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A comparison of surgical outcomes between robot and laparoscopy-assisted adenomyomectomy

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Abstract

We aimed to investigate the feasibility of robotic adenomyomectomy and compared surgical outcomes between laparoscopic and robotic approaches for adenomyomectomy.

We retrospectively reviewed the data of women who were diagnosed with adenomyosis and underwent adenomyomectomy through a minimally invasive approach between January 2014 and March 2018 at the CHA Gangnam Medical Center, Seoul, Republic of Korea. Patient demographics and operation-related outcomes were compared between the robotic and laparoscopic surgery groups.

We evaluated 43 women who underwent adenomyomectomy through a minimally invasive approach (21 underwent a laparoscopic and 22 underwent a robotic adenomyomectomy). All 22 women who had originally been scheduled to undergo robotic adenomyomectomy could successfully undergo the robotic surgery without requiring conversion to laparotomy and/or serious complications. No statistically significant differences in patient demographics were observed between the robotic and the laparoscopic surgery groups. No significant intergroup difference was observed in the operative time, estimated blood loss, weight of the resected nodule, and length of hospitalization (160.0 vs 212.5 min, $P = .106$; 500.0 vs 300.0 mL, $P = .309$; 60.0 vs 70.0 g, $P = .932$; and 5.0 vs 6.0 days, $P = .277$). No serious perioperative complications were observed in either group.

Robotic adenomyomectomy is feasible for women with adenomyosis. Surgical outcomes of robotic adenomyomectomy were comparable to those of a laparoscopic approach. There was, however, no superiority of robotic adenomyomectomy in terms of surgical outcomes. Further multicenter prospective studies using standardized surgical procedures are needed to confirm the conclusion of this study.

Abbreviation: EBL = estimated blood loss.

Keywords: adenomyosis, feasibility, minimally invasive surgical procedures, robotic surgery, surgery

1. Introduction

Adenomyosis is a common gynecological condition characterized by the ectopic presence of endometrial glandular and stromal tissues within the myometrium.[1–3] This condition is typically observed in premenopausal women aged 35 to 45 years.[4–6] The reported incidence varies between 5% and 70% based on the researcher. Women diagnosed with adenomyosis present with dysmenorrhea, menorrhagia, chronic pelvic pain, and subfertility.[7,8] Nonsteroidal anti-inflammatory drugs, gonadotropin-releasing hormone agonists, and progestin and oral contraceptives are used as medical therapy for symptom relief; however, hysterectomy is the definitive treatment for intractable symptomatic adenomyosis.[9,10]

In women who prefer uterine preservation, adenomyomectomy is a useful alternative in selected cases.[11,12] Adenomyomectomy is surgically challenging because of the obscure boundaries between the normal myometrium and the adenomyotic lesion, intraoperative blood loss, and technical difficulty with suturing tissue planes to eliminate the dead space at the operation site. A minimally invasive approach is usually preferred by most patients; thus, several researchers have explored and reported the feasibility of laparoscopic adenomyomectomy and the favorable surgical outcomes associated with this procedure. Laparoscopic adenomyomectomy, however, remains technically challenging.

A robotic platform provides a 3-dimensional view and the wrist-like motion of the robotic arm resembles the configuration of a human arm, which is therefore ergonomically a comfortable position for the surgeon. Robotic surgery offers significant technical advantages in performing complicated surgical procedures including suturing and knot tying, which are necessary to perform a successful adenomyomectomy. The absence of tactile feedback, however, serves as a primary limitation of this innovative approach because an adenomyomectomy requires complete excision of affected tissues after determining these tissues using tactile feedback.

Editor: Robert Chen.

The authors report no conflicts of interest.

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Medicine (2019) 98:18(e15466)

Received: 16 February 2019 / Received in final form: 16 March 2019 / Accepted: 6 April 2019

http://dx.doi.org/10.1097/MD.0000000000015466

To date, the literature contains a limited number of reports describing the surgical feasibility of robotic adenomyomectomy, and no report has compared surgical outcomes between laparoscopic and robotic adenomyomectomy. We investigated the surgical feasibility of robotic adenomyomectomy and compared surgical outcomes between laparoscopic and robotic adenomyomectomy.

