



## Review

# Advances in laparoscopic techniques in pelvic reconstructive surgery for prolapse and incontinence

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## ABSTRACT

Advances in minimally invasive surgery have led to an increasing adoption of laparoscopic techniques in pelvic reconstructive surgery and treatment of urinary incontinence. Our review of recent developments aims to identify and evaluate the evidence for use of these procedures.

Recent literature continues to support the use of laparoscopy for colposuspension and sacrocolpopexy, as an effective alternative to open surgery. However, with the advent of retropubic mid-urethral slings for stress urinary incontinence, laparoscopic Burch colposuspension has now become obsolete. There are relatively few reports on other laparoscopic prolapse procedures, such as uterosacral ligament vault suspension, uterine suspension, paravaginal defect repair and rectocele repair.

In conclusion, several short-term studies support the use of laparoscopy in pelvic reconstructive surgery and urogynaecology but longer-term investigations are needed to confirm their findings.

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## 1. Introduction

Pelvic organ prolapse is a common concern for women and their physicians. The estimated lifetime risk of undergoing surgical intervention for prolapse is 11% for women who reach 80 years of age and this figure is likely to increase with the current aging of our population [1].

The primary objective of prolapse surgery is to correct symptomatic pelvic-floor defects and re-establish vaginal anatomy and support, in order to restore and maintain normal bladder, bowel and sexual functions. There is growing interest in the use of laparoscopic procedures to correct pelvic organ prolapse. The laparoscopic approach has been successfully adopted for many procedures that previously relied on an abdominal or transvaginal route. The principles of the laparoscopic surgery are based upon those used in the corresponding open procedures. The laparoscopic approach offers a number of important advantages, including excellent intraoperative visualisation of the pelvic anatomy, reduction in

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adhesion formation, decreased post-operative pain and quicker post-operative recovery. However, a longer time is required to train surgeons to be highly skilled in both prolapse surgery and advanced laparoscopic techniques. In particular, a high level of laparoscopic suturing skill is necessary, if the efficacies of their laparoscopic prolapse procedures are to be comparable to those of their open abdominal counterparts.

The purpose of this review is to discuss and evaluate recently published data on the use of laparoscopy in pelvic surgery for continence procedures and pelvic organ prolapse repair.

## 2. Laparoscopic and minimally invasive techniques for stress urinary incontinence

Open abdominal Burch colposuspension has been the “gold standard” treatment for stress urinary incontinence for many years. However, since it was first described in 1991, laparoscopic colposuspension has rapidly gained in popularity because of its many reported advantages, including improved visualisation, shorter hospital stay and faster recovery.

Numerous studies on laparoscopic Burch colposuspension have been conducted, with most of the earlier trials focusing on comparing it with open Burch colposuspension. A recent Cochrane review on these two approaches included nine trials [2–6]. All of these favoured the laparoscopic approach, as it was associated with decreases in blood loss, post-operative pain, hospital stay and duration of catheterisation. Laparoscopy did, however, increase operative times by a mean of 13.7 min. Perioperative complications were greater overall in the open group but there were significantly more bladder injuries [relative risk (RR) 2.37; 95% confidence interval (CI)] in the laparoscopic group. There were no statistically significant differences in objective cure, de-novo detrusor overactivity and voiding dysfunction between the laparoscopy and laparotomy groups on follow-up at 18 months to 5 years after surgery. Subjective cure rates were in the ranges 58–96% in the laparotomy group and 62–100% in the laparoscopy group [2–5]. In one study, patients were randomised to placement of one suture or two sutures on each side of the urethra. At 1 year, the results revealed a higher objective cure rate with two sutures compared with a single suture bilaterally (83% vs. 53%) and higher subjective cure rates (89% vs. 69%) [7].

With the advent of polypropylene mid-urethral slings for stress urinary incontinence, the role of laparoscopic Burch colposuspension has been questioned. There are six published randomised controlled trials that compare bilateral two-suture laparoscopic Burch colposuspension with retropubic mid-urethral polypropylene slings (e.g. TVT) [8–13]. A systematic review concluded that the overall objective cure rate was higher with mid-urethral slings compared with laparoscopic Burch colposuspension (RR 1.16, 95% CI 1.07–1.25). In addition, laparoscopy led to a greater operative time (mean difference 20 min, 95% CI 17–24 min) and length of stay in hospital. TVT was found to be more cost-effective than laparoscopic or open Burch colposuspension [14–16].

