



# Long-term follow-up of laparoscopic sacrocolpopexy: comparison of two different techniques used in urology and gynecology

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## Abstract

**Introduction and hypothesis** Numerous studies have found that the short-term results of laparoscopic sacrocolpopexy for pelvic organ prolapse are safe and effective. This study evaluates the long-term results of the laparoscopic sacrocolpopexy operation between the urology and gynecology branches.

**Methods** A prospective study enrolling 206 patients was conducted to evaluate laparoscopic sacrocolpopexy as a surgical treatment for vaginal vault prolapse from 2011 to 2014. Two different surgical branches (urology and gynecology) applied laparoscopic sacrocolpopexy to their patients with their own techniques. The long-term results were assessed postoperatively after 4 years by pelvic examinations, including the Pelvic Organ Prolapse Quantification system (POP-Q) and quality-of-life assessments using validated questionnaires.

**Results** A total of 190 patients (94 urology and 96 gynecology patients) received a full clinical follow-up examination between April 2014–June 2018. Postoperative pelvic organ prolapse recurrence rates in each compartment were similar in both groups during the 4 years; 87.2% of the urology and 86.5% of the gynecology patients had no prolapse in any compartment according to the POP-Q system. The reoperation rate was 5.3% for the urology and 6.2% for the gynecology group. Mesh erosion was detected in two patients in both groups. Three patients responded to local estrogen therapy, and we removed the mesh vaginally in one patient. The subjective cure rate was 89.4% in the urology and 88.5% in the gynecology group after 4 years.

**Conclusions** Although different surgical branches perform laparoscopic sacrocolpopexy with their own techniques, long-term anatomical and functional results are similar between the branches. From a urogynecological point of view, laparoscopic sacrocolpopexy is a gold standard surgical procedure that can be performed by both urologists and gynecologists with similar long-term outcomes.

**Keywords** Laparoscopic sacrocolpopexy · Long-term follow-up · Gynecology · Urology

## Introduction

Pelvic organ prolapse is one of the most common gynecological problems in the later stages of women's lives [1]. Pelvic

organ prolapse surgery is the most commonly performed gynecological surgery in women over 70 years of age [2]. The treatment of pelvic organ prolapse has undergone a complete evolution from the vaginal to abdominal approach in the last 50 years [3]. Standard vaginal surgeries for pelvic organ prolapse such as McCall culdoplasty, sacrospinous fixation and uterosacral vaginal vault suspension have been performed for many years. However, vaginal mesh augmentations, especially in the USA, became very popular in the late 2000s. Although the anatomical results are satisfactory, vaginal mesh surgery for pelvic organ prolapse has considerable morbidity and has complications such as mesh exposure, infection, pain and sepsis. [4–6]. Following the FDA's latest warnings in 2011, vaginal mesh augmentation surgery came to a standstill first in the USA and then worldwide [7, 8].

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Although vaginal mesh augmentation in pelvic organ prolapse is a problematic issue, sacrocolpopexy with the abdominal, laparoscopic or robotic approach is safe and effective [9, 10]. Since its first publication in 1961, the sacrocolpopexy operation has become increasingly widespread in the treatment of pelvic organ prolapse [11]. The abdominal approach has several advantages over the vaginal approach in terms of anatomical outcomes, quality of life and sexual activity [12]. With increasing evidence, it can be claimed that abdominal sacrocolpopexy is the gold standard treatment for vaginal vault prolapse [13]. The results of abdominal sacrocolpopexy and laparoscopic or robotic sacrocolpopexy are comparable. Due to the effective outcomes and reasonable costs, laparoscopic sacrocolpopexy is now the most frequently performed operation if vaginal vault prolapse is present in a sexually active patient [14–17].

Laparoscopic sacrocolpopexy is one of the most challenging operations in laparoscopic surgery. In this procedure, the advanced pelvic surgeon must use all kinds of laparoscopic knowledge and skills such as peritoneal dissection, desiccation, traction and suturing [18, 19]. Both the urology and gynecology branches are involved in the surgical treatment of pelvic organ prolapse in the context of a urogynecological perspective. Because each surgical branch has its own surgical dynamics and practices, there are differences and nuances between the two branches in the laparoscopic sacrocolpopexy operation.

Even though surgeons in two different surgical disciplines such as urology and gynecology have been performing laparoscopic sacrocolpopexy for the last 20 years, the data on the long-term outcomes of laparoscopic sacrocolpopexy between these branches are not clear. The aim of this study is to investigate the long-term outcomes of laparoscopic sacrocolpopexy performed by two different surgical disciplines, urology and gynecology.

