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Comparative Study of Excision and Primary Closure vs Open Healing vs Limberg Flap in Pilonidal Sinus

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Abstract

Background: Pilonidal sinus disease (PSD) is a common condition in young adults, often requiring surgical intervention. Various techniques—excision with primary closure, open healing, and Limberg flap—are employed, but the optimal approach remains debated.

Objective: To compare the outcomes of excision with primary closure, excision with open healing, and Limberg flap reconstruction in the surgical management of pilonidal sinus disease.

Methods: A prospective comparative study was conducted on 100 patients diagnosed with PSD and randomly assigned to three groups: Group A (primary closure, n=34), Group B (open healing, n=33), and Group C (Limberg flap, n=33). Outcomes assessed included postoperative pain (VAS), wound healing time, return to work, surgical site infection, recurrence, and patient satisfaction. Statistical analysis was performed using SPSS v25.0.

Results: Group C (Limberg flap) showed significantly better outcomes with the shortest healing time (13.9 ± 2.4 days), lowest postoperative pain, quickest return to work (15.6 ± 2.5 days), lowest recurrence (3.0%), and highest satisfaction scores (4.6 ± 0.5). Group B had the slowest healing and longest time to resume activities. Group A had higher wound complications and recurrence.

Conclusion: The Limberg flap technique offers superior outcomes compared to primary closure and open healing, making it the preferred surgical approach for managing pilonidal sinus disease.

Keywords: Pilonidal sinus, Limberg flap, primary closure, open healing, recurrence, wound healing, comparative study.

INTRODUCTION

Pilonidal sinus disease (PSD) is a common acquired disorder affecting the sacrococcyx region, predominantly seen in young adults, especially males between the ages of 15 and 30 years. The term "pilonidal" is derived from the Latin words *pilus* (hair) and *nidus* (nest), describing the characteristic presence of hair nests within the sinus tract [1]. PSD typically presents as a midline pit or pits in the natal cleft, often with associated discharge, pain, swelling, and recurrent infections, leading to significant discomfort and impaired quality of life [2].

Though the exact pathogenesis of PSD remains debatable, it is widely accepted as an acquired condition rather than congenital. The most popular theory, proposed by Bascom, suggests that loose hair penetrates the skin due to friction and suction forces in the gluteal cleft, leading to a foreign body reaction, secondary infection, and sinus formation [3]. Risk factors include male gender, sedentary lifestyle, deep natal cleft, excessive hair, poor hygiene, obesity, local trauma, and prolonged sitting [4,5].

The management of pilonidal sinus disease remains a topic of ongoing discussion. Various conservative and surgical options are available, but surgery remains the mainstay of treatment in chronic or recurrent cases. The goals of surgical treatment include complete removal of the sinus tract, minimizing recurrence, reducing wound complications, shortening healing time, and achieving good cosmetic outcomes [6].

The three commonly employed surgical techniques are excision with primary closure, excision with open healing, and excision with flap reconstruction, most notably the Limberg flap technique.

- Excision with primary closure is a straightforward method that offers the advantage of a shorter healing period and earlier return to normal activity. However, it is associated with higher wound tension, increased risk of wound dehiscence, surgical site infection, and recurrence, especially when performed in the midline [7].

- Excision with open healing, or healing by secondary intention, involves leaving the wound open to granulate naturally after excising the sinus. This technique has the lowest recurrence rates but is associated with prolonged healing time, higher wound care demands, increased discomfort, and delayed return to work [8].
- The Limberg flap is a rhomboid excision technique followed by transposition of a fasciocutaneous flap to close the defect off the midline. This method offers several advantages, including a tension-free closure, flattening of the natal cleft, minimal wound complications, and low recurrence rates. It also improves local hygiene and reduces hair accumulation in the cleft, which is believed to contribute to recurrence [9,10].

Despite the availability of multiple surgical options, there is no universally accepted gold standard, and the choice of procedure often depends on the surgeon's experience, patient preference, and individual clinical presentation. Comparative studies are essential to evaluate the efficacy, safety, and outcomes of different surgical approaches.

Therefore, this prospective comparative study was conducted to assess and compare the outcomes of excision with primary closure, excision with open healing, and Limberg flap technique in patients with pilonidal sinus disease. The study aims to evaluate and compare the procedures in terms of postoperative pain, healing time, surgical site infection, time to return to work, recurrence rates, and patient satisfaction, in order to determine the most effective and patient-friendly approach to managing this chronic and recurrent disease.

