Original Article

LigaSure versus Ferguson Hemorrhoidectomy: A Community Hospital Experience

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Key Words
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Purpose. To compare short- and long-term surgical outcomes between LigaSure hemorrhoidectomy (LH) and Ferguson hemorrhoidectomy (FH) for grade 3 or 4 hemorrhoids.
Method. A single institution retrospective analysis of 2,729 patients who underwent LH or FH surgery was performed.
Results. No statistically significant differences were found between the two groups in age or body mass index. The mean operating time for LH was significantly shorter than that for FH (28 ± 10 min vs. 39.2 ± 21.7 min; $p < 0.001$). Patients treated with LH lost significantly less blood ($p < 0.001$), had better pain scores ($p < 0.001$), and shorter hospital stays ($p < 0.001$) than those treated with FH. Regarding short-term complications, LH resulted in less urinary retention and infection but more cases of constipation compared with FH. For long-term complications, patients treated with LH had fewer recurrent hemorrhoids and anal fissures; however, there were no differences in the numbers of skin tags, abscesses, or fistulas compared with patients treated with FH.
Conclusion. LH is faster, involves less blood loss, and causes less pain than FH, potentially offering wide applications in community hospitals.
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Hemorrhoids are one of the most common problems treated by surgical practices. Hemorrhoidectomy remains the standard procedure for treatment of symptomatic grades III and IV hemorrhoids.[1]

The Ferguson hemorrhoidectomy (FH) has remained a popular technique since its introduction in 1959.[2] Wound closure helps reduce postoperative pain.[3] However, conventional hemorrhoidectomy is often accompanied by significant pain-related complications, such as urinary retention. Additionally, meticulous hemostasis is imperative to prevent postoperative hemorrhage, as the operative field can occasionally become bloody, leading to prolonged surgery.

In recent years, new techniques, each carrying its own set of advantages and disadvantages, have been introduced.[4] One such innovation is the LigaSure™ (Valleylab, Boulder, CO, USA), a bipolar electrothermal sealing device. Using an advanced feedback system designed to recognize tissue and subsequently adjust the current and voltage, this device maintains an appropriate balance of energy and pressure to induce the melting of collagen and elastin, thereby forming a seal comparable in strength to sutures.[5] Its implementation has achieved significant reductions in operative times, blood loss, and pain scores on the first postoperative day.[6]

In this study, we used the LigaSure device for performing hemorrhoidectomies on grade III and IV he-

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morrhoids. We aimed to compare our results with those obtained through conventional closed hemorrhoidectomies, specifically the Ferguson technique.

Patients and Methods

We retrospectively analyzed patients with symptomatic prolapsed hemorrhoids (grades III and IV) who underwent LigaSure hemorrhoidectomy (LH) at the Division of Colorectal Surgery, China Medical University Hsinchu Hospital, from December 21, 2018 to June 25, 2022. A total of 2,729 patients were included in the study. Patient demographics, operative time, postoperative pain levels, postoperative analgesic requirements, duration of hospital stay, time taken to resume normal work, postoperative complications, and recurrence rates were evaluated by reviewing medical records.

Patients with concurrent anal fissures and those undergoing lateral intersphincteric resection were excluded. Additionally, patients with previous perianal surgery or other anorectal disorders were excluded. Patients with a history of cardiovascular disease (CAD) who were currently taking anticoagulants or antiplatelet medications were instructed to discontinue the medication for 3 days before the operation.

All patients were instructed to fast from midnight onwards prior to surgery. They were admitted in the morning and underwent hemorrhoidectomy the same day. All patients received a sodium phosphate enema before the hemorrhoidectomy procedure.

All patients were placed in the prone jack-knife position for the procedure, which was performed under intravenous general anesthesia (without endotracheal intubation) with local perianal anesthetic infiltration. Exposure was achieved using a medium- or large-sized Hill-Ferguson retractor.

