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A Randomized Controlled Study on Open Versus Closed Haemorrhoidectomy in Patients with Grade III and Grade IV Haemorrhoids

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KEYWORDS

Open haemorrhoidectomy, Closed haemorrhoidectomy, Haemorrhoids, Haemorrhoids, Postoperative pain, Wound healing

ABSTRACT:

Background: Haemorrhoidectomy is a common surgical procedure aimed at treating symptomatic haemorrhoids (approximately 10% of cases require surgical intervention).

Objectives: To compare the surgical outcomes of open vs closed haemorrhoidectomy – including postoperative complications such as pain, infection, and wound healing rates; duration of surgery; and length of postoperative hospital stay.

Methods: This was a hospital based, prospective experimental study – randomized controlled study design conducted in the outpatient department and/or inpatient wards of the Department of General Surgery, Aarupadai Veedu Medical College and Hospital, a tertiary healthcare facility in Puducherry, India between June 2022 and June 2024.

Results: In this study, 64 patients were randomized into two groups: 32 underwent open haemorrhoidectomy (Group A) and 32 underwent closed haemorrhoidectomy (Group B). Both groups had similar demographic and clinical characteristics, with no significant differences in age, sex, or presenting symptoms. The mean age was 44.3 years in Group A and 45.8 years in Group B. Most patients were aged 30-50 years, and the majority were male. The duration of surgery was significantly shorter in Group A (38.4 minutes) compared to Group B (46.4 minutes). Postoperative hospital stay was also significantly shorter in Group A (3.3 days) compared to Group B (4.9 days). Pain levels (VAS scores) showed no significant difference on day 1, but Group A reported significantly lower pain from day 3 onwards. Bleeding and infection rates were significantly lower in Group A on day 1, day 3, and week 1. Fever rates were significantly lower in Group A on day 3 and week 1. Wound healing rates were significantly higher in Group A on day 3, week 1, week 2, and month 1. By month 3, the wound healing rates were similar in both groups.

Conclusion: Open haemorrhoidectomy resulted in shorter surgery and hospital stays, less postoperative pain, lower rates of bleeding, infection, and fever, and faster wound healing compared to closed haemorrhoidectomy.

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Introduction

Haemorrhoidectomy is a common surgical procedure aimed at treating symptomatic haemorrhoids (approximately 10% of cases require surgical intervention),(1) which are swollen blood vessels in the lower rectum and anus.(2) The true prevalence in the general population remains unclear, partly because many patients do not seek treatment.(3) Haemorrhoids consist of columns of vascular connective tissue within the anal submucosa, aiding in maintaining continence and adding bulk to the anal canal.(4) The pathophysiology is largely unknown, but the current understanding is that haemorrhoids develop due to the deterioration and decay of vascular cushions.(5, 6) The three primary haemorrhoidal columns are located at the left lateral, right posterolateral, and right anterolateral positions.(7) Based on their location relative to the dentate line, haemorrhoids can be classified as internal or external. The condition can cause significant discomfort, bleeding, and pain, necessitating medical intervention when conservative treatments fail.(8)

External haemorrhoids are typically asymptomatic unless they become thrombosed, due to their innervation by somatic nerves.(9) Haemorrhoids can be treated conservatively or surgically depending on whether they are internal or external and the degree of prolapse.(10) The most effective treatment for symptomatic, recurrent grade-I and grade-IV haemorrhoids is surgical excision.(11) Surgical approaches to haemorrhoidectomy primarily include the open (Milligan-Morgan) and closed (Ferguson) techniques.(12) These methods differ fundamentally in the handling of the surgical wound, with the open technique leaving the wound open to heal by secondary intention, while the closed technique involves suturing the wound for primary intention healing.(13)

The open haemorrhoidectomy, introduced by Milligan and Morgan in 1937, has long been a cornerstone of haemorrhoid surgery.(14) This technique involves excising the haemorrhoidal tissue and allowing the wound to heal by secondary intention. The benefits of this approach include reduced risk of wound infection and less technical complexity, which can be particularly advantageous in settings with limited resources or where rapid surgical intervention is necessary.(15) In contrast, the closed haemorrhoidectomy, popularized by Ferguson in 1959, entails excising the haemorrhoidal tissue and then suturing the wound closed. This method is intended to reduce postoperative pain and hasten wound healing.(16) However, the closed technique has been associated with higher rates of wound infection due to the presence of sutures and the potential for increased tissue handling during the procedure.(17)

Given the differing methodologies and purported benefits and drawbacks of each technique, there is ongoing debate in the medical community regarding the optimal approach to haemorrhoidectomy. Comparative studies are essential to elucidate the relative efficacy and safety of these techniques, particularly concerning postoperative outcomes such as pain, infection, wound healing, duration of surgery, and length of hospital stay.(17) Against this background, the aim of the present study was to compare the surgical outcomes of open vs closed haemorrhoidectomy – including postoperative complications such as pain, infection, and wound healing rates; duration of surgery; and length of postoperative hospital stay.

