



Observational Study

Optimizing circumferential prolapsed hemorrhoid surgery: Transverse incision with longitudinal ligation procedure delivers superior radicality compared to Milligan-Morgan technique

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Abstract

BACKGROUND

Circumferential prolapsed hemorrhoids (CPHs) necessitate surgical intervention. While Milligan-Morgan hemorrhoidectomy (MMH) remains widely used, it compromises functional preservation and associates with significant post-operative pain, edema, and delayed healing in severe CPH cases. To address these limitations, our research team innovatively proposed the transverse incision with longitudinal ligation procedure (TILL). This novel technique utilizes targeted transverse incisions and longitudinal pedicle ligation to optimize complete resection while preserving anal anatomy and function.

AIM

To optimize CPH resection and anal function preservation through comparative efficacy-safety evaluation of TILL *vs* MMH.

METHODS

A total of 180 patients were retrospectively reviewed in China. The patients were divided into two groups of 90 based on the surgical methods. The treatment group underwent the TILL procedure, while the control group underwent MMH. The main observation index was the evaluation of clinical efficacy after wound healing. Secondary outcomes included the recurrence rate and wound healing time. Safety measurements were also evaluated.

RESULTS

The TILL group showed a significant difference compared to the MMH group ($P = 0.022$), indicating better overall treatment effects. The time for wound healing in the TILL group was shorter than that in the MMH group ($P = 0.001$). Compared to those who underwent MMH, those who underwent TILL experienced significantly reduced postoperative pain, with lower average scores for anal edema and anal stenosis (both $P < 0.05$).

CONCLUSION

TILL demonstrates superior efficacy to MMH for advanced CPH, reducing recovery times and postoperative pain, edema, and stenosis while preserving anal function.

Key Words: Circumferential prolapsed hemorrhoid; Milligan-Morgan hemorrhoidectomy; Transverse incision with longitudinal ligation procedure; Efficacy; Anal function

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Core Tip: This study compared transverse incision with longitudinal ligation procedure (TILL) and Milligan-Morgan hemorrhoidectomy (MMH) in 180 grade III/IV circumferential prolapsed hemorrhoid patients. Results showed TILL had superior clinical efficacy ($P = 0.022$), faster wound healing ($P = 0.001$), and less postoperative pain, anal edema, and stenosis (all $P < 0.05$) vs MMH. TILL provided more thorough hemorrhoid removal, shorter recovery, and better anal function preservation. The findings suggest TILL is safer and more effective than traditional MMH for advanced circumferential prolapsed hemorrhoid, reducing complications like pain and stenosis while improving surgical outcomes. TILL represents a significant advancement in hemorrhoidectomy technique.

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INTRODUCTION

Hemorrhoids are a common disease in proctology. An epidemiological survey in Austria showed that 39% of adults suffer from symptomatic hemorrhoids[1]. In China, the prevalence of anal and rectal diseases among residents aged ≥ 18 years in both urban and rural areas is 50.10%, with hemorrhoids accounting for 98.08%[2]. Circumferential prolapsed hemorrhoids (CPHs) often originate from grade III/IV mixed hemorrhoids and are classified as a severe, with surgery as the most effective treatment method. Milligan-Morgan hemorrhoidectomy (MMH) is widely used as a classic surgical technique, but finding a balance between completely removing the lesions and preserving the skin bridge of the anal canal remains a challenge in clinical practice[3]. After years of clinical practice, we found that in the surgical treatment of circumferential hemorrhoids, the MMH technique focuses on preserving the skin bridge but fails to completely remove severe hemorrhoids, resulting in significant postoperative pain, noticeable edema, and prolonged healing time, as well as risks of anal stenosis and anal incontinence[4]. Therefore, our research team conducted a systematic and standardized innovative study on the surgical removal of circumferential hemorrhoids, addressing the shortcomings of MMH and exploring a new balance between complete excision and preservation of the skin bridge, making it more suitable for the treatment of severe circumferential hemorrhoids.

