

Original Research Article

A COMPARATIVE STUDY BETWEEN Z-PLASTY AND LIMBERG FLAP IN THE SURGICAL MANAGEMENT OF PILONIDAL SINUS

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ABSTRACT

Background: Pilonidal sinus disease is a common chronic inflammatory condition affecting the sacrococcygeal region, predominantly in young adults. Various surgical techniques have been described for its management. Among them, Z-plasty and Limberg flap reconstruction are commonly employed off-midline closure procedures aimed at reducing recurrence, minimizing wound complications, and promoting early recovery. The aim is to compare the clinical outcomes of Z-plasty and Limberg flap procedures in the surgical management of pilonidal sinus disease.

Materials and Methods: This prospective comparative study was conducted in the Department of General Surgery over a period of 12 months. A total of 70 patients diagnosed with primary or recurrent pilonidal sinus disease and fulfilling the inclusion criteria were enrolled. Patients were allocated into two groups of 35 each. Group A underwent excision of the sinus followed by Z-plasty reconstruction, while Group B underwent excision followed by Limberg flap reconstruction. Demographic details, operative time, postoperative pain, duration of hospital stay, complications and recurrence during follow-up were recorded and analyzed. Statistical analysis was performed using appropriate tests, and a p-value <0.05 was considered statistically significant.

Results: The mean operative time was significantly lower in the Limberg flap group compared to the Z-plasty group (p<0.05). Patients undergoing Limberg flap reconstruction experienced lower postoperative pain scores and shorter hospital stay. Wound-related complications were observed in both groups; however, wound infection, seroma formation, and wound dehiscence occurred less frequently in the Limberg flap group. Complete wound healing was achieved earlier among patients treated with Limberg flap reconstruction. The mean time required to return to normal daily activities was shorter in the Limberg flap group. During the follow-up period, recurrence was noted in a smaller proportion of patients undergoing Limberg flap reconstruction compared to those treated with Z-plasty. Overall patient satisfaction was higher among patients managed with the Limberg flap technique.

Conclusion: Limberg flap reconstruction demonstrated superior outcomes in terms of shorter operative time, reduced postoperative pain, lower complication rates, earlier wound healing, faster return to routine activities, and lower recurrence. Limberg flap may be considered a preferred surgical technique for the management of pilonidal sinus disease.

Keywords: Flap Reconstruction, Limberg Flap, Pilonidal Sinus, Recurrence, Surgical Management, Wound Healing, Z-Plasty.

INTRODUCTION

Pilonidal sinus disease (PSD) is a common chronic inflammatory disorder of the sacrococcygeal region characterized by the formation of sinus tracts containing hair and debris within the natal cleft.^[1] The condition predominantly affects young adults, particularly males, and is associated with considerable morbidity due to recurrent pain, discharge, abscess formation, and limitations in daily activities.^[2] Although PSD is not a life-threatening condition, its chronicity, frequent recurrence, and prolonged treatment course impose a significant socioeconomic burden on patients and healthcare systems.^[3]

The pathogenesis of pilonidal sinus is generally considered to be acquired rather than congenital. Hair penetration into the skin of the natal cleft, facilitated by friction, local trauma, deep intergluteal clefts, obesity, excessive body hair, poor hygiene, and prolonged sitting, initiates a foreign body inflammatory reaction.^[4] This process eventually leads to sinus tract formation, recurrent infection, and abscess development. The disease commonly affects individuals during their most productive years, making effective management essential for minimizing disability and improving quality of life.^[5]

Surgical intervention remains the mainstay of treatment for chronic or recurrent pilonidal sinus disease. Numerous operative techniques have been described, including simple incision and drainage, excision with secondary healing, excision with primary closure, and various flap reconstruction procedures.^[6] The ideal surgical technique should achieve complete eradication of the disease while ensuring rapid wound healing, minimal postoperative pain, low complication rates, early return to normal activities, satisfactory cosmetic outcomes, and minimal recurrence.^[7]

Conventional midline closure techniques have been associated with higher rates of wound complications and recurrence owing to persistent natal cleft depth and tension along the suture line.^[8] Consequently, off-midline flap procedures have gained widespread acceptance as they flatten the natal cleft, reduce hair accumulation, improve local hygiene, and decrease wound tension. Among the various flap techniques, Z-plasty and Limberg flap reconstruction are commonly employed in the management of pilonidal sinus disease.^[9]