Materials and Methods

This was a hospital based, prospective experimental study – randomized controlled study design conducted in the outpatient department and/or inpatient wards of the Department of General Surgery, Aarupadai Veedu Medical College and Hospital, a tertiary healthcare facility in Puducherry, India between June 2022 and June 2024. The study was approved by the Institutional Human Ethics Committee (IHEC), Aarupadai Veedu Medical College, Puducherry. The participants were given the Participant Information Sheet (PIS) in their native language, and its contents were verbally explained to ensure their understanding and satisfaction. Enrolment into the study proceeded upon receipt of written informed consent. All patients between 20 and 70 years of age, of both gender, with grade III and/or grade IV haemorrhoids were enrolled in the study. However, patients with haemorrhoids associated with other perianal conditions including fissure in ano, fistula in ano, and perianal infections; with irritable bowel disease (IBD); and haemorrhoids associated with malignancy were excluded.

Shaikh et al.(18) (2013) compared the operative outcomes of Milligan-Morgan and Ferguson techniques

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for haemorrhoidectomy. Using the effect sizes noted in this study, considering the level of significance to be 5%, power to be 80% (or 20% type II error), and attrition rate (non-response rate) to be 10%, the minimum required sample size was computed to be 64 – 32 in each group with 95% confidence. We used nonprobability sampling – convenience sampling technique to recruit the patients. However, to allot patients randomly into Groups A (operated with open haemorrhoidectomy) and B (operated with closed haemorrhoidectomy), simple randomization was done – computer generated random numbers (with the help of an independent statistician, not aware of the research hypothesis) were used. A detailed history was taken, and a general physical and clinical examination, including digital rectal examination and proctoscopic examination, was conducted. Patients were followed up on postoperative day 1, day 3, week 1, week 2, and month 1. Outcomes of interest (visual analogue scale (VAS) scores, bleeding, pus, wound healing rate, and fever) were observed, noted, and compared between the two groups.

Statistical analysis: The data obtained was manually entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) v23. All the categorical variables were summarised using frequencies and percentages. Continuous variables were summarized using mean (standard deviation) and/or median (interquartile range) (based on the results of data normality, tested using Kolmogorov–Smirnov test and the Shapiro–Wilk test). To test for statistical significance, Chi square test or Fisher exact test (for categorical variables) and independent "t" test or Mann Whitney U test (for continuous variables) was used. Statistical significance was considered at p value less than 0.05.

Results

A total of 87 patients were assessed for eligibility. However, 23 patients were excluded, and the remaining 64 patients were randomised in two groups – 32 patients in Group A (operated with open haemorrhoidectomy) and 32 patients in Group B (operated with closed haemorrhoidectomy) **(Figure 1)**. The mean (SD) age of the patients in Group A was 44.3 years (8.1) and that among patients in Group B was 45.8 years (9.7). Majority of the patients in Group A (65.6%) and that in Group B (71.9%) were between 30 and 50 years of age. Importantly, the study groups did not vary significantly by age ($p>0.05$). The proportion of males in Group A was 81.3% ad that in Group B was 84.4% ($p>0.05$). The most common presenting symptom was bleeding per rectum (78.1%), followed by straining at defecation (73.4%), mass per rectum (62.5%), constipation (48.4%), and painful defecation (45.3%). The distribution of presenting symptoms were similar across the study groups – did not vary significantly ($p>0.05$). The mean (SD) pulse rate, systolic blood pressure and diastolic blood pressure among patients in Group A was 87.8 per minute (9.2), 139.5 mmHg (15.6), and 88.3 mmHg (7.2) respectively; among patients in Group B was 88.4 per minute (10.5), 137.2 mmHg (14.3), and 88.5 mmHg (6.8), respectively ($p>0.05$) **(Table 1)**.

Among 32 patients in Group A, 26 (81.2%) had grade III and 6 patients (18.8%) had grade IV haemorrhoids. Similarly, among 32 patients in Group B, 24 patients (75.0%) had grade III and 8 (25.0%) patients had grade IV haemorrhoids ($p>0.05$). Based on the position of haemorrhoids, in Group A 50.0% had left lateral, 31.2% had right posterior, and 18.8% had right anterior haemorrhoids. Similarly, in Group B 56.3% had left lateral, 28.1% had right posterior, and 15.6% had right anterior haemorrhoids ($p>0.05$).

The mean (SD) levels of haemoglobin was 11.3 (1.8), total leucocyte count was 21023.1 (10595.9), neutrophil count was 6487.4 (969.4), lymphocyte count was 4608.2 (794.9), platelet count was 160907.1 (109713.8), erythrocyte sedimentation rate was 14.0 (6.9), random blood sugar was 179.6 (78.1), blood urea was 47.7 (16.8), and serum creatinine was 1.7 (0.9). The results of test of association showed that the none of laboratory investigation varied significantly between the study groups ($p>0.05$).

