

## Perioperative complications and short-term outcomes of abdominal sacrocolpopexy, laparoscopic sacrocolpopexy, sacrospinous ligament fixation, and iliococcygeus fixation procedures

Alper BİLER<sup>1</sup>, İbrahim Egemen ERTAŞ<sup>1\*</sup>, Gökhan TOSUN<sup>1</sup>, İsmet HORTU<sup>2</sup>, Ahmet DEMİR<sup>1</sup>,  
Cüneyt Eftal TANER<sup>1</sup>, Mehmet ÖZEREN<sup>1</sup>, Fatih ŞENDAG<sup>2</sup>

<sup>1</sup>Department of Gynecology and Obstetrics, University of Health Sciences, Tepecik Education and Research Hospital, İzmir, Turkey

<sup>2</sup>Department of Gynecology and Obstetrics, School of Medicine, Ege University, İzmir, Turkey

Received: 31.12.2017 • Accepted/Published Online: 15.04.2018 • Final Version: 14.06.2018

**Background/aim:** This study aimed to investigate differences in perioperative complications and short-term outcomes of patients who underwent abdominal sacrocolpopexy/sacrohysteropexy, laparoscopic sacrocolpopexy/sacrohysteropexy, sacrospinous ligament fixation (SSLF), and iliococcygeus fixation due to apical prolapse.

**Materials and methods:** The present retrospective cohort study included 145 patients who underwent apical prolapse surgery performed by the same surgeons between 1/1/2011 and 30/6/2017. There were 68 abdominal sacrocolpopexies (44 sacrocolpopexies and 24 sacrohysteropexies), 13 laparoscopic sacrocolpopexies (10 sacrocolpopexies and 3 sacrohysteropexies), 57 SSLFs, and 7 iliococcygeus fixations. Patients' short-term outcomes, perioperative complications, blood loss, operative time, and hospital stay were analyzed.

**Results:** The mean operating time in the laparoscopic sacrocolpopexy group was 179.6 min versus 122.8, 117.3, and 107.1 min in the SSLF, abdominal sacrocolpopexy, and iliococcygeus fixation groups, respectively ( $P < 0.01$ ). The hospital stay was significantly shorter in the iliococcygeus fixation group (1.86 days) when compared with that of other groups ( $P < 0.01$ ). During a 6-month follow-up period, no prolapse recurrence or mesh exposure was observed in any groups. Wound complications were more frequent in the abdominal sacrocolpopexy group. However, the overall complication rate of each group did not differ significantly ( $P = 0.332$ ).

**Conclusion:** Overall, complication rates and short-term outcomes for the abdominal, laparoscopic, and vaginal surgical procedures were not statistically significantly different. However, minimally invasive approaches were associated with reduced procedural-related morbidity.

**Key words:** Sacrocolpopexy, sacrospinous ligament fixation, iliococcygeus fixation, complications, outcomes

### 1. Introduction

Pelvic organ prolapse (POP) is a common condition associated with the aging process and an important health problem for 50% of parous women aged over 50 years (1). Although the pathophysiology of prolapse is not completely understood, the risk of POP increases with the number of vaginal births and is higher in obese women (2).

Apical prolapse refers to the downward displacement of the vaginal apex, uterus, or cervix. It is associated with numerous signs and symptoms, including vaginal bulging, palpable or visible tissue protrusion, pelvic pain, dyspareunia, or obstructed intercourse, and interference with exercise. Without doubt, surgery is the most effective treatment option for POP (3). A variety of different

surgical techniques to correct apical prolapse have been reported in the past 60 years (4). These reconstructive techniques involve vaginal or abdominal approaches (open, laparoscopic, and robotic) or a combination of these. Although there is no consensus as to the best surgical approach, the most commonly accepted options for apical prolapse surgery are vaginal sacrospinous ligament fixation (SSLF) and abdominal sacrocolpopexy/sacrohysteropexy.

SSLF was originally introduced to correct posthysterectomy vaginal vault prolapse but was later extended for use in cases of severe apical prolapse with vaginal hysterectomy (5–7). Numerous previous studies have shown that sacrocolpopexy/sacrohysteropexy is the most effective option for apical prolapse surgery, and

\* Correspondence: drertas@gmail.com

sacrocolpopexy remains the preferred surgical procedure for restructuring the physiological axis of the vagina (8–10). A technique using a mesh bridge to hang the cervix or upper vagina to the anterior vertebral ligament in front of the sacral bone was first described in 1958 by Huguier and Scalin and expanded upon by Lane in 1962 (11). Over time, various authors have proposed modifications to the technique, including the level in front of the sacral bone for mesh fixation and the use of different types of mesh.

