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Contemporary Surgical Techniques for Pilonidal Sinus Disease: A Review of Evidence-Based Outcomes

Dr. N. JUNIOR SUNDRESH[1], Mr. KARTIK RAJA.C[2]

[1] Medical Superintendent, Govt. Cuddalore Medical College and Hospital,
[2] Pharm.d (Post baccalaureate)-II year, Department of Pharmacy, Annamalai University.

ABSTRACT :

Pilonidal sinus disease (PSD) is a chronic, acquired inflammatory condition of the sacrococcygeal region that predominantly affects young adults. The condition carries significant morbidity, with recurrence and prolonged healing being persistent challenges for both patients and surgeons. Numerous surgical techniques—including simple incision and drainage, excision with primary closure, marsupialization, and various flap-based reconstructions like the rhomboid (Limberg) flap and Karydakis flap—have been developed to optimize outcomes. This review synthesizes evidence from prospective, retrospective, and multicenter studies to evaluate contemporary surgical strategies with respect to healing time, recurrence rates, complication profiles, and patient quality of life. The evidence strongly suggests that off-midline flap techniques, particularly the Limberg and Karydakis flaps, provide superior long-term results compared with traditional midline closure methods, offering significantly lower recurrence and complication rates. However, successful outcomes are not solely dependent on the surgical technique; patient-specific risk factors and diligent postoperative care are also critical determinants in preventing recurrence.

Introduction

Pilonidal sinus disease (PSD) is an acquired inflammatory condition that typically occurs in the natal cleft of the sacrococcygeal region. With an estimated incidence of approximately 26 per 100,000 people, it is most common among young adult males. The pathogenesis, once thought to be congenital, is now widely understood to be related to the penetration of hair follicles into the skin, leading to a foreign body granulomatous reaction and subsequent abscess or sinus tract formation. Key risk factors include a deep natal cleft, hirsutism, obesity, a sedentary lifestyle, prolonged sitting, and poor personal hygiene.

The clinical presentation of PSD can range from an asymptomatic pit in the natal cleft to a painful, acute abscess or a chronically draining sinus. The management of PSD poses a significant surgical challenge, and despite a multitude of described techniques, there is no universal consensus on the optimal approach. The primary goals of surgical treatment are:
Complete excision and eradication of all sinus tracts and pits.
Achieving rapid and robust wound healing.
Minimizing hospital stay and associated costs.
Enabling an early return to work and normal activities.
Achieving low rates of recurrence and postoperative complications.
This review consolidates and appraises the evidence from several key studies to provide a contemporary overview of evidence-based outcomes in PSD surgery, focusing on the comparison between traditional methods and modern flap-based reconstructions.

Review of Surgical Techniques and Evidence

The surgical management of chronic PSD has evolved from simple excisional techniques to complex flap reconstructions designed to flatten the natal cleft and prevent hair penetration.

1. Excision and Primary Midline Closure

This technique involves the elliptical excision of the sinus tracts followed by direct suturing of the wound edges in the midline. While simple and quick to perform, it places the suture line directly in the natal cleft—an environment that is moist, poorly vascularized, and subject to high shear forces.
Evidence: Studies consistently show this method has the highest rates of recurrence and complications. A retrospective analysis of 634 patients reported a **recurrence rate of 11.4%**. Another prospective trial found that 23% of patients in the primary closure group suffered wound breakdown from hematoma or infection. Despite a short operative time (approx. 27 minutes) and minimal hospital stay (1.7 days), the high failure rate makes it a suboptimal choice for definitive management.