Comparison of study groups by outcomes of interest: The mean (SD) duration of surgery among patients in Group A was 38.4 minutes (7.3), and that among patients in Group B was 46.4 minutes (7.9) – the duration of surgery was significantly ($p<0.05$) lower in Group A, in comparison with Group B. The mean (SD) duration of postoperative hospital stay among patients in Group A was 3.3 days (1.3), and that among patients in Group B was 4.9 days (0.8) – the duration of postoperative hospital stay was significantly ($p<0.05$) lower among patients in Group A, in comparison with patients in Group B **(Table 2)**.

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The mean (SD) VAS scores among patients in Group A and Group B were 8.8 (0.7) and 8.6 (0.9) at day 1; 7.4 (0.2) and 8.2 (0.6) at day 3; 6.4 (0.4) and 6.9 (0.5) at week 1; 4.9 (0.7) and 5.4 (0.3) at week 2; 3.1 (0.6) and 3.4 (0.7) at month 1; 1.2 (0.2) and 2.0 (0.5) at month 3. The VAS scores did not vary significantly between that study groups at day 1 ($p>0.05$), however, the scores were significantly different at day 3, week 1, week 2, month 1 and month 3 ($p<0.05$) **(Figure 2)**. The proportion of patients with bleeding in Group A and Group B were 31.3% and 56.3% at day 1; 18.8% and 46.9% at day 3; 6.3% and 28.1% at week 1; 3.1% and 15.6% at week 2; 0.0% and 3.1% at month 1; 0.0% and 0.0% at month 3. The test of association showed that the proportion of patients with bleeding were significantly lower in Group A, in comparison with Group B at day 1, day 3, and week 1 ($p<0.05$). However, the difference was not statistically significant at week 2, month 1 and month 3 ($p>0.05$).

The proportion of patients with infections in Group A and Group B were 40.6% and 62.5% at day 1; 12.5% and 40.6% at day 3; 9.4% and 31.3% at week 1; 3.1% and 18.8% at week 2; 0.0% and 9.4% at month 1; 0.0% and 0.0% at month 3. The test of association showed that the proportion of patients with infections in Group A and Group B varied significantly (significantly lower in Group A) at day 3, week 1, and week 2 ($p<0.05$) **(Table 3)**. However, the difference was not statistically significant at day 1, month 1 and month 3 ($p>0.05$). The results showed that the proportion of patients with fever in Group A and Group B were 53.1% and 71.9% at day 1; 31.3% and 59.4% at day 3; 6.3% and 18.8% at week 1; 0.0% and 12.5% at week 2; 0.0% and 6.3% at month 1; 0.0% and 0.0% at month 3. The test of association showed that the proportion of patients with fever were significantly lower in Group A, in comparison with Group B at day 3 and week 1 ($p<0.05$). However, the proportion of patients with fever did not vary significantly between the study groups at day 1, week 2, month 1, and month 3 ($p>0.05$).

The results showed that the proportion of patients in Group A and Group B with wound healing were 0.0% and 0.0% at day 1; 43.8% and 18.8% at day 3; 78.1% and 56.3% at week 1; 96.9% and 71.9% at week 2; 100% and 84.4% at month 1; 100% and 96.9% at month 3. The test of association showed that the wound healing rates were significantly higher in Group A, in comparison with Group B at day 3, week 1, week 3, and month 1 ($p<0.05$). However, the difference was not statistically significant at month 3 ($p>0.05$).

Discussion

The aim of the present study was to compare the surgical outcomes of open vs closed haemorrhoidectomy. The demographic characteristics of the patients in the present study were well-matched between the two groups. The mean age of patients undergoing open haemorrhoidectomy (Group A) was 44.3 years, while those undergoing closed haemorrhoidectomy (Group B) had a mean age of 45.8 years. This similarity in age distribution between the groups suggests that age did not confound the comparison of surgical outcomes between open and closed haemorrhoidectomy.(19) Consistent age matching is crucial as it mitigates the influence of age-related physiological differences on postoperative recovery and complication rates.(20) Similarly, the gender distribution was comparable between the groups, with a predominance of males (81.3% in Group A and 84.4% in Group B). The lack of significant variation in gender is essential because gender differences can influence pain perception and wound healing rates, potentially confounding the study outcomes (Fillingim et al. (2009); Bartley et al. (2013)).(21, 22)

The presenting symptoms were also evenly distributed across both groups, with bleeding per rectum being the most common symptom (78.1%). This consistency in symptom distribution suggests that the severity and clinical presentation of haemorrhoids were similar in both groups, providing a reliable basis for comparing the efficacy and safety of the two surgical techniques.(23) The hemodynamic parameters, including pulse rate, systolic blood pressure, and diastolic blood pressure, did not differ significantly between the groups. These parameters are indicative of the patients' baseline physiological status and their ability to withstand surgery and recover postoperatively. The comparable values of these parameters in both groups suggest that both groups were similarly fit for surgery (Banov et al. (1985)).(24)

The findings of the present study align with previous research comparing open and closed haemorrhoidectomy.(18) Studies have generally found that both techniques are effective for treating Grade III and IV haemorrhoids but may differ in terms of specific

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outcomes such as postoperative pain, healing time, and complications. For instance, a study by Shaikh et al.(18) (2013) found no significant difference in the overall success rates between the Milligan-Morgan (open) and Ferguson (closed) techniques, though the closed technique was associated with a slightly faster healing time and less postoperative pain.(18) The baseline laboratory parameters, including haemoglobin levels, total leukocyte count, neutrophil count, lymphocyte count, platelet count, erythrocyte sedimentation rate, random blood sugar, blood urea, and serum creatinine, did not show significant differences between the two groups.(25) This homogeneity suggests that both groups had similar preoperative health statuses, which is important for ensuring that the observed differences in surgical outcomes are attributable to the surgical techniques themselves rather than underlying health disparities.

