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Laparoendoscopic single-site myomectomy using combined suture technique versus conventional laparoscopic myomectomy: a comparison of surgical outcomes

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Summary

Purpose of investigation: To compare surgical outcomes of laparoendoscopic single-site myomectomy (LESS-M) and three-port conventional laparoscopic myomectomy (CLM). *Materials and Methods:* Medical records and videos of 158 patients (79 LESS-M and 79 CLM) were reviewed retrospectively. The authors analyzed technical feasibility and operative outcomes for all patients. *Results:* Patient characteristics were similar in the two groups. There were no significant differences in the number of myomas (2.24 [1–8] *vs*. 2.41 [1–12]; $p = 0.571$) and size of the largest myoma (7.04 [4–15] *vs*. 6.89 [3–15] cm; $p = 0.689$) between the groups. LESS-M resulted in a significant decrease in blood loss (189 *vs*. 273 mL; $p = 0.020$). Postoperative pain scores were significantly lower in the LESS-M group at one and six hours after surgery. *Conclusions:* LESS-M using V-Loc and extracorporeal suture technique with Polysorb is associated with less blood loss and less postoperative pain.

Key words: Laparoendoscopic single-site myomectomy; Combined suture; Conventional instruments; Myoma.

Introduction

Uterine myoma is the most frequent tumor of the female genital tract, occurring in 20–50% of women [1]. Although hysterectomy is an option for managing uterine myomas, myomectomy is an attractive alternative and the preferred technique in women who desire to preserve fertility or retain the uterus.

In 1979, Semm [2] introduced laparoscopic myomectomy. Various minimally invasive techniques, such as laparoscopic, laparoscopically-assisted, and robotic-assisted myomectomies, have subsequently been described [3–5]. With improved surgical techniques and increased experience, surgeons have attempted to reduce the invasiveness, number of trocar insertion sites, and visible scars.

Since May 2008, laparoendoscopic single-site (LESS) surgery has been gradually introduced for treating gynecologic diseases, including hysterectomy, ovarian cystectomy, salpingectomy, and cancer-staging operations [6–9]. LESS provides excellent cosmetic results and reduced invasiveness compared to conventional laparoscopy using multiple trocars [10, 11]. However, LESS has not been widely performed due to associated technical difficulties, such as limited motion and clashing between instruments. Moreover, LESS myomectomy (LESS-M) is more difficult than other forms of LESS because it requires the tying of multiple sutures. Difficulties in laparoscopic suturing and knot-tying may increase operative time and intraoperative blood loss [12].

The new barbed suture has been used in conventional laparoscopies using multiple trocars, including hysterectomies [13] and myomectomies [14]. Among available equipment for barbed sutures, the V-Loc wound closure device consists of a unilateral barbed absorbable thread, armed with a surgical needle at one end and a loop at the other to secure the sutures [15]. The barb and loop ends allow the approximation of tissues without surgical knots. The use of barbed sutures in LESS-M effectively decreases the time required for suturing, operative blood loss, and surgical difficulty [15].

The optimal suture technique and extraction method after myomectomy are debatable. Several studies have compared the operative outcomes of LESS-M with those of other surgical approaches, although the data are still limited for myoma size, number, and location. This study reports a single surgeon's experience with LESS-M, using a glove port, conventional instruments, and combined suture technique, and compares the surgical outcomes with those of three-port conventional laparoscopic myomectomy (CLM).

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Materials and Methods

This study was approved by the Institutional Review Board of the Catholic University of Korea, Daejeon St. Mary's Hospital (approval date, November 12, 2015; reference number, DC 15RIS10106) and performed in accordance with the ethical standards of the 1964 Declaration of Helsinki. The study included 79 patients who underwent LESS-M between June 2013 and December 2015. All LESS-M procedures were performed by a single surgeon (E.K.P.) with experience in >100 laparoscopic myomectomies. Since September 2011, conventional laparoscopy with multiple trocars has been replaced by LESS surgery in the present institution. After May 2013, the present authors used V-Loc suture material in laparoscopic suturing.