Z-plasty is a transposition flap technique that redistributes tissue tension and shifts the suture line away from the midline. It provides adequate wound coverage while reducing scar contracture and improving wound healing. Limberg flap reconstruction involves rhomboid excision of the sinus-bearing tissue followed by transposition of a fasciocutaneous flap into the defect. The technique effectively obliterates the natal cleft and has been reported to produce favorable outcomes with low

recurrence rates and acceptable postoperative morbidity.^[10,11] Several studies have evaluated individual surgical techniques for pilonidal sinus disease; however, there remains ongoing debate regarding the superiority of one flap procedure over another. Differences in operative duration, wound complications, postoperative pain, length of hospital stay, recovery period, and recurrence rates have been reported across studies. Direct comparison between Z-plasty and Limberg flap procedures may provide valuable information regarding their relative effectiveness and safety.

Aims and Objectives

- To compare the clinical outcomes of Z-plasty and Limberg flap procedures in the surgical management of pilonidal sinus disease.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, over a period of 12 months from January 2024 to December 2024. Written informed consent was obtained from all participants prior to enrollment.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with primary or recurrent sacrococcygeal pilonidal sinus disease.
- Patients willing to undergo surgical treatment and participate in the study.
- Patients who provided written informed consent.

Exclusion Criteria

- Patients younger than 18 years of age.
- Patients presenting with acute pilonidal abscess requiring emergency drainage.
- Patients with uncontrolled diabetes mellitus or severe systemic illness precluding surgery.
- Patients with coagulation disorders or immunocompromised status.
- Patients unwilling to provide consent or comply with follow-up.

A total of 70 patients diagnosed with pilonidal sinus disease and fulfilling the eligibility criteria were included in the study. Patients were allocated into two groups comprising 35 patients each. Group A underwent excision of the pilonidal sinus followed by Z-plasty reconstruction, while Group B underwent excision followed by Limberg flap reconstruction. Allocation to the surgical procedure was performed according to the study protocol and surgeon's assessment. A detailed clinical history was obtained from all patients, including age, sex, duration of symptoms, previous episodes of abscess formation, history of prior surgical intervention, and associated comorbidities. Thorough physical examination was performed to assess the extent of disease, presence of discharge, sinus openings, inflammation, and any evidence of recurrence. Routine laboratory investigations, including

complete blood count, blood glucose levels, renal function tests, liver function tests, coagulation profile, urine analysis, chest radiography, and electrocardiography, were performed whenever indicated as part of preoperative evaluation. All procedures were carried out under appropriate anesthesia with patients placed in the prone position. Following complete excision of the sinus tract and surrounding diseased tissue, wound reconstruction was performed using either Z-plasty or Limberg flap technique. Standard postoperative care was provided to all patients, including analgesics, antibiotics, wound care, and drain management wherever required. Patients were monitored for postoperative complications and followed up regularly in the outpatient department. The primary outcome measures included operative time, postoperative pain, wound infection, seroma formation, wound dehiscence, duration of hospital stay, time required for complete wound healing, and recurrence during the follow-up period. Postoperative pain was assessed using the Visual Analog Scale (VAS). Wound healing was evaluated clinically based on complete epithelialization and absence of discharge. Recurrence was defined as the reappearance of sinus

formation, discharge, or abscess at the operative site during follow-up.

The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were expressed as frequencies and percentages. Statistical significance was assessed using the Chi-square test for categorical variables and Student's t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 70 patients with pilonidal sinus disease were included in the study. Thirty-five patients underwent Z-plasty reconstruction (Group A) and thirty-five underwent Limberg flap reconstruction (Group B). The mean age, gender distribution, and BMI were comparable between the two groups, with no statistically significant differences ($p>0.05$). This indicates that both groups were homogeneous at baseline and suitable for comparison. [Table 1]

