# ХИРУРГИЯ
# SURGERY

## COMPARATIVE STUDY OF OPEN EXCISION TECHNIQUE VERSUS LIMBERG FLAP RECONSTRUCTION IN THE MANAGEMENT OF SACROCOCCYGEAL PILONIDAL SINUS

**Ali S.M.** [1],
**Mohammed R.F.** [1],
**Mahmood K.I.** [2],
**Kadhim S.H.** [2]

[1] Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences (Corniche str., Al-Kufa 54003, Al-Najaf Governorate, Iraq)
[2] Hammurabi College of Medicine, University of Babylon (Hillah Najaf Road, 60, Hillah 51002, Babylon Governorate , Iraq)

Corresponding author:
**Sahal Mohammed Ali,**
e-mail: sahal.mohammed@jmu.edu.iq

## ABSTRACT

***Background.*** *Sacrococcygeal pilonidal sinus is a common condition in the natal cleft that typically requires surgical intervention. This study compares the outcomes of two surgical techniques for this condition: open excision and Limberg flap reconstruction.*
***The aim of the study.*** *To conduct a comparative evaluation of the open excision versus Limberg flap in managing sacrococcygeal pilonidal sinus to determine the relative advantages of the Limberg flap technique.*
***Materials and methods.*** *This prospective study involved 70 randomly selected patients diagnosed with pilonidal sinus disease. Thirty-five patients underwent open excision, while 35 underwent Limberg flap reconstruction.*
***Results.*** *The study found that the open excision method (1st method) had an average surgical duration of 33 minutes, while the Limberg flap method (2nd method) had an average duration of 40 minutes. Patients in the 1st method group recovered in 3–4 weeks, while those in the 2nd method group recovered in 12–15 days. The 1st method had two cases of wound infections and three recurrences, whereas the 2nd method had one case of seroma and no recurrence. The postoperative pain-free period ranged from 15–17 days for the 1st method and 12–15 days for the 2nd method.*
***Conclusion.*** *The Limberg flap technique excels in managing the pilonidal sinus. It offers faster healing, lower pain scores, an earlier return to standard functions, and lower recurrence rates, making it an attractive choice for treating this condition. The study's findings provide valuable insights into the comparative outcomes of these two surgical approaches, highlighting the advantages of the Limberg flap technique in managing the sacrococcygeal pilonidal sinus.*

***Key words:*** *pilonidal sinus, natal cleft, rhomboid excision, Limberg flap, PNS*

Received: 22.06.2024
Accepted: 20.01.2025
Published: 13.03.2025

**For citation:** Ali S.M., Mohammed R.F., Mahmood K.I., Kadhim S.H. Comparative study of open excision technique versus Limberg flap reconstruction in the management of sacrococcygeal pilonidal sinus. *Acta biomedica scientifica*. 2025; 10(1): 230-237. doi: 10.29413/ABS.2025-10.1.24

# СРАВНИТЕЛЬНЫЙ АНАЛИЗ МЕТОДА ОТКРЫТОГО ИССЕЧЕНИЯ И ПЛАСТИКИ ЛОСКУТОМ ЛИМБЕРГА ПРИ ЛЕЧЕНИИ ПИЛОНИДАЛЬНОГО СИНУСА

**Али С.М.** [1],
**Мохаммед Р.Ф.** [1],
**Махмуд К.И.** [2],
**Кадим С.Х.** [2]

[1] Университет медицинских и фармацевтических наук имени Джабира ибн Хайяна (54003, г. Эль-Куфа, ул. Корниш, провинция Наджаф, Ирак)
[2] Медицинский колледж Хаммурапи, Университет Вавилона (51002, г. Эль-Хилла, провинция Бабиль, Ирак)

Автор, ответственный за переписку:
**Sahal Mohammed Ali,**
e-mail: sahal.mohammed@jmu.edu.iq

## РЕЗЮМЕ

***Введение.*** *Крестцово-копчиковый пилонидальный синус – патология, характеризующаяся наличием дефекта в межъягодичной складке, которая обычно требует хирургического вмешательства. В представленном исследовании сравниваются результаты двух хирургических методов лечения данного состояния: открытого иссечения и реконструкции лоскутом Лимберга.*

