

Rhomboid Excision with Limberg Flap Repair versus Primary Closure in the Management of Sacrococcygeal Pilonidal Sinus: A Prospective Randomized Comparative Study

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ABSTRACT

Background: Sacrococcygeal pilonidal sinus is a common condition in young adults with significant morbidity and high recurrence after conventional surgery. Rhomboid excision with Limberg flap repair has emerged as a technique that addresses the root cause of recurrence by obliterating the natal cleft. This study compares the outcomes of Limberg flap repair versus primary closure following excision of pilonidal sinus. **Methods:** A prospective randomized comparative study was conducted in the Department of General Surgery, Government Medical College and Hospital, Kota, from October 2023 to December 2024. Sixty patients with sacrococcygeal pilonidal sinus were randomized into two equal groups: Group A (Limberg flap repair, n=30) and Group B (primary closure, n=30). Outcomes assessed included operative time, postoperative pain (VAS score), wound complications (infection, seroma, dehiscence), hospital stay, and recurrence at six months. **Results:** Both groups were comparable in age and sex distribution. Mean operative time was significantly longer in Group A (36.3 ± 3.24 min vs 24.93 ± 3.06 min; $p < 0.0001$). Group A demonstrated significantly lower rates of wound infection (3.33% vs 33.33%; $p = 0.006$), seroma formation (3.33% vs 26.67%; $p = 0.026$), wound dehiscence (3.33% vs 30%; $p = 0.012$), hospital stay (2.27 ± 0.52 vs 3.57 ± 1.43 days; $p = 0.0001$), and recurrence (3.33% vs 26.67%; $p = 0.026$). Long-term pain was significantly lower in Group A at 3 and 6 months. **Conclusion:** Limberg flap repair is superior to primary closure for sacrococcygeal pilonidal sinus in terms of wound complications, hospital stay, and recurrence, with the trade-off of a longer operative time and slightly higher early postoperative pain. It is recommended as the preferred surgical technique for primary pilonidal sinus disease.

Keywords: Pilonidal sinus, Limberg flap, primary closure, rhomboid excision, recurrence, wound complications

INTRODUCTION

Sacroccygeal pilonidal sinus disease is a chronic inflammatory condition of the natal cleft characterised by one or more midline pits communicating with subcutaneous tracts containing loose hair and debris. The term 'pilonidal' is derived from the Latin words pilus (hair) and nidus (nest), first used by Hodge in 1880, while the condition was formally described by Herbert Mayo in 1883.¹ It affects approximately 26 per 100,000 population, predominantly young adult males in the second and third decades of life.²

The pathogenesis of pilonidal sinus is now widely accepted as an acquired condition. Loose hairs in the natal cleft penetrate the skin under the action of friction

and suction forces created by the deep gluteal cleft, leading to a foreign body reaction, midline pit formation, and, in some cases, secondary infection and abscess formation.^{3,4} Predisposing factors include deep natal cleft anatomy, obesity, sedentary occupation, excessive body hair, and poor hygiene.⁵

Management of this condition remains challenging owing to frequent wound healing difficulties and a high recurrence rate that ranges from 1% to 43% depending on the surgical technique employed.⁶ Conventional procedures such as excision and primary midline closure are simple but are associated with recurrence rates of 7% to 42%, largely because the midline wound is under tension and the natal cleft persists as an

aetiological factor.⁷ Flap-based techniques, particularly rhomboid excision with the Limberg transposition flap, address this limitation by moving the suture line away from the midline and flattening the gluteal cleft, thereby reducing the risk of recurrent hair insertion and disease recurrence.^{8,9}

Despite a growing body of literature supporting the Limberg flap, its comparison with primary closure in the Indian subcontinent context remains limited. This prospective randomized study was therefore designed to evaluate and compare the outcomes of rhomboid excision with Limberg flap repair versus excision with primary closure in patients with sacrococcygeal pilonidal sinus disease.

AIMS AND OBJECTIVES

Aim

To compare rhomboid excision with Limberg flap repair versus excision with primary closure in the treatment of sacrococcygeal pilonidal sinus disease with respect to operative time and disease recurrence.

Objectives

- To compare postoperative pain (Visual Analogue Scale) between the two groups at multiple time points.
- To compare postoperative wound complications (infection, seroma formation, wound dehiscence).
- To compare duration of hospital stay between the two groups.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective, randomized, comparative study conducted in the Department of General Surgery, Government Medical College and Hospital, Kota, Rajasthan, India, from October 2023 to December 2024. Ethical committee approval was obtained prior to commencement of the study. Written informed consent was obtained from all participants.

