






Original Research

Comparison of the Efficacies of Sacrospinous Ligament Fixation and Laparoscopic Lateral Suspension in the Treatment of Apical Prolapse: 24-Month Follow-Up Results

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Abstract

Background: Pelvic organ prolapse (POP) significantly impacts the quality of life, particularly in older women with a history of vaginal deliveries. Although conservative treatments provide some symptom relief, surgical interventions are more effective for managing POP. This study compares the outcomes and effectiveness of sacrospinous ligament fixation (SSLF) and laparoscopic lateral suspension (LLS) surgeries in the treatment of POP. **Methods:** This retrospective comparative cohort study included patients with symptomatic stage 2 or higher apical POP, treated at a tertiary hospital in Turkey between April 2021 and June 2022. Patients were treated with either SSLF or LLS surgeries and underwent preoperative and postoperative evaluations using the Prolapse Quality of Life (P-QoL) questionnaire and the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12). Patients were divided into two groups: SSLF (n = 47) and LLS (n = 44). The primary outcome was the rate of anatomical failure, while secondary outcomes included improvements in functional capability and quality of life. **Results:** The study found that the rate of postoperative anterior compartment failure was significantly lower in the LLS group compared to the SSLF group ($p = 0.005$). The success rate of LLS for apical prolapse was 100%, compared to 93.6% for SSLF. In the posterior compartment, SSLF demonstrated a higher success rate (86.2%) than LLS (68.5%). Both procedures improved P-QoL scores and the PISQ-12 subscales; however, a significant improvement in total PISQ-12 scores was observed only in the LLS group ($p = 0.009$). **Conclusions:** Both SSLF and LLS are effective in treating POP and enhancing quality of life. However, LLS demonstrated higher success rates for anterior and apical prolapse, while SSLF was more effective in addressing in posterior compartment defects.

Keywords: pelvic organ prolapse; laparoscopic lateral suspension; sacrospinous fixation; quality of life

1. Introduction

Pelvic organ prolapse (POP) is a distressing clinical condition that profoundly affects the quality of life, particularly in older and obese women with a history of multiple vaginal deliveries [1–4]. The most common type of POP is the anterior vaginal wall prolapses with apical involvement, i.e., anterior/apical prolapse [5,6]. Diagnosis and treatment of POP present unresolved challenges with widely varying outcomes, despite its high prevalence. While conservative treatment approaches may partially alleviate the symptoms, surgical interventions are key to managing POP [7]. However, there are contradictory data available in the literature on the selection criteria and efficacies of surgical methods for the treatment of POP [8].

Both vaginal and abdominal approaches have been utilized to perform POP surgeries [1,4]. Although laparoscopic sacrocolpopexy is considered the gold standard in the surgical treatment of POP, it has disadvantages, such as requiring advanced surgical expertise and carrying a potentially high risk of serious complications [9,10]. Therefore, alternative surgical techniques have been developed

to treat POP with positive outcomes and without disadvantages [11,12]. Among these techniques, laparoscopic lateral suspension (LLS) has gained popularity due to its technical advantages and lower incidence of complications in patients with apical and anterior vaginal wall prolapse [13]. On the other hand, vaginally performed sacrospinous ligament fixation (SSLF) stands out as a cost-effective surgical option in the treatment of POP with a high success rate and low risk of morbidity [7].

Several studies have compared the short- and long-term outcomes of the POP surgeries [14,15]. However, there are limited studies explicitly comparing the effects of LLS and SSLF on POP symptoms and pelvic support restoration rates. This study was conducted to comprehensively assess and compare the outcomes and efficacy of SSLF and LLS surgeries in patients with POP.

2. Materials and Methods

2.1 Study Design

This retrospective comparative cohort study was conducted in the Department of Obstetrics and Gynecology,



Düzce University, Turkey, in accordance with the ethical considerations outlined in the Declaration of Helsinki. Written informed consent was obtained from each patient included in the study. The study protocol was approved by the local ethics committee of Düzce University (Approval Date: 25.04.2022, approval number: 2022/53).

2.2 Population and Sample

The study population consisted of all consecutive patients with symptomatic apical POP of stage ≥ 2 , regardless of concomitant anterior or posterior compartment defects, who were treated with SSLF or LLS at the Faculty of Medicine, Department of Obstetrics and Gynecology, Duzce University, Duzce, Turkey between April 2021 and June 2022. Patients were subjected to preoperative and postoperative clinical assessments. The preoperative clinical assessment was performed using the POP-Quantification (POP-Q) system [16].