***Цель исследования.*** *Провести сравнительную оценку открытого иссечения и пластики лоскутом Лимберга в лечении крестцово-копчикового пилонидального синуса с целью определения преимуществ реконструкции лоскутом Лимберга.*

***Материалы и методы.*** *В проспективном исследовании приняли участие 70 случайно выбранных пациентов с диагнозом пилонидальный синус. Тридцати пяти пациентам была проведена открытая резекция, а 35 пациентам – пластическая реконструкция с использованием лоскута Лимберга.*

***Результаты.*** *Исследование показало, что при открытом методе иссечения (1-я группа) средняя продолжительность операции составила 33 мин, а при использовании пластики лоскутом Лимберга (2-я группа) – 40 мин. Выздоровление в первой группе пациентов наступило через 3–4 недели, во второй группе – через 12–15 дней. В группе с применением открытого метода иссечения наблюдалось два случая раневой инфекции и три рецидива, тогда как во второй группе был зафиксирован один случай серомы и ни одного рецидива. Послеоперационный безболезненный период составил 15–17 дней для пациентов первой группы и 12–15 дней – для группы с применением пластической реконструкции.*

***Заключение.*** *Пластика лоскутом Лимберга является эффективным методом лечения пилонидального синуса. Она характеризуется более быстрым процессом заживления, низкими показателями боли, ранним возвращением к повседневной жизни и низким уровнем рецидивов. Это делает данную методику привлекательным выбором для лечения этой патологии. Результаты исследования предоставляют ценную информацию о сравнительных результатах двух хирургических подходов, подчеркивая преимущества пластической реконструкции с использованием лоскута Лимберга в лечении крестцово-копчикового пилонидального синуса.*

***Ключевые слова:*** *пилонидальный синус, эпителиально-копчиковый ход, межъягодичная складка, ромбовидное иссечение, лоскут Лимберга*

Статья поступила: 22.06.2024
Статья принята: 20.01.2025
Статья опубликована: 13.03.2025

**Для цитирования:** Али С.М., Мохаммед Р.Ф., Махмуд К.И., Кадим С.Х. Сравнительный анализ метода открытого иссечения и пластики лоскутом Лимберга при лечении пилонидального синуса. *Acta biomedica scientifica*. 2025; 10(1): 230-237. doi: 10.29413/ABS.2025-10.1.24

## BACKGROUND

Pilonidal disorder encompasses a spectrum of conditions, including pilonidal sinus, pilonidal cyst, and pilonidal abscess, primarily affecting the sacrococcygeal area. This condition poses significant challenges, often manifesting as infection or abscess and progressing to a chronic sinus disease state. Individuals afflicted by pilonidal disease frequently experience discomfort, which can persist over extended periods and potentially impact their ability to engage in learning or work [1, 2]. Historically, pilonidal disease was attributed to congenital origins. However, contemporary perspectives favor an acquired etiology linked explicitly to the invagination of broken hair within the skin. This process provokes localised inflammation and is now considered the principal cause of the condition [3–5]. Pilonidal disease has historically been called "jeep driver's bottom disease" due to its prevalence among certain vehicle operators. Although this ailment can manifest in various body areas, it most commonly afflicts the sacrococcygeal region. The complex nature of this disease complicates its management, primarily due to an elevated risk of wound inflammation, reduced curative efficacy, and a propensity for recurrence [6, 7]. While pilonidal disease is not a life-threatening condition, it significantly impairs patients' well-being for prolonged durations, often extending to several months and increasing the likelihood of recurrence [8–10]. Multiple surgical and non-surgical therapeutic approaches have addressed pilonidal disease. These interventions include non-operative strategies such as sclerotherapy injection, cryotherapy (cryosurgery), electrocautery, and the regular mechanical removal of hair or topical creams. Operative procedures include open and wide-ranging excision, with options for open wound management and marsupialization [11–13].

The **principal aim of this study** is to compare open excision and the Limberg technique in treating sacrococcygeal pilonidal sinus.