Our research team innovatively proposed the transverse incision with longitudinal ligation procedure (TILL), based on the anal cushion descent theory and the theory of the mother hemorrhoid area, introducing the surgical concept of “dividing one into two and two into four”[5]. Through a transverse incision, TILL allows for precise handling of the hemorrhoidal nodules, while longitudinal ligation preserves the normal anatomical structure of the anal canal, with an emphasis on adjusting anal canal tension as part of a holistic treatment approach. In the surgical treatment of circumferential hemorrhoids, TILL has innovated the incision approach with its horizontal “I” shape design, cleverly addressing pressure at the anal opening, maximizing treatment effectiveness while protecting the physiological and anatomical function of the anus. TILL achieves a balance between aesthetic and therapeutic outcomes for anal health by breaking through key technical challenges, significantly reducing the risk of postoperative pain, edema, stenosis, and other complications. This study reports on the efficacy and safety of the TILL procedure and the traditional MMH procedure in the treatment of grade III/IV CPHs.

MATERIALS AND METHODS

Participants

A computer-generated block randomization sequence was used to allocate 180 eligible CPH patients (1:1 ratio) to receive TILL ($n = 90$) or MMH ($n = 90$), following the guidelines of the Clinical Guidelines for Common Diseases in Proctology of Chinese Medicine[6]. Inclusion criteria were: (1) Patients met the criteria of grade III/IV CPHs; and (2) Aged between 18 and 60 years, with no history of anal surgery. Exclusion criteria were: (1) Severe cardiovascular diseases, liver or kidney dysfunction, or other intestinal and anal disorders; (2) Women who were pregnant, breastfeeding, or menstruating, as well as individuals with a history of epilepsy, severe depression, anxiety, or other mental disorders; and (3) Patients with allergies or scarring.

Study design

The treatment group underwent the TILL procedure, and the control group underwent MMH. Written informed consent was obtained from all participants following full disclosure of procedural risks and benefits. All surgical interventions were performed by two board-certified anorectal physicians (> 10 years' experience in anorectal procedures) adhering to standardized protocols.

Treatment group

The patient was in a right lateral position. After general anesthesia was established, sterile towels were set up for disinfection, and surgery began after local anesthesia helped relax the anal canal. The main incision was designed at the 6 o'clock and 12 o'clock positions in a horizontal "I" shape with the front and rear of the anal region: (1) Using hemostatic forceps to pull up and down, a larger connected external hemorrhoid at the 6 o'clock position was cut radially and horizontally with an electric scalpel. When cutting into the internal hemorrhoid, the incision extended inward 0.5-1 cm above the dentate line, with the depth depending on the size of the hemorrhoid, which could reach the lower edge of the internal sphincter. The external incision at the 6 o'clock position extended 1-2 cm to the distal end of the external hemorrhoid, and the length of the external was extended based on the size of the external hemorrhoid to prevent early adhesion that could lead to false healing. The same method was used to transversely cut the anterior 12 o'clock connected hemorrhoid, being careful not to cut too deep at the 12 o'clock position where the muscle was thin. This step formed a transverse "I" incision in front and behind the anus, called a horizontal incision, which divided the large hemorrhoid transversely into two (Figure 1A and B); (2) From both sides of the 6 o'clock position, the mixed hemorrhoid was longitudinally separated at the 5 or 7 o'clock position to 0.5-1 cm above the dentate line, ensuring not to cut into the muscle layer while separating. Hemostatic forceps were used to clamp the base of the corresponding hemorrhoid longitudinally, and two No. 7 silk threads were passed through the base under the clamp with a No. 45 round needle to tie a longitudinal ligation with an "8" knot, cutting off the excess ends. This step was called longitudinal ligation, which divided the already horizontally separated hemorrhoid into four, while adjusting the tension of the anal canal in accordance with its anatomical shape, effectively avoiding bleeding during the period of thread detachment (Figure 1C-E); (3) The same method was used to handle the hemorrhoids on both sides of the 12 o'clock transverse incision, with attention to lifting and suspending at the 11 o'clock position. Based on the granular boundary line of the hemorrhoids, other mixed hemorrhoid parts were processed from large to small, ensuring that all ligation points were staggered in the anal canal area to prevent excessive tension at the base of the ligation line, which might have caused too much scarring. At the end of surgery, it was important to adjust the tension and tightness of the anus, which can be done by relaxing both internally and externally at the 6 o'clock transverse incision position (Figure 1F); and (4) Finally, the wound edges were trimmed, ensuring adequate hemostasis, and the look of the wound edges was adjusted (Figure 1G and H).

Control group

The control cohort received standard MMH performed in strict accordance with the original technique specifications: Complete excision of hemorrhoidal complexes with ligation at the pedicle base; preservation of intact skin bridges (≥ 0.5 cm width); and primary open wound management as detailed in the foundational surgical atlas[7].