Patient Selection: A total of 60 patients presenting to the surgical outpatient department with sacrococcygeal pilonidal sinus disease requiring surgical management were enrolled. Patients were randomized into two groups of 30 each using sealed, numbered envelopes opened in sequence.

- **Inclusion Criteria:** All patients of either sex, aged 12 years or above, presenting with primary or recurrent sacrococcygeal pilonidal sinus disease requiring surgical intervention.
- **Exclusion Criteria:** Patients with acute pilonidal abscess; immunodeficiency; uncontrolled diabetes mellitus or hypertension; severe hirsutism in female patients; psychiatric

disease or poor personal hygiene; and patients with contraindications to spinal anaesthesia or prone position.

Surgical Techniques: All procedures were performed under spinal anaesthesia with the patient in the prone position. The natal cleft was shaved preoperatively and the operative field prepared with povidone-iodine solution.

- **Group A – Limberg Flap Procedure:** A rhomboid-shaped excision encompassing all sinus openings and tracts was marked and carried down to the presacral fascia. A fasciocutaneous flap from the adjacent gluteal region (flap width = 60% of excision length) was raised, rotated to cover the defect, and secured with interrupted 2-0 nylon sutures following placement of a closed suction drain (Fr. 16).
- **Group B – Primary Closure:** An elliptical incision was made 1 cm around the sinus tracts and deepened to the presacral fascia. After complete excision and haemostasis, the wound was closed in layers using 2-0 Vicryl for deep tissue and 2-0 nylon for skin, with a closed suction drain in situ.

Postoperative Management and Follow-up: Drains were removed when output was less than 20 ml/24 hours. Skin sutures were removed on postoperative day 14. All patients were followed up at one month and six months postoperatively. Postoperative pain was assessed using the Visual Analogue Scale (VAS, 0–10) on postoperative day (POD) 1, POD 2, at one week, one month, three months, and six months.

RESULTS

Data were compiled in Microsoft Excel and analysed using SPSS software. Continuous variables are expressed as mean $\pm$ standard deviation and compared using the unpaired Student's t-test. Categorical variables are presented as frequencies and percentages, and compared using the chi-square test. A p-value of <0.05 was considered statistically significant.

Demographic Profile: Sixty patients were enrolled – 30 in Group A (Limberg flap) and 30 in Group B (primary closure). The majority of patients were in the 21–30 year age group (53.33%), followed by the >30 years group (31.76%). The mean age in Group A was 28.33 ± 7.55 years and in Group B was 28.8 ± 7.3 years; this difference was statistically insignificant ($p = 0.809$). Males predominated in both groups (Group A: 63.33%; Group B: 70%), with an overall male-to-female ratio of approximately 2:1 ($p = 0.584$).

Table 1: Age distribution in the two study groups (p = 0.809, NS)

Age Group (Years)	Group A – Limberg (n=30)	Group B – Primary Closure (n=30)	Total (n=60)
≤20	4 (13.33%)	5 (16.67%)	9 (15.00%)
21–30	17 (56.67%)	15 (50.00%)	32 (53.33%)
>30	9 (30.00%)	10 (33.33%)	19 (31.76%)
Mean Age ± SD	28.33 ± 7.55 yrs	28.8 ± 7.3 yrs	—

Table 2: Sex distribution in the two study groups (p = 0.584, NS)

Sex	Group A – Limberg (n=30)	Group B – Primary Closure (n=30)	Total (n=60)
Male	19 (63.33%)	21 (70.00%)	40 (66.67%)
Female	11 (36.67%)	9 (30.00%)	20 (33.33%)

Operative Time: The mean operative time was significantly longer in Group A (36.3 ± 3.24 minutes, range 30–42 min) compared to Group B (24.93 ± 3.06 minutes, range 20–30 min), with a highly significant p-value of <0.0001 .

