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# A Retrospective Study Comparing Operative Time Between Single-Glove Port Laparoscopic Hysterectomy and Conventional Multiport Laparoscopic Hysterectomy for Benign Gynecology Diseases: Hospital-Based Study in Thailand

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**Background:** Laparoscopic hysterectomy is popular today. Using a 3- to 4-port for laparoscopic hysterectomy. But laparoscopic hysterectomy can be done by using a single-modified glove port. It was found to have good performance and low price.

**Objective:** To compare operative time and other surgical outcomes between single-glove port laparoscopic hysterectomy (SGPLH) and conventional multiport laparoscopic hysterectomy (MPLH).

**Methods:** A retrospective study, data were extracted from medical records of patients diagnosed with benign gynecologic diseases and underwent laparoscopic hysterectomy at Prapokklao Hospital, Chanthaburi, Thailand from February 2016 to April 2021.

**Results:** A total of 125 patients were divided into 2 groups, 65 (52%) in the SGPLH group and 60 (48%) in the MPLH group. The operative time of SGPLH was significantly shorter than conventional MPLH (mean [SD], 96 [31.35] vs 161.4 [57.37] minutes; $P < .001$). There was significant difference between 2 groups in terms of previous abdominal surgery ($P = .01$). In multivariate regression analysis, independent factors correlated with operative time were type of laparoscopic operation ($P < .001$), additional procedure of bilateral salpingo-oophorectomy ($P = .02$), unilateral salpingo-oophorectomy ($P = .01$), and complication with bladder injury ($P = .03$).

**Conclusions:** The operative time of SGPLH is shorter than the conventional MPLH. SGPLH is also feasible and economical for patients with symptomatic benign gynecologic diseases.

**Keywords:** Operative time, Hysterectomy, Single-glove port, Conventional multiport laparoscopic hysterectomy

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## Introduction

Gynecological laparoscopic surgery is less intense and minimally invasive compared to other surgical techniques. It was initially popularized as a diagnostic technique by Raoul Palmer in France during the 1950. Single-port laparoscopic surgery has been used in gynecology as early as 1969 when a laparoscopic tubal ligation was described by Wheeless et al.[1] Later, Pelosi et al[2] performed total laparoscopic hysterectomy with bilateral salpingo-oophorectomy procedures using the single-puncture technique in 1991. Today, laparoscopic surgery is recognized as a safe and effective method for treating gynecological diseases. It is an alternative to open hysterectomy because of its short recovery time and small size of surgical scars.[3-8]

A laparoscopic hysterectomy is an advanced procedure that requires a highly experienced surgeon who had more experience with open abdominal hysterectomy and vaginal hysterectomy for long period before performing laparoscopic surgery. Single-glove port laparoscopic hysterectomy (SGPLH) and conventional multiport laparoscopic hysterectomy (MPLH) have different advantages and disadvantages. Determining the appropriate laparoscopic hysterectomy for each patient depends on patient risk factors, such as prior abdominal surgery, uterine weight, and pelvic adhesion, along with the surgeon experience.

Technological advances in laparoscopic instruments and optics have allowed the development of single-port access total laparoscopic hysterectomy, which is different from the conventional MPLH. It was found that umbilical single incision laparoscopic surgery is more feasible and safe compared to conventional MPLH[9-11] and has an advantage in cosmetic outcomes[12] over MPLH. Single-port access laparoscopic surgery, however, uses special expensive equipment that requires higher surgical skills with the complexity of operation. Therefore, this technique is not widely used in surgery nowadays.[2, 13-14]

This study used a modified single-glove port instead of expensive specialized equipment used for single-port access laparoscopic surgery, and also evaluated operative time for primary outcome, other operative outcomes, and possible complications of SGPLH compared to conventional MPLH. The results of this study can be used for establishing treatment plans and providing counselling for patients on gynecological surgery.

## Methods

This observational retrospective cohort therapeutic study, was conducted at Prapokklao Hospital, Chanthaburi, Thailand. The protocol was approved by the Ethics Committee/Region 6, for Research on Humans in Chanthaburi, Thailand (COA. No. 026/2020 on March 5, 2022).

