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Modified laparoscopic sacrocolpopexy for advanced posterior vaginal wall prolapse: a 3-year prospective study

Skrócony: MLSC for advanced posterior vaginal wall prolapse

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ABSTRACT

Objectives: To evaluate and validate the safety and efficacy of modified laparoscopic sacrocolpopexy for advanced posterior vaginal wall prolapse at up to 3 years of follow-up.

Material and methods: As a prospective observational study, we collected 56 cases with advanced posterior vaginal wall prolapse and performed modified laparoscopic sacrocolpopexy (MLSC) with self-cut mesh. The main improvement is the cutting and fixing of the mesh. Patients were followed up at 6, 12, 24 and 36 months. The main indicators of follow-up were postoperative anatomic success rate and Pelvic organ prolapse quantitation (POP-Q) score, and secondary indicators were related to quality-of-life scales and postoperative complication rates.

Results: All patients completed the operation through minimally invasive surgery, and there were no vital organs and blood vessel damage during the operation. The mean age was (58.32 ± 7.63) years. There was no recurrence of stage I or lower during the follow-up maximum of 36 months (median 24 months), and the anatomic success rate was 100%. The quality-of-life scores improved significantly ($p < 0.001$) and the quality of sexual life was not affected ($p = 0.5$). There was 1 case of continuous vaginal mesh exposure at 12 months (2.86%) and 1 case of severe infection with poor healing of vaginal stump within 6 months (1.79%). No one had urinary incontinence (UI) requiring reoperation.

Conclusions: In patients with advanced posterior vaginal wall prolapse, MLSC can provide good and durable pelvic floor anatomical recovery and functional outcomes with no specific complications.

Keywords: laparoscopic sacrocolpopexy; levator ani; mesh; pelvic organ prolapse; quality of life

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INTRODUCTION

Pelvic organ prolapse (POP) is a type of dysfunctional disease in today's aging society that seriously affects the quality of life of older women. Anterior vaginal wall prolapse is the most common form of POP, while posterior vaginal wall prolapse is relatively uncommon with a prevalence of 12.9–18.6% [1], accounting for about 1/2 of anterior vaginal wall prolapse [2]. However, the treatment of posterior vaginal wall prolapses, especially of the distal and middle portions of the vagina wall, is relatively challenging. Despite the availability of various surgical approaches, there is currently a lack of high-level evidence to support the preferred surgical approach [3]. The traditional approach is transvaginal repair, with an average success rate of 83%, and complications such as sexual intercourse disorder (with an incidence of about 18%) and defecation disorder (with an incidence of about 26%) have not been effectively resolved [1]. In recent years, a growing number of clinical studies have demonstrated the integrity of pelvic support structures. Magnetic resonance imaging (MRI) evidence supports the overall weakening and general deformation of pelvic floor tissue in patients with POP, rather than specific fascia or site defects [4]. Malik RD. et al. [5] found that 16% of women who underwent anterior vaginal wall suspension also required posterior prolapse repair during long-term follow-up. At the same time, there are more than 20 years of research data demonstrating the critical role of defects in vaginal apical support structures in prolapse of the anterior and posterior vaginal walls [6]. Only transvaginal repair of the

posterior wall cannot improve the overall defect of the pelvic supporting structure, which may explain why simple transvaginal surgery cannot achieve the ideal surgical effect.

With the advancement and update of minimally invasive techniques, laparoscopic sacrocolpopexy (LSC) has become the "gold standard" for the treatment of POP caused by mid-pelvic defects in recent years [7–9]. It achieves the overall repair of the pelvic floor support structure by strengthening the uterosacral ligament complex. The surgical effect of LSC is superior to various transvaginal procedures [2]. Although there is currently no strong evidence to prove its superiority in treating posterior vaginal wall prolapse, some studies have shown that apical support plays an important role in posterior wall prolapse, and LSC can also restore the anatomy of the posterior vaginal wall [10, 11].