Table 3: Comparison of operative time between the two groups (* statistically significant)

Group	Mean Time (min)	± SD (min)	Range (min)	p-value
Group A – Limberg	36.3	3.24	30–42	$<0.0001^*$
Group B – Primary Closure	24.93	3.06	20–30	

Postoperative Pain (VAS Score): Pain scores were significantly higher in Group A on POD 1 (6.57 ± 0.90 vs 5.63 ± 1.33 ; $p = 0.004$) and POD 2 (4.4 ± 1.1 vs 3.7 ± 0.95 ; $p = 0.01$). Pain scores became comparable between groups at one week ($p = 0.449$) and one month ($p = 0.332$). From three months onwards, Group A showed significantly lower pain scores (3 months: 0.87 ± 0.57 vs 1.23 ± 0.68 ; $p = 0.027$; 6 months: 0.07 ± 0.25 vs 0.77 ± 0.77 ; $p < 0.0001$).

Table 4: Comparison of mean VAS pain scores at different postoperative time points (* statistically significant, NS = not significant)

Follow-up Point	Group A Mean VAS ± SD	Group B Mean VAS ± SD	p-value
POD 1	6.57 ± 0.90	5.63 ± 1.33	0.004^*
POD 2	4.4 ± 1.1	3.7 ± 0.95	0.01^*
1 Week	3.13 ± 1.01	2.97 ± 0.89	0.449 (NS)
1 Month	1.9 ± 0.71	2.1 ± 0.76	0.332 (NS)
3 Months	0.87 ± 0.57	1.23 ± 0.68	0.027^*
6 Months	0.07 ± 0.25	0.77 ± 0.77	$<0.0001^*$

Wound Complications: Wound infection occurred in 1 patient (3.33%) in Group A versus 10 patients (33.33%) in Group B ($p = 0.006$). Seroma formation was observed in 1 patient (3.33%) in Group A versus 8 patients (26.67%) in Group B

($p = 0.026$). Wound dehiscence occurred in 1 patient (3.33%) in Group A versus 9 patients (30%) in Group B ($p = 0.012$). All complications were significantly lower in the Limberg flap group.

Table 5: Postoperative wound complications (* statistically significant)

Complication	Group A – Limberg n (%)	Group B – Primary Closure n (%)	p-value
Wound Infection	1 (3.33%)	10 (33.33%)	0.006*
Seroma Formation	1 (3.33%)	8 (26.67%)	0.026*
Wound Dehiscence	1 (3.33%)	9 (30.00%)	0.012*

Hospital Stay: The mean hospital stay was significantly shorter in Group A (2.27 ± 0.52 days) compared to Group B (3.57 ± 1.43 days), with a p-value of 0.0001. The majority of Group A patients (76.67%) were discharged within two days, compared to only 30% in Group B.

Table 6: Hospital stay distribution ($p = 0.0001$, statistically significant)

Hospital Stay (Days)	Group A – Limberg n (%)	Group B – Primary Closure n (%)
2 days	23 (76.67%)	9 (30.00%)
3 days	6 (20.00%)	8 (26.67%)
4 days	1 (3.33%)	4 (13.33%)
5 days	0 (0.00%)	5 (16.67%)
6 days	0 (0.00%)	4 (13.33%)
Mean $\pm$ SD	2.27 ± 0.52 days	3.57 ± 1.43 days

Recurrence: At six months follow-up, recurrence was noted in only 1 patient (3.33%) in Group A, compared to 8 patients (26.67%) in Group B, a statistically significant difference ($p = 0.026$).

Table 7: Recurrence at six months follow-up ($p = 0.026$, statistically significant)

Recurrence	Group A – Limberg n (%)	Group B – Primary Closure n (%)	Total n (%)
No	29 (96.67%)	22 (73.33%)	51 (85.00%)
Yes	1 (3.33%)	8 (26.67%)	9 (15.00%)

DISCUSSION

Pilonidal sinus disease constitutes a significant source of morbidity in young working-age adults, and its optimal surgical management continues to be debated. The fundamental challenge lies not merely in excising the diseased tissue but in managing the remaining defect in a way that prevents recurrence, which arises primarily from persistence of the natal cleft and continued hair penetration.

In our study, demographic data were comparable between the two groups. The predominance of young adult males (mean age ~ 28 years, male:female ratio 2:1) is consistent with published literature, which reports peak incidence in males aged 16–30 years due to androgenic stimulation of pilosebaceous glands and increased body hair.^{2, 10}

Operative time was longer for the Limberg procedure (36.3 vs 24.93 minutes; $p < 0.0001$), which is expected given the additional steps of flap design and rotation. Akca et al.¹¹ reported a similar trend with median times of 60 and 45 minutes respectively, though absolute

values differ possibly due to learning curve differences. While statistically significant, this difference is unlikely to be of major clinical consequence.

