Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Effects of multiple mesh-pattern incisions combined with sclerotherapy for internal hemorrhoids on postoperative anal appearance and functional recovery in patients with mixed hemorrhoids

Xiangyang Song
xuchang central hosptial
Yanhao Tong
xuchang central hosptial
Jianguo Li
xuchang central hosptial
Yifang Ma
xuchang central hosptial
Yuanyuan Wu
xuchang central hosptial
Jianxun Wang
xuchang central hosptial
Yunfeng Guo
xuchang central hosptial
Zhiwei Qiao
xuchang central hosptial
Xiaoyan Zhang
xuchang central hosptial
Bingying Li
xuchang central hosptial
Xiaofeng Song
sxfslx@163.com

xuchang central hosptial

Research Article

Keywords: Mixed hemorrhoids, Surgery, mesh-pattern incisions, Sclerotherapy, Recovery

Posted Date: November 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11193969/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Objective

To evaluate the efficacy, safety, and prognostic outcomes of multiple small incisions in hemorrhoidal tissue combined with sclerotherapy for internal hemorrhoids in restoring anal appearance and function after surgery for grade III–IV mixed hemorrhoids.

Methods

A total of 300 patients with circumferential mixed hemorrhoids who met the inclusion criteria and underwent surgery in the Department of Colorectal Surgery at Xuchang Central Hospital between July and December 2025 were randomly assigned to three groups. Group A underwent multiple small incisions arranged in a mesh pattern combined with sclerotherapy for internal hemorrhoids. Group B underwent conventional surgery combined with Xiaozhiling injection for internal hemorrhoids. Group C underwent conventional external hemorrhoidal excision and internal hemorrhoidal ligation. Postoperative outcomes were recorded, and patients were followed for 6 months to assess long-term recovery of anal function.

Results

The rates of wound edema, urinary retention, wound bleeding, and anal stenosis at 6 days after surgery were 6%, 9%, 7%, and 6%, respectively, in group A, significantly lower than those in group B (19%, 21%, 18%, and 11%) and group C (24%, 25%, 25%, and 21%). Intraoperative blood loss did not differ significantly among the three groups. Overall, group A had better outcomes in terms of postoperative complications, pain relief, wound healing, anal function, and quality of life, as well as lower total hospitalization costs. The incidence of anal stenosis did not differ significantly between groups A and B. Group B showed a more pronounced postoperative inflammatory response, although its complication rates did not differ significantly from those in group C. Recovery was generally slower in group C, which had the highest rates of postoperative bleeding and anal stenosis.

Conclusion

In patients with severe mixed hemorrhoids, multiple small incisions arranged in a mesh pattern combined with sclerotherapy for internal hemorrhoids provide better therapeutic outcomes and recovery of anal function than conventional external excision and internal ligation.

Introduction

Hemorrhoids consist of submucosal vascular tissue in the anal canal. Their rich blood supply and distinctive anatomy make them susceptible to congestion and prolapse. Mixed hemorrhoids are the most common type[1–3] and typically present as enlarged vascular cushions extending above and below the dentate line. Circumferential mixed hemorrhoids represent the final stage of disease progression. According to the clinical practice guidelines of the American Society of Colon and Rectal Surgeons[4], surgical excision is currently the most strongly recommended treatment for symptomatic hemorrhoids. Surgical practice varies across countries and ethnic groups, reflecting differences in lifestyle and clinicians' approaches to the disease. The principal procedures include Milligan–Morgan hemorrhoidectomy(MMH), Ferguson submucosal hemorrhoidectomy, stapled circumferential mucosal resection, and radiofrequency ablation. In Western countries, the Transanal Hemorrhoidal Dearterialization (THD) and Hemorrhoidal Artery Liugation and Recto-Anal Repair (HAL-RAR) are also common treatment options.

The Milligan–Morgan and Ferguson hemorrhoidectomy remain the main conventional surgical treatments. Continued efforts to develop less invasive approaches have led to procedures such as the Procedure for prolapsing hemorrhoids (PPH) and Tissue-selecting Therapy Stapler (TST) surgery. Surgeons have subsequently adapted these approaches to clinical needs, including modified selective hemorrhoidectomy combined with complete preservation of the anal canal epithelium[5–10]. All surgical techniques can damage anal structure and function to varying degrees. The anal canal epithelium consists of squamous epithelium, which does not regenerate after destruction; epithelial defects can therefore lead to scar formation and subsequent anal stenosis. This region is supplied by sacral nerves and is highly sensitive. Defecation may provoke sphincter spasm and severe pain, causing considerable distress[11–13].

No single operation is universally accepted as the gold standard for mixed hemorrhoids. Each procedure has its own advantages, disadvantages, and indications. Given the sensitivity and distinctive structure of the anus, excessive disruption of its anatomy and function may cause postoperative sphincter laxity, fecal leakage, recurrent perianal eczema, itching, discomfort, and a dragging sensation, substantially reducing quality of life. Surgeons worldwide therefore continue to seek a treatment that preserves anal function while minimizing recurrence.

This study addresses the limitations of conventional surgery. Traditional hemorrhoidectomy, including the Milligan–Morgan and Ferguson procedures, and stapled procedures such as PPH are often associated with postoperative pain, delayed wound healing, anal stenosis, or recurrence[14, 15]. Treatment of mixed hemorrhoids must balance several goals, including hemostasis, correction of prolapse, and pain control. A single conventional procedure, such as external excision with internal ligation or PPH, may not fully balance efficacy and functional preservation. Combining multiple mesh-pattern incisions with sclerotherapy can substantially improve treatment outcomes.For the external component, multiple small incisions measuring 3–5 mm allow distributed removal of thrombi or connective tissue external hemorrhoids while preserving skin bridges to prevent anal stenosis. By distributing tension and reducing

local trauma, these incisions may address some of the limitations of conventional surgery. In circumferential mixed hemorrhoids or extensive disease, a single incision may result in incomplete excision or excessive functional damage; multiple incisions allow more precise removal of diseased tissue. Replacing extensive excision with groups of small incisions preserves more normal mucosa and anal cushion tissue, minimizing disruption of fine continence control. The bridges between incisions can improve local perfusion and accelerate wound healing, in a manner comparable to the principle of seton treatment for anal fistulas or skin-bridge techniques in cutaneous surgery. Distributed incisions avoid the deep injury associated with a single large wound and reduce the risks of infection, postoperative wound breakdown and bleeding, and anal stenosis caused by scar contracture. Limiting excision of anal canal skin may also reduce postoperative pain.Sclerotherapy induces fibrosis of the internal hemorrhoidal vessels, reducing bleeding and prolapse while avoiding the trauma of a separate operation on the internal component. The combined approach adds the benefits of two minimally invasive techniques, reduces foreign-body irritation associated with PPH or rubber band ligation (RBL), such as retained staples or bleeding after band slippage, and has broader indications [16–19].Exploring procedural modifications and individualized treatment may enable more flexible surgical planning for complex hemorrhoids, advance precision surgery, and support the development of modern minimally invasive care.

This study was approved by the Clinical Ethics Committee of Xuchang Central Hospital. All patients were informed about the study and voluntarily provided written informed consent.

Methods

Patient selection

The study included 300 patients with Goligher grade III–IV mixed hemorrhoids who met the inclusion criteria and underwent surgery in the Department of Colorectal Surgery at Xuchang Central Hospital between July and December 2025. The patient selection and follow-up process is shown in Fig. 1.

Inclusion criteria

(1) A diagnosis of Goligher grade III–IV mixed hemorrhoids, independence in activities of daily living, and agreement to undergo surgery;

(2) Age 18–65 years;

(3) No history of anal dysfunction, colorectal or anal surgery, or other major surgery;

(4) No history of allergy to sclerosants, analgesics, or other relevant medications, and no long-term use of sedative-hypnotics or analgesics;

(5) No severe cardiovascular, respiratory, hematologic, or endocrine disease, and no inflammatory bowel disease;

(6) No history of malignancy, radiotherapy, or chemotherapy.

Exclusion criteria

(1) Failure to meet the diagnostic criteria for Goligher grade III–IV mixed hemorrhoids;

(2) Long-term use of sedatives or analgesics;

(3) Age below 18 or above 65 years;

(4) A history of colorectal disease, including colorectal cancer, and related major surgery, or concomitant inflammatory bowel disease;

(5) A history of allergy to relevant medications;

(6) Severe cardiopulmonary, hematologic, or endocrine disease.

Preoperative preparation

The 300 eligible patients were randomly assigned using a random number table to three groups: mesh-pattern incisions for external hemorrhoids combined with sclerotherapy for internal hemorrhoids (group A), conventional external excision and internal ligation combined with sclerotherapy for internal hemorrhoids (control group B), and conventional external excision and internal ligation for mixed hemorrhoids (group C). Patients in all three groups fasted from solid food for 6 hours and from fluids for 4 hours before surgery. Routine preoperative counseling was provided to reduce anxiety, and an intravenous cephalosporin was administered 30 minutes before surgery for infection prophylaxis.

