

Limberg versus Karydakis Flap Techniques in the Surgical Management of Pilonidal Sinus Disease: A Prospective Interventional Study

RAM KUMAR BALASUBRAMANIAN¹, BV SREEDEVI², SUNDEEP KUMAR SELVAMUTHUKUMARA³,
POLA GOVARDHAN KUMAR⁴, KG MAHESH⁵



ABSTRACT

Introduction: Pilonidal Sinus Disease (PSD) is a chronic condition primarily affecting the sacrococcygeal area. Limberg and Karydakis flaps are common surgical approaches due to their low complication and recurrence rates.

Aim: To compare the outcomes of Limberg and Karydakis flap techniques in managing primary PSD.

Materials and Methods: This prospective interventional study was conducted at the Department of General Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India, over 18 months from July 2023 to December 2024. It involved 30 patients with primary PSD, who were divided into two equal groups with n=15/group: one underwent Limberg flap reconstruction, and the other received the Karydakis procedure. The outcomes were measured by operative time, blood loss, time to drain removal, and patient satisfaction with cosmetic outcome. The statistical analysis was carried out by

an Unpaired t-test for continuous variables and a Chi-square test for categorical variables.

Results: The study population was predominantly male, n=20 (80%). The patients in the Limberg flap group experienced significantly shorter operative time (49.3±4.5 vs 54.7±5.6 minutes, p-value <0.001), less blood loss (58.6±10.2 and 64.3±11.1 ml, p-value <0.05), quicker return to work (9.3±2.1 and 11.1±2.4 days, p-value <0.05), and a faster time to drain removal (2.9±0.8 and 3.7±1.1 days, p-value=0.01) than Karydakis flap, respectively. The Karydakis group had one recurrence, while the Limberg group had none. However, there were no statistically significant differences in wound complications, recurrence, or patient satisfaction between the two groups.

Conclusion: The study found that while both flap techniques are effective, the Limberg flap had better perioperative outcomes and faster recovery. Hence, the Limberg flap may offer better overall outcomes, but additional research is needed.

Keywords: Postoperative complications, Sacrococcygeal pilonidal disease, Seroma, Sinus management

INTRODUCTION

The PSD is a chronic inflammatory condition that primarily affects the sacrococcygeal region and is characterised by the presence of one or more sinus tracts lined with granulation tissue, often containing hair and debris. It typically presents with pain, swelling, purulent discharge, and occasional abscess formation [1,2]. Globally, the incidence of PSD is higher in males as compared to females, with a male-to-female ratio between 2:1 and 4:1. Though there are many varying incidences reported from different population cohorts in the published literature, the increase in incidence has been noted to be nearly similar in both genders [2,3]. The disease is particularly prevalent among young males aged 15 to 30 years, coinciding with increased hair growth, heightened physical activity, and greater susceptibility to friction and sweating. Professions that require prolonged sitting, such as driving, studying, military service, and IT work, experience a disproportionately higher burden [1,3]. PSD has a multifactorial underlying aetiology. Acquired theories currently dominate the understanding, implicating hair penetration into the skin through repeated trauma, friction, and local inflammation as primary causes. Moreover, the disease affects workplace productivity, with prolonged time off work during recovery periods. The disease course is chronic, with recurrent infections and abscesses disrupting patients' quality of life and daily functioning [2,4,5].

Management strategies for PSD have undergone significant evolution over the decades. While non operative methods may be employed in asymptomatic cases or early presentations, the cornerstone of definitive management remains surgical excision [6,7]. Several surgical procedures are utilised in the management

of PSD, ranging from simple incision and drainage to wide local excision with primary closure, marsupialisation, and reconstructive flap techniques [8]. Among these, the Limberg flap and Karydakis flap surgeries are the two most frequently performed techniques aimed at minimising recurrence and optimising postoperative recovery. The Limberg flap approach is a common approach known for offering an excellent exposure, low tension closure, and favourable cosmetic outcomes. Conversely, the Karydakis procedure employs an elliptical, asymmetric excision with lateralisation of the surgical wound away from the midline, which in turn flattens the natal cleft and reduces mechanical stress and hair insertion by shifting the incision line. It is lauded for its simplicity, shorter operative time, and relatively lower recurrence [7-10]. The published literature has varying results concerning recurrence rates, postoperative complications (such as seroma, infection, wound dehiscence), time to complete healing, duration of hospital stay, and patient satisfaction [11,12]. Hence, this study aimed to provide a comparison of the Limberg flap and Karydakis flap techniques in the surgical treatment of PSD.

