

Research Article

Anatomical Outcomes and Pelvic Organ Prolapse Quantification Following Sacrospinous Ligament Fixation for Advanced Uterovaginal Prolapse: A Prospective Observational Study

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Abstract

Background

Restoration of apical vaginal support is essential to successful surgical management of advanced uterovaginal prolapse. Vaginal hysterectomy alone may be insufficient in preventing subsequent vaginal vault prolapse because of persistent weakness of the pelvic support structures. Sacrospinous ligament fixation (SSLF) is a means of apical suspension by anchoring the vaginal vault to the sacrospinous ligament and has been increasingly incorporated into vaginal reconstructive surgery. Prior studies have demonstrated good anatomic outcomes, but prospective data evaluating postoperative pelvic organ prolapse quantification (POP-Q) measurements and prolapse recurrence after prophylactic sacrospinous ligament fixation (SSLF) are limited. The present study aimed to evaluate the anatomical success of SSLF performed at the time of vaginal hysterectomy for advanced uterovaginal prolapse.

Objectives

To assess anatomical correction using the Pelvic Organ Prolapse Quantification (POP-Q) system after prophylactic sacrospinous ligament fixation and to define short-term recurrence patterns.

Study design

We conducted a prospective observational study on 30 women with Grade III uterovaginal prolapse or procidentia who underwent vaginal hysterectomy with unilateral sacrospinous ligament fixation from October 2024 to July 2025. POP-Q measurements were compared

preoperatively and postoperatively. Mean follow-up was 12 months (range, 6 to 18 months), and anatomical success, recurrence of pelvic organ prolapse, vaginal vault support, and postoperative follow-up findings were evaluated.

Results

All POP-Q parameters showed significant improvement after surgery. All patients underwent immediate surgical anatomic correction of the vaginal apex. During follow-up, one patient (3.3%) developed first-degree cystocele, one (3.3%) developed first-degree rectocele and one (3.3%) developed granulation tissue of the vaginal vault. No patient had recurrence of vaginal vault prolapse during the follow-up. Anatomical success was obtained in 90% of the patients.

Conclusion

Prophylactic sacrospinous ligament fixation at the time of vaginal hysterectomy resulted in excellent short-term anatomic correction with significant improvement in POP-Q measurements and a low rate of recurrence. The procedure resulted in successful restoration of apical vaginal support and prevention of recurrent vaginal vault prolapse at 1 year of follow-up.

Keywords: Pelvic organ prolapse; POP-Q; Sacrospinous ligament fixation; Vaginal vault prolapse; Vaginal hysterectomy; Pelvic floor reconstruction.

Introduction

Pelvic organ prolapse (POP) is a common disorder of the female pelvic floor resulting from

failure of the supporting muscles, fascia and ligamentous structures that maintain the normal anatomical position of the pelvic organs. Progressive deterioration of these support mechanisms leads to prolapse of the uterus and vaginal walls, with symptoms including vaginal bulge, pelvic pressure, urinary dysfunction, bowel complaints, and reduced quality of life. Advanced uterovaginal prolapse is the most severe form of pelvic support failure and is often treated by surgical correction with the goal of restoring anatomy and function.[1,2]

Successful prolapse surgery requires not only correction of the prolapsed uterus, but also restoration of durable apical vaginal support. The vaginal apex is the keystone of pelvic support and poor suspension after vaginal hysterectomy has been identified as a major risk factor for recurrence of pelvic organ prolapse especially prolapse of the vaginal vault.[3] Contemporary pelvic reconstructive surgery hence emphasizes apical support as an essential component of prolapse repair.

The sacrospinous ligament fixation (SSLF) is one of the most commonly performed transvaginal apical suspension surgeries. This method involves attaching the vaginal vault to the sacrospinous ligament to restore the normal vaginal axis and provide apical support without the need for abdominal surgery. Since the first description by Randall and Nichols, SSLF has become a well accepted procedure for the treatment of post-hysterectomy vaginal vault prolapse and more recently for prophylactic use at the time of vaginal hysterectomy in women with advanced uterovaginal prolapse.[4,5] Advantages of the procedure include preservation of vaginal length, no laparotomy, concurrent repair of associated compartment defects and good anatomical results.

