Laparoscopic Paravaginal Defect Repair: Surgical Technique and a Literature Review

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ABSTRACT

Paravaginal defects, commonly seen in patients with anterior vaginal wall prolapse, are due to the detachment of pubocervical fascia from the arcus tendineus fascia pelvis (ATFP), at or near its lateral attachment. The majority of anterior vaginal wall prolapse is thought to be caused by paravaginal defects. Richardson et al. first described and demonstrated the anatomy of the paravaginal defect, as well as described the initial technique of the abdominal approach to repair. Since that time, the laparoscopic approach for repair has been developed and described with success rates of laparoscopic paravaginal defect repair reported in the range of 60% to 89%. This minimally invasive approach to address anterior wall prolapse eliminates the need for a vaginal incision, reduces risk of vaginal shortening and can be completed at the same time as other laparoscopic procedures, such as hysterectomy, sacralcolpopexy, and/or Burch Urethropexy. Compared to the open abdominal approach, there is improved visualization, less risk of bleeding, and faster recovery with the laparoscopic method. Compared to an anterior colporrhaphy, laparoscopic paravaginal repair is a much more anatomic repair of lateral defects and does not result in vaginal shortening. The laparoscopic paravaginal repair should be considered as the first-line treatment of anterior vaginal wall prolapse caused by lateral defects, including at time of laparoscopic/robotic sacralcolpopexy.
Anterior vaginal wall prolapse, also known as a cystocele, is a common defect with an overall prevalence of 33.8% of the general population. The defects of anterior wall prolapse may consist of one of the following defects by itself or in combination: 1) lateral defect 2) transverse apical defect 3) midline defect and/or a 4) distal defect. Paravaginal defect, or lateral defect, is the most common defect seen in patients with anterior vaginal wall prolapse (66%) (Fig. 1) and is due to the detachment of the pubocervical fascia from the arcus tendineus fascia pelvis (ATFP) at or near its lateral attachment. The defects can be diagnosed during surgery by visualizing the lateral detachment of the pubocervical fascia from the arcus tendineus fascia pelvis (ATFP) (Fig. 2). Miklos and Moore have previously shown that more than 90% of women presenting with either incontinence and/or anterior wall prolapse were found to have paravaginal defects on laparoscopic evaluation. Transabdominal paravaginal repair has a high success rate (91% to 95%), however, scientific evidence of laparoscopic paravaginal repair outcomes are still limited but increasing of late. Richardson et al. have proven that paravaginal defects exist and have described an abdominal approach technique to repair those defects.

The objective of this study is to describe a laparoscopic paravaginal repair surgical technique, explore related evidence of the laparoscopic approach to paravaginal repair and to provide an overall review of the paravaginal repair for anterior vaginal wall prolapse.

**INDICATION FOR LAPAROSCOPIC PARAVAGINAL REPAIR**

Laparoscopy should be considered as only a mode of abdominal access and not a change in operative technique. The surgical repair of paravaginal defects should not be different, whether the approach is vaginal, abdominal or laparoscopic. Ideally, the indications for a laparoscopic approach to paravaginal defect repair should be the same as an abdominal approach. The laparoscopic approach to paravaginal defect repair can be substituted for an open paravaginal repair in the majority of cases. Factors that might influence this decision include previous abdominal, pelvic or anti-incontinence surgery, the patient’s weight, the need for concomitant surgery and the surgeon’s experience. The surgeon’s decision to proceed with a laparoscopic paravaginal repair should be based on an objective clinical assessment that is consistent with a paravaginal defect anterior wall prolapse (cystocele), as well as the surgeon’s own surgical skills. The paravaginal repair can be performed alone or in combination with a urethropexy procedure for SUI or at the same time as a laparoscopic/robotic hysterectomy, vault suspension, or sacralcolpopexy.

**SURGICAL TECHNIQUE**

Preoperative modified bowel preparation—by full-liquid diet 48 hours prior to surgery, then a clear-liquid diet 24 hours prior to surgery, and then, finally, 8 ounces of magnesium citrate on the evening prior to surgery—is recommended. There have been recent studies that have questioned the benefit of this bowel prep. However, we have found it very helpful to have decompressed bowel for visualization purposes alone and have found much better visualization in patients that have done the full 48-hour bowel preparation.

