Comparison of perioperative outcomes among robot-assisted, conventional laparoscopic, and abdominal/ open myomectomies

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Abstract

Objective: To compare the perioperative results of myomectomy performed by robotic surgery (RM), laparoscopic surgery (LM), and open/abdominal surgery (OM).

Material and Methods: We included 227 patients who underwent either robotic (n=66), laparoscopic (n=88), or abdominal (n=73) myomectomy at our hospital between 2016 and 2020. Retrospective medical records, including fibroid characteristics, demographic findings, and surgical outcomes, were compared.

Results: The RM group had a significantly lower body mass index and significantly larger uterine size, myoma diameter, and myoma weight than the other groups. However, the OM group had the highest number of myoma. Moreover, the RM group had higher operative time and blood loss but significantly lower maximum visual analog scale values than the OM and LM groups. Hospitalization duration was significantly different among the groups. The rate of 1-day hospitalization was 56.2%, 64.8%, and 37.9% in the OM, LM, and RM groups, respectively. Furthermore, blood transfusion requirement was significantly higher in the OM group (12.3%) than in the LM and RM groups (0.0% and 4.5%, respectively).

Conclusion: Minimally invasive myomectomy may be preferable, particularly for women of reproductive age. In women with large uterine size and myoma, robot-assisted LM is recommended. (J Turk Ger Gynecol Assoc 2021; 22: 312-8)

Keywords: Robot-assisted surgery, laparoscopic surgery, open surgery, myomectomy

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Introduction

Myoma is a common problem among patients with benign gynecological disorders. Although the incidence of myoma is unclear in women of reproductive age, its frequency is approximately 5.4-70%, with manifestations including bleeding, gastrointestinal complaints, urinary complaints, pain, and infertility (1-3). Symptomatic myomas can be treated either medically or surgically. Surgical approaches include myomectomy, myolysis, endometrial ablation, hysterectomy, or uterine artery embolization (4). In cases where fertility sparing and surgical morbidity reduction are needed, myomectomy should be performed first before hysterectomy. Depending on the location, number, and size of myomas, and the skills of the surgeon, surgical options include hysteroscopic, robot-assisted laparoscopic, conventional laparoscopic, and abdominal/open myomectomy approaches. Minimally invasive surgery, including robot-assisted laparoscopy and conventional laparoscopy, reportedly has significant advantages, such as minimal bleeding, rapid recovery, short hospital stay, and less complication rates, compared with abdominal/open myomectomy (5-7). Despite some contraindications, minimal invasive surgery can be performed by experienced surgeons regardless of the size, number, or location of myomas (3,8). Studies have shown that robot-assisted surgery is superior to conventional laparoscopic surgery (LM) in terms of three-dimensional image provision, user-friendliness, and ergonomic position for the surgeon (9,10).

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In the present study, we aimed to compare the perioperative results of robot-assisted laparoscopic, conventional laparoscopic, and abdominal/open myomectomy cases in our hospital and compared this data with the data in literature.

Material and Methods

We included 227 patients who underwent either robotic (n=66), laparoscopic (n=88), or open/abdominal (OM) (n=73) myomectomy [robotic surgery (RM), LM, and OM groups, respectively] performed by the same surgeon (MG) at our hospital between 2016 and 2020. We retrospectively reviewed the medical records of these consecutive patients. We excluded patients who had undergone major surgeries other than myomectomy, had bleeding diathesis disorders, and had used gonadotropin-releasing hormone analogs preoperatively. Moreover, the size, weight, and location of the myoma; uterine size; symptoms; or previous abdominal surgery did not affect the eligibility criteria. However, we used robot-assisted LM for minimal surgery in fibroids of >20 weeks.

Myomectomy was indicated for pelvic pain, abnormal bleeding, abdominal mass, gastrointestinal symptoms, or genitourinary symptoms. After the surgical methods that can be applied according to the patient's indication and technical possibilities were explained in detail, the surgical method was decided in line with the patient's choice. The choice of the surgical route (RM, LM, or OM) was left to the discretion of the surgeon (MG) and patient preference. All procedures performed in this study conformed to the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. This study was approved by the Medical Ethics Committee of the Institutional Ethical Review Board of the Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine (approval number: ATADEK-2020/27).

The operative time was defined as the time elapsed from intubation to extubation for each patient. The blood loss amount was defined as the total quantity of suction and irrigation. Furthermore, hospitalization duration was defined as the number of days from the day of surgery to the day of patient discharge.