Objective assessment of surgical success is a necessity in pelvic reconstructive surgery. The Pelvic Organ Prolapse Quantification system (POP-Q) is a standardized, reproducible system for evaluating pelvic organ support before and after surgery, jointly developed by the International Continence Society (ICS), the American Urogynecologic Society (AUGS) and the Society of Gynecologic Surgeons (SGS).[6] POP-Q measurements allow for accurate comparison of anatomical outcomes between

studies and aid in identifying recurrent prolapse in individual vaginal compartments.

Several studies have reported good clinical outcomes after sacrospinous ligament fixation, but few prospective studies have examined objective anatomic correction using POP-Q measurements in women who underwent prophylactic SSLF at the time of vaginal hysterectomy. Moreover, data on pattern of recurrence in Indian women is meager. Therefore the present study aimed to evaluate the postoperative anatomical outcome, improvement in POP-Q parameters, maintenance of apical support and recurrence of pelvic organ prolapse during one-year follow-up following prophylactic sacrospinous ligament fixation.

Materials and Methods

Study Design

OBJECTIVE: To assess the anatomical outcomes of prophylactic sacrospinous ligament fixation (SSLF) in women undergoing vaginal hysterectomy for advanced uterovaginal prolapse. **DESIGN:** Prospective observational study. Special attention was paid to the objective assessment of pelvic support using the Pelvic Organ Prolapse Quantification (POP-Q) system and to the detection of recurrent pelvic organ prolapse during the postoperative follow-up. The study was conducted in the **Department of Obstetrics & Gynecology, Vijayanagar Institute of Medical Sciences, Ballari and its attached teaching hospitals, Ballari, Karnataka, India from October 2023 to March 2025.**

Study Population

Thirty women with advanced uterovaginal prolapse were enrolled prospectively. All patients underwent vaginal hysterectomy with unilateral sacrospinous ligament fixation and appropriate pelvic floor reconstruction according to the associated compartmental defects. Follow up was done for a mean period of 12 months (range 6-18 months) to assess the anatomical correction and the recurrence.

Study Objectives:

Primary Objective

To assess anatomical restoration of pelvic support after prophylactic sacrospinous ligament fixation with the Pelvic Organ Prolapse Quantification (POP-Q) system.

Secondary Objectives

- To compare pre and post operative POP-Q measurement.
- To assess maintenance of support of the vaginal vault.
- To assess recurrence of anterior and posterior compartment prolapse.
- To evaluate vaginal vault granulation tissue during follow up.
- Evaluate overall anatomical success after surgery.

Eligibility Criteria

Inclusion Criteria

Patients meeting the following criteria were included:

- Uterovaginal prolapse Grade III.
- Procidentia.
- Planned vaginal hysterectomy with prophylactic sacrospinous ligament fixation.
- Written informed consent to surgery and follow-up.

Exclusion Criteria

A reason for exclusion was any of the following conditions:

- History of pelvic reconstructive surgery
- *Possible genital tract malignancy.
- Active pelvic infection.
- Severe medical illness precluding surgery.
- Failure or refusal to attend post operative follow up.

Pre-operative assessment of the patient

All patients underwent a complete preoperative evaluation. Demographic data such as age, parity, menopausal status, duration of symptoms and obstetric history were documented. All patients were subjected to general physical and systemic examination.

A detailed pelvic examination was done to assess the extent of uterovaginal prolapse and associated cystocele or rectocele. Anatomic severity of prolapse was measured using the Pelvic Organ Prolapse Quantification (POP-Q) system preoperatively. POP-Q measurements at baseline were used for postoperative comparisons.

Routine laboratory investigations included complete blood count, blood grouping and Rh typing, urine analysis, blood glucose estimation, renal function tests, electrocardiography and chest radiography when indicated. All patients were examined by the anesthesiology team before surgery.

Surgical Procedure

All procedures were performed under regional or general anesthesia in a manner consistent with institutional protocol.

When clinically indicated, vaginal hysterectomy, anterior colporrhaphy, posterior colpoperineorrhaphy or other vaginal reconstructive procedures were performed. The pararectal space was used to approach the right sacrospinous ligament. Permanent polypropylene sutures were passed thru the medial aspect of the ligament, avoiding injury to surrounding neurovascular structures. The sutures were then placed in the vaginal vault to provide apical suspension and restore normal vaginal support. Hemostasis was ensured prior to closure of the vaginal cuff.