The patient is placed in dorsal lithotomy position with both arms tucked to each lateral side and both legs in compression stockings and/or inflatable sequential compression devices to prevent embolism. A 16-French catheter is inserted into the bladder for continuous drainage. The balloon is filled with only 5cc to enable better visualization in the retropubic space and periurethral/bladder neck region. A prophylactic intravenous antibiotic is administered 30 minutes prior to skin incision. The technique of abdominal entry and insufflation is a matter of surgeon’s preference. The authors routinely perform open laparoscopy at the inferior margin of the umbilicus and utilize the Surgiquest Airseal® system (SurgiQuest Company, Connecticut) (Fig. 3a) for heated high-flow insufflation, continual smoke evacuation and stable pneumoperitoneum.

The umbilical port is part of the Floseal/Airseal® system. Three additional
ports are inserted under direct vision (Fig. 3b). The authors utilize a 10mm port in the left paramedian space, just below the level of the umbilicus after first identifying the inferior epigastric vessels directly. A 5mm port is placed four finger-widths above the pubic symphysis and the other 5mm port is place in the lower right quadrant. The type of port, choice of port size and placement depend upon the planned concomitant surgery, as well as the surgeon’s preference.

To enter into Retzius space, the bladder is filled with 250 ml of sterile water to identify the superior bladder edge. An incision is made in the peritoneum with a bipolar or unipolar hook, or other cutting energy device, between the umbilical ligaments approximately 3 cm above the edge of the superior margin of the bladder. Identification of loose areolar cobweb type tissue confirms the proper plane of dissection. Once the superior edge of the pubic bone (symphysis) is identified, the bladder is drained to avoid bladder injury. The retropubic space is entered by blunt dissection of the loose areolar tissue. After successful dissection, the retropubic landmarks are visualized, including the symphysis pubis, bladder neck, obturator neurovascular bundles, Cooper’s ligament, and the arcus tendineus fascia pelvis (or white line) (Fig. 2b). Paravaginal defects can be diagnosed during surgery by visualizing the lateral detachment of the pubocervical fascia away from the arcus tendineus fascia pelvis either unilateral or bilateral. The surgeon’s finger is placed in the vagina with one hand and elevates the anterior wall on each side, and with the other hand, the surgeon uses a laparoscopic kitner to dissect the bladder medially off the pubocervical fascia, which further delineates the defects.

After identification of the defect(s), the repair is begun by inserting the surgeon’s non-dominant hand into the vagina to elevate the anterior vaginal wall and the pubocervical fascia to their normal attachment along the arcus tendineus fascia pelvis. The paravaginal repair is then performed by re-approximating the pubocervical fascia back to the Arcus from the ischial spine to the pubic symphysis with four to five interrupted 2-0 non-absorbable sutures on SH needles. The sutures are placed through the 10mm left-sided port, and the surgeon completes all sutting and retrieval of the needles by her/himself. The assistant holds the camera and retracts only. The first suture is placed through the paravesical portion of the pubocervical fascia close to the apex of the vagina and then through the ipsilateral obturator internus muscle and fascia around the ATFP, approximately 1-2cm distal to the ischial spine (Fig. 4). The suture is secured using extracorporeal knot-tying technique. Good tissue approximation is accomplished without a suture bridge.

Another three to four sutures are placed between the ischial spine and a point 1-2cm from the urethrovesical junction in an interrupted fashion. The paravaginal defect repair is repeated on the other side if bilateral defects are present (Fig. 5).

Paravaginal defect repair restores anterior vaginal wall lateral attachment and support. However, it has little support in the literature for treatment of stress urinary incontinence (SUI). If a
patient has SUI, a laparoscopic urethropexy procedure can be performed after the paravaginal repair. By completing the paravaginal repair first, this sets the appropriate level of the anterior vaginal wall and helps decrease the risk of over-tensioning the urethropexy sutures. If the surgeon’s preference is to utilize a mesh-tape sling for SUI, instead of a Burch urethropexy, then this should be performed after the laparoscopic paravaginal repair is completed.

