



## Original article

## Mini-laparoscopic surgery versus conventional laparoscopic surgery for patients with endometriosis

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## ABSTRACT

**Objective:** To compare mini-laparoscopic surgery and conventional laparoscopic surgery in patients with endometriosis that was conducted to determine the superiority of mini-laparoscopic surgical technique.**Design:** Retrospective analysis.**Settings:** Osaka Medical College Hospital, Hokusetsu General Hospital, and Daiichi-Towakai Hospital, Osaka, Japan.**Patients:** Forty-six patients with endometriosis who underwent conventional or mini-laparoscopic surgery between November 2009 and October 2012.**Intervention:** Patients were divided into three groups. Group A underwent conventional surgery with one 12-mm port for a 10-mm laparoscope and three 5-mm ports. Groups B and C underwent mini-laparoscopic surgery with one 5-mm port for a 5-mm laparoscope and one 5-mm port as well as two 3-mm ports (Group B) or two 2.3-mm ports for the Mini-Lap Grasper (Group C).**Measurements and main results:** Operating time was significantly longer in Group C than in Group B ( $p = 0.01$ ). Serum C-reactive protein levels 1 day after surgery were significantly lower in Groups B and C than in Group A ( $p < 0.001$ ). In Groups B and C, C-reactive protein levels 1 day after surgery were similar, but rescue analgesic requirements were significantly higher in Group B ( $p = 0.003$ ).**Conclusion:** Mini-laparoscopic surgery for patients with endometriosis is safe. Group C exhibited decreased postoperative incisional pain, and the procedure used was less invasive and produced superior cosmetic results. However, operating time in Group C was significantly longer. The procedure that Group B underwent was also minimally invasive with a similar operating time and improved cosmetic appearance.

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## Introduction

Expert surgeons and medical technology companies advertise and promote single-port and mini-laparoscopic surgeries as modern and safe alternatives to conventional laparoscopy. In 1992, Dorsey and Tabb<sup>1</sup> were the first to report the use of a mini-laparoscope in gynecology. Great effort has since gone into designing and selling instruments, ports, and optical devices to facilitate these approaches, leading to increased interest in and popularity of these techniques among laparoscopic surgeons.<sup>2–4</sup> However, little scientific evidence supports the proposed advantages of these alternatives, especially in

patients with endometriosis. Surgery for endometriosis is more complex than that for ovarian cysts; it is often more difficult to perform as endometriosis is frequently accompanied by severe adhesions. This is considered the main reason that surgeons avoid mini-laparoscopic surgery in patients with endometriosis.

Endometriosis is a common gynecological disorder defined by the presence of endometrial glands and stroma outside the uterus. It is estimated that endometriosis affects up to 20–25% of women during their reproductive years.<sup>5</sup> The principal symptoms of endometriosis are pain and infertility. Symptomatic disease causes prolonged suffering and disability, negatively affecting health-related quality of life and working ability.<sup>2,6,7</sup> Treatment of endometriosis depends on several factors, including disease stage, number of foci, disease site, and associated issues such as pain and infertility.<sup>8</sup> Conservative surgery maintains the reproductive organs, effectively treats endometriosis-associated pain, and delays

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disease recurrence. It is considered the first-line therapy in women with the desire to retain their fertility.<sup>4,9,10</sup>

Laparoscopy is the only diagnostic test that reliably rules out peritoneal endometriosis. It is accurate and is considered the standard investigation. Indications for laparoscopy include severe pain over several months, pain requiring systematic therapy, pain resulting in days off work or school, or pain requiring hospital admission.<sup>11–13</sup> Mini-laparoscopic techniques aim to minimize the wound incision length created by conventional laparoscopic four-port surgery; the underlying rationale is that smaller incisions produce less pain, are less invasive, and improve cosmetic results.

In the first report of its kind, we have evaluated the superiority of mini-laparoscopic surgery in patients with endometriosis.

We present the outcome of a comparison between mini-laparoscopic surgery and conventional laparoscopic surgery in patients with endometriosis that was conducted to determine the superiority of mini-laparoscopic surgical technique. Furthermore, we attempted to examine the characteristics of 3-mm port instruments and Mini-Lap Grasper.

## Materials and methods

Patients aged >18 years diagnosed with endometriotic cysts were included in this study. Patients with oligomenorrhea, infertility, and cysts >6 cm in diameter were considered as candidates for cystectomy. Patients with suspected malignancies were excluded. No definitive criteria were established to exclude patients from the mini-laparoscopic group.