POP-Q Assessment

Anatomical success was assessed using the Pelvic Organ Prolapse Quantification system (POP-Q). Preoperatively and during postoperative follow-up, POP-Q landmarks were recorded as below:

- Point Aa
 - Point Ba
 - Point Ap
 - Point Bp
 - Point D (or vault equivalent posthysterectomy)
- Standardized POP-Q methodology was used to perform measurements in centimeters relative to the hymenal ring. The main criterion of anatomic correction after surgery was the improvement of the parameters.

Follow Up Evaluation

Patients were examined at regular post-operative visits. Each follow-up assessment consisted of:

- Clinical examination of vaginal vault support.
 - Repeat POP-Q evaluation.
 - Recurrent cystocele evaluation
 - Evaluation of recurrent rectocele.
 - Vaginal vault granulation tissue examination.
 - Recurrent vaginal vault prolapse – assessment
- The mean follow-up time was 12 months (range 6 to 18 months).

Outcome Measures

Primary Outcome

The primary end point was anatomic success defined as satisfactory restoration and maintenance of apical vaginal support after sacrospinous ligament fixation without recurrent vaginal vault prolapse at follow-up.

Secondary Outcomes

Secondary outcome measures were:

- Better POP-Q measurements.
- Anatomic correction of anterior vaginal wall prolapse
- Anatomical repair of posterior vaginal wall prolapse.
- Granulation tissue of the vaginal vault.
- First-degree cystocele recurring.
- Recurrent rectocele first degree.
- General recurrence of pelvic organ prolapse.

Anatomical Success Definition

Anatomical success was defined for the purposes of this study as:

- Good vaginal vault support on clinical examination.
- POP-Q measurements postoperatively improved significantly compared to baseline.
- Vaginal vault prolapse did not recur during follow-up.
- No repeat pelvic reconstructive surgery required.

Failure of apical suspension was not considered in cases of minor first degree cystocele or rectocele without symptomatic vault prolapse. This definition is consistent with the focus of this study on the effectiveness of SSLF in maintaining apical support.

Statistical Analysis

Clinical data were prospectively entered into a computerized database and analyzed with descriptive statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation (SD) or range, and categorical variables as frequencies and percentages.

Anatomic improvement was assessed using descriptive comparison of preoperative and postoperative POP-Q measurements. As this was an observational study, and the sample size was relatively small, descriptive rather than inferential statistics were used. Statistical significance was assessed at P value <0.05 , where applicable.

Results

A total of **30 women** with advanced uterovaginal prolapse underwent vaginal hysterectomy with prophylactic unilateral sacrospinous ligament fixation during the study period. All patients completed the scheduled postoperative follow-up, with a **mean follow-up duration of 12 months (range, 6–18 months)**. The results presented in this manuscript focus specifically on objective anatomical outcomes assessed using the Pelvic Organ Prolapse Quantification (POP-Q) system, restoration of apical vaginal support, and recurrence of pelvic organ prolapse.