Inclusion and exclusion criteria: patients with symptomatic POP (feeling of heaviness in the lower abdomen or a sensation of a bulge or a lump in the vagina), apical prolapse (stage ≥ 2 according to the POP-Q system, POP-Q point C (a point that represents either the most distal (i.e., most dependent) edge of the cervix or the leading edge of the vaginal cuff (hysterectomy scar) after total hysterectomy.) > -1), regardless of concomitant anterior (POP-Q point Ba (a point that represents the most distal edge of the anterior vaginal wall, located between the hymen and the anterior vaginal apex.) ≥ -1 POP-Q) or posterior (POP-Q point Bp (a point that represents the most distal edge of the posterior vaginal wall, situated between the hymen and the posterior vaginal apex.) ≥ -1 POP-Q) compartment defects were included in the study [17]. The study excluded patients who were pregnant or breastfeeding, had pelvic inflammatory disease, adnexal masses suspected of pelvic malignancy, undergone radical pelvic surgery, had psychiatric or neurological disorders causing cooperation problems, or had incomplete follow-up data. All patients who met the inclusion criteria were included in the study. Two patients from the SSLF group and a patient from the LLS group were excluded from the study due to loss to follow-up.

In order to detect a difference of at least 30% in the anatomical failure rate between groups with 95% power, we planned to have a minimum of 40 patients in each study group, accounting for an expected 10% dropout rate. The patients included in the sample were divided into two groups: SSLF group ($n = 47$) and LLS group ($n = 44$).

2.3 Data Collection

Patients' baseline demographic (age) and clinical data (weight, height, obstetric and gynecological history, including sexual activity and menopausal status, and previous POP-related surgeries) were collected and recorded.

The POP-Q system was used for preoperative and postoperative staging of prolapse. Anatomical failure was

defined based on POP-Q points Ba, C, and Bp ≥ -1 [3]. In addition, we utilized validated Turkish versions of Prolapse Quality of Life (P-QoL) [18] tools and Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ-12) [19] to evaluate the anatomic and functional outcomes of the patients preoperatively and in the postoperative follow-up period. The total score that can be obtained from P-QoL ranges between 0 and 100, with a higher score indicating a more significant deterioration in quality of life, and a lower score indicating a better quality of life [20].

Sexual function in women with prolapse was evaluated using the PISQ-12 [21], with a total score that can be obtained ranging from 0 to 48, where a higher score indicates better sexual function [22–24].

2.4 Surgical Procedure

The decision regarding the most appropriate surgical method for each patient was made by the attending surgeon, taking into account factors such as age, medical history, POP-Q stage, and dominant descending part, and the surgeon's preferred technique [8]. Surgical procedures were performed in accordance with the technical guidelines described in the literature [2,9]. Accordingly, we used polypropylene mesh (Parietene, Sofradim-Covidien, Trévoux, France) secured with absorbable sutures (Vicryl Polyglactin 910 2-0 by Ethicon, Somerville, NJ, USA) or non-permanent tacks (AbsorbaTack, Medtronic, Minneapolis, MN, USA) for LLS [9]. Two nonabsorbable sutures (Prolene, Ethicon, Somerville, NJ, USA) were unilaterally placed in the right sacrospinous ligament with the assistance of a Deschamps needle for SSLF [2,7].

After apical defect repair was performed either laparoscopically or vaginally, patients were evaluated intraoperatively. Anterior colporrhaphy was performed in patients with a Ba point > -1 , and posterior colporrhaphy was performed in patients with a Bp point > -1 .

2.5 Follow-up Procedure

A routine check-up was performed on all patients 1–2 weeks after surgery to monitor early postoperative complications and assess the patients' readiness to return to normal activities. All patients were examined at the outpatient clinics at six-month intervals after surgery. All patients were requested to attend the final follow-up visit in June 2024, with an average follow-up duration of 24 months for patients in both groups. The anatomic cure was defined as POP-Q points C, Ba, or Bp < -1 , following the initial surgery. Postoperative recurrence was defined by prolapse-related bulge symptoms in patients with anatomical failure [1,8,10].