In this study, it is essential to note that the effectiveness of the Limberg flap technique is widely acknowledged in the management of sacrococcygeal pilonidal sinus. This acknowledgement is supported not only by the present study's findings but also by a literature review that systematically assessed the management of pilonidal diseases, such as S.P. Chopade et al. [14] and J. Grabowski et al. [15]. The reviewed literature aligns with the current research findings, emphasizing the Limberg flap's efficacy in reducing postoperative complications, including wound infections.

However, our study provides an in-depth, firsthand analysis of comparing open excision and Limberg flap techniques in pilonidal sinus management. It offers detailed findings specific to this study's cohort, including gender distribution, duration of symptoms, surgical duration, and postoperative recovery times. This data contributes to a more detailed and statistically grounded evaluation of the Limberg flap's effectiveness. However, the article adds the valuable dimension of the original study's specific statistical and clinical data, providing a more detailed assessment of the Limberg flap's advantages in a real-world clinical setting.

## METHODOLOGY

### Study design

This study assessed 70 patients presenting with clinical manifestations of pilonidal sinus (diagnosed according to clinical symptoms and physical examination) who visited the Department of Surgery of Al-Hilla Teaching Hospital between January 2020 and September 2023. The institutional ethics committee approved the study. Ethical considerations were followed, and all patients were informed about the research objectives. Informed consent was obtained from all patients. Significantly, our experience in these two techniques exceeds ten years.

### Patient selection criteria

Patients present with pilonidal sinus disease for more than three months duration with no active infection, and after the failure of conservative management, males and females, aged between 18 and 36 years and without comorbid diseases. Patients with pregnancy and those suffering from complicated or recurrent pilonidal sinuses were excluded from the study. The selected patients had a good general health status and underwent surgical intervention under general anesthesia. We discussed the applied technique with each patient, and the treatment method was based on each patient's decision. Recurrence means the same primary disease was observed within six months to 1-year follow-up after surgical removal [16]. Our study recorded pain scores using visual analog scale (VAS), widely used to measure pain intensity after surgeries.

### Surgical procedures

The surgical procedure for pilonidal sinus treatment involves several steps. Initially, patients were positioned prone to provide access to the affected pilonidal cleft, and any hair within the area was removed. Subsequently, a solution comprising methylene blue dye (a salt used as a dye and as a medication) and hydrogen peroxide ($H_2O_2$ in a concentration of 3 %) was infused into the external opening of the sinus [17]. This was done to enable visualization of both the primary sinus tract and any branching tracts, which are essential for a thorough understanding of the condition. Surgical removal of the sinus was then carried out. The wound is left open to heal through the secondary intention process.

Post-surgery, patients were advised to rest, with a focus on maintaining proper wound care. This included daily dressing changes to prevent infection and promote optimal healing. For additional support during the healing process, patients were recommended to engage in bed rest and sleep in a prone or lateral position to alleviate pressure on the affected area. Patients were typically discharged within 24–48 hours following the surgical procedure. However, their care did not end there. Patients were encouraged to continue daily dressing changes and attend weekly follow-up visits to monitor their progress and ensure the wound was healing as expected.

The surgical process for the Limberg flap involved marking the resection borders and the flap using a surgical marker. This will guide the surgical team in removing the entire sinus, ensuring a comprehensive approach to treatment. The sinus excision involves extending the surgical incision laterally and inferiorly to the *gluteus maximus* fascia. To control bleeding during the procedure, hemostasis was achieved using electrocautery (a commonly used technique in surgical settings to stop bleeding by coagulating blood vessels).

Following the successful removal of the sinus, the flap was mobilized to fill the rhombus-shaped defect created by the excision. In addition, a closed suction drain was inserted through a separate wound to aid in postoperative drainage. The final stages of the surgical procedure involved wound closure. First, the subcutaneous layer was closed using interrupted 2/0 absorbable sutures (vicryl), followed by the closure of the skin layer using subcuticular 2/0 nonabsorbable sutures (nylon) (Fig. 1, 2).

