Clinical and Experimental Obstetrics & Gynecology

Clin. Exp. Obstet. Gynecol. **2023**; 50(9): 183
https://doi.org/10.31083/j.ceog5009183

Original Research

Modified Laparoscopic Inverted Triangle Model for Extended Lesion Resection in the Treatment of Symptomatic Localized Adenomyosis in Women Who Have Completed Childbirth

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Academic Editor: Michael H. Dahan
Submitted: 21 March 2023 Revised: 8 June 2023 Accepted: 20 June 2023 Published: 5 September 2023

Abstract

Background: To evaluate the clinical efficacy and safety of the modified laparoscopic inverted triangle model for extended lesion resection in treating dysmenorrhea focal adenomyosis in women who have completed childbirth. **Methods**: A total of 52 patients with dysmenorrhea focal adenomyosis treated in the Department of Gynecology of the Affiliated Changzhou Second People's Hospital of Nanjing Medical University from July 2014 to August 2020 were retrospectively analyzed. They underwent the modified laparoscopic inverted triangle model for extended lesion resection. The scope of resection included the focal adenomyosis lesions and along with part of the surrounding normal myometrial tissue and endometrium in order to ensure full resection of adenomyosis lesions without residual. Surgical outcome and adverse effects on ovarian functions were evaluated through the retrospective analysis compared the changes of dysmenorrhea visual analog scale (VAS) score changes, uterine volume changes, changes in serum CA125 level, and serum anti-mullerian hormone (AMH) level changes prior to surgery as well as 3, 6, 12, and 24 months after surgery. **Results**: All operations were completed by laparoscopy without conversion to laparotomy. No serious complications occurred during or after surgery. The dysmenorrhea VAS score, uterine volume, and serum CA125 level at 3, 6, 12, and 24 months after surgery were significantly lower than baseline and the difference was statistically significant. The serum AMH level showed a downward trend 3 months after surgery compared with the pre-surgery level, but the difference was not statistically significant ($p = 0.27$). The response rates at 3, 6, 12, and 24 months after surgery were 98.1%, 98.1%, 96.1%, and 88.5%, respectively, and the complete response rates were 30.8%, 34.6%, 34.6%, and 21.1%, respectively. **Conclusions**: Modified laparoscopic inverted triangle model for extended lesion resection is a safe and effective conservative surgical method for treating dysmenorrhea focal adenomyosis.

Keywords: focal adenomyosis; dysmenorrhea; modified laparoscopic inverted triangle model; extended lesion resection; conservative surgery

1. Introduction

Adenomyosis refers to endometrial glands growing in the myometrium, resulting in diffuse or focal hypertrophy of the myometrium. This is called focal adenomyosis (or endometrioma), often resulting in progressive dysmenorrhea, increased menstrual flow, uterine enlargement, and infertility, all impacting the patient's work and life [1]. Adenomyosis is a common gynecological disease related to estrogen, and its incidence is about 10%–35% [2], with no more than 80% of cases are seen in patients 40–50 years old. In recent years, the age of onset of adenomyosis has been decreasing while its incidence has been increasing due to the impact of various factors, such as the older reproductive age among women, reduced number of births, increased number of induced abortions, and the increasing rate of cesarean section [3,4]. Previously, the treatment methods for adenomyosis were dominated by drug therapy and hysterectomy. However, as people's lifestyle changes and their quality of life improves, patients pay more attention to their social, family, marriage, and personal psychological and life quality, and prefer preserving reproductive organs [5]. Therefore, hysterectomy is no longer the first choice for patients with adenomyosis. The disease is prone to relapse after drug discontinuation and not all patients are suitable for drug treatment. For this reason, more patients favor conservative surgery with uterine preservation as it preserves the integrity of tissues and organs as well as improving the quality of life to meet both the physical and psychological needs of patients.

Although focal adenomyosis shows a limited growth trend in the myometrium of patients, it does not have a clear pseudocapsule similar to uterine fibroids, and lacks a clear boundary with the normal myometrium. This leads

