



Reconstructive Surgery

COMPARATIVE STUDY ON SURGICAL OUTCOMES OF KARYDAKIS FLAP VERSUS LIMBERG FLAP FOR SURGICAL MANAGEMENT OF PILONIDAL SINUS

Dr. Richa Jaiman	Professor, Department of General Surgery, SNMC Agra
Dr Bhavana Verma	Assistant Professor, Department of General Surgery, SNMC Agra
Dr Deep Shikha*	Assistant Professor, Department of General Surgery, SNMC Agra *Corresponding Author
Dr Lalit Kumar	Junior Resident, General Surgery SNMC Agra

(ABSTRACT) **Introduction:** The surgical management of pilonidal sinus disease has long been a topic of considerable debate in the field of surgery. Among the numerous surgical techniques developed, the Karydakias flap and Limberg flap procedures are two of the most widely employed and studied methods, each with distinct surgical principles, techniques, and clinical outcomes. **Objectives:** This study aimed to Compare Karydakias flap versus Limberg flap for sacrococcygeal pilonidal sinus in terms of operative time, duration of hospital stay, post operative complications and recurrence rate between Karydakias flap vs Limberg flap surgery **Methods:** It was a prospective comparative study which included 80 patients with pilonidal sinus who were operated with Karydakias or Limberg flap reconstruction at department of Surgery, Sarojini Naidu Medical College, Agra. 40 Patients were allotted in both the group and patients were operated and followed up for 6 months. The outcome measures were recorded and tabulated into an excel sheet for analysis using Chi square test. **Results:** The KF procedure was associated with a significantly shorter operation time (35.4 minutes) compared to the LF procedure (47.3 minutes), a significantly shorter hospital stay (3.85 days) compared to the LF group (5.63 days), Earlier return to work. The KF group experienced slightly higher rates of wound dehiscence ($p = 0.04$) and higher flap necrosis rate ($p = 0.04$). There was no statistically significant difference in recurrence rates between the two groups ($p = 0.136$). **Conclusion:** The results of this study indicate that the KF procedure offers several advantages, including shorter operative times and quicker recovery, leading to shorter hospital stays and faster returns to work. The LF technique also demonstrated fewer post-operative complications, including lower rates of wound dehiscence and flap necrosis. Both KF and LF are effective surgical options, with specific advantages and disadvantages.

KEYWORDS : Karydakias Flap, Pilonidal Sinus, Limberg Flap, Wound Dehiscence, Recurrence

INTRODUCTION

The surgical management of pilonidal sinus disease, a common condition affecting the sacrococcygeal region, has long been a topic of considerable debate in the field of surgery. Pilonidal sinus, characterized by chronic inflammation, abscess formation, and recurrent sinus tracts, significantly impacts patients' quality of life.[1] The incidence of IPD is estimated at 26 cases per 100,000 population. Generally, men are 2 to 4 times more prone to this disease.[26] Despite various conservative and minimally invasive treatments, surgical intervention remains the most effective and definitive approach for managing this condition, particularly in cases of recurrent or complicated disease. Complex reconstructive operations using flaps are typically applied for patients with an extensive disease or those unresponsive to simpler surgeries (e.g., excision and midline closure with sutures). [26] Among the numerous surgical techniques developed, the Karydakias flap and Limberg flap procedures are two of the most widely employed and studied methods, each with distinct surgical principles, techniques, and clinical outcomes.[1]

The Karydakias flap technique was introduced by Dr. Epaminondas Karydakias, a Greek surgeon, as a method to minimize the recurrence rate of pilonidal sinus disease by addressing its underlying etiopathogenesis. The procedure involves excising the diseased tissue and creating an off-midline flap to cover the defect, thereby shifting the natal cleft laterally. By flattening the gluteal region and reducing hair accumulation and moisture, the Karydakias flap aims to eliminate the primary factors contributing to pilonidal sinus recurrence. This approach emphasizes simplicity, tension-free closure, and minimal alteration of anatomical structures, making it a popular choice among surgeons.[2]

On the other hand, the Limberg flap, a rhomboid-shaped transposition flap, was initially described by Alexander Limberg, a Russian surgeon, for various reconstructive procedures. Its application in pilonidal sinus surgery involves the excision of the sinus along with surrounding tissue in a rhomboid shape, followed by the rotation of a flap from adjacent tissue to cover the defect. The Limberg flap technique provides excellent coverage of the excised area, eliminates dead space, and facilitates primary healing by tension-free closure. This method is particularly advantageous in extensive or recurrent cases, where a larger and more robust tissue coverage is required.[1]

formation, and dehiscence, are another crucial consideration in assessing surgical outcomes. Both techniques have shown favourable safety profiles, but subtle differences exist.