Open abdominal surgery for prolapse surgery is associated with higher morbidity as compared with vaginal routes (8). Ongoing innovations and developments in minimally invasive surgery led to the introduction of laparoscopic and later robotic-assisted laparoscopic approaches to abdominal sacrocolpopexy (11). Laparoscopic sacrocolpopexy, which has advantages of reduced morbidity and shorter hospital stays, offers outcomes as good as abdominal sacrocolpopexy in the correction of apical compartment prolapse (10,12,13). However, debate continues about whether abdominal or laparoscopic sacrocolpopexy offers the highest effectiveness, lowest perioperative complications, and higher cost-effectiveness.

The present cohort retrospective study represents the results of our 6.5-year operative experience and short-term outcomes of abdominal sacrocolpopexy/sacrohysteropexy, laparoscopic sacrocolpopexy/sacrohysteropexy, vaginal SSLF, and iliococcygeus fixation for the surgical treatment of women with symptomatic apical prolapse.

## 2. Materials and methods

The present retrospective cohort study consisted of 145 patients with a diagnosis of symptomatic stage 2 or greater apical prolapsus according to the Pelvic Organ Prolapse Quantification (POP-Q) system who underwent reconstructive surgery by the same surgeons at Tepecik Education and Research Hospital and Ege University Hospital, İzmir, Turkey, between 1/1/2011 and 30/6/2017. The study was conducted according to the ethical standards of the Declaration of Helsinki and received institutional review board approval.

Demographic data including age at surgery, parity, menopausal status, body mass index (BMI), previous pelvic surgeries (hysterectomy, pelvic floor repair, etc.), and comorbidities were obtained from the patients' medical records. All patients underwent the same preoperative protocol, which comprised a urogynecologic history, a physical examination, urine analysis, a voiding diary, cough stress test, postvoid residual urine volume analysis, and transvaginal ultrasonography. The POP-Q system for prolapse staging was used. To assess the influence of pressure and over/undercorrection, the patients were examined both in lying and sitting positions.

Only symptomatic uterine or vaginal vault prolapse patients with POP-Q stage 2 and above were included in the study. Patients who were medically unfit and had contraindications for surgery were excluded. All continent women with apical prolapse underwent a preoperative evaluation for occult stress urinary incontinence (SUI) and urinary stress (cough stress test), with and without reduction of the prolapse. Urodynamic studies were performed in women with complicated SUI.

Perioperative complications were described as any complication that occurred during surgery or within 6–10 weeks postoperatively including injury to the bladder, bowel, vagina, ureters, or vessels; wound complications; hematoma, abscess, urinary tract infection, gluteal pain, ileus, blood transfusion, and mesh infection. Short-term outcome described the 6-month period after surgery. In addition to perioperative and short-term outcome data, which included the type of surgical procedure, total operating time, estimated blood loss, and duration of hospital stay were abstracted from the electronic medical records. The total operating time began with the first skin incision and ended with the last closure of an incision. Patients having risk received antithrombotic prophylaxis with low-molecular-weight heparin. Antibiotic prophylaxis was administered to all patients. Estimated blood loss was calculated by the difference between pre- and postoperative hemoglobin levels. The duration of the hospital stay was measured from the time of admission to discharge. Women having vaginal erosion were prescribed vaginal estrogen before the surgery for 2–3 weeks. The urethral catheter was removed on the first postoperative day. All patients returned for follow-up examinations at least two times during the 6-month period after the surgery and were assessed for subjective outcome in terms of pelvic floor dysfunction symptoms and for anatomical outcome by vaginal examination.

### 2.1. Operative procedures

#### 2.1.1. Abdominal and laparoscopic sacrocolpopexy/sacrohysteropexy

The key steps of abdominal and laparoscopic sacrocolpopexy/sacrohysteropexy procedures were the same. If multiple pelvic floor defects or stress urinary incontinence were present, both open and laparoscopic sacrocolpopexy were frequently combined with other surgical procedures, such as anterior/posterior colporrhaphy, culdoplasty, and Burch colposuspension. In patients with a uterus, a sacrocolpopexy procedure was performed following total hysterectomy.

For abdominal sacrocolpopexy, the peritoneal cavity was entered with a Pfannenstiel incision. After entering the peritoneal cavity, a hysterectomy was performed. If the uterus had previously been removed, the vaginal vault was distinguished by pushing up with a probe from the vagina

and its covering peritoneum was dissected. To attach the mesh, a sufficiently broad area was exposed in the superior aspects of the pubocervical and rectovaginal fascia. The rectosigmoid colon was reflected to the left of the midline to expose the presacral area. The peritoneal layer over the promontory was elevated and then incised vertically with scissors by sharp dissection. Loose areolar tissues were gently dissected to the posterior cul-de-sac, avoiding damage to the rectum and ureters. Type 1 monofilament polypropylene mesh was attached to the anterior and posterior vagina distally using either absorbable or nonabsorbable sutures and to the anterior longitudinal ligament proximally at the level of the promontory without tension using nonabsorbable sutures. The excess mesh parts were trimmed over the sacral promontory after the fixation. The mesh was then reperitonealized with absorbable sutures. In patients with the uterus preserved, a transverse incision of 3–4 cm was performed at the posterior surface of the uterus where the sacrouterine ligaments were joined and this peritoneal incision was extended to the back of the uterine cervix for performing mesh fixation and sacrohysteropexy operation.

