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Comparative Analysis of Primary Closure, Rhomboid Flap, and Open Technique in Pilonidal Sinus Surgery: A Retrospective Cohort Study

Pilonidal Sinüs Cerrahisinde Primer Kapatma, Romboyid Flep ve Açık Tekniklerin Karşılaştırmalı Analizi: Retrospektif Kohort Çalışması

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ABSTRACT

Objective: Pilonidal sinus disease (PSD) is a common condition in young adults, with multiple surgical options available. The optimal technique remains debated due to trade-offs between recurrence, healing time, and patient satisfaction. This study aims to compare outcomes of primary closure, rhomboid flap, and open excision in the surgical management of PSD.

Methods: A retrospective cohort study was conducted on 300 patients treated between December 2024 and January 2015. Patients were grouped by technique: primary closure (n = 100), rhomboid flap (n = 100), and open excision (n = 100). Baseline characteristics, operative time, postoperative pain (VAS), length of stay, time to complete healing, Time to return to work , complications, recurrence, and satisfaction were analyzed. Statistical tests included Kruskal–Wallis for continuous variables and Chi-square for categorical variables ($P < .05$).

Results: Baseline characteristics were comparable across groups. Operative time was shortest for open excision (42.95 ± 9.98 min) and longest for rhomboid flap (54.35 ± 14.42 min; $p < 0.001$). Healing time differed significantly ($P < .001$): rhomboid flap (30.42 ± 5.36 days) and primary closure (36.56 ± 4.73 days) healed faster than open excision (75.75 ± 9.12 days). Return to work followed a similar pattern ($P < .001$) Pain scores and hospital stay were comparable. Recurrence was lowest with open excision (5.0%) versus primary closure (17.0%) and rhomboid flap (18.0%; $P = .011$). Satisfaction was highest in rhomboid flap (67% highly satisfied) and lowest in open excision (53%).

Conclusion: Open excision offers the lowest recurrence but at the cost of prolonged healing and delayed return to work. Off-midline flap procedures provide faster recovery and higher satisfaction, making it suitable for patients prioritizing early functional outcomes. Technique selection should balance recurrence risk, recovery time, and patient preference.

Keywords: Pilonidal sinus, rhomboid flap, primary closure, open excision, recurrence, wound healing.

ÖZ

Amaç: Pilonidal sinüs hastalığı (PSH), genç erişkinlerde sık görülen ve birden fazla cerrahi tedavi seçeneği bulunan bir hastalıktır. Nüks, iyileşme süresi ve hasta memnuniyeti arasındaki denge nedeniyle en uygun cerrahi teknik hâlen tartışmalıdır. Bu çalışmada pilonidal sinüs hastalığının cerrahi tedavisinde primer kapatma, romboid flep ve açık eksizyon tekniklerinin sonuçlarını karşılaştırmak amaçlanmıştır.

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Yöntemler: Bu retrospektif kohort çalışmasına Aralık 2024 ile Ocak 2025 tarihleri arasında tedavi edilen 300 hasta dâhil edildi. Hastalar uygulanan cerrahi tekniğe göre üç gruba ayrıldı: primer kapatma (n=100), romboid flep (n=100) ve açık eksizyon (n=100). Ameliyat süresi, postoperatif ağrı (VAS), hastanede kalış süresi, tam iyileşme süresi, işe dönüş zamanı, komplikasyonlar, nüks oranı ve hasta memnuniyeti değerlendirildi. İstatistiksel analizde Kruskal–Wallis ve Ki-kare testleri kullanıldı.

Bulgular: Gruplar arasında demografik özellikler açısından anlamlı fark yoktu. Ameliyat süresi açık eksizyon grubunda en kısa, romboid flep grubunda en uzun bulundu (P < ,001). İyileşme süresi romboid flep ve primer kapatma gruplarında açık eksizyona göre anlamlı olarak daha kısaydı (P < ,001). İşe dönüş süresi benzer şekilde daha hızlıydı. Ağrı skorları ve hastanede kalış süresi gruplar arasında farklılık göstermedi. Nüks oranı açık eksizyonda en düşükken (%5,0), primer kapatma (%17,0) ve romboid flepte (%18,0) daha yüksekti (P = ,011). Hasta memnuniyeti romboid flep grubunda en yüksekti.