Postoperative treatment

Postoperative treatment was the same in both groups: (1) Antimicrobial prophylaxis: Oral tinidazole (500 mg twice daily) was administered for 7 days to prevent anaerobic infections; (2) Herbal sitz bath: A standardized Chinese herbal decoction (composition: 15 g Cortex Phellodendri, 12 g Herba Portulacae, 12 g Rhizoma Atractylodis, 10 g Tuber Bletillae, 12 g Cortex Moutan, 9 g Pericarpium Zanthoxyli per liter) was applied for 5 minutes following each bowel movement, maintained at 38-40 °C; and (3) Wound treatment: After routine cleaning and disinfection, the wound was bandaged with sterile gauze.

Assessment and postoperative follow-up

Baseline data collection included basic information such as patient gender, age, duration of illness, and clinical symptoms. Clinical data collection included recording pain scores on postoperative days 1, 3 and 7, as well as scores for anal tenesmus and edema on postoperative day 7. The time taken for wound healing was recorded, and clinical symptoms and signs were noted after complete wound healing to assess how effective the treatment was, and scores for anal stenosis and incontinence were also collected. We checked for recurrence in patients 6 months after surgery.

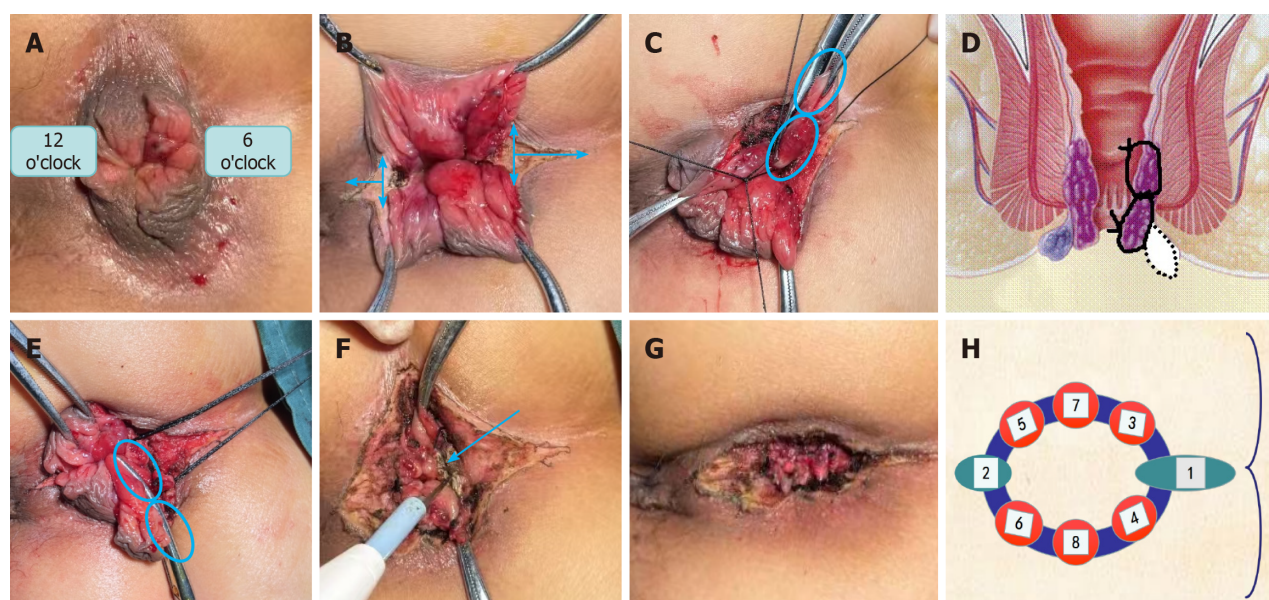


Figure 1 Transverse incision with longitudinal ligation procedure. A: Preoperative images showing circumferentially prolapsed hemorrhoids accompanied by skin tags; B: Horizontal incision: Transverse incision of the hemorrhoid at the 6 o'clock and 12 o'clock positions, forming a horizontal "I" shape in the front and rear of the anal region; C-E: Longitudinal ligation: A vertical ligation was conducted along the anal canal, incorporating multiple ligation points that pass through the "8" knot to relieve pressure; F: Degree of anal release: At the conclusion of the surgery, the focus is on both internal and external release at the horizontal incision site located at 6 o'clock; G and H: Postoperative images: Following the complete removal of circumferential hemorrhoids, multiple ligation points are visible, arranged in a staggered pattern that maintains balanced tension. The blue arrows and circles indicate the direction of the surgical incision.

