Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# Outcomes beyond 10 years after laparoscopic uterosacral ligament suspension combined with cervical amputation in young women with pelvic organ prolapse and cervical elongation: a prospective observational cohort study

**Jinbowen Yan**
Chinese Academy of Medical Sciences & Peking Union Medical College
**Yiwei Zhang**
Chinese Academy of Medical Sciences & Peking Union Medical College
**Rusha Yin**
Chinese Academy of Medical Sciences & Peking Union Medical College
**Juan Chen**
Chinese Academy of Medical Sciences & Peking Union Medical College
**Lan Zhu**
zhulan@pumch.cn
Chinese Academy of Medical Sciences & Peking Union Medical College

**Research Article**

**Keywords:** Pelvic organ prolapse, Laparoscopic uterosacral ligament suspension, Cervical amputation, Cervical elongation, Uterine preservation, Long-term follow-up, Quality of life, Sexual function

**Posted Date:** July 28th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-10230314/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

**Additional Declarations:** No competing interests reported.

**Version of Record:** A version of this preprint was published at BMC Women's Health on September 4th, 2026. See the published version at https://doi.org/10.1186/s12905-026-04822-3.

## Abstract

# Background

Pelvic organ prolapse (POP) in young women who desire uterine preservation remains clinically challenging, particularly when apical prolapse is accompanied by cervical elongation. Evidence regarding the long-term durability of laparoscopic uterosacral ligament suspension (LUSLS) combined with cervical amputation remains limited. This study aimed to evaluate long-term anatomical, symptomatic, and functional outcomes after LUSLS combined with cervical amputation in young women with POP and cervical elongation.

# Methods

This single-center prospective observational cohort study included young women with symptomatic apical POP and cervical elongation who underwent LUSLS combined with cervical amputation. The primary outcome was composite failure, defined as the occurrence of anatomical failure, subjective failure, or POP-related reoperation. Secondary outcomes included anatomical failure, subjective failure, POP-related reoperation, postoperative quality of life, sexual function, and patient satisfaction. Kaplan-Meier analysis was used to estimate cumulative failure rates.

# Results

Among 33 enrolled patients, 26 (78.79%) completed the final follow-up. The median follow-up duration was 146.15 months (interquartile range, 129.10-179.70). The estimated 10-year cumulative rates of composite failure, anatomical failure, and subjective failure were 26.36% (95% CI, 6.01%–53.14%), 7.43% (95% CI, 0.45%–46.94%), and 26.47% (95% CI, 6.07%–53.23%), respectively. The reoperation rate for recurrent POP was 11.54%. Pelvic floor distress symptoms, quality of life, and sexual function remained significantly improved more than 10 years after surgery, and 88.46% of patients reported satisfaction with the procedure. No cervical canal stenosis, cervical canal adhesion, hematometra, or menstrual outflow obstruction was documented during follow-up, and one patient achieved childbirth after surgery.

# Conclusion

LUSLS combined with cervical amputation may provide durable apical support, sustained symptom relief, and favorable functional outcomes in young women with POP and cervical elongation who desire uterine preservation. This native tissue procedure may represent an effective uterus-sparing surgical option for appropriately selected patients.

## Introduction

Pelvic organ prolapse (POP) is a common pelvic floor disorder in women and is associated with substantial impairment in quality of life and a considerable burden on healthcare systems[1]. A national epidemiological survey in China reported that the prevalence of symptomatic POP was 9.6% among adult women[2]. Surgery remains the mainstay of treatment for women with moderate-to-severe symptomatic POP, and the lifetime risk of undergoing prolapse surgery has been estimated to be 12.6% [3]. These data highlight the importance of effective and durable surgical strategies for POP

Mesh-based sacrocolpopexy is widely regarded as a standard procedure for apical suspension; however, concerns regarding mesh-related complications, including mesh exposure, erosion, and chronic pain, have led to renewed interest in native tissue repair[4]. Uterosacral ligament suspension (USLS) is a well-established native tissue procedure for apical support, and laparoscopic USLS (LUSLS) has been increasingly adopted because of its minimally invasive nature and improved visualization of the operative field[5, 6]. Nevertheless, reported outcomes after LUSLS remain heterogeneous[7, 8]. One factor that may compromise the effectiveness of uterus-preserving prolapse surgery is cervical elongation, which may contribute to persistent vaginal bulge symptoms and recurrent prolapse[9]. Although a universally accepted definition of cervical elongation has not yet been established, normal cervical length is generally considered to be approximately 3–4 cm, and a previous magnetic resonance imaging study defined cervical elongation as a cervical length greater than 33.8 mm[10].

Most previous studies of LUSLS have focused on short- to medium-term outcomes and have mainly included older or postmenopausal populations[11, 12]. In contrast, young women with POP represent a distinct clinical population because they often desire uterine preservation, maintenance of sexual function, and avoidance of long-term procedure-related complications. They may also face a longer lifetime risk of recurrent prolapse or the need for additional pelvic floor surgery. Our team previously reported that LUSLS combined with cervical amputation achieved favorable medium-term anatomical and functional outcomes in young women with severe uterine prolapse and cervical elongation after a median follow-up of 54 months[13]. However, evidence regarding outcomes beyond 10 years after this combined uterus-preserving procedure remains limited.

