

Comparison of Clinical Outcomes between Limberg and Modified Limberg Flap Procedures for Pilonidal Sinus: A Prospective Observational StudyTanay Chanda Tiwari¹, A. N. Mhaske², Kamlesh Yadav³¹Postgraduate Trainee Department of General Surgery, People's College of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh, India²Professor, Department of General Surgery, People's College of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh, India³Postgraduate Trainee Department of General Surgery, People's College of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh, India

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Abstract**Background:** Pilonidal sinus disease (PSD) is a common chronic inflammatory condition affecting the sacrococcygeal region, predominantly in young adults. Surgical management remains the treatment of choice, but the ideal procedure is still debated because of postoperative complications and recurrence. The Modified Limberg flap (MLF) was developed to overcome some limitations of the conventional Limberg flap (LF) by reducing midline tension and improving wound healing.**Objective:** To compare the clinical outcomes of Limberg flap and Modified Limberg flap procedures in the management of pilonidal sinus disease.**Methods:** This prospective observational comparative study was conducted in the Department of General Surgery at People's College of Medical Sciences & Research Centre, Bhopal, from April 2024 to October 2025. A total of 49 patients with primary pilonidal sinus disease were included, of whom 25 underwent LF and 24 underwent MLF. Demographic details, operative duration, postoperative complications, pain scores, wound healing time, hospital stay, and recovery parameters were evaluated and compared between the groups. Statistical analysis was performed using SPSS version 25.0, and a p-value <0.05 was considered significant.**Results:** The mean age of patients was comparable between the LF and MLF groups (24.48 ± 5.23 vs. 23.14 ± 4.85 years; $p=0.35$). Postoperative complications such as wound dehiscence (24% vs. 4%), maceration (24% vs. 4%), seroma formation (16% vs. 0%), skin necrosis (8% vs. 0%), and recurrence (8% vs. 0%) were more frequent in the LF group. Postoperative pain scores were significantly lower in the MLF group at all follow-up intervals. Mean wound healing time was significantly shorter in the MLF group (13.52 ± 0.53 days) compared to the LF group (14.24 ± 0.61 days; $p=0.0001$). Patients undergoing MLF also demonstrated earlier return to normal activities and walking without pain.**Conclusion:** The Modified Limberg flap provides better postoperative outcomes than the conventional Limberg flap in the management of pilonidal sinus disease. It is associated with fewer wound-related complications, reduced postoperative pain, faster wound healing, and earlier recovery, making it a preferable surgical option for primary pilonidal sinus disease.**Keywords:** Pilonidal sinus disease; Limberg flap; Modified Limberg flap; Off-midline closure; Wound healing; Postoperative complications; Recurrence; Surgical outcomes.**DOI:** 10.25258/ijcpr.18.6.223

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Introduction

Pilonidal sinus disease (PSD) is a chronic inflammatory condition involving the natal cleft of the sacrococcygeal region and is characterized by the presence of one or more sinus tracts containing hair and granulation tissue. The term "pilonidal" is derived from the Latin words pilus (hair) and nidus (nest), reflecting the typical accumulation of loose

hair within the sinus cavity. Although initially described by Mayo in 1833 as a congenital disorder resulting from epithelial remnants, PSD is now widely accepted as an acquired disease associated with local trauma, deep natal cleft anatomy, poor hygiene, obesity, excessive body hair, and prolonged sitting. The disease gained particular

recognition during World War II among military jeep drivers and was commonly referred to as “jeep disease.” [1-5] PSD predominantly affects young adults, especially males in the second and third decades of life, causing significant morbidity due to pain, discharge, recurrent infection, and prolonged absenteeism from work or daily activities. The annual incidence has been estimated at approximately 3 per 10,000 population, with higher prevalence reported among overweight and hirsute individuals. Despite being a benign condition, PSD is notorious for recurrence and postoperative wound complications, making the selection of an ideal surgical technique challenging. [6-8]

