# The Efficacy of Laparoscopic Suspension Combined With Vaginal Wall Repair in the Treatment of Pelvic Organ Prolapse: A Clinical Study

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AIM: To assess the efficacy and safety of combining laparoscopic suspension with vaginal wall repair for treating Pelvic Organ Prolapse (POP).

METHODS: Clinical data from 112 patients with POP admitted to Taishun County People's Hospital between January 2022 and October 2024 were collected and analyzed retrospectively. Based on the surgical method, the subjects were categorized into two groups: 52 patients treated with conventional vaginal wall repair were assigned to the control group, and 60 patients treated with vaginal wall repair combined with laparoscopic suspension were assigned to the study group. General characteristics, perioperative indicators, pelvic floor function, postoperative complications, and quality of life were compared between the two groups. The pelvic floor function was assessed using the Colorectal-Anal Distress Inventory-8 (CRADI-8), Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6), and Urogenital Distress Inventory-6 (UDI-6), whereas the quality of life was measured using the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12 (PISQ-12), Pelvic Floor Distress Inventory-20 (PFDI-20), and Pelvic Floor Impact Questionnaire-7 (PFIQ-7).

RESULTS: Baseline characteristics were comparable between the two groups ($p > 0.05$). The study group, however, experienced longer surgery, increased intraoperative blood loss, and extended catheterization compared with the control group, while length of hospital stay and postoperative residual urine volume showed no significant differences ($p > 0.05$). At three months postoperatively, patients in the study group showed significantly improved scores in CRADI-8, POPDI-6, and UDI-6 compared with the control group ($p < 0.05$). Postoperative complication rates were similar between the groups ($p > 0.05$). At 12 months postoperatively, the study group had higher PISQ-12 scores and lower PFDI-20 and PFIQ-7 scores compared with the control group ($p < 0.001$), suggesting more significant improvements in sexual function and quality of life.

CONCLUSIONS: Compared with vaginal wall repair alone, the combined approach of laparoscopic suspension and vaginal wall repair improves postoperative pelvic floor function and quality-of-life outcomes without increasing the risk of complications, supporting its role as a valuable surgical option for selected patients with POP.

**Keywords:** Pelvic Organ Prolapse; vaginal wall repair; laparoscopic suspension; pelvic floor function

## Introduction

Pelvic organ prolapse (POP) is a prevalent pelvic floor disorder among women, primarily characterized by the descent of the uterus or vaginal walls [1,2]. It is often accompanied by symptoms such as a vaginal foreign body sensation, urinary or defecatory dysfunction, sexual limitations, and reduced quality of life, which severely affect both physical and mental health [3,4]. Epidemiological studies show that the incidence of POP increases significantly among middle-aged and elderly women, particularly postmenopausal women [5]. Multiple childbirths, pelvic floor muscle and ligament injuries, obesity, chronic cough, and genetic factors are all associated with an increased risk of POP [6–8].

The pathogenesis of POP is primarily related to damage of the pelvic floor support structures, including weakening of the vaginal fascia, ligaments, and pelvic floor muscles, which leads to pelvic organ descent and dysfunction [9]. In addition, long-term pressure overload and reduced connective tissue elasticity are important contributing factors. POP patients are often accompanied by bladder, rectal, and anal dysfunction, which further increases the burden of symptoms such as difficulty in urination and defecation, as well as urinary incontinence [10].

Surgical treatment is the primary intervention for patients with moderate to severe POP. Traditional vaginal wall repair is a simple and minimally invasive procedure, and because it relies solely on the patient's own vaginal tissue to restore support, this technique is associated with a relatively high recurrence rate and limited improvement in pelvic floor function [11]. Laparoscopic suspension, by fix-

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ing the vaginal vault or cervix to the anterior longitudinal ligament of the sacrum, restores pelvic floor anatomy while providing firm support and reducing the risk of recurrence [12,13]. The combined approach of vaginal wall repair and laparoscopic suspension addresses both anatomical repositioning and functional recovery of the pelvic floor, offering the potential for better symptom relief, improved quality of life, and a lower incidence of postoperative complications [14].