2.6 Statistical Analysis

The statistics obtained from the collected data were presented as mean \pm standard deviation for continuous variables that followed a normal distribution, and as median with minimum and maximum values for continuous variables that did not follow a normal distribution. Categorical

variables were expressed as numbers and percentages. The normal distribution of numerical variables was analyzed using Shapiro-Wilk, Kolmogorov-Smirnov, and Anderson-Darling tests.

To compare the differences in categorical variables between the groups, we used Pearson's Chi-square test for 2×2 tables with expected cells of 5 or more, Fisher's exact test for 2×2 tables with expected cells of less than 5, and Fisher-Freeman-Halton test for Row \times Column tables with expected cells of less than 5.

Furthermore, to compare the differences in numerical variables between two independent groups, we used the independent samples *t*-test for numerical variables that followed a normal distribution, and the Mann-Whitney U test for numerical variables that did not follow a normal distribution.

In statistical comparisons between pre-treatment and post-treatment measurements, the paired samples *t*-test was used for continuous variables that followed a normal distribution, whereas the Wilcoxon signed-rank test was applied for variables that did not follow a normal distribution.

McNemar's test was used for statistical comparisons of repeated measurements of categorical variables (solely presence or absence scenarios).

A logistic regression analysis was conducted to examine the factors influencing anatomical success. The results are presented as β (unstandardized regression coefficient)

with 95% confidence intervals (95% CI). A *p*-value of less than 0.05 was considered statistically significant.

Jamovi project 2.3.28 (Jamovi, version 2.3.28.0, 2023, retrieved from <https://www.jamovi.org>) and JASP 0.18.3 (Jeffreys' Amazing Statistics Program, version 0.18.3, 2024, retrieved from <https://jasp-stats.org>) software packages were used for the statistical analyses. Probability (*p*) statistics of <0.05 were deemed to indicate statistical significance.

3. Results

The study included 91 patients: 47 in SSLF group and 44 in LLS group. The mean age of SSLF group was significantly higher than LLS group ($p < 0.001$). Additionally, patients in SSLF group were more likely to be postmenopausal compared to those in LLS group ($p = 0.001$). Furthermore, the rate of patients who had delivered vaginally was significantly higher in SSLF group than in LLS group ($p = 0.009$). The distribution of patients' demographic and clinical data by the study groups is given in Table 1.

The incidence of patients with different types of anatomical failure in the postoperative period are given in Table 2. Accordingly, the incidence of patients with anterior compartment failure was significantly lower in LLS group than in SSLF group ($p = 0.005$). The incidence of patients with anatomical failure was less, although not signifi-

Table 1. Demographic and clinical data of the study groups.

	SSLF group (n = 47)	LLS group (n = 44)	Statistical values	<i>p</i> -values
Age (years) †	65.32 ± 8.73	52.82 ± 9.91	$t = 6.396$	$<0.001^{***}$
BMI (kg/m ²) †	28.92 ± 4.44	28.63 ± 4.67	$t = 0.327$	0.745 ^{***}
Active smoking ‡	4 (8.5%)	7 (15.9%)	1.171 ^{<i>p</i>}	0.279*
Comorbidities ‡				
Hypertension	28 (59.6%)	12 (27.3%)	9.625 ^{<i>p</i>}	0.002*
Diabetes	12 (25.5%)	3 (6.8%)	5.781 ^{<i>p</i>}	0.016*
Others	16 (34.0%)	9 (20.5%)	2.106 ^{<i>p</i>}	0.147*
Obstetric/gynecological history				
Gravidity §	4.0 [1.0–9.0]	3.0 [1.0–7.0]	$Z = -0.770$	0.444 ^{**}
Parity §	3.0 [0.0–9.0]	3.0 [1.0–6.0]	$Z = -1.083$	0.281 ^{**}
Mode of delivery ‡				
Patients with vaginal delivery	45 (95.7%)	34 (77.3%)	6.773 ^{<i>p</i>}	0.009*
Patients with cesarean section	1 (2.1%)	10 (22.7%)	9.075 ^{<i>p</i>}	0.003*
Nulliparous	1 (2.1%)	0 (0.0%)	-	1.000*
Sexual activity ‡	22 (46.8%)	27 (61.4%)	1.937 ^{<i>p</i>}	0.164*
Post-menopausal status ‡	45 (95.7%)	29 (65.9%)	13.316 ^{<i>p</i>}	0.001*
Length of menopause (years) §	16.0 [3.0–34.0]	9.0 [1.0–25.0]	$Z = -3.583$	$<0.001^{**}$
Previous operations ‡				
Hysterectomy	6 (12.8%)	2 (4.5%)	-	0.269*
Surgery for pelvic organ prolapse	4 (8.5%)	3 (6.8%)	-	1.000*

