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Short-term outcomes of laparoscopic and vNOTES-assisted lateral suspension for anterior and apical pelvic organ prolapse

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ABSTRACT

Objective: Pelvic organ prolapse (POP) is a common condition affecting pelvic floor support. It often leads to significant difficulties in daily activities and reduces patients' quality of life. Different surgical methods, such as laparoscopic lateral suspension (LLS) and vaginal natural orifice transluminal endoscopic surgery (vNOTES)-assisted lateral suspension, have become increasingly popular. This study aimed to evaluate early anatomical outcomes, measure intraoperative performance, and monitor postoperative complications in patients undergoing laparoscopic or vNOTES-assisted lateral suspension for anterior and/or apical POP.

Materials and Methods: This retrospective study included 29 patients who underwent LLS for anterior and/or apical POP between January 2023 and May 2026. Demographic characteristics, prolapse stages, surgical data, perioperative outcomes, and follow-up findings were evaluated. The primary endpoint was defined as anatomical success. Factors influencing anatomical success were also analyzed.

Results: The mean age of the patients was 49.7±9.9 years, and the mean body mass index was 27.3±2.8 kg/m². 72.4% of patients underwent vNOTES-assisted lateral suspension, while 27.6% underwent conventional LLS. The mean operation time was 110.5±44.1 minutes. No intraoperative or major postoperative complications were observed. The mesh-related complication rate was 20.7%. At the last follow-up evaluation, anatomical success was achieved in 22 patients (75.9%). The recurrence rate was 17.2%, and the rate of re-operation was 24.1%. Preoperative POP-Q stage was significantly higher in patients who developed anatomical failure (p=0.010). Advanced prolapse (POP-Q ≥3) was associated with anatomical failure (p=0.035) and the need for re-operation (OR=10.5; p=0.035) (p=0.020).

Conclusion: Laparoscopic and vNOTES-assisted lateral suspension are feasible and safe methods for treating anterior and apical POP. Advanced prolapse and prolonged operation time appear to be risk factors for anatomical failure. Studies with larger sample sizes and longer follow-up periods are needed.

Keywords: Lateral suspension; vNOTES; apical prolapse; pelvic organ prolapse, mesh

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INTRODUCTION

Pelvic organ prolapse (POP) develops when weakening of the connective tissue and muscular support network permits downward displacement of one or more pelvic organs. Clinical manifestations commonly include a sensation of vaginal protrusion, pelvic heaviness, lower urinary tract symptoms, defecatory difficulties, and sexual dysfunction.[1] Epidemiological studies suggest that the lifetime risk of undergoing surgery for prolapse or urinary incontinence approaches 20%, highlighting the considerable healthcare burden associated with pelvic floor disorders.[2]

POP affects a significant number of women globally. The mechanism underlying POP development is not completely understood. However, it is believed to arise due to complex biological processes, age-related tissue alterations, obstetric trauma that are affected by hormonal influences as well as inherited susceptibility.[3] Furthermore, risk factors such as vaginal delivery, obesity and menopause which affect the levator ani muscle and support of the pelvic floor do exist. All these factors can lead to an increased risk of developing apical support defects, which are the most complex reconstructive strategies.[3,4]

The surgical options available for the correction of POP include conventional tecniques which are associated with substantially greater complications ratea than current minimally invasive alternative techniques. These surgical approaches rely on anatomical support that are achieved by direct tissue apposition and not by the use of implanted materials. In the laparoscopic route for POP repair, a mesh is either inserted through ports [as in abdominal sacrocolpopexy, that is the gold standart approach or fixed to ligaments within or outside the pelvis through incisions 8 as in laparoscopic lateral suspension (LLS)]. Both have been associated with various complications (e.g., urinary retention and incontinence, permanent loss of sensation, bladder injury, vaginal scarring, and failure to void), and therefore are not widely performed in routine practice. These issues are further compounded when a prior surgical history is present.[5] The optimal surgical approach will depend on a number of factors, including the quality of the pelvic floor dissection and mesh placement, expertise at a particular approach, and patient anatomy preference.

