Laparoscopic chordofixation:
a new technique for vaginal vault suspension

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Abstract. Objective: The aim of this study was to assess the surgical feasibility, safety and clinical/anatomical outcomes of vaginal vault suspension applying a new method at the time of laparoscopic hysterectomy. This technique was based on the theory that the use of the obliterated umbilical artery as an anchoring structure provides a safe, anatomically correct and flexible suspension to the vaginal cuff. *Methods:* Twentyfive patients during an 8-month period with a benign disease, in two cases with coexisting pelvic floor disorder, underwent total laparoscopic hysterectomy completed by a bilateral suspension of the vaginal vault to the proximal segment of the obliterated umbilical artery (chorda). Patients were examined at 6 weeks after the operation with site-specific analysis of vaginal cuff anatomy and interviewed by a questoinnaire focusing on pre- and postoperative complaints. The overall follow-up lasted 8 months. *Results:* There were no intra- and postoperative complications. Six weeks after the operation all patients were without complaints. The length, the position and the axis of the vaginal cuff was found to be excellent in all cases, yet, the fixed vaginal cuff was found to be flexible. In the two cases when surgery was performed for patients with moderate apical prolapse no prolapse of the vaginal vault could be detected at six weeks and in one case 5 month following the operation. *Conclusion:* Vaginal vault suspension through the chorda of the umbilical artery is easily performed via laparoscope and is associated with excellent clinical and anatomical outcomes in short-term follow-up.

Key words: Apical Prolapse; Laparoscopic Vaginal Vault Suspension.

INTRODUCTION

The exact incidence of vaginal vault prolapse is not known but has been estimated to occur in 0.1–45% of patients who have undergone hysterectomy[1,2]. Loss of pelvic support with resultant pelvic organ prolapse results from impairment and/or attenuation of any part of the pelvic support system. There are multiple risk factors known to increase a woman's risk for the development of pelvic organ prolapse. These risk factors can be categorized as predisposing, inciting, promoting, and decompensating events. Among the inciting events we may find prior surgery such as hysterectomy[3]. Support for the vaginal apex is provided by the fibers of the paracolpium comprising the cardinal and uterosacral ligaments (Level I)[4]. In contrast, support for the midportion of the vagina derived from the lateral attachments to the arcus tendineus fasciae pelvis and superior fascia of the levator ani muscles (Level II)[5]. However, some suggest that anterior wall support defects are often a result of coincident apical prolapse[6]. This suggests that in cases when patients have both cystocele and apical prolapse, surgery to address the apical defect may obviate additional surgery to repair the cystocele.

Apical support defects may occur because of the compromise of the cardinal uterosacral ligament complex or failure to reapproximate the superior aspects of the pubocervical and rectovaginal fascia at the time of hysterectomy[7]. The key anatomical structure for the adequate suspension of the apical vagina and the cervix of the uterus is the pericervical ring with the ligamentous condensations of the endopelvic fascia attached to it[8]. During hysterectomy, this ring might be directly, or, by impairing the blood supply to it, indirectly damaged. This damage may lead to weakening of the fascia and, thus, might later result in apical prolapse. That is why a proper suspension of the apex of the vagina at the time of hysterectomy is important. Beyond that, when hysterectomy is performed for prolapse, hysterectomy alone, or with colporrhaphy, is insufficient; a specific vault suspension procedure must be performed in addition to the hysterectomy[9]. As early as 1929, in his description of hys-

terectomy techniques, Dr Richardson emphasized the importance of proper identification and use of the uterosacral ligaments during vaginal cuff closure at the time of hysterectomy to ''guarantee'' the prevention of subsequent pelvic organ prolapsed[10]. Studies suggest that apical vault repair should be used routinely along with laparoscopic hysterectomy[11]. Based on above principles we have designed a new laparoscopic vault suspension technique that is simple to perform, uses no foreign material, appears to be safe and provides excellent support to the apical vagina with proper position, orientation and axis of the vaginal cuff. The procedure uses the obliterated umbilical artery as an anchoring structure to suspend the vaginal cuff.

MATERIALS AND METHODS

Patients

Altogether 25 patients admitted between December 1, 2009 and August 1, 2010 for hysterectomy with or without adnexectomy due to benign uterine disease were randomly selected preoperatively. After thorough preoperative counseling patients gave written consent to the procedure.

