

# Laparoscopic mesh procedures for the treatment of pelvic organ prolapse – review of the literature

Zabiegi laparoskopowe z użyciem materiałów syntetycznych w leczeniu zaburzeń statyki narządu rodnego – przegląd literatury

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## Abstract

**Objectives:** The main aim of the article was to describe laparoscopic mesh procedures for the treatment of pelvic organ prolapse, as well as evaluate their role, outcomes and limitations.

**Material and methods:** In February 2014, online search of English-language literature in PubMed was performed. This paper presents the analysis of reports published over the last decade that included at least 50 patients with a minimum of 12 months of follow-up.

**Results:** Numerous laparoscopic techniques to restore proper anatomy in patients with pelvic organ prolapse have been described. Laparoscopy provides a number of important advantages, including enhanced visualization of the pelvic anatomy, reduction of adhesion formation, lower morbidity and blood loss, decreased postoperative pain, smaller incision and quicker recovery. Nonetheless, this access is technically more difficult than an open or vaginal surgery due to two-dimensional vision and decreased degrees of freedom. It requires high level of laparoscopic suturing skills and longer operative time, especially at the beginning of the learning curve.

**Conclusions:** Laparoscopic sacrocolpopexy, hysteropexy and lateral suspension are interesting and effective options for the treatment of pelvic organ prolapse, providing a number of important advantages characteristic for endoscopic techniques.

Key words: **pelvic organ prolapse / laparoscopy / sacrocolpopexy / hysteropexy / laparoscopic lateral suspensio**

## Streszczenie

**Cel pracy:** Celem pracy jest opis zabiegów laparoskopowych z użyciem materiałów syntetycznych w leczeniu zaburzeń statyki narządu rodnego, ocena ich skuteczności i ograniczeń w stosowaniu.

**Materiał i metody:** W lutym 2014 roku dokonano przeglądu literatury anglojęzycznej dostępnej w bazie PubMed. W poniższej publikacji poddano analizie wyniki badań opublikowanych w ciągu ostatnich 10 lat, przeprowadzonych na grupie co najmniej 50 pacjentek, u których efekt zabiegu został oceniony po minimum 12 miesiącach od operacji.

**Wyniki:** W leczeniu zaburzeń statyki narządu rodnego zostało opisanych wiele technik laparoskopowych. Laparoscopia daje możliwość lepszej wizualizacji struktur anatomicznych, redukuje ilość zrostów oraz dolegliwości bólowych po operacji, zmniejsza utratę krwi i przyczynia się do szybszego powrotu do zdrowia. Ten typ operacji jest jednak trudniejszy od zabiegów pochwowych lub wykonywanych z klasycznego dostępu ze względu na dwuwymiarowe widzenie i ograniczoną swobodę ruchów, jak również wymaga umiejętności laparoskopowego szycia i dłuższego czasu operacji zwłaszcza na początku nauki.

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**Wnioski:** *Laparoskopowa sakrokolpopeksja, histeropeksja i boczne podwieszenie macicy są interesującymi i skutecznymi metodami leczenia zaburzeń statyki narządu rodneego dającymi przy tym korzyści typowe dla zabiegów endoskopowych.*

Słowa kluczowe: **zaburzenia statyki narządu rodneego / laparoscopia / sakrokolpopeksja / histeropeksja / boczne podwieszenie macicy /**

## Introduction

Pelvic organ prolapse (POP) is an important and common medical problem, affecting 50% of all women worldwide. Disease prevalence varies depending on the study and definitions used by the authors [1]. POP incidence is estimated at 3-6% in case of symptom evaluation, but 41-50% if the evaluation is based on an examination. Mild prolapse is often asymptomatic, thus only 10-20% of patients seek medical care [2]. Epidemiological studies show that 11% of the affected women will undergo surgery for POP or urinary incontinence (UI) [3]. Annually, 200.000 women in the United States (US) undergo reconstructive surgery of the pelvic floor [4]. The problem becomes more common with ageing [1]. It is estimated that by 2050 the number of patients in US with symptomatic POP will have increased to 46% [2,5]. Population trends in Europe are similar so the number of POP procedures and health care costs may be expected to rise as the population ages. The primary objective of any POP surgery is to correct the defects of the pelvic floor and restore vaginal anatomy and support in order to re-establish and preserve normal bladder, bowel and sexual function [6]. Numerous operative abdominal and vaginal techniques to restore proper anatomy by suspending the vaginal vault, uterus, bladder, and rectum have been described [7]. There is a growing interest in the use of minimally invasive procedures to correct POP [6]. The first report of laparoscopic management of pelvic floor relaxation was published in 1991 [8]. The laparoscopic approach has been successfully adopted for many procedures which were previously performed by the abdominal or vaginal route [6]. Laparoscopy provides a number of important advantages, including enhanced visualization of the pelvic anatomy, reduction of adhesion formation, lower morbidity and blood loss, decreased postoperative pain, smaller incision and quicker recovery [7]. Nonetheless, this access is technically more difficult than an open or vaginal surgery due to a two-dimensional vision and decreased degrees of freedom. Also, it requires high laparoscopic suturing skills and longer operating time, especially at the beginning of the learning curve [6, 8, 9].