LH began with a narrow V-shaped incision created from the external component to the mucocutaneous junction using a knife.[7] Subsequently, a long, smooth forceps was used to lift the hemorrhoidal plexus, facilitating continuous dissection between the intersphincteric muscle and the hemorrhoidal plexus plane with either scissors or LigaSure. The LigaSure device was then applied beneath the forceps for coagulation, extending from the mucocutaneous junction to a point above the apex of the hemorrhoidal cushion. The scissors of the LigaSure were maneuvered along the coagulum line, and the hemorrhoidal tissue above the welting line was removed.

FH was performed by making an incision with a knife from the upper anus to the mucocutaneous junction, ensuring no injury, until the internal sphincter muscle was visibly exposed. Subsequently, dissection above the internal sphincter tissue was executed approximately 1-2 cm from the incision wound. The hemorrhoid pedicle was then secured either by suture ligation or tied using black silk. Following this, the hemorrhoidal plexus was removed with scissors.

After both procedures, excision of the three main cushions, typically located at the left lateral, right anterior, and right posterior positions, was performed in all patients, resembling conventional methods. The anodermal wounds were approximated using continuous 4-0 Vicryl sutures. This procedure was repeated for each hemorrhoidal cushion. Anal packing was not performed after the operations.

Postoperatively, patients were prescribed oral magnesium oxide (1 tablet, 4 times/day) and sennoside (2 tablets) for 2 weeks before sleep. Continued use of painkillers and laxatives was recommended as needed, especially for patients with histories of constipation.

Oral acetaminophen (500 mg, 4 times/day) was administered to relieve pain. Preoperative administration of nalbuphine (150 mg, intramuscular injection) was offered based on patient preference. In cases where postoperative pain remained intolerable, patients were given intramuscular injections of Demerol (meperidine, 25-50 mg) every 6 hours on demand or Dynastat (parecoxib,40 mg) every 12 hours. Additionally, options included combining Demerol or Dynastat with Celebrex (200 mg twice daily) or with diclofenac (75 mg, once daily) or shifting oral acetaminophen to Ultracet (37.5 mg tramadol plus 325 mg acetaminophen, 4 times daily). Patients were then instructed to complete a subjective pain survey using a visual analog scale ranging from 0 (no pain) to 10 (extreme pain) each morning during their hospital stay.

Patients were instructed to irrigate the anal wound using either a warm sitz bath or water spray 4 times daily and after each bowel movement. Neomycin ointment was prescribed for topical application. Discharge from the hospital was contingent upon achieving tolerable pain levels with self-administered oral analgesics and the absence of postoperative complications.

Patients were examined at the outpatient clinic 1 week after discharge. Subsequent visits were arranged 1-3 weeks later, depending on the patient's symptoms and signs. Digital examinations were performed at each visit to detect possible infections or stenosis. If a patient had problems at 4 weeks, additional visits were scheduled.

All data were analyzed using the Statistical Package for the Social Sciences (version 26.0; SPSS, Chicago, IL, USA). Results were expressed as means ± standard deviations. If the data did not fit a normal distribution as a negative value of mean minus standard deviation, the results were expressed as a median with a range. The two-sided Chi-square test and Student's *t* tests were used to compare variables between the two groups, with a significance threshold set at $p < 0.05$. Linear and logistic regression analyses were then performed for each outcome.

The primary outcomes included surgical time, blood loss, hospitalization duration, postoperative pain score, and surgical complications. The secondary outcomes were long-term complications. Post-hemorrhoidectomy bleeding was defined as anal bleeding that needed surgical or medical intervention. Post-operation infection was defined as purulent discharge, localized cellulitis around the wound, or a perianal abscess that needed further surgical intervention or antibiotic treatment.

Results

Characteristics of the 2,729 symptomatic patients with grade III or IV hemorrhoids are summarized in Table 1. Of these patients, 1,210 women and 631 men underwent LH, and 414 women and 474 men underwent FH ($p < 0.001$). A predominance of females was observed in the LH group. The mean ages were 45.2 ± 11.4 years and 46.0 ± 12.4 years for patients undergoing LH and FH, respectively ($p = 0.107$). The mean body mass indices were 23.5 ± 3.6 and 23.9 ± 3.8 for patients undergoing LH and FH, respectively ($p = 0.390$). A higher prevalence of CAD and hypertension was observed in the FH group compared with the LH group.