Abdominal and laparoscopic sacrocolpopexy have long been regarded as reference procedures for apical prolapse because of their favorable long-term anatomical outcomes.[6] Nevertheless, sacrocolpopexy requires dissection of the sacral promontory, which may increase operative complexity and carries risks of vascular, neurologic, and osteoarticular complications.[7] Furthermore, postoperative lumbosacral pain and rare but serious complications such as spondylodiscitis have been reported after promontory fixation.[8,9]

In response to these concerns, several techniques that eliminate the need for sacral promontory dissection have been introduced. LLS, first described by Dubuisson et al.,[10] provides support to the anterior and apical compartments through lateral mesh suspension and has emerged as an attractive minimally invasive alternative to sacrocolpopexy.[11,12] Several studies have reported anatomical success rates exceeding 80%, with low rates of severe perioperative complications and acceptable long-term outcomes.[13-15]

More recently, vaginal natural orifice transluminal endoscopic surgery (vNOTES) has expanded the possibilities of minimally invasive gynecologic surgery. By combining endoscopic visualization with transvaginal access, vNOTES eliminates abdominal incisions while potentially reducing postoperative pain and facilitating recovery.[16,17] Although initially introduced for benign gynecologic procedures, the application of vNOTES in pelvic floor reconstruction has gained increasing interest. Early studies suggest that vNOTES-assisted prolapse repair is technically feasible and may offer satisfactory anatomical outcomes.[17,18]

Despite growing enthusiasm for both laparoscopic and vNOTES-assisted lateral suspension, evidence remains limited, particularly regarding real-world outcomes and factors associated with surgical failure. Therefore, the aim of the present study was to evaluate short-term anatomical outcomes, perioperative results, and complication profiles in women undergoing laparoscopic or vNOTES-assisted lateral suspension for anterior and/or apical POP. Additionally, potential predictors of anatomical failure and reoperation were investigated.

MATERIALS AND METHODS

Study Design and Patient Selection

A retrospective observational cohort was assembled from patients who underwent laparoscopic or vNOTES-assisted lateral suspension for anterior and/or apical prolapse at Aksaray Training and Research Hospital between January 2023 and May 2026. Patients under the age of eighteen, those with incomplete medical records, those for whom postoperative follow-up data were unavailable, and those with a concomitant diagnosis of pelvic malignancy were excluded from the study. Patient-related variables including age, body mass index, parity, menopausal status, prior pelvic surgery, and prolapse characteristics were extracted from institutional electronic records. The preoperative prolapse stage of the patients was also obtained from the hospital information management system (HIMS). In our clinic, prolapse

grading of all patients is performed using the POP quantification (POP-Q) system. In the perioperative evaluation, operation time, concurrently performed surgical procedures, and intraoperative complications were recorded by examining the HIMS. In the postoperative evaluation, hospital stay duration, follow-up period, anatomical success rate, recurrence development, mesh-related complications, and the need for re-surgery were also recorded.

Ethics Committee Approval

This study was approved by the Ethics Committee of Aksaray University Faculty of Medicine (approval no: 2026/201, date: 18.06.2026). The study was conducted in accordance with the principles of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for informed consent was waived by the Ethics Committee.

Surgical Technique

Surgical procedures were carried out by a dedicated urogynecology team using standardized operative protocols. Twenty-one patients underwent vNOTES-assisted lateral suspension, whereas eight patients underwent conventional LLS. A sterile, non-absorbable polypropylene mesh was used in all patients. The mesh was tailored intraoperatively into strips approximately 1 cm in width according to the patient's pelvic anatomy. The anterior vaginal wall was dissected, and the mesh was secured to the anterior vaginal fascia using interrupted 0 polypropylene (Prolene®) sutures. The mesh arms were then advanced bilaterally through the retroperitoneal tunnel and fixed to the lateral abdominal wall under appropriate tension. Care was taken to avoid excessive tension during fixation, and peritoneal closure was completed after ensuring adequate hemostasis.

LLS Technique

All patients were operated on under general anesthesia in the dorsal lithotomy position. Abdominal access was established after carbon dioxide insufflation, and standard laparoscopic port placement was performed.

After evaluating the pelvic anatomy, vesicovaginal dissection was performed to expose the anterior vaginal wall. A polypropylene mesh of appropriate size was secured to the anterior vaginal wall with non-absorbable sutures. Both arms of the mesh were advanced retroperitoneally and directed to the bilateral abdominal lateral wall. Mesh arms were secured on both sides in the anterior superior iliac spine region to ensure appropriate tension. After mesh peritonization was completed, hemostasis was checked and the operation was terminated.

vNOTES Supported Lateral Suspension Technique

In cases where vNOTES was applied, the operation was performed via a vaginal approach. After posterior colpotomy, the vNOTES port system was placed and pneumoperitoneum was created.