Evaluation of pelvic floor integrity prior and after the operation

We used the standardized pelvic organ prolapse quantification (POP-Q) exam to quantify, describe, and stage pelvic support[12].

Surgical technique

All laparoscopic hysterectomies were performed using the intrafascial technique similar to the one described recently by Hohl and Hauser[13]. Minor differences in our hysterectomy procedure are the use of Mangeshikar uterusmanipulator (Bissinger Medizintechnik GmbH, Teningen, Germany), the application of only two secondary 5-mm ports (one on each side) for the surgical instruments, the use of EnSeal Advanced Bipolar Device (Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA) for temperature con-
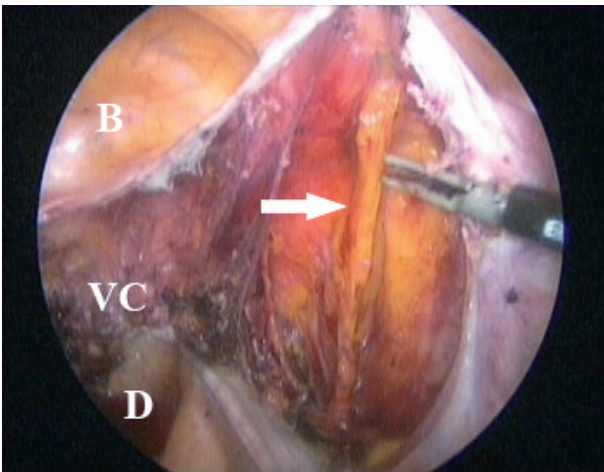
Figure 1. – The exposed chorda of the right side in the retroperitoneum at the level of resection (arrow). B: urinary bladder; VC: vaginal cuff (sutured); D: Douglas pouch.
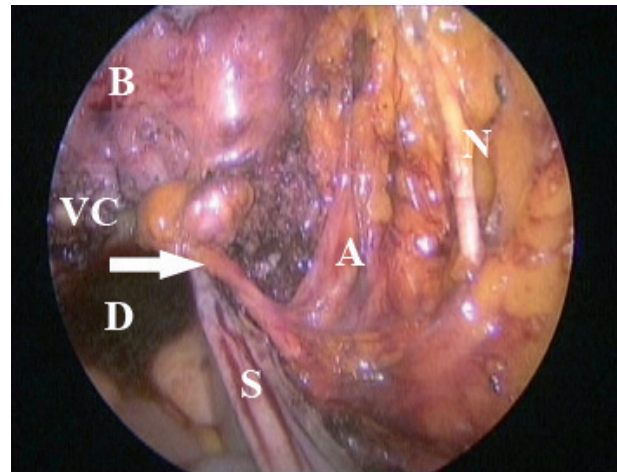

Figure 2. – The chorda of the right side (arrow) sutured to the vaginal cuff (VC). B: urinary bladder; D: Douglas pouch; S: sacrouterine fold; A: superior vesical artery; N: obturator nerve.

trolled vessel sealing and tissue cutting. At the end of hysterectomy we apply one running suture using 1–0 polydiaxonon (PDS, Ethicon, Inc. Somerville, New Jersey, USA), incorporating cardinal and sacrouterine ligaments as well as the endopelvic fascia posteriorly and anteriorly to close the vagina knotted intracorporally. At this point, the fixation of the vaginal vault starts with the preparation of the obliterated umbilical arteries (chordae). The procedure described below is performed on both sides.

Step 1. *The localization of the chorda* on the anterior abdominal wall is simple, grabbing the medial umbilical fold and tracing it back proximal shortly above the point where it crosses the pelvic brim anteriorly. In obese patients gentle movements with a blunt grasper on the abdominal wall in a horizontal way may help identify the fold and the chorda in it.

Step 2. *Preparation of the chorda* with opening the retroperitoneum next to it using EnSeal, then cutting the chorda just a few centimeters above the pelvic brim (Figure 1). Thus we ensure that ample length of the obliterated (ligamentous) vessel will be available for proper fixation, in order not to cause overstretch of the vaginal membrane. We recommend to leave some extra fat tissue of the abdominal/pelvic wall on the chorda thus making the anchoring structure bulkier. During the preparation one should pay attention to the preservation of the most distal branch of the umbilical artery that is the superior vesical artery, so blood supply to the bladder is not affected. This is better ensured by keeping bulkier fat tissue on the chorda. Also, anchorage of the chorda on the vaginal vault provides a firmer bridge if the anchoring structure is bulkier. The pulsation of the superior vesical can later be visually verified at the end of the fixation procedure.