***FIG. 1.***
*Method 1 (open technique)*

***FIG. 2.***
*Method 2 (Limberg flap)*

**Postoperative medication**

Patients received the following postoperative treatment:

- Amikacin vial 500 mg × 2
- Flagyl vial 500 mg × 3
- Paracetamol vial 1 g × 3
- Tramadol ampule once nightly (O/N).

This comprehensive approach to surgical intervention and postoperative care addressed the pilonidal sinus while ensuring optimal patient recovery and well-being.

**Statistical analysis**

The data were evaluated with the SPSS program (version 25); continuous numbers were described as mean ± standard deviation (*SD*). Categorical data were represented as frequency and percentage, in which the Chi-square test was applied. The *p*-value less than 0.05 was significant.

**Ethical approval**

The study was conducted under the ethical principles originating in the Declaration of Helsinki. Before the sample was taken, patients' verbal and analytical approval was obtained. According to document number 262, a local ethics committee reviewed and approved the study protocol, the subject information, and the consent form on January 2, 2020.

## RESULTS

The study encompassed a cohort of 70 patients, with a significant male predominance (85.72 %), accounting for 60 male and 10 female patients. The average age of the participants was 27.3 years, falling within a range of 18 to 36 years. Among the patients, 35 cases were subjected to the first surgical method, comprising 30 males and five females, while the remaining 35 cases underwent the second surgical method, with an identical gender distribution.

The average duration of clinical symptomatology before surgical intervention was 2.35 months, ranging from 1 to 3 months. The first method's average surgical duration was approximately 33 minutes, ranging from 30 to 35 minutes. For the second method, the average surgical duration was around 40 minutes, ranging from 35 to 45 minutes. The difference in surgical duration between the two methods was statistically significant ($p < 0.05$).

Postoperatively, two patients in the first method group experienced wound infections, successfully managed through conservative measures. Conversely, three cases of recurrence were observed within six months to one year after the first method. The second method, however, exhibited more favorable outcomes, with one case of wound seroma treated through multiple aspirations under local anesthesia in a private clinic. No fat necrosis or recurrence incidents were recorded in the second method group. The difference in wound complications between the two methods was statistically significant ($p < 0.05$).

The postoperative pain-free walking period, without needing analgesic medication, ranged from 15 to 17 days for the first method. In contrast, the second method was reduced to 12 to 15 days. The difference in postoperative pain scores between the two methods was statistically significant ($p < 0.01$). The time required for patients to regain their normal daily functions was 3 to 4 weeks for the first method and 2 to 3 weeks for the second method. The difference in recovery time between the two methods was statistically significant ($p < 0.05$). A detailed summary of the study results is presented in Tables 1–3, along with graphical representations in Figures 3 and 4. This analysis suggests that the second method demonstrated a favourable outcome compared to the first method, with lower postoperative complications and faster recovery times.