Data was collected retrospectively from medical records. The inclusion criteria included the following: 1) diagnosis of benign gynecological diseases, such as leiomyoma, adenomyosis, and endometrial polyp, 2) aged 30 to 80 years at hysterectomy, 3) clear indications for surgical treatment, 4) undergoing laparoscopic hysterectomy and additional procedures by well-trained certified surgeon at the Obstetrics and Gynecology Department, Prapokklao Hospital, Chanthaburi from February 2016 to April 2021, and 5) complete medical record of basic patient information, disease information, and surgery information. The exclusion criteria included 1) suspected uterine neoplasms 2) laparoscopic adnexal surgery only, 3) patients with incomplete information, and 4) other laparoscopic hysterectomies for other conditions, such as mental retardation.

Patients were divided into 2 groups, the first group included patients who underwent SGPLH and the second group included patients who received conventional MPLH. There were compared different factors between 2 groups, including total number of each types of laparoscopic hysterectomy in 6 consecutive years, age, body mass index (BMI), parity, prior abdominal surgery, clinical uterine size, and hematocrit (Hct) level before surgery. Outcome measurements were identified for operative time, estimated blood loss during surgery, uterine weight,

conversion to open abdominal surgery, additional procedures, adhesiolysis, uterine morcellation, length of hospital stay, postoperative fever, adjacent organs injury, and pathological reports.

The conventional 5 mm of each 4-incision MPLH was conducted using 4 trocars to perform the surgery. SGPLH was performed using a single longitudinal transumbilical (1.5 - 2 cm) skin incision by open technique with a surgical glove-port and 3 trocars (1-incision and 3-port laparoscopic). A surgical glove size 7.5 instead of expensive special equipment (multichannel access port) was used in SGPLH, and 3 rubber bands were utilized to secure trocars to the glove. The Alexis wound retractor (Applied Medical, Rancho Santa Margarita, California) was inserted through the incision (Figure 1A). A surgical glove was fixed to the outer ring of the wound retractor (Figure 1B and 1C). Both methods used a conventional laparoscopic instrument, 30-degree 5-mm laparoscope (KARL STORZ, Tuttlingen, Germany), Liga-Sure (Covidien, Maryland 5 mm - 37 cm, Boulder, CO, USA), nontraumatic gasper forceps, uterine manipulator, and monopolar hook (Figure 1D). The specimen was removed via the vagina. Transvaginal uterine scalpel morcellation was performed to facilitate vaginal removal of the enlarged uterus. The vaginal cuff was transvaginally sutured with continuously locked 1-0 vicryl.

The operative time was recorded from the moment of the umbilical skin incision until the completion of the last skin closure. The amount of blood loss was calculated from the total volume of liquid in the vacuum aspirator's cylinder minus the peritoneal lavage. Uterine weight was obtained by weighing after the pathological examination. Patients were evaluated for postoperative fever, which occurs when the body temperature is greater than or equal to 38°C for at least 6 consecutive hours, excluding the first 24 hours after surgery.[7]

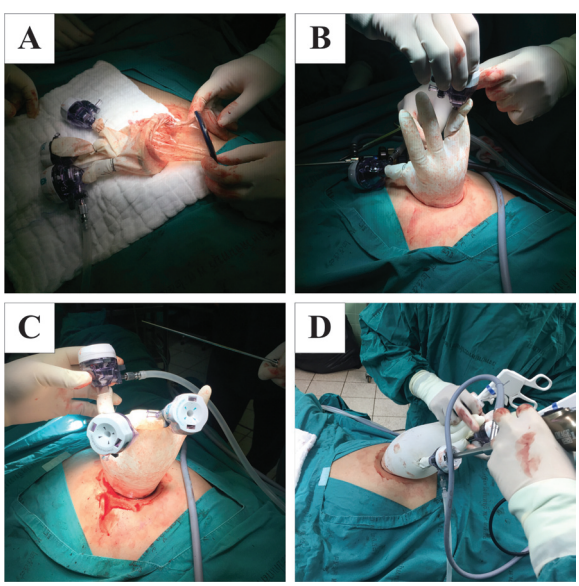
## Sample Size Calculation

Calculation of sample size based on previous studies, Bonilla et al[3] and Phongnarisorn et al.[7] Population size was calculated by statistical software using 2-sample comparison of means with power of 90%, type I error 5% (alpha 0.05). The estimate required sample sizes would be 36 participants; 18 patients of SGPLH and 18 patients of MPLH patients.