In conclusion, short-term results favour mid-urethral slings over laparoscopic colposuspension. Given the technical ease and excellent cure rates associated with retropubic mid-urethral slings, laparoscopic colposuspension now has a more limited role with indications limited to patients who are undergoing concomitant laparoscopic procedures (e.g. paravaginal repair) or who possess contraindications to implantation of synthetic grafts.

## 3. Laparoscopic sacrocolpopexy for vaginal vault prolapse

Vaginal vault prolapse has been estimated to occur in 0.2–43% of post-hysterectomy patients [17,18]. The management of vault pro-

lapse can include support with vaginal pessaries, vaginal surgery, such as vaginal repair with sacrospinous fixation or colpocleisis, and the abdominal approach with sacrocolpopexy.

Abdominal sacrocolpopexy is well described in the literature, with reported success rates in the range 78–100% [19]. When compared with sacrospinous fixation, abdominal sacrocolpopexy has been shown to have a lower rate of recurrent vaginal prolapse, less post-operative dyspareunia and a lower reoperation rate. However, the procedure takes longer to perform, has a longer recovery time and is more expensive [19–22]. Mesh erosion rates of 0–13% have been reported, the lowest rates being with type-1 macroporous, monofilament polypropylene mesh and the highest with Goretex mesh [23–25].

Laparoscopic sacrocolpopexy has evolved from classical abdominal sacrocolpopexy. The laparoscopic approach combines the advantage of using a similar technique to the open route with the absence of any need for a large abdominal incision, abdominal packing or extensive bowel manipulation, all of which are likely to reduce post-operative pain, immobility and bowel ileus. The visual magnification and ability to work with relative ease deep in the pelvis, that are provided by the laparoscopic approach, have given pelvic-floor surgeons the opportunity to modify the original open procedure, by placing the mesh much lower over the posterior vaginal wall down to the level of levator ani muscle and perineal body, in an attempt to enhance its effectiveness. The success rate of laparoscopic sacrocolpopexy has been reported to be 90–96%, with a mesh erosion rate of 1–8% [22,26–29]. However, laparoscopic sacrocolpopexy has not yet been compared with open sacrocolpopexy in a randomised controlled study. Most published reports are retrospective with few comparative cohort studies.

Controversies exist regarding the need for peritonisation or burial of the mesh. The findings from one retrospective observational study show that the burial of non-absorbable mesh in abdominal apical prolapse surgery is not necessary [30]. Moreover, the authors suggested that burial of the mesh might theoretically contribute to complications such as ureteric injury or formation of retroperitoneal haematomas. However, this data from a single retrospective observational study must be interpreted with a degree of caution. Our own observational findings, from laparoscopies conducted on patients for other reasons, suggest that non-peritonised mesh can cause significant bowel adhesions. A prospective randomised controlled trial of burial vs. non-burial of mesh is required to fully evaluate the risks and benefits.

In summary, laparoscopic sacrocolpopexy appears to be a safe technique that offers effective vault support comparable with that of the open procedure. The reported advantages of laparoscopic approach are excellent intraoperative visualization of pelvic anatomy, decreased blood loss, shorter hospital stay and quicker post-operative recovery. However, long-term follow-up data are needed to substantiate its efficacy and safety.

## 4. Laparoscopic uterosacral ligament vaginal vault suspension

Uterosacral ligament vault suspension is an alternative laparoscopic technique available for the treatment of vaginal vault prolapse. This involves suturing the uterosacral ligament to the apex of the vagina. It is normally performed by placing two sutures through each uterosacral ligament and then through the cuff or apex of the vagina. The technique includes identification of the vaginal vault and the proximal point of original insertion of the uterosacral ligaments. The peritoneum overlying the vaginal apex is incised in order to expose the pubocervical fascia anteriorly and the rectovaginal fascia posteriorly and then approximation of the two fascias performed. After the vaginal dome is reconstructed

in this fashion, it is attached to the uterosacral ligaments for support.

The literature on laparoscopic uterosacral ligament suspension is sparse. Over the past 10 years, there have been a few studies on this technique, consisting mostly of case reports and small cohort studies. A few observational studies have reported an objective cure rate in the range 75–100% at follow-up 8–12 months after surgery. The most common complications are ureteric injuries or kinking from the sutures, reported in 2–9.5% of cases [31–34]. One further study compared the outcomes of 25 laparoscopic uterosacral ligament suspensions to 25 vaginal uterosacral ligament suspensions among age-matched controls. The estimated blood loss and duration of stay in hospital were significantly less in the laparoscopic group (72 ml vs. 227 ml,  $P < 0.0001$  and 1.05 vs. 1.65 days,  $P < 0.002$ ). There were three recurrences in the vaginal group, diagnosed at 17, 34, and 58 weeks, but none in the laparoscopic group [35].

