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# Comparison of Primary Midline Closure, Limberg Flap, and Karydakis Flap Techniques in Pilonidal Sinus Surgery

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**Background:** Pilonidal sinus (PS) is a common disease of the sacrococcygeal-natal region. There are many treatment options, but there is still no consensus on the ideal treatment. We compared the results of our PS patients who were treated with primary midline closure (PMC), Limberg flap repair (LFR), and Karydakis flap (KF).

**Material/Methods:** The data for 924 PS patients from 2013 to 2017 were retrospectively examined. Demographic data, surgical procedures, schedules, and recurrence rates were examined.





**Results:** The mean age was 28.4 years (14–77 years), 82.5% were male (n=762), and 17.5% were female (n=162). PMC was performed on 53.7% (n=496) of the patients, 32.5% (n=300) received LFR, and 13.9% (n=128) underwent KF. PMC was the first choice among females but LFR was the first choice in recurrent patients. The recurrence rate was 10.8% in the PMC group, 8% in the LFR group, and 3.1% in the KF group. In Short Form Survey-36 (SF-36) scores, the best cosmetic outcomes were observed in cases of PMC (p<0.05). Overall, wound dehiscence (WD) was observed in 7.5%, surgical site infection (SSI) in 2.4%, and seroma in 8.5% of all patients. The KF group had the lowest complication rates (p<0.01).

**Conclusions:** According to the results of this study, the reason for preferring PMC among women is cosmetic concerns. PMC still remains important for treatment, but it should be noted that the recurrence rates due to inadequate excision are mostly observed in cases of PMC. Considering their low recurrence rates, LFR or KF should be considered first. When low recurrence rates, patient comfort, and cosmetic results are evaluated together, KF in particular emerges as a method preferred by physicians and patients.

**MeSH Keywords:** **Pilonidal Sinus • Recurrence • Surgical Flaps**

**Abbreviations:** **LFR** – Limberg flap repair; **KF** – Karydakis flap; **PMC** – primary midline closure; **PS** – pilonidal sinus; **SSI** – surgical site infection; **WD** – wound dehiscence; **SF-36** – Short Form 36

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## Background

Pilonidal sinus (PS) is a common chronic disease of the sacrococcygeal and natal region and has an incidence of 26/100 000 population [1,2]. Men are 2.2–4 times more susceptible than women [3]. There are many treatment methods defined for PS, but the ideal treatment in PS surgery is still controversial. The most appropriate method of treatment would be one with the lowest rate of recurrence.

The wide spectrum of surgical techniques applied for PS ranges from flap reconstructions to minimally invasive procedures [4,5]. It has been reported that flap techniques such as the Limberg, Rhomboid, Karydakis, V-Y flap, and Z-plasty techniques cause serious cosmetic concerns in patients but are more advantageous than primary midline closure (PMC) with regard to recurrence. Thus, certain patient groups, especially female patients, may prefer PMC due to cosmetic concerns despite the high level of recurrence.

The aim of this study was to report and compare the results of Karydakis flap (KF) technique, Limberg flap repair (LFR) technique, and PMC technique for PS surgery in a large patient population.

## Material and Methods

This study retrospectively evaluated patients who were seen between November 2013 and December 2017. Hitit University Erol Olçok Training and Research Hospital Scientific Research Committee approved the study (No. 40600303-604.02). The study included all patients who came to the clinic due to PS and whose regular follow-up period continued for 6 months after the operation within the study period. Informed consent was obtained from all patients. The PMC, LFR, and KF techniques were applied to the patients who came for routine PS treatment in our clinic. The technique was decided by the surgical team by considering the patient's requests after explaining the advantages and disadvantages of all methods to them. The patients who received the PMC method were group I (53.7%, n=496), those who received the LFR method were group II (32.5%, n=300), and those who received the KF method were group III (13.9%, n=128).

Age, gender, surgical schedule (after abscess drainage/elective), surgical procedures, complications, and the recurrences of all patients were evaluated. All patients underwent routine physical examination and laboratory evaluation before the operation. The PMC operation was preferred by patients who had cosmetic concerns and had not suffered from recurrence according to the pre-operation evaluation. LFR and KF operations were applied to patients who had concerns about

recurrence or if they had undergone PS surgery previously and suffered from recurrence.