Surgical procedures

All procedures were performed under neuraxial anesthesia by the same surgeon. Group A underwent multiple mesh-pattern incisions for external hemorrhoids combined with Xiaozhiling injection for internal hemorrhoids. Primary incisions were preferentially placed at prominent bulges, usually at the 3, 5, 7, and 11 o’clock positions. Short decompression incisions were made at less prominent sites between two primary incisions to create a mesh pattern. Primary incisions generally extended inward from 1 cm outside the anal verge to approximately 0.2 cm below the dentate line. They were not allowed to cross the dentate line and injure the anal canal epithelium. Auxiliary incisions were shorter, usually 3–5 mm, and involved only superficial incision for decompression, without extensive dissection.The surgeon elevated the skin over the external hemorrhoidal bulge and made a small radial fusiform incision, with its base facing outward and its tip directed toward the dentate line. After the skin was incised, mosquito

forceps were used to bluntly separate the subcutaneous connective tissue, varicose venous clusters, and accumulated thrombi. The subcutaneous varicose venous plexus, fibrotic connective tissue, and firm thrombotic nodules were completely removed. Only diseased tissue was cleared, preserving normal subcutaneous fat and fibrous tissue. Redundant, lax skin edges were trimmed to create smooth wound margins. After one primary incision had been completed, an intact skin bridge was retained before the procedure was repeated at the next bulging site. The perianal incisions were staggered to form a mesh-like pattern of windows. Skin bridges between any two adjacent incisions were at least 5 mm wide, because narrower bridges could undergo ischemic necrosis and subsequent scar contracture, resulting in anal stenosis.During hemostasis and contouring, small bleeding points were coagulated, whereas actively bleeding vessels were ligated with silk. Extensive electrocoagulation of the skin bridges was avoided to prevent necrosis. All wounds were inspected around the anal circumference. Additional small window incisions were made where residual bulging remained, and elongated or inverted skin edges were carefully trimmed to produce an even anal margin without localized protrusions or depressions. The internal hemorrhoids were treated with Xiaozhiling sclerotherapy using the four-step injection technique. All incisions were left unsutured to allow open drainage. Each wound was packed with petrolatum gauze and covered with a sterile pressure dressing.

Group B underwent the procedure used in group C with additional Xiaozhiling injection for internal hemorrhoids. Individual protruding internal hemorrhoids were treated using a four-step injection technique.First, 1–2 mL of a 1:1 mixture of Xiaozhiling injection and 1% procaine was injected into the arterial region above the hemorrhoid. Second, the same mixture was injected into the submucosal layer. The needle was introduced at the center of the hemorrhoid and advanced into the submucosa, where the solution was distributed in a fan-shaped pattern to fill the submucosal vascular plexus as completely as possible. Injection continued until diffuse swelling of the hemorrhoid was achieved, usually requiring 3–5 mL.Third, the solution was injected into the mucosal lamina propria. After the second step, the needle was slowly withdrawn until a loss of resistance indicated that the tip had reached the muscularis mucosae. Injection produced a blister-like elevation of the mucosa and usually required 1–2 mL. Fourth, the cavernous venous region was injected. The needle was inserted 0.1 cm above the dentate line, and 1–3 mL of the 1:1 mixture was injected in a fan-shaped pattern 0.5–1 cm obliquely above the hemorrhoid. The total injection volume per treatment session was 15–30 mL. After injection, the external hemorrhoids were excised using a high-frequency electrosurgical knife, and complete hemostasis was achieved by electrocoagulation.

Group C underwent conventional external excision and internal ligation. Patients were placed in the lithotomy position, followed by routine skin preparation and draping. Once anesthesia had taken effect, the anus was repeatedly dilated to a width of two to three fingers. After adequate relaxation, incisions were planned according to the size and location of the hemorrhoids. The external hemorrhoidal margin was lifted, and a V-shaped incision was made. The external hemorrhoid was dissected to 0.5 cm above the dentate line. The internal component was ligated with silk to interrupt its blood supply and induce gradual shrinkage.

Outcome measures

The following outcomes were assessed: interleukin-6 (IL-6) levels on postoperative days 1 and 6; urinary retention; wound edema; wound bleeding; anal fullness or a dragging sensation; postoperative pain; time to discharge; time to complete wound healing; quality of life; recurrence; anal function; and total costs. Urinary retention was considered absent if patients voided normally within 12 hours after surgery or, despite initial difficulty, ultimately voided spontaneously after repeated attempts or assistance. It was considered present if patients remained unable to void despite assistance and required an indwelling urinary catheter. Wound edema was defined as edema, congestion, or elevation of the wound margins within 6 days after surgery. Wound bleeding was defined as persistent dripping or pulsatile bleeding approximately 1 week after surgery. Blood staining on tissue paper or minor anal dripping during defecation that stopped spontaneously was not classified as bleeding. A marked dragging sensation, foreign-body sensation, or urge to defecate within 2 weeks after surgery was classified as pronounced anal fullness and regarded as normal.Pain on postoperative days 1, 3, and 6 was assessed using a visual analog scale (VAS), represented by a 10-cm horizontal line ranging from 0 (no pain) to 10 (severe pain); pain scores were to be assessed on postoperative days 1 and 6.Time to discharge and time to complete wound healing were recorded in days. The 36-Item Short Form Health Survey (SF-36), covering physical and mental health on a scale of 1–100, was administered before surgery and at 1, 3, and 6 months after surgery. Recurrence was assessed after 6 months of follow-up and was defined as symptoms that failed to improve relative to baseline, worsened, or returned after initial improvement. Anal function was assessed at 3 months using the Wexner score, which comprises five items, each scored from 0 to 4 according to severity, yielding a total score of 0–20; higher scores indicate more severe incontinence. Total expenditure was also recorded.

Statistical analysis

Normally distributed data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and compared using t tests. Non-normally distributed continuous variables were expressed as medians and interquartile ranges and compared using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test. To control for multiple testing in pairwise comparisons among the three groups, P values were adjusted using the Holm method. An adjusted P value < 0.05 was considered statistically significant. All analyses were performed using SPSS version 25.0.

Results

A total of 300 patients were included, with 100 in each group. Sex distribution did not differ significantly among the groups ($\chi^2 = 1.705$, P = 0.426). Age, weight, and body mass index (BMI) did not fully meet the assumption of normality and were compared using the Kruskal–Wallis H test. No significant between-group differences were found for age (H = 3.121, P = 0.210), weight (H = 1.351, P = 0.509), or BMI (H = 5.079, P = 0.079). Height was normally distributed and was compared using one-way analysis of

variance; the overall difference was not significant (F = 0.744, P = 0.476). Baseline characteristics were therefore generally balanced across the three groups (Table 1).

Table 1
Baseline and perioperative characteristics

Variable	Group A (n = 100)	Group B (n = 100)	Group C (n = 100)	Test	P value
Female sex, n (%)	55 (55.0)	61 (61.0)	52 (52.0)	χ^2	0.426
Preoperative PS-36 satisfaction score	60.27 ± 7.41	59.48 ± 6.00	60.65 ± 5.45	F	0.417
Length of hospital stay (days)	9.00 (8.00, 10.00)	9.00 (8.00, 10.00)	9.00 (8.00, 9.00)	H	0.113
Operative time (min)	30.00 (25.00, 40.00)	30.00 (25.00, 40.00)	30.00 (25.00, 35.50)	H	0.162

Values are presented as mean ± standard deviation, median (25th, 75th percentile), or n (%). F, one-way analysis of variance; H, Kruskal–Wallis statistic; χ^2, Pearson chi-square statistic.