## Objectives

The main aim of the article was to evaluate the role of laparoscopy in the treatment of pelvic organ prolapse and to describe available techniques, their outcomes and limitations.

## Material and methods

In February 2014, online search of English-language literature in PubMed was performed using the terms: *pelvic organ prolapse AND laparoscopy*. After a review of the available literature, an additional search of the same database was conducted using the following terms: *laparoscopic sacrocolpopexy, laparoscopic hysteropexy, laparoscopic lateral suspension*.

This paper includes an analysis of reports on laparoscopic mesh procedures for the treatment of POP, published over the last decade, that studied a minimum of 50 patients with at least a 12-month follow-up.

## Results

Initially, we found numerous publications regarding different techniques of laparoscopic prolapse repairs, but many of them analyzed small groups, with a short follow-up, thus providing insufficient data to evaluate their long-term efficacy. We also discovered a lack of well-designed trials comparing efficacy of different laparoscopic techniques, with the exception of laparoscopic sacrocolpopexy (LSC), whose efficiency and long-term results were reported in many studies and compared with other techniques.

### Laparoscopic sacrocolpopexy

Abdominal sacrocolpopexy is considered to be the most effective treatment for apical vaginal prolapse with long-term success rate up to 78-100% and patient satisfaction rates of 85-100% [10]. A Cochrane review comparing different surgical techniques for the treatment of POP concluded that the procedure led to lowered rates of recurrent vault prolapse and postoperative dyspareunia as compared to sacrospinous ligament fixation [9]. Promontofixation was first reported in 1889 by Freund, whereas in 1957 Hugier provided a more detailed description of open sacral colpopexy [11]. In 1993, laparoscopic promontofixation mimicking the abdominal procedure was first described [12,13], and ever since the technique has been widely used among gynecologists, who introduced some modifications to improve its effectiveness and reduce complication rates [13]. Indications for sacrocolpopexy vary depending on the region of the world. In Europe, LSC is performed for multicompartiment or recurrent prolapse, especially in young, symptomatic women. In the US and the United Kingdom, this procedure is indicated mostly for vaginal vault prolapse [14]. Today, a rapid increase in the number of LSC can be observed [10].

The principle of LSC is based on the need for strong posterior fixation to support the uterus, which would be normally provided by the uterosacral ligaments [15]. The procedure usually begins with a vertical incision of the prevertebral peritoneum and exposure of the anterior longitudinal ligament, at the level of the promontory, setting aside the right ureter laterally and rectum medially [12]. At this stage, the key to a safe surgery is excellent anatomical knowledge of the presacral and pararectal spaces. The next step is proper dissection of the rectovaginal space reaching levator ani muscle, and the vesicovaginal space reaching bladder neck should be performed to prepare a place for the mesh. The posterior part of the mesh is usually fixed to the levator ani

muscles and posterior part of the cervix, while the anterior part of the mesh is placed between the bladder and the anterior vaginal wall, and then attached. If two separate meshes are used, they should be sutured to each other as well as the cervix, and fixed without tension to the anterior longitudinal ligament. Some authors recommend vaginal repair of the coincident cystoceles and rectoceles, before sacrocolpopexy. However, others suggest that many of these defects may be caused by traction or displacement, therefore proper fixation of the vault or the uterus is sufficient to restore anatomy, unless it is a distal defect in which case additional vaginal treatment may be necessary [16].