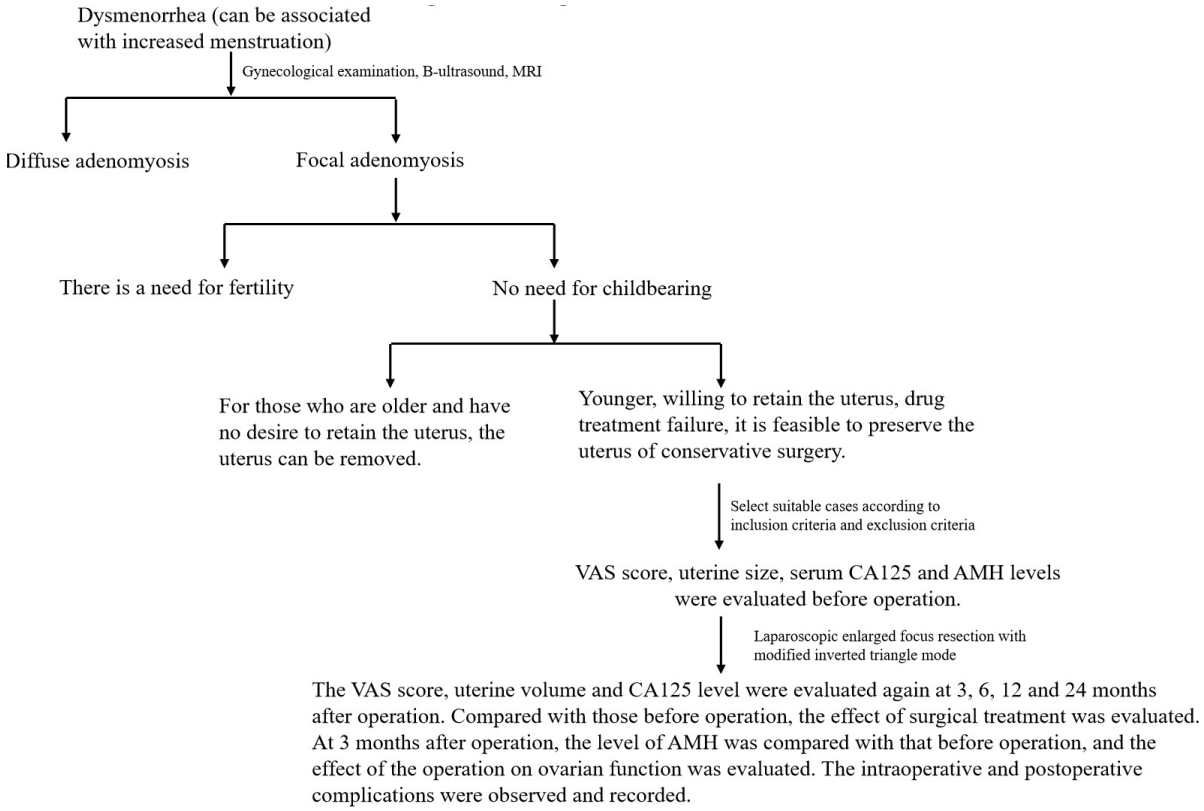

Fig. 1. Diagnosis and treatment flow chart. MRI, Magnetic Resonance Imaging; VAS, visual analog scale; AMH, anti-mullerian hormone.

to inevitable residual adenomyosis lesions during conservative surgical resection, which allows for the high recurrence rate. Therefore, most patients must continue the drug therapy after conservative surgery to further reduce recurrence [6,7]. Drug use delays disease progression in some patients, but the adverse reactions from drugs limit their long-term use. Once the drug is discontinued, the disease will quickly relapse or even progress [8]. Meanwhile, some patients are not compliant with the timely intake of drugs for the long term, and some drugs are too expensive for long time use. As a result, it has become necessary for patients who cannot tolerate long-term drug therapy or who have failed drug therapy and wish to preserve their uterus to find a surgical method that can remove the lesions, relieve symptoms, reduce recurrence, and preserve the integrity of the uterus, while minimizing the subsequent use of drugs. In this study, 52 cases of focal uterine adenomyosis treated in the Gynecology Department of the Affiliated Changzhou Second People's Hospital of Nanjing Medical University from July 2014 to August 2020 and received the modified laparoscopic inverted triangle model for extended lesion resection were selected. The patients were followed up regularly after the surgery, and the data presented is as follows. The flowchart is shown in Fig. 1.

2. Materials and Methodologies

2.1 General Data

A retrospective study with total of 52 patients with focal adenomyosis who visited the Department of Gynecology of the Affiliated Changzhou Second People's Hospital of Nanjing Medical University from July 2014 to August 2020 due to "dysmenorrhea" were selected. All patients did not receive drug treatment before operation to reduce possible intraoperative bleeding, such as gonadotropin-releasing hormone agonists (GnRH-a), oral contraceptive, progesterone drugs, *etc*. All patients underwent the modified laparoscopic inverted triangle model for extended lesion resection. The patients were not directly treated with related drugs after operation. Case inclusion criteria: (1) focal adenomyosis was diagnosed according to the clinical history, physical examination, B-ultrasound, and pelvic Magnetic Resonance Imaging (MRI), and the diagnosis was confirmed by post-surgery pathology; (2) the uterine volume was not greater than 12 weeks of gestation; (3) severe dysmenorrhea symptoms were reported (including increased menstrual flow) and the patients actively sought treatment; (4) patients were unwilling or unable to take conventional drug maintenance therapy post-surgery; (5) patients strongly desired to preserve the uterus; (6) patients had no fertility needs and willing to accept the risk of surgical treatment. Exclusion criteria: (1) patients with se-