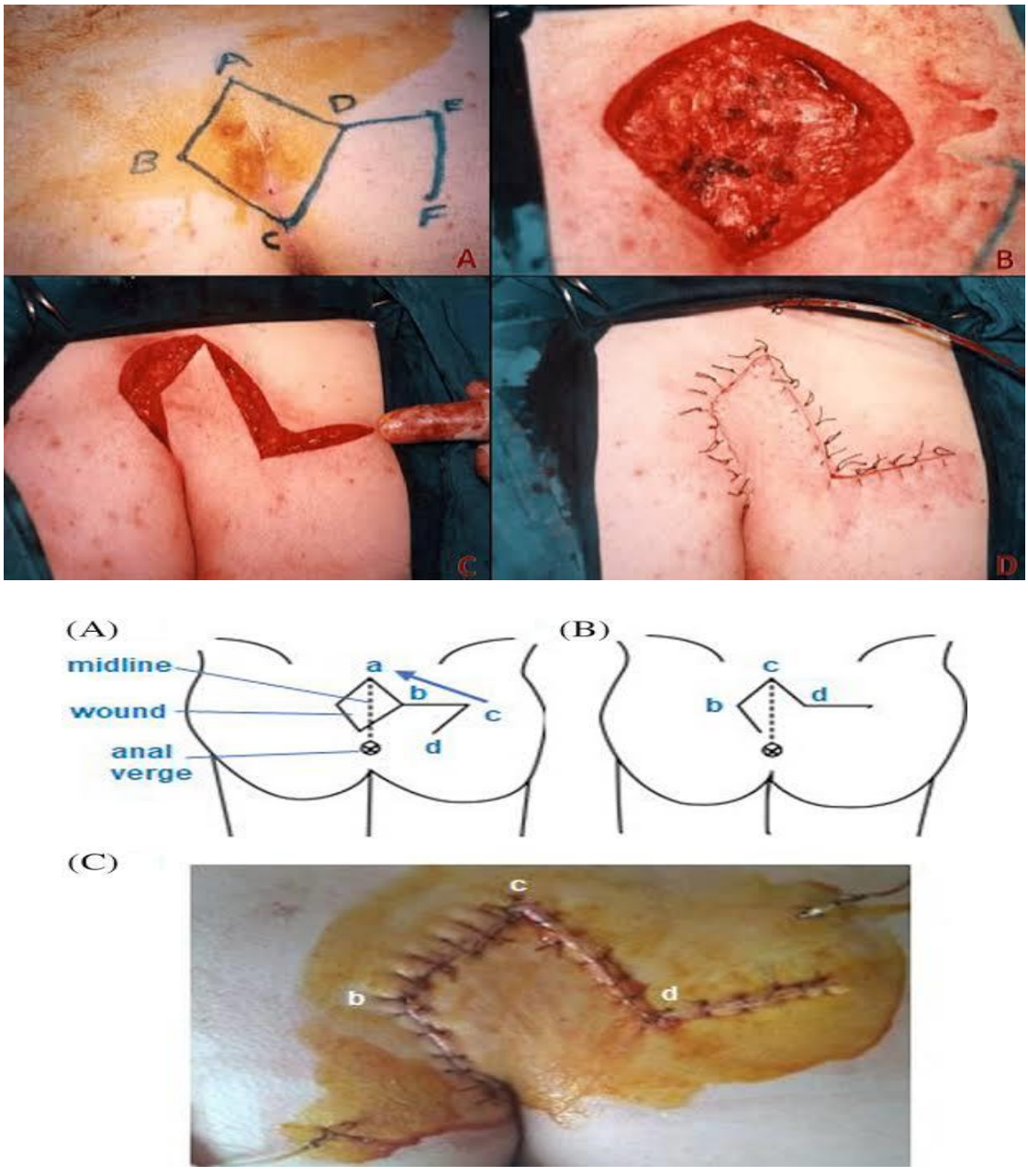
2. Excision and Marsupialization

In this technique, after the sinus is excised, the wound edges are sutured to the floor of the wound, creating a "pouch" or marsupialized cavity that heals by secondary intention. This avoids the tension of a primary closure but requires extensive postoperative wound packing and a prolonged healing period. **Evidence:** A large retrospective cohort of 823 patients found that marsupialization had a respectable long-term **recurrence rate of 4.4%**. However, this came at the cost of a significantly prolonged recovery, with patients returning to work in an average of **36 days**.

3. Rhomboid (Limberg) Flap

The Limberg flap is an off-midline flap technique where the diseased tissue is excised in a rhomboid shape, and a rotational flap is transposed from the adjacent gluteal region to cover the defect. This flattens the natal cleft and places the suture line away from the midline, in a well-vascularized area. **Evidence:** The Limberg flap demonstrates excellent outcomes. A prospective randomized trial comparing it to primary closure found **0% recurrence** in the flap group versus 9% in the closure group. Patients returned to work significantly earlier (14 vs. 23 days). A larger cohort study confirmed its superiority, reporting a low **recurrence rate of 4.7%** and the lowest infection rate (4.7%) among the compared methods.