The largest series of 363 patients undergoing LSC is presented in a retrospective study by Rozet et al. After an average follow-up of 14.6 months, 96% of the patients were satisfied with the results of their operation and none of the subjects complained of sexual dysfunction. The authors observed a 4% recurrence rate of prolapse and only 3 vaginal erosions. Low incidence of mesh-related complications was reported as a result of tacking the posterior mesh to the levator ani musculature after careful dissection of this muscle, and reperitonealisation [11].

In another study, the Clermont Ferrand team reported a series of 138 patients with a 98% satisfaction rate and few complications after mean follow-up of 33.7 months. Anatomic and functional recurrence appeared in 11% and 12% of the cases, respectively. Mesh erosions occurred in 5% of the patients. These authors emphasized that laparoscopic approach minimizes trauma during pararectal dissection and prevents rectum denervation, and consequent defecation problems. Another highlighted advantage of LSC is preservation of the sexual function, resulting in the absence of de novo dyspareunia, which is a common occurrence after laparotomic promontofixation [12]. Granese et al., demonstrated a 95% success rate after median follow-up of 43 months in a group of 138 women who underwent surgery due to vaginal vault prolapse. Mesh erosion occurred only in 1 patient, but 8 intraoperative and 37 cases of postoperative complications were reported [17]. Claerhout et al., reported the anatomic cure rate of 98%, with subjective cure rate of 92% during a mean follow-up of 12.5 months. Anatomic failures were mainly at the posterior compartment, although no patient required reoperation for recurrent prolapse [18]. Sergent et al., presented results of a prospective study of 116 patients with a mean follow-up of 34 months, and reported the anatomical success rates on the apical, anterior or posterior compartments of 97%, 89% and 98%, respectively. Also, improved quality of life and sexuality were noticed [19]. In a prospective study on 101 patients, Sarlos et al., reported 98% objective cure rate, 93% subjective cure rate and absence of mesh erosions after a mean follow-up of 12 months. They reported the anterior compartment as the main site of objective recurrence [20]. Perez et al., reported significant improvement in the quality of life and sexuality and anatomic success in 94% of cases in a series of 94 women, 12 months after the operation [21]. Price et al., demonstrated 88% and Agarwala presented 97% subjective cure, and 100% objective cure rate, in the groups of 84 and 74 patients, respectively after mean follow-up of 24 months [16, 22]. Higgs reported long-term results of LSC among 66 women after mean follow-up of 66 months assessing good vault support in 92% of the patients, with 42% recurrence of vaginal wall prolapse [8]. Mean operative time in the publications presented above varied between 55 and 190 minutes [12, 17].

The literature offers only a few studies comparing the outcomes of open vs. LSC procedures. One retrospective, randomized study compared a group of 794 patients who underwent open procedure to a group of 176 subjects who underwent laparoscopy. The laparoscopic approach turned out to be associated with significantly increased risk of re-operation for anterior vaginal wall prolapse. However, postoperative complications were more common in the open group. Mesh-related complications were more frequent after laparoscopy, when concomitant hysterectomy was performed, as compared to open surgery [10]. The results of the LAS study (randomized controlled trial of abdominal vs. LSC) showed similar outcomes for both procedures, without any advantage of LSC in terms of earlier discharge, and return to daily activities [23]. A recent multicenter retrospective cohort study compared the abdominal route with minimally invasive sacrocolpopexy in a total of 1124 patients who were analyzed. This comparison indicated that the abdominal approach (589 patients) was associated with a greater complication rate compared to laparoscopic or robotic sacral colpopexy (535 patients); 20% vs. 12.7%. Anatomical results were similar for all groups. Both minimally invasive techniques had less blood loss, shorter hospitalization but longer operative time. When comparing laparoscopy to robotic operation, there was no difference in anatomic failures but laparoscopy was associated with more complications compared with robotic sacrocolpopexy (18% vs. 7%) [24]. In a randomized control trial published in 2014, which compared laparoscopic and robotic procedures, the authors found no difference in outcomes and adverse events between the groups. However, longer operative times, higher pain scores, and higher costs were noted in the robotic group [25]. Similar results were noted in a trial carried out by Paraiso et al., in 2011 [26]. Seror et al., reported shorter strict operative time for the robotic group, but this time advantage was nullified when comparing the overall operating room time [27]. In turn, in a randomized trial carried out by Maher et al., comparing LSC versus total vaginal mesh (TVM) for vaginal vault prolapse at 2 years, the authors reported higher satisfaction and objective success rate with lower perioperative morbidity and reoperation rate for the laparoscopic group. Patients who underwent laparoscopy had quicker recovery and shorter hospital stay, but their operations lasted longer [28]. Cost analysis of both techniques revealed LSC to be less expensive than TVM due to lower consumable, inpatient and reoperation costs [29]. Ganatra et al., found that laparoscopic sacrocolpopexy reduces the risk of mesh infection and erosion as compared to the vaginal route [14].