In all LM and RM surgeries, patients were administered general anesthesia and were positioned in a lithotomy position with a steep (30°) Trendelenburg angle. Their arms were tucked with their palms facing toward lateral thighs with appropriate padding and legs were placed in booted stirrups. Pneumoperitoneum was then established up to 14 mmHg, with carbon dioxide insufflation throughout surgery.

In LM, a 10 mm 0° scope and three ancillary 5 mm ports (10 mm, umbilical; 5 mm, suprapubic; 5 mm, left; and 5 mm, right lower quadrant) were inserted. We used a 10 mm laparoscope and non-articulating instruments.

RM was performed using the da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA). Three robotic arms (8 mm; umbilical, right ancillary port, and left ancillary) and a 12 mm assistant port with a smoke evacuator (Airseal®; SurgiQuest, Inc.) were used in all RM cases. Before robot docking, the procedure was initiated as a standard laparoscopy. During RM surgery, monopolar scissors and bipolar fenestrated forceps were used for dissection and vessel sealing, respectively. At the end of surgery, we switched back to laparoscopy for morcellation.

Before incision, desmopressin (30 μg/mL diluted in 100 mL of normal saline solution) was injected using a laparoscopic needle into the planned uterine incision site to decrease bleeding. We used Ultrasonic (Thunderbeat Olympus Medical Systems Corporation of America, 3500 Corporate Parkway, Center Valley, PA 18034, USA) and integrated advanced bipolar instruments for dissection and vessel sealing. After the incision, the exposed fibroid was enucleated by traction using grasping forceps. After fibroid removal, running sutures (Covidien 2-0 V-Loc™) were placed starting from the deepest myometrial layer, followed by multilayer closure. Finally, myoma tissues were excised using a power morcellator.

In OM, patients were administered general anesthesia and transverse suprapubic incisions were made. The uterus was then exteriorized. Before uterine incision, desmopressin (30 μg/mL diluted in 100 mL of normal saline solution) was injected into the incision site. In particular, we incised the uterine area overlying the myoma. The myoma was then enucleated. The myometrial layers were subsequently re-approximated in multiple layers using 1% absorbable polyglactin sutures in a running manner.

In all surgeries, the fascia and skin were closed layer by layer. Meanwhile, postoperative pain was assessed using the visual analog scale (VAS). VAS included distance (mm) measurement on the 10 cm line between the "no pain" anchor and the patient's mark and verbal descriptions (0 point, "no pain"; 10 points, "worst pain possible").

Statistical analysis

Continuous variables are expressed as means ± standard deviation and medians (minimum-maximum), whereas categorical variables are expressed as numbers or percentages where appropriate. In the intergroup analysis of continuous variables, data normality was analyzed using the Kolmogorov-Smirnov goodness-of-fit test. The continuous variables with normal distribution were then evaluated using One-Way analysis of variance (post hoc: least significant difference), whereas variables without normal distribution were compared using the Kruskal-Wallis test (post hoc: Mann-Whitney U test) among the groups. Categorical data were compared using the chi-square test. All statistical data were analyzed using SPSS version 24.0 (IBM Corporation, Armonk, NY, USA), and the statistical significance level was set at p<0.05.

Results

A total of 227 patients were analyzed. Their mean age, parity, and previous cesarean section ratios were not significantly different among the groups (p>0.05). Compared with the other groups, the RM group had a significantly lower mean body mass index (p=0.003) and the highest mean week of gestation equivalent to the uterine size (p=0.005). However, the rate of history of previous surgery was significantly higher in the OM and LM groups (34.2% and 26.1%, respectively) than in the RM group (7.6%) (p=0.001). Bleeding (47.9%) and infertility (24.7%) were more common in the OM group, bleeding (35.2%) and pain (34.1%) were more common in the LM group, and bleeding (51.5%) and pelvic mass (22.7%) were more common in the RM group (p<0.001) (Table 1).

The myoma diameter (cm) and weight (g) were significantly higher in the RM group than in the other groups (p<0.001 and p=0.001, respectively), whereas the number of myoma was highest in the OM group (p=0.002). However, surgical location and pathology results were not significantly different among the groups (p>0.05) (Figure 1, 2, Table 2).