2. Materials and methods

We retrospectively reviewed the data of women who were diagnosed with adenomyosis and underwent adenomyomectomy between January 2014 and March 2018 at the Department of Obstetrics and Gynecology, CHA Gangnam Medical Center, Seoul, Republic of Korea. This study was approved by the Institutional Review Board (IRB, GCI-18-27) of CHA Gangnam Medical Center in 2018. All patients were diagnosed with adenomyosis using preoperative transvaginal ultrasonography or magnetic resonance imaging. Candidates were selected for surgery based on the following criteria: those aged $\leq$50 years, those who consented to proceed after being informed regarding the potential possibility of recurrent disease and operative blood loss, those desirous of becoming pregnant in the future or of avoiding hysterectomy, and those with a commercial insurance status. If the surgeons decided to perform adenomyomectomy through a minimally invasive approach, the women selected the surgical platform that they desired and the informed consent was obtained before surgery.

Adenomyosis was confirmed histopathologically postoperatively in all cases. The numeric pain rating scale was used to determine the severity of pre- and postoperative dysmenorrhea. We defined menorrhagia as menstrual bleeding that limits normal activities in women and causes anemia. The uterine size was measured using transvaginal ultrasonography, and the uterine volume was calculated using the formula: volume = 0.5233 × [anteroposterior diameter (cm)] × [longitudinal diameter (cm)] × [transverse diameter (cm)].[13] Postoperative uterine volume was measured at 3 months after the surgery.

The reusable uterine manipulator handle was used in all women. For laparoscopy, a 12-mm trocar and three 5-mm trocars were introduced through the umbilicus and the lower abdomen, respectively. The surgical procedure was performed as follows: a diluted vasopressin solution (20 U/200 mL) was administered into the myometrium preoperatively. A vertical incision of an adequate length was made in the adenomyotic lesion using a monopolar electrocautery hook. Adenomyotic tissue was divided into left and right compartments vertically until the surgeon encountered the balloon of the reusable uterine manipulator handle in the endometrial cavity. Adenomyotic tissue was excised from the uterine serosa using a harmonic scalpel and monopolar scissors. Myometrium measuring 1 cm remained after the procedure. The excised area was sutured in 2 to 3 layers using 1-0 and 2-0 absorbable sutures to obliterate the dead space. The uterine serosa was sutured continuously using 1-0 barbed suture. Robotic-assisted adenomyomectomy was performed using the da Vinci-Si robotic system (Intuitive Surgical, Inc, Sunnyvale, CA). For robotic surgery, 4 ports were placed based on manufacturer recommendations. Robotic adenomyomectomy was performed with a transverse incision on the adenomyotic lesion using monopolar scissors and following procedures were similar to those of the laparoscopic procedure using monopolar scissors, robotic tenaculum, and Mega Needle Drivers (Fig. 1). A Hemovac drain was placed in the pelvic cavity to monitor postoperative bleeding at the operation site, and the drain was removed when the amount of drainage was <200 mL/day and the color was clear, indicating serous fluid.

Postoperatively, all women were followed-up on an outpatient basis at 1 week, 1 month, and 3 months and were encouraged to undergo regular checkups every 6 months thereafter.

We defined the recurrence of disease as the need for additional treatment for symptoms associated with adenomyosis observed in women during the follow-up period.

2.1. Statistical analysis

Variables were compared using the Mann-Whitney *U* test. The chi-square test was used for intergroup comparison of categorical variables, and the Fisher exact test was used for small sample numbers. A P value <.05 was considered statistically significant.

3. Results

Between January 2014 and March 2018, 93 women with adenomyosis underwent adenomyomectomy through laparotomy, laparoscopy, or robot-assisted surgery. Eight patients underwent adenomyomectomy with myomectomy. Myomectomy was the primary procedure performed in these women. One woman underwent ovarian cystectomy as the primary surgery with concomitant adenomyomectomy. These 9 women were excluded from this study in addition to 41 women who underwent a laparotomic adenomyomectomy. The laparoscopic group included 21 women who underwent a laparoscopic adenomyomectomy, and the robotic surgery group included 22 women who underwent robotic adenomyomectomy (Fig. 2).

