Laparoscopic management of urinary incontinence, ureteric and bladder injuries

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The present review focuses on the most recently published English language literature, and addresses results and complications associated with the laparoscopic approach to urinary incontinence, anterior vaginal wall prolapse, and lower urinary tract injury. Laparoscopic Burch procedures continue to show equal efficacy, but lower morbidity as compared with conventional open techniques. Lower urinary tract injuries may also be managed effectively using the same techniques as those employed in open procedures. Laparoscopy continues to be considered a mode of surgical access, and is effective in treating urinary incontinence, anterior vaginal wall prolapse, and lower urinary tract injuries. Curr Opin Obstet Gynecol 13:411–417. © 2001 Lippincott Williams & Wilkins.

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Introduction

Since the introduction of the retropubic urethral suspension in 1910 [1], over 100 different surgical techniques for the treatment of genuine stress urinary incontinence have been described. Many have been modifications of original procedures in an attempt to improve clinical outcome, shorten operative time, or reduce surgical morbidity. Despite the number of surgical procedures developed each year, the Burch colposuspension and pubovaginal sling operations have remained the mainstay of surgical correction for genuine stress urinary incontinence because of their high long-term cure rates. However, these procedures do not address the concurrent anterior vaginal wall prolapse that is often associated with genuine stress urinary incontinence secondary to urethral hypermobility. We present a laparoscopic approach to anterior vaginal wall reconstruction that utilizes the paravaginal repair and Burch colposuspension for treatment of cystocele and stress urinary incontinence, respectively, caused by lateral vaginal wall support defects.

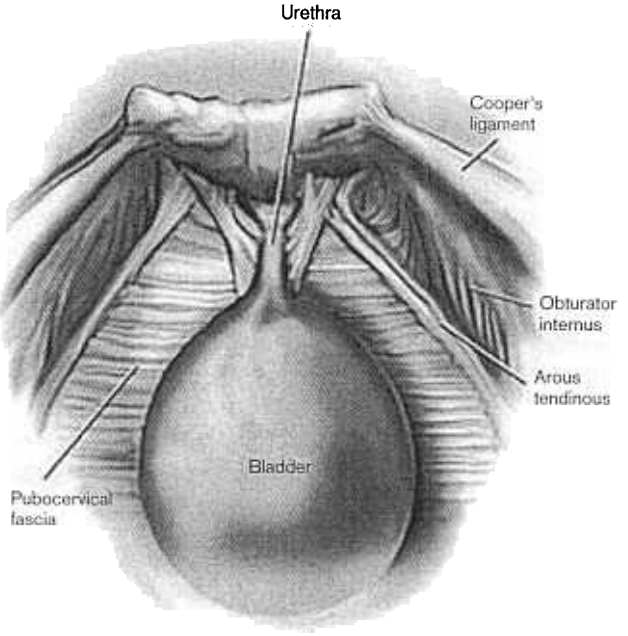
Emphasizing the principles of minimally invasive surgery, the laparoscopic approach has been successfully adopted in many procedures that previously relied on an abdominal or transvaginal route. First described in 1991, the laparoscopic retropubic colposuspension has continued to gain popularity because of its many reported advantages [2], including improved visualization, shorter duration of hospital stay, faster recovery, and decreased blood loss.

This present review concentrates primarily on new developments and data, found in the English language medically indexed literature, for the endoscopic management of urinary incontinence, ureteric, and bladder injuries. We also emphasize laparoscopic management of bladder and anterior vaginal wall prolapse.

Anterior vaginal wall prolapse and urethral hypermobility

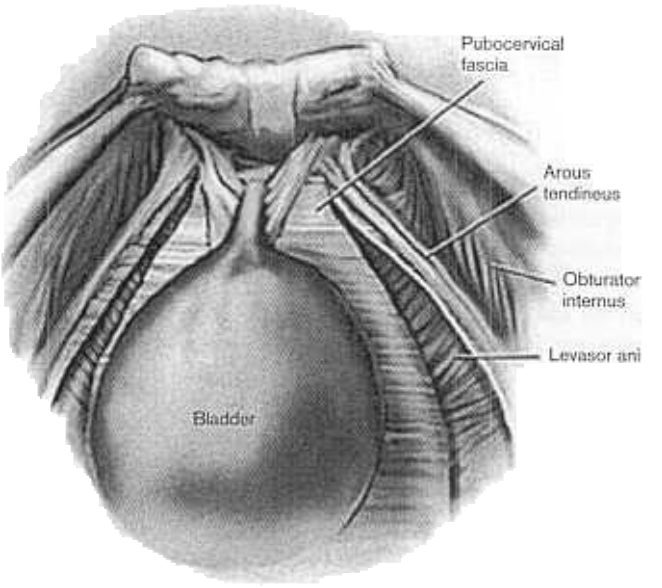
The pubocervical fascia, which constitutes the supportive structure of the anterior vaginal wall, is attached to the arcus tendineus fascia pelvis. The arcus tendineus fascia pelvis (also termed 'the white line') is a condensation of intervening connective tissue overlying the obturator internus muscle (Fig. 1). Loss of the lateral vaginal attachment to the pelvic sidewalk is called a paravaginal defect, and usually results in a cystourethro-

