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Original Article

Comparative Evaluation of Postoperative Complications Following Karydakis Versus Limberg Flap Procedures for Pilonidal Sinus Disease: A Retrospective Study

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ABSTRACT

Background: Pilonidal sinus disease is a chronic inflammatory condition of the sacrococcygeal region that frequently requires surgical treatment. Although Karydakis and Limberg procedures are widely used, the optimal technique remains debated because postoperative recovery and wound complication profiles vary across settings. Objective: To compare postoperative complications and recovery outcomes following Karydakis and Limberg procedures for pilonidal sinus disease. Methods: This retrospective comparative observational study included 78 patients who underwent pilonidal sinus surgery at Chaudhry Hospital, Lahore. Patients were categorized according to surgical procedure: Karydakis procedure (n=43) or Limberg flap procedure (n=35). Baseline characteristics, recovery outcomes, and postoperative complications were extracted from medical records and operative notes. Categorical variables were compared using appropriate statistical tests, with $p \leq 0.05$ considered statistically significant. Results: The Karydakis group had significantly shorter hospital stay (p=0.039), earlier drain removal (p<0.001), and earlier return to daily activities (p=0.018). However, wound infection was higher after Karydakis surgery than after Limberg flap surgery (41.9% vs 17.1%; OR=3.48, 95% CI 1.20–10.12; p=0.019), as were wound dehiscence (34.9% vs 5.7%; OR=8.84, 95% CI 1.86–42.02; p=0.002) and edema (41.9% vs 20.0%; OR=2.88, 95% CI 1.03–8.04; p=0.040). Hematoma and pain were not significantly different. Conclusion: Karydakis surgery showed faster recovery, whereas Limberg flap surgery demonstrated fewer wound-related complications. Keywords: Pilonidal sinus disease; Karydakis procedure; Limberg flap; postoperative complications; wound infection; wound dehiscence.

INTRODUCTION

Pilonidal sinus disease is a chronic inflammatory condition of the sacrococcygeal region that commonly affects young and middle-aged adults, particularly males, and is frequently associated with hair penetration, local irritation, recurrent infection, abscess formation, persistent discharge, and delayed wound healing. Although the disease is benign, it can cause considerable discomfort, repeated healthcare visits, work absenteeism, impaired daily functioning, and reduced quality of life. Reported incidence varies widely across populations, and higher body mass index, deep natal cleft anatomy, local hair burden, poor hygiene, prolonged sitting, and recurrent local trauma have been described as important contributors to disease persistence and postoperative morbidity (1,2).

Surgery remains the principal treatment for chronic pilonidal sinus disease, but there is still no universal agreement regarding the optimal operative technique. The ideal procedure should achieve complete disease clearance while minimizing postoperative pain, wound infection, seroma, hematoma, wound dehiscence, recurrence, hospital stay, duration of drainage, time to suture removal, and delay in returning to normal daily activities (1,3). Among commonly used off-midline closure techniques, the Karydakis procedure and Limberg flap are widely practiced because both aim to flatten or lateralize the natal cleft, reduce midline tension, and improve wound healing. However, comparative findings remain variable, with some studies reporting faster recovery after Karydakis closure, whereas others suggest lower wound-related morbidity or recurrence after Limberg flap reconstruction (4–6).

Postoperative complications are clinically important because they prolong recovery, increase treatment cost, delay mobility, and may contribute to recurrence or patient dissatisfaction. Wound infection, seroma, hematoma, edema, pain, and dehiscence are especially relevant in pilonidal surgery because the operative site is exposed to moisture, friction, local contamination, and mechanical stress. Existing literature provides useful comparative evidence, but outcomes may differ according to patient profile, BMI distribution, disease duration, operative expertise, drain protocols, postoperative care practices, and local clinical setting (2,7–9). Therefore, local comparative data remain necessary to support context-specific surgical decision-making.