Upon completion of the repair, the intra-abdominal pressure is reduced and the retropubic space is inspected for hemostasis. Any bleeding is taken care of with bipolar electrocautery. If there is any mild venous oozing remaining, hemostatic matrices such as Floseal Hemostatic Matrix may be placed in the space to assist with hemostasis. The authors have also been investigating the use of a patient’s own platelet rich plasma (PRP) in the space to assist with hemostasis. Any bleeding is taken care of with bipolar electrocautery. If there is any mild venous oozing remaining, hemostatic matrices such as Floseal Hemostatic Matrix may be placed in the space to assist with hemostasis. The authors have also been investigating the use of a patient’s own platelet rich plasma (PRP) in the space to assist with hemostasis. Any bleeding is taken care of with bipolar electrocautery.

Cystoscopy is completed prior to closure of the peritoneum to assess for any injury to bladder or the urethra, any presence of sutures in the bladder and ureteral patency. The authors in the past utilized 5mg of Indigo Carmine dye intravenously; however with the shortage of indigo carmine, they currently have the patient take 200mg per oral dose of Pyridium prior to entering the operating room, and this has worked very well to evaluate ureteral patency. After cystoscopy, the peritoneal defect is closed with a 2-0 monofilament absorbable suture in a running fashion, and all ports are removed under direct visualization.

RESULTS

Medline database was used for identifying relevant studies published in English from 1949 until July 14, 2015. Search terms and strategies were described in an Appendix. Reference lists of included trials and previous systematic reviews were explored. Our searches yielded 111 citations, of which we reviewed the abstracts of 66 and full texts of 43; 28 met all inclusion criteria (Fig. 6). All 28 studies, which provided patient-outcome data, are 3 randomized-controlled trials (2 prospective cohort, 3 retrospective cohort and 20 descriptive studies). The primary outcome was objective anatomical success which defined as anterior compartment pelvic organ prolapse POP-Q point Ba<-1 or Baden Walker grade 0-1.

From review of the literature, the success rate of overall paravaginal repair ranged from 54% to 95.8%, with long-term follow-up period. The success rate of abdominal (APVR) and vaginal paravaginal repair (VPVR) was 60% to 94.4% and 54% to 97%, respectively. Laparoscopic paravaginal repair (LPVR) success rate ranges from 60% to 89% (Table I). Most studies use conventional abdominal ports and three to six non-absorbable interrupted sutures to complete the paravaginal repairs.

DISCUSSION

The true prevalence of paravaginal defects is underestimated because the clinical assessment of paravaginal defects is challenging. The correlation of preoperative clinical evaluation and intraoperative evaluation of paravaginal defects has low specificity and positive predictive values. However, the authors have found that more than 90% of women presenting with anterior wall defects and/or SUI and have laparoscopic surgery for either are found to have paravaginal defects intra-operatively. Ultrasound may also be a useful tool for identifying paravaginal defects. Paravaginal defects can be identified preoperatively by transabdominal and introital ultrasound. In addition, ultrasound can be used to evaluate success of paravaginal defect repair. Ultimately, however, a physical exam that shows rotational descent of the anterior vaginal wall that still has rugae is indicative of paravaginal defects being present. Additionally, anterior wall prolapse that is reduced with open-ring forceps being placed vaginally up near the ischial spines is also indicative of paravaginal defects (Bonney test). We have found that the majority of patients with vault prolapse also must have paravaginal defects present as it is inherent to the anatomic defect present causing the vault prolapse. As the vault prolapses down the vaginal canal, the anterior wall has to tear away laterally, starting at the apex, and continue to tear away laterally as the prolapse progresses down. Intraoperative transabdominal visualization, either by laparotomy or laparoscopy, or palpation of the pubocervical fascia detached from the arcus tendineus fasciae pelvis is still the gold standard in diagnosing a paravaginal defect. The transabdominal/laparoscopic approach allows for visualization of the anterior vaginal wall with identification of the paravaginal defect.
Paravaginal repair is an anatomically correct operation for the treatment of anterior wall prolapse due to paravaginal defects. As described above, the objective of the paravaginal repair is to reattach the anterolateral vaginal sulcus to the obturator internus muscles and fascia at the level of the ATFP or “white line”. Anterior vaginal wall prolapse cure rates of >95% have been reported using the abdominal approach and >90% utilizing the vaginal approach. Literature of the laparoscopic approach reveals the success rate of 60% to 89%. Rivoire et al. reported the high success rate of laparoscopic paravaginal repair (89%) in 138 women with long-term follow-up. Behnia-Willison et al. also reported a 76.4% success rate in 212 LPVR cases. Washington and Somers reported an 81.8% success rate of LPVR using mesh and staples in their 12-case series. Seman et al. demonstrated the success rate of 87.5% of LPVR in 32 women. These LPVR studies showed low major-complication rates. Most of the study reported high success, except one study that abandoned the LPVR group after five cases due to a low success rate compared with other groups. Most surgeons have abandoned the vaginal approach for repair, unless a graft is being utilized, as they have found it to be a very difficult procedure to complete and/or teach. Of course, in recent years, grafts have been utilized vaginally in the anterior compartment, both synthetic and biologic; however, the current paper is primarily focusing on native tissue paravaginal repair. A retrospective cohort study comparing VPVR with and without graft demonstrated that VPVR with graft had higher success rates (91% versus 70%). An RCT comparing anterior colporrhaphy versus VPVR with porcine graft versus VPVR with mesh showed that VPVR with mesh provided the highest success rate followed by VPVR with graft and anterior colporrhaphy, respectively. Any increase in cure rate with the use of mesh must be balanced with risks of complications.