Treatment outcomes

The primary outcome was evaluation of clinical efficacy following wound healing, consisting of four levels: Cured, markedly effective, effective, and ineffective, according to the standards for syndrome diagnosis and efficacy outlined in Traditional Chinese Medicine[6]. Cured: Symptoms disappeared, hemorrhoids disappeared. Markedly effective: Symptoms were significantly improved, and hemorrhoids basically disappeared. Effective: Symptoms and signs improved, and the hemorrhoids shrunk. Ineffective: No changes in symptoms or signs.

The secondary outcomes included recurrence rate and wound healing time. Recurrence rate was assessed through standardized multimodal surveillance at 6 months postoperatively. This comprehensive evaluation incorporated three validated methods: In-person proctoscopic verification of hemorrhoidal recurrence (classified as grade $\geq$ II *via* the Goligher system); structured telephone interviews systematically documenting symptom progression [including hematochezia frequency, prolapse severity, and visual analog scale (VAS) pain scores]; and WeChat-based digital phenotyping utilizing automated symptom diaries with protocolized photographic documentation. Wound healing time was operationally defined as the duration (in days) from surgical intervention to complete epithelial regeneration, confirmed through daily photographic monitoring and blinded surgeon evaluation.

Safety measurements

(1) Postoperative pain intensity was assessed using the VAS on postoperative days 1, 3 and 7, with scores from 0 (no pain) to 10 (maximum pain)[8]; (2) On postoperative day 7, anal edema severity was classified into four grades: 0 indicated no edema; 1 described mild localized edema at the wound margin with slight erythema; 2 represented moderate edema with clear demarcation and erythematous margins; and 3 indicated severe widespread edema with tissue induration and dark red margins[9]; (3) On postoperative day 7, anal tenesmus severity was measured using scores from 0 to 3. A score of 0 indicated absence of distension, 1 represented mild tolerable sensation without functional impairment; moderate discomfort interfering with daily activities was scored as 2; and severe incapacitating symptoms with complete activity restriction received a score of 3; (4) After complete wound healing, anal stenosis was assessed through digital examination. Grade 0 (no stenosis) was characterized by unrestricted digital examination and effortless defecation; grade 1 (mild) required moderate pressure for digital insertion but maintained stool passage; grade 2 (moderate) involved failed index finger insertion with painful defecation; and grade 3 (severe) showed failed little finger insertion with obstructive symptom[10]; and (5) Six months postoperatively, anal incontinence severity was evaluated using the Wexner scoring system after complete wound healing[11].

Statistical analysis

Statistical analysis was conducted with SPSS 26.0 software (IBM Corp., Armonk, NY, United States). Continuous variables, such as age, disease duration, symptom indices, and wound healing time, were reported as mean $\pm$ SD. Comparisons between groups for these variables were conducted using the Z test. Categorical data, such as gender, were analyzed with the Pearson χ^2 test. In contrast, ranked data, such as efficacy evaluation, were assessed using the χ^2 test for trends when applicable. A two-sided $P < 0.05$ was deemed significant for all analyses.

RESULTS

There were no significant differences in gender, age, and disease duration between the TILL and MMH groups (all $P > 0.05$; Table 1).

Primary outcome

In the TILL group, 82 patients were classified as cured, seven as markedly effective, one as effective, and none as ineffective. In the MMH group, 70 cases were classified as cured, nine as markedly effective, nine as effective, and two as ineffective. There was a significant comparison of the main therapeutic effects between the two groups ($\chi^2 = 9.597$, $P = 0.022$), and the treatment group was superior to the control group (Table 2).

Secondary outcomes

In the MMH group, two patients (2.22%) had recurrence within 6 months following surgery. No recurrence was observed in the TILL group, and there was no significant difference in the recurrence rate between the two groups ($P = 0.155$). Wound healing time was significantly shorter in the TILL group compared to the MMH group (33.24 ± 4.06 days *vs* 35.94 ± 5.38 days; $P = 0.001$; Table 3).