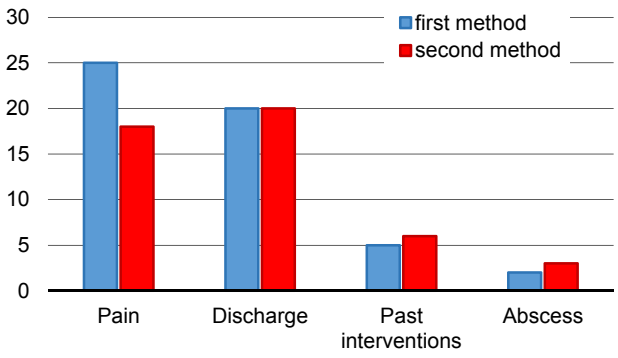


***FIG. 3.***
*Preoperative signs and symptoms of patients for the two surgical methods*

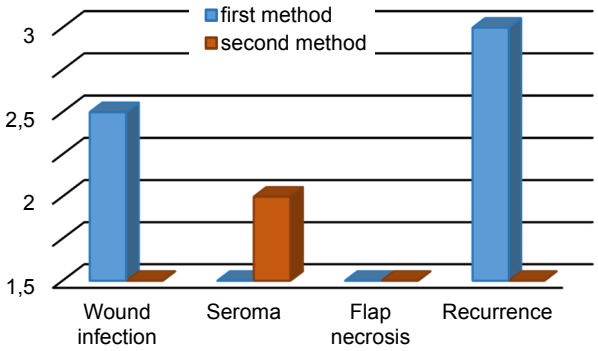


***FIG. 4.***
*Postoperative complications of patients for the two surgical methods*

**TABLE 1**
**DEMOGRAPHIC CHARACTERISTICS (BOTH METHODS)**

| Age group | Males | Females |
|---|---|---|
| 18–22.5 | 18 | 3 |
| 22.5–27 | 25 | 4 |
| 27–31.5 | 7 | 2 |
| 31.5–36 | 10 | 1 |
| Total | 60 | 10 |

**TABLE 2**
**HISTORY OF THE DISEASE (BOTH METHODS)**

| Clinical presentation | Number of patients – first method, *n* (%) | Number of patients – second method, *n* (%) |
|---|---|---|
| Pain | 25 (71.1 %) | 18 (51 %) |
| Discharge | 20 (57 %) | 20 (57 %) |
| Abscess | 2 (5 %) | 3 (8 %) |

**TABLE 3**
**OPERATIVE DATA (BOTH METHODS)**

| Parameters | Range – first method | Range – second method | *p* |
|---|---|---|---|
| Operative time | 30–35 min | 35–45 min | < 0.05 |
| Pain score (VAS) | 6–8 | 2–4 | < 0.01 |
| Hospital stay | 1–2 days | 1–2 days | 0.10 |
| Drain removal | – | Variable* | N/A |
| Suture removal | – | 12–14 days | N/A |

**Note.** * – removed after discharge dropped to less than 30 ml per day.

This analysis suggests that the second method demonstrated a favourable outcome compared to the first method, with lower postoperative complications and faster recovery times.

## DISCUSSION

Surgical management of sacrococcygeal pilonidal sinus is guided by several paramount objectives, including optimising wound healing, reducing the likelihood of recurrence, minimizing hospital duration, alleviating patient discomfort, and minimizing postoperative complications. The primary surgical goals encompass eliminating all sinus tracts and addressing the underlying causes contributing to this condition [18–21]. Various surgical techniques have been employed in pilonidal sinus treatment, ranging from excision with open wound management to primary closure of the surgical incision and, in some cases, flap reconstruction [22]. Final wound closure following pilonidal sinus surgery presents several advantages, particularly in achieving aesthetically pleasing results for selected patients.

Moreover, this approach is associated with expedited wound healing, allowing patients to resume their normal daily activities more promptly than open wound management procedures. It is important to note that leaving the wound tract exposed can be uncomfortable for patients, necessitating regular follow-up care to ensure proper wound healing and, in some cases, delaying the initial closure of the wound until it has completely healed. This emphasizes the significance of wound closure techniques in enhancing patient comfort and expediting recovery [23–27]. Wound infection rates following pilonidal sinus surgery have been a subject of interest and concern. Different series have reported infection rates ranging from 1.5 to 10 %. Our study's recorded wound infection rate was 7.5 %, which falls within this reported range. This suggests that the Limberg flap technique, while highly effective in preventing recurrence and reducing pain, aligns with the broader range of wound infection rates in other treatment modalities. It is essential to acknowledge that our study's relatively low infection rate is a positive outcome, especially considering the technique's other benefits. Pain management is a crucial aspect of postoperative care. Our study reported pain scores ranging from 2 to 4, with a mean score of 3.

In comparison, other studies employing various treatment modalities have reported varying levels of postoperative pain. For instance, patients undergoing simple excision in some studies experienced minimal to no pain (score of zero), while excision and marsupialization yielded pain scores of 6.7. The excision and midline closure approach resulted in pain scores of 7.3, and excision with flap techniques led to scores of 4.5. It is evident from these findings that the Limberg flap technique is associated with reduced postoperative pain, with our study demonstrating a mean pain score that is notably lower than that of some other modalities. This reduction in postoperative pain is a significant advantage of the Limberg flap technique, contributing to a more comfortable and less distressing patient recovery period. In terms of recurrence, our study offers particularly encouraging results. No cases of recurrence were recorded among patients treated with the Limberg flap technique. This contrasts with other studies where recurrence rates of approximately 10 % have been reported following various treatment modalities, including wide excision and marsupialization. The absence of recurrence in our study is a noteworthy finding and a testament to the efficacy of the Limberg flap technique in preventing the reappearance of the condition. This is a pivotal factor in ensuring long-term patient satisfaction and the overall success of the surgical approach [25, 28].

