Clinical Investigation / Araştırma

DOI: 10.4274/tjod.galenos.2026.21784

Turk J Obstet Gynecol

Comparison of high uterosacral ligament suspension and sacrospinous ligament fixation for apical prolapse: Two-year outcomes

Apikal prolapsus cerrahisinde yüksek uterosakral ligament süspansiyonu ile sakrospinöz ligament fiksasyonu: İki yıllık sonuçların karşılaştırılması

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Abstract

Objective: Pelvic organ prolapse is a prevalent condition that significantly impacts women's quality of life. This study aimed to compare anatomical and patient-reported outcomes after high uterosacral ligament suspension (HUS) and sacrospinous ligament fixation (SSLF) performed during vaginal hysterectomy for apical pelvic organ prolapse.

Materials and Methods: This retrospective study included 46 women who underwent total vaginal hysterectomy with either HUS (n=20) or SSLF (n=26) between 2022 and 2023. Patient characteristics, surgical outcomes, and quality-of-life data were evaluated. Validated patient-reported outcome measures were used: Pelvic Pain Impact Questionnaire (PPIQ) and Pelvic Floor Disability Index (PFDI-20). Follow-up was conducted at 1, 6, 12, and 24 months postoperatively.

Results: Both HUS and SSLF improved prolapse stage, Pelvic Organ Prolapse Quantification System C point, and pelvic floor symptoms after 24 months ($p<0.01$). Both HUS and SSLF improved anatomical and quality-of-life outcomes. In adjusted analyses, HUS was associated with lower PFDI-20 scores (β: -4.37, $p=0.015$) and showed a similar trend for PPIQ scores (β: -1.33, $p=0.059$). No major intraoperative complications were observed, and recurrence rates were low and similar between groups.

Conclusion: Both procedures provided satisfactory anatomical correction and quality-of-life improvement at two years. HUS was associated with lower PFDI-20 scores after adjustment, whereas the difference in PPIQ scores did not reach statistical significance.

Keywords: Apical prolapse, uterosacral ligament suspension, sacrospinous ligament fixation, pelvic organ prolapse, quality of life

Öz

Amaç: Pelvik organ prolapsusu, kadınların yaşam kalitesini önemli ölçüde etkileyen yaygın bir durumdur. Bu çalışma, apikal pelvik organ prolapsusu için vajinal histerektomi sırasında uygulanan yüksek uterosakral ligament süspansiyonu (HUS) ve sakrospinöz ligament fiksasyonu (SSLF) sonrası anatomik ve hasta tarafından bildirilen sonuçları karşılaştırmayı amaçlamıştır.

PRECIS: High uterosacral ligament suspension and sacrospinous ligament fixation provided comparable anatomical outcomes, while high uterosacral suspension was associated with slightly better patient-reported outcomes.

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Received/Geliş Tarihi: 21.06.2026 **Accepted/Kabul Tarihi:** 21.09.2026 **Epub:** 29.09.2026

Cite this article as: Keskin Ö, Karaşin SS, Sönmez S, Aslan S. Comparison of high uterosacral ligament suspension and sacrospinous ligament fixation for apical prolapse: two-year outcomes. Turk J Obstet Gynecol. [Epub Ahead of Print]

Gereç ve Yöntemler: Bu retrospektif çalışma, 2022 ve 2023 yılları arasında HUS (n=20) veya SSLF (n=26) ile total vajinal histerektomi geçiren 46 kadını içermiştir. Hasta özellikleri, cerrahi sonuçlar ve yaşam kalitesi verileri değerlendirilmiştir. Geçerliliği kanıtlanmış hasta tarafından bildirilen sonuç ölçütleri kullanılmıştır: Pelvik Ağrı Etki Anketi (PPIQ) ve Pelvik Taban Engellilik İndeksi (PFDI-20). Ameliyat sonrası 1, 6, 12 ve 24. aylarda takip yapılmıştır.