All laparoscopic operations were performed using standard endoscopic equipment. A 10-mm trocar was inserted from the umbilicus for the scope. Three additional 5-mm ports were inserted. One of these was placed 6–8 cm left of the umbilicus, and the other two were placed 2.5 cm medial and superior to the anterior superior iliac crests. A RUMI-2 uterine manipulator with a Koh Cup colpotomizer (Cooper Surgical, Trumbull, CT, US) was introduced vaginally at the beginning of the procedure. The procedure was the same as the abdominal procedure.

### 2.1.2. Sacrospinous ligament fixation (SSLF)

SSLF was performed unilaterally on the right side in patients with cuff prolapse or after a vaginal hysterectomy and peritoneum closure had been completed. A midline posterior incision in the vaginal wall was made just 2–3 cm below the vaginal apex and extended distally, and then the right pararectal space was dissected bluntly. Using the ischial spine and sacrum as anatomic landmarks, the right sacrospinous ligament was palpated and visualized. Two Breisky retractors were used to visualize the surgical stitching area and to retract the rectum medially. Two separate nonabsorbable sutures were applied 3 cm medial of the sacrospinous process using a curved needle-holder or suturing instrument. These sutures were then attached to the apex of the vaginal vault and upper vaginal mucosa. If multiple pelvic floor defects were present, other surgical procedures, such as anterior colporrhaphy and enterocele repair, were performed simultaneously. After separate saturation of the posterior vagina was completed, SSLF sutures were tied and apical suspension was performed followed by tying of the posterior vagina sutures lastly.

When indicated, a midurethral sling procedure, referred to as a transobturator tape (TOT) procedure (“outside-inside” technique), was performed concurrently in women with SUI.

### 2.1.3. Iliococcygeus fixation

A vaginal hysterectomy was first performed in all the patients in this group. The posterior vaginal wall was longitudinally incised from the vaginal vault to the introitus. Bilateral pararectal spaces were dissected, and the ischial spine was palpated. The levator ani muscle wall and overlying fascia were identified under direct vision. Then two separate bilateral nonabsorbable sutures were placed on the iliococcygeus muscle and levator ani fascia distally at the prespinous area (1 to 2 cm caudad and posterior to the ischial spine) using a curved needle-holder or suturing instrument. These sutures were then attached to the superior posterior vaginal vault mucosa. After completion of the posterior colporrhaphy and separate saturation of the posterior vagina, ligation of the apex suspension stitches was performed followed by tying of the posterior vagina sutures lastly.

### 2.2. Statistical analysis

The Kruskal–Wallis test for quantitative variables and chi-square test for categorical variables were used by using SPSS 20.0 (IBM Corp., Armonk, NY, USA).  $P < 0.05$  was considered to be statistically significant.

### 3. Results

In total, 145 patients with apical prolapse who were treated surgically and fulfilled the inclusion criteria were included in the study. Sixty-eight patients underwent abdominal sacrocolpopexy (sacrocolpopexy [ $n = 44$ ]; sacrohysteropexy [ $n = 24$ ]), 13 patients underwent laparoscopic sacrocolpopexy (sacrocolpopexy [ $n = 10$ ]; sacrohysteropexy [ $n = 3$ ]), 57 patients underwent vaginal SSLF, and 7 patients underwent vaginal iliococcygeus fixation. Of the 145 patients, 41 patients had vaginal cuff prolapse, 24 in the abdominal sacrocolpopexy group, 4 in the laparoscopic sacrocolpopexy group, and 13 in the vaginal SSLF group.

Table 1 shows the patients’ characteristics and pre- and postoperative data of the four groups. The median age and BMI of the patients and the rate of menopause were statistically significantly different and were higher in the iliococcygeus fixation group when compared with the other groups ( $P < 0.01$  for all). Many patients had a history of pelvic surgery. However, there was no significant difference between the groups. Previous pelvic organ prolapse surgery had been performed in 13 (8.9%) patients. There were 45 patients with stage two, 58 patients with stage three, and 42 patients with stage four according to the POP-Q.