Table 2 shows the operative details of the two groups. The mean operating time of LH was considerably faster than FH (28.0 ± 10.0 min vs. 39.2 ± 21.7 min; $p < 0.001$). Mean intraoperative blood loss was considerably less for LH than FH (4.8 ± 1.6 [range 1-20] mL vs. 5 [range 1-150] mL; $p < 0.001$).

Lower pain scores and shorter hospital stays were

Table 1. Patient characteristics

	LigaSure (n = 1841)	Ferguson (n = 888)	*p* [a]
Sex			< 0.001 [b]
Female	1210 (65.7%)	414 (46.6%)	
Male	631 (34.3%)	474 (53.4%)	
Age (years)	45.2 ± 11.4	46 ± 12.4	0.107
Hemorrhoid grade			0.041 [b]
III	1732 (94.1%)	817 (92%)	
IV	109 (5.9%)	71 (8%)	
Body height (cm)	163.4 ± 8.1	164.8 ± 8.5	< 0.001 [b]
Body weight (kg)	62.9 ± 12.3	65.1 ± 12.9	< 0.001 [b]
BMI	23.5 ± 3.6	23.9 ± 3.8	0.390
ASA			0.035 [b]
I	779 (42.3%)	338 (38.1%)	
II	1010 (54.9%)	522 (58.8%)	
III	51 (2.8%)	28 (3.1%)	
IV	0	0	
Underlying disease			
CAD	307 (16.7%)	177 (19.9%)	0.042 [b]
Hypertension	197 (10.7%)	125 (14.1%)	0.011 [b]
Stroke	4 (0.2%)	3 (0.3%)	0.689
Diabetes	55 (3.0%)	34 (3.8%)	0.252
COPD	0	1 (0.1%)	0.326
Hepatitis carrier	105 (5.7%)	38 (4.3%)	0.120
ESRD	1 (0.1%)	0	1.000

Values are presented as mean ± standard deviation or numbers (percentages).

[a] *p*-values are calculated using Chi-square test (categorical variables) or Student's t-test (continuous variables).

[b] Statistical significance ($p < 0.05$).

BMI, body mass index; ASA, American Society of Anesthesiology physical status classification; CAD, coronary artery disease; ESRD, end-stage renal disease.

observed for patients who underwent LH compared with those who underwent FH ($p < 0.001$), as listed in Table 3. Parenteral analgesic requirements were not significantly different between the groups, except nalbuphine (Table 3). After adjusting for the use of the painkillers Celebrex, diclofenic, and nalbuphine and patients' hemorrhoid grades, ASA, CAD, and hypertension, less pain was observed POD1-VAS in patients who underwent LH.

Regarding surgical complications within 1 month, a higher incidence of urinary retention was observed in the FH group compared with the LH group (3.5% vs. 1.7%; $p = 0.003$; Table 4), correlating with increased reported pain in the FH group (Table 3). However, the LH group exhibited a higher occurrence of

Table 2. Operative characteristics

	LigaSure (n = 1841)	Ferguson (n = 888)	p [a]
Operative time (min)	28 ± 10	39.2 ± 21.7	< 0.001 [b]
Blood loss (mL)	4.8 ± 1.6	5 [< 1,150]	< 0.001 [b]

Values are presented as mean ± standard deviation or median [range].
[a] p-values are calculated using linear regression and adjusted for sex, hemorrhoid grade, ASA, CAD, and hypertension.
[b] Statistical significance ($p < 0.05$).
min, minute; mL, milliliter.