## Materials and methods

The first laparoscopic sacrocolpopexy at Uludag University Hospital was done in 2008 in the Gynecology Department. The Department of Urology performed its first laparoscopic sacrocolpopexy in 2009. After 30 operations in an active learning curve, both departments were able to perform an average of 1 laparoscopic sacrocolpopexy per week by 2011. This study was planned as a prospective cohort study. In our hospital, both the gynecology and urology departments have urogynecology units. A patient with pelvic organ prolapse may be referred to either of these departments according to her general practitioner's request. The departments did not have the chance to choose their patients. After patient referral, each department managed their patients' preoperative, operative and postoperative processes. Between 2011 and 2014,

206 patients who had vaginal vault prolapse and underwent laparoscopic sacrocolpopexy participated in the study. The inclusion criteria were women with vaginal vault prolapse stage 2 and above. One hundred four patients were in the urology department, and 102 patients were in the gynecology department. The exclusion criteria were the patient's refusal to participate in the study and laparoscopic sacrocolpopexy contraindications such as chronic steroid use, major anesthesia problems or uncontrolled diabetes mellitus. Patients were prospectively monitored for 4 years. This study was approved by our local Ethics Committee, Uludag University, School of Medicine, Clinical Research Ethics Committee, Bursa, Turkey (2017–17/20). All patients participating in the study signed written informed consent.

## Preoperative evaluation

All patients underwent a detailed urogynecologic examination at preoperative evaluation and annual postoperative follow-up. Age, body mass index (BMI), parity, menopausal status, stress or urge incontinence, systemic diseases, previous surgeries for POP and urinary incontinence (stress/urge/mix) were recorded. The bladder residual volume was measured. Each patient underwent a urinary (cough) stress test. The degree of pelvic organ prolapse was documented using the International Continence Society (ICS) Pelvic Organ Prolapse Quantification (POP-Q) system [20]. The primary objective of the study, the objective cure, was defined as no prolapse in any compartment or stage 1 pelvic organ prolapse. Subjective outcome was based on the PFDI-20 (Pelvic Floor Distress Inventory short form-20) and PFIQ-7 (Pelvic Floor Impact Questionnaire short form-7) questionnaires. Subjective cure was defined when patients responded “no” to the question: “Do you have a bulge or something falling out that you can see or feel in your vaginal area?” Each patient included in the study completed the validated Turkish versions of quality of life questionnaires and their subscales in the preoperative period [21].

## Operative and postoperative evaluation

Operative outcomes such as the procedure time, blood loss, cost, concurrent sling or colporrhaphy procedure were recorded. Patients were invited to the outpatient clinic during the postoperative period annually for 4 years. In postoperative controls, each clinic evaluated their own patients. Postoperative controls were performed by a research team doctor. The patients were not introduced to their operating surgeon unless there were any surgical problems. A detailed pelvic examination and the POP-Q system evaluation were performed on each outpatient visit. Each patient filled out the PFDI-20 and PFIQ-7 questionnaires. If a patient was not able to attend the follow-up examination because of

morbidity, age or moving to another city, we asked her to send back the completed questionnaires via e-mail or post. A significant effort was made to find all the patients by searching addresses, phones or mobile phones of the patients in the computer database of the hospital and the internet. At the end of the 4th year, both subjective outcomes such as incontinence, constipation and voiding disorders and objective outcomes such as prolapse recurrence in any compartment and mesh erosion were recorded. The operation costs were calculated by the price paid by the patient's social security institution.

### Surgical procedure

All surgical procedures were performed by three senior urogynecologists experienced in laparoscopic surgery. Two of these surgeons were from the Department of Gynecology (G.U. and K.O.) and one from the Department of Urology (H.V.). Both branches have their own standard laparoscopic sacrocolpopexy technique with slight differences and nuances. The explanation of the procedure of the two branches is shown in detail in Fig. 1. In summary, the port locations were different between the two branches. Urology surgeons performed operations contralaterally while gynecology surgeons performed operations unilaterally. Urologists started the operation with promontory dissection. However, gynecologists started with vaginal vault dissection. Urologists used manually tailored type-1 polypropylene meshes (12–15 × 3 cm for the posterior and 10–12 × 3 cm for the anterior). Gynecologists used y-shaped type-1 polypropylene meshes.

### Statistical analyses

We did not formally calculate a sample size because we could not organize a pilot study between the two branches to create data for sample size calculation before this study. However, we estimated that recruiting 90 patients per group would provide enough preliminary data to reach 80% statistical power for the study based on a previous study comparing short-term results of laparoscopic and open sacrocolpopexy procedures [9]. Since there are no studies with long-term results comparing two laparoscopic sacrocolpopexy techniques, all patients were included in the study when laparoscopic sacrocolpopexy was actively performed in both departments to keep the strength of the study as high as possible.

Continuous and discrete variables were reported as median (minimum: maximum) and mean ± standard deviation values where categorical variables were expressed as *n* (%). The Mann-Whitney U, Pearson chi-squared and Fisher's exact tests were used for the intergroup comparisons. Analysis of the study was performed using the SPSS 21.0 (Chicago, IL) program. *p* < 0.05 was accepted as statistically significant for the comparisons.