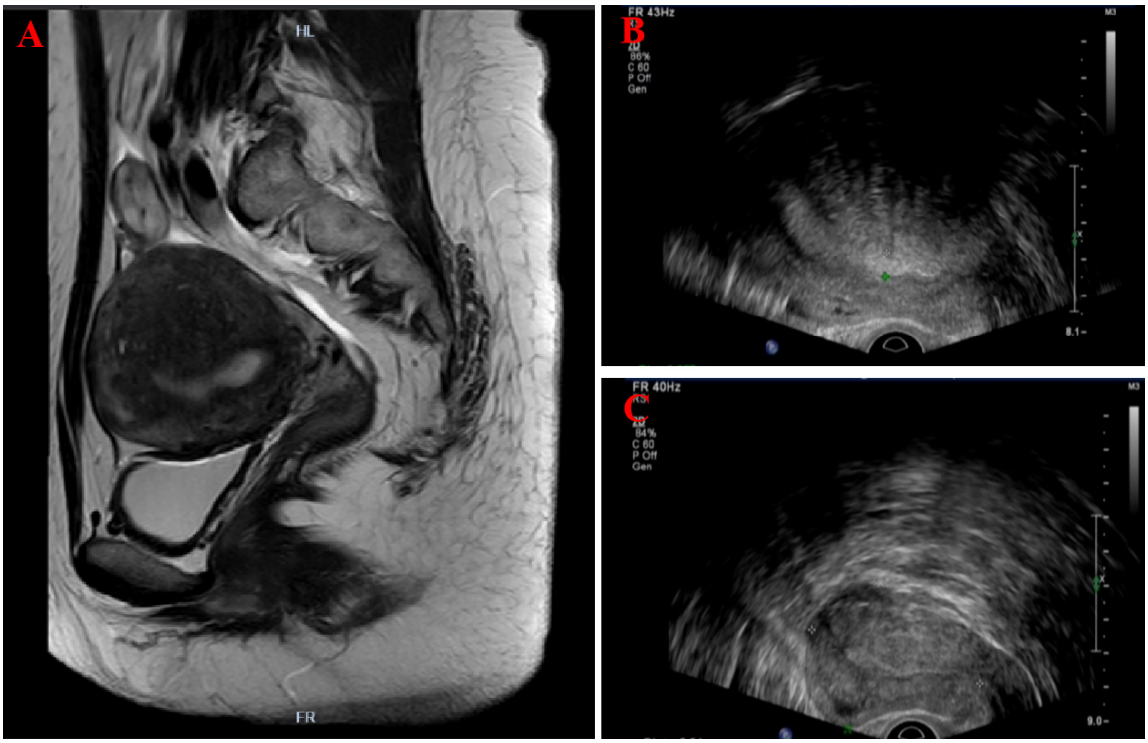

Fig. 2. Imaging examination of patients. (A) MRI map of focal adenomyosis before operation. (B) B-ultrasonography before operation. (C) Postoperative B-ultrasonography.

vere pelvic adhesions not suitable for laparoscopic surgery; (2) patients not able to tolerate surgery due to severe heart, lung, liver, or kidney function abnormalities; (3) patients with malignant cervical and endometrial lesions or primary dysmenorrhea. All patients were informed of the relevant surgical methods and the risks and benefits of the surgery. All patients signed an informed consent and underwent the modified laparoscopic inverted triangle model for extended lesion resection.

2.2 Surgical Methods

For patients suspected of focal adenomyosis after obtaining their medical history, specialist physical examination, transvaginal B-ultrasound, and a pelvic MRI examination was performed to determine the scope of the disease (see Fig. 2) to assist with precise excision of the lesions during surgery. After general anesthesia with tracheal intubation, the patient was placed in the lithotomy position, with their abdomen, perineal skin, and vagina routinely sterilized. Sterile towels were placed and catheters and uterine devices were inserted. Pneumoperitoneum was established by puncture through the umbilicus. After the pneumoperitoneum pressure reached 15 mmHg, a laparoscopic trocar of 10 mm diameter was placed to examine the uterus, appendages, and pelvic cavity. With the patient's head lowered and the buttocks elevated, the 2nd and 3rd puncture holes of 5 mm in diameter were made at the outer 1/3 site of the line connecting the left and right anterior superior iliac spines and the umbilicus, and the 4th puncture hole of 10 mm in diameter was made 2 cm to the left of the 3 fingers position above the pubic symphysis. The pneumoperitoneum pressure was reduced to 12 mmHg after laparoscopic access was established. A puncture needle injected 6 U of vasopressin (diluted 1:20 with normal saline) into the muscle layer around the adenomyosis lesion. Based on the pelvic MRI result, the adenomyosis lesion was fully excised in the modified inverted triangle model. (1) A transverse incision was made with a monopolar electrocoagulation hook at the upper edge of adenomyosis to transversely cut open the seromuscular layer, with both ends extending to the outer edge of the lesion or about 0.5–1 cm inside the horn of the uterus (to form the bottom edge of the inverted triangle shape). (2) With the endpoint on either side of the transverse incision as the starting point, an oblique incision was made in the direction of the cervix (to form the two edge sides of the inverted triangle shape). The oblique incisions on both sides converged at the lower edge of the lesion to form a triangle (see Fig. 3A). (3) Further incisions in the muscle layer were made to expose the endometrium. The ultrasonic scalpel was engaged to gradually remove the diseased muscle layer and part of the normal muscle layer, starting from the incision site and following the lateral edge of the lesion as close to the subserosal layer as possible, in order to remove the diseased muscle layer and part of the normal muscle layer following the medial border of the endometrium. (4) Part of the endometrium was selectively removed according to the uterine cavity's severity, scope, and size. A 1-0 absorbable suture was used to close the