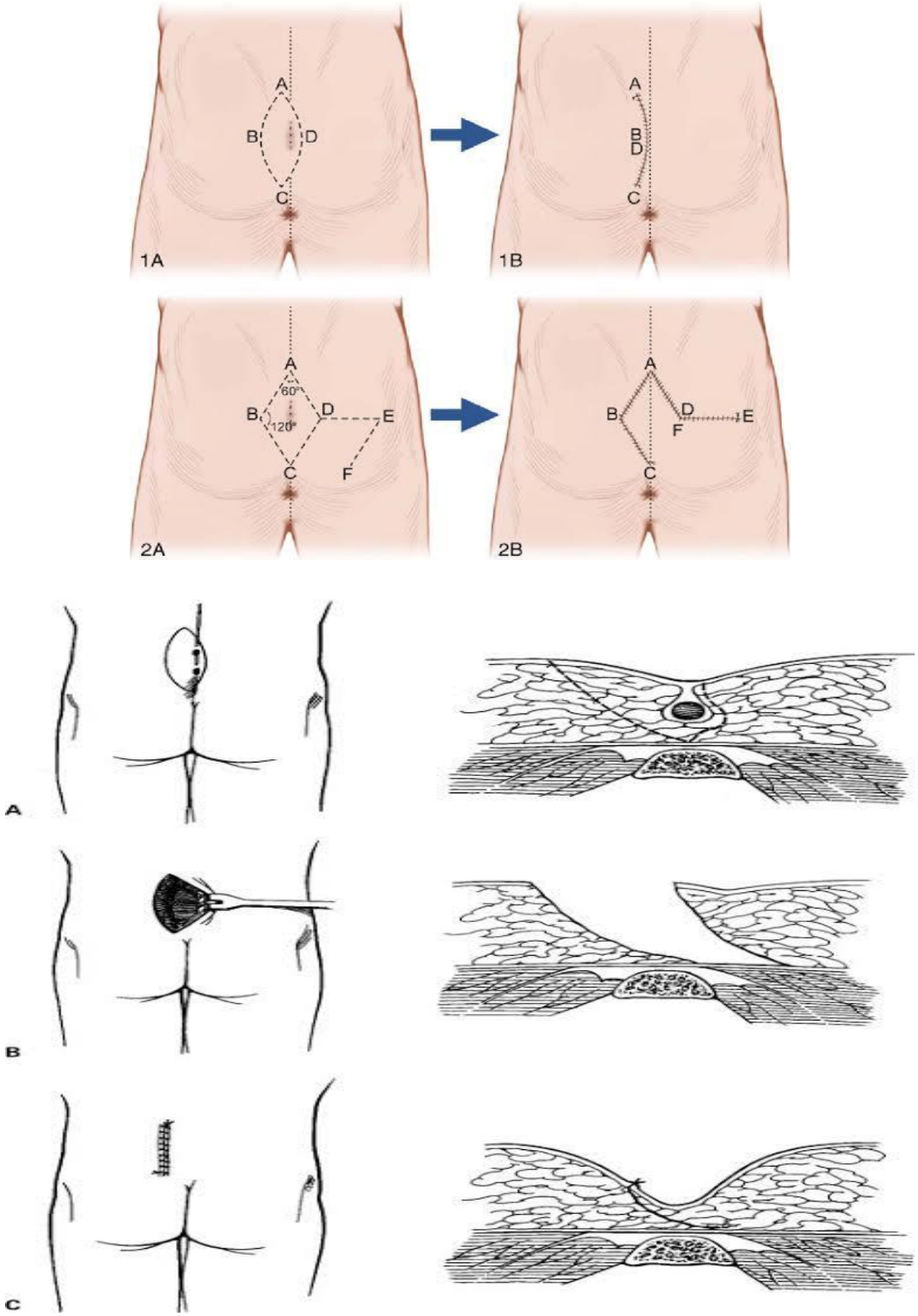
Figure 1: Diagram illustrating the Limberg flap technique. The rhomboid-shaped excision is filled by a rotational flap from the gluteal area, moving the closure line off the midline.