## Results

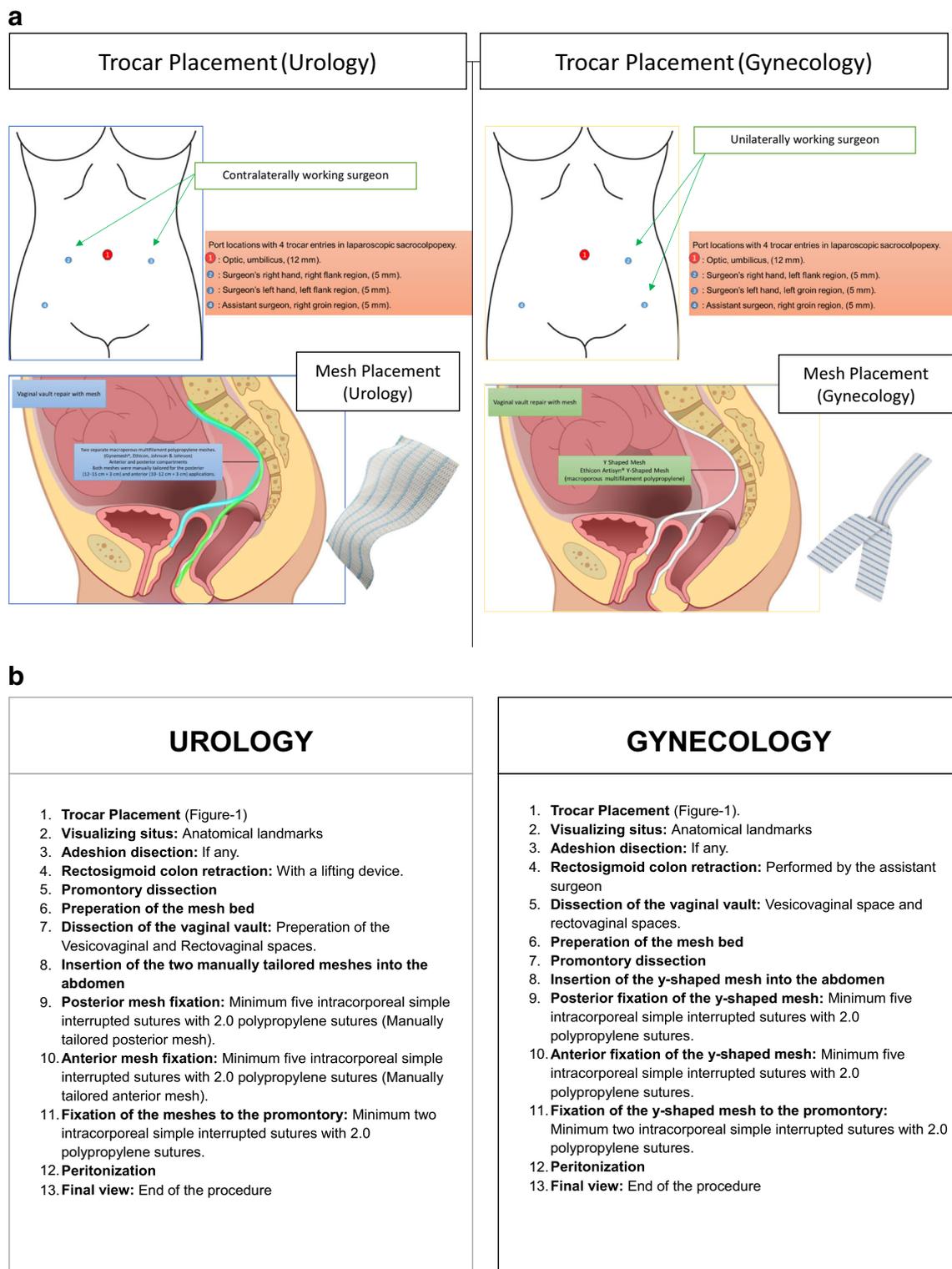
During the follow-up, 16 patients from the urology group and 11 patients from the gynecology group were excluded for various reasons (Fig. 2). These reasons were communication problems (eight patients), rejecting follow-up (six patients) and death (two patients). Of 206 patients, 190 attended the clinical follow-up examinations, and the final analysis was done on these patients. The mean follow-up time for all included patients was 48 months (4 years). Thirteen patients were assessed only by questionnaires via e-mail or mobile phones because of problems such as relocation, morbidity and age. The evaluations of these patients could be completed although the communication was via telephone or mail.

The demographic characteristics of the patients are given in Table 1. There were no statistically significant differences between patients in the urology and gynecology branches regarding demographic characteristics such as age, BMI, menopause and parity.