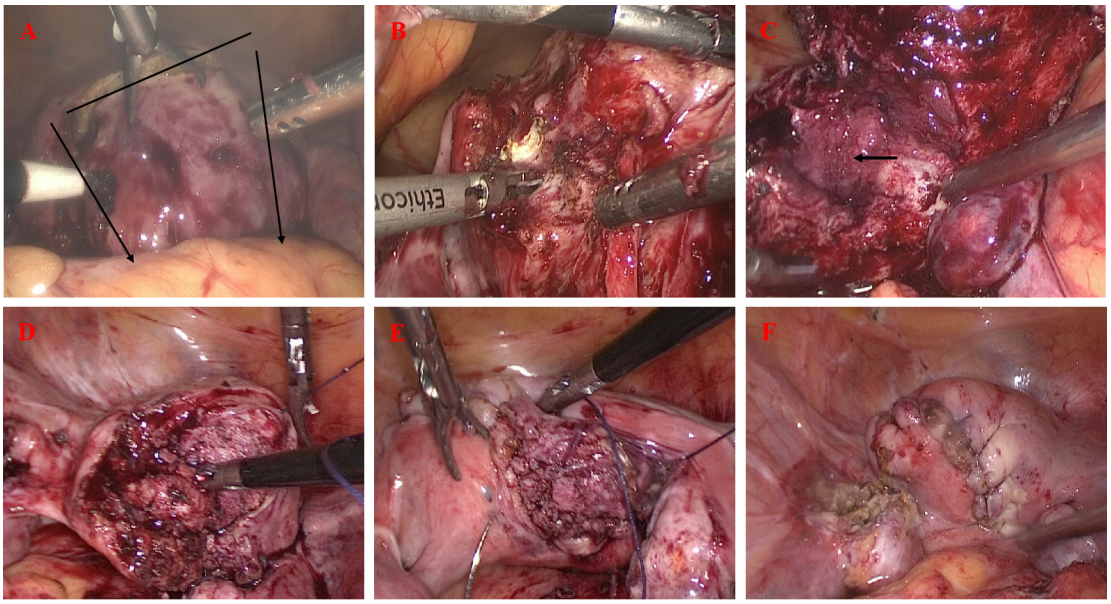

Fig. 3. Diagram of operation. (A) Inverted triangular incision to cut the serous layer (the arrow is a schematic diagram). (B) Further incision of the muscular layer to reach the uterine cavity. (C) Enlarged resection of adenomyosis focus and part of intima (uterine cavity shown by arrow). (D) Suture the uterine cavity. (E) Suture the myometrium and serosa to reconstruct the uterus. (F) "New uterus" after suture (post-operative state).

endometrium. Preservation of normal shape of the uterine cavity was desired to prevent blockage of menstrual blood flow. (5) A 1-0 absorbable suture was used to suture the wound with binding stitches in four continuous layers with knotting the ends to form a "new uterus" (Fig. 3). Attention was directed for the protection of the uterine horn tissue and the ascending branch of the uterine artery. The "new uterus" volume was significantly smaller than before the surgery. Both fallopian tubes and ovaries were fixed in the uterine horns, with the normal shape and position of the uterus and bilateral appendages retained, without a significant impact on the blood supply of the ovaries and uterus. (6) The excised tissue was placed in the specimen bag, removed with a rotary cutter, and sent for pathological examination. After the pelvis and abdominal cavity were washed hemostatic and antiadhesive membrane was placed on the wound surface and an indwelling drainage tube was placed in the rectovaginal pouch. The abdominal puncture holes were sutured.

2.3 Follow-Ups after Treatment

We compared the differences in dysmenorrhea visual analog scale (VAS) scores, uterine volumes, and serum CA125 levels before the surgery and 3, 6, 12, and 24 months after the surgery to judge the effect of this intervention and compare the differences in serum anti-mullerian hormone (AMH) levels before the surgery and 3 months after the surgery to determine whether the surgery affects ovarian function.

2.3.1 Evaluation of the Degree of Dysmenorrhea

The visual analog scoring method, namely the VAS scoring system [9], was used to score the pain. Zero points represents no pain; 1–3 points mild dysmenorrhea; 4–6 points moderate dysmenorrhea; 7–10 points severe dysmenorrhea, which is intolerable, affects work and life, and may be accompanied with symptoms of autonomic dysfunction or passive posture. The dysmenorrhea VAS scores before and after surgery were compared to determine whether symptoms were ameliorated. Complete response rate was the proportion of patients with a post-surgery VAS score being 0 points. Obvious response rate was the proportion of patients with the post-surgery VAS score being 1–6 points (Response rate = complete response rate + obvious response rate).

2.3.2 Comparison of Uterine Volume

Transvaginal B-ultrasound examination was performed to calculate the uterine volume with formula $V = 0.5236 \times a \times b \times c$ (a, b, and c represent the diameter values of the three sections of the uterus in the three-dimensional interface). The data of all patients in the study was measured by the same ultrasound team using the same set of machines.

