

Current trends and future perspectives in pelvic reconstructive surgery

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Abstract

Pelvic organ prolapse is a prevalent disorder with a high lifetime incidence of surgical repair. Pelvic organ prolapse surgery has greatly evolved over the past years, and pelvic floor reconstructive surgeons are faced with a vast array of treatment options for their patients. Our review article illustrates the current trends and future perspectives for the surgical treatment of pelvic organ prolapse.

Keywords

female urology, pelvic organ prolapse, pelvic reconstructive surgery, urogynaecology

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Introduction

Pelvic organ prolapse (POP) is a pelvic floor disorder that has affected women's health worldwide, since the dawn of humanity.¹ POP is defined by the International Urogynecological Association (IUGA) and International Continence Society (ICS) Joint Report on Terminology as *the descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix) or the apex of the vagina.*² POP is a prevalent disorder – an evaluation of 27,342 American post-menopausal women revealed that 40% of these patients had POP on pelvic examination³ – and although not all women with prolapse are symptomatic, it has been shown that 11% of women will require surgical intervention by age 80.⁴ Women with pelvic prolapse may experience a variety of symptoms affecting their bladder and bowel function,² as well as their self-esteem and their sexual health.⁵ Well-established risk factors for POP include age, parity and obesity.³

If diagnosed at an early stage, certain conservative therapies, such as pelvic floor muscle physiotherapy, may delay the apparition of symptoms and prevent the need for future surgery.⁶ Despite conservative treatment, a large number of patients will progress to require surgical correction. Pelvic floor reconstructive surgeons are faced with an array of different options to treat these patients, and POP surgery has greatly evolved over the past few decades. We will illustrate below the current trends, as well as future perspectives, for the surgical treatment of POP.

Clinical presentation and diagnosis of POP

Patients consulting for POP will most commonly present with a sensation of a 'vaginal bulge' and may, in some cases, be able to palpate a vaginal mass.⁷ Due to an anatomic shift of the pelvic organs, such as the bladder and the rectum, vaginal prolapse may also be associated with lower urinary tract symptoms, namely, voiding symptoms such as hesitancy, weak or intermittent urinary stream, and urinary retention. Defecatory symptoms may include constipation and faecal soiling.² Women with POP also have a higher risk of suffering sexual side effects, such as dyspareunia and decreased libido. This may be due to anatomic factors as well as psychological factors, as POP may affect a woman's self-esteem and body image.⁵

POP is diagnosed by physical examination of the pelvis, usually with the patient in dorsal lithotomy position or

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occasionally in standing position. The patient should cough or perform valsalva manoeuvres to recreate the maximal protrusion that she has experienced. Each compartment should be evaluated separately. Anterior, apical and posterior compartment prolapse are respectively synonymous to cystocele, uterine prolapse or colpocele (or vaginal vault prolapse, in a post-hysterectomy patient), and rectocele. The degree of prolapse of each compartment is measured relative to a fixed point of reference, the hymen. The POP-Q grading system is an objective and reproducible system, adopted by the ICS, which classifies prolapse into grades 0 through IV.⁸ A simplified version of the pelvic organ prolapse quantification system (POP-Q), the simplified POP-Q (SPOP-Q), is a 'user-friendly' model of the aforementioned grading system.⁹ A cough stress test should be performed while reducing the bladder, to rule out the presence of occult, or unmasked, stress urinary incontinence, which may be an indicator for a concomitant anti-incontinence procedure during prolapse repair.¹⁰

Conservative management of POP

One cannot discuss the surgical options for POP without first mentioning conservative management, as this may delay, or preclude, the need for surgical treatments, as well as prolong their 'life expectancy'.

Weight loss in overweight and obese women is often overlooked during initial evaluation, but may help avoid the need for surgery and reduce the rate of post-operative complications.¹¹

Pelvic floor muscle training (PFMT) should be used as first-line therapy for most patients with POP, especially those with low-grade prolapse.¹²

Vaginal pessary is another conservative option for patients unwilling or unfit to undergo surgery, notably for anterior and apical compartment defects. Despite a few undesirable effects, such as vaginal erosion, local discomfort and bothersome maintenance, the pessary is a feasible option for long-term use in more than 60% of women aged 65 years or older with POP.¹³

Current trends in reconstructive surgery for POP

Pelvic reconstructive surgery for POP may be subdivided into numerous different classifications and types of procedures. First, we have an anatomic classification by compartment (anterior, posterior and/or apical). The type of approach may be transvaginal or abdominal, with the latter being feasible by open, laparoscopic or robot-assisted laparoscopic techniques. If an apical prolapse is present, a decision as to whether or not to perform a hysterectomy must be made. And finally, the reconstruction may be performed with or without mesh for additional support, by both transvaginal and abdominal routes.

