International Journal of Women's Health

Dovepress
Taylor & Francis Group

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ORIGINAL RESEARCH

Mid-Term Outcomes of Posterior Pelvic Reconstruction Combined with Lateral Abdominal Wall Suspension versus Sacrocolpopexy for Advanced Pelvic Organ Prolapse: A Retrospective Comparative Study

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Purpose: To compare mid-term efficacy, safety, and functional outcomes of laparoscopic sacrocolpopexy (LSC) versus laparoscopic lateral abdominal wall suspension (LAWS), both combined with standardized posterior repair, for advanced multi-compartment pelvic organ prolapse (POP).

Patients and Methods: Retrospective analysis of 132 patients with POP-Q stage ≥III apical defects and concomitant anterior/posterior prolapse (2019–2021). Seventy underwent LSC + posterior repair (control), 62 underwent LAWS + posterior repair (observation). Perioperative outcomes, anatomical restoration (POP-Q), patient-reported outcomes (PFDI-20, PFIQ-7, PISQ-12), and 3-year complications were compared.

Results: LAWS showed shorter operative time (136.08±17.48 vs 174.81±27.36 min, $P<0.001$), less blood loss (27.92±12.91 vs 54.64 ±27.78 mL, $P<0.001$), and lower surgical failure rate (0% vs 4.3%, $P<0.05$). LSC failures included one conversion to laparotomy (presacral hemorrhage) and two conversions to LAWS (severe adhesions/anomalous promontory). Both groups achieved comparable anatomical restoration at 3 months and significant quality-of-life improvements at 6 months (all $P<0.05$). At 3 years, de novo stress urinary incontinence, apical recurrence, and mesh exposure did not differ between groups. Defecatory dysfunction was significantly lower with LAWS (3.2% vs 14.3%, $P<0.05$).

Conclusion: Both LSC and LAWS with posterior repair are effective for advanced POP. LAWS offers advantages in operative safety, recovery, and lower risk of defecatory dysfunction, positioning it as a viable alternative. Treatment choice should be individualized based on patient anatomy and surgeon expertise.

Keywords: pelvic organ prolapse, laparoscopic lateral suspension, laparoscopic sacrocolpopexy, pelvic floor reconstruction, treatment outcome, postoperative complications

Introduction

Pelvic organ prolapse (POP) is a prevalent condition that significantly impairs the quality of life in women, with its surgical management continually evolving. For the correction of apical support defects, laparoscopic sacrocolpopexy (LSC) has long been established as the gold standard procedure, supported by robust evidence of its durability.[1] However, LSC necessitates complex dissection within the presacral region, an area fraught with vascular and neurological hazards. This complexity translates into recognized risks of significant intraoperative hemorrhage, visceral injury, and postoperative defecatory dysfunction, which can limit its broader application.[2,3]

In search of safer and technically less demanding alternatives, laparoscopic lateral abdominal wall suspension (LAWS) has emerged as a promising option. This technique suspends the vaginal apex to the lateral abdominal wall,

https://doi.org/10.2147/IJWH.S594551
Received: 8 January 2026
Accepted: 16 May 2026
Published: 22 May 2026

thereby avoiding the hazardous presacral dissection. Recent international studies affirm that LAWS provides high anatomical success rates and patient satisfaction for anterior and apical prolapse.[4,5] A randomized controlled trial directly comparing LAWS with LSC demonstrated comparable short-term objective and subjective outcomes, reinforcing its viability as an alternative.[6] Furthermore, the technical standardization of LAWS is evolving, with descriptions highlighting its procedural consistency and manageable learning curve, which may facilitate its adoption.[7,8]

Nevertheless, a historical limitation of LAWS has been its suboptimal efficacy in addressing concomitant posterior compartment defects — a critical consideration given that advanced POP often involves multiple compartments.[9] Surgical principles emphasize the importance of comprehensive, multi-compartment repair for achieving optimal and lasting outcomes.[10,11] Therefore, combining an apical suspension procedure like LAWS with a concurrent posterior pelvic floor repair represents a logical strategy to address this limitation.[12] However, a direct comparative analysis of the mid-term outcomes between LSC and LAWS, both systematically combined with standardized posterior repair, remains inadequately documented. This retrospective study aimed to fill this gap by comparing the perioperative safety, anatomical efficacy, functional recovery, and mid-term complications of LSC and LAWS, each augmented with posterior repair, in patients with advanced multi-compartment POP.