The duration of surgery was significantly shorter for open haemorrhoidectomy (Group A) compared to closed haemorrhoidectomy (Group B) (38.4 minutes vs. 46.4 minutes). This finding is consistent with previous studies that have shown open haemorrhoidectomy to be a quicker procedure. For instance, a study by You et al.(26) (2005) reported that open haemorrhoidectomy generally takes less time due to the more straightforward nature of the procedure compared to the suturing required in closed haemorrhoidectomy. The shorter duration of surgery in open haemorrhoidectomy can be advantageous in reducing the overall operating room time and potentially lowering the risk of intraoperative complications associated with prolonged surgery.(27) Patients undergoing open haemorrhoidectomy had a significantly shorter postoperative hospital stay compared to those undergoing closed haemorrhoidectomy (3.3 days vs. 4.9 days). This is in line with findings from a study by Nisar et al.(28) (2004), which demonstrated that open haemorrhoidectomy patients often have a faster initial recovery period, leading to shorter hospital stays.(28) The quicker discharge time for open haemorrhoidectomy patients can be attributed to the less complex nature of wound management and potentially fewer immediate postoperative complications.(29)

The VAS scores indicate that pain levels in the immediate postoperative period were high for both open (Group A) and closed (Group B) haemorrhoidectomy. On day 1, the pain scores were similar between the two groups. However, from day 3 onwards, pain scores were significantly lower in the open haemorrhoidectomy group compared to the closed haemorrhoidectomy group. This trend continued through week 1, week 2, month 1, and month 3. This finding aligns with previous research by Arbman et al.(16) (2000), which suggests that although closed haemorrhoidectomy might initially be perceived as less invasive due to the sutured wound, it may result in more prolonged pain due to the tension and potential infection associated with sutures.(30)

The incidence of postoperative bleeding was consistently higher in the closed haemorrhoidectomy group at early postoperative intervals (day 1, day 3, and week 1). The higher bleeding rates in the closed haemorrhoidectomy group can be attributed to the suturing technique, which might predispose patients to bleeding due to the tension on the suture lines and potential for suture line dehiscence. This observation is supported by a study by Sayfan et al.(31) (2001), which highlighted the increased risk of postoperative bleeding in closed haemorrhoidectomy due to suturing-related complications.

Postoperative infection rates were significantly lower in the open haemorrhoidectomy group at multiple time points (day 3, week 1, and week 2). The lower infection rates in the open haemorrhoidectomy group might be due to better wound drainage and reduced tissue handling, as sutures are not involved. The closed technique's higher infection rates could be due to the closed wound environment, which may favour bacterial growth. These findings are consistent with research by Mik et al.(32) (2008), which reported higher infection rates in closed haemorrhoidectomy due to the enclosed wound environment created by suturing. The results of this study have important clinical implications for the choice of surgical technique for haemorrhoidectomy. While both techniques are effective, the open haemorrhoidectomy seems to have advantages in terms of reduced postoperative pain, lower incidence of bleeding, and fewer infections. These findings suggest that, despite the initial higher pain scores, open haemorrhoidectomy may be preferable for its better overall postoperative outcomes.

The present study observed that the proportion of patients experiencing fever postoperatively was significantly

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lower in the open haemorrhoidectomy group (Group A) compared to the closed haemorrhoidectomy group (Group B) at day 3 and week 1. The higher fever rates in the closed haemorrhoidectomy group could be attributed to the increased incidence of infection noted in this group, as fever is often a marker of postoperative infection. This finding is consistent with existing literature, such as the study by Mikuni et al.(33) (2002), which reported higher postoperative fever rates in patients undergoing closed haemorrhoidectomy due to a greater propensity for infection in a sutured wound environment.

Wound healing rates were significantly better in the open haemorrhoidectomy group at various time points. The improved wound healing observed in the open haemorrhoidectomy group may be due to better wound drainage and reduced risk of suture-related complications. Open wounds, while initially more painful, allow for natural drainage and are less likely to trap bacteria and debris, thereby promoting faster healing. This observation is corroborated by Kheng-Seong et al.(34) (2020), who found that open haemorrhoidectomy facilitates quicker wound healing due to reduced tension and better drainage. The findings of this study suggest that open haemorrhoidectomy may be preferable to closed haemorrhoidectomy in terms of postoperative recovery, particularly regarding fever incidence and wound healing. Although the closed technique might offer the theoretical advantage of a sutured, potentially more cosmetically appealing wound, the clinical outcomes in terms of infection and healing seem to favour the open technique.