Sonuç: Açık eksizyon düşük nüks oranı sağlarken, daha uzun iyileşme süresi ile ilişkilidir. Off-midline flep teknikleri daha hızlı iyileşme ve daha yüksek hasta memnuniyeti sunmaktadır.

Anahtar Kelimeler: Pilonidal sinüs, romboid flep, primer kapatma, açık eksizyon, nüks, yara iyileşmesi.

INTRODUCTION

Pilonidal sinus disease (PSD) is a common acquired condition of the sacrococcygeal region, primarily affecting young adults and often associated with significant morbidity and recurrence.[1] Despite numerous surgical techniques, the optimal approach remains controversial due to variations in recurrence rates, wound healing, and patient satisfaction.[2,3]

Current surgical options include primary midline closure, off-midline flap procedures (such as rhomboid or Limberg flap), and open excision with secondary healing. Recent evidence suggests that off-midline closure techniques reduce recurrence and improve wound healing compared to midline closure, while open healing remains widely used for complex or recurrent cases despite its association with prolonged recovery.[2-4]

A large UK multicenter cohort study (PITSTOP) reported that minimally invasive and off-midline techniques were associated with faster recovery and lower pain scores compared to traditional excisional approaches, although early treatment failure was slightly higher.[1] Similarly, a recent review in JAMA Surgery emphasized the growing trend toward off-midline and minimally invasive procedures but highlighted the need for standardized outcome reporting.[2] Furthermore, recent studies confirm that recurrence rates remain high in younger populations, reinforcing the importance of technique selection for long-term success.[3-5]

This study aims to compare primary closure, rhomboid flap, and open technique in terms of operative time, postoperative outcomes, complications, recurrence, and patient satisfaction in a large retrospective cohort.

METHODS

Study Design and Setting

This retrospective cohort study was conducted at Sohag University hospital, a tertiary care center, between January 2015 and December 2024.

Ethics approval: The study was approved by the Medical Research Ethics Committee (MREC) of Sohag University All procedures complied with the Declaration of Helsinki.

Participants

Patients diagnosed with pilonidal sinus disease who underwent surgical treatment during the study period were included. Inclusion criteria: age ≥16 years, primary or recurrent disease, and complete medical records. Exclusion criteria: incomplete follow-up data, associated anorectal pathology, or immunocompromised status.

Interventions

Patients were treated using one of three techniques:

1. Primary closure (midline excision and direct closure)
2. Rhomboid flap (off-midline flap reconstruction)
3. Open technique (excision with secondary healing)

The choice of surgical technique was determined by the operating surgeon based on disease characteristics (such as sinus extent and number of openings), patient factors, and surgeon experience.

Surgical procedures were performed by surgeons with different levels of experience within the department, including residents, assistant specialists, and senior consultants. Residents had approximately 2–3 years of surgical training, assistant specialists had at least 5 years of surgical experience, and consultant surgeons had more than 15 years of experience in general surgery. All procedures were performed under consultant supervision according to institutional practice.

Data Collection

Demographic and clinical variables included age, sex, BMI, smoking status, diabetes mellitus, family history, and

disease type (primary/recurrent). Operative details included number of sinus openings and operative time. Postoperative outcomes included:

1. Pain scores (VAS) on Day 1 and Day 3
2. Length of hospital stay
3. Time to complete healing
4. Time to return to work
5. Complications (infection, seroma, hematoma, and dehiscence). Postoperative complications were defined as follows: surgical site infection was diagnosed based on local erythema, purulent discharge, or need for antibiotic therapy; seroma was defined as clinically detectable fluid collection requiring drainage; hematoma as postoperative blood collection requiring intervention; and wound dehiscence as partial or complete separation of the surgical wound.
6. Recurrence
7. Patient satisfaction (4-point scale)

Data were extracted from electronic medical records by two independent reviewers. Discrepancies were resolved by consensus to ensure validity and reliability of the dataset.

Follow-up

Patients were followed for a minimum of 12 months postoperatively through outpatient visits and telephone interviews, with a mean follow-up of approximately 12 months. Recurrence was defined as the reappearance of symptoms or development of a new sinus tract in the sacrococcygeal region after complete wound healing, confirmed by clinical examination during follow-up.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD) and compared using Kruskal–Wallis test. Categorical variables were presented as frequencies and percentages and compared using Chi-square test or Fisher's exact test where appropriate. Subgroup analyses were performed for primary versus recurrent disease within each technique. Statistical significance was set at $P < .05$. Analyses were conducted using SPSS v26.0 (IBM SPSS Corp., Armonk, NY, USA).