Table 3. Hospital stay and return to work duration

	LigaSure (n = 1841)	Ferguson (n = 888)	p [a]
Hospital stay (days)	1 ± 0.1	1.1 ± 0.2	< 0.001 [b]
POD1-VAS	0 [0,7]	0 [0,8]	< 0.001 [c]
Pain killer			
Oral			
+ Celebrex	583 (31.7%)	137 (15.4%)	< 0.001 [b]
+ Diclofenac (75 mg)	508 (27.6%)	401 (45.2%)	< 0.001 [b]
Acetaminophen shift to Ultracet	218 (11.8%)	121 (13.6%)	0.632
Parental			
Parecoxib (IVD)	64 (3.5%)	32 (3.6%)	0.890
Meperidine (IM)	660 (35.9%)	324 (36.5%)	0.503
Meperidine dosage (mg)	0 [0,200]	0 [0,200]	0.131
Nalbuphine (IM)	340 (18.5%)	242 (27.3%)	< 0.001 [b]
Return to work (day)	9.7 ± 3.1	10.4 ± 6.4	0.064

Values are presented as mean ± standard deviation, median [range], or numbers (percentages).
[a] p-values are calculated using logistic regression (categorical variables) or linear regression (continuous variables) and adjusted for sex, hemorrhoid grade, ASA, CAD, and hypertension.
[b] Statistical significance ($p < 0.05$).
[c] p-values are calculated using linear regression and adjusted for sex, hemorrhoid grade, ASA, CAD, hypertension, and Celebrex, diclofenac, nalbuphine for POD1-VAS.
mg, milligram; POD1, postoperative day one; VAS, visual analog score; +, plus; IVD, intravenous drip; IM, intraocular injection.

Table 4. Short-term complications

	LigaSure (n = 1841)	Ferguson (n = 888)	p [a]
Urinary retention	32 (1.7%)	31 (3.5%)	0.003 [b]
Stool impaction requiring enema	128 (7%)	39 (4.4%)	0.003 [b]
Bleeding	43 (2.3%)	14 (1.6%)	0.070
Requiring surgical intervention	4 (0.2%)	6 (0.7%)	0.114
Infection	117 (6.4%)	87 (9.8%)	0.040 [b]
Debridement/fistulotomy	2 (0.1%)	1 (0.1%)	0.943

Values are presented as numbers (percentages).
[a] p-values are calculated using logistic regression and adjusted for sex, hemorrhoid grade, ASA, CAD, and hypertension.
[b] Statistical significance ($p < 0.05$).

stool impactions requiring enemas compared with the FH group (7% vs. 4.4%; $p = 0.003$). Additionally, the FH group experienced a higher infection rate than the LH group (9.8% vs. 6.4%; $p = 0.040$), although no significant differences were observed in the need for surgical intervention between the groups (Table 4). The incidence of post-hemorrhoidectomy bleeding and the requirement for surgical intervention did not vary significantly between the groups (Table 4).

Finally, the return to work as not significant between the LH and FH groups (9.7 ± 3.1 d vs. 10.4 ± 6.4 d; $p = 0.064$ (Table 3). No morbidity was reported.

The long-term complications after follow-up are listed in Table 5 and depicted in Fig. 1. In the LH group, fewer cases of recurrent hemorrhoids were observed compared with the FH group (1.7% vs. 4.2%; $p < 0.001$), along with a lower incidence of anal fissures (0.9% vs. 2.1%; $p < 0.001$). This discrepancy in complication rates could explain the shorter follow-up duration in the LH group. Repeat surgical interventions for recurrent hemorrhoids or anal fissures were not statistically significantly different between the two groups. The shortest recurrent hemorrhoid was noted 6 and 10 months after surgery in the FH and LH groups, respectively (Fig. 1). Perianal skin tags (0.4% vs. 0.7%) and fistula formation (0.9% vs. 1.2%) were also not significantly different between the groups. However, abscess formation differed slightly between the groups, with 2 cases (0.1%) in the LH group and 5 cases (0.6%) in the FH group. The onset of abscess events ranged from 12.2-22.5 months postoperatively in the LH group, whereas in the FH group, it ranged from 1.2-42.7 months. Most anal abscess patients underwent conservative treatment, including incision and drainage along with antibiotic treatment. However,