Many scholars have conducted follow-up studies on SC in patients with posterior vaginal wall prolapse. They found that the recurrence rate of vaginal apex after surgery was 1.47% to 6.1%, while the recurrence rate of posterior wall prolapse was as high as 5.88% to 31.82% [12, 13]. That suggests that SC is effective in supporting the apical vagina but cannot achieve the same ideal effect on the posterior vaginal wall. This is closely related to the complex anatomical structure of the posterior vaginal wall. DeLancey et al. [14] described the vaginal support in three different anatomical levels. In addition to the dominant role of the cardinal–uterosacral ligament complex, the levator ani muscle also plays an important role in support of the posterior vaginal wall and the entire pelvic floor. This provides a theoretical basis for us to treat posterior vaginal wall prolapse by MLSC. It enhances the overall structural support of the pelvic floor by addressing the vaginal apex defect and reinforcing the level II support. This is achieved by securing the two wings of the posterior mesh with the levator fascia on both sides. In this study, we enrolled patients with advanced posterior vaginal wall prolapse, performed the MLSC with self-cut mesh, and evaluated the safety and efficacy of this procedure during up to 3 years of follow-up.

MATERIAL AND METHODS

Baseline characteristics

As a prospective observational study, we identified a total of 56 patients with symptomatic, advanced POP who underwent MLSC with self-cut mesh between January 2019 and December 2021 at the Affiliated Hospital of Qingdao University. All women participated after informed written consent was obtained, and ethics approval was obtained from the Affiliated Hospital of Qingdao University prior to performing the surgical procedure (QYFY WZLL 27716). The following inclusion criteria were applied: (1) presenting with at least

stage 3 prolapse of the posterior vaginal wall, with or without other chamber prolapses (anterior vaginal wall, cervical prolapse, or vaginal vault prolapse); (2) age younger than 70 years. The exclusion criteria included: (1) could not tolerate surgery because of serious systemic diseases; (2) a history of pelvic cancer or pelvic radiation therapy. All included patients were graded by the POP-Q score developed by The International Continence Society (ICS). The study flowchart is depicted in Figure 1.

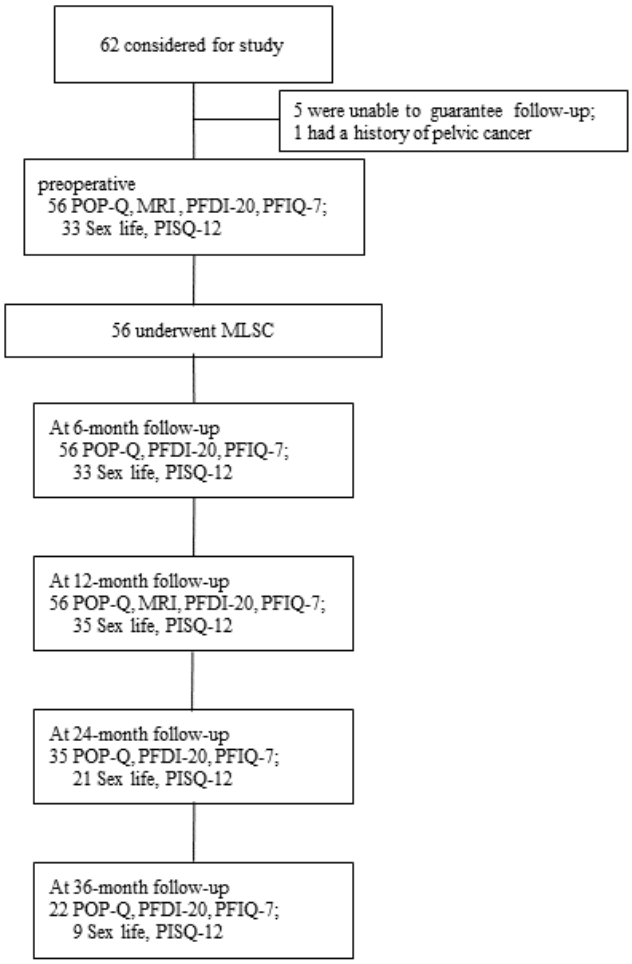

Figure 1. The study flowchart. POP-Q, Pelvic Organ Prolapse Quantitation; PFDI-20, Pelvic Floor Distress Inventory-short Form 20; PISQ-12, The Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire 12; PFIQ-7, The Pelvic Floor Impact Questionnaire 7; MLSC, Modified Laparoscopic Sacrocolpopexy

