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Original Research Article

A Comparative Analysis of Flap-Based Reconstruction and Open Excision in the Treatment of Sacrococcygeal Pilonidal Sinus: An Observational Study

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Abstract:

Background: Sacrococcygeal pilonidal sinus is a chronic inflammatory condition of the natal cleft that commonly affects young adults and is associated with pain, discharge, recurrent infection, and loss of productivity. Various surgical techniques are available for its management, with open excision and flap-based procedures being among the most commonly performed approaches. Objective: To compare the outcomes of flap surgery and open surgery in the management of sacrococcygeal pilonidal sinus.

Materials and Methods: This ambispective observational study was conducted in the Department of General Surgery, District Hospital, Sawai Madhopur, and Rajasthan. A total of 58 patients with sacrococcygeal pilonidal sinus were included, of whom 21 underwent flap surgery and 37 underwent open surgery with excision and secondary wound healing. Parameters evaluated included operative duration, wound healing time, hospital stay, return to normal activity, postoperative pain, patient satisfaction, and postoperative complications.

Results: The mean operative duration was significantly higher in the flap surgery group than in the open surgery group (48.2±7.6 vs 22.4±5.1 minutes; $p<0.001$). However, wound healing time (16.8±3.5 vs 42.6±10.4 days; $p<0.001$) and return to normal activity (17.4±4.2 vs 37.5±10.2 days; $p<0.001$) were significantly shorter in the flap surgery group. Postoperative pain scores were significantly lower and patient satisfaction scores were significantly higher in the flap surgery group at all follow-up intervals ($p<0.001$).

Conclusion: Flap surgery was associated with faster wound healing, earlier return to normal activity, lower postoperative pain, and higher patient satisfaction compared with open surgery. Despite a longer operative duration, flap surgery may be considered a preferred surgical option.

Keywords: Sacrococcygeal pilonidal sinus, Flap surgery, Open surgery, Wound healing, Postoperative outcomes.

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Introduction

Sacrococcygeal pilonidal sinus disease is a chronic inflammatory condition involving the skin and subcutaneous tissue of the natal cleft. It is an acquired condition resulting from the penetration of loose hair into the skin of the natal cleft, leading to a foreign body reaction, chronic inflammation, sinus formation, and recurrent infection. [1]

The disease may present as an asymptomatic pit, chronic discharging sinus, recurrent abscess, or persistent painful swelling in the sacrococcygeal region. Because it commonly affects young and otherwise healthy individuals, the condition is associated with considerable morbidity, repeated hospital visits, loss of productivity, and impaired quality of life. [2] The reported incidence of pilonidal sinus is approximately 26 cases per 100,000 population annually, although the incidence varies across different geographical regions. [3,4] The overall incidence increased from 26.1 to 39.6 per 100,000 person-years between 1996 and 2021, with the highest incidence observed among young adults. [5] A large German population-based study demonstrated a one-third increase in the incidence of pilonidal disease over a 12-year period. [6]

The disease predominantly affects adolescents and young adults, particularly those between 15 and 30 years of age. A marked male predominance has consistently been reported, with male-to-female ratios ranging from 2:1 to 4:1.3 Several risk factors

have been identified, including obesity, excessive body hair, prolonged sitting, poor local hygiene, deep natal cleft anatomy, family history, and sedentary lifestyle. [7]

The estimated prevalence of pilonidal disease in Asia, including India, to be approximately 6.6% in certain populations. [8,9] Rapid urbanization, increasing sedentary occupations, prolonged sitting associated with office-based work, and changing lifestyle patterns may be contributing to the growing burden of pilonidal disease in the Indian population. [8]

The pathogenesis of pilonidal sinus disease has evolved considerably over time. Earlier theories proposed a congenital origin resulting from developmental abnormalities in the sacrococcygeal region. Hair fragments are believed to penetrate vulnerable skin within the natal cleft, producing a foreign body reaction and chronic inflammatory response. Repeated friction, local trauma, moisture accumulation, and bacterial contamination promote sinus tract formation and recurrent infection. [1] The characteristic midline pits observed in pilonidal disease represent infected or obstructed hair follicles that serve as the starting point for disease progression.