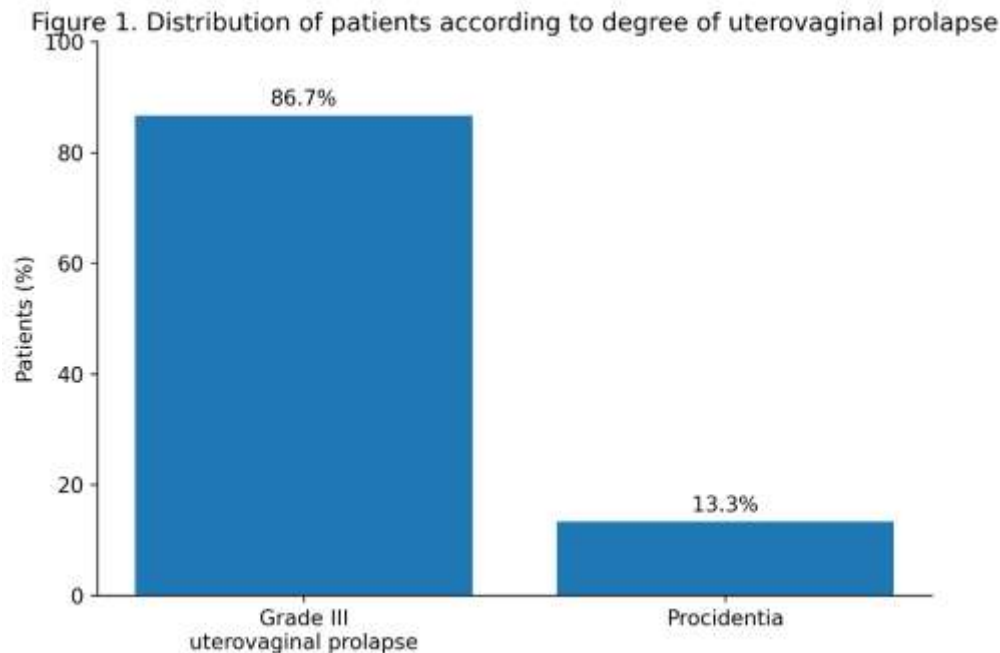
Baseline Anatomical Characteristics

Table 1. Preoperative anatomical characteristics (n = 30)

Variable	n (%)
Grade III uterovaginal prolapse	26 (86.7)
Procidentia	4 (13.3)
Associated anterior compartment defect	Present in majority*
Associated posterior compartment defect	Present in selected patients*

*The thesis reports associated pelvic floor repairs but does not quantify anterior and posterior compartment defects separately in the available results tables.

The majority of women presented with **Grade III uterovaginal prolapse (86.7%)**, whereas four patients (13.3%) had complete procidentia. These findings indicate that all women had severe apical pelvic support defects requiring reconstructive surgery.

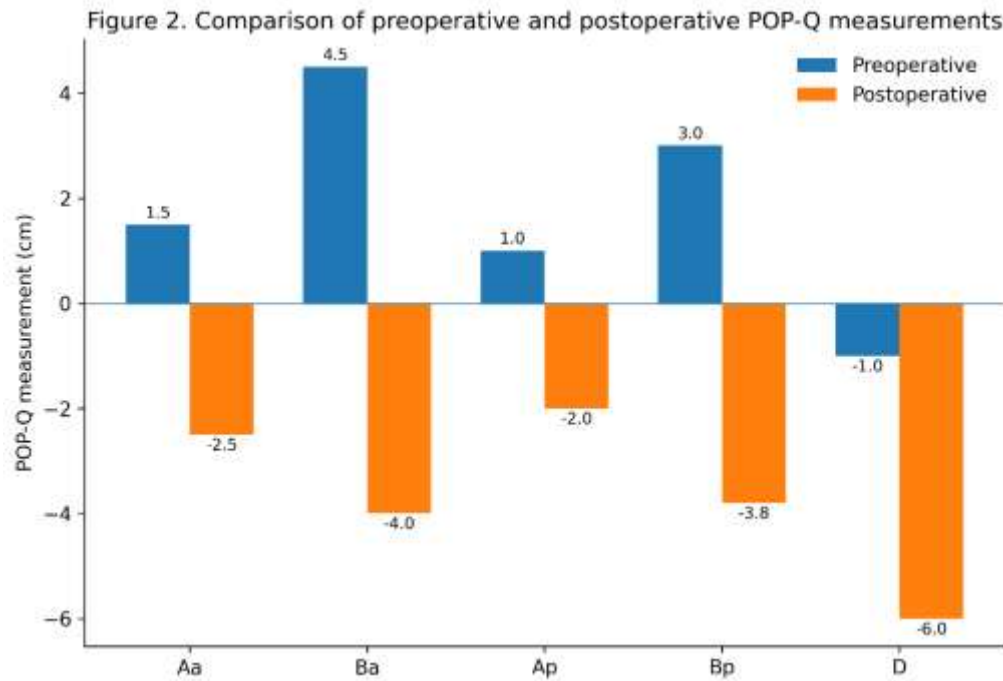


POP-Q Measurements

Table 2. Comparison of preoperative and postoperative POP-Q measurements

POP-Q point	Preoperative (cm)	Postoperative (cm)	Improvement (cm)
Aa	+1.5	-2.5	4.0
Ba	+4.5	-4.0	8.5
Ap	+1.0	-2.0	3.0
Bp	+3.0	-3.8	6.8
D	-1.0	-6.0	5.0

Marked improvement was observed in all POP-Q parameters following surgery. The greatest anatomical correction was observed at **point Ba**, which improved by **8.5 cm**, indicating substantial restoration of anterior vaginal wall support. Similarly, **point Bp** demonstrated an improvement of **6.8 cm**, reflecting correction of posterior compartment prolapse. The position of the vaginal apex (point D) improved from **-1.0 cm** preoperatively to **-6.0 cm** postoperatively, confirming successful restoration of apical support.