†: mean ± standard deviation; ‡: n (%); §: median [min-max]; ^{*p*}: Chi-square value; SSLF group, patients who underwent sacrospinous ligament fixation; LLS group, patients who underwent laparoscopic lateral suspension. BMI, body mass index.

“*””, Pearson Chi-Square, Fisher's Exact or Fisher Freeman Halton test. “**””, Mann-Whitney U test. “***””, Independent Samples *t*-test.

Table 2. Intra- and inter-group analysis of pre- and post-operative anatomical analysis via POP-Q measurements (cm), and the frequencies of preoperative and postoperative anatomical failures based on POP-Q values.

Type of anatomical failure	SSLF group	LLS group	Statistical values	<i>p</i> -values
Anterior compartment (Ba \geq -1) ‡				
Preoperative	47 (100.0%)	43 (97.7%)	1.080 ^{<i>p</i>}	0.299*
Postoperative	14 (29.8%)	3 (6.8%)	7.892 ^{<i>p</i>}	0.005*
Success rate (%)	70.2	93.0	-	-
Apical compartment (C \geq -1) ‡				
Preoperative	47 (100.0%)	44 (100.0%)	-	-
Postoperative	3 (6.4%)	0 (0.0%)	-	0.242*
Success rate (%)	93.6	100.0	-	-
Posterior compartment (Bp \geq -1) ‡				
Preoperative	36 (76.6%)	19 (43.2%)	10.612 ^{<i>p</i>}	0.001*
Postoperative	5 (10.6%)	6 (13.6%)	0.192 ^{<i>p</i>}	0.661*
Success rate (%)	86.2	68.5	-	-
Any compartment (C, Ba, Bp \geq -1) ‡				
Preoperative	47 (100.0%)	44 (100.0%)	-	-
Postoperative	15 (31.9%)	8 (18.2%)	2.269 ^{<i>p</i>}	0.132*
Success rate (%)	68.1	81.8	-	-

‡: n (%); ^{*p*}: Chi-square value; POP-Q, Pelvic Organ Prolapse-Quantification; SSLF group, patients who underwent sacrospinous ligament fixation; LLS group, patients who underwent laparoscopic lateral suspension.

“*”, Pearson Chi-Square/Fisher’s Exact test.

cantly, in LLS group than in SSLF group (18.2% vs. 31.9%, $p = 0.132$). The highest (100.0%) and lowest (68.5%) success rates for apical and posterior compartment failures were in LLS group.

PISQ-12 was administered to sexually active women in SSLF ($n = 22$) and LLS ($n = 27$) groups. P-QoL was administered to all patients in the groups. There was also no significant difference between the groups in preoperative P-QoL and PISQ-12 scores ($p > 0.050$) (Table 3).

There was no significant difference between the groups in postoperative total and subscale scores of P-QoL and PISQ-12 ($p > 0.050$). On the other hand, significant improvements were seen in postoperative total P-QoL and P-QoL subscale scores in both groups compared to preoperative scores ($p < 0.050$).

There were significant changes in PISQ-12 physical and partner-related subscale scores in both groups after surgery compared to before surgery ($p < 0.050$). Postoperative total PISQ-12 scores increased significantly in LLS group compared to preoperative scores ($p = 0.009$). On the other hand, there was no significant difference between the preoperative and postoperative total PISQ-12 scores in SSLF group ($p = 0.111$).

There were significant differences between the groups in terms of the frequency of concomitant operations ($p < 0.050$). Accordingly, the number of patients with concomitant hysterectomy and stress urinary incontinence operations were significantly higher in SSLF group than in LLS group ($p < 0.001$ and $p = 0.028$, respectively) (Table 4). The mean length of follow-up was 24.2 ± 3.9 months in SSLF group and 23.3 ± 3.5 months in LLS group ($p =$

0.322). There was no significant difference in the rates of *de novo* symptoms between the groups ($p > 0.050$) (Table 5).