In lieu of an overview of each technique, we will focus our interest on the most popular and controversial current trends in pelvic reconstructive surgery.

Transvaginal mesh versus native tissue repair

Should we or should we not use mesh for transvaginal prolapse repair? For the past decade, this question has been a recurrent and popular debate topic.

Native tissue repair, or colporrhaphy (anterior and posterior, with regard to the compartment of interest), has long been the traditional method for transvaginal prolapse repair. This consists of a plication of the vaginal wall to increase wall tension and support to the underlying prolapsed organ. If an apical defect is present, vaginal repairs may be accompanied by an apical fixation, either sacrospinous or ureterosacral ligament fixation. These techniques will be compared separately in the following section.

Although well tolerated, native tissue repairs are associated with a high risk of recurrence, up to 30%.⁴ In the 1990s, urogynaecologic surgeons began using synthetic mesh, such as polypropylene (which was then most commonly used for abdominal hernia surgery), in an attempt to increase the efficacy of their repairs.¹⁴⁻¹⁶ These surgeons trimmed and tailored the size and shape of the mesh to accommodate their use.

The commercialization of transvaginal mesh 'kits' specifically designed for POP repair began in the early 2000s. The United States Food and Drug Administration (FDA) approved the first such product in 2002.¹⁷ Although initially well received due to their 'user-friendly' format, certain drawbacks related to synthetic mesh rapidly emerged, notably vaginal mesh exposure, bladder or urethral erosion, dyspareunia and pelvic pain. This prompted the issuance of warnings regarding transvaginal mesh for prolapse surgery by a number of government health agencies, including the FDA,¹⁷⁻¹⁹ Health Canada^{20,21} and the United Kingdom's Medicines and Healthcare products Regulatory Agency (MHRA).²²

The lawsuits and the notices evidently caused a major drop in the number of transvaginal mesh kits used for prolapse, especially in the United States. These recent events prompted the Cochrane Library to produce a meta-analysis on the subject. Contrary to what the FDA had stated, the meta-analysis revealed that non-absorbable mesh repair reduces the risk of anatomical recurrence, repeat surgery for prolapse recurrence, as well as patient awareness of prolapse after surgery, when compared to non-mesh repair.²³ This data has been supported by a number of recent papers.²⁴⁻²⁶

Conversely, the recently published PROlapse Surgery: Pragmatic Evaluation and randomised Controlled Trials randomized controlled trial did not show any difference in patient satisfaction, quality of life, and anatomic success

when comparing synthetic mesh and native tissue repair, with a 2-year follow-up, and the use of synthetic mesh was not deemed cost-effective with this short-term follow-up. We are awaiting further data with a long-term, 6-year follow-up from this randomized trial.²⁷

In our own institution, we recently ran a retrospective review of 334 of our patients who underwent prolapse surgery with transvaginal mesh. Our soon-to-be published data reveal a population suffering from high-grade, multi-compartment POP, and many of our patients had previously undergone prolapse surgery. The reoperation rate for recurrence was very low in our hands, with only 3.3% requiring repeat surgery at 3 years.

Another interesting point to highlight in this section is the issue of surgeon experience. The venue of surgical ‘kits’ for POP repair, like any other novel medical technology, was likely very attractive to surgeons who were inexperienced or untrained in the field. Kelly et al. eloquently demonstrated that very high-volume surgeons (>14 cases per year) were associated with the lowest reoperation rates for transvaginal mesh POP surgery. These high-volume surgeons represent the >90th percentile, meaning that the vast majority of prolapse surgeons only perform a few cases per year,²⁸ which could explain the conflicting literature on the subject.