**Table 1.** Patients' characteristics and pre- and postoperative data of the groups.

	Abdominal sacrocolpopexy (n = 68)	Laparoscopic sacrocolpopexy (n = 13)	Sacrospinous ligament fixation (n = 57)	Iliococcygeus fixation (n = 7)	P
Age (years)*	52.8 ± 12.1	55.2 ± 11	62.8 ± 6.8	67.1 ± 5.2	<0.01‡
Parity*	3.5 ± 1.6	2.9 ± 1.1	3.8 ± 1.5	3.4 ± 0.5	0.192‡
BMI (kg/m <sup>2</sup> )*	26.9 ± 1.9	26.08 ± 1.8	28.2 ± 1.6	34.1 ± 2.3	<0.01‡
Menopause**					<0.01#
Yes	42 (61.8)	9 (69.2)	54 (94.7)	7 (100)	
No	26 (38.2)	4 (30.8)	3 (5.3)	0 (0)	
Comorbidities**					0.215#
Yes	23 (33.8)	8 (61.5)	18 (31.6)	3 (42.8)	
No	45 (66.2)	5 (38.5)	39 (68.4)	4 (57.2)	
History of prior pelvic surgery**					0.054#
Yes	25 (36.8)	7 (53.8)	15 (26.3)	0 (0)	
No	43 (63.2)	6 (46.2)	42 (73.7)	7 (100)	
History of prior prolapsus surgery**					0.834#
Yes	7 (10.3)	1 (7.7)	5 (8.8)	0 (0)	
No	61 (89.7)	12 (92.3)	52 (91.2)	7 (100)	
Operating time (min)*	117.3 ± 41.6	179.6 ± 52.4	122.8 ± 36.1	107.1 ± 14.6	<0.01‡
Preoperative Hb (g/dL)*	12.8 ± 1.1	12.1 ± 0.89	12.3 ± 1.06	12 ± 1.73	0.133‡
Postoperative Hb (g/dL)*	11.04 ± 1.05	10.6 ± 0.96	10.4 ± 1.07	10.5 ± 1.2	0.139‡
Hospital stay (days)*	2.3 ± 0.92	2 ± 0.57	1.9 ± 0.34	1.8 ± 0.37	<0.01‡

Values are expressed as \*mean ± SD and \*\*n (%). ‡: Kruskal–Wallis test, #: chi-square test.

Table 2 presents the surgical procedures that were performed simultaneously in the four groups. Concomitant antiincontinence surgery was performed in 18 patients with SUI. A concomitant retropubic incontinence procedure (Burch colposuspension) was preferred in patients with abdominal and laparoscopic sacrocolpopexy, whereas a midurethral sling procedure (TOT) or minisling was performed in patients with vaginal SSLF and iliococcygeus fixation. In patients who underwent abdominal sacrocolpopexy, the most common simultaneous surgical procedure was culdoplasty.

The mean operating time was 179.6 min in the laparoscopic sacrocolpopexy group versus 122.8 min in the vaginal SSLF group, 117.3 min in the abdominal sacrocolpopexy group, and 107.1 min in the vaginal iliococcygeus fixation group ( $P < 0.01$ ). The hospital stay was significantly shorter in the vaginal iliococcygeus fixation group (1.86 days) when compared with that of the other groups ( $P < 0.01$ ). The hospital stay was longer in the abdominal sacrocolpopexy group (2.3 days) (Table 1).

The complications are demonstrated in Table 3. There was no operative mortality in any group. Complications

were more frequent in the abdominal sacrocolpopexy group. However, the overall complication rate of each group did not differ significantly ( $P = 0.332$ ). Wound infection was the most common complication in the patients who underwent abdominal sacrocolpopexy. Two patients experienced gluteal pain, which improved 6–10 weeks after SSLF. One patient bled during SSLF. For this patient, multiple warm sponge packing with pressure was sufficient to stop the bleeding. A presacral venous hemorrhage occurred in two patients, one of which occurred during laparoscopic sacrocolpopexy and the other during abdominal sacrocolpopexy. A Z suture and exerting pressure with a warm sponge were sufficient to stop the bleeding. These patients did not require a blood transfusion. In one patient, there was mild ileus after abdominal sacrocolpopexy, but no additional treatment was required in this case.

The rates of subjective satisfaction were high in all patients at 1 week and at 6 months postoperatively. During the 6-month follow-up period, apical, anterior, and posterior vaginal prolapse recurrence, mesh erosion/exposure, and de novo persistent constipation did not

**Table 2.** Surgical reconstructive procedures performed concomitantly in each group.

	Abdominal sacrocolpopexy (n = 68)	Laparoscopic sacrocolpopexy (n = 13)	Sacrospinous ligament fixation (n = 57)	Iliococcygeus fixation (n = 7)
Sacrocolpopexy	44 (64.7)	10 (76.9)	-	-
Sacrohysteropexy	24 (35.3)	3 (23.1)	-	-
Sacrospinous fixation	-	-	57 (100)	-
Iliococcygeus fixation	-	-	-	7 (100)
Abdominal hysterectomy	20 (29.4)	-	-	-
Laparoscopic hysterectomy	-	6 (46.1)	-	-
Vaginal hysterectomy	-	-	44 (77.1)	7 (100)
Anterior colporrhaphy	5 (7.3)	1 (7.7)	45 (78.9)	6 (85.7)
Posterior colporrhaphy	11 (16.1)	3 (23)	34 (59.6)	6 (85.7)
Vaginal enterocele repair	-	-	6 (10.5)	1 (14.2)
Culdoplasty	64 (94.1)	10 (76.9)	32 (56.1)	3 (42.8)
Burch colposuspension	8 (11.7)	1 (7.7)	-	-
Trans obturator tape	-	-	6 (10.5)	-
Mini sling	-	-	2 (3.5)	1 (14.2)
Cervical amputation	4 (5.8)	-	-	-
Vaginal paravaginal repair	-	-	1 (1.8)	-
Abdominal paravaginal repair	1 (1.4)	-	-	-