At present, systematic studies on the efficacy of laparoscopic suspension combined with vaginal wall repair in improving pelvic floor function, perioperative outcomes, and quality of life remain limited, and large-sample evidence is lacking. To address this knowledge gap, the present study retrospectively analyzed 112 patients with POP treated in our hospital from January 2022 to October 2024 and compared postoperative pelvic floor function, complications, and quality of life in patients receiving conventional vaginal wall repair alone and the combined surgical procedure. The aim was to provide evidence-based support for the selection of surgical methods in clinical practice and to offer a reference for optimizing treatment strategies for POP patients.

## Patients and Methods

*General Data*

A retrospective review was performed on 112 patients with POP who were admitted to Taishun County People's Hospital between January 2022 and October 2024. Fifty-two patients receiving anterior and posterior vaginal wall repair were assigned to the control group, whereas 60 patients receiving laparoscopic suspension combined with vaginal wall repair were assigned to the study group. The baseline characteristics of both groups are summarized in Table 1. The study was approved by the Ethics Committee of Taishun County People's Hospital (Approval No. SL2024-021-001), and written informed consent was obtained from every participant. All procedures were conducted in strict compliance with the Declaration of Helsinki.

The inclusion and exclusion criteria applied in this study are listed in the following:

*Inclusion Criteria*: (1) Patients clinically diagnosed with POP stage II–IV according to the Pelvic Organ Prolapse Quantification System (POP-Q) [15]; (2) Patients with significant symptoms affecting quality of life (e.g., vaginal bulge sensation, urinary or defecatory dysfunction); (3) Patients aged $\geq$40 years, meeting surgical indications and voluntarily accepting surgical treatment; (4) Patients whose preoperative cardiopulmonary and major organ function are sufficient to undergo surgery; (5) Patients with complete clinical data available.

*Exclusion Criteria*: (1) Individuals with pelvic malignancy or severe pelvic infection; (2) Individuals with a history of prior pelvic reconstructive surgery and recurrence; (3) Individuals with severe comorbidities that preclude surgery; (4) Pregnant women or those expecting pregnancy in the near future; (5) Individuals who are allergic to synthetic mesh or with contraindications to mesh implantation; (6) Patients with incomplete clinical data or who are lost to follow-up.

*Methods*

*Control Group*: Subjects in the control group received anterior and posterior vaginal wall repair through the vaginal route. In the lithotomy position, a longitudinal incision was made on the anterior or posterior vaginal wall. The vesicovaginal or rectovaginal fascia was separated bluntly or sharply, and the lax or torn fascia was folded and sutured to enhance support. Excess vaginal wall tissue was trimmed, and the incision was closed. A urinary catheter and vaginal packing with gauze were placed at the end of the procedure.

*Study Group*: Patients in the study group underwent laparoscopic suspension combined with anterior and posterior vaginal wall repair. Under general anesthesia, patients were positioned in the lithotomy position. Pneumoperitoneum was established through a 10 mm umbilical incision, and laparoscopic ports were placed as follows: one 10 mm umbilical port for the laparoscope, one 5 mm port in the left lower quadrant, one 5 mm port in the right lower quadrant, and an optional 5 mm suprapubic port, if needed, for retraction.

The space between the bladder, rectum, and vagina was carefully dissected to expose the anterior and posterior vaginal walls or cervix, depending on surgical indications. A tailored polypropylene mesh (type I, macroporous, 10 $\times$ 15 cm) was used. The mesh was fixed to the vaginal fascia using non-absorbable polypropylene sutures (2-0), and then anchored to the anterior longitudinal ligament of the sacrum at the S1–S2 level. The uterus was preserved, and a sacral uterine suspension was performed. The peritoneum was closed over the mesh to reduce adhesion risk.

All laparoscopic incisions were sutured in layers. Postoperatively, a urinary catheter and vaginal packing were routinely placed, and prophylactic antibiotics, along with symptomatic treatments, were administered as appropriate. Detailed steps and intraoperative precautions were strictly followed to ensure procedural consistency, reproducibility, and patient safety.

*General Characteristics*

Age, body mass index (BMI), menopausal duration, duration of prolapse, parity, and prolapse stage were recorded. The POP-Q [16] was used to assess the severity of POP. Using the hymenal ring as a reference plane, the relative positions of anatomical points on the anterior and posterior vaginal walls and the cervix/vaginal apex were measured (in cm). Staging was based on the most distal point:

- Stage 0: No prolapse (all points $\geq$3 cm above the hymen).
- Stage I: Most distal point $>$1 cm above the hymen.
- Stage II: Most distal point $\leq$1 cm above or below the hymen.