MATERIALS AND METHODS

A prospective interventional study was conducted at the Department of General Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India, from July 2023 to December 2024. The study was approved by ethical approval reference number 002/SBMCH/IHEC/2023/2078.

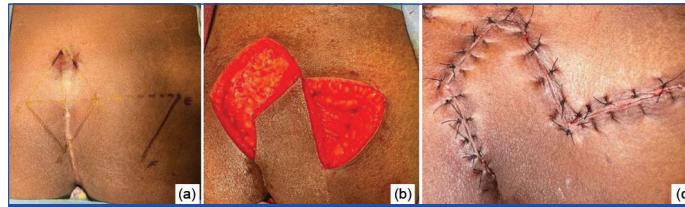
Simple consecutive sampling was applied. This study enrolled a total of 30 patients on the basis of the diagnosis. Patients were assigned to either the Limberg flap or the Karydakis flap group based on clinical suitability. Clinical suitability was decided by the surgeons.

Inclusion criteria: Patients between 15 and 65 years of age with a confirmed diagnosis of primary PSD, established through clinical examination and/or radiological findings, were included. Patients willing to give consent for surgical treatment and committed to attending postoperative follow-up visits were included.

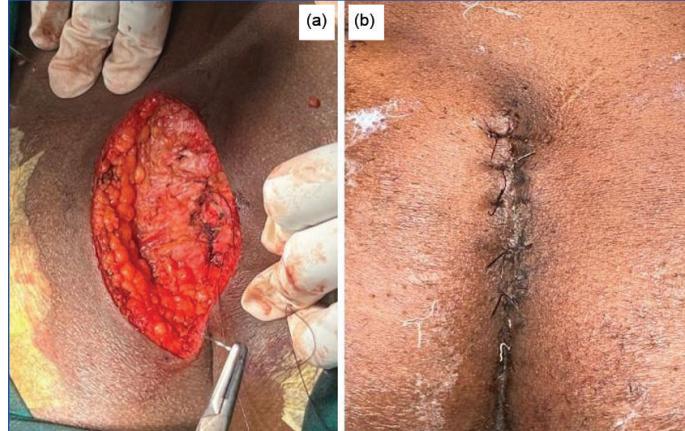
Exclusion criteria: Patients with a history of recurrent PSD and those with complex sinus tracts identified on clinical or radiological evaluation were excluded. Those presenting with an acute abscess on admission, comorbid conditions such as diabetes mellitus or immunodeficiency disorders, which can impair wound healing, were also excluded. Other exclusion criteria included the presence of secondary infection at the surgical site and refusal to undergo surgery or participate in follow-up.

Study Procedure

The Limberg flap approach involves a rhomboid-shaped excision of the sinus tract, followed by the transposition of an adjacent skin flap to cover the defect, resulting in the flattening of the natal cleft [Table/Fig-1]. The Karydakis procedure employed creating an elliptical, asymmetric excision with lateralisation of the surgical wound away from the midline, for flattening of the natal cleft and reducing the mechanical stress and hair insertion by shifting the incision line [Table/Fig-2].



[Table/Fig-1]: Limberg flap: a) Pre-operative; b) Intraoperative; c) Postoperative image.



[Table/Fig-2]: Karydakis flap: a) Intraoperative; b) Postoperative image of the flap.

Outcomes: The primary outcomes studied were operative time (in minutes), intraoperative blood loss (in mL), time to drain removal (in days), time to painless sitting (in days), and time to return to work (in days). The secondary outcomes included seroma formation, Surgical Site Infection (SSI), wound dehiscence, recurrence (within 4 months), cosmetic dissatisfaction and the willingness to recommend surgery to others.

STATISTICAL ANALYSIS

The data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) software version 25.0, Armonk, NY. Continuous variables were expressed as mean±standard deviation. Categorical variables were expressed as frequency and percentage. Comparisons between the Limberg and Karydakis groups were performed using the following tests: an unpaired t-test for continuous variables and a Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

The majority of patients (73.3%) were under 35 years of age, with a male predominance. Approximately two-thirds of patients, 19 (63.3%) had a positive history of prior antibiotic usage, most commonly due to recurrent discharge or inflammation [Table/Fig-3].