Therefore, the present study aimed to evaluate the long-term anatomical, symptomatic, and functional outcomes beyond 10 years after LUSLS combined with cervical amputation in young women with POP and cervical elongation. By focusing on durable apical support, patient-reported outcomes, sexual function, and procedure-related complications, this study may provide evidence to inform surgical decision-making for young women who desire uterine preservation.

## Materials and methods

# Population

This prospective observational cohort study was conducted at Peking Union Medical College Hospital (PUMCH) between January 2008 and August 2013. Cervical elongation was assessed using the pelvic

organ prolapse quantification (POP-Q) C-D distance. Concomitant cervical amputation was performed in patients with a C-D distance of ≥ 4 cm. Eligible patients were women aged ≤ 55 years who had symptomatic stage II-III apical POP, cervical elongation defined as a POP-Q C-D distance of ≥ 4 cm, and a desire for uterine preservation. The exclusion criteria were acute genital tract infection, severe medical comorbidities precluding laparoscopic surgery, and contraindications to minimally invasive surgery. The study was approved by the Institutional Review Board of Peking Union Medical College Hospital (No. JS-1744), and written informed consent was obtained from all participants before enrollment.

A formal sample size calculation was not performed, as this study was designed as a single-center prospective observational cohort evaluating the very long-term outcomes of a relatively uncommon uterus-preserving procedure in young women with POP and cervical elongation. The sample size was determined by the number of consecutive eligible patients treated during the predefined enrollment period.

## Preoperative assessment

Preoperative baseline assessment included collection of gynecological history, pelvic examination, pelvic ultrasonography, and evaluation using the POP-Q system. Urodynamic testing was performed in patients with urinary incontinence. The validated Chinese versions of the Pelvic Floor Distress Inventory-20 (PFDI-20)[14] and Pelvic Floor Impact Questionnaire-7 (PFIQ-7)[15] were used to assess pelvic floor symptom distress and its impact on quality of life (QoL). Sexual function was evaluated using the validated Chinese version of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire short form (PISQ-12)[16]. Baseline demographic and clinical characteristics were collected during hospitalization, verified for accuracy, and entered into a computerized database.

## Surgical procedure

All surgical procedures were performed by a single experienced surgeon (LZ), as previously described[17]. The procedure began with cervical amputation, performed according to the principles of the Manchester procedure. After exposure and traction of the elongated cervix, a circumferential incision was made at the cervicovaginal junction. The vaginal mucosa was dissected circumferentially from the underlying cervical stroma, and the bladder was mobilized cephalad to protect the lower urinary tract. The elongated portion of the cervix was amputated at an appropriate level according to the degree of cervical elongation, with care taken to preserve an adequate cervical stump and maintain patency of the cervical canal. After hemostasis, the cervical stump was reconstructed with Sturmdorf sutures, and the vaginal mucosa was reapproximated around the reconstructed cervical canal.

LUSLS was subsequently performed. After laparoscopic entry, the ureters were identified bilaterally, and hydrodissection was performed between the ureters and the uterosacral ligaments. The ureters were mobilized laterally for protection. The peritoneum overlying the uterosacral ligaments was opened

cranially from the level of the internal cervical os. The bilateral uterosacral ligaments were exposed for approximately 4 cm above the pericervical ring. Plication was then performed from the cranial portion of the exposed uterosacral ligaments toward the pericervical ring using size 2 coated polyester nonabsorbable sutures with a 22-mm 1/2-circle reverse-cutting needle (5 Ph. Eur.; X519, Ethibond; Ethicon, Somerville, NJ, USA). This continuous plication shortened and reinforced the uterosacral ligaments. The plicated uterosacral ligaments were approximated in the midline, and the pouch of Douglas was closed. Concomitant anti-incontinence surgery was performed when indicated.

## Postoperative follow-up

Follow-up visits were scheduled at 3 months after surgery and annually thereafter. At each visit, both anatomical and patient-reported outcomes were assessed. Objective anatomical evaluation included a standardized pelvic examination and POP-Q assessment. Subjective outcomes were evaluated using the validated Chinese versions of the PFDI-20, PFIQ-7, and PISQ-12, as well as the Patient Global Impression of Improvement (PGI-I) scale.

## Definition of outcome

The primary outcome was composite failure during follow-up, defined as the first occurrence of any of the following events: anatomical failure, symptomatic failure, or retreatment for POP. Secondary outcomes included anatomical failure, symptomatic failure, retreatment, postoperative complications, patient-reported global improvement, compartment-specific recurrence, and changes in patient-reported questionnaire scores. Anatomical failure was defined as recurrent prolapse beyond the hymen in any compartment during follow-up, corresponding to POP-Q point Ba, Bp, or C > 0. Symptomatic failure was defined as the presence of vaginal bulge symptoms, indicated by a positive response to Question 3 of the PFDI-20: “Do you usually have a bulge or something falling out that you can see or feel in your vaginal area?” Retreatment was defined as pessary use or reoperation for symptomatic POP recurrence. Patient satisfaction was defined as a response of “very much better” or “much better” on the PGI-I scale.

