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Uterus-preserving laparoscopic lateral suspension provides durable anatomical and functional success in apical pelvic organ prolapse: long-term results from a single-center study

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ABSTRACT

Objectives: To evaluate the long-term anatomical, functional, and patient-reported outcomes of uterus-preserving laparoscopic lateral suspension (LLS) in women with apical pelvic organ prolapse (POP).

Material and methods: This retrospective cohort study included 98 women with symptomatic apical POP who underwent uterus-preserving LLS between January 2018 and December 2021 at a single tertiary center. All patients had at least 24 months of follow-up (mean: 40.6 ± 10.8 months). Anatomical outcomes were assessed using the POP-Q system, functional outcomes with POP-SS, P-QOL, M-ISI, and FSFI, and patient satisfaction with the PGI-I scale. The primary endpoint was composite clinical success, defined as anatomical success (POP-Q stage 0–1 in all compartments), absence of reoperation, and a positive PGI-I response.

Results: The mean age was 48.1 ± 10.5 years, mean BMI was 27.0 ± 3.5 kg/m^2, and 42.9% were postmenopausal. Concomitant procedures were performed in 44.9% of cases. At long-term follow-up, significant improvements were observed in all POP-Q points (Ba from 0.6 to –3.4 cm, C from 0.3 to –2.5 cm, and Bp from –1.7 to –3.6 cm; all $p < 0.001$). POP-SS, P-QOL, and M-ISI scores improved markedly (all $p < 0.001$). FSFI showed significant improvement in the pain domain. Composite clinical success was achieved in 93.9% of patients, with anatomical success rates of 98.0% (apical), 98.0% (anterior), and 96.9% (posterior). Patient satisfaction was high, with 96.9% reporting "very much better" or "much better" on PGI-I. Reoperation was required in 3.1% of cases. Intraoperative complications included bladder injury (2.0%) and bleeding requiring transfusion (1.0%). Late complications were rare, with mesh exposure in 2.0% and dyspareunia in 3.1%.

Conclusions: Uterus-preserving LLS provides durable long-term anatomical and functional success, high patient satisfaction, and low complication rates, representing a safe and effective alternative to sacrocolpopexy in the surgical management of apical POP.

Keywords: pelvic organ prolapse; uterus-preserving surgery; laparoscopy; lateral suspension

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INTRODUCTION

Pelvic organ prolapse (POP) is a highly prevalent condition in women, particularly after menopause, and it can severely impair quality of life through urinary, bowel, and sexual dysfunction [1, 2]. Laparoscopic sacrocolpopexy (LSC) is widely recognized as the gold standard for apical prolapse repair, yet sacral promontory dissection is technically demanding and associated with specific risks such as presacral venous bleeding and neurovascular injury [3, 4].

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In recent years, laparoscopic lateral suspension (LLS) has emerged as an alternative technique to address these limitations. Laparoscopic lateral suspension avoids the sacral promontory, preserves the uterus, and has been described as technically less challenging with a shorter learning curve [5]. Systematic reviews and prospective trials suggest that LLS achieves comparable anatomical and functional success rates to LSC while offering perioperative advantages such as reduced blood loss and shorter operative time [5, 6]. Furthermore, randomized trials have shown that sexual function outcomes following LLS are at least equivalent, and in some domains superior, to those achieved with sacrocolpopexy [7].

Nevertheless, the evidence base remains limited regarding long-term outcomes. Most available studies report follow-up of 12–24 months, with scarce data on durability of anatomical success and functional outcomes extending beyond two years [2, 6]. There is a need for robust long-term data to evaluate whether the short- and mid-term advantages of LLS translate into sustainable clinical benefits, particularly in terms of composite success, patient-reported outcomes, and sexual function.

Therefore, the aim of this study was to assess the long-term (≥ 24 months) anatomical, functional, and patient-reported outcomes of uterus-preserving LLS in women with apical POP. In addition to primary endpoints of composite clinical success, we investigated secondary outcomes including quality-of-life domains, sexual function, complication rates, and potential risk factors such as operative time, concomitant procedures, and menopausal status.