Variables	Category	n (%)
Age (in years)	15-25	10 (33.3)
	26-35	12 (40)
	36-45	6 (20)
	46-55	2 (6.7)
Gender	Male	24 (80)
	Female	6 (20)
Body Mass Index (kg/m ²)	< 18.5 (Underweight)	1 (3.3)
	18.5 - 24.9 (Normal)	11 (36.7)
	25 - 29.9 (Overweight)	12 (40)
	≥ 30 (Obese)	6 (20)
Symptoms duration	<1 month	3 (10)
	1-3 months	11 (36.7)
	4-6 months	9 (30)
	>6 months	7 (23.3)
Clinical symptoms	Pain	30 (100)
	Intermittent discharge	20 (66.7)
	Swelling	14 (46.7)
	Difficulty sitting	9 (30)
Magnetic resonance imaging (done for 14 subjects only)	Simple tract (Yes)	14 (46.7)
	Complex tract (Yes)	0
Prior antibiotic history	Antibiotic use (Yes)	19 (63.3)
	Antibiotic use (no)	11 (36.7)

[Table/Fig-3]: Demographic and clinical profile of the study participants.

Statistically significant differences favouring the Limberg flap were found in operative time, blood loss, time to drain removal, time to painless sitting, and time to return to work (p-value <0.05) [Table/Fig-4].

Surgical technique	Limberg flap (n=15)	Karydakis flap (n=15)	t-statistic	p-value
Mean operative time (minutes)	49.3±4.5	54.7±5.6	-2.91	0.001#
Intraoperative blood loss (mL)	58.6±10.2	64.3±11.1	-1.46	0.04#
Time to drain removal (days)	2.9±0.8	3.7±1.1	-2.28	0.01#
Time to painless sitting (days)	6.1±1.2	7.4±1.5	-2.62	0.03#
Time to return to work/ school (days)	9.3±2.1	11.1±2.4	-2.19	0.02#

[Table/Fig-4]: Comparative profile of operative outcomes of the study groups (Limberg and Karydakis flap procedures).

#Unpaired t-test, #p-value <0.05 considered as significant.

Although both techniques were associated with low infection rates, the infection rate was half in the Limberg flap, with only 1 (6.7%) patient developing a SSI, compared to the Karydakis flap, where 2 (13.3%) patients were observed to have SSIs [Table/Fig-5].

Surgical technique	Limberg flap n (%)	Karydakis flap n (%)	p-value#
Seroma formation	1 (6.7)	3 (20.0)	0.25
Surgical Site Infection (SSI)	1 (6.7)	2 (13.3)	0.53
Wound dehiscence	0	2 (13.3)	0.14
Recurrence (≤4 months)	0	1 (6.7)	0.31

Cosmetic dissatisfaction (Self)	1 (6.7)	3 (20.0)	0.27
Willingness to recommend surgery	15 (100)	13 (86.7)	0.15

[Table/FIG-5]: Comparative evaluation of postoperative complications Limberg and Karydakis flap procedures.
#Chi-square test.

DISCUSSION

The majority of patients (73.3%) included in this research were aged between 15 and 35 years, with the highest incidence in the 26-35 years age group, emphasising the disease's predilection for young adults in their productive years. The mean age of the study group was 30.63 ± 8.76 years, which was nearly similar to the findings of Mentes O et al., and Arslan S et al., with the mean age of 27.6 and 30.6 years, respectively [8,12]. A clear male predominance was observed in the present study, with 80% of patients being male, resulting in a 4:1 male-to-female ratio. Factors such as increased hair density, deeper natal clefts, higher rates of sweating, and mechanical friction in males can be the primary underlying reasons [3,13].

The patients often undergo multiple rounds of conservative therapy before referral for definitive surgical management, which was also noted in this research. A meta-analysis highlighted that conservative measures such as antibiotics may provide temporary relief but do not eliminate the disease. Antibiotic use often delays necessary surgical intervention and might result in adverse outcomes in cases with chronic discharge and intermittent infection [14].

The mean operative time for the Limberg flap was significantly shorter than that of the Karydakis flap in this research study. It can be attributed to the familiarity of the surgical team with Limberg flap dissection. Hence, institutional experience should be taken into account when comparing operative times. In our cohort, the Limberg flap was executed with greater efficiency, suggesting its procedural suitability within this surgical unit.