**Table 1. Comparison of general characteristics between the control and study groups.**

| | Control group ($n$ = 52) | Study group ($n$ = 60) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|
| Age (years) | 65.16 ± 10.12 | 64.97 ± 9.69 | 0.100 | 0.920 |
| BMI (kg/m$^2$) | 25.61 ± 3.23 | 25.44 ± 3.41 | 0.268 | 0.789 |
| Duration of menopause (years) | 16.99 ± 9.48 | 17.03 ± 8.89 | 0.021 | 0.983 |
| Duration of prolapse (years) | 5.96 ± 1.67 | 6.16 ± 1.85 | 0.613 | 0.541 |
| The mean number of pregnancies | 3.65 ± 1.16 | 3.62 ± 1.17 | 0.166 | 0.869 |
| Prolapse stage, $n$ (%) | | | | |
| II | 12 (23.08) | 14 (23.33) | | |
| III | 23 (44.23) | 27 (45.00) | 0.014 | 0.993 |
| IV | 17 (32.69) | 19 (31.67) | | |

BMI, body mass index.

• Stage III: Most distal point ≥1 cm below the hymen but less than total vaginal length minus 2 cm.
• Stage IV: Complete vaginal eversion (prolapse to within 2 cm of total vaginal length).

*Outcome Measures*

The outcome measures of this study included:
(1) *Perioperative Indicators*: Operative time, intraoperative blood loss, catheterization duration, length of hospital stay, and postoperative residual urine volume were compared between the groups.
(2) *Assessment of Pelvic Floor Symptoms*: The following instruments were employed to assess pelvic floor function preoperatively and at 3 months postoperatively:
• Colorectal-Anal Distress Inventory-8 (CRADI-8) [17]: 8 items, each scored from 0 to 4 points, with higher scores indicating greater anorectal symptom distress.
• Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6) [17]: 6 items, each scored from 0 to 4 points, with higher scores reflecting more severe prolapse-related symptom distress.
• Urogenital Distress Inventory-6 (UDI-6) [17]: 6 items, each scored from 0 to 4 points, with higher scores indicating more severe urinary symptom distress.
(3) *Postoperative Complications*: Data on recorded events such as pain, urinary retention, vaginal bleeding, bladder injury, and incision infection were collected.
(4) *Quality of Life and Symptom Assessment*: The following instruments were employed to evaluate the quality of life of patients preoperatively and at 12 months postoperatively:
• Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12 (PISQ-12) [18]: 12 items, each scored from 0 to 4 points, with higher scores indicating better sexual quality of life.
• Pelvic Floor Distress Inventory-20 (PFDI-20) [17]: 20 items—encompassing POPDI-6, CRADI-8, and UDI-6—yield a total score ranging from 0 to 300, with a higher score indicating greater symptom burden. This score represents a standardized score calculated using the formula (raw score ÷ number of items) × 25.
• Pelvic Floor Impact Questionnaire-7 (PFIQ-7) [19]: 7 items covering urinary, colorectal-anal, and prolapse domains, yielding a total score ranging from 0 to 300, with a higher score reflecting greater negative impact on daily life and well-being. This score was based on the raw score.

The CRADI-8, POPDI-6 and UDI-6 are used to assess short-term symptom improvement at 3 months, whereas the PFDI-20 is used to assess overall symptom burden during long-term follow-up

Outcome assessors and statisticians were blinded to group allocation.

*Statistical Analysis*

Data were analyzed using SPSS software (version 27.0, IBM, Armonk, NY, USA). Using the Shapiro–Wilk test to assess normality of data distribution, we found that all continuous variables included in this study were normally distributed. Normally distributed data are presented as mean ± standard deviation, and comparisons between groups were performed using the independent-samples $t$-test. Categorical variables are expressed as counts and percentages, and comparisons between groups were conducted using the chi-square ($\chi^2$) test. A $p$-value $< 0.05$ was considered statistically significant.