Management of pilonidal sinus disease remains challenging because of the wide variety of available surgical techniques and the persistent risk of delayed healing and recurrence. The primary goals of treatment include complete eradication of disease, rapid wound healing, minimal postoperative pain, early return to normal activity, acceptable cosmetic outcomes, and prevention of recurrence. Numerous surgical approaches have been described, including incision and drainage, excision with secondary intention healing, marsupialization, primary closure, and various off-midline flap procedures such as Limberg flap, Karydakis flap, and other advancement or rotational flaps. [10]

Open excision with healing by secondary intention has traditionally been regarded as a simple and effective treatment method. The technique involves complete excision of the sinus tract while allowing the wound to heal gradually through granulation and epithelialization. [11] Higher healing time following open excision, highlighting one of the major limitations of this approach. [12]

To overcome these limitations, various flap-based procedures have been developed. These techniques not only remove diseased tissue but also flatten the natal cleft and shift the suture line away from the midline, thereby reducing hair accumulation, local friction, and moisture retention. Several studies have demonstrated improved postoperative outcomes with flap procedures. Despite the growing body of evidence supporting flap-based procedures, there remains variability in surgical practice, particularly in resource-limited settings and district hospitals where open excision continues to be widely performed. Furthermore, outcome data from Indian and Rajasthan-based healthcare settings remain limited. Therefore, the present study was undertaken to compare flap surgery and open surgery in the management of sacrococcygeal pilonidal sinus at a district hospital in Rajasthan.

Materials and Methods

The present study was conducted as an ambispective observational study to compare the outcomes of flap surgery and open surgery in the management of sacrococcygeal pilonidal sinus. The study was carried out in the Department of General Surgery, District Hospital, Sawai Madhopur, Rajasthan, India, after obtaining approval from the Institutional Ethics Committee. Data were collected during the period from January 2024 to June 2025 retrospectively from hospital records, and from July 2025 to December 2025 prospectively. An additional three months were allocated for follow-up of patients and data analysis. The hospital maintains a well-documented medical record system, which allowed reliable retrieval of patient information for retrospective assessment. Follow-up details of patients operated earlier during the study period were also obtained from the available hospital records and follow-up entries in the outpatient department register. For patients included prospectively, follow-up evaluation was carried out through scheduled outpatient visits and review of hospital records.

During the study period, a total of 70 patients with sacrococcygeal pilonidal sinus underwent surgical treatment at the study center. However, due to incomplete records and loss to follow-up, only 58 patients had complete clinical and follow-up data and were therefore included in the final analysis.

Among these, 21 patients underwent flap surgery, while 37 patients underwent open surgery with excision and secondary wound healing. Patients were included in the study if they were diagnosed with sacrococcygeal pilonidal sinus and underwent surgical treatment during the study period. Patients with recurrent pilonidal sinus disease, acute pilonidal abscess requiring emergency drainage, previous surgery in the sacrococcygeal region, or severe comorbid conditions affecting wound healing were excluded from the study.

Detailed demographic and clinical information was recorded for each patient. The data collected included age, sex, and presenting clinical features such as pain, discharge, swelling, and history of previous abscess episodes. All patients underwent a detailed clinical examination prior to surgical intervention. The type of surgical procedure was decided by the operating surgeon based on clinical assessment and standard surgical practice. Patients

were treated either by flap surgery or by open surgery with excision and secondary wound healing. Various perioperative and postoperative parameters were recorded to compare outcomes between the two groups. These included duration of surgery, time to wound healing, duration of hospital stay, and time required to return to normal activity. Postoperative pain was assessed using the Visual Analogue Scale (VAS) on postoperative day 1, day 5, and day 14. Patient satisfaction was evaluated during follow-up visits at 1 month, 3 months, and 6 months after surgery. Postoperative complications such as seroma formation, wound infection, delayed healing, flap necrosis, and recurrence were also recorded. All patients were followed up through outpatient visits and review of hospital records to assess wound healing, postoperative pain, complications, and patient satisfaction.