Operations were carried out by junior surgeons using similar techniques under the supervision of specialist surgeons. All patients were discharged after they were followed up for 24 h after the operation. The 24-h amount of drainage was less than 25 ml in cases of pulling the drain. The life quality standards of all patients who came for the 6-month follow-up period after the operation were evaluated through Short Form Survey (SF-36). On the 15<sup>th</sup> day, 3<sup>rd</sup> month, and 6<sup>th</sup> month after the operation, the patients were asked whether they had pain, rash, discomfort that limited their daily activities, incontinence problems, any problems due to their diseases at their current jobs, or disturbances due to the cosmetic outcomes of the surgery after recovery. The patients were followed up in the outpatient clinic by the specialist surgeons who had carried out the operation.

SPSS for Mac 22.0 (licensed to Hitit University) was used to statistically assess the data. The Kruskal-Wallis test was used for inter-group comparison and the Mann-Whitney U test was used for bilateral group comparison. The frequencies, minima, maxima, standard deviations, and averages are reported for demographic data.  $p < 0.05$  was considered statistically significant.

## Results

The mean age of the patients was 28.4 (14–77) years, 82.5% were male (n=762) and 17.5% is female (n=162). There were no statistically significant differences between groups in terms of gender or age ( $p > 0.05$ , Table 1). All of the surgeries were carried out with spinal anesthesia. Cefazolin sodium (1 g) was administered 30 min before anesthesia induction, and Hemovac drains were placed in 46.4% of the patients (groups II and III). Drains were applied to 91% of patients (n=841) for the first time (primary) and had been surgically administered previously (recurrence) in 9.3% (n=83). We found that 9.4% (n=87) of the patients had undergone surgery in the same session with acute pilonidal abscess drainage, and 1.6% (n=15) had undergone surgery 3 weeks after elective surgery for pilonidal abscess drainage. Surgical treatment was performed for the chronic process in 89% of the patients (n= 822). There were statistically significant differences between groups in terms of surgery timing ( $p < 0.05$ , Table 1). PMC was the first choice among female patients, followed by LFR and KF. LFR was the first choice in recurrent patients, followed by PMC and KF.

In SF-36 scores, the best cosmetic outcomes were observed in with PMC, followed by the KF and LFR techniques (Group I 73.5±14.9, Group II 85.2±16.3, Group III 80.2±15.5) ( $p < 0.05$ ). There were no statistically significant differences in the

**Table 1.** Distribution and baseline characteristics of groups.

		Group I (PMC)	Group II (LFR)	Group III (KF)	p Value
Number of patients		496 (53.7%)	300 (32.5%)	128 (13.9%)	
Age (min–max years)		26 (15–77)	27 (15–62)	24 (14–76)	p=0.42
Sex (Male/Female)		404/92	251/49	107/21	p=0.661
Surgery timing					p=0.012
Chronic process	Primary case	382	269	106	
	Recurrence case	30	23	12	
Acute process	Primary case	68	2	1	
	Recurrence case	14	1	1	
Elective process	Primary case	2	5	6	
	Recurrence case	0	0	2	

PMC – primary midline closure; LFR – Limberg flap repair; KF – Karydakias flap.

**Table 2.** Number and rates of recurrence in the groups.

	Number of patients	Recurrence (%)
Group I	496	n: 54 (10.8%)
Group II	300	n: 24 (8%)
Group III	128	n: 5 (3.16%)
Total patients	924	n: 83 (8.98%)

Group I – Primary midline closure; Group II – Limberg flap;  
Group III – Karydakias flap.

limitation of daily activities between surgical techniques ( $p>0.05$ ). The number of recurrences was examined ( $n=83$ ), and recurrence was most commonly observed in cases of PMC ( $n=54$ ). The lowest recurrence was found in patients who had undergone KF ( $n=5$ ). This difference was statistically significant ( $p<0.05$ ). Recurrence occurred in 24 patients after LFR (Table 2). The recurrence rate was 10.8% in the PMC group, 8% in the LFR group, and 3.1% in the KF group.