Figure 1. Normal vaginal support (aerial view)



The space of Retzius and normal anterior vaginal wall support.

Figure 2. Paravaginal defects (aerial view)



Loss of lateral vaginal attachment at the arcus tendineus, resulting in a cystourethrocele.

cele, uretheral hypermobility, and often stress urinary incontinence (Fig. 2) [3]. The surgical repair of paravaginal fascial defects for anterior vaginal wall prolapse and associated symptoms has traditionally been performed using an open retropubic or a vaginal retropubic incision [4]. The laparoscopic technique parallels our open technique, and has previously been described [5].

Surgical technique

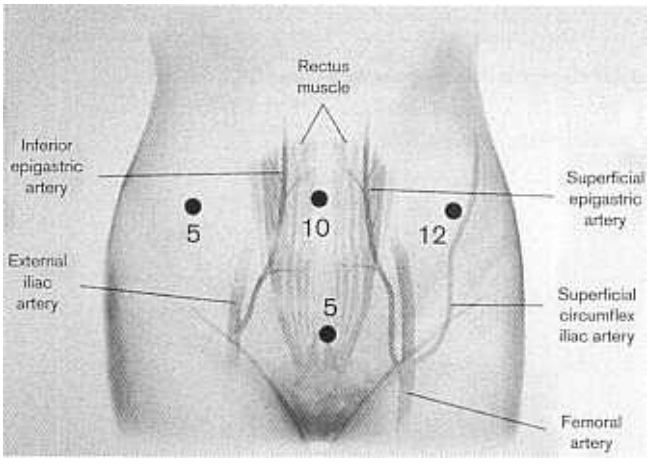
Laparoscopic techniques have several advantages over more invasive techniques, including improved visualization, shorter duration of hospital stay, faster recovery, and decreased blood loss. The specific details of these procedures are discussed here.

Laparoscopic paravaginal repair

We routinely perform open laparoscopy at the inferior margin of the umbilicus. A 10-mm access port is used at this site to introduce the laparoscope. The abdomen is insufflated with carbon dioxide to 15 mmHg intra-abdominal pressure. Three additional ports are placed under direct vision (Fig. 3). Choice of the individual port size depends on any concomitant surgery planned for each patient.

The bladder is filled in a retrograde manner with 200–300 ml normal saline, allowing identification of the superior border of the bladder edge. Entrance into the space of Retzius is accomplished by a transperitoneal

Figure 3. Laparoscopic incision sites



Port size and placement are illustrated.

approach using a harmonic scalpel. The incision is made approximately 3 cm above the bladder reflection, beginning along the medial border of the right obliterated umbilical ligament. Immediate identification of loose areolar tissue at the point of incision confirms a proper plane of dissection.

After the space of Retzius has been entered and the pubic ramus visualized, the bladder is drained in order to prevent injury. Separating the loose areolar and fatty layers using blunt dissection develops the retropubic

space. Blunt dissection is continued until the retropubic anatomy is visualized. The pubic symphysis and bladder neck are identified in the midline and the obturator neurovascular bundle, Cooper's ligament and the arcus tendineus fascia pelvis are visualized bilaterally along the pelvic sidewall (Fig. 1). The anterior vaginal wall and its point of lateral attachment from its origin at the pubic symphysis to its insertion at the ischial spine are identified. If paravaginal wall defects are present, then the lateral margins of the pubocervical fascia will be detached from the pelvic sidewall at the arcus tendineus fascia pelvis. The lateral margins of the detached pubocervical fascia and the broken edge of the white line can usually be clearly visualized, confirming the paravaginal defect. Unilateral or bilateral defects may be present (Fig. 2).