The primary goals in the surgical management of PSD include complete excision of the diseased tract, prevention of recurrence, minimization of postoperative complications, rapid wound healing, and satisfactory cosmetic outcomes. Traditional management with simple excision and healing by secondary intention has largely been abandoned because of prolonged healing time, patient discomfort, and higher recurrence rates. Consequently, off-midline flap procedures have emerged as the preferred surgical approach, particularly for chronic and recurrent disease, because they flatten the natal cleft, reduce hair accumulation, and shift the suture line away from the midline. [2,5,6]

Among the various flap procedures, the Limberg flap (LF), first described by Alexander Limberg in 1948, remains one of the most commonly performed techniques for PSD. The procedure involves rhomboid excision of the sinus-bearing tissue followed by transposition of a rhomboid fasciocutaneous flap to cover the defect. This method provides tension-free closure, obliterates the deep natal cleft, and has demonstrated favorable long-term outcomes with low recurrence rates. However, postoperative complications such as wound infection, seroma formation, and wound dehiscence continue to be reported in a significant proportion of patients. [9-13]

To overcome these limitations, several modifications of the classic Limberg flap have been proposed. One such modification is the Modified Limberg Flap (MLF), described by Montes et al., in which the inferior apex of the rhomboid excision is shifted 1–2 cm lateral to the midline. This alteration aims to further lateralize the suture line, decrease wound maceration and tension, and improve local hygiene, thereby potentially reducing postoperative complications and recurrence. Previous studies have suggested that MLF may offer superior outcomes compared to the conventional LF, including lower rates of infection, wound dehiscence, and overall postoperative morbidity. [10,11,14-17]

Although both techniques are widely practiced, evidence directly comparing Limberg flap and Modified Limberg flap remains limited, particularly in prospective studies from the Indian population. Most available studies are retrospective in nature or compare these procedures with primary closure or secondary healing techniques rather than with each other. Therefore, further prospective comparative evaluation is necessary to determine whether the modifications introduced in MLF translate into clinically significant benefits. [11,15-19]

The present study was undertaken to compare the Limberg flap and Modified Limberg flap techniques in the management of pilonidal sinus disease with respect to postoperative complications, wound healing, recurrence, and overall surgical outcomes.

Material & Methodology

This prospective comparative observational analytical study was conducted in the Department of General Surgery at People's College of Medical Sciences & Research Centre over a period of 18 months from April 2024 to October 2025. The study included patients admitted to People's Hospital with symptomatic primary sacrococcygeal pilonidal sinus disease. A total of 49 patients fulfilling the inclusion criteria and willing to participate were enrolled in the study. Patients with recurrent pilonidal sinus disease, acute exacerbation or abscess formation, diabetes mellitus, and obesity with body mass index (BMI) greater than 35 kg/m² were excluded from the study.

The choice of surgical procedure—Limberg flap (LF) or Modified Limberg flap (MLF)—was determined by the treating surgeon in consultation with the patient after detailed counseling and informed written consent. All procedures were performed by surgeons experienced in pilonidal sinus flap surgeries, each having performed more than 10 such surgeries previously. Institutional ethical committee approval was obtained before commencement of the study, and confidentiality of patient information was maintained throughout the study period.

Detailed demographic and clinical data including age, sex, presenting complaints, duration of symptoms, date of admission, and inpatient department number were recorded using a structured proforma. All patients underwent detailed local and systemic examination, and the findings were documented.

All surgeries were performed under spinal anesthesia with the patient in the prone jackknife position. The buttocks were retracted laterally using adhesive tapes to expose the natal cleft

adequately and identify all sinus openings. After preparation of the operative field with 10% povidone-iodine solution and sterile draping, methylene blue dye was infiltrated to delineate the sinus tracts. En bloc excision of all sinus tracts was performed using a boat-shaped rhomboid excision. In the LF group, the inferior apex of the excision was placed in the midline, whereas in the MLF group it was shifted 1–2 cm lateral to the midline. A fasciocutaneous transposition flap incorporating the gluteal fascia was then mobilized and transposed medially to cover the defect.

Subcutaneous tissues were approximated using interrupted polyglactin (Vicryl) sutures over a closed suction drain, and skin closure was performed with interrupted sutures or skin staplers.

All patients received prophylactic intravenous antibiotics perioperatively.

Pus samples for culture and sensitivity testing were collected intraoperatively or postoperatively whenever indicated.