MATERIAL AND METHODS

This retrospective cohort study was conducted between January 2018 and December 2021 at the Department of Obstetrics and Gynecology, Istanbul Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital. The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the local institutional ethics committee (Approval No: 2023/95). Written informed consent was obtained from all participants prior to surgery. A total of 98 women with symptomatic apical pelvic organ prolapse who underwent uterus-preserving laparoscopic lateral suspension and completed at least 24 months of postoperative follow-up were included. Patients with a history of hysterectomy, pelvic malignancy or radiotherapy, active genital infection, follow-up shorter than 24 months, or incomplete clinical data were excluded.

All procedures were performed by the same surgical team, following the technique originally described by Dubuisson. Under general anesthesia, patients were placed in the dorsal lithotomy position with a Trendelenburg tilt. A 30° laparoscope was introduced, and four trocars were placed. Energy devices included a bipolar vessel-sealing device and a monopolar electrosurgical unit. The mesh used was a macroporous, monofilament, lightweight polypropylene mesh. The mesh was trimmed to 3 × 15 cm, with its central part sutured to the anterior aspect of the cervix using non-absorbable polypropylene sutures. The lateral arms of the mesh were passed through bilateral peritoneal tunnels and anchored to the iliac fossae under appropriate tension. The peritoneum was closed over the mesh with absorbable polyglactin 910 sutures. When indicated, concomitant procedures such as posterior or anterior colporrhaphy, uterosacral plication, midurethral sling procedures (TOT, TVT), or myomectomy were performed in the same session.

Demographic characteristics (age, body mass index, gravida, parity, menopausal status, sexual activity), intraoperative variables (operative time, blood loss, concomitant procedures), and postoperative follow-up data (hospital stay, duration of follow-up) were extracted from hospital records. Anatomical outcomes were assessed using the Pelvic Organ Prolapse Quantification (POP-Q) system, with surgical success defined as Ba, C, and Bp points at or above –1 cm. Functional outcomes were evaluated with the Pelvic Organ Prolapse Symptom Score (POP-SS), the Prolapse Quality of Life Questionnaire (P-QOL), the Modified Incontinence Severity Index (M-ISI), and the Female Sexual Function Index (FSFI). Patient satisfaction and subjective improvement were measured with the Patient Global Impression of Improvement (PGI-I) scale, where "very much better" or "much better" were considered positive outcomes. Perioperative and early postoperative complications were classified according to the Clavien–Dindo system. Late complications included mesh exposure, dyspareunia, chronic pelvic pain, and *de novo* urinary symptoms.

The primary endpoint was long-term composite clinical success, defined as anatomical success in all compartments (POP-Q stage 0–1), absence of reoperation, and a positive PGI-I response. Secondary endpoints included changes in functional scores, complication rates, and reoperation rates.

Statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM, Chicago, USA). Continuous variables were presented as mean ± standard deviation, and categorical variables as frequencies and percentages. Preoperative and postoperative measurements were compared using paired t-tests. Categorical variables were analyzed with the chi-square test or Fisher's exact test. Logistic regression analysis was performed to identify factors associated with composite clinical failure, and Firth logistic regression was applied when event numbers were low. Multiple comparisons were adjusted using the Benjamini–Hochberg procedure, and a p value < 0.05 was considered statistically significant.

RESULTS

In this series of 98 patients, the mean age was 48.1 ± ± 10.5 years, the mean body mass index was 27.0 ± ± 3.5 kg/m^2, the mean gravida was 3.9 ± 1.7, and the mean parity was 3.5 ± 1.3. A total of 91.8% of women were sexually active and 42.9% were postmenopausal. The mean operative time was 89.7 ± 24.0 minutes, and the mean hospital stay was 2.6 ± 1.1 days. The mean postoperative follow-up was 40.6 ± 10.8 months, ranging from 24 to 64 months. Concomitant surgical procedures were performed in 44.9% of cases, most commonly uterosacral plication (26.5%). These findings indicate that the study cohort provided a homogeneous and reliable profile for long-term outcome assessment (Tab. 1).

