Nieminen K, Hiltunen R, Takala T, Heiskanen E, Merikari M, Niemi K, et al. Outcomes after anterior vaginal wall repair with mesh: a randomized, controlled trial with a 3 year follow-up. *Am J Obstet Gynecol* 2010;203:235.e1-8.
10. Altman D, Väyrynen T, Engh ME, Axelsen S, Falconer C; Nordic Transvaginal Mesh Group. Anterior colporrhaphy versus transvaginal mesh for pelvic-organ prolapse. *N Engl J Med* 2011;364:1826-36.
11. Chmielewski L, Walters MD, Weber AM, Barber MD. Reanalysis of a randomized trial of 3 techniques of anterior colporrhaphy using clinically relevant definitions of success. *Am J Obstet Gynecol* 2011;205:69.e1-8.
12. Menefee SA, Dyer KY, Lukacz ES, Simsiman AJ, Luber KM, Nguyen JN. Colporrhaphy compared with mesh or graftreinforced vaginal paravaginal repair for anterior vaginal wall prolapse: a randomized controlled trial. *Obstet Gynecol* 2011;118:1337-44.
13. Vollebregt A, Fischer K, Gietelink D, van der Vaart CH. Pri- 422 www.icurology.org Ko and Lee <https://doi.org/10.4111/icu.2019.60.6.413> mary surgical repair of anterior vaginal prolapse: a randomised trial comparing anatomical and functional outcome between anterior colporrhaphy and trocar-guided transobturator anterior mesh. *BJOG* 2011;118:1518-27.
14. El-Nazer MA, Gomaa IA, Ismail Madkour WA, Swidan KH, El-Etriby MA. Anterior colporrhaphy versus repair with mesh for anterior vaginal wall prolapse: a comparative clinical study. *Arch Gynecol Obstet* 2012;286:965-72.
15. de Tayrac R, Cornille A, Eglin G, Guilbaud O, Mansoor A, Alonso S, et al. Comparison between trans-obturator transvaginal mesh and traditional anterior colporrhaphy in the treatment of anterior vaginal wall prolapse: results of a French RCT. *Int Urogynecol J* 2013;24:1651-61.
16. Delroy CA, Castro Rde A, Dias MM, Feldner PC Jr, Bortolini MA, Girão MJ, et al. The use of transvaginal synthetic mesh for anterior vaginal wall prolapse repair: a randomized controlled trial. *Int Urogynecol J* 2013;24:1899-907.
17. Turgal M, Sivaslioglu A, Yildiz A, Dolen I. Anatomical and functional assessment of anterior colporrhaphy versus polypropylene mesh surgery in cystocele treatment. *Eur J Obstet Gynecol Reprod Biol* 2013;170:555-8.
18. Rudnicki M, Laurikainen E, Pogosean R, Kinne I, Jakobsson U, Teleman P. Anterior colporrhaphy compared with collagencoated transvaginal mesh for anterior vaginal wall prolapse: a randomised controlled trial. *BJOG* 2014;121:102-10; discussion 110-1.
19. Dos Reis Brandão da Silveira S, Haddad JM, de Jármy-Di Bella ZI, Nastri F, Kawabata MG, da Silva Carramão S, et al. Multicenter, randomized trial comparing native vaginal tissue repair and synthetic mesh repair for genital prolapse surgical treatment. *Int Urogynecol J* 2015;26:335-42.
20. Tamanini JT, de Oliveira Souza Castro RC, Tamanini JM, Castro RA, Sartori MG, Girão MJ. A prospective, randomized, controlled trial of the treatment of anterior vaginal wall prolapse: medium term followup. *J Urol* 2015;193:1298-304.
21. Dias MM, de A Castro R, Bortolini MA, Delroy CA, Martins PC, Girão MJ, et al. Two-years results of native tissue versus vaginal mesh repair in the treatment of anterior prolapse according to different success criteria: a randomized controlled trial. *Neurourol Urodyn* 2016;35:509-14.
22. Rudnicki M, Laurikainen E, Pogosean R, Kinne I, Jakobsson U, Teleman P. A 3-year follow-up after anterior colporrhaphy compared with collagen-coated transvaginal mesh for anterior vaginal wall prolapse: a randomised controlled trial. *BJOG* 2016;123:136-42.
23. Glazener CM, Breeman S, Elders A, Hemming C, Cooper KG, Freeman RM, et al.; PROSPECT study group). Mesh, graft, or standard repair for women having primary transvaginal anterior or posterior compartment prolapse surgery: two parallel group, multicentre, randomised, controlled trials (PROSPECT). *Lancet* 2017;389:381-92.