# Statistical analysis

Continuous variables are presented as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate. Categorical variables are presented as frequencies and percentages. Preoperative and postoperative outcomes were compared using paired analyses. The normality of paired differences was assessed before comparison. For paired continuous variables with approximately normal distributions, the paired-samples t-test was used; otherwise, the Wilcoxon signed-rank test was applied. Categorical variables were compared using the $\chi^2$ test or Fisher’s exact test, as appropriate. Kaplan-Meier analysis was used to estimate cumulative failure rates after LUSLS during more than 10 years of follow-up. All tests were two-sided, and a P value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 24.0.

# Result

During follow-up, six patients were lost to follow-up because of relocation or changes in contact information, and one patient was excluded after being diagnosed with ovarian cancer (Fig. 1). As of August 2025, 26 patients had completed the final outpatient follow-up, corresponding to a follow-up rate of 78.79%. All patients included in the final analysis were followed for more than 10 years, with a median follow-up duration of 146.15 months (range, 129.10-179.70).

Baseline characteristics are shown in Table 1. The mean age of the study population was 41.39 ± 6.64 years (range, 30–55). The median gravidity and parity were 3 (IQR, 1–4) and 1 (IQR, 1–1), respectively. Thirty-one of the 33 patients (93.94%) were premenopausal. All patients undergoing LUSLS combined with cervical amputation had symptomatic stage II or higher apical prolapse, and 27 patients (81.82%) had stage III apical prolapse. Stage III anterior compartment prolapse was observed in four patients (12.12%), and stage III posterior compartment prolapse was observed in one patient (3.03%). Concomitant anti-incontinence surgery for stress urinary incontinence was performed in four patients. No intraoperative bladder or bowel injury or postoperative pelvic hematoma occurred in this cohort.

Table 1
Demographic and baseline information

| **Variables** | **Total(N = 33)** |
|---|---|
| Age, years | 41.39 ± 6.64 |
| BMI, kg/$m^2$ | 23.29 ± 2.22 |
| Gravidity | 3 (1–4) |
| Parity | 1 (1–1) |
| Menstrual status | |
| Pre-menopause | 31 (93.94%) |
| Post-menopause | 2 (6.06%) |
| Hypertension | 1 (3.03%) |
| Diabetes mellitus | 0 (0.00%) |
| Smoking | 0 (0.00%) |
| Previous Surgery | |
| Previous prolapse repair | 1 (3.03%) |
| Hysterectomy | 0 (0.00%) |
| Continence Surgery | 0 (0.00%) |
| Prolapse POP-Q stage | |
| Anterior compartment | |
| Stage 0-I | 6 (18.18%) |
| Stage II | 23 (69.70%) |
| Stage III | 4 (12.12%) |
| Stage IV | 0 (0.00%) |
| Posterior compartment | |
| Stage 0-I | 25 (75.76%) |
| Stage II | 7 (21.21%) |
| Stage III | 1 (3.03%) |
| Stage IV | 0 (0.00%) |
| The data was recorded as mean ± SD, frequency (proportion) or median (Inter-Quartile Range, IQR: Q1-Q3) | |

| Variables | Total(N = 33) |
|---|---|
| Uterine/vaginal apex | |
| Stage 0-I | 0 (0.00%) |
| Stage II | 6 (18.18%) |
| Stage III | 27 (81.82%) |
| Stage IV | 0 (0.00%) |
| Simultaneous continence surgery | 4 (12.12%) |
| Blood loss | 50 (20–50) |
| Intestinal injury | 0 (0.00%) |
| Bladder injury | 0 (0.00%) |
| Hematoma | 0 (0.00%) |
| Postoperative Length of Stay (days) | 3 (3–4) |
| The data was recorded as mean ± SD, frequency (proportion) or median (Inter-Quartile Range, IQR: Q1-Q3) | |

Clinical outcomes are summarized in Table 2 and Fig. 2. The estimated 3-year cumulative anatomical failure rate was 3.57% (95% CI, 0.00%-62.54%), which remained unchanged at 6 years and increased to 7.43% (95% CI, 0.01%-52.27%) at 10 years after surgery. The estimated cumulative subjective failure rate was 3.57% (95% CI, 0.00%-62.54%) at 3 years, 10.99% (95% CI, 0.11%-49.10%) at 6 years, and 26.47% (95% CI, 6.07%-53.23%) at 10 years. The estimated cumulative composite failure rates at 3, 6, and 10 years were 7.14% (95% CI, 0.01%-51.69%), 10.86% (95% CI, 0.10%-48.91%), and 26.36% (95% CI, 6.01%-53.14%), respectively. Among patients with recurrent prolapse, two underwent transvaginal mesh repair and one underwent sacrospinous ligament fixation, resulting in a reoperation rate of 11.54%.