All values are expressed as n (%).

occur in any group of patients. However, one case of dyspareunia (1.2%), four cases of de novo urgency (4.9%) and three cases of de novo SUI (3.7%) occurred in the sacrocolpopexy group (n = 81). Two cases of dyspareunia (3.1%), five of de novo urgency (7.8%), and four of de novo SUI (6.2%) were diagnosed in the vaginal surgical fixations group (n = 64). Postoperative short-term outcomes were not statistically significant different among the four groups (Table 4).

#### 4. Discussion

Numerous surgical techniques are used to correct apical prolapse. Thus, it is difficult to compare perioperative short-term results and complications in published studies due to the inhomogeneous nature of the groups. Studies evaluating the perioperative complications and outcomes of the procedures are not commonly performed and only a few reports have been published (14,15). Most previous studies emphasized long-term outcomes and the efficacy of the procedures (7,9,13).

The present study demonstrated that age and BMI were highest in the vaginal iliococcygeus fixation group, and more patients in this group were menopausal. The vaginal iliococcygeus fixation group had shorter operation times

and hospital stays. Although the overall complication rates were not significantly different between the groups, the abdominal sacrocolpopexy/sacrohysteropexy group displayed a tendency toward more complications. Numerous previous studies and Cochrane collaborations have recommended sacrocolpopexy as the gold-standard surgical treatment for apical prolapse (8–10). Studies also confirmed that laparoscopic procedures, which have the advantages of reduced morbidity and short hospital stays, appear to be as effective as abdominal sacrocolpopexy (12,13). However, research also showed that laparoscopic procedures were associated with longer operating times, longer learning curves, and higher costs than either abdominal or vaginal surgery (16–18). Paraiso et al. compared laparoscopic abdominal sacrocolpopexy procedures in a comparative cohort study of 117 patients with posthysterectomy vaginal prolapse (16). They showed that the mean operating time was significantly greater in the laparoscopy group. However, the hospital stay was significantly decreased. Although we did not evaluate hospital costs in our study, the mean operating times and hospital stays in the abdominal and laparoscopic sacrocolpopexy groups were similar to those reported in previous studies (16–18).

**Table 3.** Perioperative complications in the groups.

	Abdominal sacrocolpopexy (n = 68)	Laparoscopic sacrocolpopexy (n = 13)	Sacrospinous ligament fixation (n = 57)	Iliococcygeus fixation (n = 7)	P
Hemorrhage	1 (1.4)	1 (7.7)	1 (1.7)	-	
Gluteal pain	-	-	2 (3.5)	-	
Urinary infection	2 (2.9)	-	1 (1.7)	-	
Febrile morbidity	1 (1.4)	-	-	-	
Wound infection	3 (4.4)	-	-	-	
Wound dehiscence	1 (1.4)	-	-	-	
Mild ileus	1 (1.4)	-	-	-	
Overall complications					0.332
Yes	9 (13.2)	1 (7.7)	4 (7)	0 (0)	
No	59 (86.8)	12 (92.3)	53 (93)	7 (100)	

All values are expressed as n (%).

A few previous studies compared perioperative outcomes in apical prolapse surgery in patients who underwent either abdominal sacrocolpopexy with vaginal sacrospinous fixation or abdominal and laparoscopic sacrocolpopexy (12,14,16). To our knowledge, this is the first study to compare perioperative results of various surgical methods, including abdominal laparoscopic sacrocolpopexy, vaginal SSLF, and vaginal iliococcygeus fixation, used in apical prolapse surgery.

Nygaard et al. published a comprehensive review of 3827 cases of abdominal sacrocolpopexy (9). Among these cases, the incidence of injuries was 3.1%; hemorrhages or blood transfusions or both was 4.4%; wound complications, including infections, hematomas, or superficial separation, was 4.6%; and urinary infection was 10.9% (9). Hardiman et al. (19) reported a similar incidence of wound complications (5%) and febrile morbidity of 6.3% in an abdominal sacrocolpopexy group. In the present study, the incidence of wound complications was slightly higher in the abdominal sacrocolpopexy group (5.9%) than that reported in the literature. However, there were no cases of bladder injuries and hemorrhages requiring blood transfusions.