The decision to perform LESS-M was not influenced by patient history of previous abdominal surgery, body mass index (BMI), myoma size, number, or location. Patients undergoing incidental myoma removal using LESS-M during another major operation or by another suture technique were excluded. These cases were compared to a historic cohort of 79 patients who underwent three-port CLM performed by the same surgeon between September 2009 and July 2011. After a retrospective review of medical records, 158 patients were included. No LESS-M procedures required conversion to conventional multiport laparoscopy or laparotomy.

All surgeries were performed under general anesthesia and in the dorsal lithotomy position. After skin sterilization and draping of the patient, a uterine manipulator was inserted into the uterine cavity of patients with previous sexual experience.

Using the open Hasson technique, a vertical 1.5- to 2-cm incision was made within the umbilicus. The fascial and peritoneal edges were sutured with 2-0 Polysorb for traction before port system installation. A transumbilical single-port system was fashioned with a glove port, consisting of a retractor component with inner and outer rings, a port component consisting of a separated gas inlet and outlet, and a Cook Cap to permit insertion of the scope and laparoscopic instruments (2–12 mm). The inner ring was inserted transumbilically, and the outer ring was adjusted to the thickness of the abdominal wall by rolling the sheet three to four times to maintain the pneumoperitoneum, and then the outer ring and port component were attached.

After the single-port device was placed into the umbilical incision, the abdomen was insufflated to a limited pressure of 12 mmHg with CO_2. All LESS-M procedures were performed using a rigid 0° 5-mm laparoscope and conventional rigid, straight laparoscopic instruments. After entering the peritoneal cavity, a mixed solution containing 20 IU (1 mL) of a vasoconstrictor agent (vasopressin) and 100 mL of normal saline was injected into the tissue adjacent to the base and capsule of the myoma. A horizontal incision was made to mark the myometrium using a monopolar hook electrode and then deepened until the myoma surface appeared. After identifying the cleavage plane, myoma enucleation was performed with traction using a 5-mm myoma screw to separate the capsule from the myoma. As the base of the myoma appeared, coagulation of significant bleeding and excision of the myoma from the deep myometrium were obtained with bipolar electrosurgical and ultrasonic cutting devices.

After myoma enucleation, the defect in the myometrium and serosa was closed two to three times, depending on the size, in one or two layers (Figure 1A) using interrupted figure-eight sutures (No. 1 Polysorb) with extracorporeal knots, using a knot pusher. The objective of the first sutures was the approximation of a full layer of the uterine defect and rapid control of uterine bleeding. A key point is that half of the thread length should be pulled through after the first stitch and before the second stitch, as pulling after the second stitch can cause bleeding and tearing of the tissue. Before the extracorporeal knot was made, both threads were caught with the biopsy forceps and needle holder in the abdominal cavity and drawn out of the body away from the suture site to decrease risk of loosening and were then approximated by crossing the ends in opposite directions.

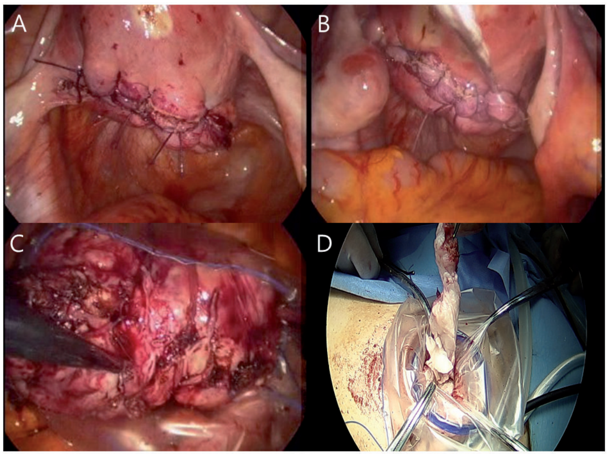

Figure 1. (A) Uterine wound was closed with interrupted figure-eight sutures with extracorporeal knots. (B) Myometrium repair was completed by barbed sutures. (C) Enucleated myoma was placed into a retrieval bag and (D) extracted transumbilically following knife morcellation.

The second suture was performed using a 30-cm 1-0 polyglyconate unidirectional barbed suture with a 23- or 37-mm half-circle taper-point needle (V-Loc 180). The first stitch was locked by a loop at one end of the uterine incision, and then a continuous suture was passed through to the opposite end and cut without tying a knot. In cases of large myoma, two or three V-Loc were used.