Patients and Methods

Study Design and Population

A retrospective analysis was conducted on 132 patients with predominant apical prolapse (POP-Q stage III or above) combined with anterior and/or posterior compartment defects, who underwent surgical management at Northwest Women's and Children's Hospital between January 2019 and December 2021. Among them, 70 patients underwent laparoscopic sacrocolpopexy (LSC) combined with posterior repair (control group), and 62 patients underwent laparoscopic lateral abdominal wall suspension (LAWS) combined with posterior repair (observation group).

Inclusion criteria were: (1) primary apical defect (POP-Q stage III or above) with concomitant anterior and/or posterior compartment prolapse, scheduled for either LSC or LAWS; (2) completion of ≥3 years of postoperative follow-up. Exclusion criteria included: (1) comorbidities precluding surgical tolerance; (2) recurrent prolapse after prior repair; (3) acute pelvic/abdominal or abdominal wall infection or malignancy; (4) presence of abdominal wall hernia.

The study protocol was approved by the Ethics Committee of Northwest Women's and Children's Hospital (Approval No. 24–1231). Written informed consent was obtained from all participants. This study complies with the Declaration of Helsinki.

Surgical Procedures

All operations were performed by gynecologic surgeons with the title of associate chief physician or higher, each with ≥5 years of experience in pelvic floor reconstructive surgery.

Laparoscopic Sacrocolpopexy (Control Group)

After standard laparoscopic hysterectomy, the ureters were identified. The presacral space was exposed at the level of the sacral promontory, and the peritoneum was incised longitudinally toward the vaginal vault along the right side of the rectum. A synthetic polypropylene mesh (PM1015, 10×15 cm, Herniamesh®) was tailored into two strips (5×15 cm and 4×15 cm) and fixed to the anterior and posterior vaginal walls, respectively. The free ends of the mesh strips were sutured to the anterior longitudinal ligament of the sacrum using non-absorbable sutures under appropriate tension. The peritoneum was subsequently closed.

Laparoscopic Lateral Abdominal Wall Suspension (Observation Group)

Following hysterectomy, the vesicovaginal space was dissected to the level of the ureterovesical junction. A lightweight titanium-coated polypropylene mesh (Ti Loop® Total 4, pfm medical) was trimmed to match the anterior vaginal wall defect and secured to the vagina. Two suspension points were marked on the abdominal wall, located 4 cm superior and 3 cm lateral to the bilateral anterior superior iliac spines. Under laparoscopic guidance, curved forceps were passed through the abdominal wall, creating a retroperitoneal tunnel angled at approximately 45° to the round ligament, and

exiting at the peritoneal reflection. The lateral arms of the mesh were then pulled through the tunnels and secured at the abdominal wall suspension points.

Posterior Repair

This transvaginal procedure was performed in both groups. After hydrodissection of the rectovaginal space, a posterior vaginal wall flap was developed. The rectovaginal fascia was plicated vertically from the vaginal cuff apex toward the perineal body. The levator ani muscles were approximated in the midline with No. 4 silk sutures to narrow the genital hiatus, reconstruct the vaginal apex, and reduce the levator hiatus. The reconstructed vagina allowed passage of two fingers. The vaginal wall was closed with a continuous 1–0 absorbable suture, and perineorrhaphy was completed. Hemostasis was confirmed by digital rectal examination, and an iodinated gauze pack was placed.

Outcome Measures

Perioperative data included operative time, estimated blood loss, time to postoperative flatus, intraoperative pelvic adhesions, and surgical failure (defined as conversion to another procedure). Anatomic outcomes were assessed using the POP-Q system at 3 months postoperatively. Subjective outcomes were evaluated at 6 months using the Pelvic Floor Distress Inventory-20 (PFDI-20), Pelvic Floor Impact Questionnaire-7 (PFIQ-7), and Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12 (PISQ-12). Long-term complications within 3 years included *de novo* stress urinary incontinence (SUI), defecatory dysfunction, mesh exposure, and prolapse recurrence. Defecatory dysfunction was defined as a positive response to question 8 of the PFDI-20 ("Do you have to strain to have a bowel movement?") combined with a standardized clinical interview confirming symptoms occurring at least monthly. Follow-up was conducted via outpatient visits and telephone interviews.