In a review of 16 studies of vaginal SSLF, David-Montefiore et al. reported rectal injury, vascular injury, blood transfusion requirement, and urinary infection in 0.4%, 0.5%, 5.2%, and 14.2% of patients, respectively (20). Similarly, Beer et al. reported bleeding in 1.9%, hematomas in 0.4%, bladder injuries in 0.8%, and gluteal-retropubic pain in 2% of 2390 patients who underwent vaginal SSLF (8). In the current study, vascular injuries occurred in 1.75% of patients in the vaginal SSLF group, and persistent

gluteal-retropubic pain occurred in 3.5% of cases. These results seem to be consistent with the incidence reported in other studies in the literature.

Iliococcygeus fixation, popularized by Shull et al. (21), is an efficient procedure for apical prolapse surgery and not inferior to more commonly used techniques (22). Although vaginal iliococcygeus fixation is technically easy and associated with low morbidity, it is rarely performed, with only a few published reports on the use of this technique (21–23). In a retrospective comparative study, Maher et al. compared iliococcygeus fixation with SSLF in 128 women with symptomatic vaginal vault prolapse (22). They reported similar subjective curative rates (>90%) for both procedures. The iliococcygeus fixation procedure has some theoretical advantages compared with vaginal SSLF (21). This technique not only corrects apical prolapse but also prevents subsequent anterior segmental defects. In addition, the risk of vessel and nerve damage is reduced with iliococcygeus fixation, and chronic pain syndromes are also less common. Milani et al. (23) compared the efficacy and safety of iliococcygeus fixation and abdominal sacrocolpopexy in the treatment of vaginal vault prolapse. They showed that both surgical methods were effective in restoring normal anatomy in women with vaginal vault prolapse. The authors emphasized that iliococcygeus fixation appeared to be effective in restoring a normal anatomy in women with a large rectocele and in relieving related symptoms. Serati et al. (24) analyzed the efficacy and safety of iliococcygeus fixation in 44 patients with a median age of 66 years. They showed that this procedure was safe in the absence of intraoperative complications, with only three postoperative complications reported.

**Table 4.** Postoperative short-term outcomes in the groups.

	Abdominal sacrocolpopexy (n = 68)	Laparoscopic sacrocolpopexy (n = 13)	Sacrospinous ligament fixation (n = 57)	Iliococcygeus fixation (n = 7)	P
Subjective satisfaction	67 (98.5)	13 (100)	55 (96.4)	7 (100)	0.342
Apical prolapse recurrence	0 (0)	0 (0)	0 (0)	0 (0)	-
De novo urgency	4 (5.8)	0 (0)	4 (7)	1 (14.2)	0.196
De novo SUI	2 (2.9)	1 (7.6)	4 (7)	0 (0)	0.361
De novo dyspareunia	1 (1.4)	0 (0)	2 (3.5)	0 (0)	0.392

All values are expressed as n (%). SUI: Stress urinary incontinence.

The iliococcygeus fixation group had lower morbidity and shorter hospitalization times. In the present study, the mean operating time in the iliococcygeus fixation group was significantly shorter than that of the other groups, and the hospital stay was also significantly decreased. Notwithstanding the relatively small sample size of the iliococcygeus fixation group, the findings of the present study are in line with those in the literature.

Freeman et al. compared laparoscopic and abdominal sacrocolpopexy in a randomized trial (25). They observed significantly less blood loss, shorter hospital stays, and less use of analgesia in the laparoscopic group. Although the operating time was longer in the laparoscopic sacrocolpopexy group, this finding was not statistically significant. More recently, in a randomized controlled trial by Costantini et al., abdominal sacrocolpopexy was associated with higher median blood loss and longer hospital stays, whereas laparoscopic sacrocolpopexy was associated with longer median operating times (12). Demirci et al. assessed perioperative results and complications in abdominal sacrocolpopexy and vaginal SSLF procedures (14). They found a significantly shorter operating time and hospital stay in the vaginal SSLF group but no significant difference in blood loss between groups.

Prolapse recurrence is higher among younger patients with POP after surgery. However they have a lower overall risk of surgery-related complications as compared with older women (26–28). Abdominal sacrocolpopexy and laparoscopic sacrocolpopexy procedures are considered to have long-term efficacy. However, they have higher surgical risks than vaginal procedures. Thus, procedures with higher long-term efficacy should be selected, especially for younger patients (26–28).

POP surgery is feasible and safe in many elderly patients. Unlike young women, the risk of recurrence is lower in older patients, although the risk of surgery-related complications is higher in older patients as compared with younger patients (26–28). Older people also have a higher

prevalence of baseline comorbidities, such as hypertension, diabetes, and cardiopulmonary diseases (29). Surgery duration of  $\geq 5$  h, age of  $\geq 70$  years, and laparotomy are accepted risk factors for postoperative complications such as blood transfusion and venous thromboembolism (29). In our study, age and menopausal status were significantly different between the groups. In elderly patients, the vaginal route is preferred for apical prolapse surgery because it is a less invasive surgical method. In the present study, the oldest patients were in the iliococcygeus fixation group and the mean operating time was significantly shorter than that in the other groups. The longest operating time was in the laparoscopic sacrocolpopexy group ( $P < 0.01$ ). Furthermore, the hospital stay was significantly decreased in the iliococcygeus fixation group and longest in the abdominal sacrocolpopexy group.