The present study was designed according to a PICO-based framework in which the population comprised patients undergoing surgery for pilonidal sinus disease, the intervention was the Karydakis procedure, the comparator was the Limberg flap procedure, and the outcomes were perioperative recovery indicators and postoperative complications during the recovery period. The objective of this study was to compare postoperative complications and recovery outcomes between Karydakis and Limberg procedures among patients treated for pilonidal sinus disease. The study hypothesized that postoperative complication rates and recovery indicators differ significantly between the two surgical techniques.

MATERIALS AND METHODS

This retrospective comparative observational study was conducted at Chaudhry Hospital, Lahore, over a four-month data collection period following approval of the study synopsis. The study included patients who had undergone surgical treatment for pilonidal sinus disease using either the Karydakis procedure or the Limberg flap procedure. A retrospective design was selected because the study objective was to evaluate real-world postoperative recovery and complication patterns using available hospital records, operative notes, and follow-up documentation.

A total of 78 patients were included through non-probability convenience sampling. Eligible participants were patients with documented pilonidal sinus disease who underwent either Karydakis or Limberg surgery and had available perioperative and postoperative follow-up records sufficient to assess the study outcomes. Patients with incomplete medical records or significant comorbid conditions likely to independently impair wound healing were excluded. The exposure variable was type of surgical procedure, categorized as Karydakis or Limberg flap. Demographic and baseline variables included age group, gender, body mass index category, American Society of Anesthesiologists classification, duration of symptoms, and duration of operation.

The primary postoperative outcomes were wound-related complications, including wound infection, hematoma, seroma, wound dehiscence, edema, and postoperative pain. Recovery-related outcomes included duration of hospital stay, time of drain removal, time of suture removal, and return to daily activities. Wound infection was recorded when postoperative documentation indicated clinical evidence of infection requiring recognition or management. Hematoma and seroma were recorded when documented as postoperative collections. Wound dehiscence was defined as partial or complete separation of the surgical wound margins during follow-up. Edema and pain were recorded as documented postoperative clinical findings. Hospital stay was categorized in days, drain removal was categorized by postoperative timing, suture removal was categorized by day of removal, and return to daily activities was categorized by postoperative month.

Data were extracted from hospital records and operative notes using a structured data collection approach to maintain consistency across cases. To reduce information bias, only documented clinical and operative information was used, and cases with insufficient records were excluded. Potential confounding by baseline characteristics was assessed descriptively by comparing age, gender, BMI, ASA classification, duration of symptoms, and duration of operation between the two procedure groups. Because the study used retrospective hospital data and a fixed available sample, the sample size was

based on all eligible cases meeting inclusion criteria during the study period rather than a prospective sample size calculation.

Data were entered and analyzed using SPSS. Categorical variables were summarized as frequencies and percentages. Group comparisons between Karydakis and Limberg procedures were performed using appropriate categorical tests, primarily the chi-square test or Fisher's exact test where expected cell counts were small. A p-value of ≤0.05 was considered statistically significant. Missing or incomplete records were handled by excluding cases that lacked essential outcome information. Data integrity was maintained by checking extracted values against source records before analysis, using consistent category coding, and preserving the same denominators across tables and narrative reporting. Ethical principles for retrospective clinical research were followed by using existing medical records and maintaining patient confidentiality throughout data extraction and analysis. No personally identifiable patient information was reported in the manuscript.

RESULTS

A total of 78 patients were included, of whom 43 underwent the Karydakis procedure and 35 underwent the Limberg flap procedure. Baseline characteristics were broadly comparable between groups, with no statistically significant differences in ASA class, duration of symptoms, or duration of operation. Most patients were male, and more than half were obese.