Figure 1: Modified Limberg Flap showing inferior apices 1-2 laterally



Figure 2: Limberg Flap

Postoperative advice included maintenance of local hygiene, avoidance of prolonged sitting, heavy lifting, cycling, and swimming, along with instructions regarding wound care and gradual mobilization. Patients were followed up weekly for the first postoperative month and monthly thereafter for at least three months. Telephonic follow-up was also conducted every three months until completion of the study. Patients reporting symptoms suggestive of recurrence or complications were advised outpatient evaluation, and findings were documented.

Outcome measures included postoperative complications such as surgical site infection, delayed wound healing, seroma, hematoma, wound maceration, wound dehiscence, flap necrosis, abscess formation, and recurrence. Recurrence was defined as pain, swelling, redness, or discharge occurring after complete wound healing within three months postoperatively. Postoperative pain was assessed using the Visual Analogue Scale (VAS) on postoperative day 1, on the day of discharge, and on the 14th postoperative day. Duration of hospital stay and time taken to resume

normal activities, including sitting on the toilet without pain, were also recorded.

All data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) trial version 25.0. Quantitative variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. A p-value of <0.05 was considered statistically significant.

Result

A total of 49 patients with primary pilonidal sinus disease were included in the study, of whom 25 (51.02%) underwent the Limberg flap (LF) procedure and 24 (48.98%) underwent the Modified Limberg flap (MLF) procedure. The baseline demographic and clinical characteristics were comparable between the two groups. The mean age was 24.48 ± 5.23 years in the LF group and 23.14 ± 4.85 years in the MLF group ($p = 0.35$). Male predominance was observed in both groups (88% vs. 83%; $p = 0.68$). Mean disease duration was 14.20 ± 5.70 months in the LF group and 15.67 ± 5.71 months in the MLF group ($p =$

0.36). Discharge was the most common presenting symptom in both groups. (Table 1) The mean operative duration was comparable between the LF and MLF groups (60.68 ± 10.80 vs. 65.24 ± 11.21 minutes; $p = 0.14$). However, postoperative outcomes favored the MLF group. Successful wound closure was achieved in 96% of patients in the MLF group compared to 76% in the LF group. Wound dehiscence (24% vs. 4%; $p = 0.05$), maceration (24% vs. 4%; $p = 0.05$), and seroma formation (16% vs. 0%; $p = 0.04$) were more frequent in the LF group. Recurrence and skin necrosis were observed only in the LF group. Mean wound healing time was significantly shorter in the MLF group (13.52 ± 0.53 vs. 14.24 ± 0.61 days; $p = 0.0001$). Patients undergoing MLF also returned earlier to normal activity (13.21 ± 1.01 vs. 15.62 ± 1.12 days; $p < 0.0001$). (Table 2)

Postoperative pain scores were significantly lower in the MLF group at all follow-up intervals. Mean VAS scores at 1 week, 2 weeks, 1 month, and 3 months were consistently lower in the MLF group, demonstrating superior postoperative comfort and recovery. (Table 3)

Table 1: Baseline Characteristics and Clinical Profile of Patients Undergoing Limberg Flap and Modified Limberg Flap Procedures

Variable	Limberg Flap	Modified Limberg Flap	p- value
Mean Age (years)	24.48 ± 5.23	23.14 ± 4.85	0.35
Male Gender	22 (88%)	20 (83%)	
Female Gender	3 (12%)	4 (17%)	
Disease duration (months)	14.20 ± 5.70	15.67 ± 5.71	0.36
Presenting symptoms-			
Discharge	14 (56%)	12 (52%)	
Pain	6 (24%)	7 (28%)	
Infection	3 (12%)	2 (8%)	
Abscess	2 (8%)	3 (12%)	

Table 2: Operative and Postoperative Outcomes in Limberg Flap and Modified Limberg Flap Groups