## Statistical Analysis

Patients' demographics and physical characteristics information were analyzed using descriptive statistics such as frequency, range, percentage, mean, median, and standard deviation (SD). All comparisons of continuous variables were analyzed using *t* test. Qualitative data was analyzed by Fisher exact test. In the case of small cells, Fisher exact test was used. The correlation between operative time and independent factors was analyzed via multiple linear regression analyses. A *P* value of less than .05 was considered statistically significant. The data was analyzed with Stata version 16 (StataCorp. Version 16. College Station, TX: StataCorp LLC; 2019).

**Figure 1. Transumbilical Skin Incision by Open Surgery (1-Incision and 3-Port Laparoscopic)**




A, Three trocars were inserted through the fingers of the glove and the wound retractor (Alexis) was inserted through the incision.

B, and C, A surgical glove was fixed to the outer ring of the wound retractor.

D, External view during the laparoscopic procedure.

## Results

A total of 125 patients were included in the study, 65 patients (52%) were in the SGPLH group and 60 patients (48%) were in the MPLH group. Twenty patients (30.77%) of the SGPLH group had previous abdominal surgeries. This number was significantly lower than the MPLH group in which 32 patients (53.33%) received previous abdominal surgeries (Table 1), this different were adjust in univariate and multivariate regression analysis. No other significant differences were found in baseline characteristics between both groups.

There was a significant difference in number of each types of laparoscopic hysterectomy during the period 2016 to 2020 (Table 2).

The perioperative outcomes were determined. Intraoperative data showed that the operative time of the SGPLH group (mean [SD], 96 [31.35] minutes) was significantly shorter than the MPLH group (mean [SD], 161.4 [57.37] minutes). There were no significant differences between both groups in terms of the amount of blood loss during surgery, the weight of the uterus, and additional combined procedures but differed significantly in types of additional procedures of bilateral salpingo-oophorectomy and bilateral salpingectomy (Table 3).

Additional combined surgeries were performed during the procedure in both groups. There were 60 combined surgeries in the SGPLH group and 49 in the MPLH group. The most common combined surgery in SGPLH and MPLH groups was bilateral salpingectomy and bilateral salpingo-oophorectomy, respectively. There were no significant differences between both groups in terms of adhesiolysis and uterine morcellation. Fourteen patients (21.54%) in the SGPLH group and 19 patients (31.67%) in the MPLH group underwent adhesiolysis during the procedure. Transvaginal uterine morcellation was performed to facilitate vaginal removal of the moderate to enlarged uterus among 16 patients (24.62%) in the SGPLH group and 9 patients (15%) in the MPLH group. The mean (SD) length of hospitalization after surgery was 2.0 (0.25) days in the SGPLH group and 2.1 (0.43) days in the MPLH group.

Two patients of the SGPLH group suffered intraoperative bladder injury complications. The first had a tear of bladder serosa during a vaginal cuff sutured.

**Table 1. Baseline Clinical Characteristics of Study Participants**

| Characteristic | Mean (SD) | | *P* Value* | Range |
|---|---|---|---|---|
| | SGPLH (n = 65) | MPLH (n = 60) | | |
| Age, y | 45.1 (8.49) | 45.4 (6.98) | .30 | 28 - 77 |
| BMI, kg/m$^2$ | 24.3 (4.47) | 24.6 (4.38) | .52 | 15.9 - 35.2 |
| Parity, median (range) | 1 (0 - 4) | 2 (0 - 5) | .40 | 0 - 5 |
| Previous abdominal surgery, No (%) | 20 (30.77) | 32 (53.33) | .01 | - |
| Previous cesarean section, No (%) | 16 (24.62) | 16 (26.67) | .79 | - |
| Clinical uterine size, wk | 11.1 (2.52) | 12.0 (2.79) | .09 | 8 - 18 |
| Preoperative Hct, % | 37.0 (3.70) | 37.0 (3.93) | .76 | 30.0 - 46.8 |

Abbreviations: BMI, body mass index; Hct, hematocrit; MPLH, multiport laparoscopic hysterectomy; SGPLH; single-glove port laparoscopic hysterectomy; SD, standard deviation.

* $P < .05$ indicated statistical significance.