The patients were divided into three groups. Group A underwent conventional laparoscopy with one 12-mm port for a 10-mm laparoscope and three 5-mm ports. Group B underwent mini-laparoscopy with one 5-mm port for a 5-mm laparoscope as well as one 5-mm and two 3-mm ports. Group C underwent mini-laparoscopy with one 5-mm port for a 5-mm laparoscope as well as one 5-mm and two 2.3-mm ports for the Mini-Lap Grasper (Stryker Japan KK, Tokyo, Japan; Fig. 1). The patients were grouped according to the policy of each institution and not according to surgeon preference or severity of endometriosis. In one institution, a 5-mm laparoscope was not available, and in another hospital, a 5-mm laparoscope was introduced in April 2011. Age, operating time, serum C-reactive protein (CRP) levels on postoperative Days 1 and 3, revised American Society for Reproductive Medicine (rASRM) score, and rescue analgesic requirements were evaluated in each group.

Procedures were performed with the patients in a modified dorsal lithotomy position with the arms tucked. General anesthesia was induced, and intravenous antibiotics were administered according to surgeon preference.

The primary surgeon stood on the patient's left side with the assistant on the right. Initial entry into the abdomen was gained via an open supraumbilical approach. A 12-mm or 5-mm port was inserted here. Insufflation pressure was automatically maintained at 8–10 mmHg, and 5-mm and 3-mm ports or a Mini-Lap Grasper were inserted as shown in Fig. 2.

As disease extent and involvement differed between patients, procedures started with an evaluation of the abdominal cavity. Surgical procedures were subsequently individualized for each patient. During laparoscopy, patients were scored according to the rASRM classification of endometriosis. In a head-down position, adhesiolysis, ovarian cystectomy, and excision or vaporization of peritoneal

endometriotic implants were performed intraoperatively. Although excision of the bladder, ureter, and bowel was not performed, adhesiolysis was thoroughly performed for the uterus, ovary, and fallopian tube until these organs were replaced to their anatomical positions.

Statistical analysis was performed using the Mann–Whitney *U* test or two-sample *t* test for continuous or ordered discrete variables. A *p* value <0.05 was considered significant.

## Results

Between November 2009 and October 2012, 46 patients with endometriosis underwent conventional laparoscopic or mini-laparoscopic surgery at three institutions. Two patients with severe tubal adhesion were excluded from this study because they switched to a 5-mm device from a 2.3-mm Mini-Lap Grasper. The remaining 44 patients were enrolled and divided into three groups: Group A (*n* = 20), Group B (*n* = 12), and Group C (*n* = 12). Table 1 shows backgrounds and outcomes in each group.

On comparing conventional laparoscopic surgery (Group A) with mini-laparoscopic surgery (Groups B and C), rASRM score, operating time, and rescue analgesic requirements were similar between groups, but the serum CRP levels 1 day after surgery were significantly higher in Group A (mean, 10.4 mg/L) than in Groups B and C (mean, 5.6 mg/L; *p* < 0.001). The age of patients was significantly greater in Group A (mean, 35.7 years) than in Groups B and C (mean, 31.2 years; *p* = 0.006). On comparing Groups B and C, operating time was significantly shorter in Group B than Group C (mean: 96.4 minutes and 127.3 minutes, respectively; *p* = 0.03); however, rescue analgesic requirements were significantly lower in Group C (mean, 1.3) than Groups A and B (mean, 3; *p* = 0.003). Summarized data are shown in Table 2.

## Discussion

Rapid instrument evolution and surgeon advocacy have increased the popularity of laparoscopic surgery in recent years.<sup>1</sup> Shorter recovery time and esthetic advantages have also fueled patient acceptance. The rationale for using smaller instruments and/or fewer incisions is to minimize tissue trauma and improve postoperative pain and cosmetic results.<sup>2,3</sup> The term “mini-laparoscopic” is used broadly in published studies to include all techniques that use smaller incisions, alone or in combination with smaller instruments. The terms “mini-laparoscopic, needlescopic” and “reduced trocar” have been used interchangeably to describe these techniques.<sup>14</sup> In this study, we defined mini-laparoscopy as using a 5-mm laparoscope with ports smaller than 5 mm.