Aim and Objectives

This study aimed to Compare Karydakias flap versus Limberg flap for sacrococcygeal pilonidal sinus in terms of operative time, duration of hospital stay, post operative complications and recurrence rate between Karydakias flap vs Limberg flap surgery

Methodology

It was a prospective comparative cohort study which included 80 patients with pilonidal sinus who were operated with Karydakias or Limberg flap reconstruction at department of Surgery, Sarojini Naidu Medical College, Agra over duration of 18 months from January 2023 to July 2024. 40 Patients were allotted in both the groups using non-randomized sampling method. Patients were operated under standard protocol of the hospital. Post-operative care included monitoring for complications, providing pain management, and encouraging early mobilization to prevent thromboembolism. Follow-up visits were scheduled at 1 week, 1 month, 3 months and 6 months post-surgery to evaluate healing, address any complications, and assess for recurrence. The outcome measures were recorded and tabulated into an excel sheet for analysis using Chi square test.

The included patients were those with uncomplicated pilonidal sinus, without any prior complications or recurrent disease, patients of both genders aged 18 to 60 years who were willing for participation in the study and were fit for surgical intervention.



Postoperative complications, including wound infection, seroma

Those patients were excluded who developed complicated pilonidal sinus during follow-up, who refused to participate in the study or were unfit for surgery, patients with a history of previous surgery for pilonidal sinus, patients with any localized skin lesions or infections.

The study parameters included:

- **Primary Outcomes:** Post-operative complications (such as infection, hematoma, or dehiscence), recurrence of pilonidal sinus, and healing time (defined as the time taken for complete wound closure).
- **Secondary Outcomes:** Pain assessment (using a visual analogue scale), patient satisfaction, and length of hospital stay.
- **Follow-up Parameters:** Frequency of post-operative visits, patient-reported outcomes, and any adverse events occurring during the follow-up period.



Data was analyzed using standard statistical methods. Descriptive statistics were used to summarize the demographic characteristics of the study population and the clinical outcomes. Comparison between the two surgical groups (Karydakís flap vs Limberg flap) was performed using appropriate statistical tests, such as the chi-square test for categorical variables and t-tests for continuous variables. The significance level was set at $p < 0.05$.

RESULTS

The study sample consisted predominantly of male participants, accounting for 86.30% of the total, with only 13.80% of female participants. The majority of patients (81.30%) experienced mild post-operative pain following surgery, while a smaller proportion (18.80%) reported moderate pain. A large majority of patients (91.30%) did not experience any post-operative infection, however a small proportion of patients (8.80%) developed infections, which suggests that while infections are uncommon, they still represent a potential complication.

The majority of patients (93.80%) did not experience a recurrence of pilonidal sinus following surgery, however a small proportion of patients (6.30%) had a recurrence. The mean age of the participants in the study was 33.16 years, with a standard deviation of 7.97, indicating that most patients were relatively young adults. The average Body Mass Index (BMI) of the participants was 26.36, with a standard deviation of 4.81, suggesting that the sample had a predominantly overweight or mildly obese population. The mean operation duration was 41.35 minutes, with a standard deviation of 8.19, reflecting the typical length of time required for each surgical procedure. Patients had an average hospital stay of 4.74 days ($SD = 1.39$), and the mean time for return to work was 13.15 days ($SD = 2.59$).

Patients who underwent the Karydakís flap procedure had a mean hospital stay of 3.85 days ($SD = 1.001$), whereas those who underwent the Limberg flap procedure had a longer mean hospital stay of 5.63 days ($SD = 1.148$). The t-value of 54.324 and the p-value of 0.00 indicate that this difference is statistically significant, suggesting that the Karydakís procedure was associated with a shorter hospital stay compared to the Limberg procedure.

The mean operation time (OT duration) for patients undergoing the Karydakís flap procedure was 35.4 minutes ($SD = 3.463$), while the mean OT duration for the Limberg flap procedure was longer, at 47.3 minutes ($SD = 7.155$). The t-value of 89.656 and a p-value of 0.00 indicate that this difference is highly statistically significant.