Statistical Analysis

Data were analyzed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables with normal distribution are presented as mean ± standard deviation and were compared using Student's *t*-test or ANOVA. Categorical variables are expressed as n (%) and were compared using the Chi-square test or Fisher's exact test as appropriate. A post-hoc power calculation for the primary outcome (operative time) indicated >90% power (α=0.05, two-tailed) with the achieved sample size. A two-sided P-value <0.05 was considered statistically significant.

Results

Patient Characteristics and Perioperative Outcomes

A total of 132 patients were included in the final analysis. There were no significant differences between the LSC group (n=70) and the LAWS group (n=62) in baseline characteristics, including age, body mass index (BMI), and parity (all $P > 0.05$) (Table 1).

Perioperative outcomes are summarized in Table 1. The LSC group had a significantly longer operative time (174.81 ± 27.36 vs 136.08 ± 17.48 minutes, $P < 0.001$), higher estimated blood loss (54.64 ± 27.78 vs. 27.92 ± 12.91 mL, $P < 0.001$), and a longer time to postoperative flatus (41.51 ± 19.05 vs. 20.08 ± 7.51 hours, $P < 0.001$) compared to the LAWS group. The rate of surgical failure was significantly higher in the LSC group (4.29% vs. 0%, $P < 0.05$). Failures in the LSC group included one conversion to laparotomy due to presacral hemorrhage, and two conversions to LAWS due

Table 1 Comparison of Baseline Characteristics and Perioperative Outcomes

Group	n	Age (years)	BMI (kg/m^2)	Parity	Time to Flatus (h)	Operative Time (min)	Blood Loss (mL)
LSC Group	70	57.10 ± 5.75	25.12 ± 1.50	1.70 ± 0.60	41.51 ± 19.05	174.81 ± 27.36	54.64 ± 27.78
LAWS Group	62	56.52 ± 4.38	24.97 ± 1.49	1.56 ± 0.53	20.08 ± 7.51	136.08 ± 17.48	27.92 ± 12.91
F-value		0.422	0.309	1.871	68.917	91.219	18.198
P-value		0.517	0.579	0.174	**<0.001**	**<0.001**	**<0.001**

Note: *P*-values < 0.05 are considered statistically significant and are presented in bold.

https://doi.org/10.2147/IJWH.S594551

to severe pelvic adhesions and an abnormally prominent sacral promontory precluding safe dissection, respectively. No significant intergroup difference was observed in the incidence of intraoperative pelvic adhesions ($P > 0.05$).

The distribution of prolapse severity (POP-Q stages) across compartments was comparable between the two groups preoperatively (all $P > 0.05$) (Table 2). Although the number of patients with stage II posterior prolapse was slightly lower in the LAWS group (53 [85.5%] vs. 64 [91.4%]), the difference was not statistically significant (P=0.283).

Anatomic Outcomes

Preoperative POP-Q measurements did not differ significantly between the two groups (all $P > 0.05$) (Table 3). At the 3-month follow-up, all POP-Q points (Aa, Ba, C, Ap, Bp, TVL, gh, pb) showed significant improvement from

Table 2 Comparison of Preoperative Prolapse Distribution and Postoperative Complications [n (%)]