The overall rates of postoperative urinary retention, wound edema on day 6, bleeding, and anal stenosis differed significantly among the three groups (all P < 0.05). Group A had the lowest rates of all four complications. The differences between groups A and C remained significant after adjustment for all four outcomes, whereas most comparisons between groups B and C did not reach the adjusted significance threshold. Pairwise P values were as follows: urinary retention, A vs B, 0.035; B vs C, 0.502; and A vs C, 0.008; wound edema on postoperative day 6, A vs B, 0.011; B vs C, 0.389; and A vs C, 0.001; postoperative wound bleeding, A vs B, 0.037; B vs C, 0.228; and A vs C, 0.002; and postoperative anal stenosis, A vs B, 0.205; B vs C, 0.108; and A vs C, 0.006 (Table 2).Compared with group A, the odds of postoperative urinary retention were significantly higher in group B (odds ratio [OR] = 2.69, 95% confidence interval [CI] 1.16–6.21; adjusted P = 0.035) and group C (OR = 3.37, 95% CI 1.48–7.66; adjusted P = 0.008). Similarly, the odds of wound edema on postoperative day 6 were significantly higher in group B (OR = 3.67, 95% CI 1.40–9.64; adjusted P = 0.011) and group C (OR = 4.95, 95% CI 1.92–12.72; adjusted P = 0.001). Postoperative bleeding followed the same pattern, with higher odds in group B (OR = 2.92, 95% CI 1.16–7.33; adjusted P = 0.037) and group C (OR = 4.43, 95% CI 1.82–10.80; adjusted P = 0.002) than in group A. For postoperative stenosis, the difference between groups B and A was not significant (OR = 1.94, 95% CI 0.69–5.46; adjusted P = 0.205), whereas the odds were significantly higher in group C (OR = 4.16, 95% CI 1.60–10.83; adjusted P = 0.006.(Table 3. Figure 2)

Table 2
Pairwise comparisons of postoperative complications

Outcome	Comparison	Test/χ^2	Unadjusted P	Holm-adjusted P
Postoperative urinary retention	A vs B		0.017	0.035
	A vs C		0.003	0.008
	B vs C		0.502	0.502
Wound edema on postoperative day 6	A vs B		0.005	0.011
	A vs C		< 0.001	0.001
	B vs C		0.389	0.389
Postoperative bleeding	A vs B		0.019	0.037
	A vs C		< 0.001	0.002
	B vs C		0.228	0.228
Postoperative stenosis	A vs B		0.205	0.205
	A vs C		0.002	0.006
	B vs C		0.054	0.108

χ^2, Pearson chi-square statistic. P values were adjusted using the Holm method across the three pairwise comparisons for each outcome.

Table 3
Odds ratios for postoperative complications

Comparison	OR	Lower 95% CI	Upper 95% CI	Holm-adjusted P
Postoperative urinary retention: Group B vs Group A	2.69	1.16	6.21	0.035
Postoperative urinary retention: Group C vs Group A	3.37	1.48	7.66	0.008
Wound edema on postoperative day 6: Group B vs Group A	3.67	1.40	9.64	0.011
Wound edema on postoperative day 6: Group C vs Group A	4.95	1.92	12.72	0.001
Postoperative bleeding: Group B vs Group A	2.92	1.16	7.33	0.037
Postoperative bleeding: Group C vs Group A	4.43	1.82	10.80	0.002
Postoperative stenosis: Group B vs Group A	1.94	0.69	5.46	0.205
Postoperative stenosis: Group C vs Group A	4.16	1.60	10.83	0.006

OR, odds ratio; CI, confidence interval. Group A is the reference group. P values were adjusted using the Holm method across the three pairwise comparisons for each outcome.

IL-6 levels differed significantly among the groups on postoperative day 1 (P = 0.009), with a more pronounced difference on day 6 (P < 0.001). These differences were mainly attributable to comparisons of group B with groups A and C. IL-6 levels were generally higher in group B, whereas groups A and C did not differ significantly. Pairwise P values for IL-6 were 0.014 for A vs B, 0.027 for B vs C, and 0.983 for A vs C on day 1, and < 0.001, 0.001, and 0.824, respectively, on day 6. Pain scores gradually decreased over time in all three groups, although between-group differences persisted. Pairwise P values for VAS scores were 0.049 for A vs B, < 0.001 for B vs C, and < 0.001 for A vs C on postoperative day 1; 0.064, 0.093, and < 0.001, respectively, on day 3; and 0.005, 0.013, and < 0.001, respectively, on day 6. The trend plot (Fig. 3) showed declining VAS scores in all groups, indicating gradual postoperative pain relief. Median VAS scores were relatively low in group A and higher in group C at all three time points; these differences were particularly evident in the statistical comparisons on days 1 and 6. Overall, postoperative pain scores were lower in groups A and B than in group C, with a statistically significant difference in early postoperative pain between groups A and B. Median wound healing time was longest in group C at 39 days, compared with 34 days in group A and 36 days in group B. The A vs B difference was not significant after adjustment (P = 0.063), whereas B vs C (P < 0.001) and A vs C (P < 0.001) were significant. The overall difference in Wexner scores at 3 months was significant (P = 0.015), mainly reflecting the difference between groups A and C. Pairwise P values were 0.650 for A vs B, 0.068 for B vs

C, and 0.014 for A vs C. Total costs also differed among the groups (P < 0.001), with the lowest overall cost in group A at Yuan 9,531.48, followed by Yuan 9,739.06 in group B and Yuan 9,948.17 in group C. Pairwise P values were 0.001 for A vs B, 0.279 for B vs C, and < 0.001 for A vs C; the difference between groups B and C was not significant. **(**Table 4**)**

Table 4
Pairwise comparisons of continuous outcomes

Variable	Comparison	Test	Unadjusted P	Holm-adjusted P
IL-6 on postoperative day 1	A vs B	Mann–Whitney U	0.005	0.014
	A vs C		0.983	0.983
	B vs C		0.014	0.027
IL-6 on postoperative day 6	A vs B	Mann–Whitney U	< 0.001	< 0.001
	A vs C		0.824	0.824
	B vs C		< 0.001	0.001
VAS pain score on postoperative day 1	A vs B	t test	0.049	0.049
	A vs C		< 0.001	< 0.001
	B vs C		< 0.001	< 0.001
VAS pain score on postoperative day 3	A vs B	Mann–Whitney U	0.032	0.064
	A vs C		< 0.001	< 0.001
	B vs C		0.093	0.093

P values were adjusted using the Holm method across the three pairwise comparisons for each outcome VAS, visual analog scale; IL-6, interleukin-6; CNY, Chinese yuan.

Table 4. Pairwise comparisons of continuous outcomes

Variable	Comparison	Test	Unadjusted P	Holm-adjusted P
VAS pain score on postoperative day 6	A vs B	t test	0.003	0.005
	A vs C		<0.001	<0.001
	B vs C		0.013	0.013
Time to wound healing (days)	A vs B	Mann–Whitney U	0.063	0.063
	A vs C		<0.001	<0.001
	B vs C		<0.001	<0.001
Preoperative PS-36 satisfaction score	A vs B	t test	0.412	0.823
	A vs C		0.680	0.823
	B vs C		0.152	0.457
1 month after surgery	A vs B	t test	<0.001	<0.001
	A vs C		<0.001	<0.001
	B vs C		0.102	0.102
3 months after surgery	A vs B	Mann–Whitney U	<0.001	<0.001
	A vs C		<0.001	<0.001
	B vs C		0.047	0.047

P values were adjusted using the Holm method across the three pairwise comparisons for each outcome. VAS, visual analog scale; IL-6, interleukin-6; CNY, Chinese yuan.

Table 4
Pairwise comparisons of continuous outcomes (continued)

Variable	Comparison	Test	Unadjusted P	Holm-adjusted P
6 months after surgery	A vs B	Mann–Whitney U	< 0.001	< 0.001
	A vs C		0.013	0.027
	B vs C		0.668	0.668
Wexner score at 3 months	A vs B	Mann–Whitney U	0.650	0.650
	A vs C		0.005	0.014
	B vs C		0.034	0.068
Total cost (CNY)	A vs B	Mann–Whitney U	< 0.001	0.001
	A vs C		< 0.001	< 0.001
	B vs C		0.279	0.279
Length of hospital stay (days)	A vs B	Mann–Whitney U	0.207	0.414
	A vs C		0.427	0.427
	B vs C		0.038	0.113

P values were adjusted using the Holm method across the three pairwise comparisons for each outcome. VAS, visual analog scale; IL-6, interleukin-6; CNY, Chinese yuan.

Preoperative SF-36 scores did not differ significantly among the groups (A vs B, P = 0.823; B vs C, P = 0.457; A vs C, P = 0.823), but differences emerged at 1, 3, and 6 months after surgery. At 1 month, group A had the highest mean score (75.73 ± 5.36), with significant differences for both A vs B and A vs C (both P < 0.001); B vs C was not significant (P = 0.102). At 3 months, the median score in group A exceeded those in the other two groups, and all three pairwise comparisons were significant (A vs B, P < 0.001; B vs C, P = 0.047; A vs C, P < 0.001). At 6 months, scores remained higher in group A than in groups B and C. The A vs B difference was the most pronounced (P < 0.001); A vs C was also significant (P = 0.027), whereas B vs C was not (P = 0.068) (Table 4).The trend plot (Fig. 4) showed improvements from baseline in all three groups, with more marked between-group differences during early and intermediate follow-up. Group A maintained relatively high scores at 1, 3, and 6 months. Differences between groups B and C varied by time point and were generally small.