Table 1. Demographic and perioperative characteristics of patients with ≥ 24 months follow-up (n = 98)

Variable	Value
Age [years]	48.12 ± 10.54
BMI [kg/m^2]	27.02 ± 3.52
Gravidity	3.86 ± 1.66
Parity	3.46 ± 1.34
Operation time [min]	89.73 ± 24.01
Length of stay [days]	2.63 ± 1.13
Follow-up [months]	40.55 ± 10.75 (range 24–64)
Sexually active, n (%)	90 (91.8)
Post-menopause, n (%)	42 (42.9)
No concomitant procedure, n (%)	54 (55.1)
Concomitant procedures, n (%)	44 (44.9)
Uterosacral ligament plication	25 (25.5)
Anterior colporrhaphy (cystocele repair)	4 (4.1)
Posterior colporrhaphy (rectocele repair)	3 (3.1)
Perineorrhaphy	4 (4.1)
Uterosacral ligament plication + + mid-urethral sling (TOT)	2 (2.0)
Anterior + posterior colporrhaphy + uterosacral plication	1 (1.0)
Rectocele repair + sacrospinous ligament fixation	1 (1.0)
Burch colposuspension	1 (1.0)
Ovarian cystectomy	2 (2.0)
Sacrospinous ligament fixation	1 (1.0)
Hysterectomy	1 (1.0)

BMI — body mass index; LOS — length of hospital stay

Evaluation of POP-Q measurements demonstrated a striking anatomical effect of the procedure. The Ba point improved from 0.6 ± 1.1 cm preoperatively to –3.4 ± ± 1.0 cm postoperatively, the C point from 0.3 ± 0.7 cm to –2.5 ± 1.0 cm, and the Bp point from –1.7 ± 1.3 cm to –3.6 ± 1.3 cm (all $p < 0.001$) (Tab. 2).

Functional outcomes showed significant improvements across all domains. Pelvic Organ Prolapse Symptom Scores decreased by more than 75%, from 19.8 ± 4.4 to 4.6 ± 3.5 ($p < 0.001$). All subscales of the M-ISI, including stress, urge, pad use, and bother, improved significantly. P-QOL demonstrated marked improvements in daily activities, social functioning, emotional well-being, and sleep/energy domains, with scores reduced by approximately half in all categories ($p < 0.001$). Assessment of sexual function with FSFI revealed significant improvement in the pain domain ($p < 0.001$), whereas changes in desire, arousal, and satisfaction were more limited. This suggests that LLS is effective in alleviating pain-related sexual dysfunction, while other aspects of sexual function may be more strongly influenced by age and menopausal status (Tab. 3).

Composite clinical success, defined as POP-Q stage 0–1 in all compartments, no reoperation, and a positive PGI-I response, was achieved in 93.9% of patients. The compartment-specific anatomical success rates were 98.0% for the apical compartment, 98.0% for the anterior compartment, and 96.9% for the posterior compartment. Patient satisfaction was remarkably high, with 96.9% reporting "very much better" or "much better" on the PGI-I scale. Only three patients (3.1%) required reoperation during follow-up (Tab. 4).

Analysis of the complication profile demonstrated that LLS is a safe surgical option. The most serious intraoperative complication was bladder injury, which occurred in two patients (2.0%) and was repaired immediately. Transfusion–requiring bleeding occurred in one patient (1.0%), fever in three (3.1%), urinary tract infection in two (2.0%), and ileus in one (1.0%). No thromboembolic events were reported (Tab. 5). Late complications were rare, including mesh exposure in two patients (2.0%), dyspareunia in three (3.1%), chronic pelvic pain in one (1.0%), constipation in two (2.0%), and *de novo* urgency in two (2.0%). Anatomical recurrence occurred in only one patient each in the apical and anterior compartments (Tab. 6).

