Archives of Gynecology and Obstetrics (2023) 307:1867–1872
https://doi.org/10.1007/s00404-023-06980-3

GENERAL GYNECOLOGY

Laparoscopic pectopexy with native tissue repair for pelvic organ prolapse

Pei Yu[1] · **Chongdong Liu**[1]

Received: 30 October 2022 / Accepted: 14 February 2023 / Published online: 7 March 2023

Abstract

Purpose The use of mesh for vaginal repair is currently problematic; consequently, there is increased interest in native tissue repair. Combining native tissue repair with sufficient mesh-applied apical repair might provide effective treatment. We describe the study focusing on the combination of pectopexy and native tissue repair.

Methods Between April 2020 and November 2021, 49 patients with symptomatic stage III or IV were treated with laparoscopic pectopexy combined with native tissue repair. The mesh was solely used for apical repair. All other clinically relevant defects were treated with native tissue repair. The perioperative parameters including surgical time, blood loss, hospital stay, and complications were recorded. The anatomical cure rate was evaluated according to the Pelvic Organ Prolapse Questionnaire (POP-Q) assessment. Validated questionnaires of the Pelvic Floor Distress Inventory (PFDI-20) and the Pelvic Floor Impact Questionnaire (PFIQ-7) were recorded to evaluate the symptom severity and quality of life.

Results The mean duration of follow-up was 15 months. All domains of POP-Q, PFDI-20, and PFIQ-7 scores improved significantly after surgery. No major complications, mesh exposure, or mesh complication occurred during the follow-up period.

Conclusion The overall repair concept of laparoscopic pectopexy as the core, assisted by vaginal natural tissue repair for severe pelvic organ prolapse can achieve satisfactory clinical results and improve patient satisfaction.

Keywords Pelvic organ prolapse · Pectopexy · Native tissue repair

What does this study add to the clinical work

The overall repair concept of laparoscopic pectopexy as the core, assisted by vaginal natural tissue repair for severe pelvic organ prolapse can achieve satisfactory clinical results and improve patient satisfaction.

Introduction

Pelvic organ prolapse (POP) occurs when the fascial structure of the pelvis is damaged. Since the support structure of the pelvic floor is damaged, this can lead to an incorrect position or function of the pelvic organs [1]. With the deepening of global aging, the prevalence of POP has increased clearly. Large reviews of the literature have found that 3–6% of women have symptomatic POP, while up to 50% of women experience anatomic prolapse [2]. It is reported in the literature that 12–19% of women will have POP surgery by age 85 in their lifetime, and 19% of women may undergo surgery again because of prolapse recurrence [3].

POP comprises anterior, middle, and posterior pelvic organ prolapse. Among these, anterior vaginal wall prolapse is common in POP and is also difficult to treat. Transvaginal mesh implantation (TVM) can repair the defects of the middle pelvis and anterior pelvis at the same time, notably for the central and lateral deformities of the anterior pelvis [4], however, the difficulties induced by mesh also increase the rate of reoperation. Due to the dispute over the use of mesh, native tissue repair in pelvic surgery has once again become the preferred choice in various nations. For a long time, native tissue repair is regarded to be insufficient. However, several studies have indicated that from a clinical point of view, it offers superior benefits than mesh in the long run [5, 6].

✉ Chongdong Liu
liuchongdong@ccmu.edu.cn

[1] Department of Obstetrics and Gynecology, Beijing Chao-Yang Hospital, Capital Medical University, 8 Gongtinanlu, Chaoyang District, Beijing 100020, People's Republic of China

Apical repair is the key part of pop surgery, and the common clinical procedures include sacral colpopexy, sacral ligament suspension, uterosacral ligament suspension, and sacrospinous ligament fixation. Among them, laparoscopic sacral colpopexy (LS) is considered the standard method for treating pelvic organ prolapse [7]. LS, however, requires extensive training and is challenging to perform. Operation in the sacral area may lead to neurological, ureteral, or vascular injuries, and post-operative defecation problem is a common occurrence. Additionally, periostitis is an uncommon occurrence that is linked to the sacral anchorage's weak anterior longitudinal ligament and the risk that an operation would pierce the periosteum [8]. Therefore, surgeons are dedicated to finding a more perfect surgical approach. To avoid the problems of LS outlined above, Banerjee and Noe proposed pectopexy in 2011 [9]. This procedure has similar results to sacral colpopexy.