In the Karydakís group, 35 patients did not experience infection, and 5 patients developed an infection. In the Limberg group, 38 patients did

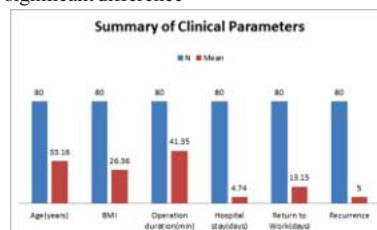
not experience infection, while only 2 patients developed an infection. The Chi-Square value of 1.409 and the p-value of 0.24 indicate that there is no statistically significant difference in infection rates between the two flap types.

In the Karydakís group, 37 patients did not experience dehiscence, while 3 patients did. In the Limberg group, 38 patients had no dehiscence, and 2 patients had dehiscence. The Chi-Square value of 0.213 and a p-value of 0.04 indicate a statistically significant difference between the two groups in terms of wound dehiscence.

In the Karydakís group, 37 patients did not experience necrosis, while 3 patients developed necrosis. In the Limberg group, 38 patients had no necrosis, and 2 patients experienced necrosis. The Chi-Square value of 0.213 and a p-value of 0.04 indicate a statistically significant difference between the two groups regarding flap necrosis.

In the Karydakís group, 36 patients did not experience recurrence, while 4 patients had a recurrence. In the Limberg group, 39 patients did not experience recurrence, and only 1 patient had a recurrence. The Chi-Square value of 2.222 and a p-value of 0.136 indicate that there is no statistically significant difference.

In the Karydakís group, 32 patients did not experience seroma, while 8 patients developed seroma. In the Limberg group, 36 patients did not develop seroma, and 4 patients experienced seroma. The Chi-Square value of 2.231 and a p-value of 0.126 suggest that there is no statistically significant difference.



CONCLUSIONS

The results of this study indicate that the KF procedure offers several advantages, including shorter operative times and quicker recovery, leading to shorter hospital stays and faster returns to work. Furthermore, the mean operation duration for the KF group was significantly shorter than LF procedure.

On the other hand, the LF procedure showed a slightly lower recurrence rate (2.5%) compared to the KF group (10%), although the difference was not statistically significant. This suggests that LF may be a better option for patients with more complex or recurrent pilonidal sinus cases. The LF technique also demonstrated fewer post-operative complications, including lower rates of wound dehiscence and flap necrosis.

Both techniques showed similar outcomes in terms of post-operative infection rates, seroma formation, and recurrence rates.

The study underscores the importance of individualized treatment plans for patients with pilonidal sinus disease. Surgeons must consider factors such as the complexity of the condition, the patient's overall health, and their personal preferences when deciding between KF and LF. For patients with simple, non-recurrent cases, KF may be the preferred choice due to its quicker recovery and lower complication rates. In contrast, slightly lower recurrence rates and fewer complications may outweigh the longer recovery time.

DISCUSSION

In this study, the gender distribution showed a significant male predominance, with 86.30% of participants being male. This finding is consistent with the well-established understanding that pilonidal sinus disease predominantly affects males. For instance, Destek et al. observed similar male predominance in their study involving 104 patients, where 53% were male and 47% female [79].

This study revealed that 81.30% of participants experienced mild post-operative pain, with 18.80% experiencing moderate pain. Similar findings were reported by Baz et al. (2022), who found that the KF group reported significantly lower pain scores and a faster return to normal activity compared to the LF group [11]. This could be attributed to the less invasive nature of the KF procedure, which typically

involves smaller incisions and less tissue disruption. This study's relatively low incidence of moderate pain aligns with these studies, underscoring that both KF and LF procedures are effective in managing post-operative pain, although the pain management strategy may need to be

The study observed a low incidence of post-operative infection, with 8.8% of patients developing infections. In contrast, Baz et al. (2022) reported a slightly higher infection rate of 2.9% in their cohort, with patients undergoing LF showing fewer infections than those undergoing KF [11].

Patients who underwent the KF procedure in our study had a shorter mean hospital stay of 3.85 days, compared to 5.63 days for those undergoing the LF procedure. The statistical significance ($p = 0.00$) highlights that KF patients experienced a quicker recovery and were discharged earlier. This is consistent with the findings of Uyan & Acehan (2022), who also reported a shorter hospital stay for KF patients, suggesting that this technique may be associated with faster recovery [81]. Similarly, Destek et al. (2020) found that KF procedures were generally less invasive, contributing to reduced hospital stays [79].