Complications related to laparoscopic sacral colpopexy are similar to those reported for other laparoscopic gynecological procedures (i.e. total laparoscopic hysterectomy) except spondylodiscitis, which is a known complication of promontofixation, and intraoperative injuries of anatomical structures during dissection in the sacral area [12, 30].

A multicenter prospective cohort study from the Netherlands comparing complications between open abdominal surgery and LSC for the treatment of vault prolapse, reported reduced blood loss, shorter hospitalization, and fewer procedure-related complications, in the minimally invasive group [30]. Use of synthetic material such as prolene mesh in POP surgery is associated with the presence of specific long-term complications such as mesh erosion or mesh migration. Reports in the literature

concerning erosion rates yielded estimates of 0 to 11% with an overall rate of 2.7% per procedure [31]. Mesh migration can be seen in 0.8-19% of cases of abdominal sacral colpopexy [32]. Some studies emphasize differences in the rates of erosion with different materials. Thus, choosing the most appropriate graft material is important [31].

In a meta-analysis of 258 studies assessing rates of recurrence after apical prolapse repair, the authors reported a reoperation rate of 2.3% for sacrocolpopexy with a mean follow-up of 26 months; in comparison to 1.3% after transvaginal mesh repair with a mean follow-up of 17 months; and 3.9% after traditional vaginal vault suspension without synthetic material after a mean of 32 months. However, the total number of reoperations due to recurrence and complications was the highest in the transvaginal mesh group, reaching 8.5% [2].

A large number of studies on laparoscopic sacrocolpopexy procedures demonstrate that the technique is feasible and effective, with low postoperative complications and satisfactory long-term results [12].

### Laparoscopic sacral hysteropexy

In the laparoscopic sacral hysteropexy, the uterus is suspended to the promontory using a bifurcated mesh. At the beginning of the procedure, each broad ligament is opened at the level of cervico-uterine junction through the avascular area. After incision of the vesico-uterine peritoneum the bladder is dissected distally [33]. Thereafter, the arms of the mesh are introduced bilaterally through previously created windows, and the mesh is fixed with the sutures to the cervix. Afterwards, both arms are fixed together to the sacral promontory and covered with peritoneum.

The largest study assessing this procedure was described by Rahmanou et al., who in an observational study of 140 patients found that 89% of the women were satisfied with the result and experienced significant improvement in all assessed aspects of life after mean follow-up of 2.1 years. The authors reported that 4% of the patients had recurrence of apical prolapse, 25% had anterior prolapse during a 1-to-4-year follow-up. No mesh exposures were observed in the treated group. The authors emphasized the need to inform patients who wish to preserve fertility that, in case of a delivery, cesarian section will be indicated due to inability of the completely encircled cervix to dilate during vaginal labor [34]. The literature lacks data on pregnancies after laparoscopic sacral hysteropexy. There were only a few pregnancies after laparoscopic uterosacral hysteropexy, but based on this publications it is difficult to indicate which type of hysteropexy is better for women who wish to conceive in the future, and guarantees fewer recurrences after pregnancy. Gutman and Maher suggested that sacral hysteropexy is as effective as sacral colpopexy and hysterectomy in anatomical outcomes. However, these procedures were associated with a five times higher rate of mesh exposure than sacral hysteropexy [35].