Table 2
Estimated clinical outcomes at 3, 6 and 10 years postoperatively

| **Outcomes** | **Estimated Probability based on K-M (95% CI)** |
|---|---|
| Composite Surgical Failure | |
| 3 y | 7.14 (0.01–51.69) |
| 6 y | 10.86 (0.10-48.91) |
| 10y | 26.36 (6.01–53.14) |
| Anatomical Failure | |
| 3 y | 3.57 (0.00-62.54) |
| 6 y | 3.57 (0.00-62.54) |
| 10y | 7.43 (0.01–52.27) |
| Subjective Failure | |
| 3 y | 3.57 (0.00-62.54) |
| 6y | 10.99 (0.11–49.10) |
| 10y | 26.47 (6.07–53.23) |
| CI: Confidence Interval | |

Preoperative and postoperative POP-Q, PFDI-20, PFIQ-7, and PISQ-12 scores are compared in Table 3. At more than 10 years after surgery, significant improvements were observed in anterior, apical, and posterior compartment support, as reflected by POP-Q points Aa, C, and Ap, respectively, compared with baseline (all $P < 0.01$). The preoperative C-D distance ranged from 4 to 10 cm, with a mean of 6.82 ± 1.77cm, confirming marked cervical elongation. After surgery, the C-D distance decreased to a range of 0 to 4 cm, with a mean of 1.02 ± 0.91cm. Pelvic floor symptom distress, quality of life, and sexual function, as assessed by the PFDI-20, PFIQ-7, and PISQ-12, respectively, all showed significant improvement from baseline to the final follow-up more than 10 years after surgery. POPDI-6 and POPIQ-7 scores were significantly reduced postoperatively, indicating sustained relief of prolapse-related symptoms and improvement in prolapse-related quality of life. No significant changes were observed in bowel or urinary symptom subscale scores. De novo urinary incontinence developed in five of 20 patients without preoperative urinary incontinence (25.00%). The overall patient satisfaction rate, assessed using the PGI-I, was 88.46% (23/26). Postoperatively, menstruation remained regular in menstruating patients, and no cervical canal stenosis, cervical canal adhesion, hematometra, or menstrual outflow obstruction was documented during follow-up. One patient achieved childbirth after surgery.

Table 3
Comparison of preoperative and postoperative scores of POP-Q and questionnaires for > 10 years

| POP-Q | Preoperative (N = 26) | postoperative | P |
|---|---|---|---|
| Aa | -1 (-1 ~ 0) | -1.25 (-2~-1) | < 0.01 |
| Ba | -1 (-1 ~ 0) | -1.25 (-2~-0.75) | 0.05 |
| C | 3 (2 ~ 3) | -6 (-6~-5) | < 0.01 |
| Ap | -2 (-2~-2) | -2 (-3~-2) | < 0.01 |
| Bp | -2 (-3~-2) | -2 (-3~-2) | 0.80 |
| C-D | 6.82 ± 1.77 | 1.02 ± 0.91 | < 0.01 |
| Questionnaires | | | |
| PFDI-20 | 54.00 (41.63–64.63) | 25.00 (5.75–66.13) | 0.01 |
| POPDI-6 | 29.25 (22.86–37.50) | 8.25 (0.00–25.00) | < 0.01 |
| CRADI-8 | 0.00 (0.00-6.25) | 0.00 (0.00-9.38) | 0.16 |
| UDI-6 | 20.75 (10.38–29.25) | 12.50 (0.00-31.25) | 0.27 |
| PFIQ-7 | 43.00 (33.00–57.00) | 5.00 (0.00–31.00) | < 0.01 |
| UDIQ-7 | 0.00 (0.00–5.00) | 0.00 (0.00-7.50) | 0.92 |
| CRAIQ-7 | 0.00 (0.00–0.00) | 0.00 (0.00–0.00) | 0.29 |
| POPIQ-7 | 38.00 (33.00-45.50) | 0.00 (0.00-21.50) | < 0.01 |
| PISQ-12 | 30.00 (25.00–30.00) | 35.00 (26.50–37.00) | < 0.01 |
| PGI-I | - | 23(88.46%) | - |
| The data was recorded as mean ± SD or median (Inter-Quartile Range, IQR: Q1-Q3) | | | |

# Discussion

The principal finding of this study is that LUSLS combined with cervical amputation was associated with durable apical support and sustained patient-reported benefits during follow-up beyond 10 years in young women with POP and cervical elongation. The estimated 10-year cumulative composite failure rate was 26.36%, whereas the anatomical failure rate remained low at 7.43%. Patient satisfaction also remained high at the final follow-up. These findings suggest that this native tissue, uterus-preserving

procedure may provide durable anatomical and functional outcomes in carefully selected young patients.

Published studies on LUSLS have generally been limited by relatively short follow-up durations, heterogeneous surgical techniques, and variable outcome definitions[8, 18]. In representative LUSLS cohorts, Chill et al. reported an anatomical failure rate of 16.4% after a mean follow-up of 31.7 months[19], Panico et al. reported an anatomical failure rate of 16.3% at 24 months[20], and Nishimura et al. reported favorable 2-year anatomical outcomes after laparoscopic uterosacral ligament colpopexy[21]. A recent study comparing vaginal and laparoscopic USLS also highlighted the limited availability of long-term data for LUSLS[22]. In the present cohort, the estimated anatomical failure rate was 3.57% at 3 years and 7.43% at 10 years. Although direct comparisons should be made cautiously because of differences in age, prolapse severity, surgical technique, and outcome definitions, these findings suggest that LUSLS may provide durable apical support when combined with correction of cervical elongation.