Operative outcomes are shown in Table 2. There were no urinary (bladder perforation or ureter injury) or gastrointestinal system complications (colorectal complications) during the operations. Six patients in both the gynecology group and the urology group underwent a TOT (transobturator tape) operation concurrently with the stress urinary incontinence indication. Both urologists and gynecologists performed anterior concurrent colporrhaphy in seven patients during laparoscopic sacrocolpopexy. There was no statistical difference between the urology and gynecology branches in terms of mean operation time, average blood loss, hospital stay time and cost.

Subjective and objective outcomes of the patients in the long-term follow-up are shown in Table 3. Stress urinary incontinence was detected in seven patients in the urology group and eight patients in the gynecology group after the operation. The transobturator tape procedure (outside-in) was applied to five of these patients in the urology group and five in the gynecology group. Other patients were treated symptomatically. All the patients who underwent surgery were continent within a year. Three patients with de novo urge urinary incontinence after laparoscopic sacrocolpopexy in both groups were treated with anticholinergic pharmacotherapy. There was no statistically significant difference between the groups in terms of subjective outcomes in the long-term follow-up. The subjective cure rate was 89.4% in the urology group and 88.5% in the gynecology group after 4 years.

Postoperative pelvic organ prolapse recurrence rates in each compartment were similar in both groups (Table 3). In the urology group, six patients had anterior wall prolapse, five patients had posterior wall prolapse, and two patients had an apical recurrence in the long-term follow-up. One patient had both anterior and apical compartment prolapse. Five of these urology patients underwent a second operation, such as colporrhaphy and/or sacrospinous fixation. In the gynecology

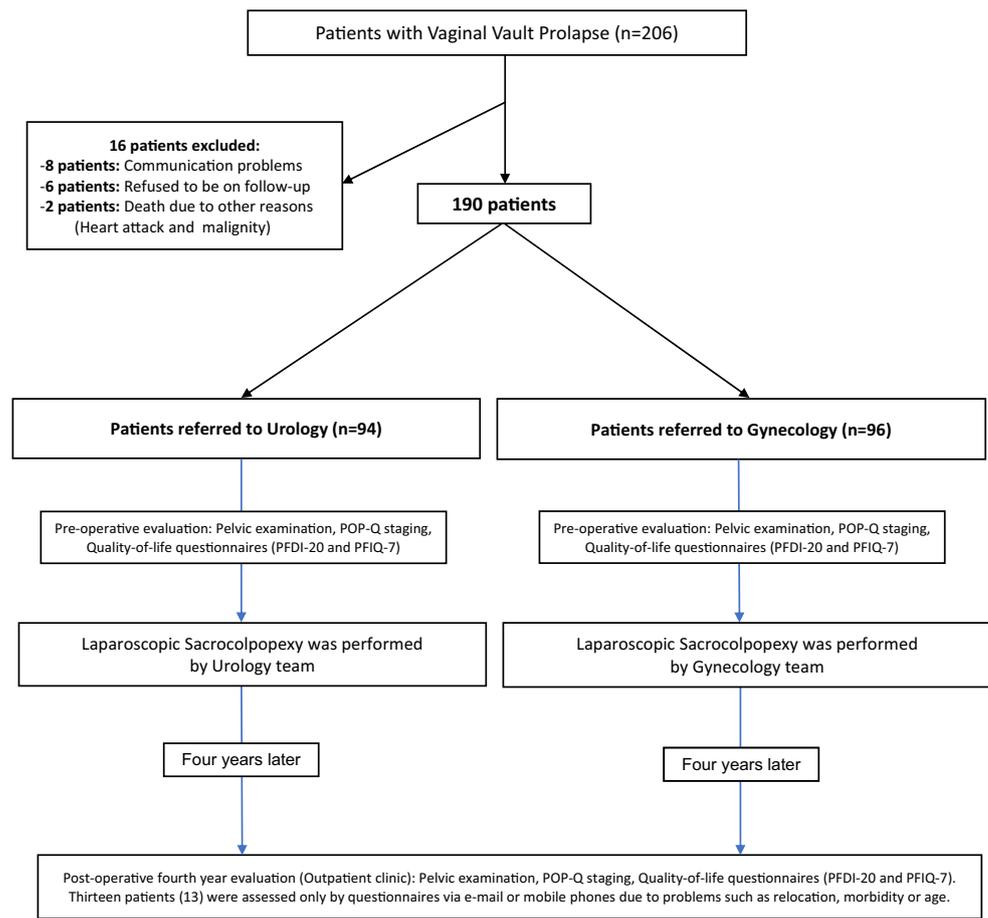


**Fig. 1 a** Explanation of the port locations and the mesh placements in the laparoscopic sacrocolpopexy procedure in the urology and gynecology branches. **b** Explanation of the laparoscopic sacrocolpopexy procedure in the urology and gynecology branches

group, seven patients had anterior wall prolapse, five patients had posterior wall prolapse, and two patients had an apical recurrence in the long-term follow-up. Only one patient had both anterior and apical compartment prolapse. Six of these

gynecology patients underwent a second operation, such as colporrhaphy and/or sacrospinous fixation. The total reoperation rate was 5.3% (5/94) for the urology group and 6.2% (6/96) for the gynecology group.