### Laparoscopic lateral suspension

The laparoscopic lateral suspension technique is based on a previously performed abdominal procedure. It was first described by Dubuisson in 1998 [36]. Multiple variations of this technique appear in the literature, but the main principles remain the same. After an incision of the peritoneum and dissection of the bladder

below the cystocele, a long, narrow mesh with a flap in the middle (whose size depends of the grade of cystocele) is fixed in the midpoint to the anterior cervix. Afterwards, through additional small incisions, which are lateral and above the anterior superior iliac spine or through incisions after withdrawn lateral trocars, tunnels are made bilaterally using blunt dissection [36,37]. The tunnels are dissected in an avascular area, under the control of transillumination, until they pass incision in vesicouterine peritoneum. Then, the free end of the mesh is passed through extraperitoneal tunnel on both sides and pulled out of the abdominal wall to elevate the uterus. The mesh is left tension free and the arms are cut at the level of the skin. This mesh works as a transversal hammock for the vaginal vault and the uterus. In case of coexisting rectocele, the posterior vaginal wall and rectovaginal septum are dissected away from the rectum and additional mesh is placed and fixed to the isthmus or the vaginal vault, to reinforce the rectovaginal septum [36]. This procedure can be performed with preservation of the uterus or together with laparoscopic subtotal (SLH) or total hysterectomy (TLH), depending of gynecological situation of the patient [36,37].

Dubuisson et al., in a prospective study of 73 patients with post-hysterectomy symptomatic vaginal vault prolapse, reported a 98.6% success rate in restoring proper anatomy of the vault after a 17.5-month follow-up. They observed recurrent or de novo prolapse in 17.8% of patients, with 11% requiring reoperation. A previous study from the same center reported a 87.7% success rate of lateral suspension in a diverse group of women (with or without preserved uterus), after median 19 months of follow-up. Mesh erosions occurred in 5.5% of cases [37]. The authors emphasized the advantages of lateral suspension which treats genital prolapse, without causing damage to the promontory (no risk of sacral osteomyelitis, vascular injury or nerve damage), and no need for peritonization.

### Uterus – to preserve or not to preserve?

Recently, uterine-preserving POP surgery has become more popular because many patients, especially younger women, either wish to preserve their fertility or believe that hysterectomy can negatively affect their sense of identify and sexuality. They also fear complications after major surgery [34,35]. Hysterectomy does not address the underlying pathophysiology of poor connective tissue support in patients with POP. Careful screening and evaluation of the affected individuals is crucial to decide whether to perform uterine-preserving surgery. Gutman and Maher, presented the following contraindications to uterine-preserving surgery: fibroids, adenomyosis, endometrial or cervical pathology, abnormal or postmenopausal uterine bleeding, tamoxifen therapy and genetic predispositions or familial cancers [35]. When these conditions are excluded, the uterus can be preserved because many studies show increased risk of mesh erosions in the group of patients after sacrocolpopexy, with concomitant hysterectomy or subtotal hysterectomy. Meta-analysis of comparative studies revealed that the risk of mesh erosion is approximately four times greater if hysterectomy is performed at the time of sacrocolpopexy (8.6%), as compared to the same procedure without hysterectomy (2.2%), or subtotal hysterectomy (1.7%) [35]. One possible explanation is that with concurrent hysterectomy, vaginal flora may contaminate the vaginal apex incision and increase the risk of infection and mesh erosion [38]. In turn, after analyzing series

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of 64 patients 2 years after surgery, Rosen et al., concluded that addition of total hysterectomy to laparoscopic pelvic floor repair adds approximately 35 minutes to surgical time and does not influence the outcome and peri- or postoperative complications. They noted however that preservation of the uterus may lead to cervical elongation, potentially requiring further surgery [39].

## Conclusions

A review of numerous techniques for treating POP reported in the literature indicates that there is still no consensus regarding this issue. However, there is common agreement that if surgery becomes necessary, it has to relieve the symptoms and restore pelvic organs to their anatomical position [11]. Minimally invasive techniques provide excellent reconstructive outcomes with decreased morbidity as compared to open and vaginal surgery [40]. LSC is the best described and studied technique in terms of efficacy, safety and long-term results. However, other procedures present interesting alternatives but need further evaluation. The choice between different surgical techniques and approaches depends upon the complexity and level of the symptoms presented, patient concerns, and experience of the surgeon.

