ORIGINAL ARTICLE

DOI: 10.34057/PPj.2022.41.03.2022-11-1
Pelviperineology 2022;41(3):178-184

Perioperative outcomes of robotic versus laparoscopic sacrocolpopexy

Esra ÖZBAŞLI, Mete GÜNGÖR

Department of Obstetrics and Gynecology, Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine, İstanbul, Türkiye

Citation: Özbaşlı E, Güngör M. Perioperative outcomes of robotic versus laparoscopic sacrocolpopexy. Pelviperineology 2022;41(3):178-184

ABSTRACT

Objective: To compare the perioperative outcomes of robotic-assisted sacrocolpopexy (RSCP) versus conventional laparoscopic sacrocolpopexy (LSCP).

Materials and Methods: A retrospective cohort of 68 patients underwent conventional LSCP or RSCP at Acıbadem Maslak University Hospital between May 2010 and June 2019. Data on demographic and surgical characteristics and peri- and postoperative outcomes were examined. The primary outcomes were operative time and postoperative complication rate. The secondary outcomes were postoperative pain score, pre- and postoperative hemoglobin values, body mass index, readmission rate, length of hospital stay, and incidence of intraoperative complication. The Kolmogorov-Smirnov goodness-of-fit test, t-test, Mann-Whitney U test, chi-square test, and Fisher's Exact test were used, and Spearman correlation analysis was performed.

Results: In total, 68 patients were evaluated (LSCP, n=52; RSCP, n=16). The RSCP group (204.88±54.97 min) had a longer operative time than the LSCP group (142.1±35.32 min) (p<0.001). The rates of early postoperative complications (such as desaturation, oliguria, and nausea) were 31.3% in the RSCP group and 5.8% in the LSCP group (p=0.015). The postoperative pain scores did not significantly differ between the LSCP group (3.9±1.64) and the RSCP group (3.38±1.54) (p=0.256). Further, there was no significant difference between the two groups in terms of pre- and postoperative hemoglobin values, demographic characteristics, readmission rate, incidence of intra- and postoperative complications (such as mesh erosion, voiding difficulty, fistula, and recurrence), and length of hospital stay.

Conclusion: LSCP may be superior to RSCP. However, the surgical route should be individualized based on the surgeon's experience and the clinic's resources.

Keywords: Sacrocolpopexy; pelvic organ prolapse; laparoscopy; robotic surgery

Address for Correspondence: Esra Özbaşlı, Department of Obstetrics and Gynecology, Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine, İstanbul, Türkiye
Phone: +90 212 304 44 95 **E-mail:** esraizmit@gmail.com **ORCID ID:** orcid.org/0000-0003-0558-7296
Received: 03 Nov 2022 **Accepted:** 21 Dec 2022

INTRODUCTION

Pelvic organ prolapse (POP) is a condition that often affects women, particularly those with risk factors such as advanced age, history of interventional birth, menopause, and family history of POP.[1] The rate of POP surgery ranges from 11% to 19%.[2,3] Sacrocolpopexy (SCP) is the gold standard procedure for apical prolapse. SCP can keep the vagina and uterus in the correct anatomical position with mesh tapes. Although SCP was initially performed with the abdominal and vaginal approach, minimally invasive techniques, such as conventional and robotic-assisted laparoscopy, are commonly preferred to date.[4] Compared with sacrospinous ligament fixation, SCP is associated with a lower incidence of dyspareunia and a higher success rate.[4,5] In a meta-analysis performed by De Gouveia De Sa et al.[6], there was no significant difference in terms of anatomical outcomes, mortality rate, length of hospital stay, and postoperative quality of life. However, robotic-assisted sacrocolpopexy (RSCP) is correlated with a longer operative time and a higher level of postoperative pain.[6]

The current study aimed to retrospectively assess the perioperative outcomes of conventional laparoscopic sacrocolpopexy (LSCP) and RSCP and compare data with previous studies.