MATERIALS AND METHODS

Study Design and Setting

This prospective, comparative study was conducted in the Department of General Surgery at Institute ABC over one year.

Study Population and Sample Size

A total of 100 patients diagnosed with pilonidal sinus disease were included in the study. Patients were randomly allocated into three treatment groups:

- Group A: Excision and Primary Closure (n=34)
- Group B: Excision and Open Healing (n=33)
- Group C: Limberg Flap Procedure (n=33)

Inclusion Criteria

- Patients aged between 18 to 50 years
- Clinically diagnosed cases of pilonidal sinus
- Patients fit for elective surgery under spinal or general anesthesia
- Willingness to provide informed consent and comply with the follow-up schedule

Exclusion Criteria

- Recurrent pilonidal sinus
- Patients with active infection or abscess requiring initial drainage
- Immunocompromised patients (e.g., uncontrolled diabetes, HIV)
- Patients unfit for surgery due to comorbidities

Preoperative Assessment

All patients underwent routine preoperative investigations including complete blood count, blood sugar, renal function tests, and ECG. Written informed consent was obtained from all participants after explaining the nature and purpose of the study.

Surgical Procedure

- Group A: Patients underwent elliptical excision of the sinus with primary midline closure using non-absorbable interrupted sutures.
- Group B: Patients underwent elliptical excision of the sinus with the wound left open to heal by secondary intention.
- Group C: Limberg flap reconstruction was performed using a rhomboid excision and transposition of a fasciocutaneous flap for tension-free closure.

All procedures were performed under spinal or general anesthesia by experienced surgeons. Prophylactic antibiotics were administered perioperatively.

Postoperative Care

- Wound dressings were done on alternate days in all groups.
- Pain assessment was done using the Visual Analog Scale (VAS).
- Patients were advised to maintain local hygiene and avoid prolonged sitting.
- Sutures were removed on postoperative day 10–14 for Group A and Group C.

Follow-Up

Patients were followed up weekly for the first month, then monthly for six months. Parameters assessed included:

- Postoperative pain duration and intensity
- Wound healing time

- Time to return to normal activities
- Surgical site infection
- Recurrence rates
- Patient satisfaction

Statistical Analysis

Data was entered in Microsoft Excel and analyzed using SPSS version 25.0. Quantitative variables were expressed as mean ± standard deviation and compared using ANOVA or t-test. Categorical variables were compared using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

A total of 100 patients with pilonidal sinus were included and randomly allocated into three surgical groups:

- Group A – Excision with Primary Closure (n=34)
- Group B – Excision with Open Healing (n=33)
- Group C – Limberg Flap Procedure (n=33)

Table 1: Demographic Profile

Parameter	Group A (n=34)	Group B (n=33)	Group C (n=33)	p-value
Mean Age (years)	27.1 ± 5.2	26.8 ± 4.7	27.0 ± 5.4	0.92
Male : Female Ratio	30 : 4	29 : 4	30 : 3	0.97

Interpretation: No statistically significant differences in demographic characteristics among groups.