Bulgular: Hem HUS hem de SSLF, 24 ay sonra prolapsus evresini, *Pelvik Organ Prolapsusu Kantifikasyon Sistemi* C puanını ve pelvik taban semptomlarını iyileştirdi (p<0,01). Hem HUS hem de SSLF, anatomik ve yaşam kalitesi sonuçlarını iyileştirdi. Ayarlanmış analizlerde, HUS daha düşük PFDI-20 skorlarıyla ilişkilendirildi (β: -4,37, p=0,015), PPIQ skorları için de benzer bir eğilim gözlendi (β: -1,33, p=0,059). Ameliyat sırasında önemli bir komplikasyon gözlenmedi ve nüks oranları düşük ve gruplar arasında benzerdi.

Sonuç: Her iki prosedür de iki yıl sonra tatmin edici anatomik düzeltme ve yaşam kalitesi iyileşmesi sağladı. HUS, daha düşük PFDI-20 puanlarıyla ilişkilendirilirken, PPIQ puanlarındaki fark istatistiksel olarak anlamlı düzeye ulaşmadı.

Anahtar Kelimeler: Apikal prolapsus, uterosakral ligament süspansiyonu, sakrospinöz ligament fiksasyonu, pelvik organ prolapsusu, yaşam kalitesi

Introduction

Pelvic organ prolapse (POP) is a common disorder of the female pelvic floor and may substantially interfere with daily activities and health-related quality-of-life[1]. It is an important indication for gynecologic surgery, particularly in older women. The development of POP is multifactorial, with vaginal and instrumental delivery, episiotomy, obesity, and advancing age recognized as relevant risk factors[2-4]. In addition to the anatomical descent of the pelvic organs, affected women may experience urinary, bowel, and pelvic pain-related symptoms, which can further impair their quality of life[5]. For women with symptomatic moderate-to-severe prolapse, surgical correction may be considered when conservative management is ineffective or is not desired.

Several reconstructive options are available for POP, including native-tissue repairs and mesh-based procedures. Apical support can be achieved through either a vaginal or an abdominal/laparoscopic route, depending on the clinical situation and surgical plan.

Sacrocolpopexy requires dissection of the sacral promontory, a step that may result in life-threatening vascular injury in the sacral region. Isenlik et al.[6] found short-term results between laparoscopic lateral suspension (LLS) and laparoscopic sacrocolpopexy (LSC). However, it is important to note that both LLS and LSC are associated with potential risks, including mesh erosion, infection, and organ perforation. The most common vaginal methods include high uterosacral and sacrospinous suspension, which also have their own set of risks and complications[7,8].

High uterosacral ligament suspension (HUS) and sacrospinous ligament fixation (SSLF) are frequently used native-tissue procedures for restoring vaginal apical support. Although both techniques have demonstrated favorable outcomes, comparative evidence regarding longer-term anatomical and patient-reported results remains limited. Therefore, this study evaluated women who underwent vaginal hysterectomy with either HUS or SSLF and compared their anatomical findings and patient-reported outcomes over a 24-month postoperative period.

Materials and Methods

This clinical study comprises a retrospective analysis of cases from a tertiary hospital during 2022-2023. The current study was conducted among women with uterine prolapse who were candidates for total vaginal hysterectomy (TVH) and repair surgeries. This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Clinical Research Ethics Committee of University of Health Sciences Türkiye, Bursa Yüksek İhtisas Training and Research Hospital (approval number: 2011-KAEK-25 2022/11-09, date: 30.11.2022). Informed consent was obtained from all participants.

Inclusion criteria were: symptomatic uterine prolapse (i.e., a feeling of tissue protruding from the vagina, a feeling of heaviness or pulling in the pelvis, and urinary leakage and incontinence); grade 2 or greater prolapse according to the POP Quantification System (POP-Q) examination; not responding to, or unwilling to undergo, conservative treatments; being a candidate for cystocele repair with TVH and vaginal apex suspension surgeries; and signing written informed consent to participate in this study.

Exclusion criteria included contraindications to major surgery or anesthesia; any malignancy of the urogenital system or vulva; active infection of the urinary, genital, or pelvic systems; pregnancy or breastfeeding; and lack of consent. All cases in the current process that met the inclusion criteria were included in the study.