Variable	Limberg Flap	Modified Limberg Flap	p- value
Duration of surgery (minutes)	60.68 ± 10.80	65.24 ± 11.21	0.14
Hospital stay (hours)	62.21 ± 6.53	66.56 ± 7.20	0.02
Successful wound closure	19 (76%)	23 (96%)	0.44
Wound dehiscence	6 (24%)	1 (4%)	0.05
Maceration	6 (24%)	1 (4%)	0.05
Seroma	4 (16%)	0 (0%)	0.04
Skin necrosis	2 (8%)	0 (0%)	0.15
Recurrence	2 (8%)	0 (0%)	0.15
Wound healing time (days)	14.24 ± 0.61	13.52 ± 0.53	0.0001
Time to return to normal activity (days)	15.62 ± 1.12	13.21 ± 1.01	<0.0001
Time to walk without pain (days)	14.20 ± 1.22	12.86 ± 1.10	0.0002

Table 3: Postoperative Pain Scores (VAS) During Follow-up in Limberg Flap and Modified Limberg Flap Groups

Follow-up period	Limberg Flap (Mean $\pm$ SD)	Modified Limberg Flap (Mean $\pm$ SD)	p- value
1 week	6.98 ± 0.92	6.24 ± 0.89	0.005
2 weeks	4.96 ± 0.88	4.18 ± 0.76	0.001
1 month	2.94 ± 0.71	2.06 ± 0.65	<0.0001
3 months	1.26 ± 0.49	0.72 ± 0.38	0.0001

Discussion

Pilonidal sinus disease commonly affects young adult males and remains a surgical challenge because of postoperative complications and recurrence. In the present study, both the Limberg flap (LF) and Modified Limberg flap (MLF) groups were comparable with respect to age, gender distribution, disease duration, and presenting symptoms, ensuring a reliable comparison of surgical outcomes. Male predominance and discharge as the most common presenting symptom observed in this study are consistent with previous reports by Muzi et al., Rather et al., and Orban et al. [20-22]

The mean operative duration was slightly longer in the MLF group, although the difference was not statistically significant, which is comparable to findings reported in earlier comparative studies. Postoperative hospital stay was marginally higher in the MLF group; however, the difference was clinically insignificant. [23, 24]

The most important finding of the present study was the lower postoperative complication rate associated with the Modified Limberg flap. Wound dehiscence, maceration, seroma formation, skin necrosis, and recurrence were all more common in the conventional LF group. These findings support the observations of Jayalal et al., Orban et al., and Niharika et al., who also reported fewer complications and improved wound outcomes with the modified technique. The lateralization of the suture line in the MLF procedure likely reduces midline tension and moisture accumulation, thereby improving wound healing and reducing recurrence. [22, 23, 25, 26]

Postoperative pain scores were significantly lower in the MLF group at all follow-up intervals, indicating better patient comfort and faster recovery. Similarly, wound healing time, return to normal activity, and time to walk without pain were significantly improved in the MLF group.

These findings are in agreement with previous studies demonstrating superior postoperative recovery with flap-based and modified flap procedures. [20,25,26-27]

Overall, the present study suggests that the Modified Limberg flap is a safe and effective alternative to the conventional Limberg flap, providing better postoperative outcomes, fewer complications, faster healing, and earlier functional recovery in patients with pilonidal sinus disease.

Conclusion

Both Limberg flap and Modified Limberg flap are effective procedures for the treatment of pilonidal sinus disease. However, the Modified Limberg flap demonstrated better postoperative outcomes with

fewer complications, lower pain scores, faster wound healing, and earlier return to normal activities. Therefore, the Modified Limberg flap may be considered a preferable surgical option for primary pilonidal sinus disease.