In summary, there is presently limited evidence to support use of laparoscopic uterosacral ligament suspension for treatment of vaginal vault prolapse. Its use should, therefore, be restricted to well-controlled clinical trials.

## 5. Uterine preservation during surgery for uterovaginal prolapse

The concept of uterine preservation during surgery for prolapse was first suggested by Bonney in the early 1900s. He emphasised the passive role of the uterus in uterovaginal prolapse [36]. Since that time, various authors have reported their experiences with reconstructive pelvic surgery with uterine preservation.

For many years vaginal hysterectomy has been the traditional surgical treatment for uterovaginal prolapse. However, hysterectomy alone often fails to address the underlying deficiencies in pelvic support that cause uterovaginal prolapse. Indeed, up to 40% of women undergoing hysterectomy subsequently present with vaginal vault prolapse [17,18,37]. In addition, the uterus and cervix may have an important role in sexual function and wellbeing. Increasingly more women are now requesting restoration of their uterine support, while preserving the uterus. This is for reasons of fertility, minimizing morbidity and individual preference. Therefore, the concept of uterine preservation during uterovaginal prolapse surgery warrants re-evaluation.

Several operations for prolapse repair with uterine preservation have been proposed, using vaginal and abdominal approaches. However, most published studies on these are small and retrospective, and their reported success rates vary widely. Open abdominal procedures, including sacrohysteropexy with synthetic meshes such as Teflon or Goretex, have been described. In a long-term follow-up of this procedure involving 30 patients, recurrence of uterine prolapse was reported in two women [38]. Transvaginal uterosacral plication has been reported to be associated with a high risk of ureteric injury and neurologic morbidity [39,40]. Sacrospinous hysteropexy has been compared favourably with vaginal hysterectomy and concomitant sacrospinous fixation of the vault in a retrospective series of 70 women with an objective success rate of 74% [41]. Posterior intravaginal slingplasty was first described in 2001 but a high rate of mesh complications including infection and erosion has since been reported [42]. Therefore, the surgical management of uterine prolapse in women who wish to retain their uterus remains a challenge.

The potential advantages of a laparoscopic approach to prolapse repair with uterine preservation include quicker recovery and a reduction in adhesion formation, which is beneficial to women wishing to preserve fertility. Three types of procedure have so far been described, namely laparoscopic suspension of the uterus to the round ligaments (ventrosuspension), to the uterosacral

ligaments and to the sacral promontory. Laparoscopic ventrosuspension involves suturing of the round ligament to the rectus sheath; however, this is associated with a poor success rate, with one case series of nine women reporting recurrence of prolapse in eight women within 3 months post-operatively [43]. Laparoscopic uterosacral plication involves placing three purse-string sutures from the uterosacral ligaments to the posterior cervix [44]. Published case series report an objective success rate of 79% after a mean follow-up time of 12 months [45]. Recently, Cutner et al. described a technique of laparoscopic uterine sling suspension using a Mersilene tape to re-suspend the uterus to the sacral promontory bilaterally. The initial results are promising but further evaluation of this technique is necessary [46].

There is a growing body of evidence supporting the concept of uterine preservation at the time of uterovaginal prolapse surgery. However, the current level of evidence in the medical literature is inadequate to assist physicians in determining which patients are ideal candidates for uterine conservation and in selecting the ideal uterus-sparing procedure for a given patient. Studies involving more patients, longer follow-up times, appropriate controls and objective assessment techniques are needed before we can routinely recommend uterine preservation at the time of uterovaginal prolapse surgery. In addition, the effects of pregnancy and of delivery on any reconstructive procedure are poorly understood, and surgery prior to the completion of childbearing should be approached with caution.

## 6. Laparoscopic anterior wall prolapse repairs

Prolapse of the anterior vaginal wall (cystocele) is the most common type of vaginal prolapse. The conventional treatment for a cystocele is anterior colporrhaphy, which can be performed under local or general anaesthesia. However, the success rate of anterior colporrhaphy is poor and varies widely between 37 and 100% [22,47–50]. The use of either absorbable or non-absorbable mesh to augment an anterior colporrhaphy offers the possibility of an improved anatomical outcome but this has to be tempered against potential complications including mesh erosion, infection and dyspareunia [22,49,50]. There is currently limited evidence to recommend the routine use of any graft in primary repairs of anterior vaginal wall prolapse.