**Fig. 2** Study flowchart. PFDI-20: Pelvic Floor Distress Inventory-short form 20. PFIQ-7: Pelvic Floor Impact Questionnaire-short form 7



**PFDI-20:** Pelvic Floor Distress Inventory- short form 20

**PFIQ-7:** Pelvic Floor Impact Questionnaire- short form 7

Mesh erosion was detected in two patients in both groups. Three of these patients responded to local estrogen therapy because the exposed mesh area was < 1 cm<sup>2</sup>. In one patient, the mesh was removed vaginally by local excision, and a sacrospinous fixation procedure was applied. Objective outcomes were similar for both branches. The objective cure rate was 87.2% in the urology group and 86.5% in the gynecology group.

The median POP-Q staging scores in the preoperative period and 4th postoperative year are given in Table 4. The median values of the difference scores due to the improvement of the prolapse are also given. There was no statistically significant difference between urology and gynecology patients in terms of both the preoperative and the 4-year postoperative POP-Q scores.

The quality-of-life questionnaire scores of the patients are shown in Table 5. In both groups, the PFDI-20 and PFIQ-7 urinary and prolapse scores were significantly improved after the operation, while the colorectal-anal scores were slightly increased. The data for both branches were similar regarding improvement in urinary and prolapse scores. Colorectal-anal scores were similar pre- and postoperatively between the groups.

## Discussion

With this study, we have shown that the long-term outcomes of two different surgical disciplines performing laparoscopic sacrocolpopexy for vaginal vault prolapse are similar. Surgeons in both the urology and gynecology branches perform laparoscopic sacrocolpopexy to treat their patients perfectly.

The main strength of the study is its prospective design and 4-year follow-up time. The use of the POP-Q system for anatomical outcomes and the use of quality-of-life scales such as PFDI-20 and PFIQ-7 for functional outcomes are also strengths of the study.

The weakness of this study is that 16 patients had to be removed from the 4-year follow-up for various reasons. The results and complications of these patients could influence the final analysis. Clinical follow-up of 13 patients by telephone or e-mail from 190 patients entering the final analysis may be a weakness of the study. However, the questionnaire forms of these patients were taken completely by telephone or e-mail, and the patients gave sufficient answers to all the questions.

**Table 1** Demographic characteristics of the patients

	Urology patients (n = 94)	Gynecology patients (n = 96)	p value
Age (years)	52 (45:59)	52 (45:60)	0.062 <sup>a</sup>
Body mass index (kg/m <sup>2</sup> )	27.7 (21.0:30.6)	27.7 (21.0:30.0)	0.153 <sup>a</sup>
Parity	4 (2:6)	3 (2:5)	0.107 <sup>a</sup>
Menopausal status	72 (76.6%)	74 (77.1%)	0.937 <sup>b</sup>
Vaginal vault prolapse stage			
Stage 2	51 (54.2%)	53 (55.2%)	0.871 <sup>b</sup>
Stage 3	32 (34.1%)	33 (34.3%)	0.754 <sup>b</sup>
Stage 4	11 (11.7%)	10 (10.5%)	0.579 <sup>b</sup>
Stress urinary incontinence	6 (6.4%)	6 (6.3%)	0.970 <sup>b</sup>
Previous surgery			
Previous sling procedure	10 (10.6%)	10 (10.4%)	0.960 <sup>b</sup>
Previous pelvic organ prolapse surgery	11 (11.7%)	12 (12.5%)	0.866 <sup>b</sup>
Major comorbidities			
Diabetes mellitus	11 (11.7%)	12 (12.5%)	0.866 <sup>b</sup>
Heart attack	9 (9.6%)	10 (10.4%)	0.847 <sup>b</sup>
Cerebrovascular disease	10 (10.6%)	11 (11.5%)	0.857 <sup>b</sup>
Respiratory disease and/or asthma	8 (8.5%)	8 (8.3%)	0.965 <sup>b</sup>

Data are given as median (minimum:maximum) plus mean ( $\pm$  standard deviation) or n (%)

<sup>a</sup> Mann-Whitney U test

<sup>b</sup> Pearson's chi-squared test

Another limitation may be the polypropylene mesh usage differences between the departments. Although urology and gynecology teams performed laparoscopic sacrocolpopexy with similar techniques, the urology team used tailored mesh while the gynecology team used y-shaped mesh. There are no randomized controlled trials showing how polypropylene mesh usage differences affect the outcomes of laparoscopic

sacrocolpopexy. In a recent systematic review, Coolen et al. concluded that a comparison of sacrocolpopexy techniques was difficult because of the heterogeneity of the trials [22]. Apart from the difference in the use of mesh, the techniques of both departments are similar. Since there is no standardized rule for the use of mesh in laparoscopic sacrocolpopexy operations (provided it is a type-1 mesh), this study can be

