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The First Cohort-Based Comparative Study of Three Minimally Invasive Apical Prolapse Surgeries: Sacropexy, Pectopexy, and Lateral Suspension

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Abstract

Background: Laparoscopic sacropexy (SP) is widely recognized as the gold standard for addressing apical pelvic organ prolapse. Nonetheless, alternative laparoscopic procedures, such as pectopexy (PP) and Dubuisson's laparoscopic lateral suspension (LLS), have gained traction due to their relative technical simplicity. **Objective**: This study aims to assess both the preoperative characteristics and surgical outcomes in a Cohort-Based Comparative Study of Three Minimally Invasive Apical Prolapse Surgeries. **Methods**: We conducted a prospective, single-center study involving patients treated laparoscopically for apical prolapse. The surgical approaches compared include: Sacropexy (SP); Laparoscopic lateral suspension following Dubuisson's technique (LLS) and Pectopexy (PP). **Results**: A total of 180 patients underwent surgery: 115 with SP, 33 with LLS, and 32 with PP. While some differences were observed in patient profiles—such as a higher average BMI and more advanced prolapse stages (III and IV) in the SP group, the rates of surgical failure (evaluated through apical recurrence, need for reintervention, pessary use, and persistent symptoms) did not differ significantly between groups. In terms of anatomical outcomes, only the total vaginal length (TVL) was notably longer in the SP group. A significant finding was the substantially reduced operative time with the alternative methods, particularly LLS, which took less than half the duration required for SP, without any increase in intraoperative complication rates**. Conclusion**: Further research, particularly well-designed randomized multicenter trials, is essential to establish the relative efficacy of the alternative approaches (LLS and PP) compared with the current gold standard, sacropexy

Keywords: laparoscopic; lateral suspension; pectopexy; sacropexy; apical pelvic organ prolapse

1. Introduction

Apical pelvic organ prolapse (POP) represents a significant challenge in urogynecologic surgery. It is estimated that over 24% of adult women present with symptoms related to pelvic floor dysfunctions [1]. Various laparoscopic techniques developed to restore pelvic anatomy and function.[1]. Laparoscopic sacropexy (SP) involves anchoring the uterus, cervix, or vaginal vault to the anterior longitudinal ligament of the sacrum using synthetic mesh, which rein-forces both the anterior and posterior vaginal wall. SP remains the gold standard for apical prolapse repair due to its high anatomical success rates and long-term durability. However, its technical complexity and potential complications—such as presacral hemorrhage and defecatory dysfunction—have led to the development of alternative techniques [2].

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Laparoscopic pectopexy (PP), introduced as a safer alternative, anchors the mesh to the iliopectineal (Cooper's) ligaments, avoiding the presacral space.[3] A 2023 randomized controlled trial found that PP significantly reduced mesh fixation time (45.0 ± 11.3 min vs. 54.7 ± 9.3 min, p = 0.019) and showed comparable improvements in quality of life and sexual function scores (P-QOL, PISQ-12) to SP[4] [5].

Laparoscopic lateral suspension (LLS), particularly the Dubuisson technique, offers a mesh-based suspension to the lateral abdominal wall. The mesh is attached to the uterus or vaginal apex, and its lateral arms are routed extraperitoneally beneath the peritoneum without anchoring them to fixed anatomical structures. This technique allows to reduce operative risks while maintaining effective apical support avoiding deep pelvic dissection.[6] Both, LLS and PP were associated with shorter operative times and fewer complications, particularly in patients with higher surgical risk .[4,7]

Despite these promising findings, direct comparative data remain limited. There are relatively few prospective, comparative, and randomized clinical trials evaluating surgical outcomesHaga clic o pulse aquí para escribir texto.. Additionally, anatomical correction does not always correlate well with functional improvement. Despite the fact that functional outcomes are the most relevant to patients' quality of life, they remain underassessed in many studies.

This study aims to evaluate the perioperative outcomes, anatomical success, and patient-reported satisfaction among SP, PP, and LLS in the surgical management of apical POP.

2. Materials and Methods

This is a single-center prospective study of patients undergoing laparoscopic repair of apical prolapse. The 3 techniques that we currently offer in our service have been compared: -Group of Sacropexy (SP), Group of Dubuisson laparoscopic lateral suspension (LLS) and group of Pectopexy (PP).