## Results

*Comparison of General Characteristics Between the Control and Study Groups*

In the control group, the mean age was 65.16 ± 10.12 years, the mean BMI was 25.61 ± 3.23 kg/m$^2$, the duration of menopause averaged 16.99 ± 9.48 years, the prolapse duration averaged 5.96 ± 1.67 years, and the mean number of pregnancies was 3.65 ± 1.16. Prolapse severity included 12 cases of stage II, 23 of stage III, and 17 of stage IV.

In the study group, the mean age was 64.97 ± 9.69 years, the mean BMI was 25.44 ± 3.41 kg/m$^2$, the duration of menopause averaged 17.03 ± 8.89 years, the prolapse duration averaged 6.16 ± 1.85 years, and the mean number of pregnancies was 3.62 ± 1.17. Prolapse severity included 14 cases of stage II, 27 of stage III, and 19 of stage IV.

No significant differences were observed in baseline characteristics between the two groups ($p > 0.05$) (Table 1).

**Table 2. Comparison of perioperative indicators between the two groups.**

| | Control group ($n$ = 52) | Study group ($n$ = 60) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|
| Length of hospital stay (days) | 5.41 ± 2.41 | 5.72 ± 2.47 | 0.654 | 0.514 |
| Intraoperative blood loss volume (mL) | 46.95 ± 13.46 | 100.57 ± 21.38 | 15.598 | <0.001 |
| Operative time (min) | 61.23 ± 16.05 | 139.20 ± 30.95 | 16.353 | <0.001 |
| Catheterization duration (days) | 3.36 ± 0.64 | 4.02 ± 0.66 | 5.341 | <0.001 |
| Postoperative residual urine volume (mL) | 46.52 ± 4.97 | 45.47 ± 4.59 | 1.161 | 0.248 |

**Table 3. Comparison of preoperative and postoperative pelvic floor symptom and prolapse staging between the two groups.**

| | Control group ($n$ = 52) | Study group ($n$ = 60) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|
| Preoperative CRADI-8 score | 26.43 ± 3.78 | 27.03 ± 3.63 | 0.858 | 0.393 |
| CRADI-8 score at 3 months postoperatively | 16.54 ± 4.12 | 12.50 ± 2.26 | 6.549 | <0.001 |
| Preoperative POPDI-6 score | 19.98 ± 3.08 | 19.67 ± 2.39 | 0.601 | 0.549 |
| POPDI-6 score at 3 months postoperatively | 13.46 ± 2.64 | 9.30 ± 1.56 | 10.298 | <0.001 |
| Preoperative UDI-6 score | 18.79 ± 3.61 | 18.76 ± 3.46 | 0.046 | 0.964 |
| UDI-6 score at 3 months postoperatively | 13.66 ± 1.65 | 9.72 ± 1.22 | 14.415 | <0.001 |
| Prolapse stage at 3 months postoperatively, $n$ (%) | | | | |
| 0 | 14 (26.92) | 25 (41.67) | | |
| I | 24 (46.15) | 29 (48.33) | 6.235 | 0.044 |
| II | 14 (26.92) | 6 (10.00) | | |

Abbreviations: CRADI8, Colorectal-Anal Distress Inventory-8; POPDI6, Pelvic Organ Prolapse Distress Inventory-6; UDI6, Urogenital Distress Inventory-6.

*Comparison of Perioperative Indicators*

No significant differences were observed between the two groups in terms of the length of hospital stay and postoperative residual urine volume ($p > 0.05$). However, the study group experienced higher intraoperative blood loss, longer operative time, and extended catheterization duration compared with the control group ($p < 0.001$) (Table 2).

*Comparison of Preoperative and Postoperative Pelvic Floor Symptom Scores and Prolapse Staging Between the Two Groups*

Preoperative scores for CRADI-8, POPDI-6, and UDI-6 did not differ significantly between the two groups ($p > 0.05$). Moreover, the study group had significantly lower CRADI8, POPDI6, and UDI6 scores at 3 months postoperatively compared with the control group ($p < 0.001$). At 3 months postoperatively, the control group had 14 cases of Stage 0, 24 of Stage I, and 14 of Stage II, whereas the study group had 25 cases of Stage 0, 29 of Stage I, and 6 of Stage II, with a between-group difference in prolapse stage of statistical significance ($p < 0.05$) (Table 3).