**Table 2** Operative outcomes of the patients

	Urology patients (n = 94)	Gynecology patients (n = 96)	p value
Procedure time (minutes)	165 (125:180)	165 (135:190)	0.07 <sup>a</sup>
Blood loss (ml)	50 (5:95)	50 (5:95)	0.523 <sup>a</sup>
Hospital stay (hours)	28 (20:40)	28 (20:44)	0.061 <sup>a</sup>
*Cost (€)	2000 (1800:2900)	2000 (1800:2900)	0.663 <sup>a</sup>
Concurrent procedure			
Sling procedure	6 (6.4%)	6 (6.3%)	0.970 <sup>b</sup>
Colponthaphy anterior/posterior	7 (7.4%)	7 (7.3%)	0.967 <sup>b</sup>

Data are given as median (minimum:maximum) plus mean ( $\pm$  standard deviation) or n (%)

\*The operation cost per patient was converted from Turkish liras to euros

<sup>a</sup> Mann-Whitney U test

<sup>b</sup> Pearson's chi-squared test

**Table 3** Subjective and objective outcomes of the patients in the long-term follow-up

	Urology patients ( <i>n</i> = 94)	Gynecology patients ( <i>n</i> = 96)	<i>p</i> value
Subjective outcomes			
De novo stress urinary incontinence*	7/88 (7.9%)	8/90 (8.8%)	0.786 <sup>a</sup>
Surgery for stress urinary incontinence*	5/88 (5.6%)	5/90 (5.5%)	0.574 <sup>a</sup>
Postop constipation	1 (1.1%)	1 (1.0%)	0.988 <sup>a</sup>
Postop voiding disorders	9 (9.6%)	10 (10.4%)	0.847 <sup>a</sup>
De novo urge urinary incontinence	3 (3.2%)	3 (3.1%)	1.000 <sup>b</sup>
Dysparonia	3 (3.2%)	3 (3.1%)	1.000 <sup>b</sup>
Subjective cure rate**	84 (89.4%)	85 (88.5%)	0.857 <sup>a</sup>
Objective outcomes			
Recurrence of anterior wall	6 (6.4%)	7 (7.3%)	0.804 <sup>a</sup>
Recurrence of posterior wall	5 (5.3%)	5 (5.2%)	1.000 <sup>b</sup>
Recurrence of apical compartment	2 (2.1%)	2 (2.1%)	1.000 <sup>b</sup>
Mesh erosion	2 (2.1%)	2 (2.1%)	1.000 <sup>b</sup>
Objective cure rate***	82 (87.2%)	83 (86.5%)	0.874 <sup>a</sup>

Data are given as *n* (%)

One patient from the urology group and one patient from the gynecology group had both anterior wall and apical prolapse

\*Rates were calculated by removing patients (6 patients in the urology group and 6 patients in the gynecology group) with preoperative stress urinary incontinence

\*\*Subjective cure was defined when patients responded “no” to the question: “Do you have a bulge or something falling out that you can see or feel in your vaginal area?”

\*\*\*The objective cure was defined as no prolapse in any compartment or stage 1 pelvic organ prolapse

<sup>a</sup> Pearson’s chi-squared test

<sup>b</sup> Fisher’s exact test

considered the comparison of the long-term outcomes of the two different laparoscopic sacrocolpopexy techniques used in urology and gynecology.

From objective outcomes, according to the POP-Q system evaluation, the location where the C point came in was similar to that in randomized controlled studies [23]. In this study, the postoperative POP-Q system C point value was  $-7.48$ . Similarly, preoperative POP-Q system C point median values were  $+3$  in the urology group and  $+4$  in the gynecology group, while  $-7$  in the urology group and  $-8$  in the gynecology group in the 4th postoperative year in our study.

Regarding long-term outcomes, few studies document the long-term results of laparoscopic sacrocolpopexy. In the study of Sarlos et al., 68 patients undergoing laparoscopic hysterectomy were followed for 5 years [24]. During the follow-up period, the anatomical outcomes of the patients were satisfactory. The objective cure rate after the end of 5 years was 83.8%. Similar to these data, the objective cure rates in our study after 4 years were 87.2% for the urology branch and 86.5% for the gynecology branch. Considering this, it can be claimed that long-term anatomical results of laparoscopic sacrocolpopexy are sufficient independently from the surgical branch.