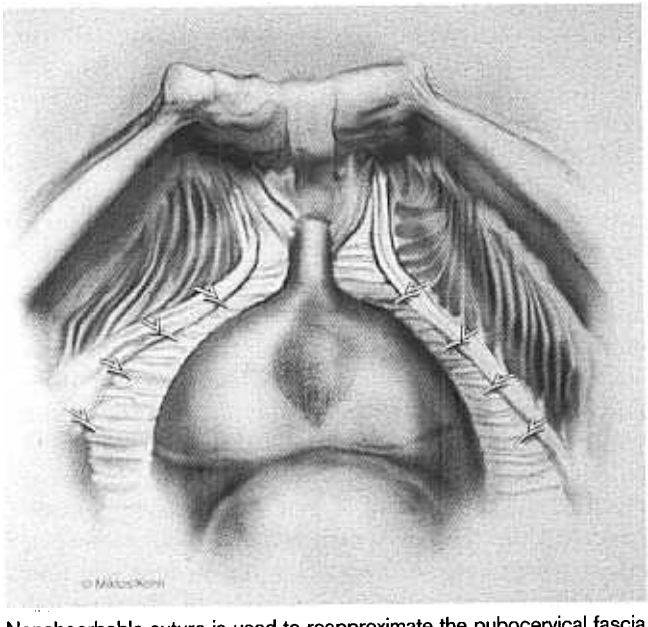
We recommend completion of the laparoscopic paravaginal repair before the colposuspension. After identification of the defect, the combined repair is begun by inserting the surgeon's nondominant hand into the vagina to elevate the anterior vaginal wall and the pubocervical fascia to their normal attachment along the arcus tendineus fascia pelvis. A 2-0 nonabsorbable suture with attached needle are introduced through the 12-mm port, and the needle is grasped using a laparoscopic needle driver.

The first suture is placed near the apex of the vagina through the paravesical portion of the pubocervical fascia. The needle is then passed through the ipsilateral obturator internus muscle and fascia around the arcus tendineus fascia at its origin 1–2 cm distal to the ischial spine. The suture is secured using an extracorporeal knot-tying technique. Good tissue approximation is accomplished without a suture bridge. Sutures are placed sequentially along the paravaginal defects from the ischial spine toward the urethrovesical junction. Usually, a series of three to four sutures are placed between the ischial spine and a point 1–2 cm proximal to the urethrovesical junction. The laparoscopic colposuspension is performed distal to the urethrovesical junction. The surgical procedure is repeated on the patient's opposite side if bilateral defects are present (Fig. 4). On completion of the bilateral paravaginal repair, the Burch colposuspension is performed (Fig. 5). By performing the paravaginal defect repair first, normal anatomic support of the anterior vaginal segment is recreated, reducing the chance of over-elevation of the paraurethral Burch sutures and subsequent voiding dysfunction. If the patient has only a cystourethrocele and no evidence of stress urinary incontinence, four to five sutures are placed bilaterally to correct the paravaginal defects. These sutures are placed from the ischial spine to the mid-urethra.

Laparoscopic Burch colposuspension

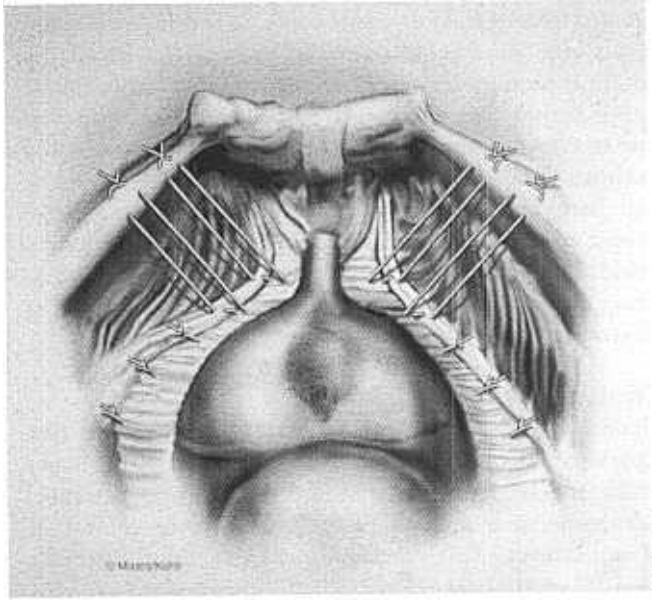
This laparoscopic technique parallels our open technique, and has previously been described [6]. The

Figure 4. Paravaginal repair: conventional repair of paravaginal defects



Nonabsorbable suture is used to reapproximate the pubocervical fascia (i.e. anterior vaginal wall) back to its original point of lateral attachment, known as the arcus tendineus fascia pelvis (i.e. white line).