Surgical techniques

All operations were performed by the same experienced team via robotic or laparoscopic-assisted surgery. A total hysterectomy was performed following routine steps in cases of uterine prolapse. A 0 absorbable suture was used to continuously suture the vaginal

stump. Separated the vaginal rectal space down to the lower third of the posterior vaginal wall and then extended it laterally to visualize the levator ani muscle fascia on both sides (Fig. 2). Opened the peritoneum to reach the presacral space to expose the middle sacral vasculature and the anterior longitudinal ligament of the first sacral vertebra below the promontory and communicated with the opened rectovaginal space below. A polypropylene mesh, Gynemesh PS (Ethicon, 10 cm × 15 cm, Somerville, NJ, USA), was cut into 2 specific shape strips (Fig. 3). The anterior mesh was fixed using conventional sutures, while the posterior mesh was positioned over and sutured to the levator fascia on both sides, and to the uterosacral ligament complex (Fig. 2). The anterior and posterior arms of the meshes were then combined over the vaginal stump and drawn through the peritoneal tunnel. The distal end of the mesh is finally fixed without tension to the anterior longitudinal ligament of the sacrum (Fig. 4). All meshes were sutured with 2-0 nylon sutures (non-absorbable sutures). The peritoneum was sutured continuously with an absorbable suture, and the mesh was completely placed within the peritoneum to ensure complete peritonealization.

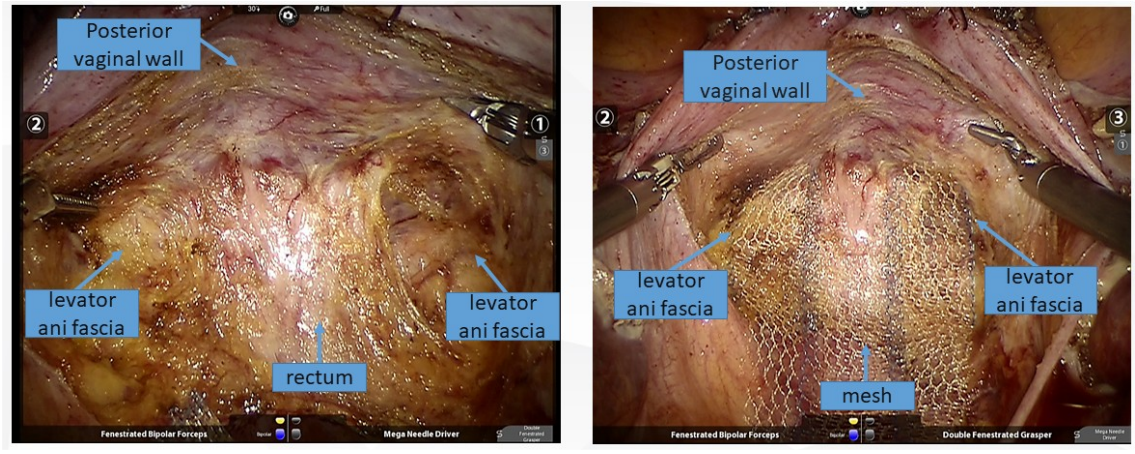

Figure 2. The vaginal rectal spaces were dissected down to the levator ani fascia on both sides, and the posterior mesh was placed over and sutured to this fascia

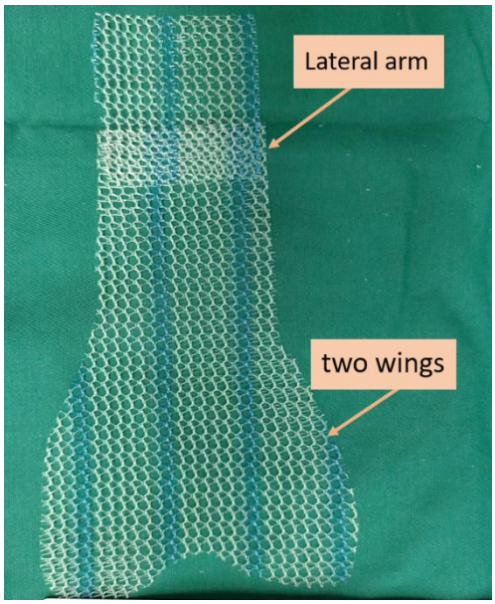

Figure 3. The posterior wall mesh was cut into the shape of the two wings and a lateral arm