MATERIALS AND METHODS

During the study period, 97 patients underwent SCP, and 29 patients were excluded due to lack of data. The data of 68 patients who underwent LSCP or RSCP at our department between May 2010 and June 2019 were collected retrospectively from the patient files. Details on demographic characteristics [such as age and body mass index (BMI)], surgical indications, menopause status, type of surgery performed and mesh used, peritoneum closure, pre- and postoperative hemoglobin values, volume of intraoperative blood loss, operative time, postoperative pain, and complications (such as fever, rectovaginal fistula, incontinence or cystosel, micturation difficulties, bladder overactivity, globe vesicale, ileus, vault prolapse, bleeding, and mesh complications) were evaluated.

This study was approved by the Medical Ethics Committee of the Institutional Ethical Review Board of Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine (ATADEK-2022-16/03).

SCP was performed on patients with POP. Transobturatuar tape (TOT) was used in patients with accompanying stress incontinence and urethral hypermobility. Colporrhaphy anterior and posterior surgeries were conducted if cystocel and rectocel were observed.

All surgeries were performed by the same surgeon. The surgical route (either LSCP or RSCP) was selected according to clinical findings and the surgeon and patient's preference.

All patients received general anesthesia, and they were placed in the lithotomy position at a Trendelenburg angle of 30°. After sterilization with iodine and draping, a Foley catheter was inserted. VCare® (©2022 CONMED Corporation) uterine manipulator was used in all uterin prolapse cases. The pneumoperitoneum was then established up to 14 mmHg, with carbon dioxide insufflation throughout surgery.

In LSCP, a 10-mm umbilical trocar, two lateral 5-mm trocars, and a 5-mm suprapubic trocar were used. Further, a 10-mm laparoscope was utilized for visualization. Ultrasonic and integrated bipolar instruments (Thunderbeat Olympus Medical Systems Corporation of America, 3500 Corporate Parkway, Center Valley, PA 18034, the USA) were used for vessel sealing and dissection. Meanwhile, non-articular instruments were applied together.

RSCP was performed using the da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA). An 8-mm umbilical port, two 8-mm right and left ancillary ports, and a 12-mm smoke evacuator (Airseal®; SurgiQuest, Inc.) were used.

In our clinic, both hysterectomy and SCP were performed similar to other methods in the literatüre.[7-9] The peritoneum was excised from the upper level of the promontory to the recto-uterine space to create a suitable area for the mesh. The peritoneum surrounding the uterus was incised. The anterior and posterior vaginal wall was dissected to secure the mesh. The bilateral ureters were visualized to prevent injury. In patients with vaginal vault prolapse or those who had hysterectomy simultaneously, the bifurcated side of the mesh was sutured to the vesicovaginal and prerectal space and the anterior and posterior vaginal vault. Meanwhile, it was sutured to the anterior and posterior parts of the uterus in patients with preserved uterus. The non-bifurcated part of the mesh was fixated to the anterior longitudinal ligament along the sacral promontory. The prevertebral parietal peritoneum was vertically incised in all cases. At the end of the surgery, the peritoneum was closed with a 2/0 polyglactin 910 running suture in all cases. The urinary catheter was removed after 24 h.

Different suture materials, such as 1/0 or 2/0 polyglactin 910 suture (Coated Vicryl™, Ethicon), 2/0 polypropylene (Prolene™, Ethicon), and 2/0 polyglycolic barbed suture (2-0, V-Loc™, 180 wound closure device, Covidien, Mansfield, the USA), were used to suture the mesh to the vagina or uterus. Simultaneously, the other end of the mesh was fixed to the promontory either with the same sutures or with a tacker (The EndoFast Reliant™, IBI Medical, Caesarea, Israel). The EndoFast Reliant™ SCP mesh or the custom-made non-absorbable 5*2-cm polypropylene Y-mesh was utilized.