Early postoperative pain (POD 1 and POD 2) was significantly higher in the Limberg group, which may be attributable to the larger tissue dissection and flap elevation required. However, from one week onward, pain scores became comparable, and at three and six months, the Limberg group had significantly less pain, reflecting superior wound healing and lower complication burden. Similar biphasic pain patterns have been reported by Mahdy¹² and Akca et al.¹¹

Wound infection, seroma formation, and dehiscence were all significantly lower in the Limberg flap group (3.33% each) compared to the primary closure group (33.33%, 26.67%, and 30% respectively). This is consistent with the findings of Petersen et al.,¹³ who reported infection rates of 12.4% for primary closure and 1.5–6.5% for Limberg flap. The superior outcomes of the Limberg technique relate to its off-midline suture

line, tension-free closure, and effective obliteration of the natal cleft dead space.

Hospital stay was significantly shorter in the Limberg group (2.27 vs 3.57 days; $p = 0.0001$). Mentes et al.⁸ documented stays of 2–3 days for Limberg flap and 2–4 days for primary closure, which closely mirrors our findings. The shortened stay in Group A is directly related to the lower complication burden.

Recurrence at six months was markedly lower in the Limberg group (3.33% vs 26.67%; $p = 0.026$). Our findings are consistent with Mentes et al.⁸ who reported 0–3% recurrence with Limberg flap, and Sondenaa et al.¹⁴ who documented 7–42% recurrence with primary closure. The mechanism underlying this difference is anatomical: rhomboid excision with Limberg flap lateralises the suture line, flattens the natal cleft, and obliterates the intergluteal dead space, thereby eliminating the principal aetiological substrate for recurrence.

Our results support the growing consensus that flap-based procedures, particularly the Limberg technique, should be considered the preferred approach for sacrococcygeal pilonidal sinus disease. Limitations of this study include a relatively small sample size ($n = 60$) and a follow-up period limited to six months, which may underestimate true long-term recurrence rates. Further studies with larger cohorts and longer follow-up are warranted.

Strengths of the Study

The present study possesses several strengths. It was conducted using a prospective randomized comparative design, which minimizes selection bias and improves the reliability of the findings. Both treatment groups were comparable in demographic characteristics, allowing an objective comparison of surgical outcomes. Multiple clinically relevant outcome measures, including operative time, postoperative pain, wound complications, duration of hospital stay, and recurrence, were systematically evaluated. Standardized surgical techniques and postoperative follow-up protocols were applied to all participants, thereby enhancing the internal validity of the study.

Limitations of the Study

This study has certain limitations. First, the sample size was relatively small, with only 60 patients included, which may limit the generalizability of the findings. Second, the study was conducted at a single tertiary care center, and therefore the results may not be representative of all healthcare settings. Third, the follow-up period was limited to six months, which may underestimate the true long-term recurrence rate of pilonidal sinus disease. Finally, patient-reported quality of life, cosmetic satisfaction, and cost-effectiveness were not evaluated.

Clinical Implications

The findings of this study support the routine use of rhomboid excision with Limberg flap repair as the preferred surgical technique for sacrococcygeal pilonidal sinus disease. The procedure significantly reduces postoperative wound complications, shortens hospital stay, and lowers recurrence rates compared with primary closure. Adoption of this technique may improve patient outcomes, reduce healthcare costs associated with recurrent disease, and facilitate earlier return to normal daily activities.

Future Scope

Future multicenter randomized controlled trials involving larger sample sizes and longer follow-up periods are required to validate the present findings. Further research should also compare Limberg flap repair with other off-midline flap techniques such as the Karydakis flap and Bascom cleft lift procedure. Evaluation of patient satisfaction, cosmetic outcomes, quality of life, and cost-effectiveness would provide additional evidence to guide surgical decision-making.

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CONCLUSION

Limberg flap repair, though associated with a longer operative time and slightly higher early postoperative pain, is superior to primary closure for the surgical management of sacrococcygeal pilonidal sinus disease. It offers significantly lower rates of wound infection, seroma formation, wound dehiscence, and recurrence, along with a shorter hospital stay. These advantages are attributable to the off-midline lateralised suture line and effective obliteration of the natal cleft. We recommend Limberg flap repair as the procedure of choice for primary sacrococcygeal pilonidal sinus disease, with the caveat that larger prospective multicentre studies with extended follow-up are needed to confirm these findings.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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Ethical Approval

Ethical committee approval was obtained from the Institutional Ethics Committee, Government Medical College, Kota, prior to commencement of the study.