Long-term reoperation risk after apical prolapse surgery varies according to surgical approach and duration of follow-up[23, 24]. In a large cohort study of apical suspension procedures with follow-up up to 15 years, Shah et al. showed that reoperation for recurrent prolapse remained clinically relevant and differed across procedures[23]. In older women, Berger et al. also reported procedure-specific differences in longitudinal reoperation risk after apical prolapse repair[24]. In our cohort, no patient required reoperation for prolapse recurrence within 3 years after surgery, whereas the reoperation rate beyond 10 years was 11.54%. This finding may reflect the extended follow-up duration and the young age of the study population, who may have a longer lifetime risk window for recurrent prolapse.

The favorable anatomical outcome observed in this cohort may be partly attributable to the young age of the study population and the concomitant correction of cervical elongation. Cervical elongation is increasingly recognized as an important and sometimes overlooked factor in uterus-preserving prolapse surgery, and recent evidence emphasizes the importance of preoperative cervical evaluation in patients with uterine descent[10]. If cervical elongation is not corrected, patients may continue to experience vaginal bulge symptoms despite adequate apical suspension. In our previous prospective study, combined cervical amputation and laparoscopic high uterosacral ligament suspension achieved satisfactory medium-term anatomical and functional outcomes in young women with severe uterine prolapse and cervical elongation[13]. The present study extends those findings by demonstrating the durability of this combined approach beyond 10 years.

The modified Manchester procedure provides relevant support for this anatomical concept. In a recent multicenter randomized clinical trial published in JAMA, the Manchester procedure was defined as cervical amputation combined with extraperitoneal plication of the uterosacral ligaments above the remaining cervical stump[25]. At 2 years, the modified Manchester procedure achieved favorable anatomical, subjective, and composite success rates and showed superior composite surgical success compared with sacrospinous hysteropexy[25]. Although that trial differed from our study in patient

population, surgical route, and follow-up duration, both procedures share a common principle: correction of cervical elongation together with reinforcement of uterosacral ligament-based apical support. Therefore, the present findings support the potential value of addressing cervical elongation during uterus-preserving prolapse repair.

Patient-reported outcomes also remained favorable beyond 10 years. Significant reductions in POPDI-6 and POPIQ-7 scores indicate sustained relief of prolapse-related symptoms and reduced interference with daily activities. In contrast, bowel- and urinary-related questionnaire scores did not improve significantly, which may be related to relatively mild baseline symptoms in these domains, the small sample size, and age-related changes in lower urinary tract and bowel function during long-term follow-up. Sexual function remained significantly improved, suggesting that correction of cervical elongation and restoration of apical support may help reduce bulge-related discomfort and maintain functional vaginal anatomy.

Procedure-related complications deserve particular attention in young women undergoing uterus-preserving surgery. In the present cohort, no intraoperative bladder or bowel injury and no postoperative pelvic hematoma were observed. During long-term follow-up, no cervical canal stenosis, cervical canal adhesion, hematometra, or menstrual outflow obstruction was documented after cervical amputation. Postoperative menstruation remained regular in menstruating patients, and one patient achieved childbirth after surgery. However, de novo urinary incontinence occurred in 25.00% of patients without preoperative urinary incontinence, indicating that postoperative lower urinary tract symptoms require continued surveillance. Given the small sample size, these safety and reproductive findings should be interpreted cautiously.

This study has several limitations. First, the sample size was small, and the study was conducted at a single tertiary center by an experienced surgeon, which may limit generalizability. Second, there was no control group treated with LUSLS alone or another uterus-preserving procedure; therefore, the independent contribution of cervical amputation cannot be definitively determined. Third, preoperative cervical length was not measured by imaging but was estimated using the POP-Q C–D distance and clinical assessment. Finally, the present study was not designed to define an evidence-based threshold for cervical amputation. The decision to perform cervical amputation should therefore be individualized according to the degree of cervical elongation, intraoperative findings, and patient preference.

# Conclusion

LUSLS combined with cervical amputation may represent an effective uterus-preserving native tissue repair option for young women with apical POP and cervical elongation. During follow-up beyond 10 years, this procedure was associated with durable apical support, sustained symptom relief, favorable functional outcomes, and high patient satisfaction, without mesh-related complications.

# Abbreviations

POP
pelvic organ prolapse
USLS
uterosacral ligament suspension
LUSLS
laparoscopic uterosacral ligament suspension
PUMCH
Peking Union Medical College Hospital
POP-Q
pelvic organ prolapse quantification
PFDI-20
Pelvic Floor Distress Inventory-20
PFIQ-7
Pelvic Floor Impact Questionnaire-7
QoL
quality of life
PISQ-12
Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire short form
PGI-I
Patient Global Impression of Improvement
IQR
interquartile range
SD
standard deviation

## Declarations

# Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of the Peking Union Medical College Hospital (PUMCH) (No. JS-1744). Written informed consent was obtained from the patients.

**Consent for publication**

Not applicable.

# Competing Interests

The authors report no conflicts of interest in this work.

# Funding

The study was funded by the National Key R&D Program of China (2023YFC2706000; 2023YFC2706001). The funding partners had no part in the planning, execution, or interpretation of this trial.

# Author Contribution

J.B.W.Y, L.Z and J.C contributed to the project development, Y.W.Z and J.B.W.Y contributed to data collection and data management. Y.W.Z and J.B.W.Y contributed to data analysis and manuscript writing. R.S.Y, L.Z and J.C contributed to manuscript review. All authors approved the final manuscript.