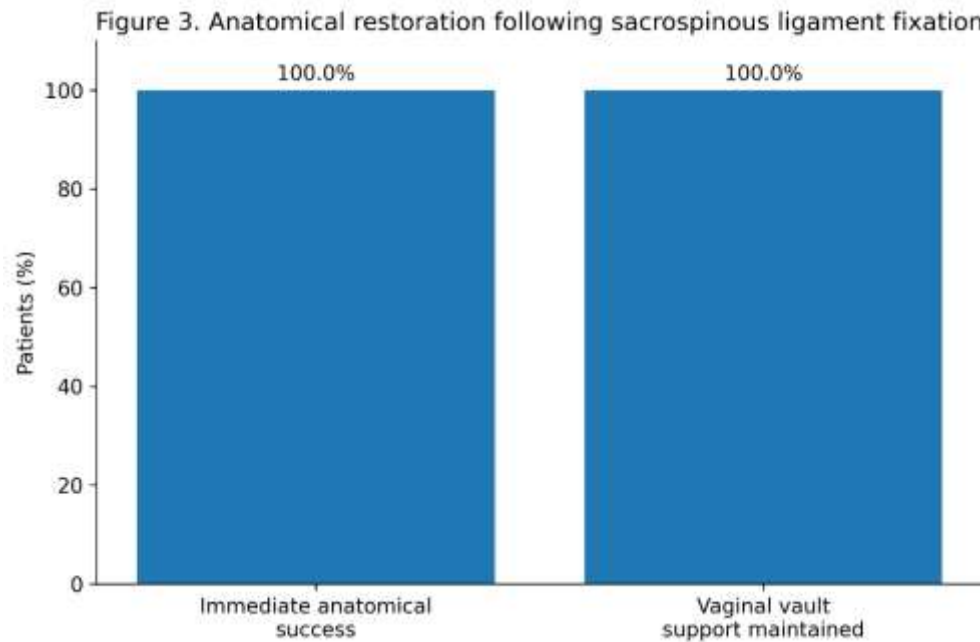


Anatomical Restoration of Vaginal Support

Table 3. Anatomical correction following sacrospinous ligament fixation

Anatomical parameter	Outcome
Restoration of apical support	Achieved in all patients
Vaginal vault suspension	Successful
Vaginal length preserved	Approximately 6 cm
Immediate postoperative anatomical success	30 (100%)

Immediately after surgery, satisfactory restoration of vaginal support was achieved in all patients. The vaginal vault remained well supported following fixation to the sacrospinous ligament, and postoperative vaginal length was maintained at approximately **6 cm**. No immediate postoperative vault prolapse was observed.

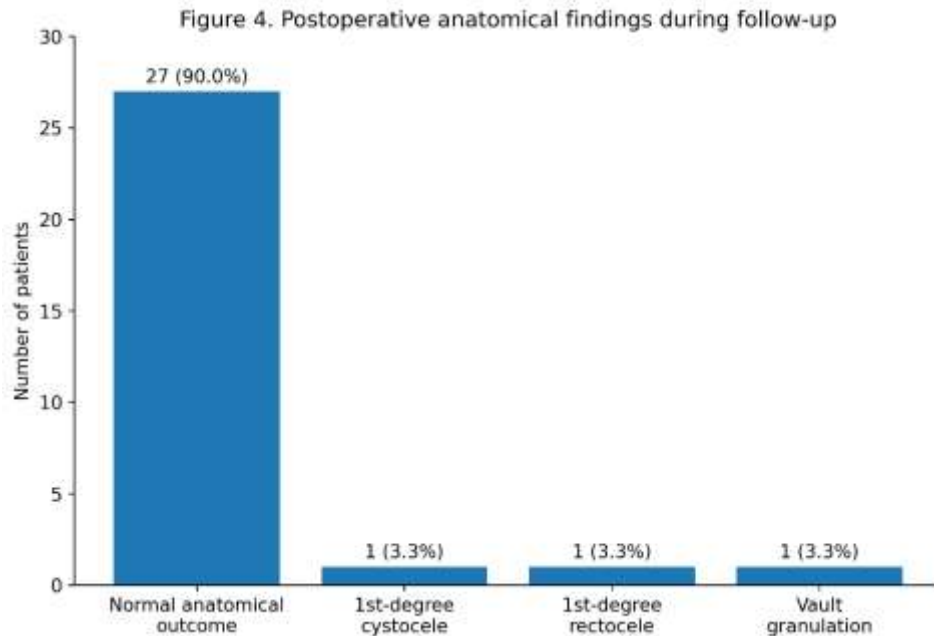


Follow-up Findings

Table 4. Clinical findings during follow-up

Finding	n (%)
Normal anatomical outcome	27 (90.0)
First-degree cystocele	1 (3.3)
First-degree rectocele	1 (3.3)
Vaginal vault granulation tissue	1 (3.3)