Table 1 shows patient demographics. The median age of the 43 women included in the study was 41 years (range 25–50 years). The median body mass index was 21.2 kg/m^2 (range 16.3–31.6 kg/m^2). The most common symptom associated with uterine adenomyosis was dysmenorrhea followed by menorrhagia (Table 1). No statistically significant intergroup difference was observed in symptom characteristics. Ten out of 43 women (23.3%) had received medical treatment before surgery. No statistically significant differences were observed in patient demographics between the laparoscopic and the robotic groups (Table 1).

Table 2 shows the detailed disease characteristics. Median preoperative uterine volume was 268.0 cm^3 (86.5–885.3 cm^3). Median value of the cancer antigen-125 was 95.8 U/mL (16.8–774.4 U/mL). Eight of 43 women were diagnosed with diffuse adenomyosis (type 2) and 35 with focal adenomyosis (type 1). Twenty-eight (65.1%) of 43 women showed adenomyosis involving the posterior uterine wall. Myomas were diagnosed in 28 women (65.1%) and endometriosis in 27 (62.8%). These characteristics did not differ between the robotic and the laparoscopic groups.

The total operative time was 190.0 minutes (40.0–420.0 min) (Table 3). The estimated blood loss (EBL) was 400 mL (50–3200) mL. The length of hospitalization was 5.0 days (4.0–18.0 days). Intergroup comparison of operative outcomes showed no statistically significant differences in the operative time, EBL, weight of the resected nodule, and length of hospitalization (160.0 vs 212.5 min, P = .106; 500.0 vs 300.0 mL, P = .309; 60.0 vs 70.0 g, P = .932; and 5.0 vs 6.0 days, P = .277). No woman required conversion to a laparotomy. Transfusion was required in 11 women (25.6%). Those diagnosed with myomas and ovarian endometriotic cysts underwent myomectomy and