After myometrium repair was completed (Figure 1B), enucleated myomas were placed into a retrieval bag (Figure 1C) and extracted transumbilically following knife morcellation (Figure 1D). Drainage tubes were inserted in some patients. After washing the pelvic cavity with normal saline, the port component was opened and the retractor component was removed after adequate evacuation of intra-abdominal gas. The peritoneum and fascia were closed with No. 1 Polysorb interrupted sutures using a detached needle. The subcutaneous tissue was closed with 2-0 Polysorb, and the skin was closed using a subcuticular continuous suture with 3-0 Dermalon.

Overall, operative procedures in the three-port CLM were similar to LESS-M with the exception of port placement (two 5-mm trocars were placed in the right lateral abdominal wall and the left lateral abdominal wall, and one 12-mm trocar was placed in the intraumbilical area), intracorporeal suture tying, and use of an electrosurgical morcellator for tissue extraction. The uterine defect was closed using No. 1 Polysorb figure-eight interrupted sutures in one or two layers using an intracorporeal technique. The enucleated myoma was extracted using a 12-mm electromechanical power morcellator through the 12-mm port side. After bleeding was controlled, the fascia was approximated using 2-0 Polysorb only at the 12-mm trocar incision site. The three skin incision sites were closed with a vertical mattress suture using 3-0 Dermalon on one or two points.

Study data were retrieved from electronic medical records and

Table 1. — *Patient characteristics.*

Variable	LESS-M (n = 79)	CLM (n = 79)	*p* value
Age, years	37.42 ± 5.832 [23–51]	35.81 ± 6.899 [23–55]	0.116
BMI, kg/m^2	23.46 ± 3.784 [23–46]	23.09 ± 4.017 [14–36]	0.556
Parity, no.	0.63 ± 0.865 [0–2]	0.86 ± 1.009 [0–3]	0.130
No. of myomas	2.24 ± 1.546 [1–8]	2.41 ± 2.060 [1–12]	0.571
Size of the largest myoma, cm	7.04 ± 2.207 [4–15]	6.89 ± 2.317 [3–15]	0.687
Weight of specimen, grams	170.63 ± 136.291 [40–780]	209.80 ± 174.439 [20–810]	0.118
Type of the largest myoma			
Intramural	61 (77.2)	63 (79.7)	0.927
Subserosal	10 (12.7)	9 (11.4)	0.927
Intraligamentary	8 (10.1)	7 (8.9)	0.927
Location of the largest myoma			
Anterior	29 (36.7)	41 (51.9)	0.223
Posterior	34 (43.0)	24 (30.4)	0.223
Fundal	6 (7.6)	7 (8.9)	0.223
Broad ligament	10 (12.7)	7 (8.9)	0.223
No. of patients with no manipulator	20 (25.3)	16 (20.3)	0.448

Values are presented as mean ± standard deviation [range] or n (%).

Table 2. — *Comparison of surgical outcomes.*

Variable	LESS-M(n = 79)	CLM (n = 79)	*p* value
Operative time, minutes	171.77 ± 67.779 [60–440]	161.90 ± 77.046 [30–360]	0.394
Blood loss, mL	189.11 ± 186.913 [10–1200]	273.67 ± 260.164 [10–1200]	0.020*
Postoperative hemoglobin decrease, g/dL	1.23 ± 0.715 [0 to 3]	1.35 ± 1.250 [-2 to 5]	0.445
Hospital stay, days	3.73 ± 0.693 [3–5]	4.00 ± 1.025 [2–8]	0.058
Blood transfusion (%)	1 (1.3)	2 (2.5)	0.056
Conversion to additional port, %	0	0	
Conversion to laparotomy, %	0	0	
Postoperative pain score (VAS score)			
1 hour	2.94 ± 0.434 (2–4)	4.19 ± 1.406 (2–8)	0.000***
6 hours	2.49 ± 0.732 (2–5)	2.95 ± 1.154 (2–6)	0.004**
12 hours	2.39 ± 0.706 (1–5)	2.66 ± 1.011 (1–5)	0.057
24 hours	1.95 ± 0.389 (1–3)	2.03 ± 0.862 (1–5)	0.476