During postoperative follow-up, **90%** of patients maintained satisfactory anatomical support without evidence of recurrent prolapse. One patient developed **first-degree cystocele**, one developed **first-degree rectocele**, and one patient developed **vaginal vault granulation tissue**. All three conditions were managed conservatively and did not require repeat reconstructive surgery.

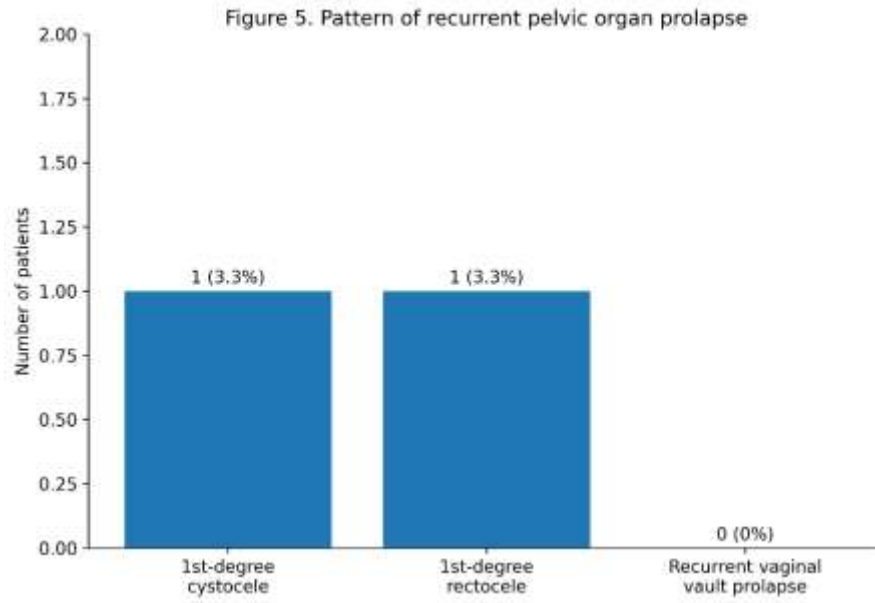


Recurrence Analysis

Table 5. Recurrence of pelvic organ prolapse

Recurrence	n (%)
Vaginal vault prolapse	0 (0)
First-degree cystocele	1 (3.3)
First-degree rectocele	1 (3.3)
Total anatomical recurrence	2 (6.7)

No patient developed recurrent **vaginal vault prolapse** during the entire follow-up period. The only recurrent anatomical defects involved the anterior and posterior vaginal compartments, each occurring in a single patient. Both recurrences were classified as **first-degree prolapse**, indicating mild anatomical descent without loss of apical support.



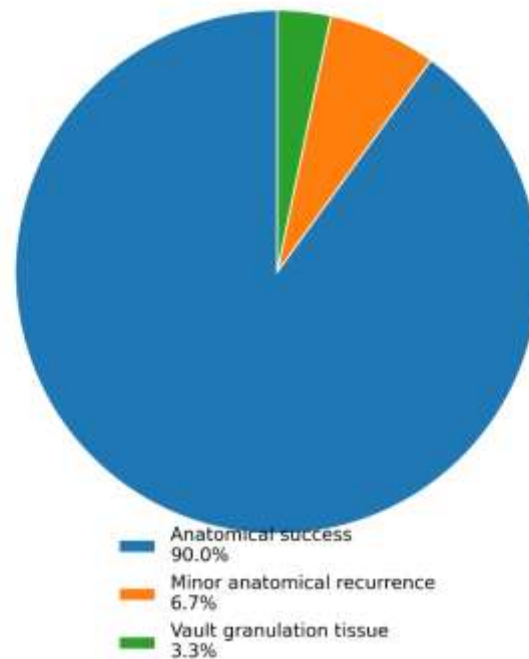
Overall Anatomical Success

Table 6. Overall anatomical outcome following SSLF

Outcome	n (%)
Anatomical success	27 (90.0)
Minor anatomical recurrence	2 (6.7)
Vaginal vault granulation tissue	1 (3.3)
Recurrent vault prolapse	0 (0)