There have been studies on the treatment of severe pelvic organ prolapse by pectopexy combined with native tissue repair. We were able to extensively confirm the approach of pectopexy in the defect-oriented strategy in our collective.

Materials and methods

The study included 49 patients with a POP-Q stage greater than 2 who underwent laparoscopic pectopexy surgery between April 2020 and November 2021. Transvaginal ultrasonography and pap smear test were performed on all patients. Patients with suspected cancer underwent endometrial sampling. Exclusion criteria included a history of pelvic inflammatory disease, a suspicion of malignancy, pregnancy, prior POP or continence surgery, and patients who refused to be operated using this technique. All surgical procedures were performed by an experienced gynecologist. The study was granted by the Medical Ethics Committee of Beijing Chao-Yang Hospital in accordance with the Declaration of Helsinki.

Data on the patient's age, BMI, parity status, surgical history, and gynecological examination were documented during the preoperative evaluation. Preoperatively, the prolapse quality of life (P-QOL) questionnaire validated for Chinese [10, 11], Pelvic Floor Distress Inventory Questionnaire (PFDI-20), and Pelvic Floor Impact Questionnaire (PFIQ-7) form utilized in our study were completed. The P-QOL questionnaire is a straightforward, reliable, and simple-to-understand questionnaire for assessing symptom intensity, the impact of these symptoms on quality of life, and treatment outcomes in women with pelvic organ prolapse [12]. In the first post-operative month and the third month, the patients were summoned for a revisit. Patients completed post-operative reproductive quality of life surveys at the third month postoperatively, and the data were collected. The preoperative and post-operative quality of life data were statistically compared. All clinical data were retrieved retrospectively from the institution's electronic medical record. Perioperative data were also gathered, including surgical time, expected blood loss, operative complications, duration of stay, and post-operative follow-up data at 1 and 3 months.

The primary outcome was anatomical cure defined as less than stage 1 (all vaginal sites at least 1 cm above the hymen on Valsalva), as scored by the POP-Q system.

The secondary outcomes included the symptom severity, and quality of life according to the Pelvic Floor Distress Inventory (PFDI-20), and Pelvic Floor Impact Questionnaire (PFIQ-7) scores at each visit point. Increasing scores of PFDI-20 and PFIQ-7 indicate impaired function.

Operative technique

The abdomen was inflated with carbon dioxide at 12 mmHg pressure and four laparoscopic ports were placed: a 10-mm umbilical, a 10-mm suprapubic port, and two 5-mm lateral ports. We opened the peritoneal layer along the right round ligament toward the pelvic wall. We started the peritoneum dissection at the side of the right external iliac vein, and we carried out this incision in the medial and caudal direction under intermittent coagulation. We dissected soft tissue in this field using blunt dissection. Hence, we identified an approximately 5 cm segment of the right Cooper's ligament (iliopectineal ligament) adjacent to the iliopsoas muscle's insertion. We repeated the same steps on the left side of the patient. Then, we opened the peritoneal layers on both sides toward the anterior peritoneum of the uterus to prepare the lower anterior segment of the uterus for mesh fixation. A large diameter non-absorbent lightweight mesh (PFM Medical, Germany) is trimmed into a butterfly shape which was used to suspend the uterus. After all these dissections, the bottom of the mesh was sutured to the front of the cervix with 3–5 nonabsorbable polyester 2–0 sutures. The mesh then surrounds the isthmus of the uterus. The ends of the two short arms to the back of the cervix are sewed. The two long arms of the mesh to the two iliopubic ligaments are sutured using 2 nonabsorbable 2–0 sutures. We then closed the peritoneal layer with 2–0 absorbable suture material (Figs. 1 and 2).

After apical suspension, we assessed the anterior and posterior vaginal walls. We added anterior or posterior surgery and perineal reconstruction if stage 2 or higher cystocele or rectocele was present according to POP-Q.