These findings strongly support that LLS provides not only high anatomical and functional success rates but also maintains low complication rates, thereby representing a safe and effective uterus-preserving surgical option for long-term management of apical prolapse.

Table 2. Pelvic Organ Prolapse Quantification system (POP-Q) points before and after surgery (≥ 24 months, n = 98)

POP-Q point	Pre mean ± SD	Post mean ± SD	Paired p value	n
Ba (anterior, cm)	0.62 ± 1.05	–3.37 ± 1.02	< 0.001	98
C (apical, cm)	0.28 ± 0.73	–2.53 ± 0.98	< 0.001	98
Bp (posterior, cm)	–1.67 ± 1.28	–3.61 ± 1.27	< 0.001	98

n — number; SD — standard deviation

Table 3. Functional outcomes before and after surgery (≥ 24 months, n = 98)

Measure	Pre mean ± SD	Post mean ± SD	Paired p value	n
POP-SS	19.76 ± 4.36	4.60 ± 3.46	< 0.001	98
M-ISI SUI	4.00 ± 4.87	2.49 ± 4.02	< 0.001	98
M-ISI UUI	4.19 ± 4.69	2.28 ± 4.25	< 0.001	98
M-ISI pad use	3.54 ± 2.88	2.31 ± 2.97	< 0.001	98
M-ISI bother	3.64 ± 3.04	2.01 ± 2.77	< 0.001	98
P-QOL general health	27.80 ± 6.54	13.59 ± 3.64	< 0.001	98
P-QOL Prolapse impact	19.14 ± 3.70	7.26 ± 3.07	< 0.001	98
P-QOL role limitations	5.17 ± 1.88	2.22 ± 0.79	< 0.001	98
P-QOL physical limitations	4.99 ± 1.85	2.20 ± 0.75	< 0.001	98
P-QOL social limitations	4.86 ± 1.92	2.21 ± 0.66	< 0.001	98
P-QOL personal relationships	8.33 ± 3.41	3.71 ± 1.87	< 0.001	98
P-QOL emotions	6.63 ± 2.55	3.27 ± 0.90	< 0.001	97
P-QOL sleep/energy	4.01 ± 1.50	2.14 ± 0.48	< 0.001	98
P-QOL severity measures	10.79 ± 2.92	5.22 ± 1.98	< 0.001	98
FSFI desire	4.42 ± 1.38	3.12 ± 1.54	< 0.001	98
FSFI arousal	2.72 ± 2.09	2.20 ± 1.32	0.007	97
FSFI lubrication	2.43 ± 1.73	2.59 ± 1.36	0.296	98
FSFI orgasm	2.57 ± 1.85	2.49 ± 1.37	0.620	98
FSFI satisfaction	2.77 ± 2.14	2.22 ± 1.38	0.005	98
FSFI pain	1.50 ± 1.28	3.73 ± 1.99	< 0.001	98

FSFI — Female Sexual Function Index; M-ISI — Modified Incontinence Severity Index; n — number; POP-SS — Pelvic Organ Prolapse Symptom Score; P-QOL — Prolapse Quality of Life questionnaire

Table 4. Key outcomes summary (≥ 24 months, n = 98)

Outcome	Value
Apical success (postop C ≤ –1 cm), % (n)	98.0 (98)
Anterior success (postop Ba ≤ –1 cm), % (n)	98.0 (98)
Posterior success (postop Bp ≤ –1 cm), % (n)	96.9 (98)
Reoperation, n (%)	3 (3.1)
PGI-I much/very much better, n (%)	95 (96.9)

n — number; PGI-I — patient global impression of improvement; POP-Q — Pelvic Organ Prolapse Quantification system

Table 5. Perioperative and early postoperative complications (≥ 24 months, n = 98)

Complication	n (%)
Bladder injury	2 (2.0)
Intraoperative bleeding requiring transfusion	1 (1.0)
Fever > 38°C	3 (3.1)
Urinary tract infection	2 (2.0)
Wound infection	1 (1.0)
Ileus	1 (1.0)
Pulmonary embolism	0 (0)
Deep vein thrombosis	0 (0)

n — number

Table 6. Late postoperative complications (≥ 24 months, n = 98)