Demographic, perioperative, and follow-up data were retrieved from hospital records. Recorded baseline variables included age, body mass index (BMI), comorbid conditions, obstetric history, delivery characteristics, and hospital stay duration. Urinary and prolapse-related symptoms, together with patient-reported quality of life, were assessed before surgery and during follow-up using the Pelvic Pain Impact Questionnaire (PPIQ) and the Pelvic Floor Disability Index (PFDI-20). The 24-month postoperative PFDI-20 score was defined as the primary endpoint. We performed pre- and postoperative prolapse stage and C point analysis using the POP-Q system, which is an evaluation method recommended by the International Urogynecological Association and The American College of Obstetricians and Gynecologists[9-11].

PFDI-20 is the abbreviated form of the Pelvic Floor Distress Inventory and is designed to quantify the symptom burden associated with pelvic floor disorders. The instrument comprises three domains: POPDI-6 for prolapse-related symptoms, CRADI-8 for colorectal and anal complaints, and

UDI-6 for urinary symptoms. Each item is scored according to the presence and perceived severity of the relevant symptom, with higher responses reflecting greater symptom-related distress[4]. The higher the score obtained as a result of this questionnaire, the greater the degree of complaint of pelvic floor dysfunction[12]. The PFDI-20 was analyzed using the raw total score (range: 0-80) of the validated Turkish version. The same scoring approach was applied consistently to all participants throughout the study, and all between-group comparisons were performed using this scoring method.

The PPIQ is a 10-item instrument developed to assess the functional and quality-of-life impact of chronic pelvic pain. Its first eight items use a 0-4 Likert-type scale. The scored items address domains such as energy, mood, sleep, gastrointestinal function, sitting tolerance, daily functioning, physical activity, and clothing. Two additional items addressing tampon use and sexual intercourse are not included in the total score. The questionnaire can be administered at the individual or group level. Because pain-related functional impairment may be relevant after native-tissue prolapse surgery, PPIQ was included alongside PFDI-20 despite its less frequent use in prolapse cohorts. Total scores are obtained by summing the scores of each item, excluding the last two items from the calculation. High scores indicate a high impact[13].

TVH was performed using a standardized surgical technique in both groups. Following hysterectomy, apical support was restored using either HUS or SSLF. In the HUS group, bilateral uterosacral ligament suspension was performed before closure of the vaginal cuff. One No. 1 delayed-absorbable polyglactin (Vicryl®, Ethicon, USA) suture was placed through each uterosacral ligament and advanced continuously along each ligament with three to four sequential bites or plications. The final portion of each suture was incorporated into the corresponding vaginal cuff angle to provide apical support. The sutures were passed from ventral to dorsal to minimize the risk of ureteral injury. In the SSLF group, unilateral right SSLF was performed after vaginal cuff closure. The right pararectal space was developed by blunt dissection until the ischial spine and sacrospinous ligament were identified by palpation. Two permanent 2-0 monofilament polypropylene (Prolene®, Ethicon, USA) sutures were placed approximately 2-3 cm medial to the ischial spine, through the sacrospinous ligament, and attached to the vaginal apex without excessive tension. Anterior and/or posterior colporrhaphy were performed when indicated by preoperative POP-Q findings. All procedures were performed by two experienced urogynecologic surgeons at the same tertiary referral center. Throughout the study period, both surgeons routinely performed HUS and SSLF procedures using standardized surgical principles.

Patients were allocated to either the HUS or the SSLF group based on the operating surgeon's clinical judgment and intraoperative findings. No predefined institutional protocol or randomization process was used because of the retrospective design of the study. All consecutive eligible patients during the study period were included.

Patients were followed at 1, 6, 12, and 24 months after surgery, and evaluated for urinary and bowel symptoms, prolapse, and sexual function. We also meticulously assessed recurrence and surgical complications (such as bleeding, infection, and back pain) using the POP-Q examination and the PPIQ and PFDI-20 questionnaires to ensure a thorough understanding of the outcomes. Recurrence was defined as apical prolapse stage ≥2 according to the POP-Q system during follow-up.