Pre- and postoperative hemoglobin and hematocrit values were compared to evaluate the volume of blood loss. The preoperative blood count was analyzed 24-48 h before the surgery. Meanwhile, postoperative blood count analysis was performed 24 h after surgery.

In one patient, a drain was placed in the abdomen and was removed on postoperative day 1.

Low-molecular-weight heparin was administered to patients who had risk factors for embolism.

The operative time was calculated as the time between intubation and extubation by the anesthesia team. The length of hospital stay was defined as the time between the patient's hospitalization before the surgery and the day of discharge.

Early complications were defined as complications occurring within the first week postoperatively. Late postoperative complications were divided into three groups based on time of occurence (within the first year after surgery, between 1 and 3 years, and after the third year).

The patients came to their first controls between the 7th and 10th postoperative days. Subsequent controls were performed between the 3rd and 6th months postoperatively.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation and/or median (minimum-maximum) and categorical variables as numbers and percentages. Normality analyses of continuous variables were performed using the Kolmogorov-Smirnov goodness-of-fit test. For normally distributed data, an independent sample t-test was used to compare the clinical outcomes and scores between the groups. When the distributions were not normal, the Mann-Whitney U test was used to compare these variables. Categorical data were compared with the chi-square test and Fisher's Exact test. The linear association between variables was assessed via Spearman correlation analysis. All data were evaluated using the Statistical Package for the Social Sciences software version 26.0 (IBM Corporation, Armonk, NY, the USA). A *p*-value of <0.05 was considered statistically significant.

Table 1. Demographic characteristics of the patients

		Robotic-assisted sacrocolpopexy group (n=16)	Laparoscopic sacrocolpopexy group (n=52)	*p*-value
Age	**Mean ± SD**	61±10.95	61.77±8.77	0.774***
Body mass index	**Mean ± SD**	26.86±3.88	27.58±4.84	0.549***
Parity	**Multiparity**	15 (93.8%)	52 (100%)	0.235**
	Nulliparity	1 (6.3%)	0 (0.0%)	
Menopause	**Yes**	13 (81.3%)	47 (90.4%)	0.612**
	No	2 (12.5%)	4 (7.7%)	
Menopause duration (years)	**Mean ± SD**	12.29±7.87	13.13±9.29	0.760***
Hormone replacement therapy (HRT)	**Yes**	0 (0%)	4 (7.7%)	0.566**
	No	16 (100%)	48 (92.3%)	
HRT duration (years)			6.5±5.05	
Concomitant disease	**Yes**	12 (75%)	39 (75%)	1.000**
	No	4 (25%)	13 (25%)	
Number of vaginal births	**1**	3 (18.8%)	9 (17.3%)	0.246*
	2	8 (50%)	35 (67.3%)	
	3	5 (31.3%)	6 (11.5%)	
	4	0 (0%)	2 (3.8%)	
Previous history of hysterectomy	**Yes**	1 (6.3%)	11 (21.2%)	0.268**
	No	15 (93.8%)	41 (78.8%)	
Previous history of surgery for urinary incontinence	**Yes**	0 (0%)	6 (11.5%)	0.323**
	No	16 (100%)	46 (88.5%)	
Previous history of surgery for pelvic organ prolapse	**Yes**	0 (0%)	6 (11.5%)	0.323**
	No	16 (100%)	46 (88.5%)	

*chi-square test; **Fisher's Exact test; ***t-test in the independent groups; ****Mann-Whitney U test; SD: standard deviation

RESULTS

The robotic surgery technique was used in 16 of 68 patients evaluated within the scope of the study and the laparoscopic surgery technique in 52 patients. The LSCP group (61.77±8.77 years) was older than the RSCP group (61±10.95 years). However, the results did not significantly differ (p=0.774).

There was no significant difference in the proportion of multiparous women in the RSCP group (93%) and the LSCP group (100%) (p=0.235).

The LSCP group (27.58±4.84 kg/m^2) had a greater BMI than the RSCP group (26.86±3.88 kg/m^2). However, the results did not significantly differ (p=0.549). Table 1 shows the demographic characteristics of patients.