2.3.3 Comparison of Serum Tumor Index CA125 Levels

The treatment effect was evaluated by comparing CA125 levels before and after surgery.

Table 1. General condition of 52 patients.

	Mean ± standard deviation
Age (year)	38.7 ± 4.07 (29–49)
Number of pregnancy (times)	2.65 ± 0.88 (1–4)
Number of births (times)	1.17 ± 0.68 (0–3)
Operation time (min)	122.40 ± 32.79 (65–205)
Intraoperative blood loss (mL)	255.19 ± 156.71 (100–600)
Length of stay in hospital (days)	10.31 ± 3.41 (5–23)
Adenomyoma of anterior wall (example)	4
Adenomyoma of posterior wall (example)	26
Mixed adenomyoma (example)	22

2.3.4 Comparison of Serum AMH Levels

The impact of surgery on ovarian function of patients was evaluated by comparing the changes in serum AMH levels of patients before and after surgery.

2.4 Statistical Methods

SPSS 22.0 statistical software (IBM Corp., Armonk, NY, USA) was used to analyze the data, and the measurement data was expressed as ($\bar{x} \pm$ s), where $\bar{x}$ was the sample mean, s was the sample standard deviation, and *t*-test was used, with $p < 0.05$ determined to be statistically significant.

3. Result

3.1 General Conditions of Patients

As shown in Table 1, patients were aged 29–49 with a mean of 38.7 ± 4.07 years old. Six patients were nulliparous, and all had a history of miscarriage. These 6 patients were between 35–49 years old and had no fertility requirements (they made it clear that they had no fertility requirements, and that severe dysmenorrhea or increased menstruation significantly affected their quality of life. Although they had been treated with drugs or menstruation in the early stage, the treatment effect was not obvious. Some patients had ring shedding, received surgical treatment after in-depth communication between doctors and patients and their families, retained the uterus and improved the patient's symptoms). The remaining 46 patients were married and had children, with an average number of pregnancies 2.65 ± 0.88 and an average number of deliveries of 1.17 ± 0.68. All patients sought medical advice due to varying degrees of dysmenorrhea symptoms with some patients experiencing menorrhagia. The surgical method was a modified laparoscopic inverted triangle model for extended lesion resection. All surgeries were successful, without conversion to laparotomy and no major post-surgery complications. Several patients had post-surgery symptoms such as low-grade fever and wound pain, which improved after symptomatic treatment. The surgery time was 122.40 ± 32.79 minutes, intra-surgery blood loss was 259.19 ± 156.71 mL, and the hospital stay was 10.31 ± 3.41 days. Among the 52 patients, 4 had with anterior wall adenomyosis, 26 with posterior wall adenomyosis, and 22 with focal adenomyoma and adenomyosis. Hemoglobin was be corrected to more than 100 g/L in patients with pre-surgery anemia. No patient had an intra-surgery or post-surgery blood transfusion. Routine catheterization was utilized for 24 hours after surgery, and abdominal drainage tube was utilized for 48–72 hours. The post-surgery pathological diagnosis was adenomyosis or adenomyoma in all patients. Regular follow-up after the surgery showed that the symptoms of dysmenorrhea were significantly improved compared with those before the surgery, implying that the surgical treatment achieved important clinical results.

3.2 Improvement of Dysmenorrhea Symptoms in Patients after Surgery

According to the VAS scoring standard, VAS was scored on dysmenorrhea before and 3, 6, 12, and 24 months after the surgery. The VAS scores were 6.13 ± 1.67 before the surgery, and 2.33 ± 1.95, 2.25 ± 2.09, 2.46 ± 2.27, and 3.63 ± 2.51 (3, 6, 12, and 24 months after the surgery). The VAS scores demonstrated significant improvement compared with those before the surgery, as shown in Fig. 4 ($p < 0.001$).

The complete response rate of dysmenorrhea symptoms 3 months after the surgery was 30.8%, and the response rate was 98.1%. The complete response rate of dysmenorrhea symptoms 6 months after the surgery was 34.6%, and the response rate was 98.1%. The complete response rate of dysmenorrhea symptoms 12 months after the surgery was 34.6%, and the response rate was 96.1%. The complete response rate of dysmenorrhea symptoms 24 months after the surgery was 21.1%, and the response rate was 88.5%. Three and 6 months after the surgery, 1 patient was dissatisfied with the surgery, as her dysmenorrhea symptoms were not relieved. Twelve months after surgery, another patient had intolerable dysmenorrhea, and 24 months after surgery, another 4 patients reported intolerable dysmenorrhea. These 6 patients reported significantly relieved dysmenorrhea after drug treatment, as shown in Table 2.

Table 2. Relief of dysmenorrhea in 52 patients after operation.

Dysmenorrhea VAS score	Preperative (example)	Three months after operation (example)	Six months after operation (example)	One year after operation (example)	Two years after operation (example)
0	0	16	18	18	11
1–3	0	19	16	13	10
4–6	34	16	17	19	25
7–10	18	1	1	2	6
Complete remission rate (%)		30.8	34.6	34.6	21.1
Effective remission rate (%)		98.1	98.1	96.1	88.5

VAS, visual analog scale.