To summarize this point, the decision ‘to mesh or not to mesh’ remains highly controversial and has created two schools of thought. Native tissue repair remains a mainstay of prolapse therapy for uncomplicated, primary POP. Transvaginal mesh is most often used as a second-line procedure, or for patients with significant grade of prolapse who are at a high risk of recurrence. Surgeon experience and volume is an undeniable prognostic factor for operative success, and these procedures should only be performed by trained professionals. Full disclosure of all the risks associated with mesh is imperative.

Apical suspension during vaginal prolapse repair: sacrospinous ligament fixation versus uterosacral ligament suspension

During a vaginal approach, the apical component of POP may be treated using an apical suspension technique. Both sacrospinous and uterosacral ligament fixation may be used. A randomized controlled trial by Barber et al. did not demonstrate superiority of either technique. Sacrospinous ligament fixation was associated with a higher risk of post-operative neurologic pain, and uterosacral ligament suspension was complicated by ureteral obstruction in 3.7% of patients.²⁹ The proximity of the ureter to the uterosacral ligament explains the higher risk of obstruction with this technique. Considering the equivalent post-operative anatomic outcomes, the technique utilized should be the one that the surgeon is most comfortable with.

Laparoscopic/robotic versus open abdominal sacrocolpopexy

Abdominal sacrocolpopexy (ASC) is a technique used to treat apical compartment prolapse and some cases of multicompartiment prolapse (notably apical and anterior compartment defects).^{30,31} During this procedure, the vaginal vault (or the cervix in cases of past or combined supracervical hysterectomy) is suspended to the anterior surface of the sacral promontory, by means of a mesh – typically a synthetic polypropylene mesh. The mesh used is fashioned into a Y-shape, to allow each arm of the Y to be fixed to the anterior and posterior walls of the vagina. The tail of the Y-graft is then secured in a tension-free manner to the sacral promontory. The mesh is then usually retroperitonealized. ASC has the advantage of preserving vaginal length³² and having decreased post-operative rates of dyspareunia³³ when compared to transvaginal sacrospinous ligament fixation, which are desirable outcomes for sexually active women. ASC is also considered to be ‘tried and true’, as multiple studies have shown long-term success rates hovering around 90% at 5 years,^{34,35} including a study showing a 74% success rate at 13.7 years.³⁶ It must be noted that abdominal mesh for sacrocolpopexy has not been reclassified as a high-risk device by the FDA and is still considered a class II device.¹⁹

With the venue of minimally invasive surgery in the early 1990s, surgeons began to perform laparoscopic ASC.^{37,38} A meta-analysis of numerous studies totalling almost 5000 patients, which compared open to laparoscopic ASC, demonstrated comparable anatomic results between both approaches. Shorter hospital stay and decreased blood loss were noted for the laparoscopic approach.³⁹ Two recent randomized, controlled trials on the subject were recently published, providing much needed insight. Coolen et al.⁴⁰ confirmed the previously stated meta-analysis’ conclusions with 12 months of follow-up. Constantini et al.⁴¹ demonstrated that open and laparoscopic ASC were equivalent for apical prolapse repair, but that the laparoscopic approach was inferior with regard to concomitant anterior compartment prolapse.

The da Vinci Surgical System is a robotically assisted surgical device used for minimally invasive surgery and has been FDA approved since 2000.⁴² It allows the surgeon to operate sitting at a console, while the robot’s arms control the laparoscopic instruments under direct observation of a scrubbed-in bedside assistant. Robotic-assisted laparoscopy has certain advantages over laparoscopic surgery, notably better depth perception due to three-dimensional (3D) vision, better surgeon ergonomics, a more natural surgical feel, and a faster learning curve.⁴²⁻⁴⁴ The first robotic ASC procedures were performed not long after the da Vinci’s introduction to market. It was noted that suture placement for fixation of the mesh was much easier with the robotic approach compared to laparoscopy, allowing a

technique similar to open repair but with the decreased operative morbidity associated with laparoscopy.^{45,46} Despite the initial fervour showing good short-term results with a robotic approach,^{45,46} further studies did not show any anatomic or functional benefit of robotic over laparoscopic sacrocolpopexy.^{47,48} Two randomized controlled trials and two review articles not only confirmed the similar functional and anatomic outcomes of robotic ASC but also compared cost and surgical time for both techniques and found that the cost and the operative time for robotic surgery was significantly higher.^{49–52}

To summarize, while robotic surgery has become widely popular in the United States, its high cost for similar efficacy outcomes limits its use in countries with universal health care, such as Canada and most European countries. When feasible, a laparoscopic approach to ASC should be favoured over an open approach, to minimize intra- and post-operative morbidity.