The smaller diameter of mini-laparoscopes confers several advantages. It reduces postoperative complications such as subcutaneous or subfascial extravasation of blood and hematoma formation. As incisions are smaller, mini-laparoscopy reduces local postoperative pain and incisional hernia. Incisional hernia occurs at a rate of 0.12% following use of a 10-mm port and 0.31% following use of a 12-mm port.<sup>15</sup> Using 5-mm or 3-mm port instruments would reduce incisional hernia compared with using 10-mm port instruments. Exteriorization of a portion of the greater omentum and bowel resection for small bowel incarcerations following herniation through the fascial site are avoided with the use of mini-laparoscopes.<sup>16,17</sup> In our study, incisional hernia did not occur in any patient. In the review of mini-laparoscopic cholecystectomy, Thakur et al<sup>17</sup> reported that patients undergoing mini-laparoscopy return to activity more quickly than those undergoing conventional laparoscopy. This is an important outcome; a faster return to activity lessens the financial impact of time away from work to recover from surgery.<sup>14</sup> Although Kadar et al<sup>18</sup> reported that mini-



Fig. 1. Mini-Lap Grasper.

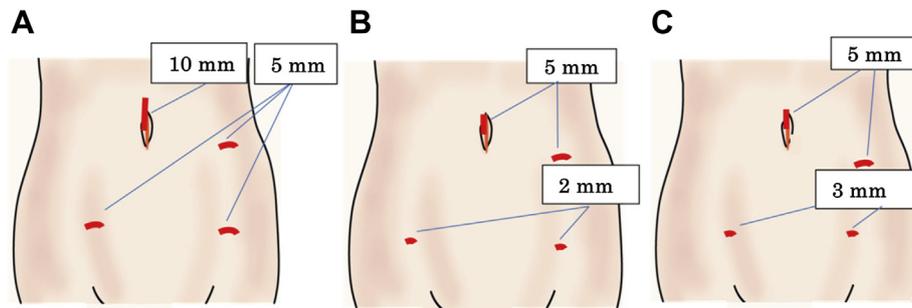


Fig. 2. Port placement in patients in Groups A, B, and C.

laparoscopes may also enable faster discharge and reduce costs, further evidence is necessary to confirm this. Nature and the extent of surgery required for excision of endometriosis is variable, and it is considered different from that of laparoscopic cholecystectomy, which involves exclusive removal of one confined organ, the gallbladder.

We first compared the outcomes of conventional laparoscopic surgery (Group A) with mini-laparoscopic surgery (Groups B and C). Patient age was significantly greater in Group A than Groups B and C. This is because patients presenting with infertility, particularly older patients, require surgery as soon as possible, hence, they were sent to an institution performing only conventional laparoscopic surgery with the shortest interval between the first visit and the operation. Our surgery for infertility patients with endometriosis is not different from that for patients whose chief complaint is the latter. Severity of endometriosis and operating time were similar between groups. The rASRM score for each group is similar, implying that the extensiveness of the surgery itself is similar in all 3 groups. However, serum CRP levels 1 day after surgery were significantly lower in Groups B and C than Group A ( $p < 0.001$ ). This means that mini-laparoscopic surgery is less invasive than conventional laparoscopic surgery. Rescue analgesic requirements did not differ significantly between groups. McCloy et al<sup>19</sup> reported a trend in procedure-specific evidence towards limited analgesic benefits; smaller total trocar incision size did not reduce postoperative pain. Therefore, it may be difficult to demonstrate reduced postoperative pain with mini-laparoscopic surgery compared with conventional laparoscopic surgery. By contrast, serum CRP levels on postoperative Day 3 were similar between the groups. Hsieh<sup>20</sup> reported that length of hospital stay was not satisfactorily shortened by mini-laparoscopic surgery. This can be explained by the fact that the speed of recovery depends not only on procedure invasiveness (5-mm or 3-mm instruments) but also on the human body's ability to recover from acute inflammation and infection.<sup>21</sup>

Second, we compared the outcomes of mini-laparoscopic surgery in Groups B and C. Patient background and postoperative serum CRP levels were similar between groups. Operating time and