Although 1-year results of laparoscopic sacrocolpopexy are excellent, it can be said that prolapse increases in all compartments when the long-term results are considered [25]. In a study comparing 7-year abdominal sacrocolpopexy results, failure rates increased in both the urethropexy and no urethropexy groups [26]. Within the 4-year follow-up period of our study, the recurrence rates in both groups (urology vs. gynecology) were 6.4% vs. 7.5% for the anterior compartment, 5.3% vs. 5.2% for the posterior compartment and 2.1% vs. 2.1% for the apical compartment. The highest failure rate was in the anterior compartment in both branches. Eleven of 27 patients were symptomatic and reoperated for pelvic organ prolapse. With these findings, it can be considered that the long-term results are sufficient and effective, independent of the surgical branch that performs laparoscopic sacrocolpopexy.

Pelvic organ prolapse and stress urinary incontinence often coexist in women with pelvic floor symptoms because of their common pathophysiology. For women with symptoms of both pelvic organ prolapse and stress urinary incontinence, a concomitant prolapse repair and continence procedure should be done. However, the staged approach should also be considered an option after careful counseling

**Table 4** Clinical long-term outcomes of laparoscopic sacrocolpopexy operations between the urology and gynecology branches according to the Pelvic Organ Prolapse Quantification System

	Urology patients (n = 94)	Gynecology patients (n = 96)	p value
<b>Aa</b>			
Preoperative	0 (–2:3)	0 (–1:3)	0.936 <sup>a</sup>
Postoperative 4th year	–2 (–3:0)	–3 (–3:–1)	–
ΔAa (postoperative 4th year-preoperative)	–2 (–6:1)	–3 (–6:2)	0.885 <sup>a</sup>
<b>Ba</b>			
Preoperative	1 (–1:2)	0 (–2:2)	0.738 <sup>a</sup>
Postoperative 4th year	–2 (–3:–1)	–3 (–3:0)	–
ΔBa (postoperative 4th year-preoperative)	–2 (–5:1)	–3 (–6:1)	0.642 <sup>a</sup>
<b>C</b>			
Preoperative	3 (1:8)	4 (0:8)	0.816 <sup>a</sup>
Postoperative 4th year	–7 (–8:–5)	–8 (–8:–5)	–
ΔC (postoperative 4th year-preoperative)	–10 (–15:–3)	–12 (–16:–1)	0.890 <sup>a</sup>
<b>Ap</b>			
Preoperative	–1 (–3:3)	–1 (–3:2)	0.323 <sup>a</sup>
Postoperative 4th year	–2 (–3:–1)	–3 (–3:–2)	–
ΔAp (postoperative 4th year-preoperative)	–1 (–8:1)	–2 (–6:2)	0.637 <sup>a</sup>
<b>Bp</b>			
Preoperative	–1 (–2:2)	–1 (–3:1)	0.629 <sup>a</sup>
Postoperative 3rd year	–2 (–3:–1)	–3 (–3:–2)	–
ΔBp (Postoperative 3rd year-preoperative)	–1 (–7:3)	–2 (–9:2)	0.925 <sup>a</sup>

Data are given as median (minimum:maximum)

Δ score = postoperative 4th-year score-preoperative score. Negative values are positive regarding pelvic examination, while positive values are in the negative direction. Since the result of a Δ score is a subtraction process, it can take more values than the POP-Q scoring system

<sup>a</sup> Mann-Whitney U test

on the risks of postoperative stress urinary incontinence. We perform a sling procedure during the operation if a patient has stress urinary incontinence at the time of laparoscopic sacrocolpopexy for vaginal vault prolapse. In our study, there were six patients with SUI in both groups. Each branch performed a transobturator tape sling procedure during laparoscopic sacrocolpopexy on their patients. All the patients became continent within 1 year after the operation. There are a few high-quality studies of combined surgery for women with SUI and vaginal vault prolapse [27]. For instance, in a recent trial by Trabuco et al., they found that the retropubic midurethral sling resulted in higher stress-specific continence rates than Burch retropubic urethropexy at 1- and 2-year follow-up. Similarly, we have demonstrated the efficacy of the sling procedure with laparoscopic sacrocolpopexy in both branches in the long term.

Mesh erosion rates in laparoscopic sacrocolpopexy vary depending on the mesh structure. Since the introduction of polypropylene mesh, the rate of mesh erosion has decreased by 1% in laparoscopic sacrocolpopexy [28].

The mesh exposure/erosion ratio was found to be 10.5% in the long-term results of the CARE study [26]. However, most of the synthetic meshes were older products in this study with the known higher risk of mesh exposure. In our study, two patients in each group had mesh erosion, and three of these patients were treated with local estrogen therapy. Both the urology and gynecology branches use polypropylene mesh in every laparoscopic sacrocolpopexy, and all the meshes used in this study were polypropylene mesh. This study showed that when polypropylene mesh was used in laparoscopic sacrocolpopexy, long-term mesh complication rates were low in both the gynecology and urology branches.