A post-hoc power analysis was performed using G*Power software to assess the adequacy of the sample size for detecting differences in recurrence rates among the three groups. Based on the observed recurrence rates (17%, 18%, and 5%) in a total sample of 300 patients, the study demonstrated adequate statistical power (>80%) at a significance level of .05.

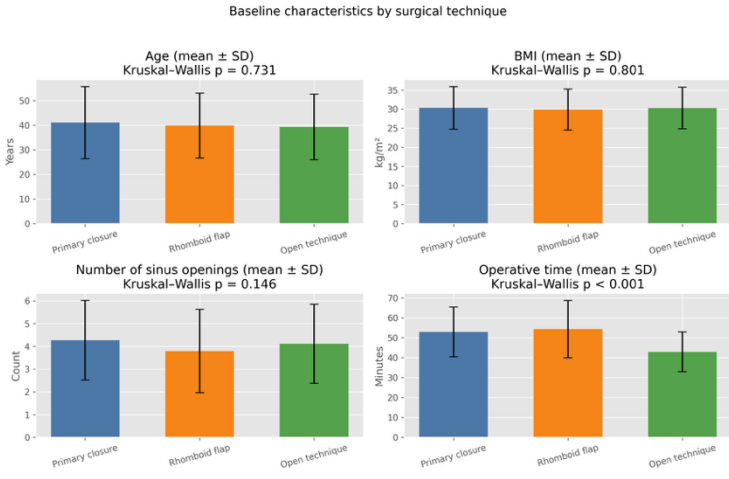

Figure 1. Baseline characteristics by surgical technique. Bars show mean ± SD. P-values from Kruskal–Wallis tests

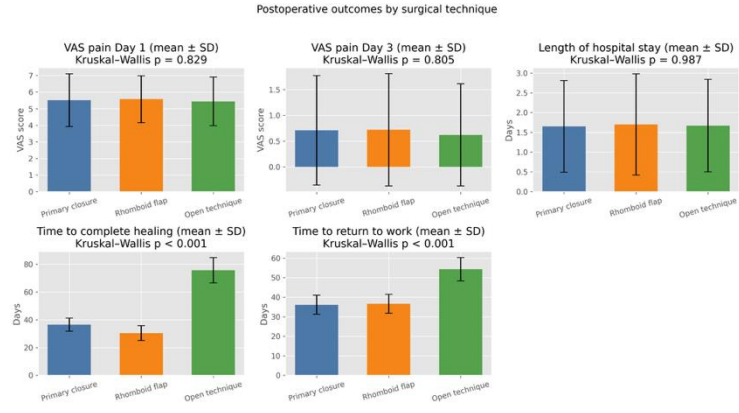

Figure 2. Postoperative outcomes by surgical technique. Bars show mean ± SD. P-values from Kruskal–Wallis tests; healing and return-to-work times differ significantly ($P < .001$).

Study Limitations

As a retrospective study, potential limitations include selection bias, reliance on existing records, and inability to control for unmeasured confounders.

RESULTS

Baseline Characteristics

A total of 300 patients were included, distributed across three surgical techniques: Primary closure (n = 100), Rhomboid flap (n = 100), and Open technique (n = 100). The overall mean age was 40.06 ± 13.71 years, with no significant difference among groups ($P = .731$). Similarly, BMI (30.19 ± 5.47 kg/m²) and the number of sinus openings (4.06 ± 1.77) were comparable across techniques ($P = .801$ and $P = .146$, respectively).