The RM group had higher operative time (minute) and more blood loss (mL) (p>0.001 for operative time, p=0.098 for blood loss) but had significantly lower maximum VAS scores (p<0.001) than the OM and LM groups. Furthermore, hospitalization duration was not significantly different among the groups (p=0.013). The rate of 1-day hospitalization was 56.2%, 64.8%, and 37.9% in the OM, LM, and RM groups, respectively. Blood transfusion requirement was significantly higher in the OM group (12.3%) than in the LM (0.0%) and RM groups (4.5%) (p=0.002). Abdominal drain requirement and complication rates were not significantly different among the groups (p>0.05). Median docking time and console time (15 and 140 minute, respectively) in RM were also noted (Figure 3, 4, Table 3).

In the LM group, one patient had postoperative fever and another patient had perineal edema. In the RM group, one patient had postoperative vomiting and another patient had ileus due to incisional hernia, requiring readmission. In the OM group, one patient had bladder injury. Meanwhile, conversion to laparotomy was not observed in the RM and LM groups.

Table 1. Comparison of demographic data and clinical findings

	OM (n=73)	LM (n=88)	RM (n=66)	Total (n=227)	p
Age (years)	38.88±5.28	38.01±5.42	38.61±5.76	38.46±5.47	0.590*
BMI (kg/m²)	24.73±4.54	23.39±3.85	**22.55±2.52[a]**	23.57±3.85	**0.003***
Gestation equavalent to the uterine size	15.64±3.48	15.15±3.32	**16.78±2.50[b]**	15.78±3.22	**0.005****
Parity (n, %)					
Nulliparity	55 (75.3)	53 (60.2)	41 (62.1)	149 (65.6)	0.103***
Multiparity	18 (24.7)	35 (39.8)	25 (37.9)	78 (34.4)	
Previous cesarean section (n, %)					
Yes	62 (84.9)	72 (70.5)	46 (69.7)	170 (74.9)	0.056***
No	11 (15.1)	26 (29.5)	20 (30.3)	57 (25.1)	
Previous abdominal surgery history (n, %)					
No	48 (65.8)	65 (73.9)	61 (92.4)	174 (76.7)	**0.001*****
Yes	**25 (34.2)**	**23 (26.1)**	5 (7.6)	53 (23.3)	
Symptoms					
Pelvic pain	14 (19.2)	**30 (34.1)**	11 (16.7)	55 (24.2)	**<0.001*****
Abnormal bleeding	**35 (47.9)**	**31 (35.2)**	**34 (51.5)**	100 (44.1)	
Infertility	**18 (24.7)**	0 (0.0)	2 (3.0)	20 (8.8)	
Gastrointestinal symptoms	4 (5.5)	5 (5.7)	1 (1.5)	10 (4.4)	
Pelvic mass	1 (1.4)	17 (19.3)	**15 (22.7)**	33 (14.5)	
Genitourinary symptoms	1 (1.4)	5 (5.7)	3 (4.5)	9 (4.0)	
Total	73 (100.0)	88 (100.0)	66 (100.0)	227 (100.0)	

*One-Way analysis of variance (post hoc: [a]least significant difference), **Kruskal-Wallis test (post hoc: [b]Mann-Whitney U test), ***chi-square test, OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery, BMI: Body mass index

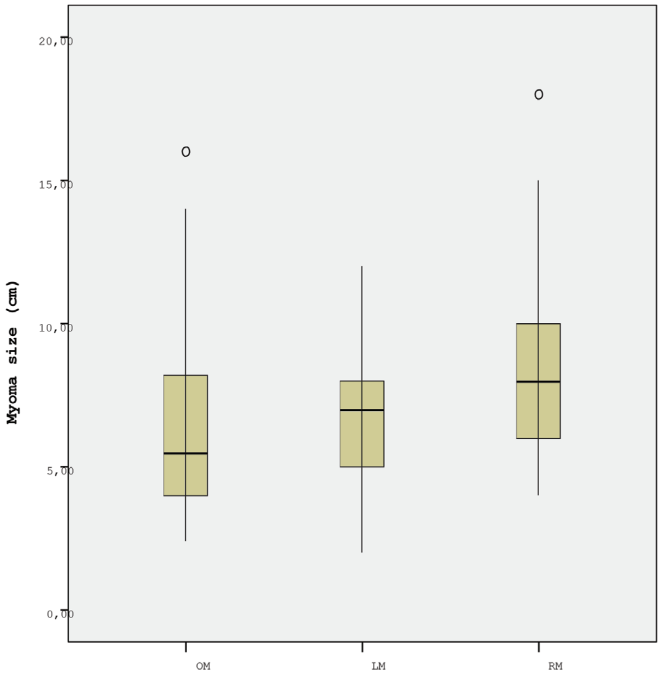

Figure 1. Box plot comparing size of the excised myomas as per surgical approach
OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery