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## References:

1. Jones KA, Shepherd JP, Oliphant SS, [et al.]. Trends in inpatient prolapse procedures in the United States 1979-2006. *Am J Obstet Gynecol.* 2010;202, 501.e1-7.
2. Barber MD, Macher C. Epidemiology and outcome assessment of pelvic organ prolapse. *Int Urogynecol J.* 2013.; 24, 1783-1790.
3. Toozs-Hobson P, Freeman R, Barber M, [et al.]. An International Urogynecological Association (IUGA)/ International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol J.* 2012, 23, 527-535.
4. Judd J, Siddiqui N, Barnett J, [et al.]. Cost-minimization analysis of robotic-assisted, laparoscopic, and abdominal surgery. *J Minim Invasive Gynecol.* 2010, 17, 493-499.
5. Cheon C, Maher C. Economics of pelvic prolapse surgery. *Int Urogynecol J.* 2013, 24, 1873-1876.
6. Price N, Jackson SZ. Advances in laparoscopic techniques in pelvic reconstructive surgery for prolapse and incontinence. *Maturitas.* 2009, 62, 276-280.
7. Margossian H, Walters MD, Falcone T. Laparoscopic management of pelvic organ prolapse. *Eur J Obstet Gynecol Reprod Biol.* 1999, 85, 57-62.
8. Higgs A, Chua HL, Smith AR. Long term review of laparoscopic sacrocolpopexy. *BJOG.* 2005, 112, 1134-1138.
9. Lee RK, Mottrie A, Payne CK, Waltregmy D. A review of the current status of laparoscopic and robot-assisted sacrocolpopexy for pelvic organ prolapse. *Eur Urol.* 2014, 1128-1137. doi: 10.1016/j.eururo.2013.12.064.
10. Khan A, Alperin M, Wu N, [et al.]. Comparative outcomes of open versus laparoscopic sacrocolpopexy among medicare beneficiaries. *Int Urogynecol J.* 2013, 24, 1883-1891.
11. Rozet F, Mandron E, Arroyo C, [et al.]. Laparoscopic sacral colpopexy approach for genitourinary prolapse: experience with 363 cases. *Eur Urol.* 2005, 47, 230-236.
12. Rivoire C, Botchorishvili, Canis M, [et al.]. Complete laparoscopic treatment of genital prolapse with meshes including vaginal promontofixation and anterior repair: a series of 138 patients. *J Minim Invasive Gynecol.* 2007, 14, 712-718.
13. Akladios C, Dautun D, Saussine C, [et al.]. Laparoscopic sacrocolpopexy for female genital organ prolapse: establishment of a learning curve. *Eur J Obstet Gynecol Reprod Biol.* 2010, 149, 218-222.
14. Ganatra AM, Rozet F, Sanchez-Salas R, [et al.]. The current status of laparoscopic sacrocolpopexy: a review. *Eur Urol.* 2009, 55, 1089-1105.
15. Raneco-Selas E, Mugnier C, Piechaud PT. Laparoscopic promontofixation. Our technique. *Acta Urol Esp.* 2010, 34, 837-844.
16. Agarwala N, Hasiak N, Shade M. Laparoscopic sacral colpopexy with Gynemesh as graft material-experience and results. *J Minim Invasive Gynecol.* 2007, 14, 577-583.
17. Granese R, Candiani M, Perino A, [et al.]. Laparoscopic sacrocolpopexy in the treatment of vaginal vault prolapse: 8 years experience. *Eur J Obstet Gynecol Reprod Biol.* 2009, 146, 227-231.
18. Claerhout F, De Ridder D, Roovers JP, [et al.]. Medium-term anatomic and functional results of laparoscopic sacrocolpopexy beyond the learning curve. *Eur Urol.* 2009, 55, 1459-1468.
19. Sergent F, Resch B, Loisel C, [et al.]. Mid-term outcome of laparoscopic sacrocolpopexy with anterior and posterior polyester mesh for treatment of genitourinary prolapse. *Eur J Obstet Gynecol Reprod Biol.* 2011, 156, 217-222.
20. Sarios D, Brandner S, Kots L, [et al.]. Laparoscopic sacrocolpopexy for uterine and post-hysterectomy prolapse: anatomical results, quality of life and perioperative outcome – a prospective study with 101 cases. *Int Urogynecol J Pelvic Floor Dysfunct.* 2008, 19, 1415-1422.
21. Perez T, Crochet P, Descargeus G, [et al.]. Laparoscopic sacrocolpopexy for management of pelvic organ prolapse enhances quality of life at one year: a prospective observational study. *J Minim Invasive Gynecol.* 2011, 18, 747-754.