Step 3. *Determining the suture points of the chorda* by approximating it to the lateral edge of the vaginal vault. If the patient has previously had a prolapse, the vault should be elevated by a manipulator to develop a normal anatomical rectouterine pouch. The basic rule is not to overstretch the vagina.

Step 4. *Placing the sutures* using nonabsorbable, braided, 2-0 Ethibond Excel Polyester surgical suture (Ethicon, Inc. Somerville, New Jersey, USA). First we place the suture in the chorda at the point what we consider to be the optimal point for fixation without overstretch. Then we continue placing the suture into the lateral edge of the vaginal cuff and the paracolpium between the cardinal and sacrouterine ligaments. The suture is knotted intracorporally. If proper

fixation has been done, a deep cul-de-sac is clearly visible (Figure 2).

Step 5. *Checking the ureters and the pulsation of the superior vesical artery* is optional. We performed that during our first few operations and found that both ureters were moving free under the fixed chorda without obliteration. The pulsation of the preserved superior vesical arteries were also clearly seen. In doubt these can be ensured by blunt dissection of the retroperitoneum below the newly placed chorda (for the ureters) and a gentle dissection alongside the chorda finding the superior vesical artery that forms a "Y" shape together with the chorda from which it is now given off laterally.

The peritoneum remains open. Hemostasis is checked and a thorough lavage using warm ringer lactate is done.

Evaluation and follow-up

In follow-ups primary gynecological care providers of patients have been involved. We constructed a detailed questionnaire for the primary gynecological care taker colleagues to standardize the long-term postoperative follow-up of patients. This questionnaire focuses on the pre- and postoperative conditions of patients regarding the presence of prolapse, problems with urinary and/or fecal continence, difficulties with emptying the bladder, pain in conjunction with or independent of sexual intercourse.

RESULTS

Until date the longest follow-up period has been eight months.

Intraoperative or short term post-operative complications

So far we have not encountered any intraoperative complication, including ureteral injury or serious bleeding from the adjacent branches of the internal iliac artery.

Anatomical outcome

At follow-up examinations 6 weeks after the operation all patients were without complaints. The anatomical outcome concerning the length, the position and the axis of the vaginal cuff was found to be excellent in all cases, using the POP-Q prolapse evaluation method. On the other hand, the fixed vaginal cuff was found to be flexible, that is believed to be enough to accommodate physical wear during intercourse. When surgery was performed for patients with moderate apical prolapse (POP-Q Stage II., 2 cases), no prolapse could be detected at 6 weeks.

Later post-operative complaints

We have no data about complaints or complications such as pain, apical prolapse, pain during intercourse, problems with voiding or defecating. One of our major concern was a later bleeding from the internal iliac vessel due to an abrupt damage during intercourse but this has not been encountered, either. Similarly, no data about fistulas or delayed postoperative recovery for any reason are known. In one of the two cases when Stage II prolapse was present prior the operation, the later follow-up examination has not been possible but in the other case, at 5 month following surgery, no apical prolapse, but cystocele and rectocele was recorded.

DISCUSSION

Our experience suggests an improved outcome of pelvic floor anatomy by applying chordofixation at the time of hysterectomy. However, due to the limited number of cases and follow-up period, we have not been able to draw firm, long-term conclusions. The treatment and prevention of vaginal vault prolapse is challenging, as best shown by the fact, that more than 40 different techniques exist to treat this pathology[14]. Moreover, controversy exists over the choice of vaginal procedure as well as the relative merits of vaginal versus abdominal suspension procedures.