Anterior vaginal repair

A rhomboid incision was made from the approximate location of the urethrovesical junction (typically 1–3 cm from the urethral meatus) to the most proximal extent of the anterior

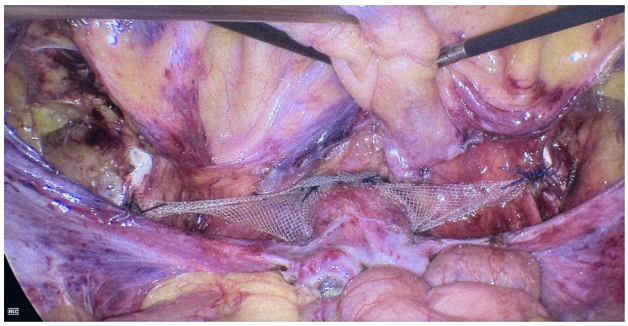

Fig. 1 Fixation of the mesh to the cervix and iliopectineal ligaments

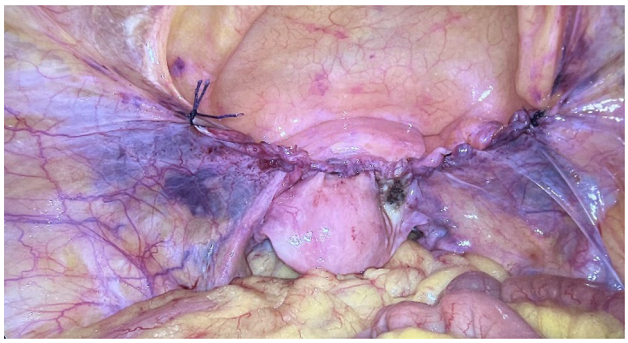

Fig. 2 Closure of the peritoneum over the mesh

vaginal wall prolapse. The bladder space was separated and the protruding part of the bladder freed. The vaginal mucosa in the medial area of the rhomboid incision was used as a "bridge", and the mucosa in this area was cauterized with an electric knife, resulting in the loss of secretory function. The vaginal mucosa on both sides of the incision was separated until entering the retropubic space, and exposed the arcus tendineus fascia pelvis (ATFP). And then we do a midline vaginal mucosa plication. The no. 0 nonabsorbable suture was used, attaching the vaginal mucosa of the "bridge" body and the pubocervical fascia to the ipsilateral ATFP, and sutures 3–4 lines from top to bottom until the bladder is completely lifted. Then we closed the anterior vaginal wall with absorbable suture.

Posterior vaginal repair

A fusiform incision was made in the posterior vaginal wall. The posterior vaginal wall was often infiltrated with a vasoconstricting agent for hydrodissection before the incision. The vaginal mucosa was dissected to expose the underlying fibromuscular layer which is plicated across the midline with nonabsorbable sutures, then closed the posterior vaginal wall with absorbable sutures.

Table 1 Demographic and perioperative data

Variables	Mean ± SD
Age(years)	64.85 ± 11.94
Gravity	3.22 ± 1.41
Parity	1.87 ± 1.00
Total operation time (minutes)	197.44 ± 32.9
BMI (kg/m^2)	24.51 ± 2.3
Estimated blood loss(ml)	40.41 ± 37.58
Hospital stay (days)	6.75 ± 1.89
Intraoperative complications	0

Statistical analysis

Analysis was performed with IBM SPSS 20.0 (IBM Corp., Armonk, NY, USA) package program. Normally distributed numerical variables were expressed as mean ± standard deviation, and non-normally distributed numerical variables were expressed as median (25–75th percentile). The *t*-test was performed for normally distributed numerical variables, and the Wilcoxon signed ranks test for the non-normally distributed variable. For the test of two-way hypotheses, the level of significance $p < 0.05$ was accepted as sufficient.

Results

All data including baseline demographic and clinical characteristics (age, parity, BMI, and perioperative data) were presented in Table 1. A total of 49 patients underwent laparoscopic pectopexy. Among them, 18 patients underwent anterior and posterior vaginal wall colporrhaphy, 6 patients underwent anterior vaginal wall colporrhaphy, 10 patients underwent vaginal posterior wall colporrhaphy, and 6 patients underwent perineal repair. No intraoperative complications were detected for all patients.