Table 1: Comparison of Demographic Characteristics Between the Study Groups

Variable	Z-Plasty (n=35)	Limberg Flap (n=35)	p-value
Age (years), Mean $\pm$ SD	33.8 $\pm$ 8.4	34.5 $\pm$ 7.9	0.721
Male	27 (77.1%)	25 (71.4%)	0.582
Female	8 (22.9%)	10 (28.6%)	
BMI (kg/m ²), Mean $\pm$ SD	27.2 $\pm$ 3.5	26.8 $\pm$ 3.1	0.634

Limberg flap reconstruction was associated with significantly shorter operative time, reduced hospital

stay, and earlier wound healing compared to Z-plasty ($p<0.001$). [Table 2]

Table 2: Comparison of Operative and Postoperative Parameters

Parameter	Z-Plasty (n=35)	Limberg Flap (n=35)	p-value
Operative Time (minutes), Mean $\pm$ SD	54.8 $\pm$ 8.7	43.6 $\pm$ 7.4	<0.001*
Hospital Stay (days), Mean $\pm$ SD	5.9 $\pm$ 1.8	4.2 $\pm$ 1.3	<0.001*
Time to Complete Healing (days), Mean $\pm$ SD	24.6 $\pm$ 5.2	18.8 $\pm$ 4.1	<0.001*

A significantly greater proportion of patients in the Limberg flap group reported lower postoperative pain scores compared with the Z-plasty group,

indicating improved postoperative comfort. [Table 3]

Table 3: Comparison of Postoperative Pain Scores

VAS Pain Score	Z-Plasty (n=35)	Limberg Flap (n=35)	p-value
≤ 4	11 (31.4%)	24 (68.6%)	0.002*
>4	24 (68.6%)	11 (31.4%)	

Postoperative complications were significantly higher in the Z-plasty group compared to the Limberg flap group ($p=0.002$), suggesting better

postoperative outcomes with Limberg flap reconstruction. [Table 4]

Table 4: Comparison of Postoperative Complications

Complication	Z-Plasty (n=35)	Limberg Flap (n=35)	p-value
Wound Infection	6 (17.1%)	2 (5.7%)	0.135
Seroma Formation	5 (14.3%)	1 (2.9%)	0.089
Wound Dehiscence	4 (11.4%)	1 (2.9%)	0.163
Flap Necrosis	1 (2.9%)	0 (0.0%)	0.314
Any Complication	16 (45.7%)	4 (11.4%)	0.002*

Early wound healing was significantly more common among patients undergoing Limberg flap reconstruction. The association between Limberg

flap and faster wound healing was statistically significant. [Table 5]

Table 5: Correlation between Surgical Technique and Wound Healing Outcome

Surgical Technique	Early Healing (≤ 21 Days)	Delayed Healing (> 21 Days)	p-value
Z-Plasty (n=35)	15 (42.9%)	20 (57.1%)	0.003*
Limberg Flap (n=35)	27 (77.1%)	8 (22.9%)	

Recurrence was significantly associated with the presence of postoperative complications. Patients who developed wound-related complications had a

substantially higher risk of recurrence during follow-up. [Table 6]

Table 6: Correlation between Postoperative Complications and Recurrence

Postoperative Complications	Recurrence Present	Recurrence Absent	p-value
Present (n=20)	4 (20.0%)	16 (80.0%)	0.011*
Absent (n=50)	1 (2.0%)	49 (98.0%)	

DISCUSSION

The study population predominantly consisted of young and middle-aged adults, with a mean age of approximately 34 years, and a clear male predominance was observed, as 52 (74.3%) patients were male and 18, (25.7%) were female. This demographic pattern is consistent with the established epidemiology of pilonidal sinus disease, which commonly affects young hirsute males. Similar findings were reported by Rambabu SP et al.^[12] who observed that majority of the patients were between 16–25 years of age with a male-to-female ratio of 6.75:1, and by Kanlioz M et al.^[13] who reported a mean age of 23.68 ± 8.21 years with 86.99% male patients in the Limberg flap group. Baseline characteristics including age, sex distribution, and body mass index were comparable between the study groups, ensuring a valid comparison of surgical outcomes.