A logistic regression analysis was conducted to assess the factors influencing anatomical success. The results indicated that none of the examined factors, menopausal status ($p = 1.000$), type of surgery ($p = 0.998$), previous cesarean section ($p = 0.999$), hypertension ($p = 0.495$), diabetes ($p = 0.999$), or concurrent hysterectomy ($p = 0.480$), were found to have a statistically significant impact on anatomical success. The analysis results are provided in Table 6.

While there was one case of bladder injury and one case of pulmonary embolism in SSLF group, no mesh-related complication was detected in LLS group. In SSLF group, four of the patients with anatomical failure underwent re-operation due to postoperative recurrence.

4. Discussion

The study results demonstrated that LLS and SSLF are effective surgical procedures for reducing POP rates. Patients undergoing LLS and SSLF showed significant improvements in all P-QoL subscale ratings, and there was notable increase in both groups’ PISQ-12 physical and partner-related subscale ratings during the recovery period. The disparities in compartmental failure rates between the groups suggest that, while Group LLS had a lower overall rate of anatomical failure than Group SSLF, LLS may be more suitable for anterior and apical compartment failures, while SSLF may be better suited for posterior compartment failures.

Overall, the varying success rates of surgical approaches for treating anterior, apical, and posterior POP

Table 3. Preoperative and postoperative P-QoL and PISQ-12 scores of the patients.

P-QoL	SSLF group (n = 47)	LLS group (n = 44)	Statistical values	p-values
General health perceptions †				
Preoperative	24.34 ± 8.03	27.06 ± 9.35	<i>t</i> * = -1.454	0.150*
Postoperative	11.48 ± 6.84	12.54 ± 5.69	<i>t</i> * = -0.829	0.409*
<i>t</i> **	9.70	10.238	-	-
<i>p</i> **	<0.001	<0.001	-	-
Prolapse impact †				
Preoperative	8.84 ± 4.70	10.15 ± 5.52	<i>t</i> * = -1.209	0.230*
Postoperative	6.0 [0.0–13.0]	6.0 [0.0–15.0]	Z = -0.182	0.856***
Z****	-4.315	-5.087	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Role limitations †				
Preoperative	4.0 [2.0–8.0]	6.0 [2.0–8.0]	Z = -1.105	0.916***
Postoperative	2.0 [2.0–4.0]	2.0 [2.0–4.0]	Z = -1.331	0.183***
Z****	-4.800	-5.054	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Physical limitations †				
Preoperative	4.0 [2.0–8.0]	5.0 [2.0–8.0]	Z = -0.059	0.953***
Postoperative	2.0 [2.0–8.0]	2.0 [2.0–4.0]	Z = -2.401	0.016***
Z****	-4.345	-5.067	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Social limitations †				
Preoperative	4.0 [2.0–8.0]	4.0 [2.0–8.0]	Z = -0.294	0.769***
Postoperative	2.0 [2.0–4.0]	2.0 [2.0–3.0]	Z = -1.690	0.091***
Z****	-4.283	-4.818	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Personal relationships †				
Preoperative	5.0 [3.0–12.0]	6.0 [3.0–12.0]	Z = -0.943	0.346***
Postoperative	3.0 [3.0–4.0]	3.0 [3.0–5.0]	Z = -0.504	0.614***
Z****	-4.557	-4.818	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Emotions †				
Preoperative	9.0 [3.0–12.0]	8.0 [3.0–12.0]	Z = -0.108	0.914***
Postoperative	3.0 [3.0–7.0]	3.0 [3.0–8.0]	Z = -0.485	0.628***
Z****	-5.217	-5.254	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Sleep-energy †				
Preoperative	3.0 [2.0–8.0]	5.0 [2.0–8.0]	Z = -0.863	0.388***
Postoperative	2.0 [2.0–7.0]	2.0 [2.0–8.0]	Z = -1.910	0.056***
Z****	-3.385	-4.344	-	-
<i>p</i> ****	0.001	<0.001	-	-
Severity measures †				
Preoperative	9.0 [4.0–15.0]	9.0 [5.0–15.0]	Z = -0.763	0.445***
Postoperative	4.0 [4.0–10.0]	4.0 [4.0–6.0]	Z = -1.592	0.111***
Z****	-5.048	-5.727	-	-
<i>p</i> ****	<0.001	<0.001	-	-
Total score †				
Preoperative	73.7 ± 24.5	78.5 ± 24.0	<i>t</i> * = -0.937	0.351*
Postoperative	37.2 ± 11.0	37.5 ± 8.8	<i>t</i> * = -0.142	0.887*
<i>t</i> **	9.519	11.708	-	-
<i>p</i> **	<0.001	<0.001	-	-
PISQ-12	SSLF (n = 22)	LLS (n = 27)	-	-

Table 3. Continued.