**Table 2. Total Number of Each Type of Laparoscopic Hysterectomy in Consecutive Years**

| Year | No. of Patient | | *P* Value* |
|---|---|---|---|
| | SGPLH (n = 65) | MPLH (n = 60) | |
| 2016 | 0 | 8 | .004 |
| 2017 | 0 | 16 | < .001 |
| 2018 | 0 | 20 | < .001 |
| 2019 | 21 | 6 | .004 |
| 2020 | 38 | 6 | < .001 |
| 2021 | 6 | 4 | .85 |

Abbreviations: MPLH, multiport laparoscopic hysterectomy; SGPLH, single-glove port laparoscopic hysterectomy.

* $P < .05$ indicated statistical significance.

The second patient had an accidental tear of the posterior wall of the bladder serosa. The lesion was sutured laparoscopically, and an indwelling catheter was left in situ for 14 days with an uneventful recovery of the patient. There was also a patient of the SGPLH group who sustained a bowel injury with bowel serosal superficial burn. Of the MPLH group, a patient had a tear of the bladder serosa during the surgery and underwent immediate sutured laparoscopically. Nevertheless, there was no significant difference in the incidence of adjacent organ injury between both groups. There was no conversion to opened surgery or postoperative fever in both groups.

**Table 3. The Perioperative and Postoperative Outcomes**

| Operative Outcome | Mean (SD) | | *P* Value* |
|---|---|---|---|
| | SGPLH (n = 65) | MPLH (n = 60) | |
| Operative time, min | 96 (31.35) | 161.4 (57.37) | < .001 |
| Estimate blood loss, median (range), mL | 150 (20 - 900) | 175 (20 - 3000) | .08 |
| Uterine weight, median (range), g | 170 (40 - 580) | 179 (49 - 832) | .62 |
| Conversion to open surgery, No (%) | 0 | 0 | NA |
| Total hysterectomy only, No (%) | 5 (7.69) | 11 (18.33) | .08 |
| Additional procedures, No (%) | | | |
| Total | 60 (92.30) | 49 (81.67) | .08 |
| BSO | 8 (12.30) | 30 (50) | < .001 |
| USO | 0 | 4 (6.67) | .05 |
| BS | 44 (67.69) | 11 (18.33) | < .001 |
| UO+BS | 6 (9.23) | 3 (5.00) | .05 |
| US | 2 (3.08) | 1 (1.67) | 1.00 |
| Adhesiolysis, No (%) | 14 (21.54) | 19 (31.67) | .20 |
| Uterine morcellation, No (%) | 16 (24.62) | 9 (15) | .18 |
| Postoperative hospital stay, d | 2.0 (0.25) | 2.1 (0.43) | .10 |
| Postoperative fever | 0 | 0 | NA |
| Organ injury, No (%) | 3 (4.62) | 1 (1.67) | .62 |
| Bladder injury, No (%) | 2 (3.08) | 1 (1.67) | 1.00 |
| Ureteric injury, No (%) | 0 | 0 | NA |
| Bowel injury, No (%) | 1 (1.54) | 0 | 1.00 |

Abbreviations: BS, bilateral salpingectomy BSO, bilateral salpingo-oophorectomy; UO+BS, unilateral oophorectomy with bilateral salpingectomy; USO, unilateral salpingo-oophorectomy; US, unisalpingectomy; MPLH, multiport laparoscopic hysterectomy; NA, not applicable; SD, standard deviation; SGPLH, single-glove port laparoscopic hysterectomy.

* $P < .05$ indicated statistical significance.

Six independent factors, uterine weight, previous abdominal surgery, type of laparoscopic operation, additional procedure of bilateral salpingo-oophorectomy, unilateral salpingo-oophorectomy, and bilateral salpingectomy were significantly associated with operative time in the univariate analysis. However, when analyzed in the final multivariate analysis, types of laparoscopic operation, uterine weight, additional procedure of bilateral salpingo-oophorectomy and unilateral salpingo-oophorectomy and bladder injury were significantly related to the operative time (Table 4). The most common pathological result was myoma uteri, followed by adenomyosis and combination pathology of adenomyosis with myoma respectively.