Raw outcome values were standardized using Z-scores to construct a hierarchical clustering heatmap (Fig. 5). Hierarchical clustering of the outcome variables was also performed to illustrate the distribution of multiple continuous outcomes across the intervention groups. The heatmap was used only for exploratory visualization; statistical significance is reported above. Rows represent postoperative outcomes, and columns represent groups A, B, and C. Colors indicate standardized group means: red

denotes values above the overall mean and blue denotes values below it. The dendrogram on the left shows hierarchical clustering of the outcomes according to the similarity of their patterns. VAS pain scores at different time points clustered with total costs. Early postoperative IL-6, the 3-month Wexner score, and wound healing time formed another cluster. Follow-up outcomes at 1, 3, and 6 months formed a separate major cluster. Group A had relatively high standardized means for the 1, 3, and 6month follow-up outcomes. Group B had higher Z-scores for early postoperative IL-6, whereas group C had relatively high standardized means for wound healing time, VAS scores at each time point, and total costs.

Discussion

Mixed hemorrhoids are the most common benign condition encountered in colorectal surgery. Moderate-to-severe circumferential mixed hemorrhoids often involve prolapse, recurrent bleeding, perianal edema, and distortion of anal morphology, with substantial effects on daily quality of life and perianal physiological function[20–22].The procedure evaluated here was developed from conventional external excision and internal ligation. This modified minimally invasive approach combines multiple mesh-pattern incisions with sclerotherapy for internal hemorrhoids. The short, dispersed incisions distribute skin tension, prevent concentrated local scar contracture, and preserve normal perianal skin and natural anatomy as fully as possible. Meanwhile, the sclerosant induces fibrosis and shrinkage of the internal hemorrhoids while preserving the normal structure of the anal cushions and avoiding functional injury caused by excessive excision.

This study compared three treatment strategies in terms of perioperative safety, pain and inflammatory responses, wound healing, anal function, and follow-up scores, focusing on the clinical goals of preserving morphology, controlling symptoms, and restoring function after surgery for mixed hemorrhoids. Sex distribution, intraoperative blood loss, preoperative scores, length of hospital stay, and operative time did not differ significantly among the groups, supporting comparability in these general characteristics. Group A had lower rates of postoperative urinary retention, wound edema, bleeding, and anal stenosis, generally lower pain scores on postoperative days 1, 3, and 6, shorter wound healing time, better Wexner scores than group C at 3 months, and generally higher follow-up scores at 1, 3, and 6 months. Comparisons of postoperative anal appearance, perianal function scores, and complication rates provide some evidence that the combined procedure can improve wound recovery, reduce surgical complications, and restore both perianal anatomy and physiological function.

These findings are consistent with the current emphasis on individualized treatment and functional preservation in hemorrhoidal disease. The 2024 American Society of Colon and Rectal Surgeons (ASCRS) guidelines identify hemorrhoidectomy as an important treatment for symptomatic external hemorrhoids or grade III–IV combined internal and external hemorrhoids, while recognizing postoperative pain, urinary retention, bleeding, and late anal stenosis as continuing clinical concerns[24].The European Society of Coloproctology guidelines likewise recommend selecting treatment according to disease grade, symptoms, and patient expectations, rather than using anatomical grade alone to determine a single procedure [24]. Conventional en bloc or extensive excision can remove

diseased tissue thoroughly, but a larger excision area and inadequate preservation of skin and mucosal bridges may increase wound tension, local inflammation, and scar contraction. Multiple small incisions, by contrast, preserve sufficient normal skin at the anal verge and mucosal bridges. In theory, this helps maintain anal canal compliance and the integrity of anal appearance, offering a plausible explanation for the lower rate of postoperative stenosis in group A. Stenosis occurred in 6% of group A and 21% of group C; the OR for group C relative to group A was 4.16 (95% CI 1.60–10.83) and remained significant after Holm adjustment, suggesting that the difference may be clinically meaningful.

Postoperative pain is a major determinant of early recovery and patient satisfaction after hemorrhoidal surgery. VAS scores declined over time in all three groups but remained relatively low in group A on postoperative days 1, 3, and 6. Differences between groups A and C remained significant at all three time points after adjustment for multiple comparisons. Previous studies have linked pain after hemorrhoidectomy to injury in sensitive regions of the anal canal, the number and extent of wounds, sphincter spasm, and local inflammation. Research on excisional hemorrhoidectomy also suggests that reducing local tissue injury or sphincter hypertonicity can relieve postoperative pain, although some additional procedures may increase the risk of impaired continence[25, 26]. The lower pain scores in group A should therefore be interpreted primarily in terms of tissue preservation rather than analgesia alone. Dispersed small incisions in a mesh pattern may reduce circumferential tension at individual wounds and the extent of contiguous tissue injury. Treating the internal component with sclerotherapy instead of more extensive excision or ligation may also reduce mechanical injury near the dentate line. A randomized controlled study published in 2026 found that, in grade IV hemorrhoids, open excision combined with 3% polidocanol foam sclerotherapy reduced postoperative bleeding and analgesic use and enabled an earlier return to daily activities compared with excision alone[27]. Although the sclerosant and surgical technique differed, these findings offer some support for the present study.

Fine continence control, perianal sensation, and normal defecation depend on intact anal cushions, anal canal skin, and sphincters. Excessive dissection of the anal cushions and injury to the anal canal mucosa during conventional external excision and internal ligation are major causes of impaired fine continence control, altered perianal sensation, and difficulty passing stool after surgery. Xiaozhiling injection may be another important component of the combined procedure. Xiaozhiling contains ingredients derived from Chinese gallnut and alum, with tannic acid and aluminum potassium sulfate among its principal active constituents. Its action is similar to that of aluminum potassium sulfate and tannic acid (ALTA) sclerotherapy, which is widely used in Japan. Early clinical studies reported that four-step Xiaozhiling injection could control prolapse and bleeding by inducing sclerosis and shrinkage of hemorrhoidal tissue[28]. A prospective cohort study of 1,520 patients with grade I–III internal hemorrhoids also used Xiaozhiling as a comparator sclerotherapy regimen and followed anal function, recurrence, and stenosis over the long term[29]. Its findings suggested that sclerosant injection has a relatively limited effect on overall anal function. More recent basic research indicates that Xiaozhiling may affect fibroblast activation and collagen synthesis in hemorrhoidal tissue, with SphK1/S1P and TGF-β-related fibrotic pathways potentially contributing to submucosal fixation[30]. Animal experiments have

also shown time-dependent changes in local perfusion and submucosal fibrous tissue after sclerosant injection [31]. All these findings provide strong biological support for reducing blood flow in hemorrhoidal tissue, promoting fixation through submucosal fibrosis, and improving prolapse.

The value of sclerotherapy, however, cannot be judged simply by whether it produces less inflammation. Sclerosants must induce a controlled local inflammatory and fibrotic response to achieve tissue fixation. In this study, IL-6 patterns did not fully parallel pain or complication outcomes: levels were highest in group B on postoperative days 1 and 6, whereas groups A and C did not differ significantly. IL-6 may therefore reflect the local inflammatory response to different procedures rather than serve as the sole mediator of clinical recovery. Group A recovered better than group C despite similar IL-6 levels, suggesting that differences in pain and healing may also depend on wound configuration, exposure of nerve endings, tissue tension, sphincter responses, and local microcirculation. Our institution plans to measure additional inflammatory markers, including CRP, TNF-α, and IL-1β, and to use repeated-measures models to assess interactions between time and treatment group. This may help clarify the relationship between inflammation and clinical recovery.

The safety and efficacy of sclerotherapy as a tissue-preserving treatment have been examined extensively in studies of other sclerosants [32–34]. A 2024 systematic review of ALTA sclerotherapy included 12 studies and 4,249 patients, reporting a pooled complication rate of approximately 5.2% and an overall recurrence rate of approximately 10%. These findings suggest that sclerotherapy may be a preferred option for selected patients[35]. Randomized trials and multicenter studies of polidocanol foam sclerotherapy have also reported high treatment success rates and low rates of serious adverse events in grade I–III hemorrhoidal disease [36, 37].Although these findings cannot be directly extrapolated to Xiaozhiling combined with small incisions, they suggest that a sclerotherapy strategy that preserves the anal cushions may reduce the need for extensive tissue excision to control symptoms arising from the internal component.

Recovery of anal function was a central focus of this study. The European Society of Coloproctology guidelines identify urinary retention, anal stenosis, and incontinence as important complications of hemorrhoidal treatment and recommend the Wexner score for assessing incontinence[24]Wexner scores at 3 months differed significantly among the three groups, mainly because of the difference between groups A and C (adjusted P = 0.014); groups A and B did not differ significantly. Median scores were low in all three groups, and the absolute differences were small. Their clinical relevance should therefore be interpreted in relation to the minimal clinically important difference, baseline continence, and incontinence to gas, liquid stool, and solid stool. It is encouraging that the lower pain and stenosis rates in group A were not accompanied by worse continence. A previous meta-analysis of hemorrhoidectomy combined with lateral internal sphincterotomy found that the procedure could reduce pain and stenosis but might increase fecal incontinence[26]. Any strategy intended to improve postoperative pain should also account for sphincter and continence outcomes. If mesh-pattern small

incisions combined with sclerotherapy can reduce trauma without dividing the sphincter, their potential to preserve function warrants further evaluation at centers in China and elsewhere.