Table 5. Long-term complications

	LigaSure (n = 1841)	Ferguson (n = 888)	p [a]
Follow up (month)	4.3 [0,62.2]	13.7 [0,61.8]	< 0.001 [b]
Recurrent hemorrhoid	31 (1.7%)	37 (4.2%)	< 0.001 [b]
Ligation	3 (0.2%)	5 (0.6%)	0.103
Thrombectomy	0	2 (0.2%)	0.986
Hemorrhoidectomy	3 (0.2%)	5 (0.6%)	0.257
Anal fissure	17 (0.9%)	19 (2.1%)	0.004 [b]
LIS	1 (0.1%)	0	0.989
Skin tag	7 (0.4%)	6 (0.7%)	0.165
Excision	1 (0.1%)	2 (0.2%)	0.133
Infection	18 (1.0%)	16 (1.8%)	0.100
Abscess	2 (0.1%)	5 (0.6%)	0.088
Debridement	0	1 (0.1%)	0.985
Fistula	16 (0.9%)	11 (1.2%)	0.384
Fistulotomy	16 (0.9%)	11 (1.2%)	0.277

Values are presented as numbers (percentages).
[a] p-values are calculated using logistic regression and adjusted for sex, hemorrhoid grade, ASA, CAD, and hypertension.
[b] Statistical significance ($p < 0.05$).
LIS, lateral internal sphincterotomy.

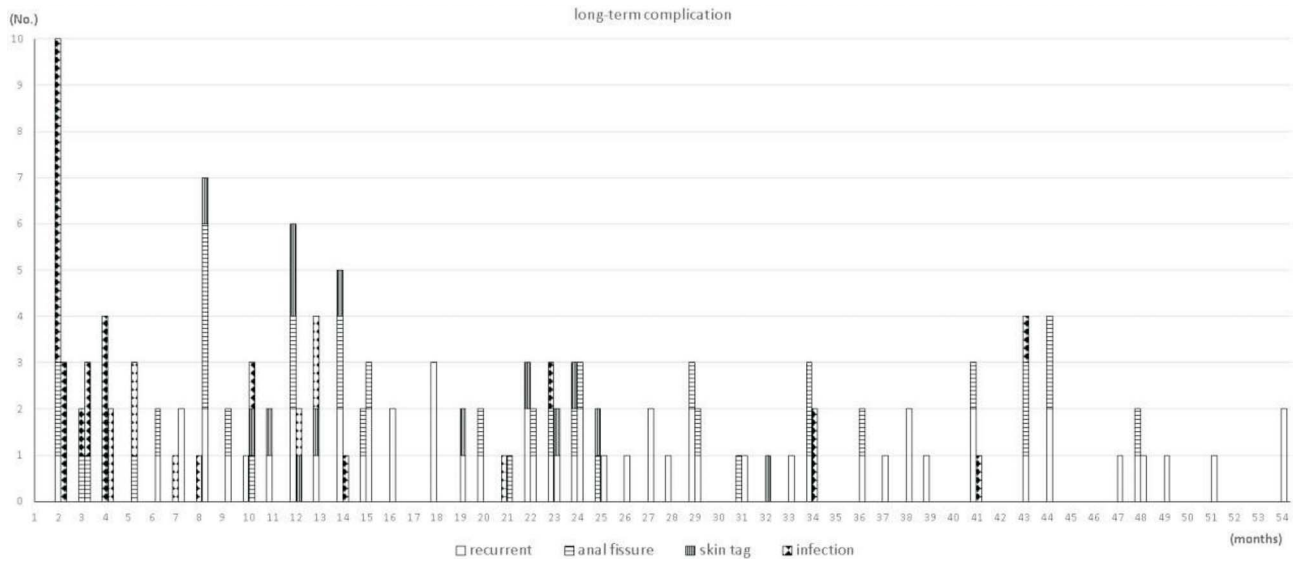

Fig. 1. Long-term complications. Side-by-side comparison of LigaSure and FH, before and after.

anal fistula cases underwent surgical intervention.