Operative time varied significantly ($P < .001$), being shortest in the open technique group (42.95 ± 9.98 min)

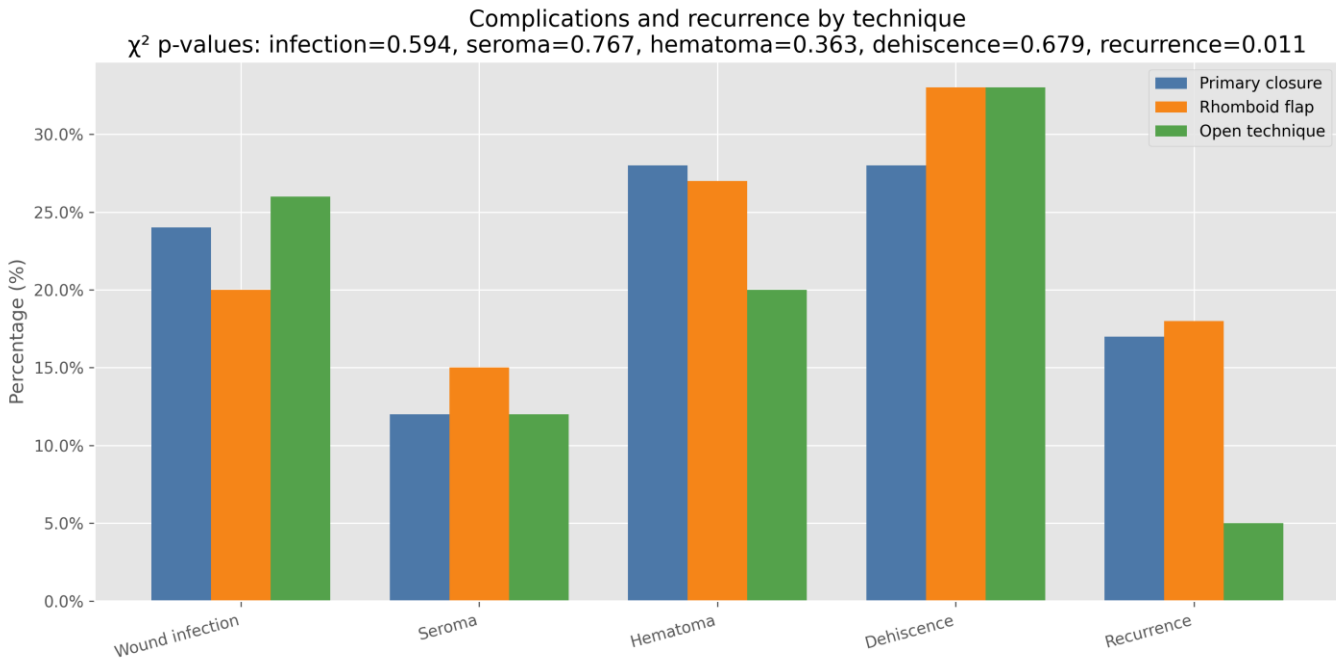

Figure 3. Postoperative complications and recurrence by technique (percentages). P-values from χ^2 tests; recurrence differs significantly ($P = .011$)

and longest in the rhomboid flap group (54.35 ± 14.42 min). Sex distribution, smoking status, diabetes mellitus, family history, and disease type were similar among groups (all $P > .05$) (Table 1, Figure 1).

Postoperative Outcomes

Pain scores decreased markedly from Day 1 (mean VAS: 5.51 ± 1.49) to Day 3 (0.68 ± 1.05) across all groups, with no significant differences between techniques ($P = .829$ and $P = .805$, respectively).

Length of hospital stay was similar (mean: 1.67 ± 1.20 days; $P = .987$).

However, time to complete healing differed significantly ($P < .001$): rhomboid flap achieved the fastest healing (30.42 ± 5.36 days), followed by primary closure (36.56 ± 4.73 days), while open technique required the longest duration (75.75 ± 9.12 days).

Return-to-work time followed a similar pattern ($P < .001$), with rhomboid flap and primary closure averaging ~36 days, compared to 54.30 ± 5.98 days for open technique (Table 2; Figure 2).

Complications and Recurrence

Overall complication rates were comparable among groups for wound infection (23.3%), seroma (13.0%), hematoma (25.0%), and dehiscence (31.3%) (all $P > .05$).

Recurrence, however, differed significantly ($P = .011$): open technique had the lowest recurrence (5.0%), compared to primary closure (17.0%) and rhomboid flap (18.0%) (Table 3; Figure 3).

Patient Satisfaction

Most patients reported being highly satisfied (60.3%) or moderately satisfied (30.3%). Satisfaction was highest in the rhomboid flap group (67.0% highly satisfied) and lowest in the open technique group (53.0%) (Table 4; Figure 4).