rescue analgesic requirements were, however, significantly different (both  $p = 0.01$ ; Table 1). Mini-Lap Grasper is an instrument combined with a trocar, but it takes time to master. Tissues are grasped by pulling the trigger with the little finger; however, it is hard to gauge how forcefully tissues are being grasped. This may be the main reason for the operating time being longer in Group C. Compared with 3-mm port instruments, Mini-Lap Grasper has a better tension traction and a wider jaw. Therefore, it can bluntly dissect the tissue even if the tissue shows severe adhesion due to fibrosis and can hold the ovarian cyst and pull up until the grasp is wide enough. However, two patients whose procedures started with the Mini-Lap Grasper switched to 5-mm port instruments because of severe adhesions involving the left fallopian tube and sigmoid colon. We separated the adnexa and sigmoid colon into their normal positions, but the ovarian cyst was surrounded by fallopian tube and we could not grasp and lift it. The grip of the Mini-Lap Grasper was strong enough to lift tissues, but its jaws were unable to grasp them gently. Therefore, it is difficult to perform adhesiolysis by Mini-Lap when there is no adequate place for a tighter grasp. Hence, we switched to 5-mm port instruments, which can grasp the fallopian tube gently. The total rASRM scores of these two patients were 52 and 68, respectively. Bona et al<sup>22</sup> reported that smaller instruments possess a weaker grasping capability and lack of tensile strength due to increased flexibility, particularly in the presence of fibrosis or inflammation. Manipulation of tiny laparoscopic instruments may increase the risk of tissue damage during dissection.<sup>23</sup> The Mini-Lap Grasper can be used in patients with severe endometriosis; however, when there is no tissue to grasp other than the fallopian tube or colon, it is difficult to perform procedures using this device.

Operating time was similar in Groups A and B but significantly longer in Group C. Serum CRP levels were highest in Group A. Rescue analgesic requirements were lowest in Group C. The procedure performed for Group B is less invasive and uncomplicated by difficulty handling instruments. Moreover, surgeries using 3-mm ports show cost benefits over those using the Mini-Lap Grasper because this is a disposable instrument. Use of various

Table 1

Baseline characteristics and short-term outcomes.

	Group A	Group B	Group C
Age (y)	35.7 ± 5.4	31.8 ± 5.5	30.6 ± 6.1
rASRM <sup>a</sup> score	53.3 ± 26.5	48.9 ± 30.5	56.2 ± 38
Operating time (min)	103 ± 35	96 ± 21	127 ± 37
POD1 CRP (mg/L)	10.4 ± 4.9	4.9 ± 3.4	6.2 ± 2.9
POD3 CRP (mg/L)	5.9 ± 3.4	5.9 ± 3.4	5.9 ± 4.5
Rescue analgesic requirements	2.5 ± 1	3 ± 1.7	1.3 ± 0.9

Data are presented as mean ± SD. CRP = C-reactive protein; POD = postoperative day; rASRM = revised American Society for Reproductive Medicine classification of endometriosis.

Table 2

Short-term outcomes of mini-laparoscopic versus conventional laparoscopic surgery.

	Group A	Group B	Group C	<i>p</i>
Operating time (min)	103 ± 35	96 ± 21	127 ± 37	NS
CRP (POD1; mg/L)	10.4 ± 4.9	4.9 ± 3.4	6.2 ± 2.9	0.04
Rescue analgesic requirements	2.5 ± 1	3 ± 1.7	1.3 ± 0.9	0.001

Data are presented as mean ± SD. CRP = C-reactive protein; POD = postoperative day.

**Table 3**  
External diameter of each port.

Port	10 mm	5 mm	3 mm	Mini-Lap
External diameter (mm)	13	6.8–8	4.2	2.3

instruments is facilitated by 3-mm ports, including bipolar electrocoagulation, suction, scissors, and graspers. Although we used 5-mm ports in all patients, this might be unnecessary if 3-mm ports proved equally versatile.

The Mini-Lap Grasper yields superior cosmetic results. Table 3 shows the external diameter of each port. A 10-mm trocar is generally a port for 10-mm instruments. Its external diameter is 13 mm, and the length of incision required is greater still. On comparing the external diameter of a 5-mm port with that for a Mini-Lap Grasper, the difference is obvious. Objective evaluation of cosmetic results is difficult. In their review of single-incision laparoscopic surgery, Pfluke et al reported that 77% of 219 studies made no mention of cosmetic results.<sup>24</sup> Of 50 studies, only one<sup>25</sup> objectively compared single-incision and conventional laparoscopic approaches. A better way of evaluating cosmetic results is necessary.

In this study, we suggested that mini-laparoscopic surgery is less invasive than conventional laparoscopic surgery in terms of serum CRP levels 1 day after surgery. Although cosmetically the Mini-Lap Grasper is excellent, it is more difficult to use in patients with severe endometriosis than instruments using 5-mm or 3-mm ports. We propose mini-laparoscopic surgery using 3-mm port instruments for average-to-severe endometriosis.

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