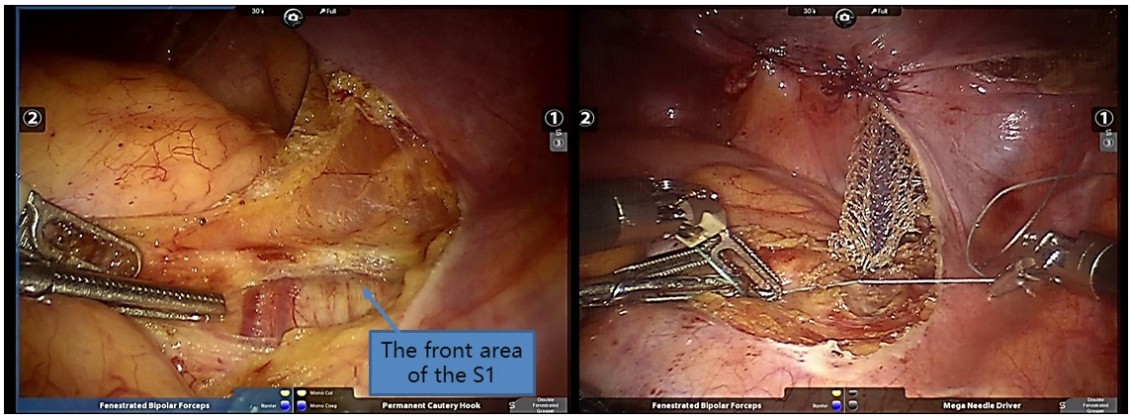

Figure 4. Exposed the front area of the first sacrum and fixed the long arm of the mesh to the anterior longitudinal ligament

Objectives

The objective of this study was to evaluate the safety and efficacy of MLSC for advanced posterior vaginal wall prolapse. Patients were primarily followed up through telephone consultations and outpatient clinic visits, starting 6 months after surgery. The main indicators of follow-up were the postoperative anatomical success rate and POP-Q score, while secondary indicators comprised quality of life scales and postoperative complication rates. Anatomical success was defined as stage I or lower based on the POP-Q. The quality of life of patients was assessed using questionnaires, including Pelvic Floor Distress Inventory-Short Form 20 (PFDI-20), the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire 12 (PISQ-12), and The Pelvic Floor Impact Questionnaire 7 (PFIQ-7). The PFDI-20 investigates the range of POP symptoms experienced by the patient and the grade of

inconvenience they cause. The PFIQ-7 covers the impact of POP on daily life. The PISQ-12 covers sexual function in sexually active women with POP. These three questionnaires have been used in numerous studies and have also been validated in their Chinese versions [15–17].

2.4 Statistical analysis

Data analysis was managed using SPSS 25 statistical software and R version 4.1.0. Data were reported as mean ± standard deviation for continuous quantitative variables and as number and percentage for qualitative variables. Preoperative and follow-up values were compared on McNemar test and Student's t-test for matched variables. A p-value < 0.05 was considered as statistically significant.

RESULTS

A total of 56 patients were included in this study. The demographic information is shown in Table 1. According to MRI assessment, fifteen of these patients combined with intestinal hernia. There were 6 cases had a history of POP surgery, which included 3 cases of simple anterior and posterior vaginal wall repair, 2 cases of sacrospinous ligament fixation, and 1 case of uterine-rectus abdominis suspension. Additionally, 8 patients were complicated with UI, including 3 patients with stress UI (SUI), 2 with urge UI (UUI), and 3 with mixed UI (MUI). None of the patients had previously undergone incontinence surgery; 42 patients (75%) underwent concurrent hysterectomy during the surgery. Among the other patients, six (10.71%) had vaginal vault prolapse, and 8 (14.29%) chose to preserve the uterus. Six cases (10.71%) underwent Tension Free Vaginal Tape-Obturator (TVT-O) surgery due to SUI or MUI. In all patients, the surgery was performed using minimally invasive techniques without conversion to laparotomy, and there were no injuries to the gastrointestinal tract, urinary system, or major blood vessels. The urinary catheter was removed within 24 hours after the operation, and none of the patients experienced discomforts such as dysuria, urgency, or dysuria. The perioperative data are presented in Table 2.