In the present study, there were more complications in the abdominal sacrocolpopexy group, but the overall complication rates were not significantly different between the groups. This finding might be explained by surgical selection according to age, with the vaginal route preferred in elderly women, as it is expected to result in fewer complications. Although there were no complications in the iliococcygeus fixation group, the relatively small sample in this group should be kept in mind. There were also no significant differences in blood loss between the groups.

Although POP prevalence is higher in obese women (2), the outcomes of surgical correction of apical prolapse in obese women do not appear to be different from those of nonobese women (30). However, obesity may be related to increased morbidity because of concomitant comorbidities, difficulties in creating the surgical field, or poor wound healing (29,30). However, in our study population, we found no differences in complication rates associated with obesity. This may be explained by the fact that the patient group with the highest BMI consisted of the oldest patients and that the vaginal surgical route was preferred in this patient group.

De novo SUI ranging from 17%–37% and 4%–50% is the most frequently reported complication associated with sacrocolpopexy and SSLF (8–10,18). In our cohort, we observed de novo SUI rates of 3.7% in the sacrocolpopexy group (n = 81) and 6.2% in vaginal suspension procedures (n = 64), which is in accordance with previously published data (10). Moreover, short-term outcome rates including subjective satisfaction, apical prolapse recurrence, de novo urgency, and de novo dyspareunia were not statistically significantly different among the four groups and these data are in concordance with previous published data (8–10,18).

The main limitation of the present study is its retrospective nature and the small sample sizes, especially in the laparoscopic sacrocolpopexy and iliococcygeus fixation groups. Retrospective cohort studies are subject to selection bias, recall bias, and unknown confounding variables, which may negatively affect the accuracy of the results. Another limitation is the relatively short-

term follow-up of patients postoperatively. We tracked outcomes for 6 months postoperatively, which may underestimate the incidence of recurrence of POP, de novo SUI, and mesh erosion. The strengths of the present study are including and evaluating four different surgical routes performed by the same experienced surgeons that may affect the duration and outcomes of the procedures and also the absence of patients lost to follow-up during the 6-month period.

In conclusion, in our cohort, overall complication rates and short-term outcomes did not differ among the groups. The mean operating times and hospital stays were shortest in the iliococcygeus fixation group. Prior to selecting the primary surgical procedure for apical prolapse, the patient's choice and age, BMI, medical status, previous surgical history, and surgeon's experience should be considered to avoid surgical complications. Further prospective studies with larger study samples are warranted to confirm our findings.

## References

- Subak LL, Waetjen LE, van den Eeden S, Thom DH, Vittinghoff E, Brown JS. Cost of pelvic organ prolapse surgery in the United States. *Obstet Gynecol* 2001; 98: 646-651.
- [No authors listed.] Risk factors for genital prolapse in non-hysterectomized women around menopause. Results from a large cross-sectional study in menopausal clinics in Italy. Progetto Menopausa Italia Study Group. *Eur J Obstet Gynecol Reprod Biol* 2000; 93: 135-140.
- Nygaard I, Barber MD, Burgio KL, Kenton K, Meikle S, Schaffer J, Spino C, Whitehead WE, Wu J, Brody DJ et al. Prevalence of symptomatic pelvic floor disorders in US women. *JAMA* 2008; 300: 1311-1316.
- Barbalat Y, Tunuguntla HS. Surgery for pelvic organ prolapse: a historical perspective. *Curr Urology Rep* 2012; 13: 256-261.
- Randall CL, Nichols DH. Surgical treatment of vaginal inversion. *Obstet Gynecol* 1971; 38: 327-332.
- Cruikshank SH. Sacrospinous fixation--should this be performed at the time of vaginal hysterectomy? *Am J Obstet Gynecol* 1991; 164: 1072-1076.
- Porges RF, Smilen SW. Long-term analysis of the surgical management of pelvic support defects. *Am J Obstet Gynecol* 1994; 171: 1518-1528.
- Beer M, Kuhn A. Surgical techniques for vault prolapse: a review of the literature. *Eur J Obstet Gynecol Reprod Biol* 2005; 119: 144-155.
- Nygaard IE, McCreery R, Brubaker L, Connolly A, Cundiff G, Weber AM, Zyczynski H; Pelvic Floor Disorders Network. Abdominal sacrocolpopexy: a comprehensive review. *Obstet Gynecol* 2004; 104: 805-823.
- Maher C, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J. Surgery for women with apical vaginal prolapse. *Cochrane Database Syst Rev* 2016; 10: CD012376.
- McDermott CD, Hale DS. Abdominal, laparoscopic, and robotic surgery for pelvic organ prolapse. *Obstet Gynecol Clin North Am* 2009; 36: 585-614.
- Costantini E, Mearini L, Lazzeri M, Bini V, Nunzi E, di Biase M, Porena M. Laparoscopic versus abdominal sacrocolpopexy: a randomized, controlled trial. *J Urol* 2016; 196: 159-165.
- Sarlos D, Kots L, Ryu G, Schaer G. Long-term follow-up of laparoscopic sacrocolpopexy. *Int Urogynecol J* 2014; 25: 1207-1212.
- Demirci F, Ozdemir I, Somunkiran A, Topuz S, Iyibozkurt C, Duras Doyran G, Kemik Gul O, Gul B. Perioperative complications in abdominal sacrocolpopexy and vaginal sacrospinous ligament fixation procedures. *Int Urogynecol J Pelvic Floor Dysfunct* 2007; 18: 257-261.
- Coolen AL, van Oudheusden AM, van Eijndhoven HW, van der Heijden TP, Stokmans RA, Mol BW, Bongers MY. A Comparison of complications between open abdominal sacrocolpopexy and laparoscopic sacrocolpopexy for the treatment of vault prolapse. *Obstet Gynecol Int* 2013; 2013: 528636.
- Paraiso MF, Walters MD, Rackley RR, Melek S, Hugney C. Laparoscopic and abdominal sacrocolpopexies: a comparative cohort study. *Am J Obstet Gynecol* 2005; 192: 1752-1758.
- Serati M, Bogani G, Sorice P, Braga A, Torella M, Salvatore S, Uccella S, Cromi A, Ghezzi F. Robot-assisted sacrocolpopexy for pelvic organ prolapse: a systematic review and meta-analysis of comparative studies. *Eur Urol* 2014; 66: 303-318.