Pelvic anatomy was evaluated under endoscopic imaging. After establishing a connection between the vaginal dome or cervical structure and the mesh, the mesh arms were directed to the bilateral pelvic lateral wall. After ensuring appropriate tension, the mesh was secured and the vaginal entrance was closed, terminating the procedure.

Simultaneous Surgeries

In some patients, total laparoscopic hysterectomy, bilateral salpingectomy, or other pelvic floor surgeries were performed simultaneously as required by clinical necessity.

The principal outcome measure was anatomical success at follow-up assessment. Successful anatomical correction was considered to be maintenance of POP-Q stage 0-1 without evidence of recurrent anterior or apical prolapse during follow-up. Secondary endpoints were defined as operation time, estimated blood loss, length of hospital stay, intraoperative and postoperative complications, mesh-related complications, recurrence rate, reoperation rate, and follow-up time.

Statistical Analysis

Data analysis was conducted using SPSS software (version 26.0; IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation or median (range), whereas categorical variables are presented as frequencies and percentages. Continuous variables were compared using the Mann-Whitney U test, and categorical variables were compared using Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 29 patients who underwent LLS due to anterior and/or apical POP during the study period were included in the analysis. The demographic and clinical characteristics of the patients are presented in Table 1.

The mean age of the patients was 49.7±9.9 years, and the mean body mass index was 27.3±2.8 kg/m^2. The median parity was 3 [interquartile range (IQR): 2-4]. Eleven patients (39.3%) were menopausal, and 10 (35.7%) had a history of previous pelvic surgery. Preoperative evaluation revealed anterior compartment prolapse in 21 patients (80.8%) and apical prolapse in 6 patients (20.7%). When the POP-Q stage distribution was examined, it was observed that 48.3% of the patients had advanced stage (stage

Table 1. Demographic and clinical characteristics of the patients (n=29)

Variable	Value
Age (years), mean ± SD	49.7±9.9
Body mass index (kg/m^2), mean ± SD	27.3±2.8
Parity, median (IQR)	3 (2-4)
Menopause, n (%) *	11 (39.3)
Previous pelvic surgery, n (%) *	10 (35.7)
Anterior prolapse, n (%)†	21 (80.8)
Apical prolapse, n (%)	6 (20.7)
Stage 1	4 (13.8)
Stage 2	11 (37.9)
Stage 3	12 (41.4)
Stage 4	2 (6.9)
vNOTES	21 (72.4)
Laparoscopy	8 (27.6)
Concomitant surgery, n (%)	19 (65.5)

SD: standard deviation; IQR: interquartile range; vNOTES: vaginal natural orifice transluminal endoscopic surgery; *: missing data in one patient (n=28); †: missing data in three patients (n=26)

Table 2. Perioperative and safety outcomes (n=29)

Outcome	Value
Operative time (min), mean ± SD	110.5±44.1
Operative time (min), median (range)	110 (30-185)
Length of hospital stay (days), median (IQR) *	2 (1-2)
Follow-up duration (months), median (IQR)	4 (3-5)
Intraoperative complications, n (%)	0 (0.0)
Postoperative complications, n (%)	0 (0.0)
Mesh-related complications, n (%)	6 (20.7)

SD: standard deviation; IQR: interquartile range; *: missing data in one patient (n=28)

≥3) prolapse. As a surgical approach, vNOTES was performed on 21 patients (72.4%), and conventional laparoscopy on 8 patients (27.6%). Additionally, simultaneous surgical intervention was performed on 19 patients (65.5%).

When perioperative outcomes were evaluated, the mean operation time was found to be 110.5±44.1 minutes (Table 2). The median hospital stay was 2 days (IQR: 1-2) and the median follow-up period was 4 months (IQR: 3-5). No intraoperative or major postoperative complications were observed. However, mesh-related complications developed in 6 patients (20.7%). Mesh-related complications were observed in six patients during follow-up. Four of these patients underwent reoperation because of symptomatic vaginal mesh exposure. Mesh excision was performed at postoperative 3, 6, 8, and 10 months, respectively. All patients recovered without major postoperative morbidity following mesh excision. In addition, three patients required reoperation because of recurrent POP. Reoperations for prolapse recurrence were performed at 1 year, 18 months, and 2 years after the initial surgery.