Statistical Analysis

Statistical analyses were conducted with IBM SPSS Statistics, version 24.0 (IBM Corp., Armonk, NY, USA). Continuous-variable distributions were examined using histograms and probability plots and evaluated with the Shapiro-Wilk and Kolmogorov-Smirnov tests. Depending on distributional characteristics, continuous data were summarized as mean ± standard deviation or median with interquartile range (IQR); categorical data were expressed as counts and percentages. Between-group comparisons of continuous variables were performed using the Student's t-test or Mann-Whitney U test, according to their distribution. Associations were examined with Pearson or Spearman correlation coefficients, as appropriate for the scale and distribution of the variables. Non-normally distributed questionnaire scores were summarized as medians (IQR) and compared between surgical groups with the Mann-Whitney U test. Changes from baseline within each group were evaluated with the Wilcoxon signed-rank test. Multivariable linear regression was subsequently used to examine factors independently associated with the 24-month PPIQ and PFDI-20 outcomes. Candidate covariates were chosen a priori on clinical grounds and included age, parity, the corresponding baseline questionnaire score, and surgical technique. Regression coefficients with 95% confidence intervals (CIs) were presented as adjusted estimates. Before interpretation, regression assumptions regarding residual distribution, variance homogeneity, and collinearity were evaluated. A two-sided p-value below 0.05 was considered statistically significant.

Results

We included 20 patients who underwent HUS and 26 who underwent SSLF, and divided them into two groups. The primary analysis of demographic data showed no significant between-group differences in age, BMI, length of hospital stay, or history of previous deliveries ($p>0.05$). Operative time was significantly shorter in the HUS group than in the SSLF group (125±16 vs. 158±7.5 minutes, respectively; $p=0.016$). We observed a relapse of apical prolapse in one patient treated with sacrospinous ligament suspension and one patient treated with high uterosacral suspension, each occurring within the 2nd year. There was no significant difference between the groups ($p=1.00$). The analysis results are shown in Table 1.

Table 2 shows that there was no significant difference between the two groups in prolapse stage before and after surgery (p=0.599). With both surgical techniques, patients' prolapse status improved after surgery (p<0.01). Although cystocele development was observed in 3 patients in the SSLF group during the 2nd year, this did not constitute a significant difference between the two groups (p=0.116). All patients showed significant improvements in C points during the second postoperative year (p<0.01), but there was no significant difference between the two groups (p=0.213).

According to the PPIQ scoring system, patient-reported outcomes improved significantly in both groups at 24 months compared with preoperative levels. At 24 months, the total PPIQ score was lower in the HUS group than in the SSLF group [median, 9 (IQR: 7-10.25) vs. 10 (IQR: 9-11.75), respectively; p=0.043]. Among the PPIQ subdomains, postoperative mood

Table 1. Comparison of demographic data and clinical outcomes of patients

	High uterosacral suspension (n=20) (mean ± SD)/median (min-max)	Sacrospinous ligament fixation (n=26) (mean ± SD)/median (min-max)	p
Age (years)	60.2±8.5	60±12	0.947
BMI (kg/m^2)	23.12±2.73	24.17±1.20	0.513
Duration of hospitalization (days)	2 (2-6)	2 (2-4)	0.369
Previous delivery (times)	2 (0-4)	2 (2-10)	0.137
Surgical complication, n (%)			
No	18 (90%)	21 (80.7%)	0.332
Pelvic pain	0 (0%)	4 (15.4%)	0.092
Hematoma	0 (0%)	1 (3.8%)	0.364
Urinary retention	2 (10%)	0 (0%)	0.184
Bladder injury	0 (0%)	0 (0%)	
Rectum injury	0 (0%)	0 (0%)	
Duration of surgery (minutes)	125±16	158±7.5	0.016
Relapse, n (%)	1 (5%)	1 (3.8%)	1.00