18. Maher C, Feiner B, Baessler K, Schmid C. Surgical management of pelvic organ prolapse in women. *Cochrane Database Syst Rev* 2013; 4: CD004014.
19. Hardiman PJ, Drutz HP. Sacrospinous vault suspension and abdominal colposacropexy: success rates and complications. *Am J Obstet Gynecol* 1996; 175: 612-616.
20. David-Montefiore E, Garbin O, Hummel M, Nisand I. Sacrospinous ligament fixation peri-operative complications in 195 cases: visual approach versus digital approach of the sacrospinous ligament. *Eur J Obstet Gynecol Reprod Biol* 2004; 116: 71-78.
21. Shull BL, Capen CV, Riggs MW, Kuehl TJ. Bilateral attachment of the vaginal cuff to iliococcygeus fascia: an effective method of cuff suspension. *Am J Obstet Gynecol* 1993; 168: 1669-1677.
22. Maher CF, Murray CJ, Carey MP, Dwyer PL, Ugoni AM. Iliococcygeus or sacrospinous fixation for vaginal vault prolapse. *Obstet Gynecol* 2001; 98: 40-44.
23. Milani R, Cesana MC, Spelzini F, Sicuri M, Manodoro S, Fruscio R. Iliococcygeus fixation or abdominal sacral colpopexy for the treatment of vaginal vault prolapse: a retrospective cohort study. *Int Urogynecol J* 2014; 25: 279-284.
24. Serati M, Braga A, Bogani G, Leone Roberti Maggiore U, Sorice P, Ghezzi F, Salvatore S. Iliococcygeus fixation for the treatment of apical vaginal prolapse: efficacy and safety at 5 years of follow-up. *Int Urogynecol J* 2015; 26: 1007-1012.
25. Freeman RM, Pantazis K, Thomson A, Frappell J, Bombieri L, Moran P, Slack M, Scott P, Waterfield M. A randomised controlled trial of abdominal versus laparoscopic sacrocolpopexy for the treatment of post-hysterectomy vaginal vault prolapse: LAS study. *Int Urogynecol J* 2013; 24: 377-384.
26. Whiteside JL, Weber AM, Meyn LA, Walters MD. Risk factors for prolapse recurrence after vaginal repair. *Am J Obstet Gynecol* 2004; 191: 1533-1538.
27. Diez-Itza I, Aizpitarte I, Becerro A. Risk factors for the recurrence of pelvic organ prolapse after vaginal surgery: a review at 5 years after surgery. *Int Urogynecol J Pelvic Floor Dysfunct* 2007; 18: 1317-1324.
28. Nieminen K, Huhtala H, Heinonen PK. Anatomic and functional assessment and risk factors of recurrent prolapse after vaginal sacrospinous fixation. *Acta Obstet Gynecol Scand* 2003; 82: 471-478.
29. Stepp KJ, Barber MD, Yoo EH, Whiteside JL, Paraiso MF, Walters MD. Incidence of perioperative complications of urogynecologic surgery in elderly women. *Am J Obstet Gynecol* 2005; 192: 1630-1636.
30. Bradley CS, Kenton KS, Richter HE, Gao X, Zyczynski HM, Weber AM, Nygaard IE; Pelvic Floor Disorders Network. Obesity and outcomes after sacrocolpopexy. *Am J Obstet Gynecol* 2008; 199: 690.e1-8.