Preoperative follow-up scores did not differ significantly among the groups, whereas differences emerged at 1, 3, and 6 months, with group A generally maintaining higher scores. Previous studies have shown that symptom relief after excisional surgery, hemorrhoidal artery ligation and recto-anal repair (HAL-RAR), or other treatments is usually accompanied by improvements in SF-36 and other quality-of-life measures [38, 39].Group A showed a clear advantage by 1 month, and some trends persisted through 6 months. These findings suggest that less early pain, fewer complications, and faster wound healing may be associated with better recovery outcomes.

In terms of healthcare resource use, total costs were lower in group A than in groups B and C, despite similar lengths of stay and operative times. The cost differences may therefore be related to consumables, postoperative medication, management of complications, or follow-up dressing changes rather than directly to operative duration or hospital stay. Because detailed cost components were not collected, this analysis remains exploratory. Future studies could separate expenditure into surgical consumables, anesthesia, medication, hospitalization, dressing changes, and complication management, and record time to return to work to evaluate the procedures from a societal cost perspective. The absence of these data is another limitation of the present study.

Prevention and control of postoperative complications are central to evaluating the safety of hemorrhoidal surgery. The forest plot in this study suggests that the modified procedure can significantly reduce the risk of several complications after surgery for mixed hemorrhoids. Wound edema, bleeding, and anal stenosis are among the most common complications of conventional surgery. Edema often results from impaired local circulation and lymphatic drainage after extensive incisions; secondary bleeding is associated with incomplete control of hemorrhoidal vessels; and stenosis primarily results from longitudinal scar contracture and excessive loss of perianal skin. The procedure used here addresses these risks through two mechanisms. First, dispersed mesh-pattern incisions preserve perianal microcirculation and lymphatic drainage, reducing local congestion and inflammatory edema and substantially lowering the incidence of wound edema. Second, the sclerosant can selectively occlude terminal vessels within internal hemorrhoids, reducing intraoperative and postoperative wound oozing and the risk of secondary bleeding. Wound healing time was a clinically relevant finding: median healing times were 34, 36, and 39 days in groups A, B, and C, respectively. The difference between groups A and C was significant, whereas the difference between groups A and B was not significant after adjustment.

Most clinical studies in China and elsewhere have evaluated sclerotherapy or conventional incision-based procedures separately [35,40,41]. Relatively few have examined the combined effects of minimally invasive small incisions and sclerotherapy, and few have considered both restoration of anal appearance and functional recovery in patients with mixed hemorrhoids. Integrating minimally invasive contouring incisions with sclerotherapy-induced shrinkage partly addresses the substantial trauma, poor cosmetic

recovery, and functional impairment associated with conventional surgery, as well as the limited effects of sclerotherapy alone on external skin tags and perianal contour. This approach expands the minimally invasive treatment options for moderate-to-severe mixed hemorrhoids.

This study has several limitations. As a single-center prospective controlled study, it is subject to unavoidable selection and follow-up bias. Multicenter prospective controlled studies are needed to validate the findings. The sample size and follow-up duration were also limited; longer observation is required to assess late recurrence and the long-term stability of anal appearance. The procedure requires surgical proficiency and has a learning curve. Further standardization and simplification of the operative steps may support wider clinical adoption. Because direct quantitative measures of anal appearance, objective anorectal manometry, and long-term recurrence data are lacking, the present findings should be regarded as supportive rather than conclusive evidence. Prospective randomized studies with clearly defined surgical protocols, blinded outcome assessment, long-term follow-up, and repeated-measures analysis would help establish the procedure's actual benefits for disease control, anal morphology, and functional preservation.

Conclusion

Combining minimally invasive mesh-pattern small incisions with sclerotherapy for internal hemorrhoids offers an approach that addresses cosmetic restoration, symptom relief, and functional preservation together. It seeks to overcome the limitations of conventional surgery, which prioritizes eradication of disease while giving insufficient attention to appearance and potentially sacrificing function. The approach is consistent with current efforts in colorectal surgery to reduce invasiveness, improve cosmetic outcomes, and preserve function. It is suitable for a broad range of patients, particularly young and middle-aged adults with high expectations for anal appearance and postoperative quality of life, and provides a new minimally invasive option for moderate-to-severe mixed hemorrhoids.

Declarations

Conflict of interest:

The authors declare no competing interests.

Funding:

This study was supported by the Joint Co-construction Project of the Henan Medical Science and Technology Research Program (grant number LHGJ20250914).

Author Contribution

XFS designed the study. YHT and JGL contributed to data analysis. XYS interpreted the results and drafted the manuscript. YFM and YFG contributed to data collation. XYZ, ZWQ, and BYL analyzed and interpreted the data. JXW contributed to manuscript revision. All authors contributed to the article and approved the final version for publication.

Data Availability

The data are available from the corresponding author upon request. They are not publicly available because of privacy or ethical restrictions.

References

1. MOUNSEY A L, HENRY S L. Clinical inquiries. Which treatments work best for hemorrhoids?. The Journal of Family Practice, 2009, 58(9): 492–493.
2. SUN Z, WU Y, ZHAO X F, el. The clinical effect of electrocoagulation plus traditional external stripping and internal ligation in the treatment of mixed hemorrhoids. Asian Journal of Surgery, 2024: S1015-9584(24)01963-8.
3. MÁRQUEZ A, SIVERIO J, ACOSTA J, et al. [Ligation and sclerosis technique combined with electrocoagulation resection of internal hemorrhoids]. G.e.n, 1991, 45(2): 114–118.
4. DAVIS B R, LEE-KONG S A, MIGALY J, et al. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Management of Hemorrhoids. Diseases of the Colon and Rectum, 2018, 61(3): 284–292.
5. HUANG H, GU Y, LI Y, et al. Modified tissue-selecting therapy stapler combined with complete anal canal epithelial preservation operation for the treatment of circumferential mixed haemorrhoids: a protocol for single-blind randomised controlled study. BMJ Open, 2021, 11(11): e052982.
6. GUPTA P J. Radiofrequency coagulation versus rubber band ligation in early hemorrhoids: pain versus gain. Medicina, 2004, 40(3): 232–237.
7. EL NAKEEB A M, FIKRY A A, OMAR W H, et al. Rubber band ligation for 750 cases of symptomatic hemorrhoids out of 2200 cases. World Journal of Gastroenterology, 2008, 14(42): 6525–6530.
8. MACRAE H M, MCLEOD R S. Comparison of hemorrhoidal treatments: a meta-analysis. Canadian Journal of Surgery. Journal Canadien De Chirurgie, 1997, 40(1): 14–17.
9. DING Z, XUAN J, TANG G, et al. Rubber band ligation versus coagulation for the treatment of haemorrhoids: a meta-analysis of randomised controlled trials. Postgraduate Medical Journal, 2023, 99(1175): 946–953.
10. RAJENDIRAN A, MAHARJAN A, GERRARD A D, et al. Feasibility and advantages of delivering radiofrequency ablation treatment for haemorrhoids under local anaesthesia in the outpatient setting in the UK: our initial experience. Techniques in Coloproctology, 2026, 30(1): 96.