Figure 5. Paravaginal plus Burch urethropexy



The paravaginal sutures are placed to restore anatomy and support the cystocele, and four additional paraurethral suspension sutures (i.e. Burch urethropexy) are placed in patients diagnosed with stress urinary incontinence.

laparoscopic Burch colposuspension is performed using nonabsorbable No. 0 sutures; we routinely use polytrifluroethyene. The surgeon's nondominant hand is placed in the vagina and a finger is used to elevate the vagina. The endopelvic fascia on both sides of the bladder neck and mid-urethra is exposed using an endoscopic Kitner. The first suture is placed 2-cm lateral to the urethra at the level of the mid-urethra. A figure-of-eight bite, incorporating the entire thickness of the anterior vaginal wall excluding the epithelium, is taken, and the suture is then passed through the ipsilateral Cooper's ligament.

With an assistant's fingers in the vagina to elevate the anterior vaginal wall toward Cooper's ligament, the suture is tied down with a series of extracorporeal knots using an endoscopic knot pusher. An additional suture is then placed in a similar manner at the level of the urethrovesical junction, approximately 2 cm lateral to the bladder edge on the same side. The procedure is repeated on the opposite side. Excessive tension on the vaginal wall should be avoided when tying down the sutures; we routinely leave a suture bridge of approximately of 2–3 cm (Fig. 5).

On completion of the paravaginal repair and Burch urethropexy, the intra-abdominal pressure is reduced to 10–12 mmHg, and the retropubic space is inspected for hemostasis. Cystoscopy is performed to rule out urinary tract injury. The patient is given 5 ml of indigo carmine and 10 ml furosemide intravenously, and a 70° cystoscope is used to visualize the bladder lumen, to assess for unintentional stitch penetration, and to confirm bilateral ureteral patency. After cystoscopy, attention is returned to laparoscopy. We recommend routine closure of the anterior pertioneal defect using an absorbable purse string suture. All ancillary trocar sheaths are removed under direct vision in order to ensure hemostasis and exclude iatrogenic bowel herniation. Excess gas is expelled, and fascial defects of 10 mm or more are closed using delayed absorbable suture. Postoperative bladder drainage and voiding trials are accomplished using either a transurethral catheter, suprapubic tube, or intermittent self-catheterization.

Clinical results

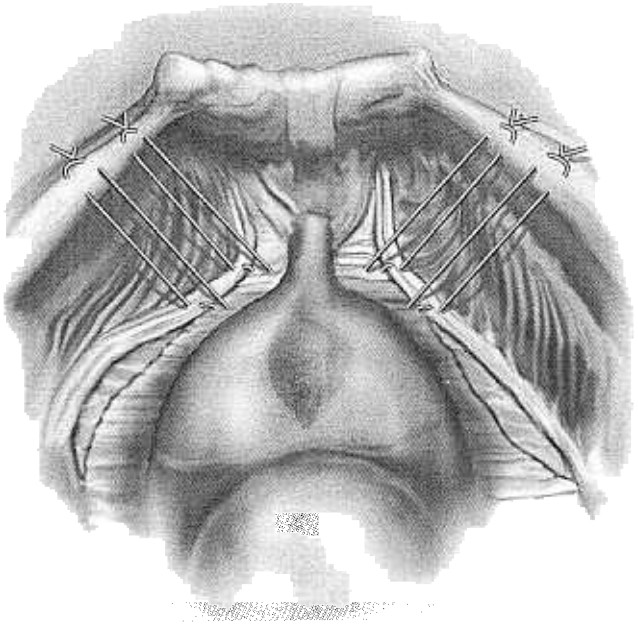
Since Vancaillie and Schuessler [2] reported the first laparoscopic colposuspension case series in 1991, many other investigators have reported their experience. Comprehensive reviews of the literature reveal a lack of uniformity in surgical technique and surgical materials used for colposuspension [7••,8••]. Persson and Wolner-Hanssen [9•] attempted to standardize the laparoscopic Burch urethropexy by comparing one or two sutures on each side of the urethra. Those investigators concluded that two single-bite sutures resulted in a significantly higher objective short-term cure rate than one double-bite suture on each side. This lack of standardization is also noted with the conventional open (laparotomy) technique.

Because of this lack of standardization and the steep learning curve that is associated with laparoscopic suturing, surgeons have attempted to develop faster and easier ways of performing a laparoscopic Burch colposuspension. These modifications have included the use of stapling devices [10], bone anchors [11], synthetic mesh [12,13], and fibrin glue [14]. However, we believe that the laparoscopic approach should be identical to the open technique, utilizing conventional sutures, in order to allow comparative studies.