The RSKP group (204.88±54.97 min) had a significantly longer operative time than the LSCP group (142.1±35.32 min) (p<0.001). In addition, there was a significant difference in the incidence of early postoperative complications (such as desaturation, oliguria, and nausea) between the RSCP group (31.3%) and the LSCP group (5.8%) (p=0.015).

The LSKP group (3.9±1.64) had a higher postoperative pain score than the RSKP group (3.38±1.54). Nevertheless, the results did not significantly differ (p=0.256).

There was no significant difference in terms of pre- and postoperative hemoglobin and hematocrit values; BMI; parity; presence and duration of menopause; hormone replacement rates; presence of concomitant disease; rates of vaginal delivery, previous hysterectomy/incontinence and/or prolapse surgery, readmission, and concomitant hysterectomy/TOT/colporrhaphy; incidence of postoperative complications, length of hospital stay; peritoneum suturing; and type of suture materials used between the two groups.

None of the patients presented with intraoperative complications. Conversion to open surgery was not required in any of the cases.

In terms of early postoperative complications, desaturation was observed in four (5.8%) patients, leg pain in one (1.4%), oliguria in one (1.4%), nausea and dizziness in one (1.4%), and throat ache in one (1.4%). Regarding late postoperative complications, rectovaginal fistula was observed in one (1.4%) patient, incontinence in two (2.9%), cystocele in three (4.4%), micturation difficulty in one (1.4%), bladder overacitvity in one (1.4%), globe vesicale in one (1.4%), ileus in one (1.4%), vaginal vault prolapse in one (1.4%), and mesh erosion in one (1.4%). Only one patient in the LSCP group underwent secondary surgery for postoperative complication (ileus). Table 2 depicts the clinical outcomes of patients.

The LSCP group (80%) had a higher postoperative complication rate within the first year than the RSCP group (33.3%). However, the RSCP group had higher complication rates between 1 and 3 years and after 3 years than the LSCP group. However, the results did not significantly differ (p=0.120) (Table 3).

In the RSCP group, none of the patients with tacker, which was used to fix the mesh to the promontory, developed late postoperative complications. Meanwhile, two (12.5%) patients with sutures had late postoperative complications. However, the results did not significantly differ (p=0.500). On the contrary, in the LSCP group, patients with tacker had a higher late postoperative complication rate than those with sutures (12.5% and 3.6%, respectively). However, the results did not significantly differ (p=0.324).

In our study, the readmission rates due to postoperative complications in all patients were compared according to the suture material used for the vaginal vault. The readmission rates were 63.6% in patients with 1/0 polyglactin 910 suture, 18.2% in those with 2/0 polypropylene suture, and 18.2% in those with 2/0 polyglycolic barbed suture. None of the patients with 2/0 polyglactin 910 suture were readmitted. Although the differences were not statistically significant, the differences were very close to the statistical significance limit (p=0.051).

The RSCP (1.81±0.54) and LSCP (1.75±0.71) groups did not significantly differ in terms of length of hospital stay (p=0.565).

DISCUSSION

Although SCP is the gold standard treatment particularly for apical prolapse, the surgical method that should be used differs based on the conditions of the clinic, patient's condition, and surgeon's preference. To date, the trend toward minimally invasive surgery has increased the rate of LSCP and RSCP.[10-12] Minimally invasive surgery is preferred because it is associated woth lesser pain, faster recovery time, and shorter hospital stay. However, previous studies comparing conventional LSCP and RSCP are limited.[8,13] Therefore, the current study aimed to compare the perioperative outcomes of LSCP and RSCP.