Overall anatomical success was achieved in **27 of 30 women (90.0%)**. The remaining patients experienced either minor compartment recurrence or vaginal vault granulation tissue without failure of apical suspension. Importantly, no woman required repeat surgery for recurrent vaginal vault prolapse during the study period.

Figure 6. Overall anatomical outcome following sacrospinous ligament fixation



Discussion.

We evaluated the anatomical outcomes of prophylactic sacrospinous ligament fixation (SSLF) performed during vaginal hysterectomy in women with advanced uterovaginal prolapse in the present prospective observational study. Using the Pelvic Organ Prolapse Quantification (POP-Q) system, the study demonstrated significant improvement of objective anatomical support with restoration of the vaginal apex in all patients immediately after surgery. During a mean follow-up of 12 months, no patient developed recurrent vaginal vault prolapse, while only two patients had minor compartment recurrence as first-degree cystocele and first-degree rectocele. The results demonstrate that prophylactic SSLF provides effective short-term apical support and a high anatomical success rate.

Anatomical Restoration of Apical Propellant

The maintenance of apical support is now recognized as a key factor in the success of pelvic reconstructive surgery. Multiple anatomical studies have shown that loss of support of the vaginal apex is an important factor in recurrent prolapse involving both the anterior and posterior compartments.[1,2] Therefore, the focus of contemporary pelvic reconstructive surgery is on

restoration of Level I support as an integral part of prolapse repair.

In the present study, objective POP-Q assessment showed significant post-operative improvement at all sites measured anatomically. Point Aa went from +1.5 cm to -2.5 cm, point Ba from +4.5 cm to -4.0 cm, point Ap from +1.0 cm to -2.0 cm, point Bp from +3.0 cm to -3.8 cm and point D from -1.0 cm to -6.0 cm. These results demonstrate substantial correction of anterior, posterior and apical vaginal support after sacrospinous ligament fixation.

The POP-Q landmark with the most improvement was at the point Ba, indicating successful correction of anterior vaginal wall descent. Furthermore, the development of point D validated the restoration of the vaginal apex, which was the primary anatomical goal of prophylactic sacrospinous ligament fixation.

Anatomic success

Vaginal support was satisfactory in all patients immediately after surgery. At follow-up, 27 of 30 women (90%) had normal anatomical support with no evidence of recurrent prolapse. These findings suggest a high short-term anatomical success rate following prophylactic SSLF.

The results are in line with those reported in the literature review of the thesis. Nichols reported an overall anatomical success rate of about 97% with sacrospinous ligament fixation in women with severe pelvic organ prolapse, whereas Morley reported satisfactory symptomatic and anatomical results in about 90% of patients with vaginal apical suspension. Cruikshank and Cox also showed good anatomic support after prophylactic sacrospinous ligament fixation during vaginal hysterectomy for advanced uterovaginal prolapse. These historical reports support the good anatomical results seen in the current study.

Recurrent Pelvic Organ Prolapse

A major finding of this study was the absence of any recurrent vaginal vault prolapse during the follow-up period. This finding supports the effectiveness of apical suspension in vaginal hysterectomy, since the main goal of prophylactic sacrospinous ligament fixation was to avoid vault prolapse.

Only two women had recurrent pelvic organ prolapse, one first-degree cystocele and one first-degree rectocele. Both demonstrated mild compartment deficits without loss of apical support. No patient required a second operation to reconstruct the defect.

Likewise, several published studies have reported that the anterior compartment prolapse is the most common site of recurrence after SSLF. The thesis review summarized studies of Marcus, Bobby and Argirović where cystocele was the predominant recurrent anatomic defect despite good vault support. In the present study the

Comparison with Previous Studies

pattern of recurrence appears to be in accordance with previous clinical experience.