There are several reported laparoscopic Burch colposuspension case series that have used conventional surgical technique and suture materials. Published cure rates range from 69 to 100%, with the majority of the studies reporting cure rates greater than 80% [15–25,26•,27–31,32•,33,34]. Most recently, two prospective randomized clinical studies that compared laparoscopic and transabdominal Burch colposuspension [35,36••] showed comparable rates of surgical cure of stress incontinence. This further supports the assertion that laparoscopy is nothing more than a mode of surgical access; it should not mandate modification to surgical technique, and subsequent cure rates should be comparable to those of open surgical techniques.

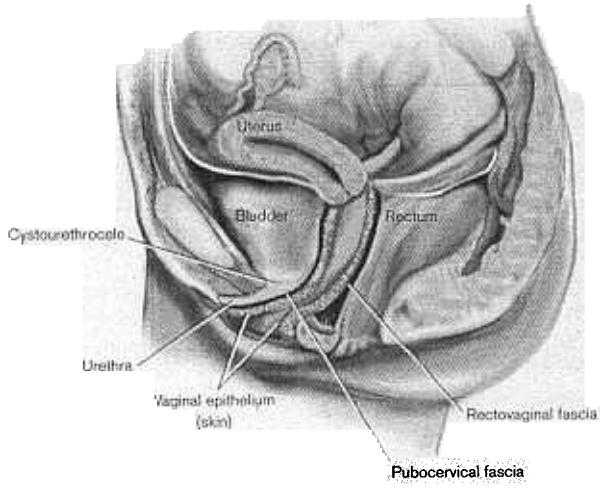
Although there have been no studies regarding the long-term results of the laparoscopic paravaginal plus Burch procedure, logic should dictate a higher cure rate for the paravaginal plus Burch (eight to 12 sutures) than for the Burch colposuspension (four sutures) alone for the treatment of stress urinary incontinence. The paravaginal plus Burch technique utilizes more sutures, which should result in a greater distribution of the force to the pelvic floor, thus decreasing the amount of tension placed on the four Burch sutures alone. Furthermore, performing a Burch urethropexy for urinary incontinence and neglecting to repair the paravaginal defect predisposes the patient to further anterior vaginal wall prolapse. Placement of the four Burch sutures should elevate and stabilize the paraurethral tissue, but should have minimal impact on the more proximal paravaginal defects (Fig. 6). Neglecting the repair of the more proximal or apical paravaginal defect could ultimately result in a symptomatic cystocele (Figs 7 and 8). We believe that, in such a case, the next surgeon to manage the patient will find great difficulty in entering the space of Retzius and attempting to repair the paravaginal defect, due to the severe scarring promoted by the previous Burch urethropexy.

Figure 6. Burch urethropexy (aerial view)



Burch urethropexy without addressing proximal paravaginal defects. Persistent paravaginal defects manifest themselves in the form of a cystocele. The diagram illustrates the paravaginal defect where the vagina does not meet the sidewall muscles.

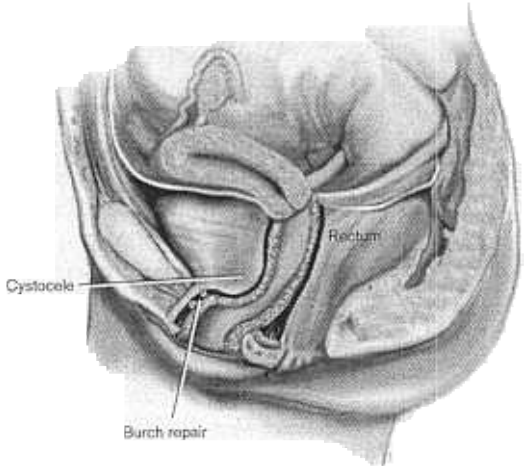
Figure 7. Cystourethrocele (sagittal view)



A lack of paravaginal attachment results in anterior vaginal wall relaxation.

Finally, most studies (as indicated above) address cure rates in terms of subjective or objective stress urinary incontinence parameters, and few clinical studies have evaluated the results of surgical procedures in terms of

Figure 8. Burch urethropexy (sagittal view)



Burch urethropexy elevates and stabilizes the urethra, but does not address the proximal cystocele.

patient-oriented outcomes, such as relief of symptoms and functional status. Meyers *et al.* [37] assessed patient-oriented outcomes after laparoscopic Burch urethropexy at 6 months and at 3–4 years. Although only 13 out of 22 women completed the study, those investigators concluded that there was a significant improvement in patient-oriented outcomes, including complaints of incontinence and functional status.