Descriptive analyses were presented using (X ± SD), median (min-max) and n (%) for normally distributed, non-normally distributed and categorical variables, respectively
SD: Standard deviation, BMI: Body mass index

Table 2. Comparison of prolapse stage and C point in patients based on the POP-Q

Findings	Degree	High uterosacral suspension (n=20)	Sacrospinous ligament suspension (n=26)	p
Prolapse stage (POP-Q)				
Before operation	2	0 (0%)	1 (3.8%)	0.509
	3	3 (15%)	6 (23.1%)	
	4	17 (85%)	19 (73.1%)	
24 months	0	19 (95%)	24 (92.3%)	0.599
	4	1 (5%)	1 (3.8%)	
	p<0.01		**p<0.01**	
Postoperative cystocele relapse in 24 months				
	2	0 (0%)	3 (11.5%)	0.116
	4	0 (0%)	1 (3.8%)	
Postoperative rectocele relapse in 24 months				
	2	4 (20%)	2 (7.7%)	0.159
C point				
Before intervention		3.96±2.90	4.37±3.80	0.762
24 months		-8.1±2.5	-7.17±2.4	0.213
	p=0.01		**p=0.01**	

Student's t-test, p<0.05 was considered significant
Pearson chi-square, p<0.05 was considered significant
POP-Q: Pelvic Organ Prolapse Quantification System

scores (p=0.007) and scores for the ability to wear certain clothes (p=0.036) were lower in the HUS group. The total PFDI-20 score at 24 months was also lower in the HUS group [median, 5 (IQR: 4-6.25) vs. 7 (IQR: 6-11.5), respectively; p=0.007]. Among the PFDI-20 subdomains, postoperative POPDI-6 scores were lower in the HUS group (p=0.001), whereas no significant between-group differences were observed for the other subdomains (Table 3).

In the multivariable linear regression analysis, surgical technique (HUS vs. SSLF) was associated with lower PPIQ scores at 24 months; however, this association did not reach statistical significance (adjusted β: -1.33, 95% CI: -2.70 to 0.05, p=0.059). For PFDI-20 scores, surgical technique remained an independent predictor of improved outcomes, with lower scores observed in the HUS group (adjusted β: -4.37, 95% CI: -7.86 to -0.89, p=0.015). Age was associated with higher PPIQ scores (β: 0.07, p=0.041) and showed a borderline association with PFDI-20 scores (p=0.055), while baseline scores and parity were not significant predictors (Table 4).

Discussion

In this study, both HUS and SSLF resulted in significant improvements in anatomical outcomes and patient-reported quality of life at 24 months. Overall, anatomical correction, recurrence, and functional outcomes were similar between the two procedures.

Although postoperative questionnaire scores tended to favor HUS, the absolute between-group differences were small. Following adjustment for baseline and clinical covariates, HUS remained associated with a lower PFDI-20 score, while the