Informed Consent

Written informed consent was obtained from all participants prior to enrolment in the study. Patient confidentiality and anonymity were maintained throughout the research process.

Author Contributions

Shanker Choudhary: Conceptualization, study design, patient recruitment, data collection, manuscript preparation.

Balveer Meena: Surgical procedures, clinical data acquisition, statistical analysis.

Vasudev Verma: Data interpretation, literature review, manuscript drafting and editing.

Navneet Parashar: Study supervision, methodology, critical revision of the manuscript, final approval of the version to be published.

All authors have read and approved the final manuscript.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Abbreviation	Full Form
VAS	Visual Analogue Scale
POD	Postoperative Day
SD	Standard Deviation
IEC	Institutional Ethics Committee
SPSS	Statistical Package for the Social Sciences

REFERENCES

1. Mayo OH. Observations on injuries and disease of the rectum. London: Burgess and Hill; 1883:45–46.
2. McCallum I, King PM, Bruce J. Healing by primary closure versus open healing after surgery for pilonidal sinus: systematic review and meta-analysis. *BMJ*. 2008;336:868–871.
3. Patey DH, Scarff RW. Pathology of post-anal pilonidal sinus; its bearing on treatment. *Lancet*. 1946;2:484–486.
4. Karydakos GE. Easy and successful treatment of pilonidal sinus after explanation of its causative process. *Aust N Z J Surg*. 1992;62:385–389.
5. Harlak A, Menten O, Kilic S, et al. Sacrococcygeal pilonidal disease: analysis of

previously proposed risk factors. *Clinics*. 2010;65:125–131.

6. Chintapatla S, Safarani N, Kumar S, Haboubi N. Sacrococcygeal pilonidal sinus: historical review, pathological insight and surgical options. *Tech Coloproctol*. 2003;7:3–8.

7. Sondenaa K, Nesvik I, Andersen E, Soreide JA. Recurrent pilonidal sinus after excision with closed or open treatment: final result of a randomized trial. *Eur J Surg*. 1996;162:237–240.

8. Menten BB, Leventoglu S, Cihan A, et al. Modified Limberg transposition flap for sacrococcygeal pilonidal sinus. *Surg Today*. 2004;34:419–423.

9. Urhan MK, Kucukel F, Topgul K, Ozer I, Sari S. Rhomboid excision and Limberg flap for managing pilonidal sinus. *Dis Colon Rectum*. 2002;45:656–659.

10. Soreide JA. Pilonidal disease. *Surg Clin North Am*. 1994;74:1309–1315.

11. Akca T, Colak T, Ustunsoy B, Kanik A, Aydin S. Randomized clinical trial comparing primary closure with the Limberg flap in the treatment of primary sacrococcygeal pilonidal disease. *Br J Surg*. 2005;92:1081–1084.

12. Mahdy T. Surgical treatment of pilonidal disease: primary closure or flap reconstruction after excision. *Dis Colon Rectum*. 2008;51:1816–1822.

13. Petersen S, Aumann G, Kramer A, et al. Short-term results of Karydakos flap for pilonidal sinus disease. *Tech Coloproctol*. 2007;11:235–240.

14. Sondenaa K, Andersen E, Nesvik I, Soreide JA. Patient characteristics and symptoms in chronic pilonidal sinus disease. *Int J Colorectal Dis*. 1995;10:39–42.

15. Aslam MN, Shaiib S, Choudhry AM. Use of Limberg flap for pilonidal sinus – a viable option. *J Ayub Med Coll*. 2009;21:31–33.

16. Dass TA, Zaz M, Rather A, Bari S. Elliptical excision with midline primary closure versus rhomboid excision with Limberg flap reconstruction in sacrococcygeal pilonidal disease: a prospective randomized study. *Indian J Surg*. 2012;74:305–308.

17. Muzi MG, Milito G, Cadeddu F, et al. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg*. 2010;200:9–14.

18. Jamal A, Shamim M, Hashmi F, Qureshi MI. Open excision with secondary healing versus rhomboid excision with Limberg transposition flap in management of sacrococcygeal pilonidal disease. *J Pak Med Assoc*. 2009;59:157–160.