The primary indication for sacrospinous ligament fixation was to correct total procidentia or post-hysterectomy vaginal vault prolapse with an associated weak or atrophied cardinal-uterosacral ligament complex[14]. There is controversy about whether it should be used as a prophylactic measure after vaginal hysterectomy[15,16]. When performed for correction, the objective cure rate ranged from 8% to 94%[14]. Complications may include hemorrhage with a transfusion rate of 2%, perforation of the bladder, rectum, and small bowel (0.8%), ureteral kinking and micturition problems (2.9%), vaginal adhesions and rectovaginal fistulas (0.5%), and nerve damage to the femoral, peroneal, or sciatic nerves (1.8%)[17]. Gluteal pain may resolve within 6 weeks, but patients may require reoperation[14]. Also, vaginal narrowing and shortening may occur. Sexual dysfunction has also been reported in up to 13% of the patients[18,17]. When performed unilaterally, normal vaginal axis is not established.

Another approach is the suspension of the vaginal vault to the uterosacral ligaments[19]. It can be used prophylactically at hysterectomy or for treatment of vault prolapse[20]. It's main advantages are a normal resultant vaginal axis and avoidance of suturing near neural or vascular structures. However, when performed in a patient with lax uterosacrals (and resultant prolapse), the anatomical outcome is highly questionable. Furthermore, intraoperative ureteral injury has been reported as high as 11%[21].

Bilateral fixation of the vaginal apex to the iliococcygeus fascia was first described in 1963[22]. A potential benefit is the absence of vulnerable structures in the area. The success rate ranges from 81%[23] to more than 90%[24-26].

An abdominal approach, using autologous, allograft, or synthetic material, is indicated after failed vaginal repair, when concomitant abdominal surgery is required, or when the surgeon is not familiar with the vaginal route[27]. In an extensive review[28], the success rate ranged from 58% to 100%. The overall rate of mesh erosion was 3.4%. Although mesh erosion can frequently be managed by vaginal excision of all or part of the mesh, laparotomy or laparoscopy is occasionally required[29]. Some concern has also been raised about the durability of allograft fascia[30].

Beyond vaginal and abdominal routes, laparoscopic approaches have also developed with the first one reported in 1992[31]. The uterosacral suspension was first reported by Miklos and colleagues using a combined vaginal and laparoscopic approach[32]. The full laparoscopic procedure was reported in 2001[33]. The laparoscopic sacral colpopexy evolved from the classical open procedure using graft material attached to the anterior and posterior vaginal walls and to the presacral ligament. There has been one cohort study to compare laparoscopic sacral colpopexy with the open procedure[34]. In the laparoscopic group the mean operating time was longer, blood loss was lower, and hospital stay appeared to be shorter.

The large number of operative techniques demonstrates the lack of one univocally successful operative procedure. The disadvantage of the vaginal routes comprises relatively lower success rates, less visualization, higher incidence of injury to adjacent organs or bleeding. Furthermore, unilateral operations establish distorted vaginal anatomy. The abdominal routes might be considered obsolete unless there is a need for concomitant abdominal surgery. All techniques that use the sacrouterine and/or cardinal ligament complex to restore anatomy, might face the challenge of restoring anatomy using the already lax tissues. Laparoscopic sacral colpopexy uses foreign material that can be a source of later erosion or *de novo* dyspareunia. Moreover, a recent safety communication of the U.S. Department of Food and Drug Administration[35] has shown, that no evidence exists to prove any added benefit of transvaginal apical repair with mesh compared to traditional surgery without mesh. Also, the FDA review advocated, that most cases of POP can be treated successfully without mesh.

Our technique of chordofixation uses no foreign material, thus no later erosion can be expected. Also, the procedure is extremely cost-effective. So far no *de novo* dyspareunia has been encountered. It is probable, that the obliterated umbilical artery maintains its basically vessel-type flexibility, that synthetic meshes never possess. Furthermore, this anatomical structure bears no signs of wear or tear over the years or due to a multiparous status. Thus, it can be safely used even in patients presenting with prolapse. In addition, based on the course of the vessel and its relation to the apex of the vaginal cuff, proper axis, length and orientation of the vagina is ensured. The procedure is easy to perform, requires no extra surgical skills and it is not time consuming. The technique is extremely safe, puts no extra risk to the bladder, ureters, the rectum or great vessels, mainly because of the ease of the preparation and the anatomical location of the chorda. Based on our experience, we highly recommend this method be applied routinely in all laparoscopic hysterectomies as a preventive measure. However, in order to elucidate its long term efficacy, prospective studies are necessary. Beyond that, we believe, that our procedure should also be offered as a curative method for patients presenting with vaginal vault prolapse. For that, prospective studies concerning efficacy and safety must be designed.

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