*Comparison of Postoperative Complication Rates Between the Two Groups*

The incidence of postoperative complications—including pain, urinary retention, vaginal bleeding, bladder injury, and incision infection—was comparable between the two groups, with no statistically significant differences observed ($p > 0.05$) (Table 4).

*Comparison of Postoperative Quality of Life and Pelvic Floor Symptoms Between the Two Groups*

Preoperative scores for PISQ-12, PFDI-20, and PFIQ-7 were comparable in both groups, with no statistically significant differences observed ($p > 0.05$). At 12 months postoperatively, PISQ-12 scores increased while PFDI-20 and PFIQ-7 scores decreased in both groups compared with preoperative values. At 12 months postoperatively, the study group had higher PISQ-12 scores and lower PFDI-20 and PFIQ-7 scores compared with the control group, with statistically significant differences ($p < 0.001$) (Table 5).

## Discussion

In this retrospective study of 112 patients with POP, various aspects—including perioperative indicators, pelvic floor function, postoperative complications, and quality of life—of conventional vaginal wall repair and laparoscopic suspension combined with vaginal wall repair were analyzed and compared. The results showed that at 3 months postoperatively, the study group had remarkably lower CRADI-8, POPDI-6, and UDI-6 scores compared with the control group, indicating that the combined procedure was more effective in improving colorectal-anal symptoms, lower urinary tract symptoms, and prolapse-related symptoms. At 12 months postoperatively, PISQ-12, PFDI-20, and PFIQ-7 scores demonstrated that the study group experienced greater improvements in sexual function and overall quality of life than the control group.

In this study, patients in the study group undergoing laparoscopic suspension combined with vaginal wall repair experienced longer operative time, greater intraoperative blood

**Table 4. Comparison of postoperative complication rates between the two groups.**

| | Control group ($n$ = 52) | Study group ($n$ = 60) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|
| Pain, $n$ (%) | | | | |
| Yes | 3 (5.77) | 2 (3.33) | 0.027 | 0.870 |
| No | 49 (94.23) | 58 (96.67) | | |
| Urinary retention, $n$ (%) | | | | |
| Yes | 2 (3.85) | 1 (1.67) | 0.016 | 0.900 |
| No | 50 (96.15) | 59 (98.33) | | |
| Vaginal bleeding, $n$ (%) | | | | |
| Yes | 2 (3.85) | 3 (5.00) | 0.000 | 1.000 |
| No | 50 (96.15) | 57 (95.00) | | |
| Bladder injury, $n$ (%) | | | | |
| Yes | 1 (1.92) | 1 (1.67) | 0.000 | 1.000 |
| No | 51 (98.08) | 59 (98.33) | | |
| Incision infection, $n$ (%) | | | | |
| Yes | 3 (5.77) | 2 (3.33) | 0.027 | 0.870 |
| No | 49 (94.23) | 58 (96.67) | | |

**Table 5. Comparison of quality of life and pelvic floor symptom scores between the two groups.**

| | Control group ($n$ = 52) | Study group ($n$ = 60) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|
| Preoperative PISQ-12 score | 22.15 ± 3.04 | 21.33 ± 2.60 | 1.531 | 0.129 |
| PISQ-12 score at 12 months postoperatively | 29.84 ± 4.61 | 32.81 ± 4.69 | 3.371 | <0.001 |
| Preoperative PFDI-20 score | 70.65 ± 13.19 | 70.71 ± 13.07 | 0.023 | 0.982 |
| PFDI-20 score at 12 months postoperatively | 42.55 ± 10.26 | 31.99 ± 8.82 | 5.860 | <0.001 |
| Preoperative PFIQ-7 score | 233.44 ± 45.86 | 230.51 ± 44.81 | 0.341 | 0.733 |
| PFIQ-7 score at 12 months postoperatively | 76.58 ± 13.87 | 62.60 ± 13.58 | 5.379 | <0.001 |

Abbreviations: PFDI-20, Pelvic Floor Distress Inventory-20; PFIQ-7, Pelvic Floor Impact Questionnaire-7; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12.

loss, and prolonged catheterization compared with those in the control group. These differences can be reasonably explained by several factors. First, laparoscopic suspension is a more complex procedure than conventional vaginal wall repair, involving additional steps such as establishing pneumoperitoneum, performing precise dissection between the bladder, rectum, and vagina, and securely fixing the polypropylene mesh to the anterior longitudinal ligament of the sacrum. The complexity of these steps inherently increases operative duration and may contribute to slightly higher blood loss. Second, some patients in the study group had more advanced prolapse stages or concomitant comorbidities, which may increase the difficulty of surgery and the intraoperative manipulation required, further prolonging operative time and catheterization duration. Third, although the surgical team followed standardized procedures, variations in tissue characteristics, intraoperative hemostasis, and the learning curve associated with laparoscopic techniques could also have influenced these perioperative indicators.