Values are presented as mean ± standard deviation [range] or n (%).
$*p < 0.05$, $**p < 0.01$,$***p < 0.001$.

surgery video if necessary. Patient characteristics extracted included age, BMI, myoma size, number and location, total operative time, estimated blood loss, postoperative hemoglobin decrease, length of hospital stay, complications, and postoperative pain. Total operative time, which was electronically recorded, was defined as time from skin incision to skin closure. Estimated blood loss was calculated by the anesthesiology unit as the difference between the total amount of suction and irrigation. Hemoglobin decrease was defined as the difference between preoperative hemoglobin level and hemoglobin level on postoperative day 1. Length of hospital stay was defined as time from day of surgery to day of discharge. Possible operative complications included bladder, ureter, major vessel or bowel injuries, postoperative ileus, fever, wound infection, intra-abdominal bleeding, and blood transfusion. Patients were monitored during the hospital stay and follow-up examinations at one week and one month after surgery. Postoperative pain was assessed using a visual analogue scale (VAS, 0 = no pain; 10 = worst pain imaginable) as described previously [16] where patients were asked to evaluate their maximal level of pain. Pain scores were recorded by a nurse at one, six, 12, and 24 hours after surgery. Generally, postoperative pain was managed by a patient-controlled fentanyl-based intravenous analgesia pump (IV-PCA); bolus dose, 0.12 mg/kg of fentanyl; lockout interval, five minutes; basal infusion, 0.02 mL/kg). Patients were instructed to press the IV-PCA bolus button when their pain was ≥3 on the VAS. IV-PCA was maintained for 48 hours after surgery, if earlier removal was not requested by the patient because of side effects. The authors acquired these data from nursing charts. Pregnancy outcomes were confirmed by medical chart review and/or by telephone contact.

Statistical analysis was performed using Student's *t*-test for continuous variables and the c^2 test for categorical variables where appropriate. Pain scores were compared between groups or times using repeated measures of analysis of variance. SPSS version 18.0 statistical software was used, and results were considered statistically significant at $p < 0.05$.

Results

Medical records of 171 patients who underwent laparoscopic myomectomy during the study period were reviewed, and 158 patients were included. Baseline patient characteristics are shown in Table 1. Patient age, median BMI, myoma weight and properties, and number of patients with no manipulator were similar in the two groups. For sexually inexperienced patients in the LESS-M group, the myomas ranged from 5 to 12 cm in size and one to five in total number. Ten myomas were located in the posterior uterus, eight in the anterior uterus, and two in the fundus. All patients had intramural myomas.

Operative outcomes are summarized in Table 2. The surgical outcomes, such as operative time, postoperative hemoglobin decrease, and postoperative hospital stay were not significantly different between the groups. No complications other than blood transfusions were observed. For patients requiring transfusion in the three-port CLM group, the myomas ranged from 10 to 12 cm in size and one to four in total number. One was located in the posterior uterine wall, and another was in the anterior cervix. All patients had intramural myomas. In the LESS-M group, one patient received intraoperative transfusion during the removal of a 13-cm posterior intramural myoma, but this did not extend her hospital stay. No conversion to laparotomy or additional port laparoscopy was required. LESS-M resulted in a statistically significant decrease in blood loss and postoperative pain score at one and six hours postoperatively. Median days of follow-up were statistically lower in the LESS-M group than that in the three-port CLM group.

Ten (12.7%) women in the three-port CLM group achieved pregnancy. Nine of these patients delivered at full term by cesarean section without complications and one patient delivered by emergency cesarean section because of preterm labor following premature rupture of membranes at 34+2 weeks. In the LESS-M group, three (3.8%) women achieved pregnancy. Two of these patients delivered by cesarean section at full term without complications. One patient was in the early stage of gestation, without complication, and was receiving antenatal care at the present hospital.

Discussion

In recent years, many studies have demonstrated the feasibility and safety of LESS in various gynecologic surgeries. However, reports on LESS-M have only been published since 2010, with studies comparing the surgical outcomes and suture techniques [15, 17–22] of LESS-M and CLM. Despite small sample sizes, data indicate that LESS-M is a feasible and safe treatment option with comparable operative outcomes to CLM in selected cases.