Discussion

Hemorrhoidectomy remains a widely accepted treatment for symptomatic grades III and IV hemorrhoids. Traditional methods such as the Milligan-Morgan method[8] and Ferguson's method[2] have been practiced for over half a century. However, postoperative pain is a well-known complication of hemorrhoidectomies.[9]

Recently, several new technologies have been developed for performing hemorrhoidectomies.[4,10,11] Among these, LH seems to achieve satisfactory results through complete coagulation, minimal thermal spread, and limited tissue charring.[12,13] For instance, the LigaSure vessel sealing system uses an advanced electrocautery mechanism that optimally delivers energy across its diathermy jaws. It incorporates a high-frequency feedback system capable of recognizing tissue impedance, thereby adjusting current and voltage output to ensure complete coagulation while minimizing thermal spread and tissue charring. Theoretically, this mechanism prevents extended thermal injury, which may result in decreased postoperative pain and anal spasms.[14] These advantages translate into less postoperative pain, reduced analgesic requirements, faster wound healing, and earlier resumption of normal activities.

Better hemostasis provides better visualization of the surgical area.[15] It is associated with reduced intraoperative blood loss and shorter operative durations. In our study, we observed shorter operative durations, decreased intraoperative blood loss, reduced hospitalization stays, less postoperative pain (Table 3), and less acute urinary retention (Table 4). However, despite a trend favoring LH, we did not observe a statistically significant difference in early return to normal work.

Painkillers are another consideration in hemorrhoidectomy clinical practice. In our institute, we frequently combine different mechanical painkillers for relieving pain, including collaborating with the anesthesia department for ultrasound-guided nalbuphine injection before surgery. This may explain why most patients did not suffer severe postoperative pain. Even in the FH group, who experienced more pain, the median POD1-VAS in our study was 0, compared with 2.47-4.4, as reported in other studies.[16,17]

The parecoxib and meperidine did not differ between LH and FH. However, more nalbuphine was used in the LH group. At the completion of this study, parecoxib and nalbuphine are still paid for by the patient in Taiwan, and more LH patients may have chosen to take these medications.

In terms of oral painkillers, Celebrex was used more often by the LH group, whereas diclofenac was used more often by the FH group. The patient chooses which medication to take. However, there was no difference in the shift from acetaminophen to Ultracet for enhancing pain relief after POD1 between groups.

Posthemorrhoidectomy bleeding was not significantly different in our study. All patients exhibited oozing at the edges of unhealed, dehiscent wounds. However, surgical intervention was required in only 0.2% of patients who underwent LH and 0.7% of patients who underwent FH.

The incidence of acute infections was also lower in the LH group (Table 4). Notably, antibiotics were not initially prescribed after the operation. Most infections within 1 month postoperatively can be treated with antibiotics and proper wound care.

In addition, postoperative manometry showed a rapid return to normal values of maximal resting and squeeze pressures in patients who underwent LH.[7,13,18] This recovery may explain the observation in the literature that patients who underwent LH instead of FH experienced less constipation. However, our study revealed a higher incidence of postoperative constipation requiring enemas in the LH group, contrary to existing literature reports. This could not be attributed to post-operative pain or a history of constipation. In our study, less post-operative pain was experienced by the LH group, which implied that pain induced by fear of defecation was not the reason. Also, both groups were given stool softeners and laxatives, which implied the constipation was not induced by slowed bowel movements. One possible explanation is anal canal edema.[19] In our FH patients, we performed extensive dissection

above the sphincter layer and excised more hemorrhoidal Cushing tissue. As a result, the FH group exhibited less residual tissue prone to swelling compared with the LH group.

The long-term risk of recurrence of symptomatic hemorrhoids after surgery is the main concern for both patients and surgeons. Reported long-term recurrence rates after conventional hemorrhoidectomy range from 0%-7.5%.[20,21] Recurrence rates after LH ranged from 2.0%-11.8%.[7,18,22-25] In our study, 1.7% of patients who underwent LH and 4.2% of those who underwent FH experienced recurrent anal bleeding or thrombosis and subsequently sought examination in the outpatient clinic (Table 5). A fraction of patients, comprising 0.4% of patients who underwent LH and 1.6% of patients who underwent FH, required further surgical intervention, while the remaining patients were managed conservatively.