Lower urinary tract injuries

The true frequency of surgically induced trauma of the urinary tract (ureter, bladder) in both traditional and laparoscopic surgery is unknown. There is potential for lower urinary tract injuries during gynecologic surgery because of the anatomic proximity of the reproductive and lower urinary tracts. Almost every major gynecologic operation has been reported to lead to a lower urinary tract injury [38]. The incidence of lower urinary tract injury is reported to be approximately 1% in major traditional gynecologic procedures [39]; however, the actual frequency is probably greater, because injuries are generally under-reported and iatrogenic ureteric impairment may remain silent [40]. The overall frequency of injury to the lower urinary tract in open or vaginal reconstructive surgery for urinary incontinence and pelvic organ prolapse is often quoted to be approximately 4% [41,42]. Data on open Burch procedures alone showed the frequency of injury to the bladder or ureter to be approximately 10%. Speight *et al.* [43•] demonstrated a 2.3% bladder injury rate when performing a laparoscopic paravaginal repair with or without a Burch urethropexy.

Lower urinary tract injury repair

The best approach is to avoid lower urinary tract injury, by meticulous and careful surgical technique (identifying, dissecting, and reflecting contiguous lower urinary tract structures during gynecologic surgery). If injury occurs despite those efforts, the next best approach is intraoperative recognition and repair. Routine intraoperative cystoscopy after all major gynecologic operations may facilitate the recognition of a real or potential injury, allowing intraoperative repair. Repair at primary surgery often is easier, more successful, and less morbid for the patient [44]. If a bladder injury is identified intraoperatively, then the surgeon must decide on the best surgical approach for the repair. The decision to repair cystotomy laparoscopically is normally based on the surgeon's skill and comfort level. Although the laparoscopic repair of cystotomy has been previously reported, Speight *et al.* [43•] recently reported the successful repair of four unintentional cystotomies at the time of laparoscopic paravaginal repair or Burch. Delayed absorbable suture was used to perform the repair, and all patients recovered without sequelae.

A review of the literature revealed three reports of laparoscopic end-to-end anastamosis of the ureter published during the early 1990s [45–47]. Since these initial reports, little has been mentioned in the literature on the laparoscopic management of ureteral injuries until the year 2000. Tulikangas *et al.* [48•] injured the ureter during resection of an ovarian remnant, and the ureter was subsequently repaired by primary end-to-end anastamosis laparoscopically. The diagnosis was made intraoperatively after the patient had been given intravenous indigo carmine dye. The dye freely spilled from the proximal ureteral segment. The proximal and distal ends of the injured ureter were identified and spatulated using laparoscopic microscissors. The cut ends were reapproximated over a double J-stent using 4-0 delayed absorbable suture.

Evidence suggests that the frequency of lower urinary tract complications appears to be on the rise as a result of greater numbers of increasingly complex operative laparoscopic procedures being performed [49,50]. Laparoscopic repair of certain lower urinary tract injuries is feasible for surgeons who are skilled in laparoscopic suturing. This approach to injury repair offers many possible benefits to the patient, including lower rates of wound infection and incisional hernia, and decreased postoperative pain.

Conclusion

The literature continues to support laparoscopy as a mode of access in which urinary incontinence, anterior vaginal wall prolapse, and lower urinary tract injuries may be managed. However, as with all types of surgery, surgical cure and morbidity is heavily dependent on surgical skill, experience, and comfort. As subspecialized surgical training in laparoscopy continues to expand, we can continue to expect the literature to support laparoscopy as a viable alternative to traditional laparotomy.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

1 Goebell R. About the surgical procedure for the treatment of incontinence of the urehta in men [in German]. A Gynak Urol 1910; 2:187–191.

2 Vancaillie TG, Schuessler W. Laparoscopic bladderneck suspension. J Laparoendosc Surg 1991; 1:169–173.

3 Richardson AC, Lyons JB, Williams NL. A new look at pelvic relaxation. Am J Obstet Gynecol 1976; 126:568–573.

4 Shull BL. How I do the abdominal paravaginal repair. J Pelvic Surg 1995; 1:43–48.

5 Miklos JR, Kohli N. 'Paravaginal plus' Burch procedure: a laparoscopic approach. J Pelvic Surg 1998; 4:297–302.

6 Kohli N, Miklos JR. Laparoscopic Burch colposuspension: a modern approach. Contemp Obstet Gynecol 1997; 42:36–55.

7 •• Miklos JR, Kohli N. Laparoscopic paravaginal repair plus Burch colposuspension: review and descriptive technique. Urology 2000; 56(suppl 6A):64–69.
This is an excellent and concise review of laparoscopic Burch colposuspension using conventional suturing technique. Also described is the laparoscopic approach to paravaginal repair.