Table 3. Changes of uterine volume and CA125 level in 52 patients before and after operation (mean ± standard deviation).

	Before operation	Three months after operation	Six months after operation	One year after operation	Two years after operation
Uterine volume (cm^3)	161.56 ± 72.21	80.25 ± 39.69	79.18 ± 39	76.36 ± 35.78	83.40 ± 27.63
Serum CA125 (U/mL)	75.21 ± 63.82	44.63 ± 30.17	44.99 ± 19.21	42.13 ± 34.01	53.54 ± 21.25

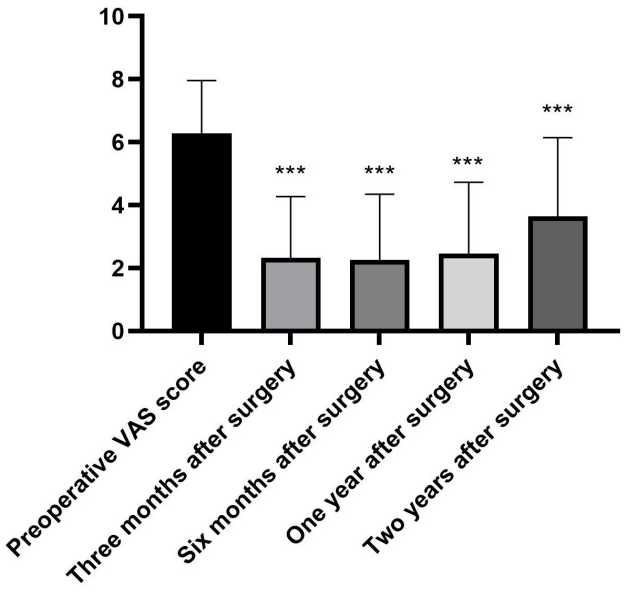

Fig. 4. Changes of VAS scores before and after surgery. ***, $p < 0.001$.

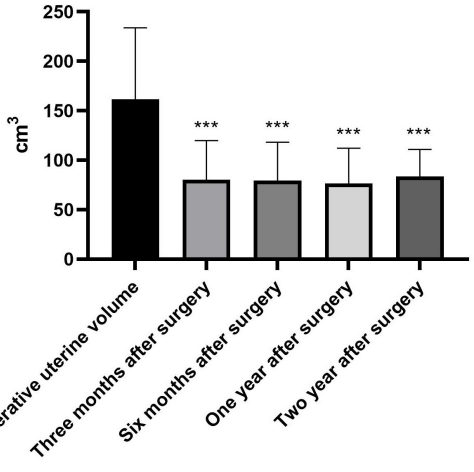

Fig. 5. Changes in uterine volume before and after surgery. ***, $p < 0.001$.

3.3 Changes in Uterine Volume and Serum CA125 Level before and after Surgery

3.3.1 Changes in Uterine Volume before and after Surgery

Uterine volumes before the surgery and at 3, 6, 12, and 24 months after the surgery are shown in Table 3. With the pre-surgery uterine volume as a reference, the uterine volumes at 3, 6, 12, and 24 months after surgery were used as metrics to calculate whether the difference was significant. It was found that the post-surgery uterine volume was significantly smaller than that before the surgery ($p < 0.001$, see Fig. 5).

3.3.2 Changes in Serum CA125 Level before and after Surgery

Serum CA125 levels before surgery and at 3, 6, 12, and 24 months after the surgery are shown in Table 3. With the pre-surgery serum CA125 level as a reference, the serum CA125 levels at 3, 6, 12, and 24 months after the surgery were used as metrics to calculate whether the difference was significant. It was found that no significant difference existed between the pre-surgery level and the level 24 months after the surgery ($p = 0.08$), but significant differences existed between the pre-surgery level and the levels at 3 months, 6 months, and 12 months after the surgery, as shown in Fig. 6.

3.4 Changes in Serum AMH Levels before and after Surgery

Compared with pre-surgery serum AMH level, the post-surgery AMH levels showed a slight downward trend,

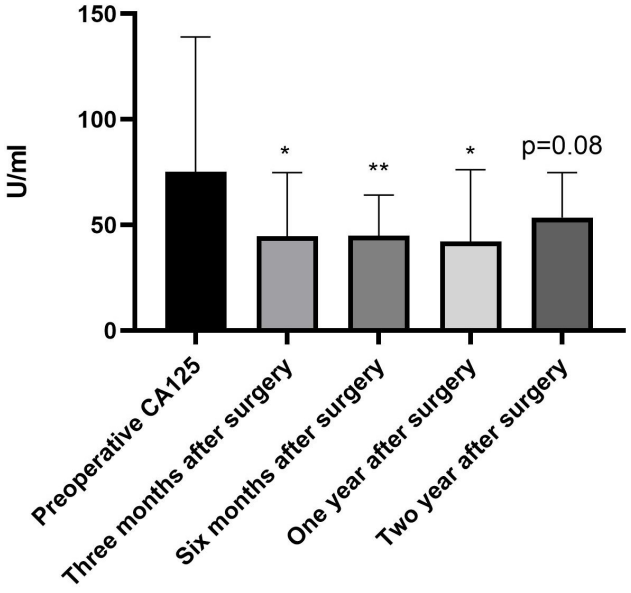

Fig. 6. Changes of CA125 levels before and after surgery. *, $p < 0.05$, **, $p < 0.01$.