The presence of skin tags may have been a significant concern for elderly patients. In patients who underwent LH and FH, the long-term incidence of skin tags was 0.4% and 0.7%, respectively. Though this bothersome problem causes those patients to return for help, most patients did not agree to additional surgical intervention. Only 0.1% of LH and 0.2% of FH patients requested excision of the skin tags. The others chose to adjust their lifestyle, took stool softeners, and applied ointment to the affected areas.

Long-term infections occurred in 18 (1%) patients who underwent LH and 16 (0.6%) patients who underwent FH (Table 5). Most anal abscesses could be managed at the clinic, but all fistula cases required fistulotomies. Only one patient developed an abscess, which occurred 1.2 months after surgery, that required surgical debridement. Abscesses in other patients (appearing from 11.4-42.7 months postoperatively) were managed with incision and drainage, along with antibiotic therapy at the outpatient clinic. The follow-up period was also shorter in the LH group, indicating that these patients were satisfied and experienced minimal discomfort.

Limitations

This was a retrospective study, and there were some biases. For example, the LH group contained significantly more female patients. The LigaSure™ medical device was paid for by the patient until the study was completed. Also, after clinical explanations of the surgery, more females may have chosen the LH procedure. However, this influence was corrected using regression model statistics.

Conclusions

LH with submucosal dissection is a rapid, bloodless, and minimally painful surgical option with low morbidity compared with FH. Such advantages suggest its potential for widespread application within community hospital settings.

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Declaration of Competing Interests

Dr. Jau-Jie You, on behalf of all authors, declares that there are no conflicts of interest or financial ties to disclose.

Authors' Contributions

Dr. Jau-Jie You conceptualized and designed the study, designed the data collection instruments, collected the data, carried out the initial analyses, drafted the initial manuscript, and revised the manuscript. Dr. Ming-Yin Shen conceptualized and designed the study and reviewed and revised the manuscript. Dr. William Tzu-Liang Chen modified the study design and re-

viewed and revised the manuscript. Drs. Yen-Chen Shao, Chu-Cheng Chang, and Yu-Hao Su reviewed and revised the manuscript. All authors have approved the final manuscript as submitted and agreed to be accountable for all aspects of this work.

Data availability Statement

The datasets presented in this article are not readily available because data release is not allowed by the China Medical University Hsinchu Hospital. Requests to access the datasets should be directed to Dr. Ming-Yin Shen (E-mail: mingyin.shen@gmail.com).

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原　著

地區醫院 LigaSure 或 Ferguson 痔瘡切除術的經驗報告

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目的　比較 LigaSure 或 Ferguson 痔瘡切除術治療 3 級或 4 級痔瘡的短期和長期手術結果。

方法　在單一機構對接受 LigaSure 或 Ferguson 共 2,729 位痔瘡切除術治療的患者，回溯性研究。

結果　在年齡、體重指數方面，兩組之間沒有統計學顯著差異。LigaSure 痔瘡切除術的平均手術時間明顯短於 Ferguson 痔瘡切除術 (28 ± 10 vs. 39.2 ± 21.7 分鐘；$p < 0.001$)。採用 LigaSure 方法治療的患者出血量明顯減少 ($p < 0.001$)，疼痛評分較低 ($p < 0.001$)，住院時間較短 ($p < 0.001$)。對於短期併發症，與 Ferguson 痔瘡切除術相比，LigaSure 痔瘡切除術患者較少出現尿瀦留和感染，但便秘發生率更高。對於長期併發症，與 Ferguson 痔瘡切除術相比，LigaSure 痔瘡切除術患者復發痔瘡和肛裂發生率較低，但在皮膚皺褶、膿腫或廔管方面沒有差異。

結論　與 Ferguson 痔瘡切除術相比，LigaSure 痔瘡切除術更快、出血少、疼痛少。它可以廣泛應用於社區醫院。

關鍵詞　LigaSure 痔瘡切除術、Ferguson 痔瘡切除術、社區醫院。