11. DU B, XU Z, ZHONG X. Electroacupuncture for postoperative pain in mixed hemorrhoids: A meta-analysis. Medicine, 2022, 101(50): e32247.
12. ZOU S, LI X, YANG Y B, et al. A Comprehensive Evidence Summary for Pain Assessment and Management After Hemorrhoidal Surgery to Inform Clinical Practice Guidelines. Journal of Multidisciplinary Healthcare, 2025, 18: 6857–6870.
13. LIU J W, LIN C C, KIU K T, et al. Effect of Glyceryl Trinitrate Ointment on Pain Control After Hemorrhoidectomy: A Meta-analysis of Randomized Controlled Trials. World Journal of Surgery, 2016, 40(1): 215–224.
14. LIU X, SHENG B, ZHANG J, et al. Modified whitehead hemorrhoidectomy versus partial hemorrhoidectomy for fourth-degree circular mixed hemorrhoids: A retrospective analysis. Heliyon, 2024, 10(7): e28465.
15. TRENTI L, BIONDO S, GALVEZ A, et al. Distal Doppler-guided transanal hemorrhoidal dearterialization with mucopexy versus conventional hemorrhoidectomy for grade III and IV hemorrhoids: postoperative morbidity and long-term outcomes. Techniques in Coloproctology, 2017, 21(5): 337–344.
16. PESCATORI M, GAGLIARDI G. Postoperative complications after procedure for prolapsed hemorrhoids (PPH) and stapled transanal rectal resection (STARR) procedures. Techniques in Coloproctology, 2008, 12(1): 7–19.
17. SHEN K, WANG C, GAO Z D, et al. [Procedure for prolapse and hemorrhoids versus stapled transanal rectal resection in the treatment of grade IV hemorrhoids]. Zhonghua Wei Chang Wai Ke Za Zhi = Chinese Journal of Gastrointestinal Surgery, 2019, 22(12): 1165–1169.
18. RENZI A, BRILLANTINO A, DI SARNO G, et al. PPH-01 versus PPH-03 to perform STARR for the treatment of hemorrhoids associated with large internal rectal prolapse: a prospective multicenter randomized trial. Surgical Innovation, 2011, 18(3): 241–247.
19. BOCCASANTA P, VENTURI M, ROVIARO G. Stapled transanal rectal resection versus stapled anopexy in the cure of hemorrhoids associated with rectal prolapse. A randomized controlled trial. International Journal of Colorectal Disease, 2007, 22(3): 245–251.
20. ZHANG Y, SUN S, HAN Z. Establishment and validation of clinical prediction model for hemorrhoid recurrence after procedure for prolapse and hemorrhoids. Medicine, 2023, 102(26): e34062.
21. YU Q, ZHI C, JIA L, et al. Efficacy of Ruiyun procedure for hemorrhoids combined simplified Milligan-Morgan hemorrhoidectomy with dentate line-sparing in treating grade III/IV hemorrhoids: a retrospective study. BMC surgery, 2021, 21(1): 251.
22. JIANG H, HAO X, XIN Y, et al. Comparison of clinical outcomes of multi-point umbrella suturing and single purse suturing with two-point traction after procedure for prolapse and hemorrhoids (PPH) surgery. International Journal of Surgery, 2017, 47: 77–82.
23. HAWKINS A T, DAVIS B R, BHAMA A R, et al. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Management of Hemorrhoids. Diseases of the Colon and Rectum, 2024, 67(5): 614–623.

24. VAN TOL R R, KLEIJNEN J, WATSON A J M, et al. European Society of ColoProctology: guideline for haemorrhoidal disease. Colorectal Disease: The Official Journal of the Association of Coloproctology of Great Britain and Ireland, 2020, 22(6): 650–662.
25. EMILE S H, YOUSSEF M, ELFEKI H, et al. Literature review of the role of lateral internal sphincterotomy (LIS) when combined with excisional hemorrhoidectomy. International Journal of Colorectal Disease, 2016, 31(7): 1261–1272.
26. WANG W G, LU W Z, YANG C M, et al. Effect of lateral internal sphincterotomy in patients undergoing excisional hemorrhoidectomy. Medicine, 2018, 97(32): e11820.
27. YIN X, JIANG J, LIANG B, et al. Preliminary Results of Open Excisional Hemorrhoidectomy Combined With 3% Polidocanol Foam Sclerotherapy in Patients With Grade IV Hemorrhoidal Disease: A Randomized Controlled Open-Label Single-Center Study. Diseases of the Colon and Rectum, 2026, 69(5): 809–818.
28. SHI Z. [Treatment of hemorrhoid of III, IV stage by four steps injection of xiaozhiling]. Zhongguo Zhong Xi Yi Jie He Za Zhi Zhongguo Zhongxiyi Jiehe Zazhi = Chinese Journal of Integrated Traditional and Western Medicine, 1998, 18(4): 201–203.
29. AN A yue, FENG D yong, WANG C hui, et al. Comparing the effect of An's Shaobei Injection ([symbols; see text]) with Xiaozhiling Injection ([symbols; see text]) in patients with internal hemorrhoids of grade I-III: a prospective cohort study. Chinese Journal of Integrative Medicine, 2014, 20(7): 555–560.
30. KE M H, HUANG S Y, LIN W G, et al. Single-nucleus RNA sequencing and spatial transcriptomics reveal the mechanism by which Xiaozhiling injection treats internal hemorrhoids. World Journal of Gastrointestinal Surgery, 2025, 17(4): 103494.
31. HUANG S Y, LIN W G, LAN H, et al. Mechanism of Xiaozhiling injection in the treatment of internal hemorrhoids based on changes in perianal blood flow and rectal submucosal fibers. World Journal of Gastrointestinal Pharmacology and Therapeutics, 2026, 17(1): 113444.
32. RAO A G, NASHWAN A J. Redefining hemorrhoid therapy with endoscopic polidocanol foam sclerobanding. World Journal of Gastroenterology, 2024, 30(36): 4021–4024.
33. WANG W, YANG Y, HOU L, et al. Comparative effectiveness and recurrence rates of endoscopic sclerotherapy, ligation, and combined therapy for grades I-III internal hemorrhoids. BMC surgery, 2025, 25(1): 543.
34. ZHU Y, YANG Y, XU W, et al. Multicenter analysis of the efficacy and factors related to recurrence of endoscopic sclerotherapy for internal hemorrhoids: a large-sample, retrospective cohort study. Surgical Endoscopy, 2025, 39(11): 7240–7251.
35. MANAKI V, BONTINIS V, BONTINIS A, et al. Aluminum potassium sulfate and tannic acid (ALTA) sclerotherapy for hemorrhoidal disease: a systematic review and meta-analysis. Acta Chirurgica Belgica, 2024, 124(4): 253–260.
36. MOSER K H, MOSCH C, WALGENBACH M, et al. Efficacy and safety of sclerotherapy with polidocanol foam in comparison with fluid sclerosant in the treatment of first-grade haemorrhoidal

disease: a randomised, controlled, single-blind, multicentre trial. International Journal of Colorectal Disease, 2013, 28(10): 1439–1447.

37. SALGUEIRO P, GARRIDO M, SANTOS R G, et al. Polidocanol Foam Sclerotherapy Versus Rubber Band Ligation in Hemorrhoidal Disease Grades I/II/III: Randomized Trial[J]. Diseases of the Colon and Rectum, 2022, 65(7): e718-e727.
38. CARVAJAL LÓPEZ F, HOYUELA ALONSO C, JUVANY GÓMEZ M, et al. Prospective Randomized Trial Comparing HAL-RAR Versus Excisional Hemorrhoidectomy: Postoperative Pain, Clinical Outcomes, and Quality of Life. Surgical Innovation, 2019, 26(3): 328–336.
39. MARTINSONS A, NARBUTS Z, BRUNENIEKS I, et al. A comparison of quality of life and postoperative results from combined PPH and conventional haemorrhoidectomy in different cases of haemorrhoidal disease. Colorectal Disease: The Official Journal of the Association of Coloproctology of Great Britain and Ireland, 2007, 9(5): 423–429.
40. MIYAMOTO H. Minimally Invasive Treatment for Advanced Hemorrhoids[J]. Journal of the Anus, Rectum and Colon, 2023, 7(1): 8–16.
41. LUO X, XIA Y, GU M, et al. Analgesic Effect of Ropivacaine Combined with Hydromorphone following Surgery for Mixed Hemorrhoids: A Pilot Study. Pain Research & Management, 2022, 2022: 2033580.