Table 4. Changes of serum AMH hormone levels in 52 patients before and after operation (mean ± standard deviation).

	AMH (ng/mL)
Before operation	3.79 ± 2.09
After the operation	3.18 ± 2.28
	$p = 0.27$

AMH, anti-mullerian hormone.

but the difference was not statistically significant ($p = 0.27$). The study found that this surgical approach had no significant effect on the ovarian function of the patients, as shown in Table 4.

4. Discussion

Focal adenomyosis occurs when the adenomyosis lesions show localized growth within the myometrium. The main clinical manifestations of such patients are a progressive aggravation of secondary dysmenorrhea, increased menstrual flow, secondary anemia, enlarged uterus, infertility, and dyspareunia. Some patients experience symptoms which seriously affect their life and work and require active treatment. The treatment of focal adenomyosis is challenging, and its treatment principles are to relieve and eliminate symptoms, reduce and remove lesions, improve and promote fertility, and avoid or reduce recurrence. Individualized treatment should be implemented according to the patient's age, symptoms, fertility needs, or specific requirements. Currently, the treatment methods for focal adenomyosis mainly include drug therapy, surgical therapy, interventional therapy, and comprehensive therapy. For patients with initial treatment, conservative drug treatment is generally adopted. Commonly used drugs include oral contraceptives, progestins, gonadotropin-releasing hormone agonists (GnRH-a), and levonorgestrel-releasing intrauterine system (Mirena) [10,11]. Although oral contraceptives are relatively simple, inexpensive, and effective, long-term use can lead to increased side effects such as irregular uterine bleeding, gastrointestinal symptoms, thrombotic diseases, and trance [12]. Long-term oral progestin therapy can cause irregular vaginal bleeding, headache, weight gain, breast tenderness, and other adverse reactions [13,14]. GnRH-a has become the gold standard for non-surgical treatment, but its price is high, and long-term use can cause adverse reactions such as osteoporosis, low estrogen symptoms, and decreased libido [15]. Some patients may experience intolerable back pain, vaginal bleeding, lower abdominal discomfort, ring detachment, and other symptoms after the placement of Mirena [16]. Drug therapy can only temporarily relieve symptoms, and drug treatment of uterine adenomyosis is generally ineffective, with the symptoms recurring quickly after drug withdrawal, therefore requiring long-term use [17]. Radiofrequency ablation is suitable for small uterine adenomyosis lesions, but it does not achieve satisfactory therapeutic effect for uterine diffuse lesions or larger uterine adenomyomas. Embolization refers to blocking the uterine artery through emboli, reducing or eliminating the blood flow to the uterus, thus causing the uterus to be in a state of ischemia and promoting the ischemic atrophy of the adenomyosis lesion. Secondary to the existence of collateral circulation in the uterus, when the collateral circulation is established, the atrophied ectopic endometrium will continue to regrow. Also, embolization affects the blood supply of the ovaries, affecting the ovarian function and possibly causing premature menopause. There is a paucity of research on the treatment of adenomyosis by high-intensity focused ultrasound. It is mainly used in premenopausal women, preferably without a history of lower abdominal surgery. It is easy to damage the endometrium during the course of treatment, which leads to long-term vaginal discharge and bleeding. Subtotal hysterectomy removes the patient's uterus while retaining the cervix. The remaining cervix may develop cervical intraepithelial neoplasia, or cervical cancer, which requires reoperation to remove the residual cervix. Total hysterectomy was once the most important method utilized to cure focal adenomyosis [18]. However, with economic development, modern medical technological progress, and the increasing attention of women to the integrity of their organs, the modern medical model has changed, and the treatment scheme should be determined based on comprehensive considerations of many factors. Hysterectomy is suitable for older patients with severe dysmenorrhea or heavy and difficult-to-control menstrual flow and without a need to preserve fertility [19]. After a hysterectomy, ovarian function may inevitably decline due to the impact on the ovarian blood supply. This may lead to premature failure of ovarian re-