# Acknowledgement

We sincerely thank all participating patients and the staff involved in the maintenance of the pelvic floor disorder database.

# Data Availability

The datasets generated and analysed during the current study are not publicly available due to privacy and ethical restrictions but are available from the corresponding author on reasonable request

## References

1. Hegde A, Goh J, Kearney R, Tan YH, Carboni C, Thariani K, et al. Chronic maternal pelvic morbidity: a neglected tragedy: where is pelvic maternal morbidity in maternal and child health? advocating for a public health approach to pelvic floor disorders resulting from pregnancy and childbirth trauma. Int Urogynecol J. 2026. https://doi.org/10.1007/s00192-025-06449-8.
2. Pang H, Zhang L, Han S, Li Z, Gong J, Liu Q, et al. A nationwide population-based survey on the prevalence and risk factors of symptomatic pelvic organ prolapse in adult women in China - a pelvic organ prolapse quantification system-based study. BJOG: Int J Obstet Gynaecol. 2021;128:1313–23. https://doi.org/10.1111/1471-0528.16675.
3. Wu JM, Matthews CA, Conover MM, Pate V, Jonsson Funk M. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. Obstet Gynecol. 2014;123:1201–6. https://doi.org/10.1097/AOG.0000000000000286.
4. Bretschneider CE, Myers ER, Geller EJ, Kenton KS, Henley BR, Matthews CA. Long-term mesh exposure 5 years following minimally invasive total hysterectomy and sacrocolpopexy. Int Urogynecol J. 2024;35:901–7. https://doi.org/10.1007/s00192-024-05769-5.
5. Nager CW, Visco AG, Richter HE, Rardin CR, Rogers RG, Harvie HS, et al. Effect of vaginal mesh hysteropexy vs vaginal hysterectomy with uterosacral ligament suspension on treatment failure in

women with uterovaginal prolapse: a randomized clinical trial. JAMA. 2019;322:1054–65. https://doi.org/10.1001/jama.2019.12812.

6. Schulten SFM, Detollenaere RJ, Stekelenburg J, IntHout J, Kluivers KB, van Eijndhoven HWF. Sacrospinous hysteropexy versus vaginal hysterectomy with uterosacral ligament suspension in women with uterine prolapse stage 2 or higher: observational follow-up of a multicentre randomised trial. BMJ. 2019;366:l5149. https://doi.org/10.1136/bmj.l5149.
7. Kowalski JT, Barber MD, Klerkx WM, Grzybowska ME, Toozs-Hobson P, Rogers RG, et al. International urogynecological consultation Chap. 4.1: definition of outcomes for pelvic organ prolapse surgery. Int Urogynecol J. 2023;34:2689–99. https://doi.org/10.1007/s00192-023-05660-9.
8. Campagna G, Panico G, Lombisani A, Vacca L, Caramazza D, Scambia G, et al. Laparoscopic uterosacral ligament suspension: a comprehensive, systematic literature review. Eur J Obstet Gynecol Reprod Biol. 2022;277:57–70. https://doi.org/10.1016/j.ejogrb.2022.08.006.
9. Berger MB, Ramanah R, Guire KE, DeLancey JOL. Is cervical elongation associated with pelvic organ prolapse? Int Urogynecol J. 2012;23:1095–103. https://doi.org/10.1007/s00192-012-1747-6.
10. Güler Çekiç S, Aktoz F, Urman B, Aydin S. A systematic review of uterine cervical elongation and meta-analysis of manchester repair. Eur J Obstet Gynecol Reprod Biol. 2024;300:315–26. https://doi.org/10.1016/j.ejogrb.2024.07.029.
11. Mao M, Fu H, Wang Q, Bai J, Zhang Y, Guo R. The effect of hysteropreservation versus hysterectomy on the outcome of laparoscopic uterosacral suspension in pelvic organ prolapse surgery. Maturitas. 2023;170:58–63. https://doi.org/10.1016/j.maturitas.2023.01.005.
12. Haj-Yahya R, Chill HH, Levin G, Reuveni-Salzman A, Shveiky D. Laparoscopic uterosacral ligament hysteropexy vs total vaginal hysterectomy with uterosacral ligament suspension for anterior and apical prolapse: surgical outcome and patient satisfaction. J Minim Invasive Gynecol. 2020;27:88–93. https://doi.org/10.1016/j.jmig.2019.02.012.
13. Sun Z, Zhu L, Hu H, Lang J, Shi H, Gong X. Medium-term outcomes after combined trachelectomy and uterosacral ligament suspension among young women with severe uterine prolapse. Int J Gynaecol Obstet: Off Organ Int Fed Gynaecol Obstet. 2016;132:224–8. https://doi.org/10.1016/j.ijgo.2015.07.012.
14. Ma Y, Xu T, Zhang Y, Mao M, Kang J, Zhu L. Validation of the chinese version of the pelvic floor distress inventory-20 (PFDI-20) according to the COSMIN checklist. Int Urogynecol J. 2019;30:1127–39. https://doi.org/10.1007/s00192-018-3847-4.
15. Zhu L, Yu S, Xu T, Yang X, Lu Y, Li B, et al. Chinese validation of the pelvic floor impact questionnaire short form. Menopause. 2011;18:1030–3. https://doi.org/10.1097/gme.0b013e31820fbcbe.
16. Zhu L, Yu S, Xu T, Yang X, Lu Y, Lang J. Validation of the chinese version of the pelvic organ prolapse/urinary incontinence sexual questionnaire short form (PISQ-12). Int J Gynaecol Obstet: Off Organ Int Fed Gynaecol Obstet. 2012;116:117–9. https://doi.org/10.1016/j.ijgo.2011.08.021.
17. Sun Z, Zhu L, Hu H, Lang J, Shi H, Gong X. [laparoscopic high uterosacral ligament suspension combined with cervical amputation in treatment of women severe uterine prolapsed at child-bearing