Statistical Analysis: The collected data were entered in Microsoft Excel and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. The Chi-square test was used to compare categorical variables between the two groups, while the independent t-test was used to compare continuous variables.

A p-value less than 0.05 was considered statistically significant.

Results

[Table-1] In the present study, a total of 58 patients with sacrococcygeal pilonidal sinus were included, of whom 21 patients underwent flap surgery and 37 patients underwent open surgery. Most patients belonged to the 31–40 years age group, followed by the 41–50 years age group. The majority of patients were male, accounting for 72.4% of the study population. Pain was present in all patients, while discharge and swelling were observed in a large proportion of cases. A previous abscess episode was reported in 20.7% of patients. The distribution of demographic and clinical variables was comparable between the two groups ($p > 0.05$).

[Table-2] In the present study, the mean duration of surgery was significantly higher in the flap surgery group compared with the open surgery group (48.2±7.6 vs 22.4±5.1 minutes; $p<0.001$). The mean time to wound healing and time required to return to normal activity were significantly lower in the flap surgery group than in the open surgery group (16.8±3.5 vs 42.6±10.4 days and 17.4±4.2 vs 37.5±10.2 days, respectively; $p<0.001$). However, the mean duration of hospital stay was significantly higher in the flap surgery group compared with the open surgery group (3.2±0.8 vs 2.1±0.6 days; $p<0.001$).

[Table-3] In the present study, postoperative pain assessed using the Visual Analogue Scale (VAS) was lower in the flap surgery group at all postoperative time intervals. The mean VAS scores on day 1, day 5, and day 14 were lower in the flap surgery group compared with the open surgery group, and the differences were statistically significant ($p < 0.001$). Patient satisfaction scores were also higher in the flap surgery group at all follow-up intervals. The mean satisfaction scores at 1 month, 3 months, and 6 months were 7.5±1.0, 8.4±0.9, and 9.1±0.7 in the flap surgery group compared to 5.4±1.2, 6.7±1.1, and 7.8±0.9 in the open surgery group, and the differences were statistically significant ($p<0.001$).

[Table-4] In the present study, seroma formation was observed in 2 patients (9.5%) in the flap surgery group, whereas no cases were reported in the open surgery group ($p = 0.245$). Wound infection, delayed healing, and recurrence were more frequently observed in the open surgery group compared with the flap surgery group. No cases of flap necrosis were observed in either group. The differences in postoperative complication rates between the two groups were not statistically significant ($p>0.05$).

Table 1: Baseline demographic and clinical characteristics of patients in the flap surgery and open surgery groups

Variable	Flap Surgery (n=21)	Open Surgery (n=37)	Total	p value
Age group (years)				
18–30	5 (23.8%)	9 (24.3%)	14 (24.1%)	1.000
31–40	7 (33.3%)	14 (37.8%)	21 (36.2%)	
41–50	6 (28.6%)	9 (24.3%)	15 (25.9%)	
>50	3 (14.3%)	5 (13.5%)	8 (13.8%)	
Sex				
Male	15 (71.4%)	27 (73.0%)	42 (72.4%)	0.858
Female	6 (28.6%)	10 (27.0%)	16 (27.6%)	
Clinical feature				
Pain	21 (100%)	37 (100%)	58 (100%)	-
Discharge	20 (95.2%)	35 (94.6%)	55 (94.8%)	0.610
Swelling	8 (38.1%)	13 (35.1%)	21 (36.2%)	0.953
Previous abscess episode	4 (19.0%)	8 (21.6%)	12 (20.7%)	0.917

Table 2: Comparison of operative duration and postoperative recovery parameters between flap surgery and open surgery

Variable	Flap surgery	Open surgery	p value
Duration of surgery (minutes)	48.2 ± 7.6	22.4 ± 5.1	<0.001
Time to wound healing (days)	16.8 ± 3.5	42.6 ± 10.4	<0.001
Hospital stay (days)	3.2 ± 0.8	2.1 ± 0.6	<0.001
Return to normal activity (days)	17.4 ± 4.2	37.5 ± 10.2	<0.001

Table 3: Comparison of postoperative pain scores and patient satisfaction between the two surgical groups