## Discussion

The results showed that the SGPLH had a shorter operative time compared with the MPLH group. This finding is contrary to a study by Yim et al[15] that found no difference in surgical time between 2 methods and a study by Xie et al[6] which concluded that the operative time of SGPLH was longer. This shorter operative time of SGPLH may be due to the more experienced laparoscopic operative skills of the surgeon.[16] More experience in managing conventional multiport shortens the learning curve and helps overcome technical difficulties. Previous abdominal surgery and high uterine weight were known factors that increases operative time.[7, 9, 17]

**Table 4. Univariate and Multivariate Regression Analysis Operative Time With Independent Factors**

| Parameter | Univariate Analysis | | | Multivariate Analysis | | |
|---|---|---|---|---|---|---|
| | B | 95% CI | *P* Value* | B | 95% CI | *P* Value* |
| Age, y | 0.02 | -1.26 to 1.31 | .97 | -0.77 | -1.99 to 0.44 | .21 |
| BMI, kg/m$^2$ | -0.75 | -3.01 to 1.50 | .51 | -1.41 | -3.26 to 0.43 | .13 |
| Type of surgery | 65.48 | 49.28 to 81.69 | < .001 | 45.10 | 25.59 to 64.62 | < .001 |
| Previous surgery | 21.59 | 1.70 to 41.46 | .03 | 8.80 | -8.21 to 25.80 | .31 |
| Uterine weight, g | 0.10 | 0.02 to 0.17 | .01 | 0.13 | 0.03 to 0.22 | .009 |
| Additional procedures | | | | | | |
| BSO | 22.50 | 12.33 to 32.67 | < .001 | 34.66 | 6.65 to 62.67 | .02 |
| USO | 27.31 | 9.05 to 45.58 | .004 | 62.83 | 13.37 to 112.30 | .01 |
| BS | -11.76 | -16.33 to -7.19 | < .001 | 0.77 | -24.65 to 26.18 | .95 |
| USO+US | -0.20 | -5.72 to 5.31 | .94 | 25.61 | -9.94 to 61.15 | .16 |
| US | 2.25 | -5.90 to 10.39 | .59 | 36.62 | -17.15 to 90.39 | .18 |
| Adhesiolysis | 20.45 | -1.89 to 42.80 | .07 | 14.86 | -3.25 to 32.98 | .11 |
| Uterine morcellation | 8.81 | -16.09 to 33.71 | .49 | -15.30 | -45.06 to 14.46 | .31 |
| Organ injury | | | | | | |
| Bowel injury | -62.94 | -174.42 to 48.55 | .27 | -27.34 | -118.09 to 63.41 | .55 |
| Bladder injury | 29.95 | -35.05 to 94.95 | .36 | 56.47 | 5.53 to 107.42 | .03 |

Abbreviations: B, regression coefficients; BS, bilateral salpingectomy; BMI, body mass index; BSO, bilateral salpingo-oophorectomy; USO, unilateral salpingo-oophorectomy; USO+US, unilateral salpingo-oophorectomy with unilateral salpingectomy; US, unisalpingectomy.

* $P < .05$ indicated statistical significance.

The analysis of type of additional surgery was showed that the MPLH group perform greater bilateral salpingo-oophorectomy, which is one of the reasons for longer operation and more intraoperative blood loss complication.

The another advantage of SGPLH is its lower cost than single-port laparoscopic multichannel devices used. The cost of latex surgical gloves-powder-free is about ฿35 in Thai. This finding is consistent with a study by Yang et al.[14] SGPLH uses traditional surgical tools excluding unnecessary disposable trocars. The costs of the Alexis wound retractor and surgical gloves are lower than for commercial single-port devices that use disposable trocars.

There was no significant difference in the conversion rates for laparotomy between both groups, which is in line with those of previous studies.[6, 15, 18]

No significant differences were found in surgical complications between 2 groups in this study. This finding is consistent with those obtained by Xie et al[6] and Yang et al.[14]

There were limitations of this study including a small number of patients, retrospective design, nonrandomized patients, and an inherent selective bias. A larger population might have lead to differences in the results.

There might be a selection bias in the decision of surgical procedures because patients with risk factors such as large uterus and concomitant adnexal pathology are more likely to be referred to MPLH over SGPLH. Therefore, univariate and multivariate logistic regression analyses were performed to eliminate bias and confounding factors. Prospective, randomized control trials with large scale sample size comparing between SGPLH with MPLH are needed to determine the perioperative outcomes and greater insights.