Safety measurements

The safety parameters, including postoperative pain, anal edema, anal tenesmus, anal stenosis, and anal incontinence, are detailed in Tables 4 and 5. Postoperative anal pain is an important aspect for evaluating the safety of anorectal surgery and the rapid recovery of the wound surface. The statistical analysis showed significant differences in the VAS scores for anal pain on the postoperative days 1, 3 and 7 between the two groups ($P < 0.05$). The treatment group demonstrated a significant reduction in postoperative pain. The mean anal edema scores differed significantly between the two groups: 1.02 ± 0.69 for the TILL group and 1.39 ± 0.68 for the MMH group ($P = 0.000$). The mean anal tenesmus scores were 0.91 ± 0.65 for the TILL group and 0.96 ± 0.63 for the MMH group, indicating no significant difference ($P = 0.636$). The mean anal stenosis score was 0.14 ± 0.38 in the TILL group, which was significantly lower than 0.39 ± 0.56 in the MMH group ($P = 0.001$). The mean anal incontinence score was 0.20 ± 0.43 in the TILL group and 0.18 ± 0.41 in the MMH group, with no significant difference between the groups ($P = 0.701$).

DISCUSSION

CPHs are a severe type of hemorrhoids that present challenges in surgical treatment. MMH is considered the gold standard for hemorrhoid surgery[12,13]. However, MMH has limitations in treating grade III/IV circumferential hemorrhoids, which are larger and lack clear boundaries, making it difficult to completely excise the diseased tissue while preserving anal function[14,15]. Following the MMH principle of completely excising the hemorrhoidal tissue may lead to severe pain, prolonged wound healing, and even anal stenosis[16]. However, over-preserving these skin and mucosal bridges can result in incomplete treatment, with leftover skin bridges causing edema, pain, and recurrence of new hemorrhoids, creating a significant psychological and economic burden on patients. Therefore, it is crucial to effectively remove and prevent complications after surgery in the treatment of CPHs, and there is an urgent need for colorectal specialists to rethink the surgical approach and removal techniques for these hemorrhoids[17]. The innovative application of TILL focuses on the overall treatment of hemorrhoids, aiming to remove all hemorrhoidal tissue in one go, while also emphasizing the anterior and posterior release of the anal canal through a linear incision during surgery, which helps prevent anal stenosis and reduces pain and edema after surgery, promoting rapid wound healing.

The results of this study show that TILL outperforms MMH, effectively alleviating symptoms and improving signs. The primary outcomes indicate that TILL has clear advantages over the traditional classic MMH in treating CPHs. Secondary outcomes also suggest that TILL promotes wound healing more quickly and has a lower recurrence rate. The anal area is unique, facing daily defecation stimulation and contamination, and postoperative anal pain is a core concern for both doctors and patients. This study monitored anal pain at three key intervals: On postoperative days 1, 3 and 7. The TILL group had significantly lower VAS scores than the MMH group, which means they experienced less pain and more comfort. Therefore, TILL demonstrates an advantage in reducing postoperative anal pain. Additionally, in terms of evaluating the safety of surgical efficacy, the TILL group had a lower incidence of anal edema and stenosis during recovery compared to the MMH group. This related to how anal canal tension was adjusted during surgery, which allowed for rapid restoration of normal blood and lymphatic flow in the wound area, thereby reducing the occurrence of postoperative anal edema and stenosis. Both groups showed no significant difference in anal tenesmus, possibly due to both groups experiencing relatively severe conditions, with stimulation from the ligation suture ends inside the anal canal and unavoidable defecation stimulation leading to noticeable tenesmus. The Wexner score for anal incontinence is an important safety indicator for anal surgery. In this study, there was no significant difference in Wexner scores between the two groups, and no obvious risk of anal incontinence was found postoperatively, confirming the safety of MMH as a widely used and trusted surgical method. It also supports that while TILL involves partial release of the anal sphincter's lower edge during surgery, the results after wound healing show that TILL does not carry a risk of anal incontinence.

In this study, the key technology of TILL is the dual control and preventive adjustment of tension between hemorrhoidal ligation and the anal canal's resting pressure throughout the surgical process. By making a transverse incision to split large hemorrhoids, and then using longitudinal ligation to further divide the hemorrhoidal masses on both sides into four, this technique reduces the tension between the ligation points, effectively preventing anal edema and anal pain,

Table 1 Baseline demographic and clinical characteristics of two groups, mean $\pm$ SD

Variables	TILL group	MMH group	Z/ χ^2	P value
Gender, male	39	42	0.202	0.653
Female	51	48		
Age (years)	41.71 $\pm$ 9.26	40.53 $\pm$ 9.00	-0.899	0.369
Disease duration (years)	4.67 $\pm$ 2.49	4.86 $\pm$ 2.38	-0.685	0.494

TILL: Transverse incision with longitudinal ligation procedure; MMH: Milligan-Morgan hemorrhoidectomy procedure.