Table 1. Baseline and Clinical Characteristics of Patients by Surgical Procedure

Variable	Karydakis, n=43	Limberg, n=35	Total, N=78	p-value
Type of procedure	43 (55.1%)	35 (44.9%)	78 (100%)	—
ASA I	3	1	4	0.317
ASA II	30	21	51	
ASA III	9	13	22	
ASA IV	1	0	1	
Symptoms 1–6 months	9	15	24	0.143
Symptoms 6 months–1 year	18	8	26	
Symptoms 1–1.5 years	4	2	6	
Symptoms 1.5–2 years	12	10	22	
Operation duration 40–50 min	11	8	19	0.780
Operation duration 51–70 min	32	27	59	

Table 2. Overall Demographic Distribution of the Study Population

Variable	Frequency	Percentage
Age 18–25 years	12	15.4%
Age 26–35 years	21	26.9%
Age 36–45 years	23	29.5%
Age 46–55 years	15	19.2%
Age 56–65 years	7	9.0%
Male	58	74.4%
Female	20	25.6%
Overweight BMI 25–29.9	34	43.6%
Obese BMI >30	44	56.4%

Table 3. Recovery Outcomes After Karydakis and Limberg Procedures

Outcome	Karydakis, n=43	Limberg, n=35	Total, N=78	p-value
Hospital stay 1 day	8	1	9	0.039
Hospital stay 2 days	25	19	44	
Hospital stay 3 days	10	15	25	
Drain removal after 24 hours	30	9	39	<0.001
Drain removal after 48 hours	6	14	20	
Drain removal after 72 hours	7	12	19	
Suture removal after 12 days	5	4	9	0.555
Suture removal after 14 days	18	16	34	
Suture removal after 16 days	7	4	11	

Outcome	Karydakis, n=43	Limberg, n=35	Total, N=78	p-value
Suture removal after 18 days	11	6	17	
Suture removal after 20 days	2	5	7	
Return to daily activity after 2 months	31	15	46	0.018
Return to daily activity after 3 months	10	13	23	
Return to daily activity after 4 months	2	7	9	

The Karydakis group showed significantly faster postoperative recovery, with shorter hospital stay (p=0.039), earlier drain removal (p<0.001), and earlier return to daily activities (p=0.018). Suture removal timing was similar between groups (p=0.555).

Table 4. Postoperative Complications by Procedure

Complication	Karydakis Yes/Total	Limberg Yes/Total	Odds Ratio	95% CI	p-value
Wound infection	18/43	6/35	3.48	1.20–10.12	0.019
Hematoma	16/43	12/35	1.14	0.45–2.89	0.789
Seroma	2/43*	18/35*	Not calculated	Not calculated	<0.001
Wound dehiscence	15/43	2/35	8.84	1.86–42.02	0.002
Edema	18/43	7/35	2.88	1.03–8.04	0.040
Pain	14/43	11/35	1.05	0.40–2.74	0.915

*The seroma table in the source manuscript contains inconsistent row totals; therefore, effect size and confidence interval were not calculated until the raw count is verified. Wound infection was significantly more frequent in the Karydakis group than in the Limberg group (41.9% vs 17.1%; OR=3.48, 95% CI 1.20–10.12; p=0.019). Wound dehiscence was also markedly higher after Karydakis surgery (34.9% vs 5.7%; OR=8.84, 95% CI 1.86–42.02; p=0.002). Edema occurred in 41.9% of Karydakis patients compared with 20.0% of Limberg patients (OR=2.88, 95% CI 1.03–8.04; p=0.040). Hematoma and postoperative pain did not differ significantly between groups.

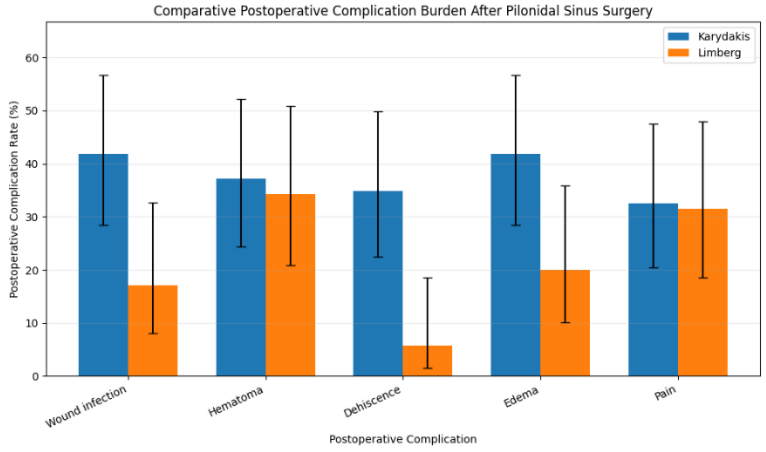

Figure 1. Comparative Postoperative Complication Burden After Pilonidal Sinus Surgery