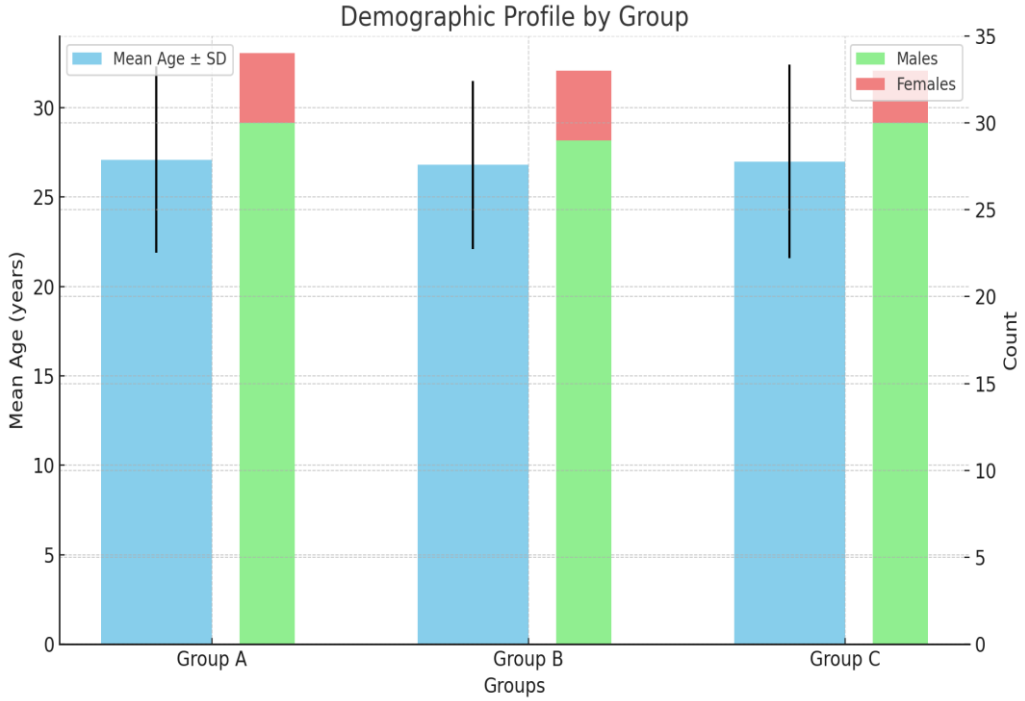


Figure 1; Demographic Profile

The mean age in group A was27.1+/-5.2 years, in group B was 26.8+/-4.7 years and in group C was 27.0+/-5.4 years.

Table 2: Postoperative Pain Score (VAS)

Postoperative Day	Group A (mean ± SD)	Group B (mean ± SD)	Group C (mean ± SD)	p-value
Day 1	6.1 ± 1.2	5.2 ± 1.1	4.5 ± 1.0	<0.001*
Day 3	4.3 ± 1.0	3.6 ± 0.9	2.7 ± 0.8	<0.001*
Day 7	2.7 ± 0.8	2.2 ± 0.6	1.3 ± 0.5	<0.001*

Statistically Significant differences were observed in mean VAS score of post operative pain on day 1,3 ,7. Limberg Flap technique showed the least average VAS pain score on all three days.

Table 3: Wound Healing Time(in days)

Parameter	Group A	Group B	Group C	p-value
Mean Healing Time (days)	18.3 ± 3.6	41.7 ± 5.8	13.9 ± 2.4	<0.001*

. Healing was fastest in Group C (Limberg Flap), slowest in Group B (Open Healing).

Table 4: Time to Resume Work(in days)

Parameter	Group A	Group B	Group C	p-value
Mean Time (days)	19.2 ± 3.2	43.5 ± 6.0	15.6 ± 2.5	<0.001*

Patient undergoing limberg flap technique surgery returned to work in 15.6+/-2.5 days , statistically significant p value comparing other techniques.

Table 5: Surgical Site Infections

Outcome	Group A (n=34)	Group B (n=33)	Group C (n=33)	p-value
SSI Cases	5 (14.7%)	6 (18.2%)	2 (6.1%)	0.32

Incidence of surgical site infection in the three techniques was not statistically significant . Total of 13 cases developed SSI of which Limberg flap surgery had the least , 2 cases of SSI.

Table 6: Recurrence at 6 Months

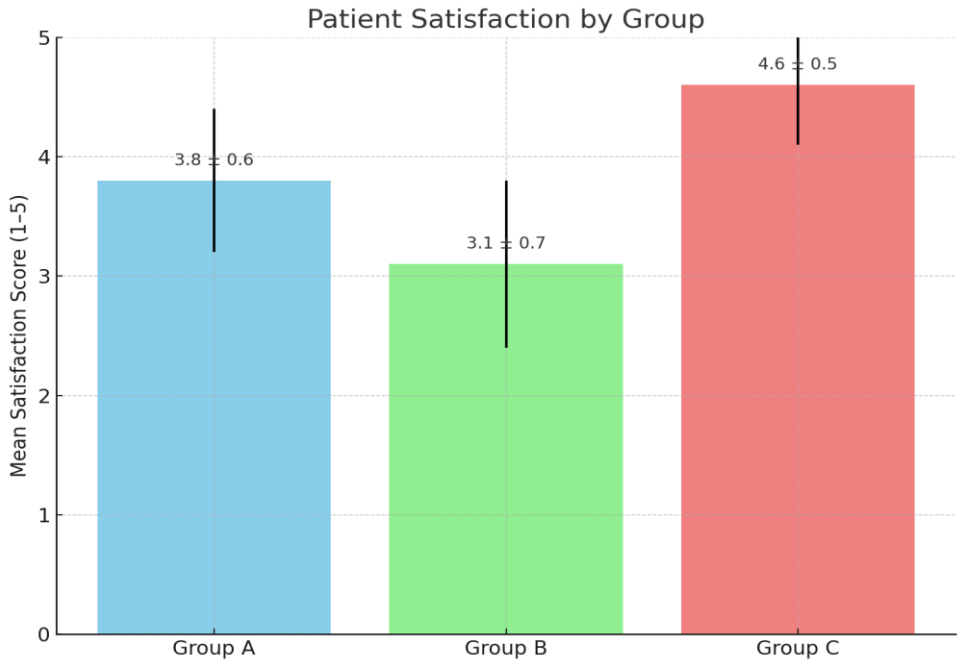
Outcome	Group A (n=34)	Group B (n=33)	Group C (n=33)	p-value
Recurrence Cases	3 (8.8%)	4 (12.1%)	1 (3.0%)	0.41