P-QoL	SSLF group (n = 47)	LLS group (n = 44)	Statistical values	p-values
Behavioral emotional †				
Preoperative	10.45 ± 3.50	9.71 ± 4.30	$t^* = 0.654$	0.516*
Postoperative	9.31 ± 4.32	9.03 ± 4.91	$t^* = 0.210$	0.834*
t^{**}	1.008	0.949	-	-
p^{**}	0.325	0.352	-	-
Physical †				
Preoperative	12.31 ± 3.28	11.14 ± 3.86	$t^* = 1.139$	0.261*
Postoperative	15.0 [7.0–16.0]	15.0 [1.0–16.0]	$Z = -0.108$	0.914***
Z^{****}	-2.226	-3.354	-	-
p^{****}	0.026	0.001	-	-
Partner-related †				
Preoperative	10.40 ± 3.00	10.28 ± 2.90	$t^* = 0.147$	0.884*
Postoperative	13.0 [5.0–16.0]	10.0 [6.0–15.0]	$Z = -0.562$	0.574***
Z^{****}	-2.495	-2.102	-	-
p^{****}	0.013	0.036	-	-
PISQ-12 total †				
Preoperative	33.2 ± 5.1	31.1 ± 5.6	$t^* = 1.344$	0.185*
Postoperative	35.0 ± 5.9	34.1 ± 4.1	$t^* = 0.570$	0.572*
t^{**}	-1.661	-2.840	-	-
p^{**}	0.111	0.009	-	-

†: mean ± standard deviation; P-QoL, Prolapse-Quality of Life; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire; SSLF group, patients who underwent sacrospinous ligament fixation; LLS group, patients who underwent laparoscopic lateral suspension.

“*”, Independent Samples t -test. “**”, Paired Samples t -test. “****”, Mann-Whitney U test. “*****”, Wilcoxon test.

Table 4. Operative details of the groups.

	SSLF group (n = 47)	LLS group (n = 44)	Statistical values	p-values
Concurrent operations †				
Hysterectomy	40 (85.1%)	1 (2.3%)	62.987 ρ	<0.001*
Stress urinary incontinence surgery	11 (23.4%)	3 (6.8%)	4.802 ρ	0.028*
Length of operation (min) §				
With hysterectomy	109.0 [60.0–220.0]	202.0 [202.0–202.0]	$Z = -1.606$	0.118**
Without hysterectomy	100.0 [30.0–135.0]	113.0 [55.0–430.0]	$Z = -1.497$	0.138**
Preoperative hemoglobin (g/dL) †	12.3 ± 1.2	12.6 ± 1.1	$t = -1.278$	0.205***
Postoperative hemoglobin (g/dL) †	10.8 ± 1.2	11.0 ± 0.9	$t = -0.506$	0.615***
Change in hemoglobin level (g/dL) §	1.4 [-0.2–3.5]	1.7 [0.3–3.4]	$Z = -1.176$	0.241**
Need for blood transfusion ‡	0 (0.0%)	1 (2.3%)	-	0.484*
Length of follow-up (months) †	24.2 ± 3.9	23.3 ± 3.5	$t = 1.177$	0.322***

‡: n (%); †: mean ± standard deviation; §: median [min-max]; ρ : Chi-square value; SSLF group, patients who underwent sacrospinous ligament fixation; LLS group, patients who underwent laparoscopic lateral suspension.

“*”, Pearson Chi-Square, Fisher’s Exact or Fisher Freeman Halton test. “**”, Mann-Whitney U test. “***”, Independent Samples t -test.

highlight the importance of considering the specific anatomical compartment of the prolapse when selecting the appropriate surgical approach. There is ongoing controversy on the best surgical method for treating POP, with the literature indicating that laparoscopic or abdominal sacrocolpopexy and LLS and SSLF have similar efficacies [3,5,12,25].