We compared the complications of each surgical procedure. Overall, wound dehiscence was observed in 7.5% ( $n=70$ ), surgical site infection was observed in 2.4% ( $n=23$ ), and seroma was observed in 8.5% ( $n=79$ ) of all patients. There were no cases of skin necrosis in any groups (Table 3). There were statistically

**Table 3.** Complications according to groups and surgical case type.

		Group I (PMC)	Group II (LFR)	Group III (KF)	p Value
SSI (n)	Primary case	11	5	1	p=0.08
	Recurrence case	2	3	1	
	Total: 13	Total: 8	Total: 2		
WD (n)	Primary case	26	15	0	p=0.03
	Recurrence case	18	8	3	
	Total: 44	Total: 23	Total: 3		
Seroma (n)	Primary case	24	15	0	p=0.07
	Recurrence case	19	13	8	
	Total: 43	Total: 28	Total: 8		
Necrosis (n)	Primary case	0	0	0	p>0.05
	Recurrence case	0	0	0	
	Total: 0	Total: 0	Total: 0		

SSI – surgical site infection; WD – wound dehiscence; PMC – primary midline closure; LFR – Limberg flap repair; KF – Karydakias flap.

significant differences in surgical site infections (SSI) in all groups ( $p < 0.01$ ), and the KF group had the lowest SSI rates (Table 3). The rates of wound dehiscence and seroma showed statistically significant differences in all groups ( $p < 0.01$ ), and the KF group had the lowest rates (Table 3).

## Discussion

Herbert Mayo described PS in detail for the first time in 1833. This chronic, infectious, benign disease of the sacro-coccygeal region [6] is 2.2–4 times more common in males than in females [3,7]. We also observed that it was more common in males than females. The incidence of the disease was 29/100 000 in the 2000s but is now 48/100 000 [8]. Many conservative and surgical methods have been defined for the treatment of PS, but there is still no method that is accepted as the ideal treatment, and, most importantly, no treatment method can eliminate the risk of the recurrence of the disease [9].

In patients who underwent PMC, the duration of the operation and the duration of hospital stay were quite short compared to other methods, but there are many studies reporting that the recurrence rates are higher [10–12], as well as some studies suggesting that PMC has a lower rate of recurrence and should be preferred [13]. The present study found that the recurrence rate was highest for patients with PMC, which is consistent with the literature. The recurrence rate when PS was treated with LFR has been reported as 0–5% [14,15]. In the present study, the recurrence rate was 8% in patients with LFR [16].

The KF technique is an asymmetric primary closure technique. The KF technique had a reported recurrence rate of less than 1% in 7471 patients in approximately 20 years of follow-up [17,18]. We observed the lowest recurrence rate in cases of KF (3.1%).

The results of this study show that PMC is preferred among female patients compared to the other operations. We think this is due to cosmetic concerns. PMC is still important as a treatment method for many surgeons. However, it should be

noted that the recurrence rates due to inadequate excision are highest in PMC.

As another cause of recurrence, it is clear that a large number of recurrences occurred with certain surgeons in acute infective cases. In this study, 9.3% of the patients had undergone surgery in the same session with acute pilonidal abscess drainage, and 10% of recurrence cases occurred in this group. Therefore, after the abscess drainage is established, it is recommended that sinus excision be performed in another session after inflammation has subsided. Considering the low recurrence rates in recurrent cases, LFR or KF should be considered first. Even if flap techniques such as KF or LFR are unpopular, KF is a preferable method for patients who have concerns about cosmetics and recurrence, which has also been reported in other studies [19,20].

This study has some limitations. First, it was retrospective, and multiple surgeons performed the operations, which could have a negative impact in terms of standardization. However, we tried to standardize the patients through operation notes and pathological examinations. Another limitation is that the statistical difference between the groups may not be significant due to the high population differences between them. This may explain some of our differences from the literature in the recurrence rates. Therefore, it would be desirable to conduct a prospective study with a large population to improve the validity of the results.

## Conclusions

Considering their low recurrence rates, LFR or KF should be considered first. When low recurrence rates, patient comfort, and cosmetic results are evaluated together, KF emerges a method that is preferred by physicians and patients.

## Conflicts of interest

None.

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