24. Maher C, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J. Surgery for women with anterior compartment prolapse. *Cochrane Database Syst Rev* 2016;11:CD004014.
25. Sung VW, Rogers RG, Schaffer JI, Balk EM, Uhlig K, Lau J, et al.; Society of Gynecologic Surgeons Systematic Review Group. Graft use in transvaginal pelvic organ prolapse repair: a systematic review. *Obstet Gynecol* 2008;112:1131-42.
26. Feiner B, Jelovsek JE, Maher C. Efficacy and safety of transvaginal mesh kits in the treatment of prolapse of the vaginal apex: a systematic review. *BJOG* 2009;116:15-24.
27. Bako A, Dhar R. Review of synthetic mesh-related complications in pelvic floor reconstructive surgery. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:103-11.
28. Food and Drug Administration. Urogynecologic surgical mesh: update on the safety and effectiveness of transvaginal placement for pelvic organ prolapse. Food and Drug Administration; 2011.
29. Skoczylas LC, Turner LC, Wang L, Winger DG, Shepherd JP. Changes in prolapse surgery trends relative to FDA notifications regarding vaginal mesh. *Int Urogynecol J* 2014;25:471-7.
30. NICE Guidance - Urinary incontinence and pelvic organ prolapse in women: management: © NICE (2019) Urinary incontinence and pelvic organ prolapse in women: management. *BJU Int* 2019;123:777-803.
31. Petri E, Ashok K. Comparison of late complications of retropubic and transobturator slings in stress urinary incontinence. *Int Urogynecol J* 2012;23:321-5.
32. MacDonald S, Terlecki R, Costantini E, Badlani G. Complications of transvaginal mesh for pelvic organ prolapse and stress urinary incontinence: tips for prevention, recognition, and management. *Eur Urol Focus* 2016;2:260-7.
33. Jacquetin B, Fatton B, Rosenthal C, Clavé H, Debodinance P, Hinoul P, et al. Total transvaginal mesh (TVM) technique for treatment of pelvic organ prolapse: a 3-year prospective followup study. *Int Urogynecol J* 2010;21:1455-62.
34. Bjelic-Radisic V, Aigmueller T, Preyer O, Ralph G, Geiss I, Müller G, et al.; Austrian Urogynecology Working Group. Vaginal prolapse surgery with transvaginal mesh: results of the Austrian registry. *Int Urogynecol J* 2014;25:1047-52.
35. Song W, Kim TH, Chung JW, Cho WJ, Lee HN, Lee YS, et al. Anatomical and functional outcomes of prolift transvaginal mesh for treatment of pelvic organ prolapse. *Low Urin Tract Symptoms* 2016;8:159-64.
36. Barski D, Arndt C, Gerullis H, Yang J, Boros M, Otto T, et al. Transvaginal PVDF-mesh for cystocele repair: a cohort study. *Int J Surg* 2017;39:249-54.
37. Aubé M, Guérin M, Rheaume C, Tu LM. Efficacy and patient satisfaction of pelvic organ prolapse reduction using transvaginal mesh: a Canadian perspective. *Can Urol Assoc J* 2018;12:E432-7.
38. Whiteside JL, Weber AM, Meyn LA, Walters MD. Risk factors for prolapse recurrence after vaginal repair. *Am J Obstet Gynecol* 2004;191:1533-8.
39. Rooney K, Kenton K, Mueller ER, FitzGerald MP, Brubaker L. Advanced anterior vaginal wall prolapse is highly correlated with apical prolapse. *Am J Obstet Gynecol* 2006;195:1837-40.
40. Elliott CS, Yeh J, Comiter CV, Chen B, Sokol ER. The predictive value of a cystocele for concomitant vaginal apical prolapse. *J Urol* 2013;189:200-3.
41. Eilber KS, Alperin M, Khan A, Wu N, Pashos CL, Clemens JQ, et al. Outcomes of vaginal prolapse surgery among female Medicare beneficiaries: the role of apical support. *Obstet Gynecol* 2013;122:981-7.
42. Liu JS, Netter O, Vo AX, Hofer MD, Flury SC, Kiehl SJ. Prolapse repair with and without apical resuspension-Practice patterns among certifying American urologists. *Neurourol Urodyn* 2017;36:344-8.
43. Maher C, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J. Surgery for women with apical vaginal prolapse. *Cochrane Database Syst Rev* 2016;10:CD012376.