Variable	LSC Group (n=70)	LAWS Group (n=62)	χ^2-value	*P*-value
Preoperative Prolapse, n (%)				
Anterior Compartment				
Stage II	32 (45.7)	30 (48.4)	0.094	0.759
Stage III	38 (54.3)	32 (51.6)		
Apical Compartment				
Stage III	65 (92.9)	58 (93.5)	0.025	0.875
Stage IV	5 (7.1)	4 (6.5)		
Posterior Compartment				
Stage II	64 (91.4)	53 (85.5)	1.154	0.283
Stage III	6 (8.6)	9 (14.5)		
Intraoperative Findings, n (%)				
Pelvic Adhesions	5 (7.1)	7 (11.3)	0.684	0.408
Surgical Failure, n (%)	3 (4.3)	0 (0.0)	3.868	**0.049**
Postoperative Complications (3-Year), n (%)				
Defecatory Dysfunction	10 (14.3)	2 (3.2)	4.866	**0.027**
De novo SUI	4 (5.7)	2 (3.2)	0.469	0.493
Mesh Exposure	4 (5.7)	3 (4.8)	0.050	0.823
Prolapse Recurrence	5 (7.1)	4 (6.5)	0.025	0.875

Note: *P*-values < 0.05 are considered statistically significant and are presented in bold.
Abbreviation: SUI, stress urinary incontinence.

Table 3 Comparison of POP-Q Measurements Before and After Surgery

POP-Q Point	Preoperative		F-value	P-value
	LSC	LAWS		
Aa	1.24 ± 0.57	1.42 ± 0.78	2.22	0.139
Ba	1.86 ± 1.23	1.81 ± 1.29	0.053	0.818
C	3.61 ± 1.05	3.42 ± 1.01	1.18	0.279
Ap	0.16 ± 0.50	0.31 ± 0.78	1.75	0.188
Bp	0.20 ± 0.65	0.37 ± 0.93	1.53	0.218
TVL	7.86 ± 0.55	7.74 ± 0.68	1.171	0.281
gh	6.00 ± 0.98	6.13 ± 0.80	0.678	0.412
pb	2.44 ± 0.61	2.56 ± 0.70	1.273	0.261

(*Continued*)

Table 3 (Continued).

POP-Q Point	Preoperative		F-value	P-value
	LSC	LAWS		
	3 Months Postop			
Aa	−2.81 ± 0.39*	−2.79 ± 0.40*	0.118	0.732
Ba	−2.66 ± 0.48*	−2.73 ± 0.45*	0.717	0.399
C	−6.97 ± 1.02*	−6.82 ± 0.97*	0.734	0.393
Ap	−2.77 ± 0.42*	−2.73 ± 0.45*	0.360	0.549
Bp	−2.61 ± 0.49*	−2.68 ± 0.47*	0.565	0.453
TVL	7.10 ± 0.66*	6.97 ± 0.65*	1.33	0.251
gh	4.00 ± 0.57*	3.98 ± 0.55*	0.027	0.869
pb	2.03 ± 0.45*	3.15 ± 0.62*	1.544	0.216

Notes: Data are presented as mean ± SD. Asterisk (*) indicates $P < 0.05$ compared with preoperative value within the same group.
Abbreviations: TVL, total vaginal length; gh, genital hiatus; pb, perineal body.

preoperative values within each group (all $P < 0.05$). Satisfactory anatomical restoration was achieved in both groups, with no significant differences in any POP-Q point between the groups at 3 months postoperatively (all $P > 0.05$).

Patient-Reported Outcomes

Both groups demonstrated significant improvement in symptom distress, quality of life impact, and sexual function at 6 months postoperatively. The PFDI-20 and PFIQ-7 scores decreased significantly, while the PISQ-12 scores increased significantly compared to preoperative baselines in both groups (all $P < 0.05$). The magnitude of PISQ-12 improvement was large (mean increase of ~22 points), which may reflect a floor effect due to severe preoperative sexual dysfunction secondary to prolapse. There were no statistically significant differences in the 6-month PFDI-20, PFIQ-7, or PISQ-12 scores between the two groups (all $P > 0.05$) (Table 4).

Mid-Term Complications (3-Year Follow-Up)

The incidences of *de novo* stress urinary incontinence, apical prolapse recurrence, and mesh exposure during the 3-year follow-up period were not significantly different between the LSC and LAWS groups (all $P > 0.05$) (Table 2). However, the incidence of defecatory dysfunction was significantly higher in the LSC group (14.29% vs. 3.23%, $P < 0.05$).