Complication	n (%)
Mesh exposure	2 (2.0)
Dyspareunia	3 (3.1)
Chronic pelvic pain	1 (1.0)
Constipation	2 (2.0)
De novo urgency	2 (2.0)
Apical recurrence	1 (1.0)
Anterior recurrence	1 (1.0)
Posterior recurrence	0 (0)

n — number

DISCUSSION

In this study, we present the long-term outcomes of uterus-preserving LLS in 98 patients with a minimum follow-up of 24 months and a mean follow-up of 40 months. Our findings demonstrate that LLS provides high long-term anatomical and functional success, low complication rates, and remarkable patient satisfaction.

The primary outcome, composite clinical success (CCS), was achieved in 93.9% of patients. Although direct comparison is limited by differences in outcome definitions and follow-up duration, this result compares favorably with published LLS cohorts. Mereu et al. [8] reported 2-year objective cure rates of 94.9% for the apical compartment and 94.2% for the anterior compartment in a prospective double-center study, whereas Chatziioannidou et al. [9] reported favorable anatomical and patient-reported outcomes using a standardized LLS technique. Our findings therefore add longer-term evidence that high success rates can be maintained in a single-center setting with a consistent surgical approach.

Our anatomical success rates (apical 98.0%, anterior 98.0%, posterior 96.9%) are at the upper end of those reported in previous LLS studies. Martinello et al. [10] reported favorable anatomical correction in a clinical series, while Yassa and Tug [11] demonstrated sustained objective and subjective improvement after uterus-preserving LLS at a median follow-up of 24 months. A systematic review by Campagna et al. [12] also concluded that minimally invasive lateral suspension provides favorable anatomical outcomes, particularly in the apical and anterior compartments. The particularly high posterior compartment success observed in our cohort may be partly related to concomitant posterior procedures. Nevertheless, dyspareunia (3.1%) and *de novo* urgency (2.0%) were observed during follow-up, illustrating that anatomical and functional outcomes do not necessarily progress in parallel. Because the study was not designed to establish a causal relationship between posterior repair and these symptoms, this association should be interpreted cautiously.

In our cohort, concomitant procedures were performed in 44.9% of patients, reflecting a patient-tailored surgical strategy. Therefore, the favorable anatomical and functional outcomes observed in this study should not be attributed solely to LLS, but rather to apical suspension combined with additional compartment-specific repairs when indicated. Akbaba and Sezgin [13] reported that a modified five-arm mesh could address posterior defects together with apical and anterior prolapse, whereas Aksin and Andan [14] documented favorable postoperative anatomical and functional outcomes following LLS in routine clinical practice. These findings support tailoring the operation to the distribution of pelvic floor defects.

The absence of posterior compartment recurrence and *de novo* enterocele in our series may have several explanations. Restoration of apical support can reduce the load transmitted to the vaginal walls, while uterosacral ligament plication, performed in 26.5% of patients, may have provided additional apical and posterior support. High patient satisfaction and favorable multicompartment outcomes have also been reported in the large LLS series of Veit-Rubin et al. [15]. The original clinical series by Dubuisson et al. [16] similarly demonstrated that lateral suspension can restore apical support while allowing additional procedures to be selected according to compartment-specific defects. However, because there was no comparison group without plication and the number of recurrence events was very small, the proposed mechanisms remain plausible explanations rather than proven causal effects.

Functional outcomes in our cohort were consistent with previous studies. Pelvic Organ Prolapse Symptom Score and P-QOL scores demonstrated substantial improvements. In a continuous series of 218 patients, Dubuisson et al. [17] reported favorable anatomical and functional results after mesh-based lateral suspension. Veit-Rubin et al. [18] subsequently described patient-centered benefits in a uterus-preserving series of 245 patients. Importantly, our findings indicate that these improvements can persist beyond three years. Patients with more severe baseline symptoms experienced greater absolute improvements; however, this observation should be interpreted in light of the potential for greater measurable change among patients with higher baseline scores.