The reported suture techniques in LESS-M studies include barbed sutures [15, 22], Hem-o-lock ligation clips [21], extracorporeal knot-pusher devices [20], and intracorporeal sutures using articulating laparoscopic instruments [18, 19]. Intracorporeal suturing of uterine wall defects using conventional laparoscopic instruments during LESS-M is more difficult than extracorporeal sutures because of narrower range of movement and frequent clashing or lack of triangulation between instruments. Articulating instruments often offer lesser tension than conventional rigid instruments, which can contribute to poor obstetric outcomes. Moreover, the use of barbed sutures in LESS-M significantly reduces the suture time in the treatment of uterine wall defects, as well as total operative time [15].

In a previously published study by another group in the present hospital [23], LESS-M resulted in an increase in operative time compared with three-port CLM; however, the previous study group only included 31 initial cases of LESS-M using intracorporeal sutures performed by a single surgeon (E.K.P.). In the present study, the use of LESS-M with barbed suture and extracorporeal sutures caused some differences in the outcome. There was significantly less blood loss and postoperative pain compared with the three-port CLM.

All patients requiring myomectomy during the study period underwent single-port surgery, regardless of the size or location of the myomas, and no conversion to laparotomy or additional ports was required. To the present authors' knowledge, this study represents the largest study to date comparing surgical outcomes between LESS-M and CLM. Transfusion in a small number of patients was the only complication in either group.

Some literature reported that intraligamentary, subserosal, and intramural myomas located in the anterior uterine wall are appropriate for LESS-M [17, 24-26]. In addition, LESS-M may be more effective for myomas located proximal to the fundus than for myomas in the lower uterus. In the LESS-M group, the patient who received intraoperative transfusion had a posterior intramural myoma.

The mean diameter of the largest extracted myoma during LESS-M was 7.04 cm, and the maximum diameter was 15.0 cm. Previous studies comparing LESS-M and CLM reported a maximum myoma size ≤ 12 cm with LESS-M [15, 18, 22].

To the present authors' knowledge, this is the first report to compare two groups with regards to manipulator insertion. Recent literature has reported that manipulation of the uterus in the proper direction for suturing is important and that myomas located in the lateral, posterior, or lower segment of the uterus are difficult to properly expose for suturing, even with uterine manipulation [24]. However, in the present authors' experience, intramural myomas in the posterior uterine wall were easier to suture without a manipulator, although the early procedure was more difficult without the manipulator until the enucleation of the myoma. This is because maximum anterior bending of the uterus is possible, although further study is necessary to confirm this. The present authors carefully checked for collapsed lumen and then completely sutured the full defect layer without anastomotic failure in the case of deep myoma.

The extraction of the enucleated myoma during laparoscopy has recently become a major issue. A recent US Food and Drug Administration safety communication has discouraged the use of power morcellators for myoma extraction [27, 28], which has resulted in a shift in the surgical technique for laparoscopic myomectomy. The specimen can be extracted easily through the umbilical retractor ring because the size of the opening in the single-port system is larger than in the multiport system [25]. In the study, myoma morcellation using a knife within an Endobag was fast and convenient for the operator and prevented sarcoma seeding in the patient. Thus, LESS-M may be the most favorable approach for specimen extraction.

Although most studies found no significant difference in pain, some have reported reduced postoperative pain with LESS-M compared with CLM [21]. An important finding of the present study is that there was less pain with LESS-M than with three-port CLM at one and 6 hours after surgery. The present authors used a morcellator knife for tissue extraction in the LESS-M group and a 12-mm, hard, and heavy electromechanical morcellator in the three-port CLM group. As the umbilicus has no muscle layer beneath the skin, the relatively tension-free umbilical incision in the LESS-M method could cause less pain than that of the three incisions with rectus abdominis dissection used in the CLM method [29]. This could affect the postoperative pain score in patients. In addition, procedures in the present study differed by port number, suture technique, and extraction method. Moreover, suture technique can contribute to decreases in blood loss and reduction in port number and, along with knife extraction, can contribute to less postoperative pain.