Tan-Kim et al.[13] showed that RSCP is longer by almost 75 min than LSCP. Hence, the cost will be high. Although out study did perform cost comparison, the operative time of RSCP was longer by approximately 63 min than that of LSCP. Kallidonis et al.[14] showed that the operative time of LSCP was 99.75 min, which was lower than that observed in our study. However, in the study of Lee et al.[8], the mean operative time of LSCP was 124 min, which is consistent with our study. In the same review, the mean surgical time of RSCP was almost similar to that of our study (202 and 204.8 min, respectively). Docking time may prolong robotic surgery. However, the proceudre duration was approximately 10 min in our study.

Table 2. Peri- and postoperative outcomes and surgical characteristics

		Robotic-assisted sacrocolpopexy (n=16)	Laparoscopic sacrocolpopexy (n=52)	*p*-value
Intraoperative complications	Yes	0 (0%)	0 (0%)	
	No	16 (100%)	52 (100%)	
Pre-/postoperative hemoglobin difference	Mean ± SD	-1.71±0.71	-1.73±0.64	0.949***
Early postoperative complications	Yes	5 (31.3%)	3 (5.8%)	0.015**
	No	11 (68.8%)	49 (94.2%)	
Readmission	Yes	3 (18.8%)	8 (15.4%)	0.712**
	No	13 (81.3%)	44 (84.6%)	
Late postoperative complications	Yes	2 (12.5)	4 (7.7%)	0.620**
	No	14 (87.5%)	48 (92.3%)	
Secondary surgery for complications	Yes	0 (0%)	1 (1.9%)	1.000**
	No	16 (100%)	50 (96.2%)	
Length of hospital stay (days)	Mean ± SD	1.81±0.54	1.75±0.71	0.565****
Duration of urinary catheter (days)	Mean ± SD	1.13±0.34	1.06±0.24	0.371****
Drain usage	Yes	0 (0%)	1 (1.9%)	1.000**
	No	16 (100%)	51 (98.1%)	
Peritonisation	Yes	16 (100%)	52 (100%)	
	No	0 (0%)	0 (0.0)	
Mesh fixation method to the promontory (EndoFast Reliant™)	Sütür	10 (62.5%)	28 (53.8%)	0.542*
	Tacker	6 (37.5%)	24 (46.2%)	
Number of sutures used to suture the mest to the vagina	2	8 (50%)	28 (53.8%)	0.964*
	3	6 (37.5%)	18 (34.6%)	
	4	2 (12.5%)	6 (11.5%)	
Concomitant hysterectomy	Yes	12 (75%)	35 (67.3%)	0.759**
	No	4 (25%)	17 (32.7%)	
Concomitant colporraphy (anterior/posterior)	Yes	16 (100%)	49 (94.2%)	1.000**
	No	0 (0%)	3 (5.8%)	
Concomitant urinary incontinence surgery	Yes	16 (100%)	47 (90.4%)	0.330**
	No	0 (0%)	5 (9.6%)	

*chi-square test; **Fisher's Exact test; ***t-test in the independent groups; ****Mann-Whitney U test; SD: standard deviation

Contrary to some studies, the LSCP group had a higher postoperative pain than the RSCP group. However, the results did not significantly differ.[6,10,15]

In our study, there was no significant difference between the two groups in terms of late postoperative complications, which is consistent with a meta-analysis conducted in 2015.[6]

The mesh erosion rate in our study was consistent with the mesh erosion rate (1%) in the review study of Lee et al.[8], which included 11 studies with 1221 patients. Claerhout et al.[16] revealed that complications such as *de novo* constipation and dyspareunia were observed in the postoperative period. Meanwhile, ileus was not observed. In our study, contrary to this study, which did not show other symptoms, ileus was observed in 1.4% of patients.