In studies comparing transvaginal apical methods, SSLF was found to be effective as uterosacral ligament sus-

pension in terms of surgical failure, symptom severity, and adverse events [26,27]. While several studies have examined the effectiveness of different surgical procedures for treating POP [14,15], there is limited research comparing the results of SSLF and LLS in terms of anatomical failure rates, impact on quality of life, and sexual activity. In a study by Baki Erin *et al.* [1], LLS and SSLF were compared in patients with apical compartment prolapse. The study also reported that while both procedures resulted in simi-

Table 5. Association between operation type and changes in clinical characteristics of symptoms.

	SSLF group (n = 47)	LLS group (n = 44)	p-values*
<i>De novo</i> stress urinary incontinence ‡	0 (0.0%)	3 (6.8%)	0.109
<i>De novo</i> urge urinary incontinence ‡	2 (4.3%)	2 (4.5%)	1.000
<i>De novo</i> mixed urinary incontinence ‡	0 (0.0%)	1 (2.3%)	0.484
<i>De novo</i> constipation ‡	3 (6.4%)	0 (0.0%)	0.242
<i>De novo</i> dyspareunia ‡	3 (6.4%)	0 (0.0%)	0.242

‡: n (%); SSLF group, patients who underwent sacrospinous ligament fixation; LLS group, patients who underwent laparoscopic lateral suspension.

*, Fisher's Exact test.

Table 6. Logistic regression analysis for anatomical success.

Variables	β	Standard error	Wald	df	p	Exp(B)	95% CI lower	95% CI upper
Menopausal status	-0.290	11223.800	0.000	1	1.000	0.749	0.000	-
Type of surgery	-19.199	6805.756	0.000	1	0.998	0.000	0.000	-
Previous cesarean section	-15.347	9899.139	0.000	1	0.999	0.000	0.000	-
Hypertension	0.877	1.286	0.465	1	0.495	2.403	0.193	29.879
Diabetes	-18.180	10063.379	0.000	1	0.999	0.000	0.000	-
Concurrent hysterectomy	0.942	1.333	0.500	1	0.480	2.565	0.188	34.944

Logistic regression analysis was used. β , Unstandardized regression coefficient; CI, confidence interval; df, degrees of freedom; Exp(B), exponentiated beta (odds ratio). p value of <0.05 was considered significant.

lar anatomical recovery rates, LLS was superior to SSLF in terms of improved sexual functions, fewer POP-related symptoms, lower reoperation rates, and fewer complications.

Campagna *et al.* [28] reported an overall anatomic success rate of over 90% in the apical compartment and over 88% in the anterior compartment for patients who underwent LLS due to POP. Aksin and Andan [4] reported an anatomic success rate of 78% in the apical compartment and over 73% in the anterior compartment for patients who underwent LLS. Another study reported an objective success rate of 87.3% in patients who underwent LLS due to anterior or apical POP after a mean follow-up duration of more than three years [9]. Our findings were comparable to those reported in the literature [1,10,28,29]. Differences in success rates between studies may be attributed to the technical features of POP, operative details, and duration of follow-up.

POP classification based on anatomical compartments is essential for selecting the appropriate surgical technique and evaluating success rates. Notably, the success rates of LLS vary depending on differences in anatomic compartments.

We found a success rate comparable to that reported in the study by Baki Erin *et al.* [1], where the LLS's anatomical recovery rate in patients who underwent LLS for apical prolapse was reported to be 96.1%. The success rate of LLS was higher than that of SSLF for anterior and apical compartment failures, whereas the success rate of SSLF was higher than that of LLS for posterior compartment failures. Similarly, Veit-Rubin *et al.* [10] reported optimal or satisfactory outcomes in 85% of patients who underwent LLS due to posterior compartment failure and in 91% and 93%

of patients who underwent LLS due to anterior and apical compartment failures, respectively. These findings indicate that the anatomical location of POP failure should be considered when selecting the surgical technique for treating POP.