serve functions with resulting perimenopausal symptoms. Therefore, uterine-sparing surgery for adenomyosis is increasingly being accepted, especially among patients of a reproductive age who cannot tolerate long-term drug therapy or in whom drug therapy fails. The laparoscopic adenomyosis lesion resection has become a major therapeutic option. However, in traditional adenomyosis lesion resection, it is necessary to avoid incisions of the uterine cavity when removing the lesion. Because the adenomyosis lesion grows diffusely in the myometrium, with unclear boundaries and lacking a pseudocapsule, complete excision is difficult, which will greatly increase the possibility of residual lesions and incomplete improvement of symptoms [20]. It has been reported that the post-surgery recurrence rate of adenomyosis lesions after conservative laparoscopic surgery is as high as 50% [21], so drugs are often required for maintenance therapy. The surgical method used in this study removed part of the surrounding normal myometrium and part of the endometrium, so as to ensure complete removal of the lesions. Meanwhile, if the patient has a large uterine cavity and increased menstrual flow, the uterine cavity can be further incised to remove part of the endometrial tissue and reduce uterine cavity volume, thereby alleviating the increased menstrual flow. The advantages of this surgical method are that the uterine arteries and veins are not ligated, the peritoneal reflections are not opened, and the sacral ligament and surrounding connective tissue are not cut. The uterine integrity is preserved without destroying the ovarian blood supply and the pelvic floor tissue structure, reducing the potential impact on ovarian function. This reduces the possibility of serious complications during and after surgery and the risk of post-surgery pelvic organ prolapse. The improved surgical method of expanded lesion resection can remove the lesions as much as possible, effectively reducing post-surgery recurrence while improving the symptoms significantly in the short term. Removing focal adenomyosis lesions reduces subsequent use of drugs, effectively cuts down the expenditure of medical resources, and alleviates the economic burden of patients. After uterine cavity reconstruction, the remaining endometrial tissue can still form periodic menstruation, reducing anxiety among patients and ensuring sound psychological comfort. We named this new conservative surgery for treating focal adenomyosis as "modified laparoscopic inverted triangle model for extended lesion resection". The improved surgical method is easy to understand and highly reproducible.

In this study, 52 patients with focal adenomyosis dysmenorrhea were treated with the modified laparoscopic inverted triangle model for extended lesion resection, and the patient's conditions before and after the surgery were analyzed. This study showed that the uterine volume of the patients after surgery was significantly reduced. The dysmenorrhea symptoms in 50 patients were effectively relieved 1 year after surgery, with the response rate being 96.1%. Two patients had intolerable dysmenorrhea. One patient experienced no significant relief of dysmenorrhea after treatment, with persisting dysmenorrhea symptoms, and 1 patient had dysmenorrhea symptoms again 1 year after the surgery, with the 1-year recurrence rate being 3.8%. Two years after the surgery, the dysmenorrhea symptoms in 46 patients were effectively relieved, with the response rate being 88.5%, and 4 more patients reported intolerable dysmenorrhea compared with that of the previous year, with the 2-year recurrence rate being 11.5%. The recurrence rate was close to that of the combined therapy of GnRH-a and conventional resection of endoscopic adenomyosis lesions [22]. The degree of dysmenorrhea in relapsed patients was significantly relieved after drug treatment, and the relapse may be related to the combination of Stage III–IV endometriosis. The serum CA125 level in patients with adenomyosis was higher than that of normal women, and the degree of increase was positively correlated with the severity of the lesion [23]. This study compared the changes in serum CA125 levels before and after surgery to evaluate objectively the effect of surgical treatment. The study found that the CA125 level of the patients after the surgery decreased significantly, indicating that the degree of focal adenomyosis was reduced. The CA125 level 2 years after the surgery was not significantly different from that before, which was considered related to the recurrence of dysmenorrhea in 6 patients. The changes in serum AMH levels were measured, and no significant changes before and after the surgery were observed, indicating that the surgery did not have a significant adverse effect on the ovarian function.

Our study found that this surgery can effectively relieve symptoms without significant adverse effects on the ovarian function of patients, few intra-surgery and post-surgery complications and strong reproducibility. However, it still has many limitations. First, this method has high requirements on the operator's skills, and not all hospitals and surgeons can perform it. In addition, the scope of surgical resection of the lesion will greatly affect the prognosis of the patients. Due to the larger resection scope, patients who have received this treatment should utilize adequate contraception after surgery and delay future pregnancy. Whether patients with long-term pregnancy plans can undergo this surgery still requires more clinical data for evaluation. Second, this is a retrospective case study with a small number of 52 cases and a relatively short follow-up period of 24 months. In the future, we will conduct a larger-scale randomized case-control study, including comparisons with other treatment methods, to analyze and evaluate the surgical efficacy, recurrence rate, and complications of modified laparoscopic inverted triangle model for extended lesion resection in the treatment of focal adenomyosis.

5. Conclusions

Modified laparoscopic inverted triangle model for extended lesion resection is a safe and effective conservative surgical method for treating dysmenorrhea focal adenomyosis.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Author Contributions

JMC, BYL and BRX designed the research study. LBL, WWW and HMT performed the research. YC and HZ consulted relevant literature. BT and RXS analyzed the data. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Changzhou second people's Hospital (approval number: [2021] YLJSC0023).

Acknowledgment

We would like to express our gratitude to all those who helped us during the writing of this manuscript. Thanks to all the peer reviewers for their opinions and suggestions.

Funding

This work was supported by grants from Changzhou High-Level Medical Talents Training Project (2022CZBJ074), the maternal and child health key talent project of Jiangsu Province (RC202101), the maternal and child health research project of Jiangsu Province (F202138), the Scientific Research Support Program for Postdoctoral of Jiangsu Province (2019K064), and the Scientific Research Support Program for "333 Project" of Jiangsu Province (BRA2019161).

Conflict of Interest

The authors declare no conflict of interest.

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