From a clinical standpoint, surgeons should consider the trade-offs between initial postoperative pain and longer-term recovery benefits. While open haemorrhoidectomy might result in higher immediate postoperative pain, the overall recovery trajectory, including lower rates of fever, better wound healing, and fewer infections, appears to be more favourable. The present study is not without limitations. It includes single-centre study limiting the generalizability of findings, short follow-up period, non-probability sampling technique, lack of blinding, and subjective pain measurement.

Conclusion

The study demonstrated several key findings that highlight the advantages of open haemorrhoidectomy over closed haemorrhoidectomy. Notably, patients who underwent open haemorrhoidectomy experienced significantly less postoperative pain at later follow-up points, specifically on day 3, week 1, week 2, month 1, and month 3, compared to those who had closed haemorrhoidectomy. Additionally, the incidence of postoperative bleeding was significantly lower in the open haemorrhoidectomy group at early time points, including day 1, day 3, and week 1. Furthermore, the study found that the proportion of patients experiencing postoperative infections was significantly lower in the open haemorrhoidectomy group at day 3, week 1, and week 2. Fewer patients in this group also experienced fever at day 3 and week 1. The open haemorrhoidectomy group exhibited significantly faster wound healing rates at day 3, week 1, week 2, and month 1. In terms of procedural efficiency, the duration of surgery and postoperative hospital stay were significantly shorter for patients undergoing open haemorrhoidectomy.

Overall, the study contributes significantly to the body of evidence guiding the choice of surgical technique for treating grade III and IV haemorrhoids. These insights have the potential to influence clinical practice by enhancing patient outcomes and reducing postoperative complications.

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Table 1: Baseline characteristics of patients in the study groups

		Open N = 32	**Closed N = 32**	**Total N = 64**	**p value**
		n (%)	**n (%)**	**n (%)**	
Age (in years) *Mean (SD)*		44.3 (8.1)	45.8 (9.7)	45.1 (8.9)	0.504
Age (in years)	≤30	3 (9.4)	2 (6.2)	5 (7.8)	0.836
	30 to 50	21 (65.6)	23 (71.9)	44 (68.8)	
	>50	8 (25.0)	7 (21.9)	15 (23.4)	
Gender	Male	26 (81.3)	27 (84.4)	53 (82.8)	0.740
	Female	6 (18.7)	5 (15.6)	11 (17.2)	
Presenting symptoms *(the numbers are not mutually exclusive)*	Bleeding per rectum	24 (75.0)	26 (81.2)	50 (78.1)	0.836
	Mass per rectum	19 (59.4)	21 (65.6)	40 (62.5)	
	Straining at defecation	24 (75.0)	23 (71.9)	47 (73.4)	
	Painful defecation	12 (37.5)	17 (53.1)	29 (45.3)	
	Constipation	16 (50.0)	15 (46.9)	31 (48.4)	
	Discharge per rectum	9 (28.1)	7 (21.9)	16 (25.0)	
	Anal irritation	7 (21.9)	6 (18.8)	13 (20.3)	
Pulse rate		87.8 (9.2)	88.4 (10.5)	88.1 (9.9)	0.809
Systolic BP		139.5 (15.6)	137.2 (14.3)	138.4 (14.9)	0.541
Diastolic BP		88.3 (7.2)	88.5 (6.8)	88.4 (7.0)	0.909
Haemorrhoids					
Grade	III	26 (81.2)	24 (75.0)	50 (78.1)	0.545
	IV	6 (18.8)	8 (25.0)	14 (21.9)	
Position	Left lateral	16 (50.0)	18 (56.3)	34 (53.1)	0.878
	Right posterior	10 (31.2)	9 (28.1)	19 (29.7)	
	Right anterior	6 (18.8)	5 (15.6)	11 (17.2)	
Laboratory investigations					
Haemoglobin		11.0 (1.8)	11.5 (1.9)	11.3 (1.8)	0.284
Total leucocyte count		22492.5 (11621.1)	19662.6 (9418.7)	21023.1 (10595.9)	0.289
Neutrophils		6300.2 (938.4)	6674.6 (1000.3)	6487.4 (969.4)	0.128
Lymphocytes		4483.5 (738.4)	4732.8 (851.4)	4608.2 (794.9)	0.216
Platelets		148126.7 (108197.4)	172740.7 (110445.9)	160907.1 (109713.8)	0.371

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ESR	14.2 (6.2)	13.8 (7.5)	14.0 (6.9)	0.817
RBS	170.0 (70.4)	188.4 (85.8)	179.6 (78.1)	0.817
Blood urea	49.6 (16.3)	46.0 (16.9)	47.7 (16.8)	0.389
Serum creatinine	1.8 (1.0)	1.6 (0.8)	1.7 (0.9)	0.380
*Statistically significant at p<0.05 SD, Standard deviation				