The inclusion criteria were patients with primary or recurrent symptomatic prolapse in stage > II according to the POP-Q. We excluded women with cervical elongation (defined as POP-Q Point C minus Point D ≥4). It was possible to perform hysteropexy, cervicopexy or colpopexy in all groups. The exclusion criteria for hysteropexy (in these cases we perform supracervical hysterectomy) were contraindications for uterine preservation: uterine pathology, risk of ovarian/tubal cancer (BRCA 1 and 2), or endometrium, treatment with tamoxifen, and inability to follow a gynecologic cancer prevention program.

Other exclusion criteria were: history of abdominal prolapse reconstructive surgery, history of prolapse reconstructive surgery with vaginal mesh, Stage I according to the POP-Q classification, asymptomatic prolapse, medical contraindication for general anesthesia and patient preference for treatment vaginal surgery.

The primary outcome was treatment failure, which is defined as the existence of any of the following 3 elements:

(1) new treatment for prolapse (pessary placement or surgery)

(2) anatomical outcomes, defined as recurrence of apical prolapse (stages II-and any non-static POP-Q measurement greater than 0

(3) symptoms, measured using the validated PFDI-20 questionnaires

(specifically, the question: "Do you notice a sensation of lump in your genitals?", including the analysis of the questionnaires (POPDI-6, CRAD-8 and UDI-6) and PISQ-12.

For the primary analysis, this outcome will be assessed cumulatively, so that once a participant meets any of the failure criteria, her outcome will be classified as treatment failure

The secondary objectives were to assess if there were differences in surgical times, complications, adverse events, individual anatomical measurements in the POP-Q examination, the presence, severity and impact of symptoms or discomfort derived from prolapse, urinary, intestinal and of pain, measured by validated scales: the PFDI-20 and PISQ-12

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The surgical techniques can be seen in Annexe 1.

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of CEIm Hospital Virgen de la Arrixaca (protocol code 2022-3-8-HCUVA and date of approval: 26 April 2022). (Annexe 2) Written informed consent was obtained from all subjects involved in the study.

A presurgery visit and 3 follow-up visits (1 month, 6 months and 1-year post-surgery) are planned. The stydy began in October 2020.

The collection of follow-up variables has been conducted by a specialist who does not know which surgical technique was performed for each patient to eliminate the possibility of bias in the assessment of post-surgical results.

3. Results

We have operated a total of 180 cases: 115 SP, 33 LLS and 32 PP. There were no significant differences in the mean age of the patients in the 3. There were differences in BMI (body mass index), the mean was 27.51 (±4.45) Kg/m2 for the PP, and 25.67 (±3.69) Kg/m2 for the SP group. On physical examination, both groups demonstrated comparable findings, although there were some differences in the baseline characteristics of the patients prior to surgery, such as anatomical differences since the highest rate of apical stages III and IV were also higher in the SP. No statistically significant differences were identified between the groups in parity, mode of delivery (vaginal or instrument-assisted), incidence of macroscopic fetuses, history of constipation, engagement in chronic physical exertion or sports, previous abdominal or vaginal hysterectomy, or prior vaginal surgeries. Additionally, analysis of symptom-specific scales revealed no significant group differences in the mean scores of POPDI-6, CRAD-8, UDI-6, and PISQ-12 (Table 1).

Table 1. Descriptive analysis of the laparoscopic surgery sample (n=180).

CHARACTERISTICS	SACROPEXY (N=115)	DUBUISSON (LLS) (N=33)	PECTOPEXY (N=32)	P-VALUE
Age (years), mean (SD)	54.77 (10.13)	57 (7.64)	57.41 (9.90)	0.148
BMI (kg/m²), mean (SD)	25.67 (3.69)	26.78 (3.42)	27.51 (4.45)	0.025
Multiparous, n (%)	100	94.3	100	0.014
Vaginal births, n (%)	99.13	94.29	100	0.356
Previous hysterectomy, n (%)	21.7	5.7	28.1	0.049
Apical or uterine prolapse stage ≥II				
Stage II (%)	26.5	59.4	58.1	
Stage III (%)	56.6	38.2	29.0	
Stage IV (%)	16.8	6.3	12.9	0.001
Anterior prolapse or cystocele ≥II				
Stage II (%)	26.9	11.8	10.0	
Stage III (%)	53.8	70.6	63.3	
Stage IV (%)	19.4	17.6	26.7	0.110
Posterior prolapse or rectocele ≥II				