Variable	Flap surgery	Open surgery	p value
Post-Op VAS Score			
Day 1	4.8 ± 1.0	6.2 ± 1.2	<0.001
Day 5	3.0 ± 0.8	4.6 ± 1.0	<0.001
Day 14	1.7 ± 0.7	3.0 ± 1.1	<0.001
Patient Satisfaction Score			
1 month	7.5 ± 1.0	5.4 ± 1.2	<0.001
3 months	8.4 ± 0.9	6.7 ± 1.1	<0.001
6 months	9.1 ± 0.7	7.8 ± 0.9	<0.001

Table 4: Postoperative complications observed in the flap surgery and open surgery groups

Complication	Flap surgery	Open surgery	p value
Seroma	2 (9.5%)	0 (0.0%)	0.245
Wound infection	1 (4.8%)	7 (18.9%)	0.269
Flap necrosis	0 (0.0%)	0 (0.0%)	-
Delayed healing	1 (4.8%)	9 (24.3%)	0.125
Recurrence	0 (0.0%)	2 (5.4%)	0.737

Discussion

In the present study, most patients belonged to the 31–40 years age group, 33.3% in flap surgery group and 37.8% in open surgery group. This finding is consistent with the known epidemiology of pilonidal sinus disease, which predominantly affects young adults. Similar observations were reported by Varnalidis et al [11], who studied 111 patients with a mean age of 25.1 years. Deepankar Saha et al [13], who reported a mean age of 26.4 years among 30 patients, Wadhawan et al [14], who reported mean ages ranging from 22 to 26 years across treatment groups, and Karaca et al [15], who reported a mean age of 25.01±11.02 years among 549 patients.

Males constituted 72.4% of the study population, with no significant difference between the flap surgery and open surgery groups (71.4% vs 73.0%; p=0.858). The observed male predominance is in agreement with the established epidemiological pattern of pilonidal sinus disease and is likely related to greater body hair density, deeper natal clefts, and prolonged sitting habits. Comparable findings were reported by Varnalidis et al [11], who observed 82.8% male patients, Deepankar Saha et al. (ROL-2), who reported 83.3% males, Chopade et al [16], who reported 76% males, and Karaca et al [15], who reported 84.3% male patients. Thus, the male predominance observed in the present study is in agreement with the majority of published literature. In present study, pain was present in all patients (100%), discharge was observed in 94.8% of patients, swelling in 36.2%, and a previous history of abscess in 20.7%. These findings reflect the chronic inflammatory and recurrent nature of the disease, where repeated hair penetration and local infection result in persistent pain, discharge, and occasional abscess formation. The distribution of these clinical features was comparable between the two study groups (p>0.05), indicating similar baseline disease characteristics and allowing meaningful comparison of postoperative outcomes.

Comparison of Operative Duration and Postoperative Recovery Parameters: In the present study, the mean duration of surgery was significantly higher in the flap surgery group compared with the open surgery group (48.2±7.6 vs 22.4±5.1 minutes; p<0.001). The longer operative duration in flap surgery is attributable to flap mobilization, reconstruction, and off-midline closure. Similar findings were reported by Karaca et al. (ROL-8), who observed a mean operative time of 59.64±7.76 minutes in the Limberg flap group compared with 27.26±6.41 minutes in the excision and primary closure group (p<0.001). Mohamed Sayed et al [17] also reported longer operative duration in the rhomboid flap group (54.35±14.42 minutes) than in the open excision group (42.95±9.98 minutes). Wadhawan et al [14] also reported that operative duration was longer in

patients undergoing rhomboid excision with Limberg flap closure. In our study, wound healing was significantly faster in the flap surgery group, with a mean healing time of 16.8±3.5 days compared with 42.6±10.4 days in the open surgery group (p<0.001). This may be explained by primary healing through well-vascularized tissue approximation in flap procedures, whereas open wounds heal by granulation and epithelialization. Similar findings were reported by Varnalidis et al [11], who observed healing times of 46.4 days following open excision, Chopade et al [16], who reported 20±2 days in the Limberg flap group versus 57±11 days in the open excision group, and Wadhawan et al [14], who reported complete healing in 20±8.22 days following Limberg flap reconstruction. Mohamed Sayed et al [17] also reported significantly shorter healing times in the rhomboid flap group (30.42±5.36 days) compared with the open excision group (75.75±9.12 days). Berthier et al [18] further demonstrated a mean reduction of 43.69 days in wound-healing time with flap procedures.