Table 3. Comparison of PPIQ and PFDI-20 scores between the HUS and SSLF groups

Outcome	Time	HUS (n=20), median (IQR)	SSLF (n=26), median (IQR)	p
PPIQ subgroups				
Energy levels	Before surgery	4 (3-4)	3 (3-4)	0.374
	After 24 months	1 (0-1)	1 (1-1)	0.173
Mood	Before surgery	3.5 (3-4)	3 (3-4)	0.687
	After 24 months	1 (0-1)	1 (1-1)	0.007
Sleep	Before surgery	3 (3-4)	3 (2.25-3.75)	0.135
	After 24 months	2 (2-3)	2 (2-3)	0.924
Stomach and intestinal function	Before surgery	3 (3-3)	3 (2.25-3)	0.510
	After 24 months	2 (1.75-3)	2 (2-3)	0.879
Ability to sit >20 min	Before surgery	4 (3-4)	3.5 (3-4)	0.179
	After 24 months	1 (1-1)	1 (1-1)	0.433
Ability to perform/function normally	Before surgery	4 (3-4)	3.5 (3-4)	0.179
	After 24 months	1 (0.75-1)	1 (1-1)	0.312
Physical activity	Before surgery	4 (3-4)	3 (3-4)	0.038
	After 24 months	1 (0-1)	1 (1-1)	0.100
Ability to wear certain clothes	Before surgery	4 (3-4)	3 (3-4)	0.280
	After 24 months	1 (0-1)	1 (1-1)	0.036
PPIQ total	Before surgery	28.5 (24-31)	26.5 (23.25-28)	0.086
	After 24 months	9 (7-10.25)	10 (9-11.75)	0.043
PFDI subgroups				
POPDI-6				
	After 24 months	0 (0-1)	2 (1-4.75)	0.001
CRADI-8	Before surgery	4 (1.75-6.25)	4 (3-5.75)	0.893
	After 24 months	0.5 (0-2.25)	2 (1-2)	0.232
UDI-6	Before surgery	10 (8.75-11.25)	10 (9-11)	0.875
	After 24 months	3 (2-4)	4 (3-5.75)	0.071
PFDI-20 total	Before surgery	32 (28-36)	32 (29.25-34.5)	0.991
	After 24 months	5 (4-6.25)	7 (6-11.5)	0.007

Data are presented as median [interquartile range (IQR)]. Between-group comparisons were performed using the Mann-Whitney U test. Changes from baseline within each group were evaluated with the Wilcoxon signed-rank test. p<0.05 was considered statistically significant

HUS: High uterosacral ligament suspension, SSLF: Sacrospinous ligament fixation, PPIQ: Pelvic Pain Impact Questionnaire, PFDI: Pelvic Floor Disability Index

Table 4. Multivariable linear regression analysis of factors associated with PPIQ and PFDI-20 scores at 24 months

Variables	β (B)	95% CI	p-value
PPIQ model			
Surgery (HUS vs. SSLF)	-1.33	-2.70 to 0.05	0.059
PPIQ baseline	-0.07	-0.20 to 0.06	0.273
Age	0.07	0.003 to 0.137	0.041
Parity	0.10	-0.32 to 0.51	0.637
PFDI model			
Surgery (HUS vs. SSLF)	-4.37	-7.86 to -0.89	0.015
PFDI baseline	0.22	-0.08 to 0.53	0.146
Age	0.17	-0.004 to 0.34	0.055
Parity	-0.73	-1.78 to 0.32	0.166

β: Unstandardized regression coefficient, negative β-values indicate lower (better) questionnaire scores
CI: Confidence interval, HUS: High uterosacral ligament suspension, SSLF: Sacrospinous ligament fixation, PPIQ: Pelvic Pain Impact Questionnaire, PFDI: Pelvic Floor Disability Index

corresponding PPIQ association did not reach conventional statistical significance. These findings may indicate an advantage of HUS, but the study does not provide sufficient evidence to establish its superiority.

These findings are consistent with previous studies and meta-analyses reporting similar efficacy and safety profiles between HUS and SSLF[14-16]. Our results extend the existing literature by incorporating 24-month follow-up data and validated patient-reported outcome measures, which are less frequently emphasized in comparative studies.

Pain-related scores were somewhat higher among patients undergoing SSLF. Differences in the extent of dissection, or in the site or method of fixation, could contribute to this observation, although the present study was not designed to test these mechanisms. Accordingly, this finding should be regarded as exploratory.