The POP-Q point measurements showed statistically significant improvements at 3-month post-surgery compared with preoperative measurements (Table 2). On the anterior vaginal wall, the Aa point improved from 0.49 ± 1.21 to − 2.34 ± 0.61, and the Ba point from 1.65 ± 0.96 to − 2.61 ± 0.46 ($p < 0.001$). The Ap point on the posterior vaginal wall increased from − 0.08 ± 1.33 to − 2.5 ± 0.5, and the Bp point increased from 0.69 ± 1.74 to − 2.69 ± 0.44 ($p < 0.001$). The C point increased from 2.35 ± 1.10 to − 4.83 ± 0.65, and the D point increased from 0.65 ± 1.05 to − 6.05 ± 0.78 significantly ($p < 0.001$). Total vaginal length TVL also presents significant improvement as compared with preoperation.

Table 2 Pre- and post-operative (3-month follow-up) pelvic organ prolapse quantification

Variables	Preoperative assessment		Postoperative assessment		*p*
	mean ± SD	Median(minimum–maximum)	mean ± SD	Median(minimum–maximum)	
Aa	0.49 ± 1.21	1.00(− 2.0–3.0)	− 2.34 ± 0.61	− 2.00(− 3.0–1.0)	< 0.001
Ba	1.65 ± 0.96	2.00(− 2.0–3.0)	− 2.61 ± 0.46	− 3.00(− 3.0–2.0)	< 0.001
Ap	− 0.08 ± 1.33	0.00(− 2.0–3.0)	− 2.52 ± 0.57	− 3.00(− 3.0–1.0)	< 0.001
Bp	0.69 ± 1.74	1.00(− 2.0–3.0)	− 2.69 ± 0.44	− 3.00(− 3.0–2.0)	< 0.001
C	2.35 ± 1.10	2.00(0.0–5.0)	− 4.83 ± 0.65	− 5.00(− 6.0–4.0)	< 0.001
D	0.65 ± 1.05	0.00(− 1.0–3.0)	− 6.05 ± 0.78	− 6.00(− 8.0–5.0)	< 0.001
TVL	6.71 ± 0.71	7.00(6.0–8.0)	7.29 ± 0.59	7.00(6.0–8.0)	< 0.001

Table 3 Quality of life results of patients

Variables	Preoperative assessment		Postoperative assessment		*p*
	mean ± SD	Median(minimum–maximum)	mean ± SD	Median(minimum–maximum)	
PFDI-20	79.62 ± 35.69	81.25(8.25–154.0)	9.97 ± 10.73	7.12(0–35.25)	< 0.001
PFIQ-7	89.69 ± 60.05	76.18(9.52–228.5)	11.7 ± 10.16	9.52(0–57.12)	< 0.001

Comparison of quality of life scores

Functional outcomes, assessed by comparing the pre- and post-operative scores, were shown in Table 3. A significant improvement at 3-month follow-up was noted as compared to the baseline score using the following validated questionnaires: PFDI-20, and PFIQ-7 scores. The median value of the preoperative PFDI-20 score was 79.62 ± 35.69, and the post-operative score was 9.97 ± 10.73. The difference was statistically significant ($p < 0.001$). Preoperative and post-operative median PFIQ-7 scores were 89.69 ± 60.05 and 11.7 ± 10.16, respectively, and the difference was statistically significant ($p < 0.001$).

One patient was found to have lower extremity intermuscular vein thrombosis 4 days after the operation, which was cured after active treatment, while no perioperative complications occurred in the rest of the patients. During the follow-up period, recurrence of apical prolapse was not observed. In our study, the patients did not have any problems with defecation. One patient developed de novo stress urinary incontinence 1 month after the operation and eventually underwent mid-urethral suspension surgery. No mesh-related erosion was observed. The complications and short-term follow-up outcomes are shown in Table 4.

Discussion

Patients with POP often have multiple anatomical defects at the same time, our group tries to treat severe pelvic organ prolapse with the concept of overall repair with pectopexy as the core, assisted personalized self-tissue repair at the same time. In this study, the mesh was used solely for apical support. We combined apical support with concomitant repair depending on individual defects and disorders.