Table 2 Comparison of primary outcome between two groups, n (%)

Grade	TILL group	MMH group	χ^2	P value
Ineffective	0 (0.00)	2 (2.22)	9.597	0.022
Effective	1 (1.11)	9 (10.00)		
Markedly effective	7 (7.78)	9 (10.00)		
Cured	82 (91.1)	70 (77.80)		
Total	90 (100.00)	90 (100.00)		

TILL: Transverse incision with longitudinal ligation procedure; MMH: Milligan-Morgan hemorrhoidectomy procedure.

Table 3 Comparison of secondary outcomes between two groups

Variables	TILL group	MMH group	Z/ χ^2	P value
Rate of recurrence, n (%)	0	2 (2.22)	2.022	0.155
Healing time (days), mean $\pm$ SD	33.24 $\pm$ 4.06	35.94 $\pm$ 5.38	-3.216	0.001

TILL: Transverse incision with longitudinal ligation procedure; MMH: Milligan-Morgan hemorrhoidectomy procedure.

Table 4 Comparison of anal pain scores between two groups, mean $\pm$ SD

Group	n	Anal pain (day 1)	Anal pain (day 3)	Anal pain (day 7)
TILL group	90	1.01 $\pm$ 0.95	2.60 $\pm$ 1.15	4.01 $\pm$ 1.12
MMH group	90	1.23 $\pm$ 0.84	2.98 $\pm$ 0.79	4.47 $\pm$ 1.19
Z		-2.119	-2.667	-2.249
P value		0.034	0.008	0.025

TILL: Transverse incision with longitudinal ligation procedure; MMH: Milligan-Morgan hemorrhoidectomy procedure.

and allows for the complete removal of multiple inseparable hemorrhoidal masses, thus breaking through and resolving the core controversy between preserving the skin bridge and complete excision. The TILL surgical approach utilizes a horizontal "I" shape design in the front and rear of the anal region, ensuring the safety of the surgery while keeping the anal canal's original shape, ultimately achieving a pleasing aesthetic result post-recovery. The design of TILL surgery no longer requires preserving the skin bridge but focuses on the skin margin, with a particular emphasis on adjusting the resting pressure of the anal canal in the final step of the surgery. If the anal canal tension remains high, further relaxing the lower edge of the internal anal sphincter at the 6 o'clock position incision is performed. After adjusting the tension, postoperative issues such as anal pain, anal edema, anal stenosis, and recurrence are effectively addressed, which is one of TILL's innovations.

This study also had limitations. Firstly, participants were enrolled during clinical observation, which may have introduced potential selection bias in this study. Secondly, the study was done at a single center with a small sample size. Finally, the follow-up period was limited to 6 months, requiring long-term follow-up. We hope that future research will

Table 5 Comparison of safety measurements between two groups, mean $\pm$ SD

Group	Cases	Anal edema	Anal tenesmus	Anal stenosis	Anal incontinence
TILL group	90	1.02 $\pm$ 0.69	0.91 $\pm$ 0.65	0.14 $\pm$ 0.38	0.20 $\pm$ 0.43
MMH group	90	1.39 $\pm$ 0.68	0.96 $\pm$ 0.63	0.39 $\pm$ 0.56	0.18 $\pm$ 0.41
Z		-3.488	-0.474	-3.455	-0.384
P value		0.000	0.636	0.001	0.701

TILL: Transverse incision with longitudinal ligation procedure; MMH: Milligan-Morgan hemorrhoidectomy procedure.

include multicenter clinical studies to provide more data support and evidence-based rationale for the implementation of TILL.

CONCLUSION

This study highlights the advantages of the TILL technique over MMH for the treatment of grade III/IV CPHs. TILL overcomes the limitations of traditional techniques and demonstrates better outcomes, including more complete removal of hemorrhoids, shorter healing time, less postoperative anal pain, and improved anal canal function.

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FOOTNOTES

Author contributions: Lai LX designed the study; Song XB, Wang YZ, Wang YM, Sun H, Li JN, Ma HF, Sui TT, Li X, and Liu RH conducted the study and collected the data; Wang YZ analyzed the manuscript; Song XB wrote the manuscript; Song XB and Wang YZ contributed equally to this manuscript as co-first authors. All authors approved the final manuscript.

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