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Stage II (%)	55.9	5.0	87.5	
Stage III (%)	32.4	-	12.5	
Stage IV (%)	11.8	-	-	0.205
Aa	1.89 (1.44)	1.77 (1.00)	1.71 (1.05)	0.315
Ba	2.40 (2.20)	2.40 (1.17)	2.40 (1.43)	0.942
C or D	2.55 (2.76)	0.650 (2.22)	1.13 (2.58)	0.003
Ap	-0.915 (1.66)	-2.21 (0.77)	-1.38 (2.49)	0.001
Bp	-0.74 (2.07)	-2.13 (1.33)	-1.72 (1.93)	0.002
gh	5.86 (1.64)	5.25 (1.60)	5.36 (1.18)	0.177
pb	2.82 (0.76)	2.98 (1.76)	3.23 (0.82)	0.021
TVL	7.61 (1.24)	7.25 (0.042)	6.92 (1.20)	0.058
Hiatal area	32.93 (8.76)	32.45 (7.97)	31.31 (7.07)	0.464
POPDI-6	13.79 (5.66)	13.50 (5.71)	12.44 (4.56)	0.691
CRAD-8	8.63 (5.87)	4.94 (4.73)	8.93 (6.06)	0.077
UDI-6	13.44 (6.11)	12.06 (6.72)	9.25 (5.82)	0.118
Constipation (%)	9.6	14.3	28.1	0.026
PISQ-12	27.00 (10.23)	30.80 (9.30)	29.09 (7.56)	0.522

BMI: Body mass index; LLS: Laparoscopic lateral suspension; SCL sacropexy; POP-Q: Pelvic organ prolapse quantification.

Regarding surgical results, the highest rate of supracervical hysterectomies were performed in the SP group (78.3%) and the lowest in the LLS (5,7%) (P=0.000). The surgical time was significantly longer in the SP [214.44 (±65.38) vs LLS 108.79 (±34.93) and PP 163.83 (±49.80) minutes p=0.000], although the surgical time used in subtotal hysterectomy in the 3 groups was not statistically different. We also did not find significant differences in the rate of intraoperative and major post-operative complications. Concerning pain on the first postoperative day assessed using the visual analogue scale, there were no significant differences between three groups (Table 2).

Although there were some differences in the baseline characteristics of the patients prior to surgery, such as a higher BMI for the SP group and anatomical differences since the highest rate of apical stages III and IV were also in the SP, it is interesting to consider the other 2 alternative techniques because there were no significant differences in the failure rate (measured by the apical recurrence rate, reintervention rate or use of pessaries and symptoms). (Table 2).

Regarding the POP-Q measures, we only found differences in the higher TVL in the SP. However, the much shorter surgical time in alternative techniques is notable (in LLS less than half time compared with time used for SP). After surgery, the symptom scales (POPDI-6, CRAD-8, UDI-6 and PISQ-12) had no significant differences between the three groups in the mean values. (Table 2).

Table 2. Surgical Outcomes.

Surgical Results	SACROPEXY	DUBUISSON (LLS)	PECTOPEXY	P-VALUE
Subtotal hysterectomy, n (%)	78.3	5.7	28.1	0.000
Operative time (min)	214.44 (65.38)	108.79 (34.93)	163.83 (49.80)	0.000