Sacrum fixation has always been considered the gold standard for the treatment of apical prolapse. However, in laparoscopic sacral fixation, the important anatomical structures, such as the sigmoid colon, right ureter, hypogastric nerve, and anterior sacral vein, are very close. Complications associated with these important structures may lead to adverse consequences. At the same time, laparoscopic sacrum fixation is a technically difficult surgical method. In 2011, Banerjee reported that laparoscopic pectopexy was used to treat POP. The laparoscopic synthetic mesh was used to symmetrically fix the vaginal stump or cervix to the lateral part of the bilateral iliopubic ligament at the S2 level, to restore the prolapsed vaginal tip or cervix to the normal

Table 4 complications and short-term follow-up outcomes in the study groups

Variables	Value
Severe bleeding, *n* (%)	0 (0)
Nerve/vessel injury, *n* (%)	0 (0)
Bladder/bowel injury, *n* (%)	0 (0)
Thrombosis	1 (2)
De novo stress urinary incontinence, *n* (%)	1 (2)
De novo urgency, *n* (%)	0 (0)
De novo constipation, *n* (%)	0 (0)
Prolapse recurrence, *n* (%)	0 (0)
Mesh erosion, *n* (%)	0 (0)

anatomical position, correct and repair the defects of the pelvic floor, and achieve good clinical results. At present, many studies have shown that laparoscopic pectopexy has similar anatomical effects as sacral fixation [13, 14], shorter operation time, and lower incidence of complications, which can be used as a new method for the treatment of pelvic defects.

In our study, laparoscopic pectopexy combined with native tissue repair has achieved good results in the treatment of moderate and severe pelvic prolapse.

The support of the anterior vaginal wall is a complex system involving the levator ani muscle, ATFP, pubocervical fascia, and uterosacral ligament. Conventional anterior vaginal wall repair only repairs central defects without attention to paravaginal defects, which may be one of the reasons for the high recurrence rate after surgery. In our study, the vaginal mucosa of the "bridge" body and the pubocervical fascia are sutured to the ipsilateral ATFP with nonabsorbable suture, which closes the paravaginal defect and restores the integrity of the pelvic floor, while filling the tissue with autologous vaginal mucosa, which not only strengthens the support of the bladder and urethra, but also avoids the risks associated with the application of mesh. The results of this study showed that the anatomical reduction achieved ideal results 3 months after the operation, and the indication points of POP-Q were basically in the normal range compared with those before the operation. In this study, there was no recurrence of vaginal apical prolapse in 49 patients after the operation.

High incontinence rates (5–40%) have been reported after LSC, in our study, all patients with stress urinary incontinence improved after the operation. only one patient developed de novo stress urinary incontinence 1 month after the operation. In a prospective international multicenter study for combined pectopexy and native tissue repair, 7% reported persistent stress urinary incontinence after surgery. Compared with this study, we have achieved good clinical results [15]. This shows that simultaneous repair of multiple levels of pelvic defects can improve the symptoms of stress urinary incontinence and reduce the de novo stress urinary incontinence.

Because multiple operations were performed at the same time to correct and improve the pelvic floor function, the minimum total operation time was 125 min and the maximum was 270 min.

The exposure rate of transvaginal mesh placement for POP surgery was 4–19% [16, 17], while the incidence of complications associated with abdominal placement of mesh was low [18]. No mesh exposure associated with synthetic mesh was reported during laparoscopic pectopexy. In our study, the mesh was only used for the treatment of apical prolapse, and there was no additional mesh for cystocele and rectocele repair. No mesh-related exposure was observed after 1-year follow-up.

Defecation problems and de novo stress urinary incontinence ranging from 17 to 37% and 4 to 50%, respectively, are the most frequently reported complications associated with sacrocolpopexy [7, 19]. No bowel injury was caused by suturing the mesh to the lateral side of the bilateral iliopubic ligament at the S2 level, and there was no symptom of defecation disturbance during the follow-up in this study.

Hysterectomy is widely accepted to be an independent risk factor for recurrent vaginal vault prolapse. The main reason is the destruction of the integrity and continuity of the supporting tissue, such as the pubocervical and rectovaginal fascia. Hysterectomy itself may not correct the underlying problem of insufficient apical support [20, 21]. Therefore, whether the uterus should be removed is controversial. In our study, uterine preservation surgery was performed on all patients. The advantage of preserving the uterus is to maintain pelvic anatomy, reduce complications related to hysterectomy, reduce intraoperative blood loss, shorten operation time and hospital stay, reduce mesh erosion rate and increase patients' self-confidence, and provide physical and psychological benefits for women.