Thus, this study offers a comprehensive comparative analysis of open excision and Limberg flap techniques for managing sacrococcygeal pilonidal sinus. It notably demonstrates the Limberg flap technique's advantage in reducing postoperative pain. The Limberg flap technique eliminates the risk of recurrence, a vital outcome in pilonidal sinus management. These findings strongly advocate for the broader adoption of the Limberg flap technique in the clinical management of sacrococcygeal pilonidal sinus, as it offers a patient-centered approach to treatment with superior outcomes. Further research and clinical implementation of this technique are warranted to advance the field of pilonidal sinus management and enhance patient care.

## CONCLUSION

In conclusion, the effectiveness of the Limberg flap technique in managing the sacrococcygeal pilonidal sinus has been widely acknowledged in the literature, including reviews conducted by S.P. Chopade et al. [29] and J. Grabowski et al. [15] have consistently demonstrated the Limberg flap's efficacy in reducing postoperative complications, including wound infections, compared to other treatment modalities. The surgical management of sacrococcygeal pilonidal sinus poses some challenges, requiring a balance between efficient wound healing, low recurrence rates, and shorter hospital stays. This study conducted a comparative analysis of two surgical techniques, open excision and Limberg flap, in pursuit of these objectives.

The results indicate that the Limberg flap technique outperforms the open excision method regarding surgical duration, postoperative recovery time, pain scores, and recurrence rates compared to other studies [26, 30, 21]. These advantages make the Limberg flap an attractive choice for treating sacrococcygeal pilonidal sinus, as it offers faster healing, an earlier return to standard functions, and a lower risk of complications, ultimately improving patient outcomes and quality of life. The study's findings contribute to the growing body of evidence supporting the clinical adoption of the Limberg flap as a preferred surgical approach for this condition.

**Conflicts of interest**

The authors declare no conflict of interest.

**Acknowledgements**

This study was conducted in Al-Hilla Teaching Hospital; we appreciate the efforts of our seniors and colleagues and the excellent assistance of all the medical staff.

## REFERENCES

1. Seow-Choen F, Seow-En I. Pilonidal disease: A new look at an old disease. *Semin Colon Rectal Surg.* 2022; 33(4). doi: 10.1016/j.scrs.2022.100909

2. Kumar M, Clay WH, Lee MJ, Brown SR, Hind D. A mapping review of sacrococcygeal pilonidal sinus disease. *Tech Coloproctol.* 2021; 25(6): 675-682. doi: 10.1007/s10151-021-02432-9

3. Gil LA, Deans KJ, Minneci PC. Management of pilonidal disease. *JAMA Surg.* 2023; 158(8): 875-883. doi: 10.1001/jamasurg.2023.0373

4. Rudd AB, Davis A, Butts CC. Presentation, management, and women's health implications of pilonidal disease. *Nurs Womens Health.* 2021; 25(4): 312-318. doi: 10.1016/j.nwh.2021.06.004

5. Bubenova M, Mittlboeck M, Kulinna-Cosentini C, Teleky B, Cosentini E. Pilonidal sinus disease: A 25-year experience and long-term results of different surgical techniques. *Eur Surg.* 2022; 54(5): 240-248. doi: 10.1007/s10353-022-00767-7

6. Kaleem M, Mubarik F, Afzal MU, Zahid A, Andrabi WI, Qureshi SS, et al. Compare outcome of simple excision with primary closure vs rhomboid excision with Limberg flap for pilonidal sinus. *Pakistan J Med Health Sci.* 2021; 15(11): 2920-2922. doi: 10.53350/pjmhs2115112920

7. Bukhari SH, Masood S, Asaf HM, Saleem MA, Naseem N, Zubair Z. Comparative study of outcome of simple excision with primary closure versus rhomboid excision with Limberg flap for sacrococcygeal pilonidal sinus. *Pakistan J Med Health Sci.* 2020; 14(3): 632-637.