Table 2: Distribution of patients, by duration of surgery and postoperative hospital stay

	Open N = 32	**Closed N = 32**	**Total N = 64**	**p value**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Duration of surgery (in minutes)	38.4 (7.3)	46.4 (7.9)	42.4 (7.6)	<0.001*
Duration of postoperative hospital stay (in days)	3.3 (1.3)	4.9 (0.8)	4.1 (1.1)	<0.001*
*Statistically significant at p<0.05				

Table 3: Comparison of study groups, by rates of infection/pus and presence or absence of fever

		Open N = 32	**Closed N = 32**	**Total N = 64**	**p value**
		n (%)	**n (%)**	**n (%)**	
Infection	Day 1	13 (40.6)	20 (62.5)	33 (51.6)	0.079
	Day 3	4 (12.5)	13 (40.6)	17 (26.6)	0.011*
	Week 1	3 (9.4)	10 (31.3)	13 (20.3)	0.029*
	Week 2	1 (3.1)	6 (18.8)	7 (10.9)	0.045*
	Month 1	0 (0.0)	3 (9.4)	3 (4.7)	0.302
	Month 3	0 (0.0)	0 (0.0)	0 (0.0)	1.000
Fever	Day 1	17 (53.1)	23 (71.9)	40 (62.5)	0.121
	Day 3	10 (31.3)	19 (59.4)	29 (45.3)	0.024*
	Week 1	2 (6.3)	6 (18.8)	8 (12.5)	0.044*
	Week 2	0 (0.0)	4 (12.5)	4 (6.3)	0.316
	Month 1	0 (0.0)	2 (6.3)	2 (3.1)	0.301
	Month 3	0 (0.0)	0 (0.0)	0 (0.0)	1.000
*Statistically significant at p<0.05					

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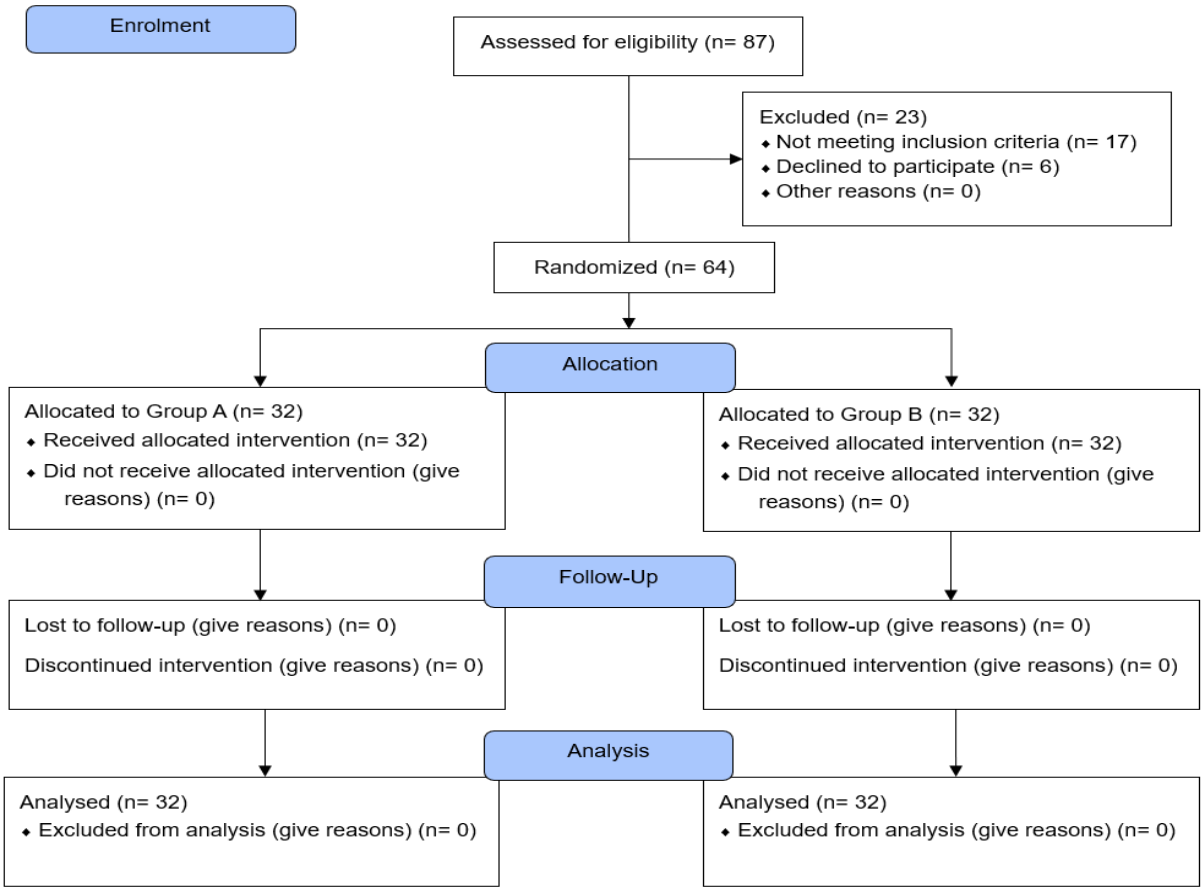
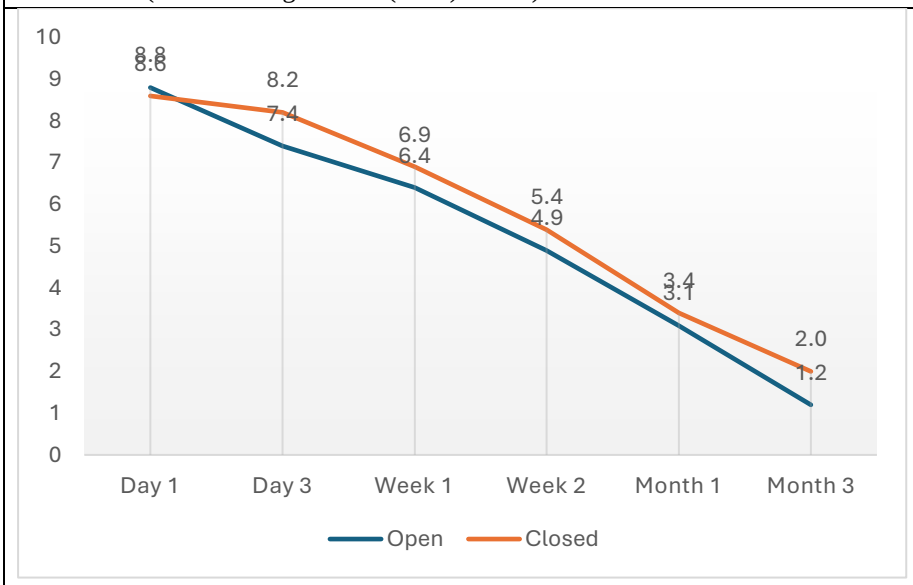