8 •• Buller JL, Cundiff GW. Laparoscopic surgeries for urinary incontinence. Clin Obstet Gynecol 2000; 43:604–618.
This is a comprehensive review of the literature that attempts to cover all types of laparoscopic urinary incontinence procedures – the most comprehensive review to date.

9 • Persson J, Wolner-Hanssen P. Laparoscopic Burch colposuspension for stress urinary incontinence: a randomized comparison of one or two sutures on each side of the urethra. Obstet Gynecol 2000; 95:151–155.
This study represents an attempt at randomizing and comparing the laparoscopic Burch procedure using one or two sutures bilaterally. This is a study that should have been performed decades ago using an open technique.

10 Henley C. The Henley staple-suture technique for laparoscopic Burch colposuspension. J Am Assoc Gynecol Laparosc 1995; 2:441–444.

11 Das S, Palmer JK. Laparoscopic colpo-suspension. J Urol 1995; 154:1119–1121.

12 Ou CS, Presthus J, Beadle E. Laparoscopic bladder neck suspension using hernia mesh and surgical staples. J Laparoendosc Surg 1993; 3:563–566.

13 Soygur T, Safak M, Yesilli C, *et al.* Extraperitoneal laparoscopic bladder neck suspension using hernia mesh and tacker. Urology 2000; 56:121–124.

14 Kiilholma P, Haarala M, Polvi H, *et al.* Sutureless colposuspension with fibrin sealant. Tech Urol 1995; 1:81–83.

15 Albala DM, Schuessler WW, Vancaillie TG. Laparoscopic bladder suspension for the treatment of stress incontinence. Semin Urol 1992; 10:222–225.

16 Burton G. A randomized comparison of laparoscopic and open colposuspension [abstract]. Abstract in Neurourology and Urodynamics 1993; 16:353–354.

17 Polascik TJ, Moore RG, Rosenberg MT, Kavoussi LR. Comparison of laparoscopic and open retropubic colposuspension for treatment of stress urinary incontinence. Urology 1995; 45:647–652.

18 Liu CY. Laparoscopic treatment of genuine urinary stress incontinence. Clin Obstet Gyencol 1994; 8:789–798.

19 Gunn GC, Cooper RP, Gordon NS, Gragnon L. Use of a new device for endoscopic suturing in the laparoscopic Burch procedure. J Am Assoc Gynecol Laparosc 1994; 2:65–70.

20 Nezhat CH, Nezhat F, Nezhat CR, *et al.* Laparoscopic retropubic colposuspension. J Am Assoc Gynecol Laparosc 1994; 1:339–349.

21 Lyons TL, Winer WK. Clinical outcomes with laparoscopic approaches and open Burch procedures for urinary stress incontinence. J Am Assoc Gynecol Laparosc 1995; 2:193–197.

22 McDougal EM, Klutke CG, Cornell T. Comparison of transvaginal versus laparoscopic bladder neck suspension for stress urinary incontinence. Adult Urol 1995; 45:641–645.

23 Ross JW. Laparoscopic Burch repair compared to laparotomy Burch for cure of urinary stress incontinence. Int Urogynecol 1995; 6:323–328.

24 Langebrekke A, Dahlstrom B, Eraker R, Urnes A. The laparoscopic Burch procedure: a preliminary report. Acta Obstet Gyencol Scand 1995; 74:153–155.

25 Radomski SB, Herschorn S. Laparoscopic Burch bladder neck suspension: early results, J Urol 1996; 155:515–518.

26 • Ross JW. Two techniques of laparoscopic Burch repair for stress incontinence: a prospective randomized study. J Am Assoc Gynecol Laparosc 1996; 3:351–357.
This study supports the traditional and more difficult laparoscopic Burch versus a less traditional and easier procedure utilizing mesh and staplers.

27 Cooper MJ, Cario G, Lam A, Carolton M. A review of results in a series of 113 laparoscopic colposuspensions. Aust NZ J Obstet Gynaecol 1996; 36:44–49.

28 Lam AM, Jenkins GJ, Hyslop RS. Laparoscopic Burch colposuspension for stress incontinence: preliminary results. Med J Aust 1995; 162:18–22.

29 Su TH, Wang KG, Hsu CY, *et al.* Prospective comparison of laparoscopic and traditional colposuspensions in the treatment of genuine stress incontinence. Acta Obstet Gynecol 1997; 76:576–582.

