



# Surgical Outcome of Modified Karydakis Flap and Modified Limberg Flap in the Management of Sacrococcygeal Pilonidal Disease: A Comparative Study

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## Abstract

**Introduction** Sacrococcygeal pilonidal disease (SPD) is a chronic suppurative condition of the sacrococcygeal region causing chronic sinus tract or cyst. It is an acquired complex disease more common in young adult males, causing considerable morbidity and long periods of interruption in work or education. From simple conservative techniques to complex flap reconstruction, many debatable treatment options are offered; however clear dynamics toward the widespread use of minimally invasive methods and off-midline flap reconstruction are suggested in all guidelines, which recommend the Karydakis and Limberg flap modification. The plethora of literature compares procedures for identification of a single best treatment approach, which has proven to be difficult. The surgical outcome of both techniques is compared in the present study.

**Objective** To compare the surgical outcomes of the modified Karydakis flap (MKF) versus the modified Limberg flap (MLF) in SPD.

**Materials and Methods** The present study was conducted at the general surgery department on SPD patients who were  $\geq 18$  years old. A total of 67 participants were included after obtaining the informed consent, with group A comprising 33 patients undergoing the MLF procedure and group B comprising 34 patients undergoing the MKF procedure.

**Results** The mean patient age was 28.85 (range, 18–44) years old. For the MKF and MLF methods, the average operating duration was 32.5 (range, 25–40) and 54.5 (range, 45–65) minutes, respectively. The MKF approach was found to significantly improve pain score, mean sitting painless time, return to normal activity, wound healing time, and patient satisfaction.

**Conclusion** Comparative outcomes were seen between both MKF and MLF; however, our findings show that MKF is a more favourable method than MLF with superior outcomes.

## Keywords

- ▶ modified karydakis
- ▶ limberg flap
- ▶ pilonidal sinus

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## Introduction

A chronic sinus or cyst in the gluteal cleft are two main symptoms of sacrococcygeal pilonidal disease (SPD), which is defined as a chronic suppurative condition of the sacrococcygeal region that is occasionally misunderstood as an anal-related condition.<sup>1-3</sup> It may be asymptomatic or may present with acute abscess formation. In its chronic phase, there is intermittent or continuous discharge from the primary mid-line sinus or from eccentric (secondary) openings.<sup>4</sup>

The incidence of SPD is 0.26 to 0.7%, more common in young adult males, being rare both after the age of 40 years old and before puberty.<sup>2,4</sup>

The etiology and pathogenesis of SPD was surrounded by controversy, since 1950 was supposed to be a congenital disease<sup>5</sup> but there has recently been global agreement that it is an acquired condition.<sup>6</sup> It was hypothesized that it was related to anatomically deep natal cleft associated with a long list of other predisposing factors such as excessive sweating, poor personal hygiene, maceration, bacterial contamination, penetration of the skin of the intergluteal region with shed hair shafts causing foreign body reaction that leads to abscess formation, male gender, positive family history, obesity, sedentary lifestyle, and patient jobs that necessitate sitting for long times are among the enumerated risk factors.<sup>7</sup>

Sacrococcygeal pilonidal disease is a complex disease because of the increased chance of poor wound healing, postoperative wound infection, and recurrence. It also has considerable morbidity due to long periods of interruption in education or work.<sup>3</sup>

From simple conservative techniques to complex flap reconstruction, many debatable treatment options are offered; however, clear dynamics toward the widespread usage of off-midline flap reconstruction and minimally invasive techniques for minimal SPD are suggested in all international guidelines, which recommend the Karydakis flap and the Limberg flap modification. The plethora of literature compares procedures for identification of a single best treatment approach, which has proven to be difficult.<sup>8-12</sup>

The present study was conducted to compare the surgical outcomes of the modified Karydakis flap (MKF) and the modified Limberg flap (MLF) procedures for the treatment of SPD.

## Materials and Methods

This was a prospective study involving 67 patients who attended the Helwan and Zagazig University hospitals between January 2019 and January 2021. Written informed consent was provided and the research ethical committee authorized the study. Our work was done in conformity with the Declaration of Helsinki, which is the code of ethics of the World Medical Association for studies involving humans. According to the type of procedure, the patients were split into two groups.

Group A included 33 patients undergoing the MLF procedure and group B involved 34 patients undergoing the MKF procedure.

The study included all patients diagnosed with SPD who met the criteria for inclusion; patients  $\geq 18$  years old who gave their consent for the procedure, had baseline required investigation, were fit for anesthesia, and were scheduled for operations under spinal anesthetic, while patients with comorbid conditions such as diabetes mellitus, immunodeficiency, pregnancy, abscess, secondary infections, recurrence, and those unwilling to undergo surgery were excluded from the study.