Table 1. Baseline characteristics (n = 56)

Characteristics	Value
Type of POP	
Simple posterior wall prolapses	18 (32.14)
Combined with other chamber prolapses	38 (67.8)
Age (years)	58.32 ± 7.63
BMI (kg/m2)	24.96 ± 3.45
Number of deliveries	1.55 ± 0.63
Menopause	37 (66.07)

Chronic constipation	25 (44.64)
Urinary incontinence	8 (14.29)
Uterine fibroids or adenomyoma	20 (35.71)
Intestinal hernia	15 (26.79)
Previous pelvic surgery	18 (32.14)
Previous POP surgery	6 (10.71)
Comorbidities	
Hypertension	9 (16.07)
Diabetes mellitus	11 (19.64)
Heart disease (Arrhythmia, Myocardial infarction, etc.)	2 (3.57)
Respiratory diseases (Emphysema, bronchiectasis, etc.)	5 (8.93)
Cerebral infarction	2 (3.57)

Data are mean ± standard deviationor n (%); POP — pelvic organ prolapse; BMI — body mass index

Table 2. Perioperative characteristics

Characteristic	Value
Surgical approach	
Laparoscopic	38 (67.86)
Robot-assisted	18 (32.14)
Concomitant procedures,	
Total hysterectomy	42 (75)
TVT surgery	6 (10.71)
Adhesiolysis	7 (12.5)
Duration of surgery (min)	197.39 ± 55.91
Estimated blood loss (ml)	44.19 ± 26.33
Length of postoperative hospital stay (day)	3.45 ± 1.04

Data are mean ± standard deviationor n (%); TVT — tension-free vaginal tape

All patients underwent gynecological examinations, MRI imaging, and laboratory tests during outpatient follow-up visits. The vaginal capacity of all patients could accommodate 2-3 fingers, and the POP-Q values returned to the normal anatomical range after the operation. The difference was statistically significant compared with the preoperative value ($p < 0.001$). The anatomic success rate was 100% during the maximum 36-month follow-up period (Tab. 3).

Functional pelvic problems (PFDI-20 scores) and their impact on patients' quality of life (PFIQ-7 scores) significantly improved postoperatively ($p < 0.001$). We did not collect information on patients' sexual activity for 6 months after surgery as it was necessary to avoid sexual intercourse in immediate post-surgery period. 33 patients who had a sexual life before

the operation recovered and resumed normal sexual activity after the operation, as confirmed during the 12-month follow-up evaluation. In addition, two patients who had no sex activity 6 months before the operation also resumed sexual activity after the procedure. There was no statistically significant difference from the preoperative score ($p = 0.5$). Patients experienced improved urinary system-related symptoms and sensory disturbances after the operation ($p < 0.05$). 19 out of the 25 patients who had constipation before the operation returned to normal 1 month after the procedure, with significant improvement in their anorectal symptoms. 12 cases experienced new-onset constipation, and their symptoms improved or resolved within 6 months after the operation through changes in dietary habits and the use of laxative drugs. Additionally, the 6 patients with UI underwent TVT-O surgery simultaneously, resulting in significant symptom improvement post-surgery without dysuria or urinary retention. There were 5 patients with new-onset UI, two of whom had UUI and were cured with cholinergic receptor blockers and other medications, while three had SUI with mild symptoms, and none required further surgery (Tab. 4).