Most studies report that the rate of mesh erosion increases significantly when laparoscopic sacrocolpopexy is performed after total laparoscopic hysterectomy [29, 30]. In parallel, we do not perform laparoscopic sacrocolpopexy in the same session after total laparoscopic hysterectomy. In this study, both the urology and gynecology branches performed the laparoscopic sacrocolpopexy operation only for

**Table 5** Clinical long-term outcomes of the laparoscopic sacrocolpopexy operation between urology and gynecology patients according to the quality-of-life questionnaires

	Urology patients (n = 94)	Gynecology patients (n = 96)	p value
<b>UDI-6</b>			
Preoperative	29.1 (12.5:75.0)	29.2 (25.0:75.0)	0.571 <sup>a</sup>
Postoperative 3rd year	12.5 (12.5:50.0)	13.9 (12.5:37.5)	–
ΔUDI-6 (postoperative 4th year-preoperative)	–16.6 (–62.5:20.9)	–15.3 (–60.4:18.4)	0.538 <sup>a</sup>
<b>POPDI-6</b>			
Preoperative	87.5 (75.0:91.6)	89.7 (75.0:94.8)	0.536 <sup>a</sup>
Postoperative 3rd year	20.8 (12.5:25)	22.4 (13.6:27.7)	–
Δ POPDI-6 (postoperative 4th year-Preoperative)	–66.7 (–79.1:–54.2)	–67.3 (–75.0:–62.5)	0.734 <sup>a</sup>
<b>CRADI-8</b>			
Preoperative	25.0 (0:34.3)	25.2 (0:34.3)	0.367 <sup>a</sup>
Postoperative 3rd year	37.5 (0:50)	39.2 (0:47.5)	–
ΔCRADI-8 (postoperative 4th year-preoperative)	12.5 (–34.3:37.5)	14.0 (–25.0:37.5)	0.629 <sup>a</sup>
<b>UIQ-7</b>			
Preoperative	33.3 (0:42.8)	31.2 (0:49.1)	0.865 <sup>a</sup>
Postoperative 3rd year	19.0 (0:33.3)	18.6 (0:23.8)	–
ΔUIQ-7 (postoperative 4th year-preoperative)	–14.3 (–42.8:19.0)	–12.6 (–33.3:0)	0.876 <sup>a</sup>
<b>POPIQ-7</b>			
Preoperative	80.9 (66.6:100)	81.4 (69.7:100)	0.628 <sup>a</sup>
Postoperative 3rd year	28.5 (23.8:33.3)	29.6 (21.9:39.6)	–
ΔPOPIQ-7 (postoperative 4th year-preoperative)	–52.4 (–66.7:–38.1)	–51.8 (–76.2:–33.3)	0.756 <sup>a</sup>
<b>CRAIQ-7</b>			
Preoperative	19.0 (9.5:33.3)	19.1 (9.5:42.8)	0.549 <sup>a</sup>
Postoperative 3rd year	33.3 (19.0:42.8)	33.5 (19.0:42.8)	–
ΔCRAIQ-7 (postoperative 4th year-preoperative)	14.3 (0:33.3)	14.4 (–14.3:23.8)	0.360 <sup>a</sup>

Data are given as median (minimum:maximum)

**PFDI-20:** Pelvic Floor Distress Inventory-short form 20. This form has 20 items and three scales, Urinary Distress Inventory 6 (UDI-6), Pelvic Organ Prolapse Distress Inventory 6 (POPDI-6) and Colorectal-Anal Distress Inventory 8 (CRADI-8). All of the scores range from 0 to 100 with higher scores indicating worsening symptoms

**PFIQ-7:** Pelvic Floor Impact Questionnaire-short form 7. This form has three scales, Urinary Impact Questionnaire (UIQ-7), Pelvic Organ Prolapse Impact Questionnaire (POPIQ-7) and Colorectal-Anal Impact Questionnaire (CRAIQ-7). Each scale has the same seven questions. All of the scores range from 0 to 100 with higher scores indicating worsening symptoms

Δ score = postoperative 4th-year score-preoperative score. Negative values are evaluated in the positive direction because the scale score decreases, while positive values are evaluated in the negative direction. Since the result of a Δ score is a subtraction process, it can take more values than the scale scores

<sup>a</sup> Mann-Whitney U test

<sup>b</sup> Pearson's chi-squared test

<sup>c</sup> Fisher's exact test

vaginal vault prolapse. The opening of the vaginal mucosal integrity and association of the vaginal flora with the abdominal environment may be one of the main causes of mesh-related complications.

In conclusion, we compared the long-term outcomes of 4 years of laparoscopic sacrocolpopexy operations performed

by two different branches in this study. Although the same operation was performed with two different surgical disciplines using their techniques, the long-term results were similar. Laparoscopic sacrocolpopexy is a useful and successful procedure in the surgical treatment of vaginal vault prolapse independently of the surgeon or surgical branch.

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## Compliance with ethical standards

**Conflicts of interest** None.

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