On the day of surgery, intravenous antibiotics were given to each patient. The participants were positioned in the position permitting better exposure of the site of surgery and both of the buttocks were taped laterally. The surgical site was sterilized with solution of 10% povidone iodine before being covered.

Procedure performed in the MKF group (MKFG) (**►Fig. 1**) via a paramedian elliptic excision of the sinus containing area, with the lower and upper ends being positioned at  $\sim 2$  cm lateral to the midline and all defective unhealthy tissues being resected until getting to healthy boundaries. Then, after the medial edge of the incision was mobilized laterally, the flap was slid by suturing to a layer of fascia and the skin to suitable layers on the lateral edge of the wound corresponding to one another. Using 2-0 polyglactin (vicryl) interrupted sutures, the subcutaneous layer was approximated. The skin layer was closed by 3-0 polypropylene subcuticular stitches that were reinforced by interrupted stitches of polypropylene or staples. A suction tube drain was inserted in all participants. When the drained volume was less than 20 mL/d, the drain was removed.

In the MLF group (MLFG) (**►Fig. 1**), a rhomboid excision was done, the lower caudal end being 2 cm lateral to the natal cleft and including the whole sinus containing defective tissue. Via electrocautery diathermy, hemostasis was achieved. To confirm tension free repair, the MLF was released at the bottommost including the gluteal fascia, and then it was slid medially to cover the rhomboidal defect. A suction tube drain was inserted in all patients. The subcutaneous tissue layer was approximated with 2/0 vicryl suture and the skin was closed by 3-0 polypropylene subcuticular stitches that were reinforced by interrupted



**Fig. 1** Modified Karydakis flap & modified Limberg flap.

stitches of polypropylene or staples. When the drained amount of the inserted suction drain was less than 20 mL/d, the drain was removed.

Standardized procedures for assessing variables and their assessment methodologies, Data regarding preoperative independent variables included participants' age, sex, body mass index (BMI), and preoperative disease period. Outcome variables included procedure time, postoperative pain, sitting painless time, drainage days, normal activity access, wound healing time, postoperative complications (infection, dehiscence, hematoma, and seroma), and patient cosmetic satisfaction and were recorded in our work. Data was collected by assessment of the participants during postoperative visits for dressing. Patients' wounds on a daily basis as needed for dressing. The patients were examined once weekly for the 1<sup>st</sup> month and afterwards every month for the 1<sup>st</sup> 6 months. Subsequently, patients were requested to contact us if they had any complications.

### Statistical Analysis

The data of the participants was entered in a Microsoft Excel 14.0.4763.1000 (Microsoft Corp., Redmond, WA, USA) spreadsheet and registered in a preformed template. Using

tables, figures, and bar charts, continuous variables were represented as mean and standard deviation (SD), and categorical variables as frequencies and percentages. The independent sample two tailed *t*-test, the contingency chi-squared test, the two tailed Mann-Whitney test, and the Fisher exact test were the statistical analysis tests used in our study. The entire statistical study was performed with IBM SPSS Statistics for Windows version 23 (IBM Corp., Armonk, NY, USA). Statistical significance was considered when  $p < 0.05$ .

### Results

A total of 67 patients participated in our study. Of these, 33 patients formed the MLFG, and 34 patients the MKFG (– Table 1).

The mean patient age in the current study was found to be 28.85 (18 to 44) years old, while that of patients who underwent MLF was 29.88 (18 to 42) years old and that of patients who underwent MKF was 27.85 (18 to 44) years old.

Of the total 67 patients, 38 (56.72%) were men and 29 (43.28%) were women. Ten women and 23 men underwent the MLF surgery, while 19 women and 15 men underwent the MKF procedure.