Figures

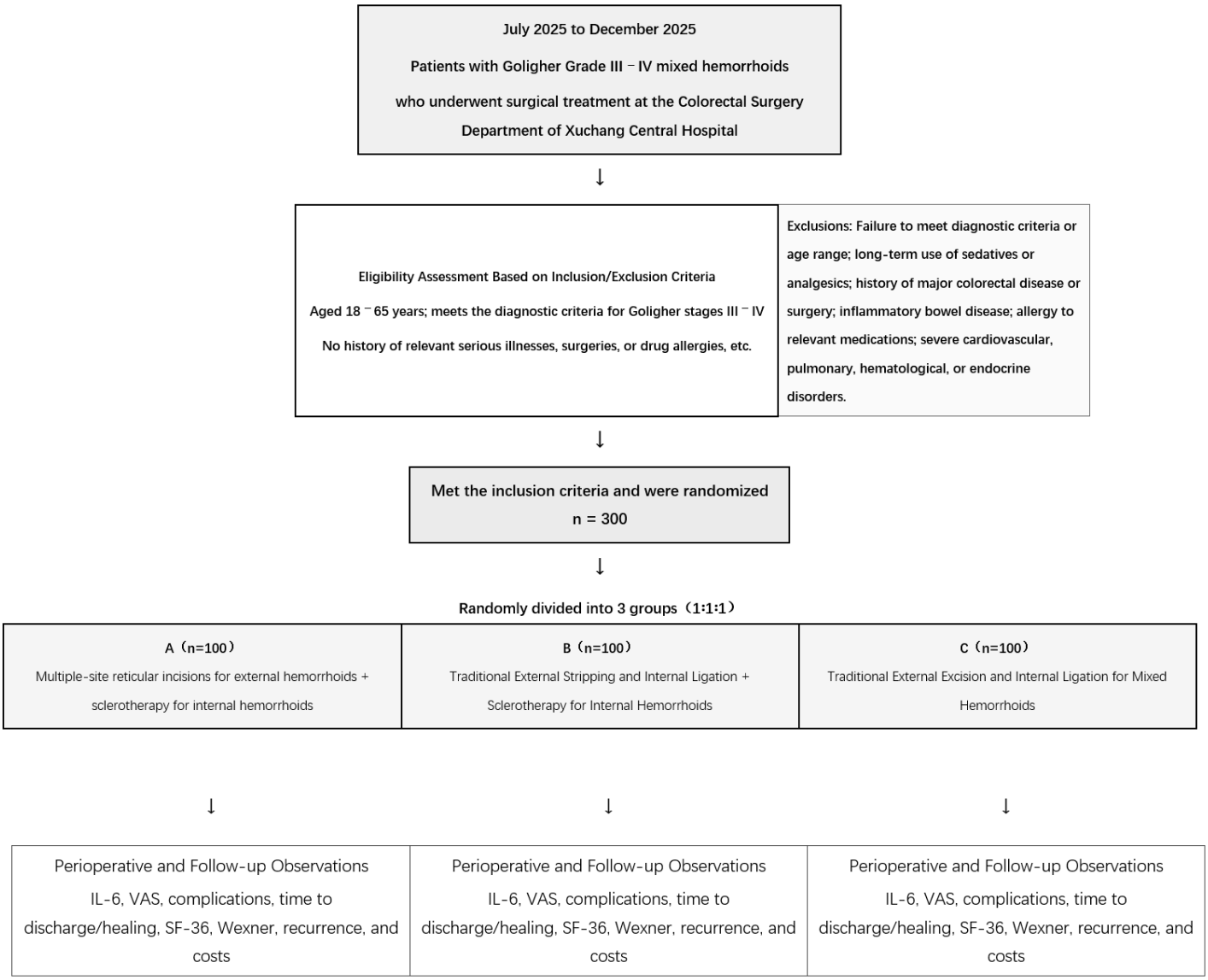


Figure 1

Flowchart of Screening, Randomization, and Follow-Up

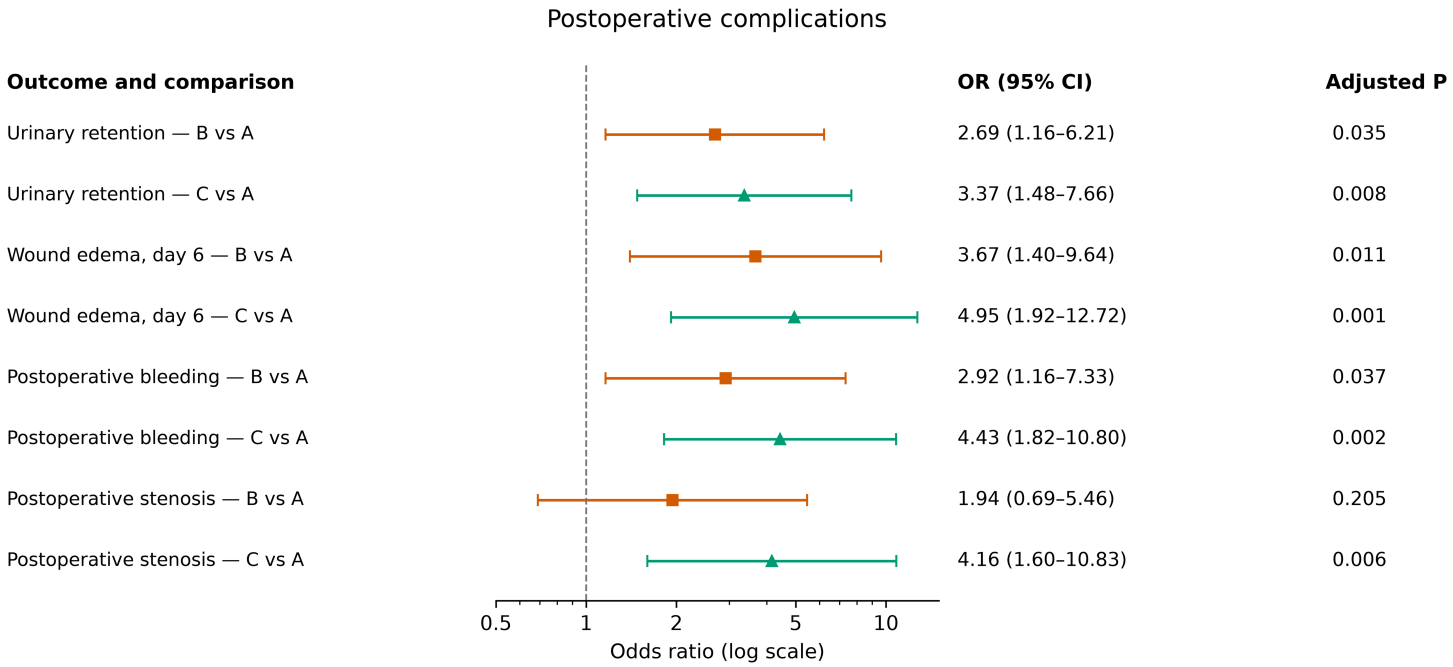


Figure 2

Postoperative complications relative to Group A.

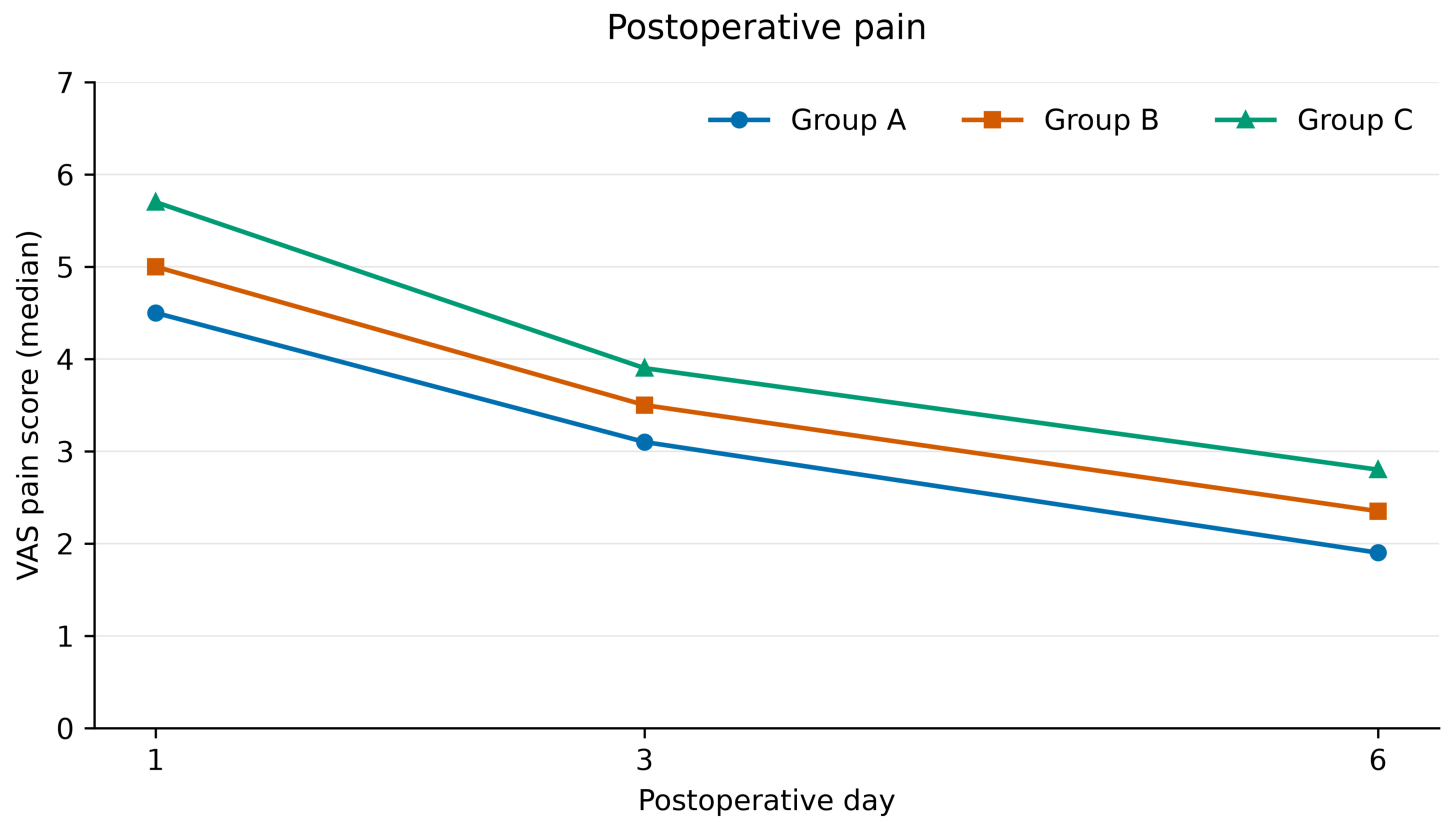


Figure 3

Changes in postoperative VAS pain scores.