Additionally, the durations of time to painless sitting and return to work/school were also shorter in the Limberg flap group, which may be due to the comfort provided by lateralised incision lines in this cohort. This is likely due to better flap fixation and wound integrity [15,16]. An earlier return to work is often influenced by pain, drain removal timing, and wound confidence-all of which favoured the Limberg group in this research setting. While Favuzza J et al., documented slightly faster return with Karydakis or cleft-lift techniques, their cohorts included daycare surgeries and younger patients under enhanced recovery protocols [17].

Seroma formation, wound dehiscence, and SSI were lower in the Limberg flap group than in the Karydakis flap group, suggesting greater wound stability and better tension distribution with the Limberg flap; however, the difference was not statistically significant. Tezel et al., reported similar trends, noting higher seroma rates in Karydakis flap patients due to the wider undermined area and less geometrically confined flap [5]. Mentes O et al., recommended quilting sutures in Limberg procedures to further minimise dead space, a technique applied in our study, which likely contributed to the low seroma incidence [8]. Mahdy T reported higher wound infection rates in midline closures and emphasised the benefits of flap techniques, particularly the Limberg technique, in reducing bacterial colonisation and enhancing wound healing [18]. Enriquez-Navascues JM et al., also emphasised that completeness of excision and off-midline closure are the most reliable predictors of recurrence, features well-integrated into the Limberg approach [19]. In this cohort, the single recurrence in the Karydakis group likely reflects individual variability or early mobilisation stresses; however, the zero-recurrence rate in Limberg patients suggests the reliability of this approach for the definitive management of primary PSD. All 15 patients in the Limberg group (100%) expressed willingness to

recommend the procedure, compared to 13 patients (86.7%) in the Karydakis group. It suggests a higher perceived success rate and confidence among Limberg recipients. These findings were also supported by Favuzza J et al., who emphasised that patient satisfaction is a composite measure, encompassing pain control, scar appearance, time to recovery, and recurrence prevention [17].

Limitation(s)

A major limitation is that the allocation of patients was not randomised; instead, patients were assigned based on clinical judgment. Additionally, it was a single-centre study with a follow-up period limited to four months, which may not fully capture long-term recurrence or late complications. Potential confounding variables, including co-morbidities, smoking status, hygiene practices, and occupational activity, were not controlled in the analysis.

CONCLUSION(S)

Both the Limberg flap and Karydakis flap techniques are safe and effective for treating primary PSD. The Limberg flap demonstrated statistically superior outcomes in perioperative parameters, including shorter operative times, less blood loss, and a faster return to daily activities, in a single-centre study with a limited follow-up duration.