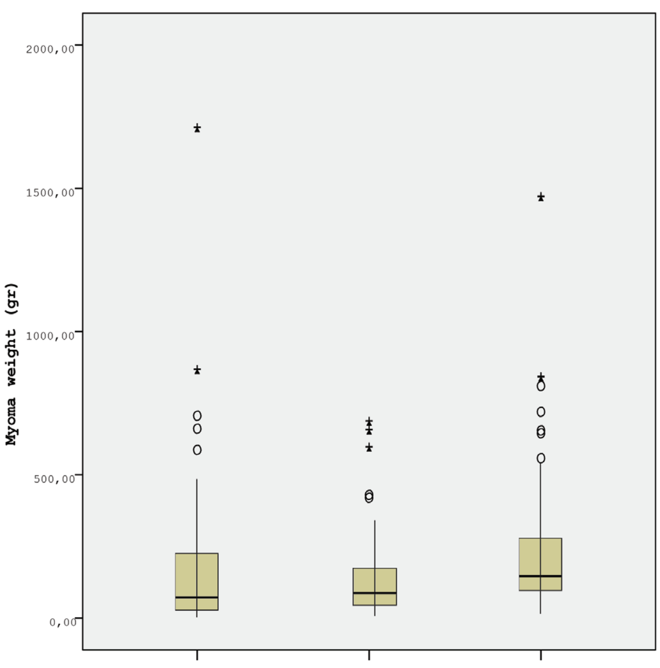

Figure 2. Box plot comparing weight of the excised myoma as per surgical approach
OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery

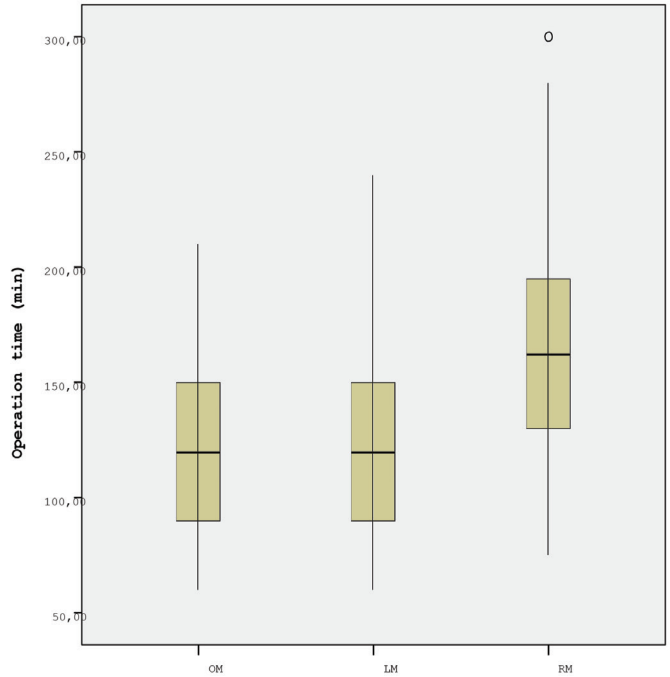

Figure 3. Box plot comparing operative time as per surgical approach
OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery

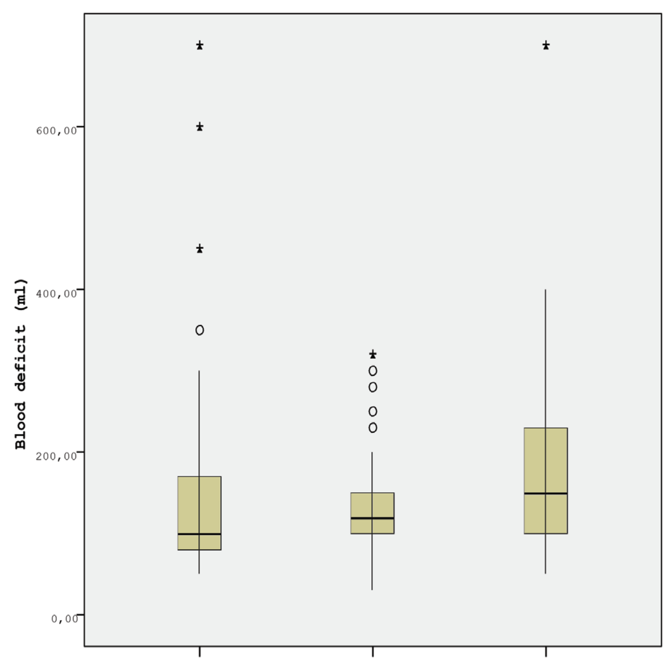

Figure 4. Box plot comparing blood loss as per surgical approach
OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery