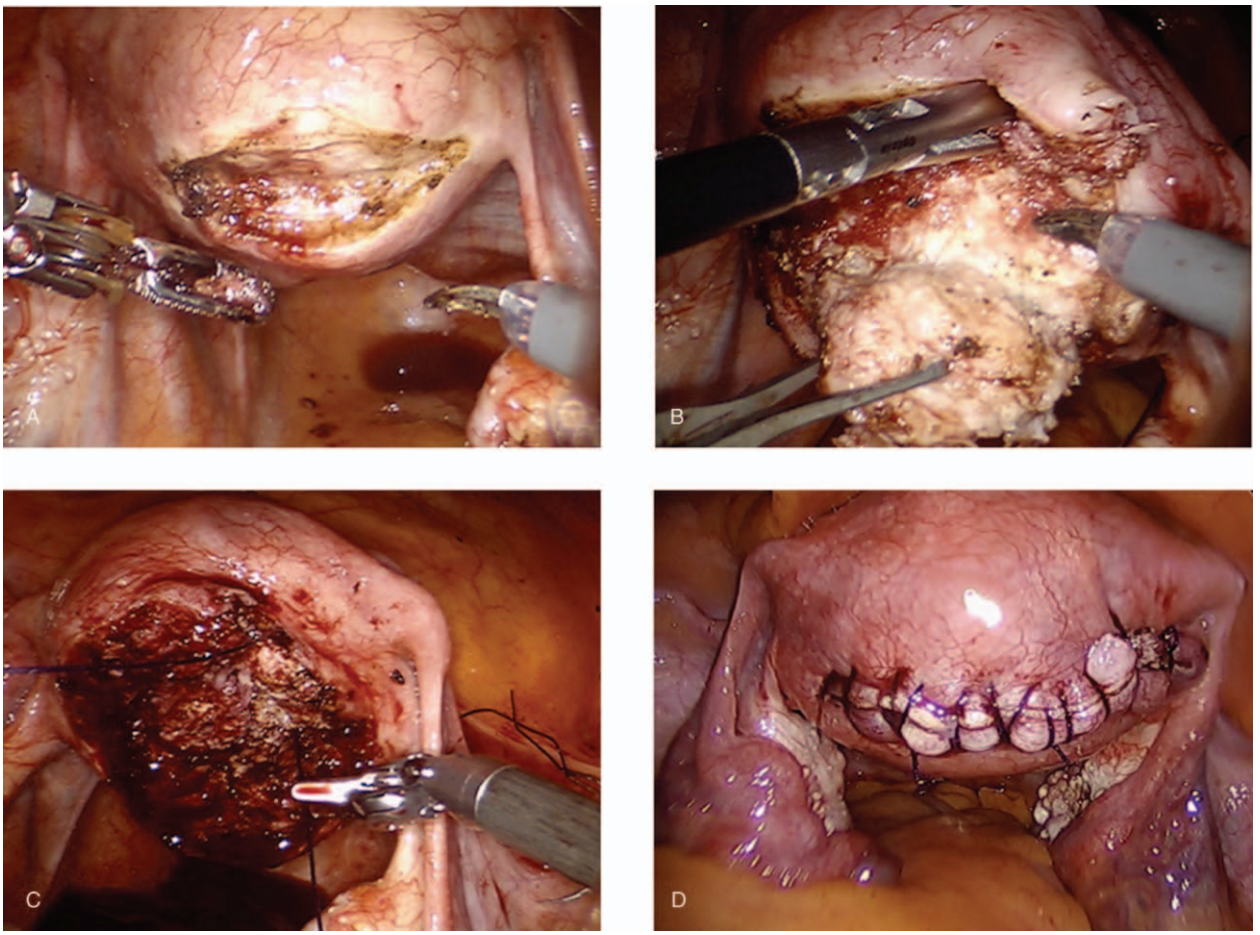

Figure 1. Surgical procedures of robotic adenomyomectomy. A, A transverse incision on the posterior wall of the uterus with a monopolar scissors. B, Removal of adenomyotic lesion using tenaculum forceps. C, The first layer, continuous running suture with a barbed suture. D, The second layer, repairing of the remaining myometrium and serosa with continuous running suture with a barbed suture.

ovarian cyst enucleation with adenomyomectomy, respectively. Only 12 women (27.9%) underwent an exclusive adenomyomectomy. Fourteen women (32.6%) underwent adenomyomectomy with myomectomy and 11 (25.6%) underwent adenomyomectomy with myomectomy and ovarian cyst enucleation. Surgical procedures affect surgical outcomes; therefore, we compared intergroup differences in surgical procedures used to perform the adenomyomectomy. No intergroup differences were observed in surgical procedures ($P = .147$). Postoperative uterine volume did not differ between groups (112.0 vs 105.0 cm^3, $P = .613$). No postoperative complications were observed including infection, voiding dysfunction, or hysterectomy.

Three women showed recurrence necessitating additional medical treatment with nonsteroidal anti-inflammatory drugs postoperatively.

4. Discussion

The treatment of adenomyosis depends on the symptoms, severity, and childbearing circumstances. Those with severe adenomyosis accompanied by disabling pain and anemia affecting their daily activities require hysterectomy as the definitive treatment. Several women with severe adenomyosis, however, prefer radical treatment with uterine conservation for future pregnancy or owing to emotional and/or cultural reasons. These women may be candidates suited to undergo adenomyomectomy.[14,15]

In those with adenomyosis, a clear margin cannot be identified between the affected tissue and the normal myometrium. Therefore, complete removal of adenomyotic tissue is often difficult. In addition, appropriate uterine reconstruction is important to prevent uterine rupture in future pregnancies, which is a serious complication of adenomyomectomy.