44. Lee RK, Motttrie A, Payne CK, Waltregny D. A review of the current status of laparoscopic and robot-assisted sacrocolpopexy for pelvic organ prolapse. *Eur Urol* 2014;65:1128-37.
45. Nygaard IE, McCreery R, Brubaker L, Connolly A, Cundiff G, Weber AM, et al.; Pelvic Floor Disorders Network. Abdominal sacrocolpopexy: a comprehensive review. *Obstet Gynecol* 2004;104:805-23.
46. Anger JT, Mueller ER, Tarnay C, Smith B, Stroupe K, Rosenman A, et al. Robotic compared with laparoscopic sacrocolpopexy: a randomized controlled trial. *Obstet Gynecol* 2014;123:5-12.
47. Freeman RM, Pantazis K, Thomson A, Frappell J, Bombieri L, Moran P, et al. A randomised controlled trial of abdominal versus laparoscopic sacrocolpopexy for the treatment of posthysterectomy vaginal vault prolapse: LAS study. *Int Urogynecol J* 2013;24:377-84.
48. Geller EJ, Siddiqui NY, Wu JM, Visco AG. Short-term outcomes of robotic sacrocolpopexy compared with abdominal sacrocolpopexy. *Obstet Gynecol* 2008;112:1201-6.
49. Nosti PA, Umoh Andy U, Kane S, White DE, Harvie HS, Lowenstein L, et al. Outcomes of abdominal and minimally invasive sacrocolpopexy: a retrospective cohort study. *Female Pelvic Med Reconstr Surg* 2014;20:33-7.
50. Paraiso MF, Jelovsek JE, Frick A, Chen CC, Barber MD. Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse: a randomized controlled trial. *Obstet Gynecol* 2011;118:1005-13.
51. Siddiqui NY, Geller EJ, Visco AG. Symptomatic and anatomic 1-year outcomes after robotic and abdominal sacrocolpopexy. *Am J Obstet Gynecol* 2012;206:435.e1-5.
52. Costantini E, Mearini L, Lazzeri M, Bini V, Nunzi E, di Biase M, et al. Laparoscopic versus abdominal sacrocolpopexy: a randomized, controlled trial. *J Urol* 2016;196:159-65.
53. Salamon CG, Lewis C, Priestley J, Gurshumov E, Culligan PJ. Prospective study of an ultra-lightweight polypropylene Y mesh for robotic sacrocolpopexy. *Int Urogynecol J* 2013;24:1371-5.
54. Pan K, Zhang Y, Wang Y, Wang Y, Xu H. A systematic review and meta-analysis of conventional laparoscopic sacrocolpopexy versus robot-assisted laparoscopic sacrocolpopexy. *Int J Gynaecol Obstet* 2016;132:284-91.
55. Costantini E, Porena M, Lazzeri M, Mearini L, Bini V, Zucchi A. Changes in female sexual function after pelvic organ prolapse repair: role of hysterectomy. *Int Urogynecol J* 2013;24:1481-7.
56. Pan K, Cao L, Ryan NA, Wang Y, Xu H. Laparoscopic sacral hysteropexy versus laparoscopic sacrocolpopexy with hysterectomy for pelvic organ prolapse. *Int Urogynecol J* 2016;27:93-101.
57. Warner WB, Vora S, Hurtado EA, Welgoss JA, Horbach NS, von Pechmann WS. Effect of operative technique on mesh exposure in laparoscopic sacrocolpopexy. *Female Pelvic Med Reconstr Surg* 2012;18:113-7.
58. Tan-Kim J, Menefee SA, Luber KM, Nager CW, Lukacz ES. Prevalence and risk factors for mesh erosion after laparoscopic-assisted sacrocolpopexy. *Int Urogynecol J* 2011;22:205-12.
59. Stepanian AA, Miklos JR, Moore RD, Mattox TF. Risk of mesh extrusion and other mesh-related complications after laparoscopic sacral colpopexy with or without concurrent laparoscopic-assisted vaginal hysterectomy: experience of 402 patients. *J Minim Invasive Gynecol* 2008;15:188-96.
60. Meyer I, McGwin G, Swain TA, Alvarez MD, Ellington DR, Richter HE. Synthetic graft augmentation in vaginal prolapse surgery: long-term objective and subjective outcomes. *J Minim Invasive Gynecol* 2016;23:614-21.
61. Myers EM, Siff L, Osmundsen B, Geller E, Matthews CA. Differences in recurrent prolapse at 1 year after total vs supracervical hysterectomy and robotic sacrocolpopexy. *Int Urogynecol J* 2015;26:585-9.