Table 2. Myoma characteristics

	OM (n=73)	LM (n=88)	RM (n=66)	Toplam (n=227)	p
Size of largest myoma (cm) [median (min.-max.)]	5.5 (2.4-16)	7 (2-12)	**8 (4-18)[b]**	7 (2-18)	**<0.001***
Number of myomas [median (min.-max.)]	**4 (1-44)[b]**	3 (1-11)	3 (1-11)	3 (1-44)	**0.002***
Weight (g) [Median (min.-max.)]	75 (3-1,710)	90 (5-685)	**150 (15-1.469)[b]**	105 (3-1,710)	**0.001***
Location (n, %)					
Anterior	5 (6.8)	1 (1.1)	3 (4.5)	9 (4.0)	0.356**
Posterior	2 (2.7)	6 (6.8)	1 (1.5)	9 (4.0)	
Multiple	64 (87.7)	74 (84.1)	59 (89.4)	197 (86.8)	
Pedinculated	1 (1.4)	3 (3.4)	1 (1.5)	5 (2.2)	
Fundus	1 (1.4)	4 (4.5)	2 (3.0)	7 (3.1)	
Pathology (n, %)					
Leiomyoma	70 (95.9)	87 (98.9)	63 (95.5)	220 (96.9)	0.397**
Adenomyosis	3 (4.1)	1 (1.1)	3 (4.5)	7 (3.1)	
Total	73 (100.0)	88 (100.0)	66 (100.0)	227 (100.0)	

*Kruskal-Wallis test (post hoc: [b]Mann-Whitney U test), **: chi-square test, OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery, min.: Minimum, max.: Maximum

Table 3. Surgical factors and outcomes

	OM (n=73)	LM (n=88)	RM (n=66)	Total (n=227)	p
Operative time (minute) [median (min.-max.)]	120 (60-210)	120 (60-240)	**162.5 (75-300)[b]**	125 (60-300)	**<0.001***
Blood loss (mL) [median (min.-max.)]	100 (50-700)	120 (30-320)	150 (50-700)	120 (30-700)	0.098*
Maximum VAS [median (min.-max.)]	5 (2-9)	5.5 (2-9)	**3 (2-9)[b]**	5 (2-9)	**<0.001***
Docking time (minute) [median (min.-max.)]	-	-	15 (10-45)	-	-
Console time (minute) [median (min.-max.)]	-	-	140 (60-275)	-	-
Hospital stay (day) (n, %)					
1 day	**41 (56.2)**	**57 (64.8)**	25 (37.9)	123 (54.2)	**0.013****
2 days	25 (34.2)	27 (30.7)	**36 (54.5)**	88 (38.8)	
≥3	7 (9.6)	4 (4.5)	5 (7.6)	16 (7.0)	
Need for abdominal drain (n, %)					
No	69 (94.5)	88 (100.0)	64 (97.0)	221 (97.4)	0.095**
Yes	4 (5.5)	0 (0.0)	2 (3.0)	6 (2.6)	
Need for blood transfusion (n, %)					
No	64 (87.7)	88 (100.0)	63 (94.5)	225 (94.7)	**0.002****
Yes	**9 (12.3)**	0 (0.0)	3 (4.5)	12 (5.3)	
Complication (n, %)					
No	72 (98.6)	86 (97.7)	64 (97.0)	222 (97.8)	0.800**
Yes	1 (1.4)	2 (2.3)	2 (3.0)	5 (2.2)	
Total	73 (100.0)	88 (100.0)	66 (100.0)	227 (100.0)	-

*: Kruskal-Wallis test (post hoc: [b]Mann-Whitney U test), **: chi-square test, OM: Open/abdominal surgery, LM: Laparoscopic surgery, RM: Robotic surgery, min.: Minimum, max.: Maximum

Discussion

Considering that myomas are common in women of reproductive age, myomectomy is the gold standard in those who desire fertility. In this study, we evaluated the superiority of the different myomectomy methods by comparing the perioperative results of LM, RM, and OM cases in our hospital.