The mean operation duration was significantly shorter for the KF group (35.4 minutes) compared to the LF group (47.3 minutes), with a highly significant p -value of 0.00. Jayaprakas et al. (2024) found that KF surgeries were performed in an average of 41.7 minutes, significantly shorter than the 51.5 minutes required for LF surgeries [9].

In comparing the two surgical techniques, the recurrence rate was higher in the KF group (10%) compared to the LF group (2.5%). However, the difference was not statistically significant ($p = 0.136$), indicating that both techniques offer similar effectiveness in preventing recurrence. These findings are consistent with the study by Elhiny et al. (2020), who found that the LF group had no recurrences, while the KF group experienced a recurrence rate of 11.1% [80]. On the other hand, Destek et al. (2020) found that recurrence rates were low in both groups, although the LF group showed a slight advantage in recurrence prevention [79].

The difference in infection rates between the KF and LF groups observed in this study and others could be related to factors like wound closure techniques, drainage, and the use of appropriate dressings. These results are promising as they suggest that both KF and LF are effective in minimizing post-operative infections, provided appropriate care is administered.

This study's 13.15-day average is a reasonable estimate for return to work, particularly for less complex cases. However, the recovery time may increase for patients with more complicated disease or comorbid conditions, as reflected in some of the longer recovery times noted in other studies.

Cosmetic outcomes and patient satisfaction were key aspects of this study, with results indicating a high level of satisfaction in both KF and LF groups. The enhanced cosmetic results in the KF group may be attributed to the less invasive nature of the procedure, which leads to more favorable aesthetic outcomes and quicker wound healing.

In this study, the time to return to normal activity was significantly shorter for patients who underwent the KF procedure (13.15 days) compared to those who had the LF procedure (15.63 days). This aligns with the findings from Jayaprakas et al. (2024), who also observed that KF patients returned to normal activities faster than those who underwent LF [9]. The faster return to normal activity in the KF group may be due to the shorter surgical time, less tissue manipulation, and faster recovery typically associated with the KF procedure.

The strength of this study lies in its balanced approach, with an equal distribution of participants between the Karydakias Flap (KF) and Limberg Flap (LF) groups, which allows for a fair comparison of the two surgical techniques. The prospective nature of the study further strengthens its validity by reducing the risk of biases associated with retrospective studies. Furthermore, the study's findings align with previous research, confirming the reliability and consistency of the results, which adds credibility to the conclusions drawn from the data.

The results of this study have significant implications for clinical

practice in the management of pilonidal sinus. This study provides a clear framework for clinicians to tailor their approach to pilonidal sinus surgery, taking into consideration both the patient's preferences and the complexity of the condition.

Based on the findings, it is recommended that surgeons consider individual patient characteristics, such as the complexity of the pilonidal sinus, when selecting between KF and LF procedures. Additionally, further studies with larger sample sizes and longer follow-up periods are recommended to validate the long-term effectiveness of both procedures and to explore the potential benefits of combining both techniques in complex cases.

Despite the strengths of this study, several limitations should be acknowledged such as relatively small sample size. Furthermore, the study was conducted at a single center, which may limit the external validity of the findings. The lack of a detailed analysis of factors such as patient lifestyle, compliance with post-operative care, and socio-economic status also limits the ability to fully understand the factors contributing to the outcomes.