From our review, there were studies comparing conventional anterior colporrhaphy and paravaginal repair. An RCT comparison between conventional anterior colporrhaphy plus polyglactin 910 mesh and abdominal paravaginal defect repair shows that there was no difference in both objective (32% versus 40%, p=0.56) and subjective failure rates and patient satisfaction at the 2-year follow-up period. Larrieux et al. conducted a study comparing APVR versus AR with a 26-month-average follow-up period. The success rate of APVR was higher than conventional anterior colporrhaphy (86.7% versus 31.3%).

A concern with any pelvic/vaginal reconstructive surgery is preservation of vaginal length. Conventional colporrhaphy has been shown to decrease the vaginal length by 28% after the procedure. The authors stated this was secondary to being able to repair an anterior enterocele at the time of surgery and therefore reducing the length of the vagina to normal. However, if the vaginal length is normal pre-operatively, there is a high risk of vaginal shortening with colporrhaphy. There is no available data of vaginal length after paravaginal repair; however, given the fact that no vaginal incision is made in the technique and no vaginal epithelium is removed, the likelihood of any vaginal shortening is inherently almost impossible. This is...
one of the major advantages of paravaginal repair, that is, there is no vaginal incision necessary, no splitting of the fibromuscular layer of the anterior vaginal wall and no vaginal epithelium that is excised. The paravaginal repair inherently preserves the nerves of the anterior vaginal wall, as well as vaginal length.

Assuming that the paravaginal repair technique is not compromised by the abdominal approach utilized (laparoscopic/robotic versus laparotomy), one should expect equal efficacy. The laparoscopic approach has been shown to have increased visibility, decreased complications, decreased blood loss, shorter hospital stay and faster recovery compared to an open abdominal approach. The paravaginal defect repair for anterior wall prolapse is a much more anatomic repair compared to traditional vaginal colporrhaphy, which is a compensatory procedure. In traditional anterior colporrhaphy, the surgeon plicates the fibromuscular layer of the anterior wall in the midline, reducing the prolapse/bulge. Theoretically, if lateral defects are present, this is pulling the healthy tissue farther away from their anatomic points of attachment laterally to the ATFP. This may be one of the reasons for the purported high failure rates of traditional colporrhaphy.

Currently, many surgeons are ignoring the anterior wall prolapse and attempting to treat all compartments with robotic sacralcolpopexy. Reduction of anterior wall prolapse with concurrent vault prolapse is accomplished by over-tensioning the vault in attempts to pull the anterior wall back up at the same time. This may solve the problem over the short term; however, this is not an anatomic repair of the anterior compartment and can lead to pain at the apex secondary to the mesh being overtightened. Additionally, we are now seeing reports of anterior wall prolapse following robotic sacralcolpopexy in which there was no anterior compartment repair. We would argue that the majority of patients with concomitant vault and anterior wall prolapse need a paravaginal repair at the same time as sacralcolpopexy, done robotically/laparoscopically or open.