4. Karydakis Flap

The Karydakis flap is an asymmetrical advancement flap. It involves an elliptical excision of the sinus that is shifted to one side of the natal cleft. A flap of skin and fat is then mobilized from the contralateral side and advanced across the midline to close the defect, effectively effacing the cleft.
Evidence: The Karydakis flap has emerged as one of the most effective techniques. In a retrospective analysis of 634 patients, it demonstrated the **lowest recurrence rate at 2.2%** and the lowest overall complication rates (seroma, infection, dehiscence). While the operative time is longer than primary closure (approx. 47 minutes), its superior outcomes justify its use.

Figure 2: Diagram of the Karydakis flap. An asymmetrical excision allows for the advancement of a flap across the midline, which flattens the natal cleft and ensures an off-midline scar.



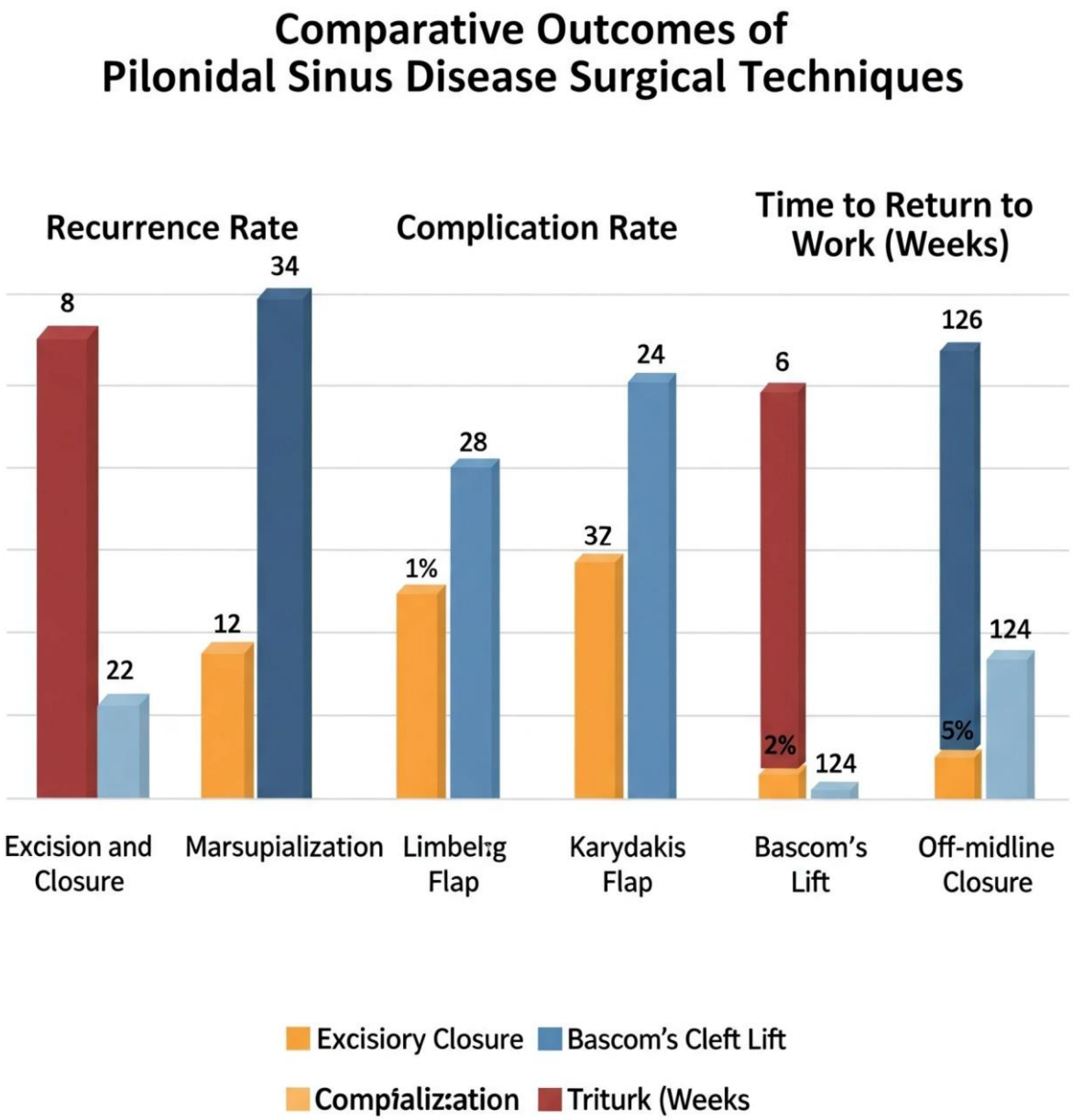
Comparative Analysis of Outcomes

The data from the reviewed studies clearly favors off-midline flap reconstructions over traditional midline techniques. While primary closure offers the quickest initial recovery, its long-term failure rate is unacceptably high. Marsupialization provides a durable result but is demanding for the patient due to its long healing time.

The Limberg and Karydakis flaps represent the best balance of efficacy, recovery, and patient convenience. The Karydakis flap, in particular, shows a marginal but consistent advantage in having the lowest reported recurrence and complication rates.

Graphical Comparison of Surgical Outcomes

Figure 3: A comparative bar chart illustrating the recurrence rates, complication rates (wound breakdown/infection), and time to return to work for different PSD surgical techniques. Flap techniques show markedly lower recurrence and complications.



Summary of Key Studies

Study Type	Patients (N)	Techniques Compared	Key Findings
Prospective Randomized Trial	46	Rhomboid Flap vs.Primary Closure	Rhomboid flap had 0% recurrence, faster healing, and earlier return to work compared to primary closure (9% recurrence).
Large Retrospective Cohort	823	Primary Closure vs.Marsupialization vs. Limberg Flap	Limberg flap and marsupialization had the lowest recurrence (~4.5%), but Limberg had a much faster return to work.
Retrospective Analysis	634	Limberg Flap vs. Karydakis Flap vs. Primary Closure	Karydakis flap had the lowest recurrence (2.2%) and complication rates. Primary closure had the highest (11.4%).
Tertiary Center Review	369	Risk Factor Analysis	Recurrence was 22.8%, linked to older age and seroma. Postoperative hair removal was a key protective factor.