ASC versus vaginal mesh repairs

Apical and multicompartamental POP may be addressed surgically with either ASC or vaginal repairs. As described above, ASC is a highly effective surgical treatment for prolapse, with the added benefit of preserved vaginal length and low post-operative dyspareunia rates – advantageous for sexually active women. Vaginal prolapse repairs were considered as ‘lower risk’ surgeries when compared to ASC – well suited for the elderly, non-sexually active patient – although the advent of minimally invasive surgery has reduced peri- and post-operative morbidity associated with ASC, bridging the gap between abdominal and vaginal repairs. Shvelky et al. retrospectively reviewed their robotic ASC and Transvaginal mesh (TVM) anteroapical prolapse repairs in their centre and found that success rates at 1 year were superior in the robotic group (94.1%) than in the TVM group (70.2%). Patients in the TVM group were older, has a higher body mass index (BMI) and a more severe prolapse; these patients also had shorter vaginal length postoperatively. The robotic group has a longer surgical time and hospital stay, but decreased intraoperative blood loss.⁵³ A prospective randomized trial of 108 patients, comparing laparoscopic ASC and TVM repair for patients with apical prolapse, also showed superior results for ASC (77% vs 43% at 2 years). Patients in the mesh group had four times higher rate of reoperation than the ASC group, primarily due to mesh exposure and contraction, as well as significantly shorter vaginal length. Interestingly, the ASC patients had a shorter hospital stay and a faster return to activities of daily living than the patients in the mesh group. However, quality of life data did not differ between both groups of patients.⁵⁴ Finally, a Medicare-based review of over 40,000 patients showed that both open and laparoscopic ASC were superior to native tissue and mesh vaginal repairs, with TVM repairs

having the highest reoperation rate for mesh-related complications (5.1% vs 1.7% for laparoscopic and 1.2% for open ASC).⁵⁵

To summarize, in patients fit to undergo abdominal repairs, ASC is an anatomically superior choice to transvaginal mesh repairs, with decreased sexual side effects and mesh-related complications.

Uterus sparing versus hysterectomy at the time of prolapse repair

In patients with uterine prolapse, it is debated whether a hysterectomy should be performed at the time of the repair to decrease recurrence rates. Arguments for uterus-sparing prolapse repair include preservation of fertility in premenopausal women, decreased intraoperative risk including bleeding and ureteral injury and patient preference. A hysterectomy may be performed via both the abdominal and vaginal routes, and a total versus supracervical approach may be used in both cases. Patients undergoing a supracervical hysterectomy should be counselled to continue cervical cancer screening. The ovaries may or may not be preserved at the time of the hysterectomy, and this should also be discussed with the patient, as bilateral salpingo-oophorectomy has been associated with increased risk of osteoporosis, cardiovascular disease, decreased quality of life and increased risk of all-cause mortality^{56–58} and may not decrease the risk of ovarian cancer.⁵⁹

A recent review of 11 articles looking at the topic of hysteropreservation during prolapse surgery showed a trend towards higher success rates and lower reoperation rates in patients with concomitant hysterectomy. However, hysterectomy was associated with longer operative times, higher blood loss and a higher risk of visceral injury. Mesh exposure rates were also higher in the hysterectomy groups,⁶⁰ and this data is supported by two other papers.^{61,62}

Detailed pre-operative discussion with the patient is recommended to make the best decision regarding hysterectomy during uterine prolapse surgery.

Future perspectives in pelvic reconstructive surgery

The aforementioned debates surrounding the current trends in pelvic reconstructive surgery have created a movement towards developing new products and techniques to better serve our patients.

Biosynthetic and coated transvaginal mesh

The controversy concerning the use of transvaginal mesh has prompted the development of biosynthetic and coated mesh products, in an attempt to reduce the inflammatory reaction caused by synthetic materials, and ultimately

decrease side effects such as vaginal exposure and pelvic pain.