62. Gracia M, Perelló M, Bataller E, Espuña M, Parellada M, Genís D, et al. Comparison between laparoscopic sacral hysteropexy and subtotal hysterectomy plus cervicopexy in pelvic organ prolapse: a pilot study. *Neurourol Urodyn* 2015;34:654-8.

63. Lee W, Tam J, Kobashi K. Surgery for apical vaginal prolapse after hysterectomy: abdominal sacrocolpopexy. *Urol Clin North Am* 2019;46:113-21. 424 www.icurology.org Ko and Lee <https://doi.org/10.4111/icu.2019.60.6.413>
64. Oliver JL, Kim JH. Robotic sacrocolpopexy-is it the treatment of choice for advanced apical pelvic organ prolapse? *Curr Urol Rep* 2017;18:66.
65. Majercik S, Tsikitis V, Iannitti DA. Strength of tissue attachment to mesh after ventral hernia repair with synthetic composite mesh in a porcine model. *Surg Endosc* 2006;20:1671-4.
66. Greenberg JA, Clark RM. Advances in suture material for obstetric and gynecologic surgery. *Rev Obstet Gynecol* 2009;2:146-58.
67. Linder BJ, Anand M, Klingele CJ, Trabuco EC, Gebhart JB, Occhino JA. Outcomes of robotic sacrocolpopexy using only absorbable suture for mesh fixation. *Female Pelvic Med Reconstr Surg* 2017;23:13-6.
68. Callewaert G, Bosteels J, Housmans S, Verguts J, Van Cleynenbreugel B, Van der Aa F, et al. Laparoscopic versus robotic-assisted sacrocolpopexy for pelvic organ prolapse: a systematic review. *Gynecol Surg* 2016;13:115-23.
69. Claerhout F, Verguts J, Werbrueck E, Veldman J, Lewi P, Deprest J. Analysis of the learning process for laparoscopic sacrocolpopexy: identification of challenging steps. *Int Urogynecol J* 2014;25:1185-91.
70. Mowat A, Maher C, Pelecanos A. Can the learning curve of laparoscopic sacrocolpopexy be reduced by a structured training program? *Female Pelvic Med Reconstr Surg* 2018;24:272-6.
71. Tan-Kim J, Nager CW, Grimes CL, Luber KM, Lukacz ES, Brown HW, et al. A randomized trial of vaginal mesh attachment techniques for minimally invasive sacrocolpopexy. *Int Urogynecol J* 2015;26:649-56.
72. Borahay MA, Oge T, Walsh TM, Patel PR, Rodriguez AM, Kilic GS. Outcomes of robotic sacrocolpopexy using barbed delayed absorbable sutures. *J Minim Invasive Gynecol* 2014;21:412-6.
73. Kallidonis P, Al-Aown A, Vasilas M, Kyriazis I, Panagopoulos V, Fligou F, et al. Laparoscopic sacrocolpopexy using barbed sutures for mesh fixation and peritoneal closure: a safe option to reduce operational times. *Urol Ann* 2017;9:159-65.
74. Guan X, Ma Y, Gisseman J, Kleithernes C, Liu J. Robotic single-site sacrocolpopexy using barbed suture anchoring and peritoneal tunneling technique: tips and tricks. *J Minim Invasive Gynecol* 2017;24:12-3.
75. Liu J, Bardawil E, Zurawin RK, Wu J, Fu H, Orejuela F, et al. Robotic single-site sacrocolpopexy with retroperitoneal tunneling. *JSLs* 2018;22:e2018.00009.
76. Matanes E, Lauterbach R, Mustafa-Mikhail S, Amit A, Wiener Z, Lowenstein L. Single port robotic assisted sacrocolpopexy: our experience with the first 25 cases. *Female Pelvic Med Reconstr Surg* 2017;23:e14-8.
77. Lowenstein L, Matanes E, Burke YZ. Surgical technique for robot-assisted sacrocolpopexy performed via a single port. *Urology* 2017;103:272.
78. Kim S, Pollock GR, Twiss CO, Funk JT. Surgery for posterior compartment vaginal prolapse: graft augmented repair. *Urol Clin North Am* 2019;46:87-95.
79. Paraiso MF, Barber MD, Muir TW, Walters MD. Rectocele repair: a randomized trial of three surgical techniques including graft augmentation. *Am J Obstet Gynecol* 2006;195:1762-71.
80. Mowat A, Maher D, Baessler K, Christmann-Schmid C, Haya N, Maher C. Surgery for women with posterior compartment prolapse. *Cochrane Database Syst Rev* 2018;3:CD012975.