Conclusion
Defects in the lateral attachment of the pubocervical fascia to the ATFP results in anterior vaginal wall prolapse. The literature supports the use of paravaginal repair in the treatment of anterior wall prolapse, but not for SUI. Higher cure rates are seen with paravaginal repair as compared with conventional vaginal colporrhaphy. With the recent concerns regarding transvaginal mesh procedures, surgeons are once again exploring traditional native tissue repair and/or turning to laparoscopic/robotic approaches to treat prolapse. One emerging concern, however, with the robotic sacralcolpopexy approach to treat all compartments, including the anterior compartment, is that it is resulting in over-tensioning of the mesh at the apex by trying to pull the anterior wall back into position in addition to the vault. This can lead to increased risk of pain or dyspareunia and/or pain and risk of anterior wall prolapse at a later date.

The authors support the use of laparoscopic paravaginal repair in the treatment of anterior wall prolapse and have been utilizing this approach for 20 years. We recommend consideration of its use at the same time as sacralcolpopexy if any anterior wall prolapse is present after appropriate tensioning of the mesh. The advantages of laparoscopic paravaginal defect repair are improved visualization of paravaginal defects versus the transvaginal approach and, therefore, correction of the actual defect. The laparoscopic or robotic approach (unfortunately, there has been very little work done in robotic retropubic procedures because of the difficulty of suturing in the space as well as having no tactile sensation to elevate the vagina with the surgeon’s hand) offers improved visualization, decreased risk of bleeding and infection, and faster recovery compared to laparotomy. The laparoscopic paravaginal repair can be performed alone or at
<table>
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<th>N</th>
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<th>Approaches</th>
<th>Outcomes</th>
<th>Cure rate</th>
<th>F/U time (months)</th>
<th>Operative time (min)</th>
<th>Complications</th>
<th>Length of stay (days)</th>
<th>EBL (ml)</th>
</tr>
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<tbody>
<tr>
<td>Minassian et al, 2014</td>
<td>70</td>
<td>RCT</td>
<td>APVR (n=35), AR (n=35)</td>
<td>Objective: POP-Q point Ba&lt;-1</td>
<td>APVR 60% vs. AR 68% (p=0.56)</td>
<td>24</td>
<td>30</td>
<td>7 (21%) unspecified</td>
<td>2 (2-3)</td>
<td>200 (100-300)</td>
</tr>
<tr>
<td>Hosni et al, 2013</td>
<td>45</td>
<td>prospective comparative</td>
<td>APVR (n=20), VPVR (n=20), LPVR (n=5)</td>
<td>POP-Q point Ba&lt;-1 and improvement of prolapse symptom</td>
<td>LPVR 60% vs. APVR 94.44% vs. 90% VPVR</td>
<td>12</td>
<td>N/A</td>
<td>8 blood transfusion (3 APVR, 4 VPVR, 1 LPVR), 1 LPVR bladder injury, 3 LPVR pyrexia</td>
<td>N/A</td>
<td>LPVR 560±53.1, APVR 477±51.6, VPVR 492±64.4</td>
</tr>
<tr>
<td>Leone Roberti Maggiore et al, 2012</td>
<td>36</td>
<td>Single-center prospective</td>
<td>VPVR using Capio suture-capturing device</td>
<td>The absence of a recurrent anterior vaginal wall prolapse of stage ≥2</td>
<td>91.40%</td>
<td>24</td>
<td>86 (67-130)</td>
<td>No major complications, 3 post-operative fever</td>
<td>3.3±5</td>
<td>35 (20-65)</td>
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<tr>
<td>Reid et al, 2011</td>
<td>111</td>
<td>Retrospective cohort</td>
<td>APVR (n=52), VPVR (n=59)</td>
<td>Objective anatomic success: Baden-Walker stage 0-1</td>
<td>APVR 88.5%, VPVR 69.5% (p=0.019)</td>
<td>72 (22-141)</td>
<td>N/A</td>
<td>None related to PVR</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Reid and Luo, 2011</td>
<td>108</td>
<td>Retrospective cohort</td>
<td>VPVR with graft or mesh (n=89), VPVR native tissue (n=59)</td>
<td>Objective anatomic success: Baden-Walker stage 0-1</td>
<td>VPVR with graft 90.7%, VPVR native tissue 69.6%</td>
<td>≥ 48</td>
<td>N/A</td>
<td>2 pelvic hematoma, 1 transient ureteral obstruction, 3 mesh related complication, 1 VVF</td>
<td>N/A</td>
<td>N/A</td>
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<td>Menefee et al, 2011</td>
<td>99</td>
<td>RCT</td>
<td>AR (n=32), VPVR with porcine dermis graft (n=31), VPVR with mesh (n=36)</td>
<td>Anatomical success: POP-Q point Ba&lt;-1</td>
<td>AR 42%, VPVR with porcine dermis graft 54%, VPVR with mesh 72%</td>
<td>24</td>
<td>AR 150±52, VPVR with porcine dermis graft 153±46, VPVR with mesh 170±65</td>
<td>3 SUI, 14% mesh erosion, 4% graft erosion, 7 new-onset dyspareunia</td>
<td>AR (n=32), VPVR with porcine dermis graft (n=31), VPVR with mesh (n=36)</td>
<td>AR 182±114, VPVR with porcine dermis graft 241±103, VPVR with mesh 251±155</td>
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<td>Geoffrion et al, 2011</td>
<td>105</td>
<td>descriptive</td>
<td>VPVR with porcine graft</td>
<td>No anterior wall prolapse recurrence at or beyond the hymen</td>
<td>68.80%</td>
<td>27.5 (12-60)</td>
<td>N/A</td>
<td>14 (23.7%) voiding dysfunction, 4 (6.8%) intraoperative cystotomy, 3 (5.1) blood transfusion, 2 (3.4) UTI, 2 (3.4) fever, 8.3% dyspareunia</td>
<td>N/A</td>
<td>N/A</td>
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### Table I