period]. Zhonghua fu chan ke za zhi. 2014;49:167–71.

18. Ronsini C, Pasanisi F, Cianci S, Vastarella MG, Pennacchio M, Torella M, et al. Laparoscopic uterosacral ligament suspension: a systematic review and meta-analysis of safety and durability. Front Surg. 2023;10:1180060. https://doi.org/10.3389/fsurg.2023.1180060.
19. Chill HH, Gutman-Ido E, Navon I, Reuveni-Salzman A, Haj-Yahya R, Shveiky D. Laparoscopic uterosacral ligament suspension versus vaginal colposuspension using the uphold lite™ mesh system: clinical outcome and patient satisfaction. Int Urogynecol J. 2021;32:1513–8. https://doi.org/10.1007/s00192-020-04563-3.
20. Panico G, Vacca L, Campagna G, Lombisani A, Caramazza D, Caporale N, et al. Quality of life recovery after laparoscopic high uterosacral ligament suspension: a single centre observational study. Eur J Obstet Gynecol Reprod Biol. 2021;260:212–7. https://doi.org/10.1016/j.ejogrb.2021.03.035.
21. Nishimura K, Yoshimura K, Hoshino K, Myoga M, Kubo T, Hachisuga T. Laparoscopic uterosacral ligament colpopexy for apical support in addition to hysterectomy for pelvic organ prolapse. J Obstet Gynaecol Res. 2019;45:1522–9. https://doi.org/10.1111/jog.14005.
22. Sears S, Abrams M, Palm K, Wherley S, Pollard R, Mangel J, et al. Long-term outcomes following vaginal versus laparoscopic uterosacral ligament suspension. Int Urogynecol J. 2025;36:1293–9. https://doi.org/10.1007/s00192-025-06132-y.
23. Shah NM, Berger AA, Zhuang Z, Tan-Kim J, Menefee SA. Long-term reoperation risk after apical prolapse repair in female pelvic reconstructive surgery. Am J Obstet Gynecol. 2022;227. https://doi.org/10.1016/j.ajog.2022.05.046. :306.e1-306.e16.
24. Berger AA, Bretschneider CE, Gregory WT, Sung V. Longitudinal reoperation risk after apical prolapse procedures in women aged 65 years and older. Obstet Gynecol. 2024;143:411–8. https://doi.org/10.1097/AOG.0000000000005511.
25. Enklaar RA, Schulten SFM, van Eijndhoven HWF, Weemhoff M, van Leijsen SAL, van der Weide MC, et al. Manchester procedure vs sacrospinous hysteropexy for treatment of uterine descent: a randomized clinical trial. JAMA. 2023;330:626–35. https://doi.org/10.1001/jama.2023.13140.