The primary endpoint of the study, anatomical success, was achieved in 22 patients (75.9%) at the last follow-up evaluation. During the follow-up period, recurrence occurred in five patients (17.2%). Three of these patients required repeat surgery because of recurrent POP, whereas the remaining two patients were managed conservatively. Overall, seven patients (24.1%) underwent further surgical intervention, including four patients who underwent mesh excision because of symptomatic vaginal mesh exposure and three patients who underwent repeat surgery because of recurrent prolapse.

When factors affecting anatomical success were examined, it was found that preoperative POP-Q stages were significantly higher in patients who developed anatomical failure (median 3 vs. 2; p=0.010) (Table 3). Similarly, advanced prolapse (POP-Q ≥3) was significantly associated with anatomical failure (85.7% vs.

Table 3. Comparison of patient characteristics and outcomes according to anatomical success

Variable	Anatomical success (+) (n=22)	Anatomical success (-) (n=7)	*p*-value
Age (years), median (range)	48.5 (37-69)	42.0 (40-66)	0.386
Body mass index (kg/m^2), median (range)	27.1 (23.0-32.8)	25.7 (24.2-32.8)	1.000
Parity, median (range)	3 (1-6)	3 (1-5)	0.714
Preoperative POP-Q stage, median (range)	2 (1-3)	3 (2-4)	0.010
Advanced prolapse (POP-Q ≥3), n (%)	8 (36.4)	6 (85.7)	0.035
Operative time (min), median (range)	97.5 (30-155)	180.0 (50-185)	0.020
Length of hospital stay (days), median (range)	2 (1-7)	1 (1-6)	0.497
Follow-up duration (months), median (range)	4 (3-9)	6 (3-12)	0.261

Continuous variables were analyzed using the Mann-Whitney U test, and categorical variables were analyzed using Fisher's exact test. POP-Q: pelvic organ prolapse quantification

36.4%; p=0.035). Operation time was also significantly longer in patients who developed anatomical failure (180 minutes vs. 97.5 minutes; p=0.020). In contrast, no significant relationship was found between age, body mass index, parity, length of hospital stay, and follow-up time and anatomical success (p>0.05 for all comparisons).

In additional analyses, it was observed that operation time was significantly longer in patients who developed mesh-related complications (180 minutes vs. 95 minutes; p<0.001). Furthermore, advanced prolapse was found to be significantly associated with the need for repeat surgery (odds ratio =10.5; p=0.035).

DISCUSSION

This analysis provides insight into the early clinical performance of laparoscopic and vNOTES-assisted lateral suspension in routine urogynecologic practice. Several noteworthy observations emerged from the current dataset. First, anatomical success was achieved in approximately three-quarters of patients. Second, no intraoperative or major postoperative complications were observed. Third, advanced preoperative prolapse stage emerged as the most important factor associated with anatomical failure and the need for reoperation.

The overall anatomical success rate of 75.9% observed in our cohort is somewhat lower than that reported in many previously published series. Dubuisson et al.[10] reported success rates exceeding 90% following LLS, while subsequent studies generally demonstrated anatomical success rates ranging between 80% and 95%.[13,19,20] Several factors may explain this difference. Nearly half of our cohort presented with advanced prolapse (POP-Q stage ≥3), a proportion higher than that reported in many surgical series. Moreover, our analysis reflects routine clinical practice rather than highly selected study populations, potentially providing a more realistic representation of contemporary outcomes.

One of the most important observations of our study was the association between advanced prolapse and unfavorable surgical outcomes. Patients with POP-Q stage ≥3 had significantly higher rates of anatomical failure and reoperation. This finding is consistent with previous evidence indicating that baseline prolapse severity is among the strongest predictors of recurrence following reconstructive pelvic floor surgery.[3,20] Advanced prolapse likely reflects more extensive connective tissue deterioration and pelvic floor dysfunction, which may compromise the long-term durability of surgical repair.

Recurrence occurred in 17.2% of patients. Although recurrence rates following lateral suspension vary considerably across studies because of differences in follow-up duration and outcome definitions, published rates generally range between 5% and 20%.[13,19] Therefore, our findings remain within the upper range of previously reported outcomes. Importantly, the relatively short follow-up period in our cohort may not fully capture delayed recurrences, emphasizing the need for longer-term evaluation. The relatively short follow-up duration may partly explain the observed recurrence and complication profile.