The purpose of the treatment of pelvic organ prolapse is to restore the normal anatomical position of pelvic organs, improve organ function and improve the quality of life of patients. Studies have shown that laparoscopic pectopexy can improve the quality of life after operation [14, 22]. In this study, the PFIQ-7 and PFDI-20 scores were compared before and 3 months after the operation, and the quality of life of the patients was significantly improved after treatment. This underlines that the symptoms in urogynecological operations essentially determine the success and not only the anatomical changes.

The initial planned follow-up period is at least 1 year after the operation, but due to the outbreak of COVID-19, many patients are reluctant to come to the hospital for a revisit many times. 1 month and 3 months after the operation, all the patients completed the follow-up, came to the hospital for a physical examination and filled out the questionnaires, and then followed up by telephone, including asking if there were any de novo SUI, existing cystocele/rectocele, apical prolapse recurrence, and constipation. During the average telephone follow-up of 15 months, all patients expressed satisfaction with the operation, which made us feel gratified.

We acknowledge that our study has some limitations, such as a small patient group and a lack of long-term follow-up. We had a follow-up visit 3 months after the operation, and an average telephone follow-up of 15 months, the complications, such as recurrence of POP, de novo stress urinary incontinence, or mesh erosion, may require longer to occur.

Conclusion

Our study shows that the overall repair of laparoscopic pectopexy as the core and assisted vaginal natural tissue repair for severe pelvic organ prolapse can achieve satisfactory clinical results and improve patient satisfaction. However, further prospective comparative studies as well as long-term follow-up are necessary to show long-term effectiveness.

Author contributions PY analyzed the data and wrote the paper; CL conceived and designed the experiments and revised the paper. All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Funding This research has not received any relevant financial support.

Data availability The data are not publicly available due to information that could compromise the privacy of research participants.

Declarations

Conflict of interest The authors have no conflict of interest.

Ethical and consent statement Ethical approval was granted by the Medical Ethics Committee of Beijing Chao-Yang Hospital in accordance with the Declaration of Helsinki, and the written informed consent was obtained from each participant involved.