22. Price N, Slack A, Jackson S. Laparoscopic sacrocolpopexy: an observational study of functional and anatomical outcomes. *Int Urogynecol J.* 2011, 22, 77-82.
23. Freeman RH, Pantazis K, Thomson A, [et al.]. A randomized controlled trial of abdominal versus laparoscopic sacrocolpopexy for the treatment of post-hysterectomy vaginal vault prolapse: LAS study. *Int Urogynecol J.* 2013, 24, 377-384.
24. Nosti PA, Umoh Andy U, Kane S, [et al.]. Outcomes of abdominal and minimally invasive sacrocolpopexy: a retrospective cohort study. *Female Pelvic Med Reconstr Surg.* 2014, 20, 33-37.
25. Anger JT, Mueller ER, Tarnay C, [et al.]. Robotic compared with laparoscopic sacrocolpopexy: a randomized controlled trial. *Obstet Gynecol.* 2014, 123, 5-12.
26. Paraiso MF, Jelovsek J, Frick A, [et al.]. Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse: a randomized controlled trial. *Obstet Gynecol.* 2011, 118, 1005-1013.
27. Seror J, Yates DR, Seringe E, [et al.]. Prospective comparison of short-term functional outcome obtained after pure laparoscopic and robot-assisted laparoscopic sacrocolpopexy. *World J Urol.* 2012, 30, 393-398.
28. Maher CE, Feiner B, DeCuyper EM, [et al.]. Laparoscopic sacral colpopexy versus total vaginal mesh for vaginal vault prolapse: a randomized trial. *Am J Obstet Gynecol.* 2011, 204, 360.e1-7.
29. Maher CF, Connelly LB. Cost minimization analysis of laparoscopic sacral colpopexy and total vaginal mesh. *Am J Obstet Gynecol.* 2012, 206, 433.e1-7.
30. Coolen AL, van Oudehousden AM, van Eijndhoven HW, [et al.]. A comparison of complications between open abdominal sacrocolpopexy and laparoscopic sacrocolpopexy for the treatment of vault prolapse. *Obstet Gynecol Int.* 2013, 2013, 528636. doi: 10.1155/2013/528636.
31. Begley JS, Kupferman SP, Kuznetsov DD. Incidence and management of abdominal sacrocolpopexy mesh erosions. *Am J Obstet Gynecol.* 2005, 192, 1956-1962.
32. Ulekont SC, Kaya B, Bat O, [et al.]. Prolene mesh migration into the rectum after sacral colpopexy presented with frozen pelvis. *Int J Surg Case Rep.* 2013, 4, 1004-1006.
33. Price N, Slack A, Jackson SR. Laparoscopic hysterectomy: the initial results of a uterine suspension procedure for uterovaginal prolapse. *BJOG.* 2010, 117, 62-68.
34. Rahmanou P, White B, Price N, Jackson S. Laparoscopic hysterectomy: 1-to 4-year follow-up of women postoperatively. *Int Urogynecol J.* 2014, 25, 131-138.
35. Gutman R, Maher C. Uterine-preserving POP surgery. *Int Urogynecol J.* 2013, 24, 1803-1813.
36. Dubuisson JB, Yaron M, Wenger JM, Jacob S. Treatment of genital prolapse by laparoscopic lateral suspension using mesh: a series of 73 patients. *J Minim Invasive Gynecol.* 2008, 15, 49-55.
37. Dubuisson J, Eperon I, Dallenbach P, Dubuisson JB. Laparoscopic repair of vaginal vault prolapse by lateral suspension with mesh. *Arch Gynecol Obstet.* 2013, 287, 307-312.
38. Krause HG, Goh JT, Sloane K, [et al.]. Laparoscopic sacral suture hysterectomy for uterine prolapse. *Int Urogynecol J Pelvic Floor Dysfunct.* 2006, 17, 378-381.
39. Wu JM, Wells EC, Hundley AF, [et al.]. Mesh erosion in abdominal sacral colpopexy with and without concomitant hysterectomy. *Am J Obstet Gynecol.* 2006, 194, 1418-1422.
40. Rosen D, Shukla A, Cario GH, [et al.]. Is hysterectomy necessary for laparoscopic pelvic floor repair? A prospective study. *J Minim Invasive Gynecol.* 2008, 15, 729-734.
41. Banach R, Antosiak B, Blewniewska G, Malinowski A. Evaluation of safety and effectiveness of pelvic organ prolapse treatment with the use of polypropylene mesh depending on mesh and application technique. *Ginekol Pol.* 2013, 84, 596-602.