Table 4 Comparison of Quality of Life Scores Before and After Surgery

Scale	Time Point	LSC Group (n=70)	LAWS Group (n=62)	*P*-value (Intergroup)
PFDI-20	Preoperative	63.64 ± 10.89	64.97 ± 10.53	0.480
	6 Months Postop*	7.49 ± 2.58	6.90 ± 2.79	0.216
PFIQ-7	Preoperative	51.97 ± 12.17	52.40 ± 14.66	0.854
	6 Months Postop*	8.46 ± 2.32	8.29 ± 2.20	0.674
PISQ-12	Preoperative	17.86 ± 3.36	18.77 ± 2.37	0.136
	6 Months Postop*	39.99 ± 4.53	38.60 ± 4.56	0.091

Notes: Data are presented as mean ± SD. *Indicates a significant improvement from the preoperative value within the same group ($P < 0.05$).
Abbreviations: PFDI-20, Pelvic Floor Distress Inventory-20; PFIQ-7, Pelvic Floor Impact Questionnaire-7; PISQ-12, Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire-12.

Discussion

This comparative study demonstrates that both LSC and LAWS, when integrated with a standardized posterior repair, provide effective and comparable mid-term anatomical and functional outcomes for women with advanced POP. The satisfactory restoration of apical support and significant improvement in quality-of-life metrics at the 3-year follow-up underscore that either approach, as part of a holistic repair strategy, achieves the primary goals of POP surgery. Our finding of comparable anatomical success aligns with the growing body of international evidence. Crucially, the first randomized controlled trial comparing LAWS with LSC found no significant difference in objective or subjective cure rates at one year, providing high-level evidence for their comparable efficacy.[6] A more recent retrospective cohort study further supports this, showing no significant differences in anatomical or patient-reported outcomes among LAWS, LSC, and transvaginal mesh approaches after adjustment for confounders.[13]

Despite comparable effectiveness, our findings reveal a distinct and favourable perioperative profile for the LAWS procedure. The significantly shorter operative time, reduced intraoperative blood loss, and lower rate of surgical failure are clinically meaningful advantages. These benefits are logically attributable to the avoidance of the technically demanding presacral dissection required in LSC. Dissection in this area is associated with recognized risks of vascular and visceral injury.[3,14] This safety advantage is corroborated by other studies reporting fewer vascular complications with LAWS.[15] Moreover, the relatively shorter learning curve associated with LAWS, as highlighted in comparative studies and technical reviews, may enhance its accessibility and reproducibility across different surgical settings.[7,8]

A key functional differentiator was the significantly higher incidence of postoperative defecatory dysfunction in the LSC group (14.3% vs. 3.2%). While presacral dissection may contribute to autonomic nerve disturbance, the presence of a posterior mesh strip in LSC is likely the major cause, as it can tether the rectum and induce dyssynergic defecation.[16] In contrast, LAWS avoids any mesh on the posterior vaginal wall, which probably accounts for the lower rate of defecatory dysfunction. Our results are consistent with a large retrospective cohort study that reported worse bowel-related symptom scores in patients undergoing LSC compared to a modified LAWS procedure.[17]

The addition of a standardized posterior repair in both groups of our study was intended to mitigate the traditional weakness of lateral suspension techniques in supporting the posterior compartment. Our results showing comparable posterior compartment restoration and low recurrence rates suggest this strategy was successful. Thus, our study provides direct evidence that a standardized posterior reconstruction effectively neutralizes the historical limitation of LAWS in the posterior compartment, yielding outcomes equivalent to LSC. This concept is critical, as studies have shown that without concomitant posterior support, LAWS techniques are associated with a high rate of *de novo* posterior compartment prolapse.[9] The study by Xiong et al, where LAWS combined with uterosacral ligament folding achieved posterior compartment success rates equivalent to LSC, further supports this integrated approach.[17]

Regarding mesh-related safety, our mid-term findings are reassuring for both techniques, with low and comparable rates of mesh exposure. This aligns with data from a standardized LAWS cohort, which reported a 0% mesh exposure rate,[15] and the RCT by İşenlik et al[6] Furthermore, the LAWS technique eliminates the risk of rare but serious complications such as sacral discitis or life-threatening presacral hemorrhage,[2,18] potentially offering a superior safety profile in this regard.