The overall reoperation rate of 24.1% deserves particular attention. At first glance, this rate appears higher than those reported in most contemporary prolapse series. However, detailed review demonstrated that not all repeat procedures were performed because of recurrent prolapse. A substantial proportion involved management of mesh-related complications.[15] Consequently, reoperation rates should be interpreted cautiously and not considered a direct surrogate for anatomical failure alone.

Another noteworthy finding was the association between prolonged operative time and both anatomical failure and mesh-related complications. Longer procedures may indicate technically demanding surgery, advanced disease, distorted pelvic anatomy, or the need for concomitant procedures. Although causality cannot be established within a retrospective design, operative duration may represent a useful surrogate marker for surgical complexity and deserves further investigation in larger cohorts.

Mesh-related complications occurred in 20.7% of patients. This rate is higher than that reported in several large LLS series.[15,19] The relatively small sample size likely contributed to this finding, as a limited number of events may substantially affect percentage-based estimates. Differences in complication definitions and reporting standards across studies may also hinder direct comparison. Nevertheless, these findings underscore the importance of careful mesh handling, meticulous surgical technique, and structured postoperative surveillance. Although the overall rate of mesh-related complications appeared relatively high in our cohort, all mesh-related reoperations were performed because of symptomatic vaginal mesh exposure, which represents one of the most frequently reported mesh-related adverse events after transvaginal or abdominal mesh surgery. Importantly, all affected patients were successfully managed by surgical mesh excision without severe morbidity. Likewise, prolapse recurrence requiring reoperation occurred in three patients during longer-term follow-up (1-2 years after surgery), suggesting that recurrence developed gradually rather than as an early technical failure. Considering the relatively small sample size of the present study, a limited number of adverse events may have resulted in a seemingly higher complication rate when expressed as percentages.

An additional strength of our study is the inclusion of patients undergoing vNOTES-assisted lateral suspension. Although vNOTES has rapidly gained popularity in gynecologic surgery, evidence regarding its application in prolapse repair remains relatively limited.[16-18] Because nearly three-quarters of patients in our cohort underwent the vNOTES-assisted approach, our findings provide further real-world evidence supporting the technical feasibility of this procedure. However, adequately powered comparative studies are still needed before definitive conclusions regarding comparative effectiveness can be drawn.

The absence of intraoperative and major postoperative complications observed in the present study supports the overall safety profile of lateral suspension. Avoidance of promontory dissection may reduce the risk of major vascular injury and presacral complications that are traditionally associated with sacrocolpopexy.[7,8] This advantage may be particularly relevant in patients with obesity, extensive adhesions, or challenging pelvic anatomy.

Study Limitations

Several limitations should be acknowledged. The retrospective design introduces the potential for selection bias and incomplete data collection. The relatively small sample size limits statistical power and restricts subgroup analyses. Furthermore, the single-center nature of the study may reduce generalizability. Finally, the short follow-up period precludes comprehensive assessment of long-term durability and delayed mesh-related complications.

CONCLUSION

In conclusion, laparoscopic and vNOTES-assisted lateral suspension appear to be feasible minimally invasive options for the treatment of anterior and apical POP. Although satisfactory short-term outcomes were achieved and major perioperative complications were not encountered, advanced prolapse stage was associated with increased risks of anatomical failure and reoperation. Larger prospective multicenter studies with longer follow-up are warranted to further clarify the long-term effectiveness and safety of these approaches.

ETHICS

Ethics Committee Approval: This study was approved by the Ethics Committee of Aksaray University Faculty of Medicine (approval no: 2026/201, date: 18.06.2026). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Due to the retrospective nature of the study, the requirement for informed consent was waived by the Ethics Committee.

FOOTNOTES

Contributions

Surgical and Medical Practices: M.B., R.B., Ş.Ö.G., Concept: M.B., R.B., Ş.Ö.G., Design: M.B., R.B., Ş.Ö.G., Data Collection or Processing: M.B., Analysis or Interpretation: M.B., Ş.Ö.G., Literature Search: M.B., Writing: M.B., Ş.Ö.G.

DISCLOSURES

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

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