Figure 1: CONSORT flow diagram

Pain scores (visual analogue scale (VAS) scores)

Bleeding

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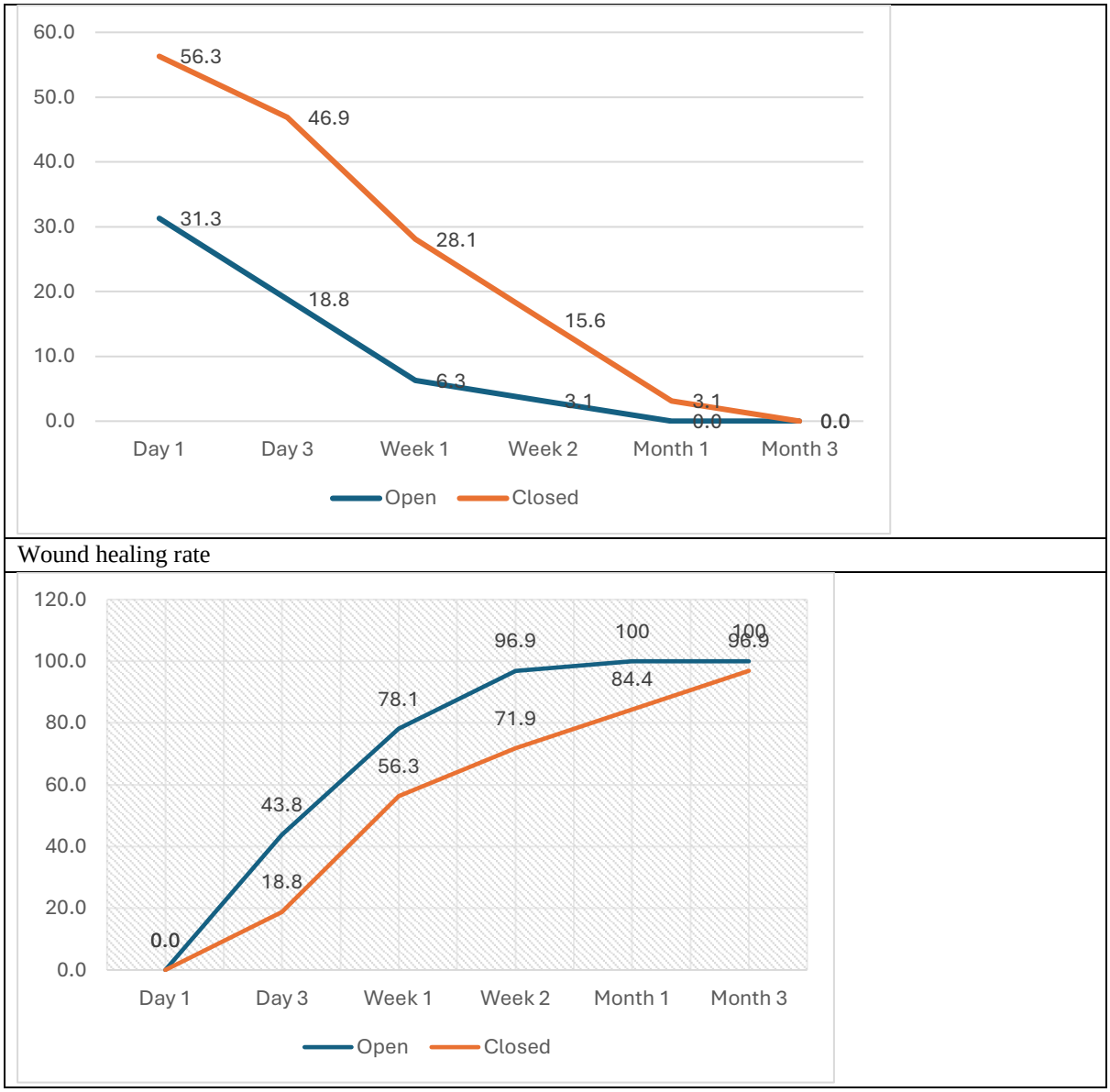