References

1. Weintraub AY, Glinter H, Marcus-Braun N (2020) Narrative review of the epidemiology, diagnosis and pathophysiology of pelvic organ prolapse. Int Braz J Urol 46(1):5–14. https://doi.org/10.1590/S1677-5538.IBJU.2018.0581
2. Collins S, Lewicky-Gaupp C (2022) Pelvic organ prolapse. Gastroenterol Clin North Am 51(1):177–193. https://doi.org/10.1016/j.gtc.2021.10.011
3. Smith FJ, Holman CDAJ, Moorin RE, Tsokos N (2010) Lifetime risk of undergoing surgery for pelvic organ prolapse. Obstet Gynecol 116(5):1096–1100. https://doi.org/10.1097/AOG.0b013e3181f73729
4. Schimpf MO, Abed H, Sanses T, White AB, Lowenstein L, Ward RM et al (2016) Graft and mesh use in transvaginal prolapse repair a systematic review. Obstet Gynecol 128(1):81–91. https://doi.org/10.1097/aog.0000000000001451
5. Kowalski JT, Mehr A, Cohen E, Bradley CS (2018) Systematic review of definitions for success in pelvic organ prolapse surgery. Int Urogynecol J 29(11):1697–1704. https://doi.org/10.1007/s00192-018-3755-7
6. Noe GK, Alkatout I, Schiermeier S, Soltecz S, Anapolski M (2019) Laparoscopic anterior and posterior native tissue repair: a new pelvic floor approach. Minim Invasive Ther Allied Technol 28(4):241–246. https://doi.org/10.1080/13645706.2018.1510420
7. Maher C, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J (2016) Surgery for women with apical vaginal prolapse. Cochrane Database Syst Rev. https://doi.org/10.1002/14651858.Cd012376
8. Lee RK, Mottrie A, Payne CK, Waltregny D (2014) A review of the current status of laparoscopic and robot-assisted sacrocolpopexy for pelvic organ prolapse. Eur Urol 65(6):1128–1137. https://doi.org/10.1016/j.eururo.2013.12.064
9. Banerjee C, Noé KG (2011) Laparoscopic pectopexy: a new technique of prolapse surgery for obese patients. Arch Gynecol Obstet 284(3):631–635. https://doi.org/10.1007/s00404-010-1687-7
10. Ma Y, Xu T, Zhang Y, Mao M, Kang J, Zhu L (2019) Validation of the Chinese version of the pelvic floor distress inventory-20 (PFDI-20) according to the COSMIN checklist. Int Urogynecol J 30(7):1127–1139. https://doi.org/10.1007/s00192-018-3847-4
11. Zhu L, Yu S, Xu T, Yang X, Lu Y, Li B et al (2011) Chinese validation of the pelvic floor impact questionnaire short form. Menopause 18(9):1030–1033. https://doi.org/10.1097/gme.0b013e31820fbcbe
12. Al-Badr A (2013) Quality of life questionnaires for the assessment of pelvic organ prolapse: use in clinical practice. Low Urin Tract Symptoms 5(3):121–128. https://doi.org/10.1111/luts.12006
13. Biler A, Ertas IE, Tosun G, Hortu I, Turkay U, Gultekin OE et al (2018) Perioperative complications and short-term outcomes of abdominal sacrocolpopexy, laparoscopic sacrocolpopexy, and laparoscopic pectopexy for apical prolapse. Int Braz J Urol 44(5):996–1004. https://doi.org/10.1590/S1677-5538.IBJU.2017.0692
14. Noe KG, Schiermeier S, Alkatout I, Anapolski M (2015) Laparoscopic pectopexy: a prospective, randomized, comparative clinical trial of standard laparoscopic sacral colpocervicopexy with the new laparoscopic pectopexy-postoperative results and intermediate-term follow-up in a pilot study. J Endourol 29(2):210–215. https://doi.org/10.1089/end.2014.0413
15 Noe GK, Schiermeier S, Papathemelis T, Fuellers U, Khudyakovd A, Altmann HH et al (2021) Prospective international multicenter pelvic floor study: short-term follow-up and clinical findings for combined pectopexy and native tissue repair. J Clin Med. https://doi.org/10.3390/jcm10020217
16. Milani AL, Vollebregt A, Roovers JP, Withagen M (2013) The use of mesh in vaginal prolapse. Ned Tijdschr Geneeskd 157(31):A6324
17. Walter JE (2019) A comparison of the use of mesh to native tissue in the management of vaginal vault prolapse. Best Pract Res Clin Obstet Gynaecol 54:73–88. https://doi.org/10.1016/j.bpobgyn.2018.11.006
18. Siddiqui NY, Grimes CL, Casiano ER, Abed HT, Jeppson PC, Olivera CK et al (2015) Mesh sacrocolpopexy compared with native tissue vaginal repair: a systematic review and meta-analysis. Obstet Gynecol 125(1):44–55. https://doi.org/10.1097/aog.0000000000000570
19. El Hamamsy D, Fayyad AM (2015) New onset stress urinary incontinence following laparoscopic sacrocolpopexy and its relation to anatomical outcomes. Int Urogynecol J 26(7):1041–1045. https://doi.org/10.1007/s00192-015-2641-9
20. Gutman R, Maher C (2013) Uterine-preserving POP surgery. Int Urogynecol J 24(11):1803–1813. https://doi.org/10.1007/s00192-013-2171-2
21 Meriwether KV, Antosh DD, Olivera CK, Kim-Fine S, Balk EM, Murphy M et al (2018) Uterine preservation vs hysterectomy in pelvic organ prolapse surgery: a systematic review with meta-analysis and clinical practice guidelines. Am J Obstet Gynecol 219(2):129–146. https://doi.org/10.1016/j.ajog.2018.01.018
22. Tahaoglu AE, Bakir MS, Peker N, Bagli İ, Tayyar AT (2018) Modified laparoscopic pectopexy: short-term follow-up and its effects on sexual function and quality of life. Int Urogynecol J 29(8):1155–1160. https://doi.org/10.1007/s00192-018-3565-y