Figure 1 demonstrates a higher wound-related complication burden after the Karydakis procedure for wound infection, dehiscence, and edema, while hematoma and pain showed overlapping confidence intervals between groups. The largest clinically meaningful difference was observed for wound dehiscence, affecting 34.9% of Karydakis patients compared with 5.7% of Limberg patients, followed by wound infection at 41.9% versus 17.1% and edema at 41.9% versus 20.0%, respectively. Seroma was excluded from the figure because the source table contained inconsistent denominators requiring correction before visual or inferential interpretation.

DISCUSSION

This retrospective comparative study found that both Karydakis and Limberg procedures were used successfully for pilonidal sinus disease, but their postoperative profiles differed. The Karydakis procedure was associated with faster recovery indicators, including shorter hospital stay, earlier drain removal, and earlier return to daily activities. These findings support the practical advantage of off-

midline closure techniques that reduce natal cleft depth and may facilitate earlier mobilization and postoperative recovery. However, this recovery advantage must be interpreted alongside the higher frequency of wound-related complications observed in the Karydakis group, particularly wound infection, wound dehiscence, and edema.

The predominance of male patients and the high proportion of overweight and obese participants are consistent with the established epidemiological pattern of pilonidal sinus disease. Previous studies have reported that pilonidal disease occurs more frequently in males and is influenced by local hair burden, deep natal cleft anatomy, friction, sweating, obesity, and prolonged sitting. These factors may increase local inflammation and mechanical stress at the surgical site, thereby contributing to postoperative morbidity (1,2). In the present study, more than half of the participants were obese, which may have increased the overall risk of wound complications, although the retrospective design limited detailed adjustment for BMI-related confounding.

The lower rates of wound infection, dehiscence, and edema in the Limberg group suggest that flap-based reconstruction may provide more favorable wound stability in this cohort. This finding is clinically relevant because wound complications after pilonidal sinus surgery can prolong dressing requirements, delay return to work, increase follow-up visits, and affect patient satisfaction. Previous comparative literature has shown variable results between Karydakis and Limberg techniques, with some studies favoring Karydakis for shorter recovery and others favoring Limberg for lower wound morbidity or recurrence risk (4–6,10–12). The present findings align with the concept that no single procedure is universally superior; rather, the preferred surgical technique should be individualized according to patient characteristics, disease extent, surgeon expertise, and whether the priority is faster recovery or reduced wound morbidity.

Hematoma and postoperative pain did not differ significantly between the two groups, suggesting that both procedures may have comparable short-term profiles for these outcomes. Similarly, suture removal timing was not significantly different, indicating that wound maturation sufficient for suture removal followed a broadly similar timeline in both groups. In contrast, drain removal and hospital stay favored the Karydakis group, which may reflect differences in flap geometry, dead space, surgeon preference, or postoperative drain protocols. Because these variables were collected retrospectively, procedural standardization could not be fully confirmed.

This study has several limitations. Its retrospective design limits control over documentation quality, postoperative assessment timing, and unmeasured confounders. Convenience sampling may reduce generalizability, and the modest sample size limits statistical power for less frequent complications. Important factors such as smoking status, hygiene practices, disease complexity, prior abscess drainage, surgeon experience, antibiotic use, wound care protocol, drain criteria, and recurrence were not fully analyzed. Despite these limitations, the study provides useful local comparative evidence and highlights the clinical trade-off between faster recovery and wound complication risk after pilonidal sinus surgery.