We acknowledge a potential limitation regarding the imbalance in stage II posterior prolapse between groups (64 in LSC vs. 53 in LAWS). Although the overall distribution was not statistically different (P=0.283), and all patients received the same standardized posterior repair, this imbalance could theoretically favor LAWS. However, the equivalent posterior anatomical outcomes (POP-Q points Ap, Bp) and low recurrence rates argue against any meaningful bias.

Recent advances in preoperative planning using three-dimensional (3D) reconstruction of pelvic floor anatomy may further improve surgical precision and patient selection.[19] Such technologies could help individualize the choice between LSC and LAWS, particularly in complex cases with distorted anatomy.

Several limitations of our study warrant acknowledgment. Its retrospective, non-randomized design inherently carries risks of selection and information bias. The sample size may be underpowered for evaluating rarer long-term complications. All procedures were performed by experienced surgeons at a single tertiary centre, which may affect generalizability. Finally, a 3-year follow-up is insufficient to evaluate very long-term outcomes such as late mesh complications

or recurrence beyond five years. Future prospective, randomised multicentre trials with longer follow-up are warranted to confirm these findings.

Conclusion

In conclusion, this study demonstrates that both LSC and LAWS, when combined with a standardized posterior repair, are effective surgical strategies for the treatment of advanced multi-compartment POP, providing comparable mid-term anatomical restoration and significant improvement in patient-reported quality of life. However, the LAWS approach offers distinct clinical advantages, including superior perioperative safety characterized by shorter operative time, reduced blood loss, and a lower surgical failure rate. A particularly notable finding is the significantly lower incidence of postoperative defecatory dysfunction associated with LAWS, attributable to the absence of posterior mesh and avoidance of presacral dissection. These benefits, coupled with a relatively shorter learning curve and its particular suitability for uterine preservation, position LAWS combined with posterior repair as a compelling and potentially preferable surgical alternative to LSC for many patients. The final surgical decision should be individualized, incorporating patient-specific anatomy, symptom profile, desire for uterine preservation, and surgeon expertise.

Research Strengths and Limitations

Strengths

The strengths of this study are severalfold. First, it provides a direct comparative analysis of mid-term outcomes for two contemporary laparoscopic apical suspension techniques (LSC and LAWS) in the management of advanced POP, addressing a relevant gap in the literature where both procedures are systematically augmented with posterior repair. This design specifically targets the historical limitation of LAWS regarding posterior compartment support. Second, all surgical procedures were performed with a concurrent, standardized posterior repair by experienced surgeons, which is crucial for ensuring comprehensive repair in multi-compartment prolapse and enhances the internal validity of the anatomical comparisons. Third, the study employed a comprehensive outcome assessment, integrating objective anatomical evaluation using the POP-Q system, validated patient-reported outcome measures (PFDI-20, PFIQ-7, PISQ-12), and detailed documentation of perioperative and mid-term complications. Fourth, the follow-up period of 3 years provides valuable data beyond the typical short-term reports, offering insights into the durability of the repair and the incidence of delayed complications such as mesh exposure and recurrence.

Limitations

This study has limitations that must be considered when interpreting the results. First, its retrospective, non-randomized design introduces the potential for selection bias and limits the strength of causal inferences that can be drawn. Despite statistical adjustments, unmeasured confounding factors may persist. Second, while the sample size was adequate to detect significant differences in several primary outcomes, it may be underpowered to evaluate rarer complications or sub-group analyses. Third, the study was conducted at a single tertiary care center, and all surgeries were performed by experienced pelvic floor surgeons. This may affect the generalizability of the operative times, technical outcomes, and complication rates to broader clinical settings or less experienced practitioners. Fourth, although informative for a mid-term assessment, the 3-year follow-up duration is insufficient to evaluate very long-term outcomes, such as late mesh-related complications, prolapse recurrence beyond five years, or the long-term fate of the posterior native tissue repair. Finally, the study did not include a formal cost-effectiveness analysis, which limits the evaluation of the economic implications of choosing one procedure over the other in different healthcare settings. Future prospective, randomized, multicenter trials with longer follow-up and economic evaluations are warranted to confirm these findings and further define the optimal role of each technique.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

All authors report no conflicts of interest in this work.

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