#### Characteristics (continued)

<table>
<thead>
<tr>
<th>Author, year</th>
<th>N</th>
<th>Study design</th>
<th>Approaches</th>
<th>Outcomes</th>
<th>Cure rate</th>
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<tr>
<td>Shippey et al, 2010&lt;sup&gt;12&lt;/sup&gt;</td>
<td>170</td>
<td>Retrospective cohort</td>
<td>ASC with APVR (n=62), ASC (n=108)</td>
<td>Objective: POP-Q point B&lt;sub&gt;a&lt;/sub&gt;&lt;1</td>
<td>ASC with APVR 83.9%, ASC 72.1% (p=0.13)</td>
<td>ASC with APVR 16 (0.5-62), ASC 12.9 (0.4-56)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>de Tayrac et al, 2010&lt;sup&gt;13&lt;/sup&gt;</td>
<td>48</td>
<td>Descriptive</td>
<td>Bilateral SSF with VPVR with mesh</td>
<td>Objective: POP-Q point B&lt;sub&gt;a&lt;/sub&gt;&lt;1</td>
<td>95.80%</td>
<td>8 (1-18)</td>
<td>N/A</td>
<td>1 (2.1%) bladder injury, 3 (6.3%) hematoma, 2 (4.3%) ureteral kinking, 2 (4.2%) sciatic nerve pain</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Banerjee et al, 2010&lt;sup&gt;14&lt;/sup&gt;</td>
<td>85</td>
<td>Descriptive</td>
<td>LPVR with suture/mesh</td>
<td>N/A</td>
<td>N/A</td>
<td>30 (12-52)</td>
<td>50</td>
<td>1 (1.1%) bladder injury, 9 (5.8%) urinary retention, 2 (2.4%) hematoma</td>
<td>4 (2-17)</td>
<td>25 (10-150)</td>
</tr>
<tr>
<td>Ward et al, 2007&lt;sup&gt;15&lt;/sup&gt;</td>
<td>33</td>
<td>Retrospective monocentric study</td>
<td>VPVR with AlloDerm graft</td>
<td>Objective: POP-Q point B&lt;sub&gt;a&lt;/sub&gt;&lt;1</td>
<td>41.70%</td>
<td>52 (18-86)</td>
<td>N/A</td>
<td>10 SUI</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Rivoire et al, 2007&lt;sup&gt;16&lt;/sup&gt;</td>
<td>138</td>
<td>Retrospective monocentric study</td>
<td>Laparoscopic promontofixation using mesh with LPVR (n=40)</td>
<td>Objective: absence of recurrent (grade 0-2) not specific to anterior compartment</td>
<td>89%</td>
<td>33.7±17.4</td>
<td>190</td>
<td>1 hemorrhage, 2 bladder injury, 3 vaginal injury, 2 subcutaneous emphysema, 7 mesh erosion</td>
<td>4.7±2.1</td>
<td>N/A</td>
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<td>Morse et al, 2007&lt;sup&gt;17&lt;/sup&gt;</td>
<td>165</td>
<td>Retrospective cohort</td>
<td>AR (n=32), VPVR with porcine dermis graft (n=31), VPVR with mesh (n=36)</td>
<td>Objective: Baden-Walker grade&lt;2 at anterior compartment, Subjective failure: bladder or bulge symptom</td>
<td>Not report success rate, median survival (time to recurrence) 41 months for AR vs. 12 months for AR with VPVR, subjective failure 55% AR and 46% AR with VPVR</td>
<td>98 AR, 46 AR with VPVR</td>
<td>N/A</td>
<td>AR 305±172, AR with VPVR 387±245 (p=0.005)</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Demirci et al, 2007¹⁸</td>