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Intraoperative complications	7	2.7	0	0.214
Pessary (%)	0.9	-	-	0.746
Surgical reintervention (%)	5.2	5.7	-	0.406
Any POP-Q ≥ 0 (%)	7.4	3.3	20	0.084
Apical prolapse recurrence ≥II				
Stage II (%)	-	-	0.9	
Stage III (%)	-	2.9	-	
Stage IV (%)	-	-	-	0.309
Anterior prolapse recurrence ≥II				
Stage II (%)	0.9	-	-	
Stage III (%)	1.7	-	-	
Stage IV (%)	-	-	-	0.363
Posterior prolapse recurrence ≥II				
Stage II (%)	1.7	17.1	6.3	
Stage III (%)	0.9	-	3.1	
Stage IV (%)	-	-	-	0.019
Aa (postsurgery)	-2.37 (1.01)	-2.20 (1.17)	-2.14 (1.18)	0.690
Ba (postsurgery)	-2.19 (1.18)	-2.43 (1.06)	-2.14 (1.32)	0.578
CoD(postsurgery)	-5.99 (2.25)	-5.58 (1.42)	-4.76 (3.13)	0.132
Ap (postsurgery)	-2.38 (1.07)	-2.48 (1.03)	-1.96 (1.29)	0.117
Bp (postsurgery)	-2.46 (1.04)	-2.48 (1.03)	-2.04 (1.39)	0.201
gh (postsurgery)	4.14 (1.10)	3.75 (1.12)	4.22 (1.29)	0.335
pb (postsurgery)	3.20 (0.72)	3.57 (0.98)	3.28 (0.81)	0.344
TVL(postsurgery)	8.81 (1.37)	7.93 (1.15)	7.74 (1.18)	0.000
POPDI-6	5.89 (4.87)	4.03 (3.62)	3.65 (4.13)	0.089
CRAD-8	7.60 (6.86)	4.17 (4.09)	5.05 (4.78)	0.081
UDI-6	7.40 (6.62)	5.59 (6.01)	5.40 (5.35)	0.357
Genital bulge sensation (%)	3.5	2.9	0	0.567
PISQ-12	31.13 (11.89)	31.48 (11.39)	31.90 (12.25)	0.987
Maximum follow-up time (months)	17.09 (13.92)	7.60 (5.75)	7.59 (8.73)	0.000

LLS: Laparoscopic lateral suspension; SCL sacropexy; POP-Q: Pelvic organ prolapse quantification.

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4. Discussion

To date, no studies have been identified in the medical literature that directly and simultaneously compare the three main minimally invasive techniques for apical prolapse repair—laparoscopic sacropexy, pectopexy, and laparoscopic lateral suspension (LLS)—within the same patient cohort. Available evidence is limited to pairwise comparisons between two of these techniques, and no clinical trial has yet evaluated all three in parallel.[4,5,7,9] Nevertheless, the existing evidence from randomized controlled trials, observational studies, systematic reviews, and meta-analyses supports the effectiveness of all three procedures in achieving high anatomical and subjective success rates, each with distinct surgical and functional profiles.

This comparative analysis of the three techniques provides relevant insights into the anatomical and functional outcomes of three abdominal approaches for apical prolapse repair.

Demographic and baseline characteristics of the patients were mostly homogeneous across groups, except for a higher BMI in the PP group and a greater prevalence of advanced apical prolapse stages (III–IV) in the SP group. These differences may reflect a selection bias, with SP reserved for more severe cases according with the data supporting in the literature about its superior long-term anatomical durability, lower recurrence rates, and reduced need for reoperation—especially in younger, sexually active women or those with recurrence risk factors (e.g., age <60, stage III–IV prolapse, BMI >26, shortened vaginal length, or prior failed repairs)[10]. However, in this study, these anatomical differences did not translate into significant disparities in subjective symptoms, as measured by validated scales (POPDI-6, CRAD-8, UDI-6, and PISQ-12), either before or after surgery.

Regarding surgical parameters in our study, SP was associated with significantly longer operative time compared to LLS and PP, despite similar durations for subtotal hysterectomies across groups. This finding supports previous literature highlighting the technical complexity and longer learning curve of sacropexy[11]. In contrast, LLS required less than half the operative time of SP, positioning it as an efficient alternative for apical support, especially in high-risk or elderly patients[12–14]. Pectopexy also demonstrated favorable operative times [4,5,9]and may be considered an intermediate option between SP and LLS.