Discussion

The collective evidence strongly indicates that the surgical approach for PSD should prioritize techniques that flatten the natal cleft and move the suture line away from the midline. The high moisture, bacterial load, and friction within the natal cleft make midline wounds inherently prone to dehiscence, infection, and ultimately, recurrence.
Off-midline flaps, such as the Limberg and Karydakis, address this fundamental pathophysiological issue by creating a more durable and hygienic local environment.

The choice between a Limberg and Karydakis flap may come down to surgeon preference and experience, as both yield excellent results. The Karydakis flap is often considered slightly less invasive with a smaller excision, which may contribute to its marginally lower complication rates.

It is crucial to recognize that surgery is only one component of successful PSD management. The Saudi tertiary-center study underscores the importance of patient-related factors and postoperative care. Recurrence was significantly associated with postoperative seroma and the absence of hair removal. This highlights that factors independent of the surgical technique, such as:
Patient Compliance: Adherence to wound care and hygiene instructions.
Hair Management: Regular, long-term hair removal from the sacrococcygeal area
(e.g., laser epilation, shaving).
Risk Factor Modification: Weight management and avoiding prolonged periods of sitting.
These elements are paramount to preventing the disease from recurring. Therefore, comprehensive patient education is an indispensable part of the treatment pathway.

Conclusion

Based on current evidence, off-midline flap reconstructions, specifically the **Karydakis and Limberg flaps**, represent the gold standard for the surgical treatment of pilonidal sinus disease. They consistently provide the lowest recurrence and complication rates when compared to traditional midline primary closure and marsupialization. While primary closure is technically simpler, its high failure rate makes it a poor choice for definitive treatment.

The success of any procedure is multifactorial. Optimal outcomes depend on a combination of meticulous surgical technique, diligent postoperative care including long-term hair management, and patient education on risk factor modification. Future research should focus on large-scale, multicenter randomized controlled trials to further refine surgical guidelines and explore the integration of minimally invasive techniques with established flap procedures to further improve patient outcomes.

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