**Table 1** Demographic, clinical, and surgical outcomes variable characteristics of patients

|                                    | Characteristics                                  | Total (67 patients) | MLFG (33/67patients) | MKFG (34/67patients) | p-value | Test                |
|------------------------------------|--|---------------------|----------------------|----------------------|---------|---------------------|
|                                    | Age (years old) mean (range)                     | 28.85 (18–44)       | 29.88 (18–42)        | 27.85 (18–44)        | NS      | t-test <sup>a</sup> |
|                                    | Gender male/female n (%)                         | 38/29 (56.7%/43.3%) | 23/10 (69.7%/30.3%)  | 15/19 (44.1%/55.9%)  | NS      | Chi-S <sup>b</sup>  |
|                                    | BMI mean (kg/m <sup>2</sup> ) (range)            | 25.58 (21–37)       | 25.21 (21–37)        | 25.94 (21–36)        | NS      | t-test <sup>a</sup> |
|                                    | Preoperative disease period mean (weeks) (range) | 29.06 (18–41)       | 28.36 (18–39)        | 29.74 (18–41)        | NS      | MW-U <sup>c</sup>   |
|                                    | Operative time mean (min) (range)                | 43.38 (25–65)       | 54.5 (45–65)         | 32.5 (25–40)         | < 0.001 | t-test <sup>a</sup> |
|                                    | Postoperative Pain* mean (range)                 | 6.54 (3–10)         | 7.03 (4–10)          | 6.06 (3–9)           | < 0.01  | MW-U <sup>c</sup>   |
|                                    | Sitting painless time mean(days) (range)         | 15.87 (10–22)       | 16.94 (14–22)        | 14.82 (10–21)        | < 0.001 | t-test <sup>a</sup> |
|                                    | Drain removal POD (Post Operative Day) (range)   | 5.24 (3–11)         | 4.52 (3–7)           | 5.94 (4–11)          | < 0.001 | MW-U <sup>c</sup>   |
|                                    | Normal activity access mean (days) (range)       | 12.19 (10–17)       | 12.7 (10–17)         | 11.71 (10–15)        | < 0.01  | t-test <sup>a</sup> |
|                                    | Wound healing time Mean(days) (range)            | 25.01 (12–31)       | 26.21 (23–31)        | 23.85 (12–27)        | < 0.001 | t-test <sup>a</sup> |
| Post operative complications n (%) | Infection  | 2 (3%)              | 1 (3%)               | 1 (2.9%)             | NS      | FET <sup>d</sup>    |
|                                    | Dehiscence                                       | 1 (1.5%)            | 0                    | 1 (2.9%)             | NS      | FETd                |
|                                    | Hematoma   | 4 (6%)              | 4 (12.1%)            | 0                    | NS      | FETd                |
|                                    | Seroma   | 5 (7.5%)            | 0                    | 5 (14.7)             | NS      | FETd                |
|                                    | Patient Satisfaction*                            | 7.25 (4–10)         | 6.82 (4–9)           | 7.68 (4–10)          | < 0.01  | MW-U <sup>c</sup>   |
|                                    | Recurrence n (%)                                 | 5 (7.5%)            | 2 (6.1%)             | 3 (8.8%)             | NS      | FET <sup>d</sup>    |

Abbreviations: BMI, body mass index; MKFG, modified Karydakís flap group; MLFG, modified Limberg flap group; NS, not statistically significant. <sup>a</sup>Numerical rating scale from 1–10, <sup>a</sup>Independent sample t-test two tailed, <sup>b</sup>Contingency Chi-square test, <sup>c</sup>two-tailed Mann-Whitney test, <sup>d</sup>Fisher's exact test, Visual methods were used to detect non normal data by careful inspection before using any parametric test IBM SPSS Statistics for Windows Version 23.

In our study, the overall BMI was 25.58 (21–37) with a *P* value of 0.394%. There was no statistically significant difference in BMI between the MLFG 25.94 (21–36) and the MKFG 25.21 (21–37). ► **Table 1** shows that there was no significant statistical difference in the mean preoperative disease period between the two groups.

Regarding operative time, postoperative pain, sitting painless time, mean drainage days, normal activity access, and wound healing time, there was a significant statistical difference between the two study groups ► **Table 1**. The mean patient satisfaction on a numerical scale of 1 to 10 was 7.25 (4 to 10), 6.82 (4 to 9), and 7.68 (4 to 10) for the total sample and the MLFG and MKFG, respectively.

There was no significant statistical difference between the two groups in terms of post-operative complications, as we discovered: seroma in five (7.5%) patients, all of whom were in the MKF group, while there was no seroma in the MLFG patients; hematoma in four (6% of the patients), all of whom were in the MLFG; infection in two (3% of the patients), one in each group; and wound dehiscence in one (1.5%) patient in the MKF group.

In our research, there were a total of 5 patients with recurrence (7.5%) after surgery, 2 of them had undergone MLF and 3 MKF, with no significant statistical difference between the two study groups.

## Discussion

There is an extensive list of prescribed procedures for the treatment of SPD, beginning with totally conservative non-surgical treatment to extensive resection with or without reconstruction techniques.<sup>6</sup> Although off-midline closure has been shown to be superior to mid-line closure, there is currently no gold standard for off-midline closure procedures, including MKF and MLF, because both surgical approaches have been found to have comparable results.<sup>13</sup>

According to the literature reviews, the baseline patient characteristics of age, gender, and BMI were found to not significantly differ between the two groups in our study, which is in line with the results of the study by Antony et al.<sup>3</sup>

In line with the findings by Ekici et al.,<sup>12</sup> who concluded that there was no significant statistical difference between the two groups regarding whether surgery was performed due to primary or recurrent SPD, we found in our study that the mean preoperative disease period was not significantly different between the two groups, while Tokac et al.<sup>14</sup> found that the duration of symptoms was a significant factor in their analysis. Guner et al.<sup>11</sup> showed a correlation between SPD severity and duration of patient symptoms.