Collagen-coated transvaginal mesh for vaginal prolapse surgery was initially studied in an animal model by De Tayrac and colleagues. They demonstrated that mesh exposure was twice as prevalent in the non-coated mesh population, although the level of inflammatory response was the same in both groups.⁶³ The collagen-coated mesh was then studied in anterior compartment prolapse in humans, showing conflicting results with regard to efficacy and exposure rates.^{64,65} A prospective comparison of collagen-coated and non-coated mesh by Lo et al.⁶⁶ showed similar short-term (20 months) anatomic and functional efficacy, and exposure rates between both groups, although mesh thickness and neovascularization at 1 year were significantly decreased in the collagen-coated group. Rudnicki and colleagues performed a randomized controlled trial, comparing collagen-coated mesh for anterior repair to native tissue anterior colporrhaphy in 160 patients. At 3 years' follow-up, anatomic success, defined as a POP-Q score < 2, was superior in the mesh group (91.4%) when compared to the colporrhaphy group (41.2%), although mesh exposure rates neared 15% and patient reported outcomes were similar in both groups.⁶⁷

Numerous other types of biosynthetic-coated mesh are being tested with positive preliminary results, such as extracellular matrix hydrogel coating,⁶⁸ phosphorylcholine coating,⁶⁹ nitric oxide coating,⁷⁰ as well as small intestinal submucosa-modified polypropylene hybrid mesh.⁷¹ To date, no biosynthetic mesh product has been successfully marketed.

Autologous tissue

Autologous tissue, such as rectus sheath fascia, is commonly used for stress urinary incontinence surgery. More recently, fascia lata has been used for transvaginal prolapse repair^{72,73} and ASC⁷⁴ with satisfactory results. Harvest site complications are rare and include local pain and haematoma. This venue must be further studied with randomized controlled trials compared to synthetic mesh.

Laser therapy for POP

Laser technology in urologic surgery has been prospering over the past two decades, notably with the use of the holmium laser for treatment of kidney stones and benign prostatic hyperplasia. Similar technologies are now being used to treat pelvic floor disorders in women, such as vaginal atrophy, stress urinary incontinence and POP. Although not a surgical reconstructive procedure, we predict that the laser will gain significant popularity in the near future, in particular for young women with mild prolapse.

The CO₂ laser has tissue-remodelling properties and acts by increasing endogenous production of collagen

and elastin fibres.^{75,76} The fractional CO₂ laser was successful in improving patients' prolapse symptoms, among other benefits (bladder function, vaginal sensation and lubrication).⁷⁷

The Erbium:YAG laser has more recently been introduced for treatment of pelvic floor disorders. Similar to the CO₂ laser, the Er:YAG laser remodels collagen's structure and stimulates neo-collagenesis to improve tissue strength.⁷⁸ Current studies have shown improvements in stress urinary incontinence,^{79,80} vaginal atrophy in postmenopausal women^{81,82} and anterior compartment prolapse.⁸³ Further studies concerning the use of erbium laser for vaginal prolapse are pending.

Conclusion

Although there is no simple, straightforward answer to the complexity that is pelvic reconstructive surgery for POP, we are able to summarize our recommendations such as:

For mild, first-episode POP, after failure of conservative measures, native tissue repair should be performed, unless the surgeon believes that a mesh-augmented repair is indicated.

If an apical defect exists, ASC is an excellent option, especially if the patient is sexually active.

If ASC is performed, it should be done via a minimally invasive approach. Laparoscopy is more cost-effective than robotic surgery for ASC.

Concomitant hysterectomy for uterine prolapse repair may decrease recurrence rates, but entails a higher peri-operative risk. The procedure of choice should be thoroughly discussed with the patient.

Although its use is controversial, transvaginal mesh should be reserved for complex cases at high risk of failure, such as multicompartments or recurrent prolapse. Transvaginal mesh should only be used in the hands of trained and experienced surgeons.

Patient factors, such as age and co-morbidities, sexual activity and risk factors for recurrence – including severity of disease, pelvic floor muscle weakness, constipation, and so on – and patient preference should always guide the decision-making process.

Although still emerging, future techniques, such as autologous fascial harvesting, and novel technologies, such as biosynthetic mesh and lasers, will likely reshape pelvic reconstructive surgery in women.

Declaration of conflicting interests

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