A standard operative procedure has not been established for adenomyomectomy. Laparoscopic surgery is associated with fewer complications and lesser postoperative pain, and adhesions, and faster recovery than that associated with laparotomy. Inaccurate assessment of the extent of adenomyosis and a limited range of motion available to repair a myometrial defect without appropriate elimination of dead space, however, serve as limitations of laparoscopy. Laparoscopic surgery may be a useful choice to treat small and localized adenomyosis, whereas diffuse adenomyotic lesions across the uterus necessitate open surgery.

Kwack and Kwon[16,17] have reported surgical outcomes of laparoscopic adenomyomectomy for focal adenomyosis. To minimize operative blood loss, the authors transiently occluded the uterine artery using endoscopic vascular clips and excised 26 g

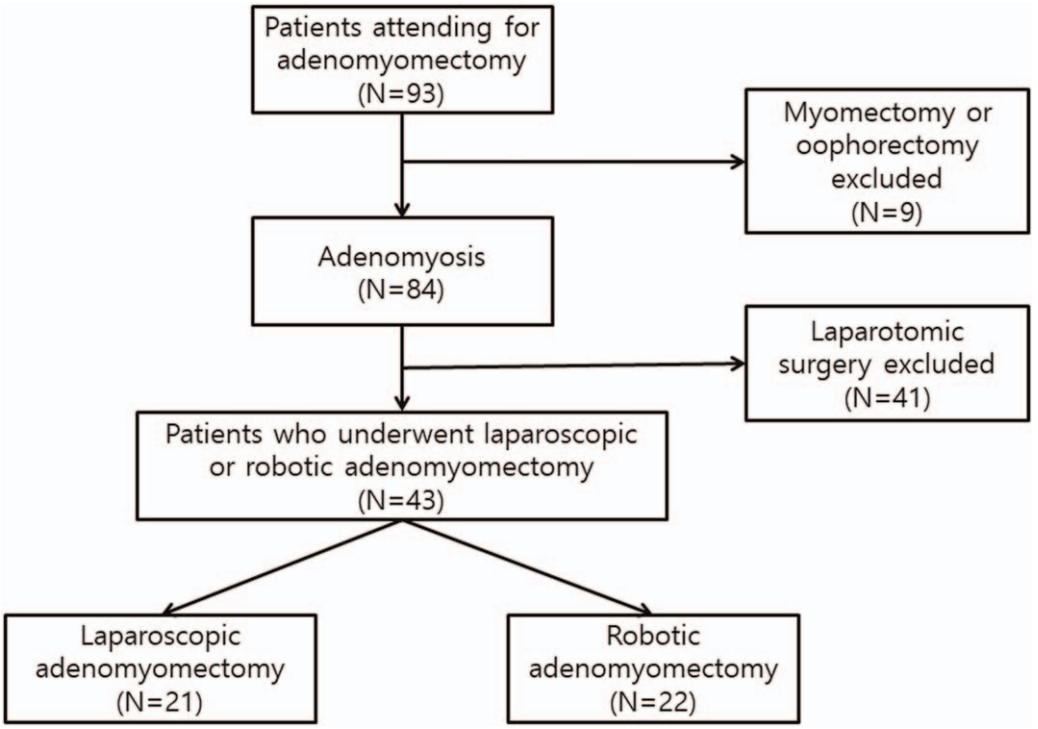

Figure 2. Flowchart of the study selection process.

of adenomyotic tissue. The operative time was 75 minutes, and EBL was 148 mL. Kim et al[18] performed laparoscopic-assisted adenomyomectomy using a double flap method in 9 women with adenomyosis. The operative time was 130.6 minutes, and EBL was 383.3 mL. The authors did not remove adenomyotic tissue laparoscopically, but only explored the pelvic cavity and removed pelvic adhesions laparoscopically before performing a laparotomic adenomyomectomy. In contrast, Huang et al[19] reported laparoscopic adenomyomectomy using a double-flap method for diffuse uterine adenomyosis. They resected 235.7 g of adenomyotic tissue from the uterus (preoperative uterine volume 209.1 cm^3). Surgical outcomes of laparoscopic adenomyomectomy observed in our study were comparable with those of previous studies.

Chung et al[20] have reported the feasibility of robot-assisted laparoscopic adenomyomectomy. The mean operative time was

Table 1

Patient demographics.