Laparoscopic sacropexy is associated with a higher risk of presacral hemorrhage, nerve or bowel injury[13,15]. Pectopexy has emerged as a safe and effective alternative, particularly in patients with contraindications to sacral dissection (such as obesity, pelvic adhesions, vascular anomalies), or those at high risk for postoperative bowel dysfunction. By anchoring the vaginal apex to the iliopectineal ligaments and avoiding the sacral promontory, pectopexy offers shorter operative times, reduced blood loss, and a lower incidence of bowel dysfunction, without compromising anatomical outcomes. However, studies [4,5]have reported a higher rate of recurrent urinary symptoms postoperatively. Laparoscopic lateral suspension (LLS) is another effective option, especially for apical and anterior compartment prolapse. It offers benefits such as uterine preservation (although it is possible in sacropexy and pectopexy too), lower complication rates, and shorter surgical times, making it particularly suitable for obese patients or those with limited access to the sacral promontory.[12,16] .Regarding postoperative complications, all three techniques carry shared risks, including mesh-related complications (such as exposure or erosion), de novo stress urinary incontinence, and bowel dysfunction. Sacropexy has a higher association with postoperative bowel issues, while pectopexy appears more prone to persistent or recurrent urinary symptoms[4]. LLS shows a favorable safety profile, though the evidence base is less robust compared to sacropexy.[12] Nevertheless, no statistically significant differences were found in intraoperative or major postoperative complications in this study

Regarding efficacy, importantly, all three techniques yielded comparable rates of prolapse recurrence and reintervention, with no significant differences in the need for pessaries or further surgery. Although SP showed slightly better apical correction on POP-Q point C, this was not associated with better symptom control or quality-of-life scores. This finding has been reported previously by other investigators [4,5,7] An interesting finding was the significantly higher total vaginal length (TVL) achieved in the SP group. While a longer TVL may be considered an anatomical

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advantage, it did not correlate with improved patient-reported outcomes. The similar postoperative PISQ-12 scores across all groups suggest that sexual function was preserved regardless of the procedure. One notable difference was observed in posterior compartment recurrence, which was more frequent in the LLS group. This could be related to the lateral vector of suspension not adequately correcting posterior defects, a limitation previously described in the literature[12,13,16] because the efficacy of LLS may be reduced in cases of severe posterior compartment prolapse, and long-term data are less extensive than for sacropexy. In contrast, SP may provide better correction of multicompartment prolapse due to their more central fixation points. Pectopexy, although newer, demonstrated comparable outcomes to both LLS and SP in terms of apical support, operative safety, and functional recovery. However, its role in posterior compartment repair remains under investigation[5]

Therefore, the choice of surgical technique should be individualized based on patient-specific clinical and anatomical factors, including compartment involvement, desire for uterine preservation, baseline bowel or urinary function, surgical history, and patient preferences. Preoperative assessment tools—such as symptom questionnaires, urodynamic studies, and risk stratification protocols—are essential to reduce complications and optimize outcomes. In summary, although current studies suggest that all three techniques yield comparable short-term effectiveness and safety, there are important differences in perioperative characteristics, complication profiles, and ideal indications. The absence of studies directly comparing all three techniques within a single clinical trial highlights the need for future well-designed comparative research to establish evidence-based recommendations.

Our study's main strength lies in its multicenter, comparative design and relatively large sample size, especially for SP. We provided comprehensive analysis including POP-Q data, complications, recurrence, and validated symptom scales. However, limitations include variability in surgical indications, as well as the relatively shorter follow-up for LLS and PP, which may underestimate late recurrences

5. Conclusions

In conclusion, LLS and PP appear to be effective and less time-consuming alternatives to SP for apical prolapse repair, particularly in selected patients. SP remains a robust option for complex or multi-compartment prolapse, but its longer operative time and technical demands must be considered. Ongoing randomized studies with longer follow-up are needed to further define the indications and long-term outcomes of these evolving techniques.

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Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All the data used to support the findings of this study are included in the article.

Conflicts of Interest: The authors declare no conflicts of interest.

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Abbreviations

The following abbreviations are used in this manuscript:

POP	Pelvic organ prolapse
SCL	Sacropexy (Laparoscopic)
LLS	Laparoscopic Lateral Suspension
POPQ	Pelvic organ prolapse quantification
PFDI-20	Pelvic Floor Distress Inventory Questionnaire-Short Form 20
POPDI-6	Pelvic Organ Prolapse Distress Inventory
CRAD-8	Colorectal–Anal Distress Inventory
UDI-6	Urinary Distress Inventory
PISQ-12	Pelvic Organ prolapse/Urinary Incontinence Sexual Function Questionnaire
BMI	Body mass index

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