Table 3. Anatomical results according to POP-Q classification and stage at 6, 12, 24 and 36months follow-up

	Preoperative n = 56	6 months n = 56	p value	12 months n = 56	p value	24 months n = 35	p value	36 months n = 22	p value
POP-Q point									
Aa (cm)	0.95 ± 1.33	–2.8 ± 0.4	< 0.001	–2.8 ± 0.5	< 0.001	–2.7 ± 0.5	< 0.001	–2.7 ± 0.5	< 0.001
Ba (cm)	2.36 ± 2.13	–2.9 ± 0.3	< 0.001	–2.8 ± 0.2	< 0.001	–2.7 ± 0.4	< 0.001	–2.7 ± 0.5	< 0.001
Ap (cm)	1.25 ± 1.08	–2.9 ± 0.5	< 0.001	–2.6 ± 0.5	< 0.001	–2.5 ± 0.6	< 0.001	–2.3 ± 0.7	< 0.001
Bp (cm)	3.6 ± 1.0	–2.9 ± 0.2	< 0.001	–2.9 ± 0.2	< 0.001	–2.8 ± 0.3	< 0.001	–2.6 ± 0.3	< 0.001
C (cm)	1.9 ± 2.8	–6.4 ± 1.3	< 0.001	–6.6 ± 1.2	< 0.001	–6.5 ± 1.4	< 0.001	–5.5 ± 0.6	< 0.001
Anatomical success rate, n %		56 (100)		56 (100)		35 (100)		22 (100)	

Data are mean ± standard deviation or n (%); p value — compared to preoperative data. Aa, Ba, C, Ap and Bp were the measured parameters, as defined by the ICS POP-Q; C, those with a uterus represent the cervix, and those without a uterus represent the top of the fornix

Table 4. Quality of life scores and Complications at 6, 12, 24 and 36 months follow-up

	Preoperative n = 56	6 months n = 56	p value	12 months n = 56	p value	24 months n = 35	p value	36 months n = 22	p value
Quality of life score sheet									
PFIQ-7	159.3 ± 15.7	145.7 ± 15.7	□0.001	51.2 ± 12.9	□0.001	46.3 ± 13.8	□0.001	49.2 ± 11.9	□0.001

PFDI-20	143.6 ± 31.7	33.5 ± 14.7	<0.001	33.0 ± 9.4	<0.001	29.1 ± 9.0	<0.001	29.5 ± 9.2	<0.001
Sexual relations	33 (58.9)	-	-	35 (62.5)	>0.990	21 (60)	0.500	9 (40.91)	>0.990
PISQ-12	26.5 ± 5.5	-	-	27.6 ± 5.0	0.034	29.0 ± 4.7	0.286	28.3 ± 5.9	0.187
Symptoms									
Bowel dysfunction	26 (46.43)	2 (3.57)		1 (1.79)		0 (0)		0 (0)	<0.001
Urination dysfunction	12 (21.43)	5 (8.93)		4 (7.14)		1 (2.86)		1 (4.55)	0.031
Sensory dysfunction	25 (44.64)	3 (5.36)		2 (3.57)		0 (0)		0 (0)	<0.001
Complications									
Mesh-related complications		1 (1.79)		1 (1.79)		0 (0)		0 (0)	
Infection		8 (14.29)		3 (5.36)		0 (0)		0 (0)	
Urinary incontinence		5 (8.93)		4 (7.14)		1 (2.86)		1 (5.44)	

Data are mean ± standard deviation or n (%); p value — compared to preoperative data; bowel dysfunction, Constipation, Digital assistance, Fecal incontinence, *etc*. Urination dysfunction, Urine leakage, difficulty urinating, *etc*.; Sensory dysfunction, Dyspareunia, abdominal and lumbosacral discomfort, *etc*.; Mesh-related complications, Mesh shrinkage, Vaginal mesh exposure, *etc*.; Infection, Vaginal infection, pelvic infection, osteomyelitis, pondyloperiostitis, *etc*.

1 patient with persistent mesh exposure recovered after debridement and suturing of the stump 12 months after the operation. Infection-related complications mainly include vaginal stump inflammation and pelvic infection. 3 vaginal stump infections were observed during an outpatient follow-up visit 1 month after the surgery. During the gynecological examination, none of the patients presented obvious symptoms such as vaginal stump congestion, loose sutures, or poor healing. All patients recovered after treatment with estrogen-containing vaginal suppositories and estrogen cream. There were no serious mesh-related complications such as adhesive bowel obstruction or mesh erosion during the follow-up period (Tab. 4).