# Figures

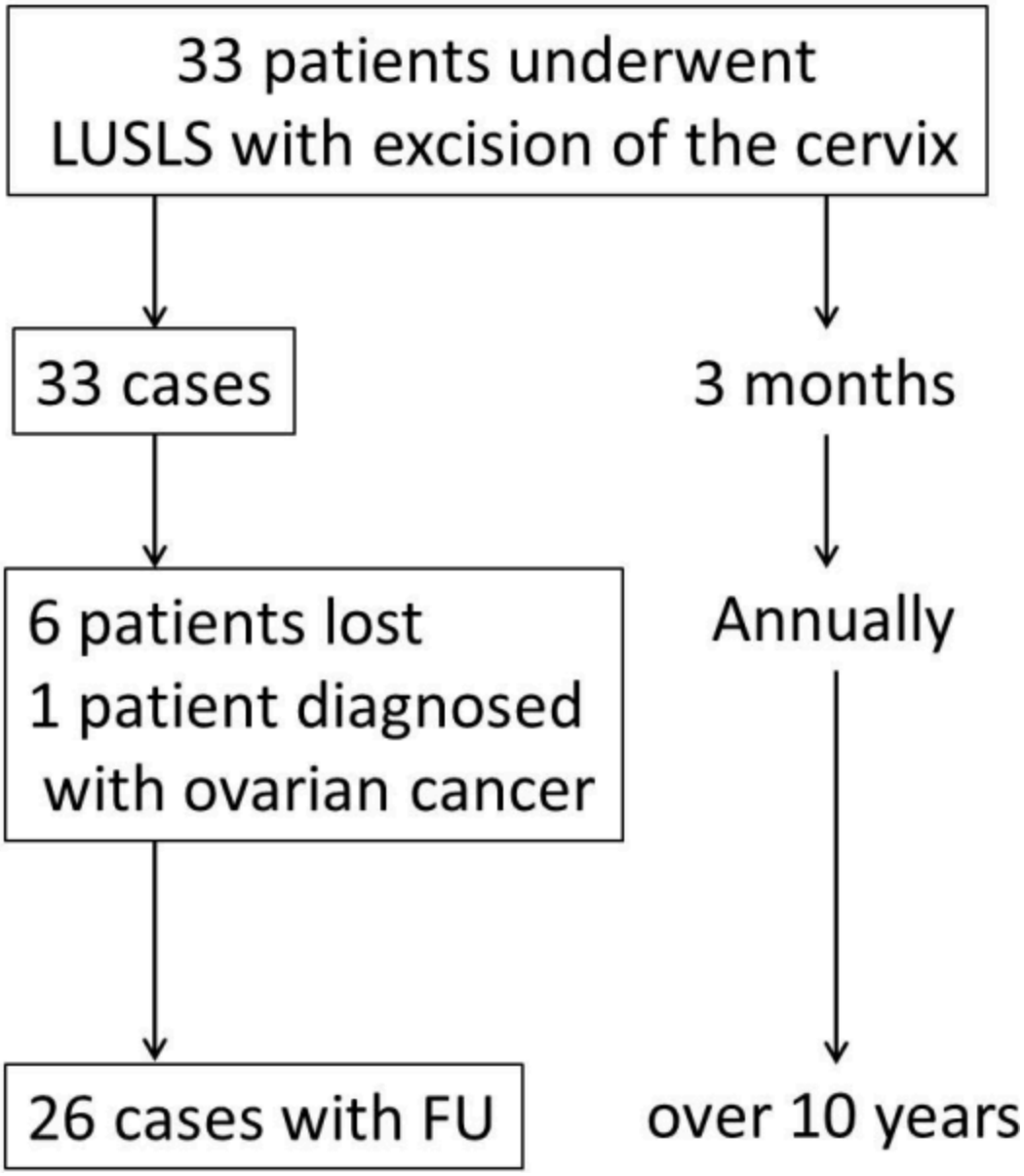
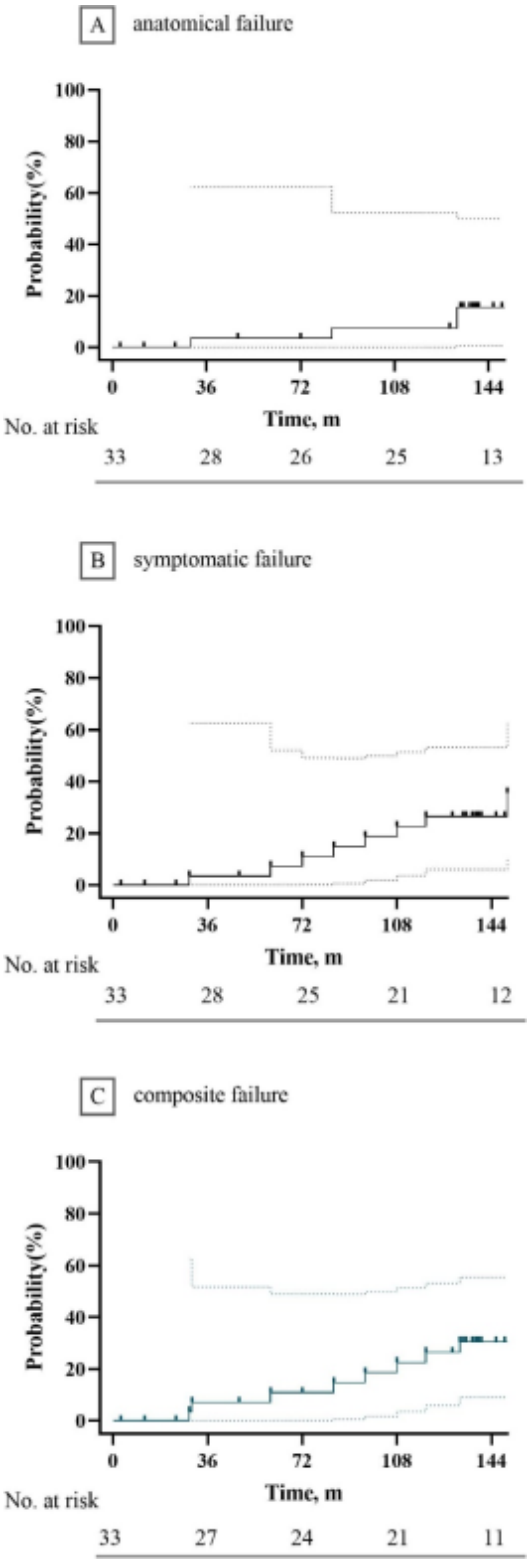



**Figure 1**

Flowchart of the study. POP, pelvic organ prolapse; LUSLS, Laparoscopic uterosacral ligament suspension; FU, follow-up




## Figure 2

Clinicla outcoms of patients underwent LUSLS. 2-A: Survival Curve of Anatomical Failure; 2-B: Survival Curve of Subjective Failure; 2-C: Survival Curve of Composite Failure. LUSLS, Laparoscopic uterosacral ligament suspension