Variables	Laparoscopy (n = 21)	Robot (n = 22)	*P*
Age, y (median, range)	41.0 (25.0–50.0)	39.0 (35.0–46.0)	.643
Gravida (median, range)	0 (0–7)	0 (0–4)	.673
Para (median, range)	0 (0–2)	0 (0–2)	.732
BMI, kg/m^2 (median, range	21.5 (16.3–27.6)	21.1 (17.7–31.6)	.771
Symptom (n, %)			
Dysmenorrhea	17 (81.0%)	18 (81.8%)	1.0
Menorrhagia	13 (61.9%)	9 (40.9%)	.169
Chronic pelvic pain	4 (19.0%)	4 (18.2%)	1.0
Infertility	9 (42.9%)	10 (45.5%)	.864
Preoperative pain score (NRS)	8. (1.0–10.0)	7.5 (0.0–10.0)	.677
Preoperative medical treatment	4 (19.0%)	6 (27.3%)	.721
GnRH agonist	2 (9.5%)	2 (9.1%)	
Oral contraceptives	0 (0%)	1 (4.5%)	
Progestin releasing IUD	1 (4.8%)	1 (4.5%)	
SPRM	1 (4.8%)	2 (9.1%)	
Hemoglobin, g/dL	12.7 (7.7–14.9)	12.5 (7.7–14.8)	.368

BMI = body mass index, IUD = intrauterine device, NRS = numeric pain rating scale, SPRM = selective progestin receptor modulator.

Table 2

Disease characteristics.

Variables	Laparoscopy (n = 21)	Robot (n = 22)	*P*
Preoperation uterine volume, cm^3	250.5 (86.5–885.3)	285.3 (94.4–564.8)	.923
Anteroposterior diameter, cm	7.1 (4.1–10.5)	7.1 (5.6–10.6)	
Transverse diameter	7.7 (5.3–10.6)	7.7 (5.6–10.6)	
Longitudinal diameter	9.9 (6.2–16.3)	9.5 (5.5–14.6)	
Type of adenomyosis			1.0
Focal	17 (81.0%)	18 (81.8%)	
Diffuse	4 (19.0%)	4 (18.2%)	
Location of adenomyosis			.260
Anterior	2 (13.3%)	4 (18.2%)	
Posterior	12 (57.1%)	16 (72.7%)	
Anteroposterior	4 (19.0%)	1 (4.5%)	
Other	3 (14.3%)	1 (4.5%)	
Combined disease			
Myoma	11 (52.4%)	17 (77.3%)	.087
Endometriosis	12 (57.1%)	15 (68.2%)	.454
ASRM stage 1	1 (4.8%)	3 (13.6%)	
Stage 2	0	1 (4.5%)	
Stage 3	4 (19.0%)	5 (22.7%)	
Stage 4	7 (33.3%)	6 (27.3%)	
CA125, IU/mL (range)	89.9 (29.2–774.4)	106.3 (16.8–570.6)	.742

ASRM = American Society for Reproductive Medicine, CA125 = cancer antigen-125.

Table 3

Surgical outcomes.