Anatomical recovery after surgery in POP patients leads to significant improvements in quality of life and sexual function [5]. Baki Erin *et al.* [1] reported significantly higher Female Sexual Function Index (FSFI) and Pelvic Organ Prolapse Symptom Scores (POP-SS) after LLS than after SSLF surgery. They attributed better postoperative sexual function to the preservation of the physiological axis and correction of the apical, posterior, and anterior compartments. Although we used different patient self-report tools, such as P-QoL and PISQ-12, we observed comparable postoperative outcomes in LLS and SSLF groups.

An additional metric used to assess the performance of POP-related procedures is the reoperation rate. The literature reports that the reoperation rate following POP-related operations ranges from 3.4% to 11% [9,12]. In a recent meta-analysis that reviewed data from twelve studies, the recurrence rate for SSLF was found to be 11.34% [30]. Variations in reoperation rates following POP surgery across studies have been attributed to differences in methodology, such as whether the reoperations were performed within the same or different compartments, and to discrepancies in follow-up periods [3,30]. In our study, anatomic failure was observed in 15 patients undergoing SSLF, with anterior compartment failure in 14 cases. Apical failure was seen in three patients, all of whom also had anterior and posterior failures, and posterior compartment failure was seen in five patients. Among these, three patients with apical failure underwent colpoceleisis due to

symptomatic presentation, two patients had anterior defects extending beyond the hymen and one undergoing anterior colporrhaphy. When colpoceleisis patients were excluded, none of the two patients with posterior compartment defects had defects extending beyond the hymen. There were a total of eight patients with anatomical failure in the group treated with LLS surgery, of which two patients had a defect extending 1 cm beyond the hymen and were asymptomatic; hence, they did not undergo re-operation. In two recent meta-analyses, preserving the uterus during apical defect repair in POP surgery has been shown to offer certain advantages [31,32] compared to its removal, which increases the risk of vault prolapse [33]. Although vaginal vault prolapse was more frequently observed in cases where concomitant hysterectomy was performed in our study, there was no observed negative effect on anatomical success, regardless of whether the uterus was preserved or removed.

Randomized controlled trials may enable more definitive conclusions. However, the development of patient groups with comparable features maybe hindered by patient and physician preferences, primarily due to concerns over mesh.

The strength of the study is that it is one of the first to compare outcomes between LLS and SSLF for apical compartment prolapse. However, a limitation of the study is the potential selection bias due to differences in age, comorbidities, and sexual activity between the patient groups. The preference for uterine preservation directly influenced the choice of surgical approach, resulting in differences in age and comorbidities between the groups. These differences may be particularly limiting when assessing sexual function. To reduce this bias, we used the PISQ-12 only in sexually active patients. A logistic regression analysis was performed to examine the factors influencing anatomical success. The variable examined, including menopausal status, type of surgery, previous cesarean section, hypertension, diabetes, or concurrent hysterectomy, did not show a statistically significant impact on anatomical success. Finally, the current surgeries were not compared with a group that included sacrocolpopexy, which is considered the gold standard for apical prolapse. This is another limitation of the study.

5. Conclusions

The study results showed that both LLS and SSLF lowered POP rates and enhanced the quality of life in patients. However, for anterior and apical compartment abnormalities, the success rate of LLS was greater than that of SSLF, while for posterior compartment defects, the success rate of SSLF was higher than that of LLS. As a result, LLS and SSLF should be customized based on the anatomical and clinical presentation of the patient. More randomized controlled studies are needed to examine the long-term efficacies and safety profiles of both approaches in order to draw more definitive conclusions.

Availability of Data and Materials

The authors of the study are custodians of the data in anonymous form, which can possibly be provided to anyone who makes a motivated and reasoned request.

Author Contributions

Conceptualization: EY, AB, BK, and AT; methodology: EY, AB, and BK; formal analysis: EY, AB, and AT; investigation: EY, BK and BS; data curation: EY, BK, and BS; writing—original draft preparation: EY, AB and AT; writing—review and editing: EY, AB and AT; visualization: EY, BK and BS; supervision: AT; project administration: EY. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study protocol was approved by the local ethical committee of Düzce University (2022/53) The study was conducted in accordance with the ethical considerations outlined in the Declaration of Helsinki. Written informed consent was obtained from each patient included in the study.

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Conflict of Interest

The authors declare no conflict of interest. Andrea Tinelli is serving as one of the Editorial Board members and Guest editors of this journal. We declare that Andrea Tinelli had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Emanuele Perrone.

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