The present study has some limitations. It was retrospective and included a small number of patients, although it is currently the largest reported study comparing LESS-M with CLM. All operations were performed by a single surgeon, which limits the generalizability. The procedure in the two groups differed by number of ports, suture technique, and extraction method for the enucleated myomas. LESS-M has been performed more recently than CLM. This could contribute to a surgical advantage with LESS-M, as the surgeon's skill level improves. Additionally, because the follow-up period was brief in the LESS-M group, pregnancy outcomes could not be compared, and long-term follow-up is needed.

Conclusions

LESS-M is a feasible and safe procedure for management of uterine myoma when performed by a surgeon experienced in laparoscopic myomectomy. LESS-M, using a combined suture technique, is associated with reduced blood loss and postoperative pain. A multicenter, prospective trial and long-term follow-up are needed to confirm the present results.

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References

[1] Sami Walid M., Heaton R.L.: "The role of laparoscopic myomectomy in the management of uterine fibroids". *Curr. Opin. Obstet. Gynecol.*, 2011, *23*, 273.

[2] Semm K.: "New methods of pelviscopy (gynecologic laparoscopy) for myomectomy, ovariectomy, tubectomy and adnectomy". *Endoscopy*, 1979, *11*, 85.

[3] Paul G.P., Naik S.A., Madhu K.N., Thomas T.: "Complications of laparoscopic myo-mectomy: a single surgeon's series of 1001 cases". *Aust. N. Z. J. Obstet. Gynaecol.*, 2010, *50*, 385.

[4] Jin C., Hu Y., Chen X.C., Zheng F.Y., Lin F., Zhou K., *et al.*: "Laparoscopic versus open myomectomy – a meta-analysis of randomized controlled trials". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2009, *145*, 14.

[5] Di Gregorio A., Maccario S., Raspollini M.: "The role of laparoscopic myomectomy in women of reproductive age". *Reprod. Biomed. Online.*, 2002, *4*, 55.

[6] Park H.S., Kim T.J., Song T., Kim M.K., Lee Y.Y., Choi C.H., et al.: "Single-port access (SPA) laparoscopic surgery in gynecology: a surgeon's experience with an initial 200 cases". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2011, *154*, 81.

[7] Fagotti A., Boruta D.M., 2nd, Scambia G., Fanfani F., Paglia A., Escobar P.F.: "First 100 early endometrial cancer cases treated with laparoendoscopic single-site surgery: a multicentric retrospective study". *Am. J. Obstet. Gynecol.*, 2012, *206*, 353.e1.

[8] Marocco F., Fanfani F., Rossitto C., Gallotta V., Scambia G., Fagotti A.: "Laparoendo-scopic single-site surgery for fertility-sparing staging of border line ovarian tumors: initial experience". *Surg. Laparosc. Endosc. Percutan. Tech.*, 2010, *20*, e172.

[9] Tergas A.I., Fader A.N.: "Laparoendoscopic single-site surgery (LESS) radical hysterectomy for the treatment of early stage cervical cancer". *Gynecol. Oncol.*, 2013, *129*, 241.

[10] Song T., Cho J., Kim T.J., Kim I.R., Hahm T.S., Kim B.G., Bae D.S., et al.: "Cosmetic outcomes of laparoendoscopic single-site hysterectomy compared with multi-port surgery: randomized controlled trial". *J. Minim. Invasive Gynecol.*, 2013, *20*, 460.

[11] Song T., Kim T.J., Cho J., Kim I.R., Kang P.N., Lee J.W., *et al.*: "Cosmesis and body image after single-port access surgery for gynaecologic disease". *Aust. N. Z. J. Obstet. Gynaecol.*, 2012, *52*, 465.

[12] Yuen L.T., Hsu L.J., Lee C.L., Wang C.J., Soong Y.K.: "A modified suture technique for laparoscopic myomectomy". *J. Minim. Invasive Gynecol.*, 2007, *14*, 318.

[13] Bassi A., Tulandi T.: "Evaluation of total laparoscopic hysterectomy with and without the use of barbed suture". *J. Obstet. Gynaecol. Can.*, 2013, *35*, 718.