REFERENCES

- Li Z, Jin L, Gong T, Qin K, Cui C, Wang Z, Wu J. An effective and considerable treatment of pilonidal sinus disease by laser ablation. *Lasers Med Sci*. 2023;38(1):82. Doi: 10.1007/s10103-023-03741-1. PMID: 36856904; PMCID: PMC9977879.
- Doll D, Brengelmann I, Schober P, Ommer A, Bosche F, Papalois AE, et al. Rethinking the causes of pilonidal sinus disease: A matched cohort study. *Scientific reports*. 2021;11(1):6210. Doi: 10.1038/s41598-021-85830-1.
- Luedi MM, Schober P, Stauffer VK, Diekmann M, Anderegg L, Doll D. Gender-specific prevalence of pilonidal sinus disease over time: A systematic review and meta-analysis. *ANZ J Surg*. 2021;91(7-8):1582-87. Doi: 10.1111/ans.16990.
- Chintapatla S, Safarani N, Kumar S, Haboubi N. Sacrococcygeal pilonidal sinus: Historical review, pathological insight and surgical options. *Tech Coloproctol*. 2003;7:03-08. Doi: 10.1007/s101510300001.
- Faurschou IK, Erichsen R, Doll D, Haas S. Time trends in incidence of pilonidal sinus disease from 1996 to 2021: A Danish population-based cohort study. *Colorectal Dis*. 2025;27(1):e17227. Doi: 10.1111/codi.17227.
- Huurman EA, Galema HA, de Raaff CA, Wijnhoven BP, Toorenvliet BR, Smeenk RM. Non-excisional techniques for the treatment of intergluteal pilonidal sinus disease: A systematic review. *Tech Coloproctol*. 2023;27(12):1191-200. Doi: 10.1007/s10151-023-02870-7.
- Song Y, Zang Y, Chen Z, Li J, Zhu M, Zhu H, et al. The application of the Limberg flap repair technique in the surgical treatment of pilonidal sinus disease. *Int Wound J*. 2023;20(6):2241-49. Doi: 10.1111/iwj.14105.
- Mentes O, Bagci M, Bilgin T, Ozgul O, Ozdemir M. Limberg flap procedure for pilonidal sinus disease: Results of 353 patients. *Langenbecks Arch Surg*. 2008;393:185-89. Doi: 10.1007/s00423-007-0227-9.
- Karydakis GE. Easy and successful treatment of pilonidal sinus after explanation of its causative process. *Aust N Z J Surg*. 1992;62:385-89. Doi: 10.1111/j.1445-2197.1992.tb07208.x.
- Lee MJ, Strong EB, Lund J, Hind D, Brown SR; PITSTOP Management Group. A survey of treatment preferences of UK surgeons in the treatment of pilonidal sinus disease. *Colorectal Dis*. 2023;25(10):2010-16. Doi: 10.1111/codi.16696. Epub 2023 Aug 15. PMID: 37583061.
- Oueidat D, Assi TB, Tomasello G, Mortada I, Jurjus A. Surgical treatment of sacrococcygeal pilonidal sinus with the Limberg flap: Review of 81 cases. *Euro Mediterranean Biomed J*. 2016;11:15.
- Arslan S, Karadeniz E, Ozturk G, Aydinli B, Bayraktutan MC, Atamanalp SS. Modified primary closure method for the treatment of pilonidal sinus. *Eurasian J Med*. 2016;48(2):84-89. Doi: 10.5152/eurasianjmed.2015.0059.
- Balı İ, Aziret M, Sozen S, Emir S, Erdem H, Çetinkünar S, et al. Effectiveness of Limberg and Karydakis flap in recurrent pilonidal sinus disease. *Clinics (Sao Paulo)*. 2015;70(5):350-55. Doi: 10.6061/clinics/2015(05)08.
- Gavriilidis P, Bota E. Limberg flap versus Karydakis flap for treating pilonidal sinus disease: A systematic review and meta-analysis. *Can J Surg*. 2019;62(2):131-38. Doi: 10.1503/cjs.003018.
- Arslan K, Said Kokcam S, Koksal H, Turan E, Atay A, Dogru O. Which flap method should be preferred for the treatment of pilonidal sinus? A prospective randomized study. *Tech Coloproctol*. 2014;18(1):29-37. Doi: 10.1007/s10151-013-0982-2.
- Alvandipour M, Zamani MS, Ghorbani M, Charati JY, Karami MY. Comparison of Limberg flap and Karydakis flap surgery for the treatment of patients with pilonidal sinus disease: A single-blinded parallel randomized study. *Ann Coloproctol*. 2019;35(6):313-18. Doi: 10.3393/ac.2018.09.27.

- [17] Favuzza J, Brand M, Francescatti A, Orkin B. Cleft lift procedure for pilonidal disease: Technique and perioperative management. *Tech Coloproctol*. 2015;19(8):477-82. Doi: 10.1007/s10151-015-1333-2.
- [18] Mahdy T. Surgical treatment of pilonidal sinus disease: Primary closure or flap reconstruction after excision. *Dis Colon Rectum*. 2008;51:1816-22. Doi: 10.1007/s10350-008-9436-8.
- [19] Enriquez-Navascués JM, Emparanza JI, Alkorta M, Placer C. Meta-analysis of randomized controlled trials comparing different techniques with primary closure for chronic pilonidal sinus. *Tech Coloproctol*. 2014;18(10):863-72. Doi: 10.1007/s10151-014-1149-5.

PARTICULARS OF CONTRIBUTORS:

1. Junior Resident, Department of Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India.
2. Professor, Department of Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India.
3. Assistant Professor, Department of Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India.
4. Assistant Professor, Department of Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India.
5. Senior Resident, Department of Surgery, Sree Balaji Medical College and Hospital, Chromepet, Chennai, Tamil Nadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. BV Sreedevi,
Professor, Department of Surgery, Sree Balaji Medical College and Hospital, No: 7,
CLC Works Road, Chromepet-600044, Chennai, Tamil Nadu, India.
E-mail: surgeonsreedevi@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.](#)

- Plagiarism X-checker: Oct 05, 2025
- Manual Googling: Nov 19, 2025
- iThenticate Software: Nov 21, 2025 (8%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Sep 12, 2025**

Date of Peer Review: **Oct 20, 2025**

Date of Acceptance: **Nov 23, 2025**

Date of Publishing: **Feb 01, 2026**