REFERENCES

- Bostanoğlu S, Sakcak I, Aşar F, Coşgun E, Hamamci E. Comparison of Karydakias technique with Limberg Flap Procedure in Pilonidal Sinus Disease: Advantages of Karydakias technique. *Pak J Med Sci*. 2010;26:773-777.
- Sahebally S, McMahon G, Walsh S, Burke J. Classical Limberg versus classical Karydakias flaps for pilonidal disease- an updated systematic review and meta-analysis of randomized controlled trials. *The Surgeon*. 2019.
- Neti SK, Samal SR, Bhargav KR. Effectiveness of Limberg Flap and Karydakias Procedure in Pilonidal Sinus Disease – A Comparative Interventional Study in a Tertiary Care Centre of Eastern India. *Int J Sci Res*. 2023.
- Prassas D, Rolfs T, Schumacher FJ, Krieg A. Karydakias flap reconstruction versus Limberg flap transposition for pilonidal sinus disease: a meta-analysis of randomized controlled trials. *Langenbecks Arch Surg*. 2018;403:547-554.
- Sit M, Aktas G, Yilmaz E. Comparison of the Three Surgical Flap Techniques in Pilonidal Sinus Surgery. *Am Surg*. 2013;79:1263-1268.
- Ardelt M, Dittmar Y, Rauchfuß F, Fahrner R, Scheuerlein H, Settmacher U. Classic Limberg Flap Procedure for Treatment of a Sacrococcygeal Pilonidal Sinus Disease - Explanation of the Surgical Technique. *ZentralblChir*. 2015;140(5):473-475.
- Khan K, Ghaffar A, Choudhry S, Irshad K. Comparison of Early Outcome between Modified Limberg and Karydakias Flap Procedures in Patients with Sacrococcygeal Pilonidal Sinus. 2016.
- Bubenova M, Konečná D, Kala Z. Pilonidal sinus disease: Karydakias flap procedure in our patients. *RozhlChir*. 2020;99(8):350-355.
- Jayaprakas R, Jacob N, Gopan A. The Karydakias Flap Versus the Limberg Flap in the Treatment of Pilonidal Sinus Disease in Rural Area of Thodupuzha. *Indian J Appl Res*. 2024.
- Kohla SM, Alssey A, Abd El-Aziz TF, Mohammed M, Abo Zaid M. Comparative study between the Karydakias technique and the Limberg flap in pilonidal sinus. *Menoufia Med J*. 2016;29:539-544.
- Baz Y, Orban Y, Ezzat M. Surgical Outcome of Modified Karydakias Flap and Modified Limberg Flap in the Management of Sacrococcygeal Pilonidal Disease: A Comparative Study. *J Coloproctol*. 2022;42:335-339.
- Waxman B, Coventry B. Pilonidal Sinus Surgery. 2014;99-107.
- Ghosh S, Barman J. Management of Pilonidal Sinus Disease with Homoeopathy: An Evidence-Based Case Report. *Int J Multidiscip Res*. 2023.
- Humphries AE, Duncan J. Evaluation and management of pilonidal disease. *SurgClin North Am*. 2010;90(1):113-124.
- Šmíd D, Novák P, Liska V, Treska V. Pilonidal sinus—surgical management at our surgical clinic. *RozhlChir*. 2011;90(5):301-305.
- Bernier G, Johnson E, Maykel J, Steele S. Reoperative surgery for pilonidal disease. *Semin Colon Rectal Surg*. 2015;26:211-217.
- Vaghholkar K. Pilonidal sinus. *Int J Surg Sci*. 2020.
- Bulut SP, Bengisu N. The clinical presentation of pilonidal sinus and selection of the appropriate minimally invasive approach. *Ann ItalChir*. 2022;93:702-710.
- Korenkov M. Subcutaneous destruction of sinus tract with long-term vessel loop drainage as a minimally invasive surgical treatment for primary pilonidal sinus. *Surg Technol Int*. 2016;28:96-98.
- Rizk M, Kilany E, Oraby E, Barakat A. Five Layers Repair in Management of Pilonidal Sinus. 2020;5:1-4.
- Jandik J. Sinus pilonidalis - possibilities of surgical treatment. *RozhlChir*. 2014;93(10):496-501.
- Sahsamanis G, Samaras S, Mitsopoulos G, Deverakis T, Dimitrakopoulos G, Piniailidis D. Semi-closed surgical technique for treatment of pilonidal sinus disease. *Ann Med Surg*. 2017;15:47-51.
- Pilonidal Sinus Disease: 10 Steps to Optimize Care. *Adv Skin Wound Care*. 2016;29(10):E1.
- Rambabu S, Puvvala PMK, Kumar G, Ramu P. Study of surgical management of pilonidal sinus. *Int J Health Sci*. 2022.
- Mahmood F, Hussain A, Akingboye A. Pilonidal sinus disease: Review of current practice and prospects for endoscopic treatment. *Ann Med Surg*. 2020;57:212-217.
- Alvandipour M, Zamani MS, Ghorbani M, Charati JY, Karami MY. Comparison of Limberg Flap and Karydakias Flap Surgery for the Treatment of Patients With Pilonidal Sinus Disease: A Single-Blinded Parallel Randomized Study. *Ann Coloproctol*. 2019 Dec 31;35(6):313-318. doi: 10.3393/ac.2018.09.27. Epub 2019 May 22. PMID: 31113167; PMCID: PMC6968717.