Table 3. Timing of postoperative complications

Timing of postoperative complication	Group		*p*-value
	Robotic-assisted sacrocolpopexy	Laparoscopic sacrocolpopexy	
1 week to 1 year	1 (33.3%)	8 (80.0%)	0.120*
1–3 years	1 (33.3%)	2 (20.0%)	
>3 years	1 (33.3%)	0 (0.0%)	
Total	3 (100.0%)	10 (100.0%)	

*chi-square test

As suggested by Culligan et al.[3] re-peritonization was performed on the mesh to prevent bowel-related complications in our study. Securing the mesh with peritonization may explain the

low rates of bowel-related complications. However, some studies revealed that re-peritonization does not affect the bowel-related complication rate.[17]

In the review of Costantini et al.[18], it was stated that mesh erosion was more common in cases that underwent hysterectomy with SCP. In our study, mesh erosion was observed in only one patient who had undergone LSCP, hysterectomy, TOT, colporrhaphy anterior and posterior operations. However, we could not compare because this complication was not observed in another patient.

In our study, in accordance with the literature, there was no significant difference in terms of late postoperative complications between patients with sutures and those with tackers, which were used in the fixation of the mesh to the promontorium in the LSCP and RSCP groups.[19]

Borahay et al.[20] evaluated the outcomes of using barbed delayed absorbable sutures in RSCP in 20 patients. Ileus, mesh erosion, and apical defect recurrence were not observed. Meanwhile, grade 2 cystocele was observed in 5% of patients. The cystocele rate in this study was 4.4%, which is similar to the current one. Moreover, the rate of concomitant hysterectomy in the same study was 60%, which is similar to that of this study (75%).

Borahay et al.[20] showed that barbed delayed absorbable sutures are safe and effective for over 1 year in RSCP cases.

In our study, the readmission rates due to postoperative complications were compared according to the type of suture used in the vaginal vault. Meanwhile, the rate of readmission was 18.2% in patients with 2/0 polyglycolic barbed sutures. However, no readmission was observed among cases where 2/0 polyglycolic barbed suture was used.

Study Limitations

The current study had several limitations. The patients underwent different concomitant surgeries. In relation to this, the patient group was not homogenized. However, concomitant surgeries were commonly performed in the LSCP group. Therefore, it had no effect on the surgical time of the RSCP group. Further, the study was retrospective in nature, not randomized, and patients did not have preoperative POP-Q staging data on the degree of prolapse.

Although we did not compare the cost in our study, some studies in the literature showed that the cost of RSCP is higher than that of LSCP.[10,13,15]

CONCLUSION

LSCP was superior to RSCP in terms of operative time and early postoperative complication rate. Based on previous studies, RSCP had a higher cost than LSCP. Hence, the latter is the primary choice of treatment. However, with consideration of three-dimensional visualization, greater precision, and enhanced dexterity provided by robotic surgery, the choice of surgical method should be individualuzed according to the patient's preference and the the clinic's resources.

Acknowledgments

We would like to thank Enago (www.enago.com) for the English language review.

ETHICS

Ethics Committee Approval: This study was approved by the Medical Ethics Committee of the Institutional Ethical Review Board of Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine (ATADEK-2022-16/03).

Informed Consent: Retrospective study.

Peer-review: Internally and externally peer-reviewed.

Contributions

Concept: E.Ö., M.G.; Design: E.Ö., M.G.; Data Collection or Processing: E.Ö., M.G.; Analysis or Interpretation: E.Ö., M.G.; Literature Search: E.Ö., M.G.; Writing: E.Ö., M.G.

DISCLOSURES

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

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. Obstet Gynecol 1997; 89: 501- 6.
2. Takacs EB, Kreder KJ. Sacrocolpopexy: Surgical Technique, Outcomes, and Complications. Curr Urol Rep 2016; 17: 90.
3. Culligan PJ, Saiz CM, Rosenblatt PL. Contemporary Use and Techniques of Laparoscopic Sacrocolpopexy With or Without Robotic Assistance for Pelvic Organ Prolapse. Obstet Gynecol 2022; 139: 922-32.
4. Cho EH, Shin ES, Kim SY. Laparoscopic sacrocolpopexy versus open abdominal sacrocolpopexy for pelvic organ prolapse repair: A retrospective cohort study. Ann Med Surg (Lond) 2022; 78: 103852.
5. Campbell P, Cloney L, Jha S. Abdominal Versus Laparoscopic Sacrocolpopexy: A Systematic Review and Meta-analysis. Obstet Gynecol Surv 2016; 71: 435-42.
6. De Gouveia De Sa M, Claydon LS, Whitlow B, Dolcet Artahona MA. Robotic versus laparoscopic sacrocolpopexy for treatment of prolapse of the apical segment of the vagina: a systematic review and meta-analysis. Int Urogynecol J 2016; 27: 355-66.