The mean hospital stay in the present study was significantly higher in the flap surgery group than in the open surgery group (3.2±0.8 vs 2.1±0.6 days; p<0.001). The slightly longer hospitalization in flap surgery may be related to postoperative monitoring of flap viability and wound integrity. Similar findings were reported by Berthier et al [18], who observed approximately one additional day of hospitalization following flap procedures. Karaca et al [15] reported hospital stays of 2.69±2.32 days in the Limberg flap group and 3.05±3.42 days in the excision and primary closure group, while Ekici et al [19] reported hospital stays ranging from 1.9 to 2.2 days across various surgical techniques.

The mean time required to return to normal activity was significantly lower in the flap surgery group compared with the open surgery group (17.4±4.2 vs 37.5±10.2 days; p<0.001). Faster recovery following flap surgery is likely due to earlier wound healing, reduced pain, and lower wound care requirements. Comparable findings were reported by Karaca et al [15], who observed return-to-work times of 16.31±3.86 days in the Limberg flap group and 33.25±7.42 days in the excision and primary closure group (p<0.001). Chopade et al [16] reported longer work loss in the open excision group, while Wadhawan et al. (ROL-3) reported incapacity for work of 9 days in the Limberg flap group compared with 26 days in the open surgery group. Mohamed Sayed et al [17] and Berthier et al [18] similarly demonstrated earlier return to work following flap procedures.

Comparison of Postoperative Pain Scores and Patient Satisfaction: In the present study, postoperative pain assessed using the Visual Analogue Scale (VAS) was significantly lower in the flap surgery group at all postoperative time intervals. The mean VAS score on postoperative day 1 was 4.8±1.0 in the flap surgery group compared with 6.2±1.2 in the open surgery group (p<0.001). On day 5, the scores decreased to 3.0±0.8 and 4.6±1.0, respectively (p<0.001), while on day 14, the mean VAS score was 1.7±0.7 in the flap surgery group compared with 3.0±1.1 in the open surgery group (p<0.001). The lower pain scores observed following flap surgery may be attributed to primary wound closure, reduced wound exposure, less tissue tension, and avoidance of prolonged dressing-related trauma associated with open wounds. Similar findings were reported by Wadhawan et al [14], who demonstrated significantly lower postoperative pain scores in patients undergoing rhomboid excision with Limberg flap closure compared with simple excision and open techniques (p<0.001). Chopade et al [16] also reported prolonged postoperative pain in the open excision group, with mean VAS scores of 3±0 and 1±0 even at one and two months after surgery. Mohamed Sayed et al [17] similarly observed lower pain scores among patients undergoing flap procedures than those treated with open excision. These findings indicate that flap procedures provide better postoperative comfort and faster pain resolution.

In the present study, patient satisfaction scores were significantly higher in the flap surgery group throughout follow-up. At one month, the mean satisfaction score was 7.5±1.0 in the flap surgery group compared with 5.4±1.2 in the open surgery group (p<0.001). At three months, the scores increased to 8.4±0.9 and 6.7±1.1, respectively (p<0.001), while at six months the mean satisfaction score was 9.1±0.7 in the flap surgery group compared with 7.8±0.9 in the open surgery group (p<0.001). Higher satisfaction following flap surgery may be explained by faster wound healing, earlier return to normal activity, lower postoperative pain, and reduced wound care requirements. Comparable findings were reported by Wadhawan et al [14], who observed the highest patient satisfaction scores in the Limberg flap group (3.3±0.44) compared with the primary closure group (2.5±0.5) and open surgery group (2.8±0.14). Mohamed Sayed et al [17] reported that 67% of patients undergoing rhomboid flap surgery were highly satisfied compared with 53% of patients undergoing open excision. Similarly, Berthier et al [18] demonstrated a trend toward improved quality of life and patient satisfaction following flap procedures. Karaca et al [15] also reported superior functional recovery in the Limberg flap group, with pain-free walking achieved in 12.36±3.74 days compared with 25.72±8.51 days and pain-free sitting achieved in 14.72±5.47 days compared with 28.54±6.71 days in the comparison group.