DISCUSSION

Traditional LSC is applicable to uterine prolapse with mid-pelvic defects. The mesh is mainly sutured to the upper third of the posterior vaginal wall and the uterosacral ligament. However, it provides less support for the lower part of the anterior and posterior vaginal walls and cannot achieve the same ideal effect [18]. In an analysis by Sullivan et al. [19], in which mesh was fixed to the sacrum to treat multicompartmental POP, 28% of their patients (n = 236, follow-up 5 years or 3 years) required reoperation for recurrent low posterior vaginal wall prolapse. Moreover, rectocele resulting from uncorrected central or distal defects may create a downward traction force on the apical suspension recurrence sites, which can contribute to the apical plateau recurrence [20]. WONG et al. [19] utilized ultrasound to evaluate the location of the anterior mesh in LSC patients' post-surgery and discovered that the lower the mesh position, the lower likelihood of recurrence rate. Therefore, there is a view that the posterior wall mesh can be fixed to the perineal body in LSC, but excessive dissection of the posterior vaginal wall may increase bowel complications [22].

In this study, we performed MLSC in 56 patients with advanced posterior vaginal wall prolapse. The procedure involved dissecting the rectum from the posterior vaginal wall down to the levator ani fascia on both sides of the rectum. It not only fixes Level I support (vagina apical) but also has major influences on Level II (midvaginal) and Level III (introital) support. In our follow-up, we observed a significant improvement in POP-Q score among all patients, resulting in an overall objective cure rate of 100%. It shows that the MLSC is not only suitable for apex prolapse but also for patients with simple posterior wall prolapse, especially for those experiencing POP recurrence or had a combined intestinal hernia. Carter-Brooks et al. [11] conducted a follow-up study and found that compared to patients who did not undergo Level III support procedures (such as posterior repair and/or perineorrhaphy), those who underwent LSC alone showed similar genital hiatus (GH) 1-year post-surgery, with no

difference in recurrence rate. In this study, the 56 included patients did not undergo Level III support procedures, regardless of the presence of anatomical defects in the perineal body. All patients achieved satisfactory anatomical reduction after surgery. Our initial experience showed that MLSC seemed to safely cure advanced posterior vaginal wall prolapse, suggesting that the indications of the MLSC could potentially be expanded. For patients with total pelvic floor deficiencies, this procedure can be used to achieve satisfactory results and maintain long-term outcomes.

Gluck et al. confirmed that numerous technical variants for LSC exist and that there is still little consensus on various issues regarding the technique [22]. Many scholars have improved the LSC procedure in the past. Gadonneix [23] used two separate meshes along the anterior and posterior vaginal walls to correct multicompartment pelvic organ prolapse, and the recurrence rate was 12% with a median follow-up of 24 months for posterior vaginal wall prolapse. Lan Z [24] performed LSC in 30 patients with the attachment of mesh straps transvaginally, and only 1 patient had a recurrence of the posterior vaginal wall two years after surgery. The patients enrolled in our study were followed up for a maximum of 3 years, and currently, no patient has a recurrence of the posterior vaginal wall. The results herein presented demonstrate the effectiveness of this procedure in reducing the recurrence of posterior vaginal wall prolapse.

In terms of quality of life, it was found that prolapse-related symptoms significantly improved ($p < 0.001$), as did patients' overall quality of life. However, the quality of sexual life was not affected ($p = 0.5$). In our data, 25 patients (44.64%) had chronic constipation before surgery. Among them, 19 patients regained normal defecation function within 1 month after surgery, suggesting that the restoration of the anatomical structure of the posterior vaginal wall contributes to the improvement of defecation function. Although there were 12 patients with new-onset constipation after surgery, most cases occurred within the first month post-surgery. Anorectal symptoms improved within 6 months after surgery, likely due to the use of medications to facilitate bowel movements and improvements in dietary habits. It was previously believed that deep dissection of the posterior vaginal wall during the operation could alter rectal compliance and anorectal angulation, resulting in obstructed defecation. In addition, pararectal dissection could cause autonomic nerve injury contributing to a reduction in rectal mobility [25]. Fox and Stanton [26] separated the rectum from the posterior vaginal wall down to the perineal body during surgery. With a median follow-up of 14 months, postoperative bowel-related complications increased from 41% to 50%. However, our data suggest that the MLSC may temporarily affect the patient's bowel dysfunction, but the repair