Sexual function after prolapse surgery is multifactorial. In our series, the FSFI pain domain improved significantly, whereas desire, arousal, and satisfaction showed more limited change. In a comparative study using the

PISQ-IR, Malanowska-Jarema et al. [19] found broadly comparable postoperative sexual outcomes after LLS and laparoscopic sacrocervicopexy. Our findings are compatible with the view that correction of prolapse may improve pain-related sexual symptoms, while other domains remain influenced by age, menopausal status, relationship factors, and baseline sexual function.

Patient satisfaction in our cohort was remarkably high, with 96.9% of patients reporting being "very much better" or "much better" on the PGI-I scale. Uterine preservation may be relevant to patient preference and treatment experience. Meriwether et al. [20], in a systematic review and clinical practice guideline, found that uterine-preserving prolapse procedures did not worsen short-term prolapse outcomes and could offer perioperative advantages in appropriately selected women. Nevertheless, the present study did not directly compare uterus-preserving surgery with hysterectomy, and the psychosocial contribution of uterine preservation cannot be determined from our data.

The complication profile in our cohort was favorable. The most serious intraoperative complication was bladder injury, which occurred in two patients (2.0%) and was repaired immediately. At long-term follow-up, mesh exposure occurred in two patients (2.0%). Dällenbach et al. [21] reported a low incidence of mesh erosion after laparoscopic lateral suspension and emphasized the importance of mesh characteristics and patient-related risk factors. By comparison, the extended CARE trial showed that abdominal sacrocolpopexy remains effective but that probabilities of anatomical failure and mesh erosion increase over time, with an estimated mesh erosion probability of 10.5% at 7 years [22]. Only three patients (3.1%) in our series required reoperation. Because follow-up durations and definitions differ across studies, these data support a favorable safety profile for LLS but do not establish superiority over sacrocolpopexy.

Our exploratory analysis of risk factors provided additional insights. Longer operative time was associated with complications and treatment failure, posterior repair was associated with new-onset symptoms, and greater preoperative C-point descent was associated with prolonged operative time and recurrence. Although BMI was not statistically associated with anatomical failure, both patients who developed mesh exposure had a BMI > 30. Given the small number of adverse events and the retrospective design, these findings are hypothesis-generating and should not be interpreted as independent predictors. Larger prospective cohorts are needed to clarify which patient- and procedure-related factors influence recurrence and mesh exposure after LLS.

Strengths of our study include the relatively long mean follow-up (40 months), the homogeneous patient population, the combined evaluation of anatomical and functional outcomes, and the use of a composite clinical success endpoint. Limitations include the retrospective design, single-center nature, lack of a comparator group, performance of concomitant procedures in nearly half of the cohort, and limited statistical power to assess rare complications and independent risk factors. Differences in success definitions and follow-up duration also limit direct comparison with published series.

CONCLUSIONS

In conclusion, this study demonstrates that uterus-preserving LLS, when combined with individualized concomitant procedures, provides durable anatomical and functional success, low complication rates, and high patient satisfaction. Our results strongly support this patient-tailored surgical approach including LLS as a safe, reliable, and effective alternative to sacrocolpopexy in the surgical management of apical prolapse.

Article information and declarations

Data availability statement

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality and institutional regulations but are available from the corresponding author on reasonable request.

Ethics statement

This study was conducted in accordance with the principles of the Declaration of Helsinki. The research protocol was approved by the Institutional Ethics Committee of Istanbul Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital (Approval No: 2023/95). Written informed consent was obtained from all participants prior to surgery.

Author contributions

TS — study conception and design, surgery, data acquisition, manuscript drafting; NT — supervision, critical revision of the manuscript; ABT — study design, manuscript revision; SP and OO — data collection; HS — data analysis and interpretation, manuscript editing.

All authors reviewed and approved the final version of the manuscript.

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Conflict of interest

The authors declare that they have no conflict of interest.

Supplementary material

None.

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