Figure 2: Comparison of study groups, by pain scores, bleeding, and wound healing rate

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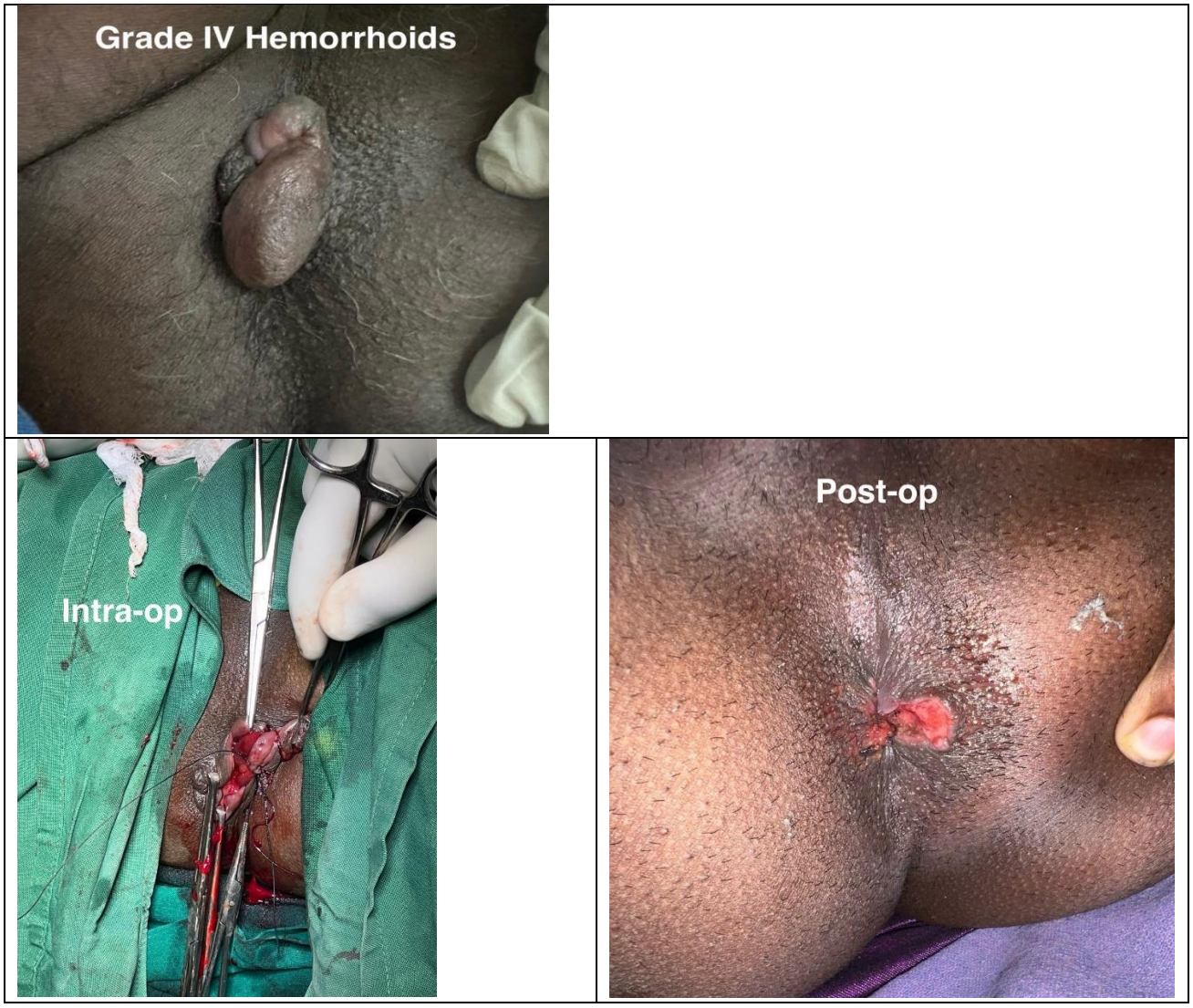

Figure 3: Preoperative, intraoperative and postoperative images