7. Manodoro S, Werbrouck E, Veldman J, et al. Laparoscopic sacrocolpopexy. Facts Views Vis Obgyn 2011; 3: 151-8.

8. Lee RK, Mottrie A, Payne CK, Waltregny D. A Review of the Current Status of Laparoscopic and Robot-assisted Sacrocolpopexy for Pelvic Organ Prolapse. Eur Urol 2014; 65: 1128-37.

9. Kanti V, Verma V, Singh M, et al. A Comparative Analysis of Nondescent Vaginal Hysterectomy, Laparoscopy-Assisted Vaginal Hysterectomy, and Total Laparoscopic Hysterectomy for Benign Uterine Diseases at a Rural Tertiary Care Center. Gynecol Minim Invasive Ther 2022; 11: 164-70.

10. Paraiso MFR, Jelovsek JE, Frick A, Chen CCG, Barber MD. Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse: a randomized controlled trial. Obstet Gynecol 2011; 118: 1005-13.

11. Siddiqui NY, Geller EJ, Visco AG. Symptomatic and anatomic 1-year outcomes after robotic and abdominal sacrocolpopexy. Am J Obstet Gynecol 2012; 206: 435.e1-5.

12. Shveiky D, Iglesia CB, Sokol AI, Kudish BI, Gutman RE. Robotic sacrocolpopexy versus vaginal colpopexy with mesh: choosing the right surgery for anterior and apical prolapse. Female Pelvic Med Reconstr Surg 2010; 16: 121-7.

13. Tan-Kim J, Menefee SA, Luber KM, Nager CW, Lukacz ES. Robotic-assisted and laparoscopic sacrocolpopexy: comparing operative times, costs and outcomes. Female Pelvic Med Reconstr Surg 2011; 17: 44-9.

14. Kallidonis P, Al-Aown A, Vasilas M, et al. Laparoscopic sacrocolpopexy using barbed sutures for mesh fixation and peritoneal closure: A safe option to reduce operational times. Urol Ann 2017; 9: 159.

15. Anger JT, Mueller ER, Tarnay C, et al. Robotic compared with laparoscopic sacrocolpopexy: a randomized controlled trial. Obstet Gynecol 2014; 123: 5-12.

16. Claerhout F, De Ridder D, Roovers JP, et al. Medium-term anatomic and functional results of laparoscopic sacrocolpopexy beyond the learning curve. Eur Urol 2009; 55: 1459-68.

17. Mueller MG, Jacobs KM, Mueller ER, Abernethy MG, Kenton KS. Outcomes in 450 Women After Minimally Invasive Abdominal Sacrocolpopexy for Pelvic Organ Prolapse. Female Pelvic Med Reconstr Surg 2016; 22: 267-71.

18. Costantini E, Brubaker L, Cervigni M, et al. Sacrocolpopexy for pelvic organ prolapse: evidence-based review and recommendations. Eur J Obstet Gynecol Reprod Biol 2016; 205: 60-5.

19. Vieillefosse S, Thubert T, Dache A, Hermieu JF, Deffieux X. Satisfaction, quality of life and lumbar pain following laparoscopic sacrocolpopexy: suture vs. tackers. Eur J Obstet Gynecol Reprod Biol 2015; 187: 51-6.

20. Borahay MA, Oge T, Walsh TM, et al. Outcomes of Robotic Sacrocolpopexy Using Barbed Delayed Absorbable Sutures. J Minim Invasive Gynecol 2014; 21: 412-6.