The change in vaginal axis after unilateral sacrospinous fixation has been proposed as a possible reason for recurrent anterior compartment descent. However, recurrence is probably multifactorial and associated with pre-existing weakness of connective tissue, parity, age and severity of pelvic floor damage prior to surgery rather than simply the fixation procedure. [3,4]

Vaginal Vault Support

An important finding of this study was the preservation of the vaginal vault support during the follow-up. Immediate postoperative examination showed satisfactory suspension of the vaginal apex with preservation of vaginal length of approximately 6 cm, with no subsequent loss of apical support documented.

Adequate vault support is important as recurrent vault prolapse commonly leads to progressive failure of both anterior and posterior compartments. This study indicates that prophylactic SSLF is effective in restoring Level I support and may reduce the risk of future vault prolapse.

Granulation Tissue, Vaginal Vault

In one patient, vaginal vault granulation tissue was noted at follow-up. Granulation tissue is a known minor complication of vaginal reconstructive surgery and is usually associated with healing around permanent suture material. In the present study, granulation tissue did not affect anatomical support and was managed conservatively without any further surgery.

Table 7. Comparison of anatomical outcomes with previous studies

Study	Sample size	Follow-up	Anatomical outcome
Nichols (1982)	163	≥2 years	Overall success approximately 97%
Morley	100	≥1 year	Approximately 90% satisfactory support
Cruikshank & Cox	48	Variable	Good vault support following SSLF
Argirović et al.	37	12 months	One vault recurrence (2.7%)
Present study	30	Mean 12 months	90% anatomical success; no vault recurrence

The present study demonstrated anatomical outcomes comparable with those reported in the literature reviewed in the source thesis. Although differences in patient selection, follow-up duration, and outcome definitions limit direct comparison, the absence of recurrent vaginal vault prolapse in the current series supports the effectiveness of prophylactic SSLF in maintaining apical support.

Clinical Implications

The results of this study emphasize the value of incorporating apical suspension into reconstructive surgery for advanced uterovaginal prolapse. In addition to correcting the existing prolapse, restoration of vaginal apex support helps to provide long-term stability of the anterior and posterior vaginal compartments. As SSLF can be performed by vaginal route without laparotomy, it is an attractive option for women who have undergone vaginal hysterectomy. POP-Q assessment performed regularly before and after surgery provides reproducible documentation of the anatomical outcome and allows comparison of surgical techniques. Finally, the present study further demonstrates the utility of POP-Q as an objective measure of post-operative success.

Strengths

The strengths of the present study are:

- Observational, prospective design.
- Consistent surgical technique at one tertiary-care teaching hospital.
- Use of the standardized POP-Q system for objective assessment.
- Full follow-up of all postoperatively enrolled patients.
- Outcomes were evaluated based on anatomical results rather than subjective symptom relief.

Limitations

The results must be interpreted considering several limitations. The study included 30 patients, which limited statistical precision and subgroup analyzes. This was a single institution and there was no comparison group of vaginal hysterectomy without sacrospinous ligament fixation or other form of apical suspension. Thus, comparative effectiveness cannot be determined from this study alone.

The mean follow-up of 12 months is sufficient for evaluation of early anatomic results but is not sufficient for evaluation of long-term durability

of pelvic support. Furthermore, the thesis did not include validated patient-reported outcome measures, quality-of-life instruments or sexual function questionnaires. Therefore, this manuscript is limited to objective anatomic outcomes as determined by POP-Q measurements rather than functional or patient-centered outcomes.

Future multicenter comparative studies with larger sample sizes, longer follow-up, and standardized patient-reported outcomes are needed to determine the long-term anatomical durability and functional benefits of prophylactic sacrospinous ligament fixation.

Conclusion

Prophylactic sacrospinous ligament fixation in women with advanced uterovaginal prolapse during vaginal hysterectomy results in excellent short-term anatomical results in the present study. All POP-Q measurements improved significantly, suggesting effective restoration of anterior, posterior and apical vaginal support. Overall anatomical success rate was 90% with no recurrent vaginal vault prolapse during one year follow up period. Minor recurrence was restricted to isolated first-degree cystocele and rectocele. Granulation tissue of the vaginal vault was uncommon and was treated conservatively.

These findings support prophylactic sacrospinous ligament fixation as an effective vaginal apical suspension procedure that can restore objective pelvic support in women undergoing vaginal hysterectomy for advanced uterovaginal prolapse. However, the relatively small sample size, single-center design, and limited follow-up call for cautious interpretation and larger prospective comparative studies are needed to confirm the long-term anatomical benefits of this approach.

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