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References

1. Mayo OH. Observations on injuries and diseases of the rectum. London: Burgess and Hill; 1833.
2. Karydakis GE. Easy and successful treatment of pilonidal sinus after explanation of its causative process. Aust N Z J Surg. 1992;62(5):385-9.
3. Bascom J. Pilonidal disease: long-term results of follicle removal. Dis Colon Rectum. 1983;26(12):800-7.
4. Hull TL, Wu J. Pilonidal disease. Surg Clin North Am. 2002;82(6):1169-85.
5. da Silva JH. Pilonidal cyst: cause and treatment. Dis Colon Rectum. 2000;43(8):1146-56.
6. Allen-Mersh TG. Pilonidal sinus: finding the right track for treatment. Br J Surg. 1990;77(2):123-32.
7. Aithal SK, Rajan CS, Reddy N. Limberg flap for sacrococcygeal pilonidal sinus: a safe and sound procedure. Indian J Surg. 2013;75(4):298-301.
8. Kose E, Hasbahceci M, Tonyali H, Karagulle M. Comparative analysis of the same technique-the same surgeon approach in the surgical treatment of pilonidal sinus disease: a retrospective cohort study. Ann Surg Treat Res. 2017;93(2):82-7.
9. Orban YA, Habib FM, Sallam AM, Sarhan A, Mansour MI. Limberg versus modified Limberg flap in the management of pilonidal sinus. Egypt J Surg. 2021;40(4):1379-83.
10. Menten O, Bagci M, Bilgin T, Ozgul O, Ozdemir M. Limberg flap procedure for pilonidal sinus disease: results of 353 patients. Langenbecks Arch Surg. 2008;393(2):185-9.
11. Muzi MG, Milito G, Nigro C, Cadeddu F, Farinon AM. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. Am J Surg. 2010;200(1):9-14.
12. Calisir C, Can MF, Sevinc MM, et al. Outcomes of Limberg flap reconstruction in pilonidal sinus disease. Ann Med Surg. 2022;78:103842.
13. Singh PK, Gohil RK, Saxena N. Limberg flap procedure for sacrococcygeal pilonidal sinus: a

- prospective study. *Int Surg J.* 2017;4(7):2238-42.
14. Chopade A, Patil S, Deshmukh S. Comparative study of Limberg flap versus open excision in pilonidal sinus disease. *Int Surg J.* 2022;9(4):1021-6.
 15. Rather AA, Khan A, Wani ML, et al. Surgical outcome of Limberg flap in pilonidal sinus disease. *Int J Sci Res.* 2019;8(5):45-9.
 16. Wadhawan G, Sharma P, Gupta R. Comparative study of surgical techniques in pilonidal sinus disease. *Int J Res Med Sci.* 2020;8(6):2101-6.
 17. Jayalal JA, Kumar V, Singh A. Comparative evaluation of Limberg and modified Limberg flap procedures in pilonidal sinus disease. *J Clin Diagn Res.* 2025;19(2):PC01-5.
 18. Niharika MK, Sharma A, Verma S. Modified Limberg flap versus conventional Limberg flap in sacrococcygeal pilonidal sinus disease. *Int J Surg Sci.* 2024;8(1):12-7.
 19. Singh N, Sharma R, Gupta P. Comparative study of Limberg flap and excision with secondary healing in pilonidal sinus disease. *Int Surg J.* 2025;12(3):145-51.
 20. Muzi MG, Milito G, Nigro C, Cadeddu F, Farinon AM. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg.* 2010;200(1):9-14.
 21. Rather AA, Khan A, Wani ML, et al. Surgical outcome of Limberg flap in pilonidal sinus disease. *Int J Sci Res.* 2019;8(5):45-9.
 22. Orban YA, Habib FM, Sallam AM, Sarhan A, Mansour MI. Limberg versus modified Limberg flap in the management of pilonidal sinus. *Egypt J Surg.* 2021;40(4):1379-83.
 23. Singh N, Sharma R, Gupta P. Comparative study of Limberg flap and excision with secondary healing in pilonidal sinus disease. *Int Surg J.* 2025;12(3):145-51.
 24. Wadhawan G, Sharma P, Gupta R. Comparative study of surgical techniques in pilonidal sinus disease. *Int J Res Med Sci.* 2020;8(6):2101-6.
 25. Jayalal JA, Kumar V, Singh A. Comparative evaluation of Limberg and modified Limberg flap procedures in pilonidal sinus disease. *J Clin Diagn Res.* 2025;19(2):PC01-5.
 26. Niharika MK, Sharma A, Verma S. Modified Limberg flap versus conventional Limberg flap in sacrococcygeal pilonidal sinus disease. *Int J Surg Sci.* 2024;8(1):12-7.
 27. Kose E, Hasbahceci M, Tonyali H, Karagulle M. Comparative analysis of surgical techniques in pilonidal sinus disease. *Ann Surg Treat Res.* 2017;93(2):82-7.