CONCLUSION

In this retrospective comparison of Karydakis and Limberg procedures for pilonidal sinus disease, the Karydakis procedure was associated with shorter hospital stay, earlier drain removal, and faster return to daily activities, whereas the Limberg flap showed a more favorable wound-complication profile, particularly for wound infection, dehiscence, and edema. Hematoma, postoperative pain, duration of operation, and timing of suture removal were comparable between groups. These findings suggest that both procedures remain valid surgical options, but procedure selection should be individualized according to patient risk factors, surgical expertise, and the clinical priority of either faster functional recovery or reduced wound morbidity. The seroma data should be verified before final submission because the current table contains inconsistent denominators.

REFERENCES

1. Demiryas S, Donmez T. Could early postoperative complications be considered as risk factor for recurrence after pilonidal sinus surgery. Chirurgia. 2019;114(4):475-486.
2. Onder A, Girgin S, Kapan M, Toker M, Arikanoglu Z, Palanci Y, et al. Pilonidal sinus disease: risk factors for postoperative complications and recurrence. Int Surg. 2012;97(3):224-229.
3. Brown SR, Hind D, Strong E, Bradburn M, Din F, Lee E, et al. Real-world practice and outcomes in pilonidal surgery: Pilonidal Sinus Treatment Studying The Options (PITSTOP) cohort. Br J Surg. 2024;111(3):znae009.
4. Kanlioz M, Ekici U. Complications during the recovery period after pilonidal sinus surgery. Cureus. 2019;11(4).
5. de Kort J, Pronk AA, Vriens MR, Smakman N, Furnee EJ. Long-term follow-up of sacrococcygeal pilonidal sinus disease after previous abscess drainage: a retrospective cohort study. J Gastrointest Surg. 2025;29(2):101892.
6. Kaba M. New factors affecting wound healing and recurrence after pilonidal sinus surgery in adolescents; seborrheic dermatitis and psychiatric co-occurring conditions. Int Wound J. 2024;21(1):e14404.
7. Spyridakis M, Christodoulidis G, Chatzitheofilou C, Symeonidis D, Tepetes K. The role of platelet-rich plasma in accelerating the wound-healing process and recovery in patients being operated for pilonidal sinus disease: preliminary results. World J Surg. 2009;33(8):1764-1769.
8. Zubair R, Channa MA. Limberg flap technique for pilonidal sinus disease treatment: an experience of Hamdard University Hospital. J Ayub Med Coll Abbottabad. 2022;34(2):230-234.
9. Al-Khayat H, Al-Khayat H, Sadeq A, Groof A, Haider HH, Hayati H, et al. Risk factors for wound complication in pilonidal sinus procedures. J Am Coll Surg. 2007;205(3):439-444.
10. Milone M, Velotti N, Manigrasso M, Anoldo P, Milone F, De Palma GD. Long-term follow-up for pilonidal sinus surgery: a review of literature with metanalysis. Surgeon. 2018;16(5):315-320.
11. Kartal A, Aydın HO, Oduncu M, Ferhatoğlu MF, Kıvılcım T, Filiz Aİ. Comparison of three surgical techniques in pilonidal sinus surgery. Prague Med Rep. 2019;119(4):148-155.
12. Unalp HR, Derici H, Kamer E, Nazli O, Onal MA. Lower recurrence rate for Limberg vs VY flap for pilonidal sinus. Dis Colon Rectum. 2007;50(9):1436-1444.
13. Breidung D, Billner M, Buben P, Grieb G, Sievers R, Reichert B, et al. Evaluation of clinical outcomes and quality of life following the Karydakis flap procedure for pilonidal sinus treatment. Adv Skin Wound Care. 2024;37(11-12):1-6.
14. Ali MA. To study the surgical outcome of Z plasty versus Limberg flap in the management of pilonidal sinus disease [master's thesis]. Rajiv Gandhi University of Health Sciences; 2019.