On follow up for 6months ,recurrence in excision and primary closure was 3 cases, excision and lay open techniques was 4 cases, and in limberg flap surgery was 1case.

Table 7: Patient Satisfaction (1–5 Likert Scale)

Group	Mean Satisfaction Score ± SD	p-value
Group A	3.8 ± 0.6	
Group B	3.1 ± 0.7	
Group C	4.6 ± 0.5	<0.001*

On a scale 5 , patient satisfaction with respect to surgical techniques in limberg flap was 4.6+/-0.4, more than other techniques.



Figure; 2 Patient Satisfaction

DISCUSSION

Pilonidal sinus disease presents a significant burden in young adults due to its chronicity, discomfort, and impact on daily activities. Selecting the most effective surgical technique is essential to minimize complications, reduce recurrence, and

ensure patient satisfaction. This study compared three commonly used surgical techniques—excision with primary closure, excision with open healing, and Limberg flap procedure—in 100 patients over a 1-year period.

Our findings suggest that Limberg flap reconstruction had the most favorable outcomes across multiple parameters. Patients in the Limberg flap group experienced significantly shorter healing times, fewer wound infections, reduced postoperative pain, earlier return to work, and the lowest recurrence rate. These findings are consistent with previous studies. Kapan et al. reported that Limberg flap reconstruction provided effective off-midline closure, low recurrence (2.2%), and high patient satisfaction [1]. Similarly, Hull TL. found that modified Limberg flaps resulted in faster healing, better hygiene, and improved long-term outcomes [2].

In contrast, the excision with primary closure group in our study had a relatively faster initial healing than open healing but also had higher rates of wound dehiscence and infection. This outcome aligns with results from Al-Khamis et al., who, in a systematic review, showed that primary midline closure, although cosmetically appealing, was associated with the highest rates of surgical site infection and recurrence [3].

The open healing group had the lowest incidence of recurrence after Limberg, but it also demonstrated the longest healing times and significant postoperative discomfort. Allen-Mersh and others have noted that although open healing is a safe and low-recurrence approach, it is often poorly tolerated due to prolonged wound care and delayed return to normal activity [4,5].

A key aspect of successful PSD surgery is flattening the natal cleft and avoiding midline closure, both of which are achieved with the Limberg flap technique. By shifting the closure line laterally and removing deep cleft anatomy, it reduces local humidity, friction, and hair accumulation—factors implicated in recurrence [6].

Patient satisfaction was notably highest in the Limberg flap group, correlating with rapid healing and early return to work. This supports the conclusions of Kitchen et al. and others, who advocate for flap-based techniques as the standard approach in recurrent or complex pilonidal disease [7].

Despite the strengths of this study—prospective design, standardized procedures, and comprehensive follow-up—it has limitations. The sample size, though adequate for initial analysis, may be expanded in future multicenter studies for stronger generalizability. Moreover, long-term follow-up beyond 1 year could provide deeper insights into recurrence rates.

CONCLUSION

The Limberg flap technique proved to be the most effective among the three surgical methods for pilonidal sinus, offering faster healing, less pain, quicker return to work, fewer infections, and highest patient satisfaction. Although open healing had low recurrence, it involved prolonged recovery. Primary closure showed higher complication rates. Thus, the Limberg flap is recommended as the preferred surgical option for better overall outcomes.

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