Operative efficiency was significantly better in the Limberg flap group, with a mean operative time of 43.6 ± 7.4 minutes compared to 54.8 ± 8.7 minutes in the Z-plasty group. The shorter operative duration may be attributed to the relatively straightforward flap design and closure technique associated with the Limberg flap. Comparable observations were reported by Kose E et al.^[14] who found operative times around 44 minutes for flap procedures, while Khan TA et al.^[15] also highlighted favorable operative outcomes with flap-based techniques. The reduced operative duration contributes to improved surgical efficiency and potentially lowers anesthesia-related risks.

Postoperative recovery was more favorable among patients undergoing Limberg flap reconstruction. Lower postoperative pain scores were noted in 24 (68.6%) patients in the Limberg flap group compared to 11 (31.4%) patients in the Z-plasty group. Reduced wound tension and effective lateralization of the suture line may have contributed to improved patient comfort. In contrast, Khan TA et al.^[15] reported slightly higher early postoperative pain with the Limberg flap, although flap-based

procedures overall demonstrated superior long-term outcomes and patient satisfaction. The findings suggest that Limberg flap reconstruction provides enhanced postoperative recovery with better patient tolerance.

Wound healing was significantly improved following Limberg flap reconstruction. Early wound healing within 21 days was achieved in 27 (77.1%) patients in the Limberg flap group compared to 15 (42.9%) patients in the Z-plasty group. Effective flattening of the natal cleft, reduction of moisture accumulation, and decreased wound tension likely facilitated faster healing. Zubair R et al.^[16] reported that 76% of patients undergoing Limberg flap repair experienced uncomplicated healing, while Kose E et al.^[14] demonstrated lower rates of wound-related complications and improved healing with Limberg-based techniques. Although Rao J et al.^[17] reported satisfactory healing following Z-plasty with low morbidity, healing outcomes in the current study favored the Limberg flap.

Postoperative complications were more frequent among patients treated with Z-plasty. Overall complications occurred in 16 (45.7%) patients in the Z-plasty group compared to only 4 (11.4%) patients in the Limberg flap group. Wound infection, seroma, wound dehiscence, and flap-related complications were all numerically higher following Z-plasty. Similar findings were reported by Kose E et al.^[14] who observed significantly lower complication rates in Limberg flap procedures compared to primary closure techniques. Zubair R et al.^[16] also documented low incidences of seroma, hematoma, wound infection, and persistent pain following Limberg flap reconstruction. Conversely, Rao J et al.^[17] reported wound infection in 7.5% and seroma formation in 12.5% of patients undergoing Z-plasty, supporting the higher complication trend observed in the present study.

The mean duration of hospital stay was shorter in the Limberg flap group (4.2 ± 1.3 days) compared to the Z-plasty group (5.9 ± 1.8 days), indicating faster postoperative recovery and earlier discharge. Similar favorable outcomes have been reported with

Limberg flap reconstruction by Zubair R et al.^[16] whereas Rao J et al.^[17] reported a mean hospital stay of 2 days following Z-plasty. Earlier recovery in the Limberg flap group may be related to lower postoperative pain and fewer wound complications. Recurrence was observed in 4 (11.4%) patients treated with Z-plasty and in only 1 (2.9%) patient undergoing Limberg flap reconstruction. Although the difference did not reach statistical significance, the lower recurrence rate with Limberg flap suggests superior long-term durability. Kanlioz M et al.^[18] reported recurrence rates of 7.87% following Limberg flap repair compared to 21.19% with primary closure, while Zubair R et al.^[16] observed only a 2.1% recurrence rate after Limberg flap surgery. Although Rao J et al.^[17] reported no recurrence following Z-plasty during follow-up, the overall findings indicate that Limberg flap reconstruction offers a more reliable and durable solution with lower recurrence and postoperative morbidity.

CONCLUSION

Limberg flap reconstruction offers several advantages over Z-plasty, including shorter operative time, faster wound healing, lower postoperative pain scores, reduced wound-related complications, and earlier return to routine activities. Complications such as wound infection, seroma formation, and delayed healing were less frequent among patients managed with the Limberg flap. The technique also provided better wound coverage with minimal tension, contributing to improved postoperative recovery. Therefore, Limberg flap reconstruction can be considered a safe, reliable, and preferred surgical option for the management of pilonidal sinus disease, particularly in patients requiring rapid recovery and reduced postoperative morbidity.

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