<td>42</td>
<td>descriptive</td>
<td>APVR</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>92.90%</td>
<td>40</td>
<td>N/A</td>
<td>1 bladder injury, 2 hemorrhages</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Behnia-Willison et al, 2007¹⁹</td>
<td>212</td>
<td>descriptive</td>
<td>LPVR</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>76.40%</td>
<td>14.2</td>
<td>50-255</td>
<td>2 (0.9%) excessive blood loss, 7 (3.3%) bladder injury, 2 (0.9%) unintended laparotomy, 1 (0.5%) bowel injury</td>
<td>4 (2-17)</td>
<td>50</td>
</tr>
<tr>
<td>Viana et al, 2006²⁰</td>
<td>66</td>
<td>descriptive</td>
<td>VPVR</td>
<td>Objective anatomic success: Baden-Walker stage 0-1</td>
<td>91.60%</td>
<td>12</td>
<td>N/A</td>
<td>No major complications, 25 Hemoglobin drop&lt;2</td>
<td>4.9 (3-10)</td>
<td>N/A</td>
</tr>
<tr>
<td>Simsiman et al, 2006²¹</td>
<td>111</td>
<td>descriptive</td>
<td>VPVR with polypropylene mesh</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>78%</td>
<td>24±10.1 (6-44)</td>
<td>N/A</td>
<td>8% postoperative SUI, 3 ureteral kinking, 15 (16.7%) graft erosion</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Rodriguez et al, 2005²²</td>
<td>98</td>
<td>descriptive</td>
<td>VPVR with polypropylene mesh</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>85%</td>
<td>3</td>
<td>N/A</td>
<td>1 transient ureteral obstruction due to hematoma, 1 recurrent enterocoele needed surgical correction, 3 de novo SUI</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Washington and Somers, 2003²³</td>
<td>12</td>
<td>case series</td>
<td>LPVR using mesh and staples</td>
<td>Objective: the difference between point Ba pre and postoperatively</td>
<td>81.80%</td>
<td>5-25</td>
<td>N/A</td>
<td>1 deep dyspareunia, 1 bladder drop, 1 failure of one side</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>Seman et al, 2003²⁴</td>
<td>73</td>
<td>descriptive</td>
<td>LPVR (n=32)</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>87.50%</td>
<td>8 (0-26)</td>
<td>156 (45-990)</td>
<td>1 blood transfusion, 12 (16.4) UTI</td>
<td>5.4 (2-12)</td>
<td>129 (20-1300)</td>
</tr>
<tr>
<td>Clemons et al, 2003²⁵</td>
<td>33</td>
<td>descriptive</td>
<td>VPVR with Alloderm graft</td>
<td>Objective: POP-Q point Ba&lt;1</td>
<td>59%</td>
<td>18 (6-48)</td>
<td>N/A</td>
<td>1 Feble morbidity, 1 cystotomy, 1 hematoma, 5 erosion</td>
<td>N/A</td>
<td>378 (150-1000)</td>
</tr>
<tr>
<td>Author, year</td>
<td>N</td>
<td>Study design</td>
<td>Approaches</td>
<td>Outcomes</td>
<td>Cure rate</td>
<td>F/U time (months)</td>
<td>Operative time (min)</td>
<td>Complications</td>
<td>Length of stay (days)</td>
<td>EBL (ml)</td>
</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Young et al, 2001</td>