Points represent group medians on postoperative days 1, 3, and 6; n = 100 per group. Connecting lines illustrate changes between observed time points. VAS, visual analog scale.

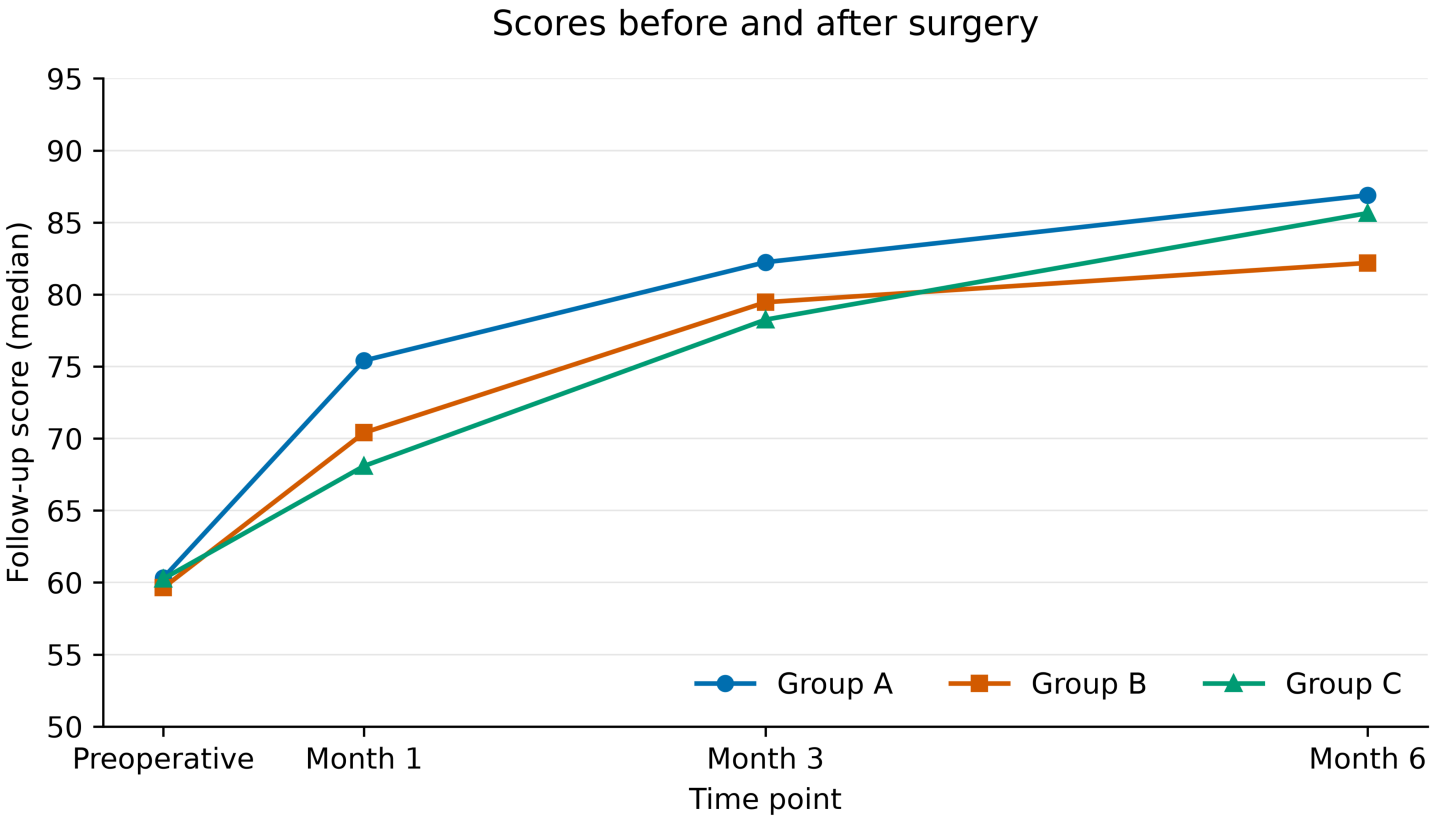


Figure 4

Changes in scores before and after surgery.

Points represent group medians before surgery and at 1, 3, and 6 months after surgery; n = 100 per group. Connecting lines illustrate changes between observed time points.

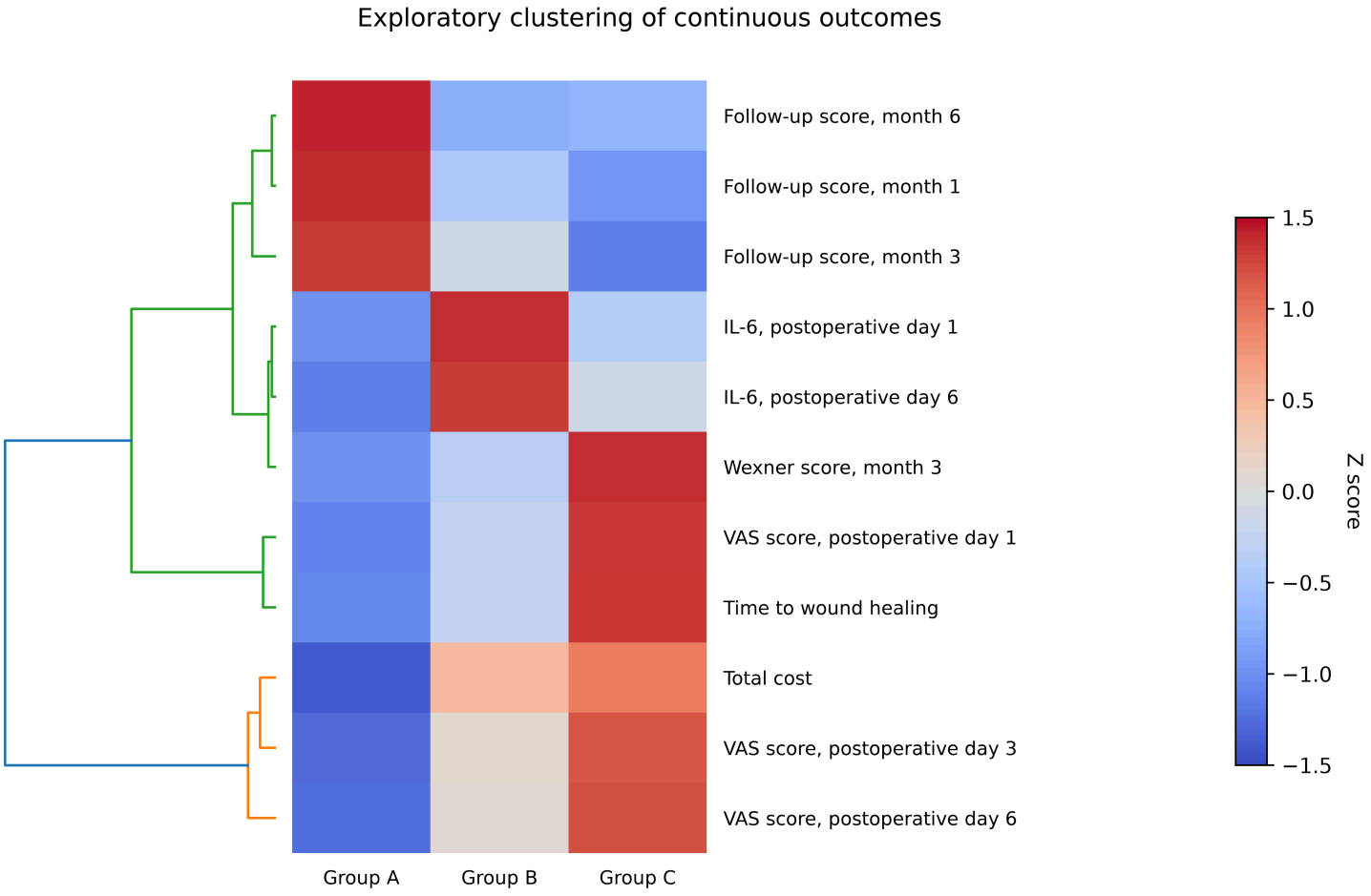


Figure 5

Exploratory cluster heatmap of continuous outcomes.

Colors represent standardized group means (Z scores). The dendrogram depicts similarity in group-level outcome patterns. Clustering is descriptive and is based on three group-level summaries per outcome. VAS, visual analog scale; IL-6, interleukin-6.