30 Papasakelariou C, Papasakelariou B. Laparoscopic bladder neck suspension. J Am Assoc Gynecol Laparosc 1997; 4:185–188.

31 Lobel RW, Davis GD. Long-term results of laparoscopic Burch colposuspension. J Am Assoc Gyencol Laparosc 1997; 4:341–345.

32 • Ross JW. Multichannel urodynamic evaluation of laparoscopic Burch colposuspension for genuine stress incontinence. Obstet Gynecol 1998; 91:55–59.
This is one of the first papers to evaluate the laparoscopic Burch procedure using multichannel urodynamic studies.

33 Miannay E. Cosson M, Querleu D, Crepin G. Comparison of laparoscopic and laparotomy colposuspension in the treatment of urinary stress incontinence. Comparative study of 72 matched cases [in French]. Contracept Fertil Sex 1998; 26: 376–385.

34 Saidi MH, Gallagher MS, Skop IP, *et al.* Extraperitoneal laparoscopic colposuspension: short-term cure rate, complications and duration of hospital stay comparison with Burch colposuspension. Obstet Gyencol 1998; 92:619–625.

35 Summit RL, Lucente V, Karram MM, *et al.* Randomized comparison of laparoscopic and transabdominal Burch urethropexy for the treatment of genuine stress incontinence. Obstet Gynecol 2000; 95:(Suppl) 2.

36 •• Fatthy H, El Hoa M, Samaha I, Abdallah K. Modified Burch colposuspension: laparoscopy versus laparotomy. J Am Assoc Gynecol Laparosc 2001; 8:99–106.
This paper describes a prospective, randomized clinical trial of laparoscopy versus laparotomy for the Burch colposuspension using traditional suturing technique. The study appears to be well designed and appropriately performed.

37 Meyers DL, Peipert JF, Rosenblatt PL, *et al.*, and the George Anerson Outcomes Measurement Unit. Patient satisfaction with laparoscopic Burch retropubic urethropexy. J Reprod Med 2000; 45:939–943.

38 Drake MJ, Noble JG. Ureteric trauma in gynecologic surgery. Int Urogynecol J Pelvic Floor Dysfunct 1998; 9:108–117.

39 American College of Obstetricians and Gynecologists. Lower urinary tract operative injuries. ACOG Educational Bulletin 1997; 238:573–577

40 Hasson HM, Parker WH. Prevention and management of urinary tract injury in laparoscopic surgery. J Am Assoc Gynecol Laparosc 1998; 5:99–112.

41 Harris RL, Cundiff GW, Theofrastous JP, *et al.* The value of intraoperative cystoscopy in urogynecologic and reconstructive pelvic surgery. Am J Obstet Gynecol 1997; 177:1367–1369.

42 Pettit PD, Petrou SP. The value of cystoscopy in major vaginal surgery. Obstet Gynecol 1994; 84:318–320.

43 • Speight SE, Moore RD, Miklos JR. Frequency of lower urinary tract injury at laparoscopic Burch and paravaginal repair. J Am Assoc Gynecol Laparosc 2000; 7:515–518.
The emphasis of this paper is on the incidence of lower urinary tract injury during laparoscopic Burch and paravaginal repair. The authors also describe the repair and follow up of the unintentional cystotomies encountered.

44 Gilmour DT, Dwyer PL, Carey MP. Lower urinary tract injury during gynecologic surgery and its detection by intraoperative cystoscopy. Obstet Gynecol 1999; 94:883–889.

45 Nezhat C, Nezhat F. Laparoscopic repair of ureter resected during operative laparoscopy. Obstet Gynecol 1992; 80:543–544.

46 Nezhat C, Nezhat F, Green B. Laparoscopic treatment of obstructed ureter due to endometriosis by resection and ureteroureterostomy: a case report. J Urol 1992; 148:865–868.

47 Gomel V, James C. Intraoperative management of ureteral injury during operative laparoscopy. Fertil Steril 1991; 55:416–419.

48 • Tulikangas PK, Goldberg JM, Gill IS. Laparoscopic repair of ureteral transection. J Am Assoc Gynecol Laparosc 2000; 7:415–416.
This interesting case report contributes to our understanding of the diagnosis and laparoscopic repair of ureteral transection.

49 Harkki-Siren P, Kurki T. A nationwide analysis of laparoscopic complications. Obstet Gynecol 1997; 89:108–112.

50 Saidi MH, Sadler RK, Vancaillie TG. Diagnosis and managment of serious urinary complications after major operative laparoscopy. Obstet Gynecol 1996; 87:272–276.