8. Sinnott CJ, Glickman LT. Limberg flap reconstruction for sacrococcygeal pilonidal sinus disease with and without acute abscess: Our experience and a review of the literature. *Arch Plast Surg.* 2019; 46(03): 235-240. doi: 10.5999/aps.2018.01312

9. Dass TA, Zaz M, Rather A, Bari S. Elliptical excision with midline primary closure versus rhomboid excision with Limberg flap reconstruction in sacrococcygeal pilonidal disease: A prospective, randomized study. *Indian J Surg.* 2012; 74(4): 305-308. doi: 10.1007/s12262-011-0400-9

10. Salih AM, Kakamad FH, Essa RA, Othman S, Salih RQ, Aziz MS, et al. Pilonidal sinus of the face: Presentation and management – A literature review. *Pilonidal Sinus J.* 2017; 3(1): 9-13.

11. Irpatgire R, Chakrod S. Limberg flap reconstruction following rhomboid excision of the sacrococcygeal pilonidal sinus. *Int J Surg.* 2016; 3(2): 846-849. doi: 10.18203/2349-2902.isj20161159

12. Dogra V, Mushtaq U, Gilkar IA, Peer JA. Pilonidal sinus and use of Limberg flap: A three years' experience from two tertiary care centres of Northern India. *Int J Surg.* 2022; 9(2): 444-448. doi: 10.18203/2349-2902.isj20220339

13. Ekici U, Kanlıöz M, Ferhatoğlu MF, Kartal A. A comparative analysis of four different surgical methods for treatment of sacrococcygeal pilonidal sinus. *Asian J Surg.* 2019; 42(10): 907-913. doi: 10.1016/j.asjsur.2018.12.011

14. Chopade SP, Adhikari GR. Comparative study of Limberg flap reconstruction with wide-open excision and healing by secondary intention in the management of pilonidal sinus: Our experience at a tertiary care center in India. *Cureus.* 2022; 14(6): e26396. doi: 10.7759/cureus.26396

15. Grabowski J, Oyetunji TA, Goldin AB, Baird R, Gosain A, Lal DR, et al. The management of pilonidal disease: A systematic review. *J Pediatr Surg.* 2019; 54(11): 2210-2221. doi: 10.1016/j.jpedsurg.2019.02.055

16. Myles PS, Myles DB, Galagher W, Boyd D, Chew C, MacDonald N, et al. Measuring acute postoperative pain using the visual analog scale: The minimal clinically important difference and patient acceptable symptom state. *Br J Anaesth.* 2017; 118(3): 424-429. doi: 10.1093/bja/aew466

17. Aldaqal SM, Kensarah AA, Alhabboubi M, Ashy AA. A new technique in management of pilonidal sinus, a university teaching hospital experience. *Int Surg.* 2013; 98(4): 304-306. doi: 10.9738/INTSURG-D-13-00064.1

18. Khan N, Singhal P, Chandrashekhar S, Goel D. Is Limberg flap better than excision and primary closure for treatment of sacrococcygeal pilonidal sinus – a prospective randomised study of 30 cases. *Int J Surg.* 2021; 8(2): 699-703. doi: 10.18203/2349-2902.isj20210388

19. Ghaffar N, Farooq N, Hussain MS. Limberg flap versus open procedure in treatment of chronic pilonidal sinus. *Pakistan J Med Health Sci.* 2022; 16(3): 248. doi: 10.53350/pjmhs22163248

20. Büyükakincak S, Tarim IA, Karapolat B, Ateş G. Comparison of different surgical techniques of sacrococcygeal pilonidal sinus disease. *J Experim Clin Med (Turkey).* 2021; 38(3): 283-287. doi: 10.52142/omujecm.38.3.14

21. Palsania OP, Galwa R, Choudhary G, Singh N, Meena SK. A comparative study between wide local excision with lay open versus Limberg flap transposition in the management of pilonidal sinus disease – A single center study. *Asian J Med Sci.* 2023; 14(10): 251-257. doi: 10.3126/ajms.v14i10.55335