Despite these differences, it is important to note that the observed increases in operative time, blood loss, and catheterization duration did not translate into a higher incidence of postoperative complications, indicating that laparoscopic suspension combined with vaginal wall repair is a safe and feasible approach. These findings suggest that while the procedure is technically more demanding, the benefits in terms of improved pelvic floor function and quality-of-life outcomes may justify the slightly increased perioperative burden in selected patients.

The above results are consistent with previous studies. According to available literature, vaginal wall repair effectively improves POP symptoms; however, because it relies solely on native tissue for support, it has limitations in terms of recurrence rates and postoperative functional outcomes [20,21]. Laparoscopic suspension, by fixing the vaginal vault or cervix to the sacral promontory fascia, can restore pelvic anatomy and enhance pelvic floor support, thereby improving symptoms related to urination, defecation, and sexual function [22]. The combination of vaginal wall repair and laparoscopic suspension not only restores vaginal wall support but also reinforces support at the pelvic apex, which may explain why improvements in pelvic floor function and quality of life were significantly more pronounced in the recipients than those receiving vaginal wall repair as the only treatment.

Despite the greater intraoperative blood loss and the longer operative time, a significant increase in the incidence of postoperative complications was not observed in the patients treated with the combined approach of laparoscopic

suspension and vaginal wall repair, consistent with previous reports on the safety of this combined procedure [23]. The slightly prolonged postoperative catheterization duration may be related to the laparoscopic procedure and mesh fixation, but it did not significantly affect the length of hospital stay or postoperative residual urine volume—advantages that position the procedure as a potential strategy from a perioperative management perspective.

This study also found that the combined procedure resulted in significant improvements in postoperative sexual function (PISQ-12) and the overall quality of life (PFDI-20, PFIQ-7), which are directly related to symptom relief and anatomical restoration in POP patients. These findings suggest that the combined procedure not only provides superior anatomical restoration compared with vaginal wall repair alone but also offers greater benefits in terms of functional outcomes and quality of life.

It should be noted that this single-center retrospective study involved a limited number of patients and a follow-up period of only 12 months, which may not be adequate to comprehensively assess long-term recurrence and complication rates. In addition, as patients were not randomly assigned to the two groups due to the retrospective cohort design, this study is prone to selection bias. Moreover, patient factors such as surgeon preference, pelvic anatomy, and other unmeasured confounders may have influenced the choice of surgery, thereby affecting the study outcomes. Future studies should involve multicenter, large-sample, prospective randomized controlled trials to further verify the efficacy and safety of laparoscopic suspension combined with vaginal wall repair in POP patients, as well as to explore the mechanisms underlying long-term recovery of postoperative pelvic floor function.

## Conclusions

The findings of this retrospective study suggest that laparoscopic suspension combined with vaginal wall repair may provide additional postoperative benefits for patients with moderate-to-severe POP, particularly in terms of pelvic floor function and quality-of-life–related outcomes, when compared with vaginal wall repair alone. Although the combined procedure entails longer operative time, greater intraoperative blood loss, and an extended catheterization period, its overall perioperative safety is comparable to that of vaginal wall repair alone.

## Availability of Data and Materials

The data used or analyzed during the current study are available from the corresponding author upon reasonable request.

## Author Contributions

XLK: Conceptualization, Methodology, Investigation, Writing—Original Draft. TTH: Conceptualization, Study design, Supervision, Writing—Review & Editing. Both authors contributed to the critical revision of the manuscript for important intellectual content. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Taishun County People's Hospital (Approval No. SL2024-021-001). All participants provided written informed consent. All procedures were conducted in strict compliance with the Declaration of Helsinki.

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## Conflict of Interest

The authors declare no conflict of interest.

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