[14] Angioli R., Plotti F., Montera R., Damiani P., Terranova C., Oronzi I., *et al.*: "A new type of absorbable barbed suture for use in laparoscopic myomectomy". *Int. J. Gynaecol. Obstet.*, 2012, *117*, 220.

[15] Song T., Kim T.J., Kim W.Y., Lee S.H.: "Comparison of barbed suture versus traditional suture in laparoendoscopic single-site myomectomy". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2015, *185*, 99.

[16] Vassiliou M.C., Feldman L.S., Andrew C.G., Bergman S., Leffondré K., Stanbridge D., Fried G.M.: "A global assessment tool for evalu-

ation of intraoperative laparoscopic skills". *Am. J. Surg.*, 2005, *190*, 107.
[17] Yoshiki N., Okawa T., Kubota T.: "Single-incision laparoscopic myomectomy with intracorporeal suturing". *Fertil. Steril.*, 2011, *95*, 2426.
[18] Lee J.R., Lee J.H., Kim J.Y., Chang H.J., Suh C.S., Kim S.H.: "Single port laparoscopic myomectomy with intracorporeal suture-tying and transumbilical morcellation". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2014, *181*, 200.
[19] Kim S.K., Lee J.H., Lee J.R., Suh C.S., Kim S.H.: "Laparoendoscopic single-site myomectomy versus conventional laparoscopic myomectomy: a comparison of surgical outcomes". *J. Minim. Invasive Gynecol.*, 2014, *21*, 775.
[20] Kim J.Y., Kim K.H., Choi J.S., Lee J.H.: "A prospective matched case-control study of laparoendoscopic single-site vs conventional laparoscopic myomectomy". *J. Minim. Invasive Gynecol.*, 2014, *21*, 1036.
[21] Choi C.H., Kim T.H., Kim S.H., Choi J.K., Park J.Y., Yoon A., et al.: "Surgical outcomes of a new approach to laparoscopic myomectomy: single-port and modified suture technique". *J. Minim. Invasive Gynecol.*, 2014, *21*, 580.
[22] Song T., Kim T.J., Lee S.H., Kim T.H., Kim W.Y.: "Laparoendoscopic single-site myomectomy compared with conventional laparoscopic myomectomy: a multicenter, randomized, controlled trial". *Fertil. Steril.*, 2015, *104*, 132531.
[23] Kim S.M., Baek J.M., Park E.K., Jeung I.C., Choi J.H., Kim C.J., Lee Y.S.: "A comparison of single-, two- and three-port laparoscopic myomectomy". *JSLS*, 2015, *19*, e2015.00084.
[24] Lee J.H., Choi J.S., Jeon S.W., Son C.E., Lee S.J., Lee Y.S.: "Single-port laparoscopic myomectomy using transumbilical GelPort access". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2010, *153*, 81.
[25] Kim Y.W., Park B.J., Ro D.Y., Kim T.E.: "Single-port laparoscopic myomectomy using a new single-port transumbilical morcellation system: initial clinical study". *J. Minim. Invasive Gynecol.*, 2010, *17*, 587.
[26] Yoon A., Kim T.J., Lee Y.Y., Choi C.H., Lee J.-W., Bae D.-S., Kim B.-G.: "Laparoendoscopic single-site (LESS) myomectomy: characteristics of the appropriate myoma". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2014, *175*, 58.
[27] Senapati S., Tu F.F., Magrina J.F.: "Power morcellators: a review of current practice and assessment of risk". *Am. J. Obstet. Gynecol.*, 2015, *212*, 18.
[28] Brölmann H., Tanos V., Grimbizis G., Choi C.H., Lee J.-W., Bae D.-S., Kim B.-G.: "Options on fibroid morcellation: a literature review". *Gynecol. Surg.*, 2015, *12*, 3.
[29] Kim T.J., Lee Y.Y., Cha H.H., Kim C.J., Choi C.H., Lee J.W., *et al.*: "Single-port-access laparoscopic-assisted vaginal hysterectomy versus conventional laparoscopic-assisted vaginal hysterectomy: a comparison of perioperative outcomes". *Surg. Endosc.*, 2010, *24*, 2248.

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