Bessa et al.<sup>19</sup> found that the median time of operation was significantly shorter in MKF participants than in MLF participants: 33 (range, 28–40) min vs. 52 (range, 48–62) min; *p*-value 0.001, and Karaca<sup>15</sup> reported the operation time (mean value: 33.5 + 15.7 min and 45.3 + 11.3 min; *P* 0.001). The median operative time in our study was significantly shorter (22 minutes) in MKFG than MLFG.

There is a significant statistical difference between the two study groups in terms of participants' comfort in their

postoperative period regarding postoperative pain, the mean sitting painless time, access to normal activities, drain removal, and wound healing in our study. Ahmad et al.<sup>2</sup> published that the MKFG had better pain score than the MLFG. Turan<sup>17</sup> published that drain removal time was earlier in the MKFG but it was not significantly different between their two study groups. Ekici et al.<sup>12</sup> published that, in their study, the mean time to return to labor was 10 (11.4 ± 4.0) days. However, Tokac et al.<sup>14</sup> published that no significant statistical difference was found between the groups regarding painless sitting starting time, painless walking time, and painless toilet-sitting time while they found that access to normal activities was better among the MLFG. Karaca et al.<sup>16</sup> reported that MLF procedures were better than MKF regarding postoperative pain and painless sitting time, with no significant difference between the groups regarding full healing time.

Regarding postoperative complications in our patients, there was no statistical significant difference between the MKFG and the MLFG regarding hematoma (0 versus 12.1%; *p* = 0.053), seroma formation (14.7 versus 0%; *p* = 0.053), wound infection (2.9 versus 3%; *p* = 1), or wound disruption (2.9 versus 0% in the MLFG; *p* > 0.99), which is in line with the literature review as reported by Bessa et al.<sup>15</sup> No significant statistical differences were found between their study groups regarding overall complication rate, which agrees with the literature review by Caliskan et al.,<sup>18</sup> who published that patients operated with an MKF had a similar rate of overall complications such as wound site infection and formation of seroma. In another investigation, patients operated with an MKF had a significant higher rate of seroma development and wound dehiscence compared with participants undergoing MLF.

Also, Turan<sup>17</sup> published that the complication rates were similar in both the MLF and MKF techniques. Ekici et al.<sup>12</sup> found that there were no significant statistical differences regarding seroma formation, wound site infection, and wound dehiscence. Khan et al.<sup>19</sup> had proven that, in terms of early outcomes, MLFG was significantly better than MKF regarding wound site infection and seroma development. Alam et al.<sup>20</sup> published in their primary analysis outcomes the following results: seroma formation 8/87 (9.2%), hematoma formation 1/87 (1.2%), superficial wound dehiscence 7/87 (8.0%).

The rate of recurrence in our study was 5.7% (5/67); 3 patients (8.8%) (3/34) in the MKFG developed recurrent disease versus 2 patients (6.1%) (2/33) in the MLFG (*p* > 0.99), which is in line with the literature as published by Ekici et al.,<sup>12</sup> in whose study the recurrence rate was 5.7%. Turan<sup>17</sup> found that the recurrence was seen in two participants in the MKFG and in one patient in the MLFG and that both operations had a similar recurrence rate. Caliskan et al.<sup>18</sup> published that no significant statistical difference in recurrence rates was found and the overall recurrence rate was 4.7%. Alam et al.<sup>20</sup> published in their study that the secondary outcome of MKF recurrence at the 6-month follow-up was 2/87 (2.3%).

In our study, participants were more satisfied with the cosmetic outcome in the MKFG than in the MLFG (*p* < 0.001),

which agrees with the findings of Bessa et al.,<sup>15</sup> who found that 97% of the participants in the MKFG were satisfied with the cosmetic outcome, compared with 72% in the MLFG ( $p < 0.001$ ).

The MKF and MLF procedures have shown to be effective and can be safely used as a treatment of SPD and can both be performed as day-case surgeries, according to Turan,<sup>17</sup> Bessa et al.,<sup>15</sup> and Alam et al.,<sup>20</sup> who reported good promising surgical outcomes with MKF operations with careful surgical technique as it offers a significantly reduced operating time, less wound dehiscence, and a higher rate of patient cosmetics satisfaction.

According to Ekici et al.,<sup>12</sup> the KF and LF are safer than the other two methods (lay-open and primary closure) regarding lower rates of relapse and faster return to work. Iesalnieks et al.<sup>10</sup> recommended that KF and LF with its technique modification should be used instead of the original operation and should be considered as one of favored off-midline procedure.

## Conclusions

The MKF approach is effectively dominated above the MLF technique as a favored preferred method for treating SPD because it provides less postoperative pain, better sitting painless time, earlier return to normal activity, more rapid wound healing, and better patient satisfaction.

### Conflict of Interests

The authors have no conflict of interests to declare.

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