22. Eldsoky ES, Atwa NS, Naroz MI, Hifny A. Comparative study between excision with primary closure versus flap reconstruction in management of sacrococcygeal pilonidal sinus. *Sci J Med Scholar.* 2021; 2021(1): 13-22. doi: 10.55675/sjms.v2021i1.45

23. Fahrni GT, Vuille-Dit-Bille RN, Leu S, Meuli M, Staerkle RF, Fink L, et al. Five-year follow-up and recurrence rates following surgery for acute and chronic pilonidal disease: A survey of 421 cases. *Wounds.* 2016; 28(1): 20-26.

24. Muzi MG, Milito G, Cadeddu F, Nigro C, Andreoli F, Amabile D, et al. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg.* 2010; 200(1): 9-14. doi: 10.1016/j.amjsurg.2009.05.036

25. Ersoy E, Devay AO, Aktimur R, Doganay B, Özdoğan M, Gündoğdu RH. Comparison of the short-term results after Limberg and Karydakis procedures for pilonidal disease: Randomized prospective analysis of 100 patients. *Colorectal Dis.* 2009; 11(7): 705-710. doi: 10.1111/j.1463-1318.2008.01646.x

26. Kumar R, Hastir A, Walia RS, Goyal S, Kaur A. Prospective randomized study of surgical treatment of pilonidal sinus; primary midline closure after elliptical excision versus rhomboid excision with Limberg flap reconstruction versus open excision and healing by secondary intention. *Int J Surg.* 2017; 4(11): 3646-3651. doi: 10.18203/2349-2902.isj20174879

27. Algazar M, Zaitoun MA, Khalil OH, Abdalla WM. Sinus laser closure (SiLaC) versus Limberg flap in management of pilonidal disease: A short-term non-randomized comparative pro-

spective study. *Asian J Surg.* 2022; 45(1): 179-183. doi: 10.1016/j.asjsur.2021.04.026

28. Boshnaq M, Phan YC, Martini I, Harilingam M, Akhtar M, Tsavellas G. Limberg flap in management of pilonidal sinus disease: Systematic review and a local experience. *Acta Chirurgica Belgica.* 2018; 118(2): 78-84. doi: 10.1080/00015458.2018.1430218

29. Uçar AD, Carti EB, Oymaci E, Sari E, Yakan S, Yildirim M, et al. Recurrent pilonidal disease surgery: Is it second primary or reoperative surgery? *Turk J Surg.* 2016; 32(3): 162. doi: 10.5152/UCD.2015.3112

30. Wadhawan G, Sharma D, Vyas KC. A comparative study of different treatment outcomes in cases of pilonidal disease. *Int J Surg.* 2020; 4(3): 292-297. doi: 10.33545/surgery.2020.v4.i3e.511

**Information about the authors**

***Sahal Mohammed Ali*** – Bachelor of Medicine, Bachelor of Surgery, Fellow of Iraqi Board of Medical Specialties (General Surgery), Lecturer at the Faculty of Medicine, Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences, e-mail: sahal.mohammed@jmu.edu.iq, https://orcid.org/0000-0001-6444-5437

***Raad Fadhil Mohammed*** – Lecturer at the Faculty of Medicine, Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences, e-mail: raad.fadhil@uobabylon.edu.iq, https://orcid.org/0000-0002-0387-1552

***Karrar Ibrahim Mahmood*** – Assistant Professor, Fellow of Iraqi Commission for Medical Specializations, Lecturer at the Department of Surgery, University of Babylon, Hammurabi College of Medicine, e-mail: Karar.ibrahim@uobabylon.edu.iq, https://orcid.org/0000-0002-6154-9609

***Salah Hadi Kadhim*** – Assistant Professor, Fellow of Iraqi Commission for Medical Specializations, Lecturer at the General Surgery Department, Hammurabi College of Medicine, University of Babylon, e-mail: Salahaljanaby@yahoo.com, https://orcid.org/0000-0001-8416-8860