Minimally invasive surgery, either LM or RM, has several advantages, including shortened hospitalization duration and reduced postoperative pain (8). Postoperative adhesion rate also appears to be lower in LM, which is beneficial for reproductive age patients (11). Although uterine rupture during labor or pregnancy is one of the main concerns in this group of women, it appears to be an infrequent complication when LM is performed by skilled surgeons (4,12). One of the factors that facilitate uterine rupture is poor closure of the uterine incision (12). Hence, we perform multilayer closure at our hospital.

In a meta-analysis with 2,027 participants conducted in 2015 by Iavazzo et al. (13), the size of myomas was significantly larger in the OM and RM groups than in the LM group. Likewise, our study demonstrated that the RM group had a significantly larger myoma size and higher weight than the LM and OM groups.

Although significantly numerous myomas were excised in both the RM and OM groups in the study by Barakat et al. (14), significantly more myomas were excised in the OM group than in the RM and LM groups in our study. In minimally invasive surgery (RM or LM), extremely small intramural myomas may not be noticed when touched unlike in OM. This can explain the significantly higher number of myomas excised in the OM group.

In our study, the operative time was significantly higher in the RM group than in the OM and LM groups, although no difference was observed between the OM and LM groups. This finding is compatible with the findings of previous studies (13,15). In the study by Nezhat et al. (15), the operative time and cost of RM were significantly high, similar to our study. In another study, the blood loss amount and hospitalization duration were higher in the RM group (12). Processes such as setting up the RM device and switching to laparoscopy for morcellation after myoma excision may explain the longer operative time of RM than that of LM. Moreover, a larger myoma size and higher weight might explain the higher operative time in the RM group.

In the study by Barakat et al. (14), blood loss and blood transfusion requirement were less observed in the RM group, with 4.7% as the total blood transfusion rate in the entire cohort of their study, compared with 5.3% in our study. The RM group in our study had higher blood loss but had significantly less requirement for blood transfusion than the other groups.

In the study by Griffin et al. (7), pain scores were not different between the OM and RM groups. In our study, however, the postoperative pain score was significantly lower in the RM group than in the other groups. Thus, RM is more advantageous in terms of postoperative pain. Although postoperative fever can be observed after myomectomy (16), it was observed only in one patient among all groups in our study.

To minimize the risk of uterine rupture in pregnancy after myomectomy in women of reproductive age, the incision must be closed meticulously in a multilayer manner. Although the dexterity provided by the instruments in RM enables performing this closure more easily, its high cost, larger incisions, and longer operative time appear to be disadvantages that need to be overcome according to experience. In addition, conventional LM can be performed safely by skilled surgeons, thereby overcoming the disadvantages of RM.

Study Limitation

Some of the limitations of our study are its retrospective design and the failure to compare long-term outcomes, such as pregnancy rates, uterine rupture, and uterine adhesions. Moreover, the number and size of myomas excised were not similar in either of the groups. RM is preferred for myomas with large size and weight owing to the higher cost of the surgery at our hospital. Prospective, randomized trials on similar myoma size and number, as those in our study, with long-term outcomes are needed.

Conclusion

When performed by experienced surgeons, minimally invasive myomectomy (LM or RM) may be a good choice, particularly for women of reproductive age because of its several advantages, such as short hospitalization duration, less blood transfusion and drain requirement, and less postoperative pain. Although RM might not be preferred because of its long operative time, increased blood loss, and cost, it is preferable for patients with large myomas because it includes three-dimensional imaging, facilitates more precise surgery, and has significantly less postoperative pain.

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Ethics Committee Approval: *This study was approved by the Medical Ethics Committee of the Institutional Ethical Review Board of the Acıbadem Mehmet Ali Aydınlar University Faculty of Medicine (approval number: ATADEK-2020/27).*

Informed Consent: *Medical records were compared retrospectively.*

Peer-review: *Externally peer-reviewed.*

Author Contributions: *Surgical and Medical Practices: M.G.; Concept: M.G., E.Ö.; Design: E.Ö.; Data Collection or Processing: E.Ö.; Analysis or Interpretation: E.Ö.; Literature Search: E.Ö.; Writing: E.Ö.*

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