of the postoperative anatomical structure is ultimately beneficial to the recovery of the patient's defecation function. This finding is consistent with the conclusions of Grimes et al. [27] and Ramanah et al. [25]. Overall, this procedure can significantly improve prolapse-related symptoms and quality of life of patients for an extended period. And it did not have a negative impact on the sexual life of patients, some patients even experienced improvements. This fully demonstrates the superiority of this procedure compared to transvaginal and transanal routes. Its potential benefits to sexual function (preserving vaginal length and axial direction, thereby reducing the incidence of dyspareunia) makes this procedure the first choice for relatively young, sexually active women. Similar conclusions were drawn in a 1-year follow-up study by Thibault et al. [28] using the same questionnaire.

Intraoperative complications mainly include bladder, ureter, intestinal injury, excessive bleeding, and hematoma formation. Simultaneously, placing the mesh lower requires more dissection of the posterior vaginal wall, which can result in increased intraoperative blood loss, longer operative time, and a heightened risk of intestinal injury. All surgical procedures in this study were performed by a professional physician with nearly ten years of experience in pelvic floor surgery. The data confirms the safety of this operation. However, the LSC is associated with technical challenges and a steep learning. The security of the operation also depends on the surgeon’s technical expertise and surgical experience.

In previous reports, mesh-related complications are one of the most common and intractable complications of SC, with a risk as high as 10.5% at 7 years following the procedure [29]. Infections, failure of prolapse repair, and mesh erosions may require mesh removal and, if applicable, repeat LSC [9]. Although the mechanism of mesh exposure is unclear, factors such as infection, hematoma, concomitant uterine resection, history of POP surgery, different types of mesh or suture, vaginal mesh tension, mesh peritoneal coverage, and vaginal use of estrogen may contribute to the pathogenesis of mesh exposure [30–32]. To prevent mesh-related complications, we placed the mesh without tension, strictly carried out the peritonealization of the mesh, and implemented additional measures during the operation. The follow-up data of this study suggested that only 1 patient (1.8%) who had persistent mesh exposure was treated with secondary surgery, which is lower than the 3% reoperation rate for mesh-related complications reported in the recent literature [33].

In recent years, the concept of prophylactic anti-incontinence surgery for women has sparked a popular and controversial debate. It has been reported in the literature that about 5.3% of patients developed SUI requiring surgical treatment after LSC [34]. A high-quality meta-study in 2014 showed that combined surgery reduced the risk of postoperative SUI, but

there was also a risk of complications such as overactive bladder symptoms and obstructive urination [35]. We performed TVT-O surgery on patients with preoperative SUI and MUI. In our study, we effectively alleviated post-surgery urinary leakage symptoms without increasing surgery-related complications. None of the patients required anti-incontinence surgery again.

The main advantages of this study include its prospective design and the systematic preoperative and postoperative assessment using the POP-Q system, standardized surgical techniques, standardized scoring scales, etc. Dynamic collection and comparison of the result data can clearly and directly reflect the changes in the relevant indicators of the patients after surgery. However, due to the limited number of cases and short observation period in this study, further investigation involving more cases treated with this procedure is needed. In addition, factors such as the depth of rectal dissection and the level of levator ani muscle fascia fixation may also affect the study results. Therefore, we look forward to further research using large sample size, long-term follow-up, and standardized randomized controlled trials to validate the superiority of MLSC in advanced posterior vaginal wall prolapse in the future. This operation is expected to evolve into a first-line surgical approach for treating advanced pelvic defects after adequate evaluation.

Article information and declarations

Acknowledgments

We thank all patients for providing signed permission to publish this article.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to the inclusion of information that compromise the privacy of research participants.

Author contributions

YifanYin (first author): conceptualization, methodology, investigation, formal analysis, writing — original draft; YufangXia: data curation, writing — original draft; ShujunJi: investigation; Enhui Guo: resources, supervision; Chen Chen: writing — original draft;
Yanhui Lou (corresponding author): conceptualization, resources, writing — editing.

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Ethics statement

All subjects gave their informed consent for inclusion before they participated in the study. The Ethics Committee of the Affiliated Hospital of Qingdao University approved this study, ethics NO. QYFYWZLL27716.

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