<td>100</td>
<td>case series</td>
<td>VPVR</td>
<td>Objective: the lateral sulci of anterior vaginal walls were grade 0 and firmly apposed to the lateral pelvic sidewall</td>
<td>98%</td>
<td>11 (1-36)</td>
<td>N/A</td>
<td>3 hemorrhage, 16 blood transfusion, 2 lower extremity neuropathy</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Malipeddi et al, 2001</td>
<td>45</td>
<td>descriptive</td>
<td>VPVR</td>
<td>Objective anatomic success: Baden-Walker stage 0-1</td>
<td>97%</td>
<td>20.18±8.5 (0.8-34.63)</td>
<td>N/A</td>
<td>N/A</td>
<td>2.6±1.1 (1-6)</td>
<td>400 (100-1,000)</td>
</tr>
<tr>
<td>Larrieux et al, 2001</td>
<td>77</td>
<td>descriptive</td>
<td>ASC with Burch with APVR (n=39/45) vs. SSF±AR (n=32)</td>
<td>No present paravaginal defects</td>
<td>ASC with APVR 86.7%, 31.3% SSF±AR</td>
<td>26 (6-71)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Miklos and Kohli, 2000</td>
<td>171</td>
<td>review and case series</td>
<td>LPVR with Burch</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>4 (2.3%) cystotomy</td>
<td>1</td>
<td>70</td>
</tr>
<tr>
<td>Mallipeddi et al, 1998</td>
<td>45</td>
<td>descriptive</td>
<td>VPVR</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1 bilateral ureteral obstruction, 1 retro pubic hematoma, 2 vaginal abscess, 2 blood transfusion</td>
<td>2.6±1.1 (1-6)</td>
<td>N/A</td>
</tr>
<tr>
<td>Farrell and Ling, 1997</td>
<td>27</td>
<td>descriptive</td>
<td>VPVR using Currycombs</td>
<td>N/A</td>
<td>80%</td>
<td>8</td>
<td>N/A</td>
<td>15% febrile morbidity, 15% UTI, 22% transient urinary retention</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Benson et al, 1996</td>
<td>88</td>
<td>RCT</td>
<td>SSF with VPVR (n=48) vs. ASC (n=38)</td>
<td>Asymptomatic vaginal apex descent &lt;50% of its length of vaginal wall protrusion beyond the hymen</td>
<td>SSF with VPVR 67% vs. ASC 84%</td>
<td>30 (12-66)</td>
<td>SSF with VPVR 196±38 vs. ASC 215±47</td>
<td>N/A</td>
<td>SSF with VPVR 5.1±1.2 vs. ASC 5.4±1.1</td>
<td>N/A</td>
</tr>
</tbody>
</table>
the time of other prolapse procedures, hysterectomy and/or procedures for SUI. The outcomes may vary, depending on several factors such as surgeon experience, surgeon's preference, and extent of anterior vaginal wall defect. For further study, an RCT should be conducted to demonstrate the benefit of laparoscopic vaginal repair compared with other approaches.

**AUTHORS’ DISCLOSURES**

The authors have no conflicts to disclose.

**REFERENCES**


**APPENDIX**

Table I. PubMed Search Strategy

| paravaginal[All Fields] | AND | ("wound healing"[MeSH Terms]) OR ("wound")[All Fields] AND "healing"[All Fields] OR "wound repair"[All Fields] | 11 |