Variables	Laparoscopy (n = 21)	Robot (n = 22)	P
Operation time, min (median, range)	160.0 (40.0–420.0)	212.5 (120.0–420.0)	.106
Estimated blood loss, mL	500.0 (50.0–1500.0)	300.0 (100.0–3200.0)	.309
Transfusion	5 (23.8%)	6 (27.3%)	.795
Surgical procedure			.147
Adenomyomectomy only	7 (26.7%)	5 (22.7%)	
With myomectomy	4 (26.7%)	10 (45.5%)	
With ovarian cyst enucleation	6 (20.0%)	0	
With myomectomy and ovarian cyst enucleation	4 (26.7%)	7 (31.8%)	
Length of hospital stay, day	5.0 (4.0–18.0)	6.0 (5.0–10.0)	.277
Amount of surgical drainage, mL	227.5 (61.5–1340.0)	202.5 (70.0–550.0)	1.0
Nodule weight, g	60.0 (5.0–185.0)	70.0 (5.0–250.0)	.932
Postoperation uterine volume, cm^3	112.0 (38.0–265.0)	105.0 (32.0–324.0)	.613
Anteroposterior diameter, cm	5.4 (3.4–7.1)	5.1 (2.8–8.7)	
Transverse diameter	5.7 (3.7–8.7)	5.4 (4.1–9.2)	
Longitudinal diameter	7.8 (5.6–10.1)	7.5 (5.2–9.7)	
Follow-up duration, mo	8.0 (1.0–24.0)	4.5 (1.0–28.0)	.819
Postoperative symptom			
Menorrhagia (n = 32)	1 (8.3%, n = 11)	2 (10%, n = 20)	.876
Dysmenorrhea (n = 30)	3 (25%, n = 12)	4 (22.2%, n = 18)	.860
Postoperative medical treatment			.319
GnRH agonist	3 (14.3%)	2 (9.1%)	
Oral contraceptive	1 (4.8%)	2 (9.1%)	
Progestin	7 (33.3%)	2 (9.1%)	
Progestin-releasing IUD	6 (28.6%)	9 (40.9%)	

GnRH = gonadotropin-releasing hormone; IUD = intrauterine device.

159.25 minutes, and the EBL was 117.5 mL. Chong et al[13] reported long-term efficacy in 8 cases of robotic adenomyomectomy. The authors excised 78.0 g of adenomyotic tissue and the operative time was 204.2 minutes, and EBL was 48 mL. Patients were hospitalized for 5.6 days. Surgical outcomes of robotic adenomyomectomy observed in our study were similar to those reported by previous studies.

Robotic surgery was expected to show better surgical outcomes than those observed with laparoscopic adenomyomectomy owing to several advantages of a robotic platform over laparoscopic surgery. Our study, however, showed no statistically significant differences in operative outcomes between robotic and laparoscopic surgery. Only a few studies have compared surgical outcomes between robotic and laparoscopic surgeries. Chong et al[13] reported a longer operative time but similar length of hospitalization and EBL in the robotic versus the laparoscopic adenomyomectomy group.[13] In addition, suturing time was significantly longer in the robotic than in the laparoscopic adenomyomectomy group (79.8 ± 23.4 vs 39.7 ± 17.9 min, $P < .001$).

No study has demonstrated the superiority of robotic over laparoscopic adenomyomectomy. This observation could be attributed to the following: absence of tactile feedback may affect the surgical result. Although robotic surgery provides better visualization of the operative field with a 3-dimensional view, tactile sensation is more important to distinguish adenomyotic tissues from normal myometrium. Laparoscopic surgery offers an advantage in this context. The knot-tying technique (a major weakness of laparoscopic surgery) is easier to perform laparoscopically after the introduction of barbed suture technology. Operators skilled in laparoscopic surgery were on their learning curve for robotic adenomyomectomy.

Limitations of this study: This study involved a retrospective review of patients' medical records. Therefore, patient characteristics were heterogeneous. The number of patients enrolled for this study was relatively small to arrive at a definitive conclusion regarding our results. Surgical procedures for adenomyomectomy varied depending upon the patient, disease severity, and location. To overcome these drawbacks, we compared patient demographics that could have affected surgical outcomes between groups using the appropriate statistical methods. Statistical analysis revealed no significant differences between these variables.

Despite these limitations, to our knowledge, this is the first study to compare surgical outcomes between laparoscopic and robotic adenomyomectomy. In addition, considering that laparoscopic or robotic adenomyomectomy are not very common, our study population is relatively large.

In conclusion, robotic adenomyomectomy is feasible for women with adenomyosis. Our data show that surgical outcomes of robotic adenomyomectomy were comparable to those of a laparoscopic adenomyomectomy. We, however, could not demonstrate the advantage of robotic adenomyomectomy over laparoscopic procedure in terms of surgical outcomes. Further multicenter prospective studies using standardized surgical procedures are needed to confirm the conclusions of this study.

Author contributions

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