In 2021, the American College of Surgeons National Surgical Quality Improvement Program database was searched. Vaginal approaches were associated with higher rates of postoperative blood transfusions, urinary tract infections, and overall complications. Minimally invasive sacrocolpopexy required longer operative times. However, colpopexy was found to be more successful in terms of readmission and reoperation[17]. In our study, one patient in each group experienced a recurrence of apical prolapse at the end of the second year. In the SSLF group, the recurrence was associated with failure of the polypropylene fixation suture at reoperation. Although the difference was not statistically significant, anterior compartment prolapse and cystocele recurrence were observed more frequently in patients in the SSLF group. This finding was also consistent with reports in the literature on this surgical technique. This finding is consistent with previous reports suggesting that, although SSLF provides adequate apical support, recurrence in the anterior compartment may occur more frequently. Song et al.[18] showed that extraperitoneal HUS and SSLF techniques improved POP-Q scores and urgency symptoms after surgery. They also described the HUS technique as easier, shorter, and associated with fewer perioperative and postoperative complications. They stated that apical suspension could be preferred if the prolapse was not severe. McDonald et al.[19] also compared laparoscopic uterosacral ligament suspension and vaginal SSLF techniques. According to this study, the difference at point C was not significant after 24 months. The reoperation rates for apical recurrence were also similar between the groups. We also obtained similar data after 2 years of follow-up in our study, and we emphasize that these similarities and differences are closely related to surgical technique and surgeon experience.

Taken together, the findings support both HUS and SSLF as effective vaginal apical suspension procedures, with meaningful anatomic and patient-reported improvements. The present analysis provides a two-year follow-up, which is longer than that of many published reports focusing on 12 months. The inclusion of validated PPIQ and PFDI-20 instruments also provides a patient-centered assessment of postoperative outcomes. The adjusted analysis showed an association between HUS and lower PFDI-20 scores; this observation requires confirmation in adequately powered prospective cohorts. The estimates generally favored HUS, but the PPIQ result was not statistically significant. The practical importance of the observed score differences, therefore, remains uncertain.

The clinical relevance of the observed differences should also be considered. A large prospective study of women undergoing POP surgery reported a minimal important difference of approximately 24 points for the standardized PFDI-20 score. However, because the present study used the raw PFDI-20 scoring system, direct comparison with this MID is not appropriate. Although the adjusted PFDI-20 difference reached statistical significance, its clinical importance remains uncertain. No established minimal clinically important difference has been reported for the PPIQ in the context of POP surgery; therefore, the clinical significance of the observed PPIQ difference cannot be reliably determined[13,20].

Study Limitations

The principal limitation is the small cohort size, which is typical of a single-center retrospective surgical series. An a priori sample size calculation was not performed because the study used cases available retrospectively. The limited number of participants also reduces the ability to detect differences in uncommon events, particularly recurrence and surgical complications. The relatively long, 24-month follow-up and the use of validated patient-reported instruments are important strengths. The retrospective nature of the study is an additional limitation. Because several questionnaire subdomains were examined without multiplicity adjustment, these secondary comparisons should be interpreted as exploratory. Unmeasured or incompletely recorded prognostic factors may also have contributed to residual confounding. Nonetheless, the use of validated outcome measures and longer follow-up strengthen the reliability of our results. Confirmation in larger, preferably multicenter, prospective studies is warranted. The involvement of two surgeons introduces the possibility of operator-related variation. Both surgeons, however, were experienced in pelvic reconstructive surgery and used standardized operative principles. To limit overfitting in this small cohort, the regression models were restricted to a parsimonious set of clinically relevant covariates. Some degree of overfitting may nevertheless remain; therefore, the adjusted analyses should be viewed as exploratory and hypothesis-generating rather than definitive.

Conclusion

At two years' follow-up, both HUS and SSLF yielded satisfactory anatomic correction and patient-reported outcomes. After adjustment, HUS was associated with lower PFDI-20 scores, while the difference in PPIQ remained not statistically significant. Because of the retrospective design, limited sample size, and possible selection bias, these results should be interpreted as exploratory comparative evidence rather than proof that one technique is superior. Further prospective multicenter studies with larger cohorts are needed for confirmation.

Ethics

Ethics Committee Approval: This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Clinical Research Ethics Committee of University of Health Sciences Türkiye, Bursa Yüksek İhtisas Training and Research Hospital (approval number: 2011-KAEK-25 2022/11-09, date: 30.11.2022).

Informed Consent: Informed consent was obtained from all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Ö.K., S.S.K., S.S., Concept: Ö.K., Design: S.S.K., Data Collection or Processing: Ö.K., S.A., Analysis or Interpretation: S.S.K., Literature Search: S.S., Writing: Ö.K., S.S.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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