## Conclusions

In this study, the mean operative time of SGPLH was shorter than MPLH. No differences were found in the length of hospital stay, complications rate, and rates of conversion to opened abdominal surgery. Therefore, SGPLH should be considered first in laparoscopic hysterectomy for benign gynecological diseases and MPLH is the standard of choice in cases where SGPLH is not possible.

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# การศึกษาย้อนหลังเปรียบเทียบระยะเวลาในการผ่าตัดมดลูกระหว่างวิธีการผ่าตัดส่องกล้องแบบรูเดียวและหลายรูแบบดั้งเดิม: การศึกษาในโรงพยาบาลศูนย์แห่งหนึ่งในประเทศไทย

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**บทนำ:** การผ่าตัดมดลูกผ่านกล้องเป็นที่นิยมในปัจจุบัน โดยใช้ช่องสอด 3 ถึง 4 ช่อง สำหรับตัดมดลูกด้วยกล้อง แต่พบว่าสามารถทำผ่าตัดมดลูกผ่านกล้องโดยใช้ช่องสอดเดียวที่ดัดแปลงจากถุงมือได้โดยมีประสิทธิภาพดีราคาถูก

**วัตถุประสงค์:** เพื่อเปรียบเทียบระยะเวลาในการผ่าตัดและผลลัพธ์อื่น ๆ ระหว่างวิธีการผ่าตัดมดลูกส่องกล้องแบบรูเดียวและหลายรูแบบดั้งเดิม

**วิธีการศึกษา:** การศึกษาแบบย้อนหลัง เก็บข้อมูลจากเวชระเบียนผู้ป่วยในที่วินิจฉัยเป็นโรคทางนรีเวชที่ไม่ใช่มะเร็งที่ได้รับการผ่าตัดมดลูกโดยการส่องกล้อง ณ โรงพยาบาลพระปกเกล้า จังหวัดจันทบุรี ตั้งแต่เดือนกุมภาพันธ์ พ.ศ. 2559 ถึงเดือนเมษายน พ.ศ. 2564

**ผลการศึกษา:** ผู้ป่วยจำนวนทั้งหมด 125 คน แบ่งเป็น 2 กลุ่ม คือ กลุ่มผ่าตัดมดลูกแบบรูเดียว จำนวน 65 คน คิดเป็นร้อยละ 52 และกลุ่มผ่าตัดมดลูกแบบหลายรู จำนวน 60 คน คิดเป็นร้อยละ 48 โดยระยะเวลาในการผ่าตัดของกลุ่มผ่าตัดแบบรูเดียวสั้นกว่ากลุ่มผ่าตัดส่องกล้องหลายรูอย่างมีนัยสำคัญ (mean [SD], 96 [31.35] และ 161.4 [57.37] นาที; $P < .001$) และประวัติเคยผ่าตัดทางหน้าท้องทั้ง 2 กลุ่ม มีความแตกต่างกันอย่างมีนัยสำคัญ ($P < .001$) เมื่อวิเคราะห์การถดถอยเชิงพหุคูณพบว่า ปัจจัยที่มีความสัมพันธ์ต่อระยะเวลาผ่าตัดคือ ชนิดของการผ่าตัดส่องกล้อง ($P < .001$) การผ่าตัดรังไข่และท่อนำไข่ออกทั้ง 2 ข้าง ($P = .02$) การผ่าตัดรังไข่และท่อนำไข่ออก 1 ข้าง ($P = .01$) และภาวะแทรกซ้อนต่อการบาดเจ็บของกระเพาะปัสสาวะ ($P = .03$)

**สรุป:** การผ่าตัดมดลูกของกลุ่มผ่าตัดส่องกล้องแบบรูเดียวโดยใช้ช่องสอดที่ดัดแปลงจากถุงมือใช้ระยะเวลาสั้นกว่ากลุ่มผ่าตัดส่องกล้องหลายรูแบบดั้งเดิม เป็นหนึ่งในวิธีการรักษาที่มีประสิทธิภาพและประหยัด สำหรับผู้ป่วยที่เป็นโรคทางนรีเวชชนิดไม่เป็นมะเร็ง

**คำสำคัญ:** ระยะเวลาผ่าตัด ตัดมดลูก ผ่าตัดแผลเดียวช่องสอดดัดแปลงจากถุงมือ การผ่าตัดมดลูกผ่านกล้องหลายช่องสอดแบบดั้งเดิม

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