Postoperative Complications: In the present study, postoperative complications were evaluated in terms of seroma formation, wound infection, delayed healing, flap necrosis, and recurrence. Although some complications were more frequent in one group than the other, none of the differences were statistically significant ($p>0.05$).

Seroma formation was observed in 2 patients (9.5%) in the flap surgery group, whereas no cases were reported in the open surgery group ($p=0.245$). This may be related to flap mobilization and dead-space formation. Similar findings were reported by Ekici et al [19], who observed seroma rates of 7.0% in the Limberg flap group and 7.4% in the Karydakis flap group, while Wadhawan et al [14] also reported seroma following flap reconstruction.

Wound infection occurred in 1 patient (4.8%) in the flap surgery group and 7 patients (18.9%) in the open surgery group ($p=0.269$). Although not statistically significant, infection was nearly four times more common following open surgery, possibly due to prolonged wound exposure and repeated dressing changes. Wadhawan et al [14] reported wound infection in six patients undergoing simple excision compared with two patients in the Limberg flap group. Berthier et al [18] also demonstrated a lower risk of wound infection following flap procedures.

Delayed wound healing was observed in 1 patient (4.8%) in the flap surgery group and 9 patients (24.3%) in the open surgery group ($p=0.125$). Varnalidis et al [11] reported healing times of 46.4 days following open excision, and Chopade et al [16], who reported healing times of 57±11 days after open excision compared with 20±2 days following Limberg flap reconstruction. Wadhawan et al [14] similarly reported complete healing within 20±8.22 days following Limberg flap surgery. No cases of flap necrosis were observed in either group, indicating satisfactory surgical technique and flap vascularity.

Recurrence occurred in 2 patients (5.4%) in the open surgery group, whereas no recurrence was observed in the flap surgery group ($p=0.737$).

Although statistically non-significant, the absence of recurrence following flap surgery is clinically important. Wadhawan et al [14] reported one recurrence in the Limberg flap group compared with five recurrences in the simple excision group and three in the open surgery group. Karaca et al [15] reported recurrence rates of 7.1% after Limberg flap surgery and 9.2% after excision with primary closure, while Ekici et al [19] observed recurrence rates of 2.5–2.6% in flap procedures compared with 5.7–9.1% in non-flap procedures. Berthier et al [18] also demonstrated a significantly lower recurrence risk with flap procedures. The present study was conducted at a single center with a relatively small sample size, which may limit the generalizability of the findings. The follow-up period was also relatively short for assessing long-term recurrence. Larger multicentric studies with longer follow-up periods are recommended to validate the findings of the present study. Randomized controlled trials comparing flap surgery and open surgery may provide stronger evidence regarding the optimal surgical approach.

Conclusion

In the present study, flap surgery and open surgery were compared for the management of sacrococcygeal pilonidal sinus with respect to operative duration, postoperative recovery, pain, patient satisfaction, and postoperative complications. Although flap surgery was associated with a significantly longer operative duration and slightly longer hospital stay, it demonstrated superior postoperative outcomes compared with open surgery.

Patients who underwent flap surgery experienced significantly faster wound healing and earlier return to normal daily activities. Postoperative pain scores were significantly lower in the flap surgery group at all assessed time intervals, while patient satisfaction scores were significantly higher throughout the follow-up period. Postoperative complications such as wound infection, delayed healing, and recurrence were observed more frequently in the open surgery group, although these differences did not reach statistical significance. Based on the findings of the present study, flap surgery provided better postoperative recovery, reduced postoperative pain, earlier functional recovery, and greater patient satisfaction compared with open surgery. Therefore, flap surgery may be considered a preferred surgical option for the management of sacrococcygeal pilonidal sinus.

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