Abdominal and vaginal paravaginal repair have shown success rates varying between 76 and 100%, although no randomised trials have been performed [22,50]. There is a paucity of data regarding laparoscopic paravaginal defect repairs. A few retrospective observational studies have reported success rates ranging from 76 to 93% [35,51]. In one study of 212 patients, who underwent laparoscopic bilateral paravaginal repair for anterior wall prolapse and were prospectively followed for an average of 14.2 months, the objective cure rate was 76%. There were nine complications, including blood loss greater than one litre, bladder injury, bowel injury, and unintended laparotomy [52].

The surgical management of anterior vaginal wall prolapse remains controversial, with limited and often conflicting data available. Significant further research is required to provide clarification, such as: comparison of anterior colporrhaphy with and without synthetic or biological grafts; vaginal paravaginal repair vs. abdominal (open or laparoscopic) paravaginal repair, etc.

## 7. Laparoscopic posterior wall prolapse repairs

The traditional transvaginal rectocele repair method on its own has a cure rate of 80–90% [53]. A randomised trial, designed to show an improvement with the placement of a prosthetic material from this baseline to 90–95%, would require 300–400 subjects

in each arm. Trials so far undertaken to evaluate mesh augmentation of posterior repair have been too small to address this question reliably [49,54]. Therefore, the use of mesh augmentation for posterior repair should be restricted to secondary procedures and well-controlled clinical trials.

There have been few studies on laparoscopic rectocele repair, mainly because of the preference of most surgeons for the vaginal approach and the high objective and subjective cure rates associated with it. One investigation prospectively evaluated 20 patients, who underwent laparoscopic rectocele repair with polyglactin mesh, and found that 16 patients had resolution of prolapse symptoms and digital defecation after 1 year. The estimated blood loss was minimal and hospital stay was less than 24 h [55].

The laparoscopic repair of high rectocele and enterocele, in women undergoing surgery for uterine or vault prolapse, is advocated to avoid a separate vaginal procedure. Several studies that looked at the extension of the mesh over the posterior vaginal wall down to the level of levator ani muscle and perineal body reported good anatomic and functional results [54,56,57]. However, on objective examination at a mean follow-up time of 26 months after laparoscopic sacrocolpopexy with posterior mesh extension, 57% of 31 women were found to have recurrent low rectoceles. The authors recommended a posterior vaginal repair to be incorporated for low rectoceles at the time of sacrocolpopexy [57,58].

In summary, the traditional transvaginal rectocele repair method on its own associated with high objective and subjective cure rates. There is no evidence to support the use of mesh grafts for primary rectocele repair but these may have a role in recurrent posterior wall prolapse. The laparoscopic approach of posterior compartment prolapse, with an extension of mesh over the posterior vaginal wall at the time of sacrocolpopexy, is an effective technique for repair of enterocele and high rectocele; however, further evaluation of anatomical and functional outcomes is needed. Concomitant transvaginal repair of low rectocele at the time of sacrocolpopexy is beneficial.

## 8. Conclusions

Despite the methodological limitations of the data reviewed, there is a growing body of evidence supporting use of laparoscopic approach to incontinence and pelvic organ prolapse surgery. Laparoscopy should be considered only as a mode of abdominal access and not a change in the operative technique.

Recent literature continues to support the use of laparoscopy for colposuspension and sacrocolpopexy, as an effective alternative to open surgery. However, with the advent of retropubic mid-urethral slings for stress urinary incontinence, laparoscopic Burch colposuspension has now become obsolete, except for special cases.

Pelvic-floor reconstruction with uterine preservation has been shown to be feasible and safe. However, the current body of medical literature is inadequate to assist physicians in selecting the ideal uterus-sparing procedure. Since the demand for uterine preserving surgery in the management of uterine prolapse is increasing, there is a need for further prospective comparative studies assessing the outcome of available surgical techniques.

The literature regarding other laparoscopic prolapse procedures, such as uterosacral ligament vault suspension, paravaginal repair, and rectocele repair, is sparse. Studies involving more patients, longer follow-up times, appropriate controls and objective assessment techniques are needed.

Although initial data suggest that laparoscopic techniques for prolapse and incontinence surgery can provide a safe and effective alternative to traditional laparotomy, surgeons should approach these with caution. Most published papers are based on the work of experienced and highly skilled surgeons who have performed

large numbers of laparoscopic prolapse procedures. A high level of laparoscopic suturing skill and thorough knowledge of anatomy are essential to achieve outcomes equivalent to those of the traditional open techniques. Prospective randomised clinical trials are needed to further evaluate the laparoscopic approach as a minimally invasive method for successful long-term treatment of pelvic organ prolapse and urinary incontinence.

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