Subgroup Analysis

Extended analyses stratified by disease type (primary vs recurrent) were performed within each surgical technique and are summarized in Table 5. Across all techniques, age, BMI, number of sinus openings, operative time, and pain scores (VAS Day 1 and Day 3) showed no statistically significant differences between primary and recurrent cases (all $P > .05$).

Within the primary closure group, recurrent cases demonstrated a significantly shorter hospital stay compared to primary cases (1.18 ± 0.73 vs 1.75 ± 1.21 days; $P = .036$), while healing time and return-to-work intervals were comparable between subgroups.

In the rhomboid flap group, recurrent disease was associated with a numerically longer return-to-work duration; however, this difference did not reach statistical significance. Healing time remained consistent across disease types.

Similarly, in the open technique group, recurrent cases exhibited a longer healing duration compared to primary cases, though without statistical significance. Overall, disease recurrence did not substantially influence operative parameters, postoperative pain, or long-term recovery outcomes across the studied techniques.

Table 1. Baseline Characteristics by Surgical Technique

Variable	Overall	Primary closure	Rhomboid Flap	Open technique	*P*
Age (years)	40.06 ± 13.71	41.05 ± 14.67	39.84 ± 13.20	39.29 ± 13.29	.731[a]
BMI	30.19 ± 5.47	30.34 ± 5.61	29.90 ± 5.37	30.32 ± 5.48	.801[a]
Number of sinus openings	4.06 ± 1.77	4.27 ± 1.75	3.79 ± 1.83	4.11 ± 1.73	.146[a]
Operative time (min)	50.07 ± 13.38	52.90 ± 12.48	54.35 ± 14.42	42.95 ± 9.98	<.001[a]
Gender Male/Female	228 (76.0%)/ 72 (24.0%)	78 (78.0%)/ 22 (22.0%)	71 (71.0%)/ 29 (29.0%)	79 (79.0%)/ 21 (21.0%)	.353[b]
Smoking: Yes/No	242 (80.7%)/ 58 (19.3%)	86 (86.0%)/ 14 (14.0%)	80 (80.0%)/ 20 (20.0%)	76 (76.0%)/ 24 (24.0%)	.197[b]
Diabetes mellitus Yes/No	150 (50.0%)/ 150 (50.0%)	56 (56.0%)/ 44 (44.0%)	42 (42.0%)/ 58 (58.0%)	52 (52.0%)/ 48 (48.0%)	.125[b]
Family history Yes/No	41 (13.7%)/ 259 (86.3%)	19 (19.0%)/ 81 (81.0%)	13 (13.0%)/ 87 (87.0%)	9 (9.0%)/ 91 (91.0%)	.117[b]
Type of disease Primary/Recurrent	253 (84.3%)/ 47 (15.7%)	83 (83.0%)/ 17 (17.0%)	85 (85.0%)/ 15 (15.0%)	85 (85.0%)/ 15 (15.0%)	.904[b]

Continuous variables are presented as mean ± SD; categorical variables as n (%). BMI; body mass index, min; minutes. [a] Kruskal–Wallis (continuous). [b] χ^2 test (categorical).

Table 2. Postoperative Outcomes by Surgical Technique

Outcome	Overall	Primary closure	Rhomboid Flap	Open technique	*P* [a]
VAS pain Day 1	5.51 ± 1.49	5.51 ± 1.59	5.57 ± 1.41	5.44 ± 1.47	.829
VAS pain Day 3	0.68 ± 1.05	0.71 ± 1.06	0.72 ± 1.09	0.62 ± 0.99	.805
Length of hospital stay (days)	1.67 ± 1.20	1.65 ± 1.16	1.70 ± 1.28	1.67 ± 1.17	.987
Time to complete healing (days)	47.58 ± 21.19	36.56 ± 4.73	30.42 ± 5.36	75.75 ± 9.12	<.001
Time to return to work (days)	42.34 ± 9.97	36.11 ± 4.88	36.61 ± 4.86	54.30 ± 5.98	<.001

Continuous variables are presented as mean ± SD; VAS; Visual Analog Scale; [a] Kruskal–Wallis test.

DISCUSSION

Principal Findings

In this retrospective cohort of 300 patients, baseline characteristics were well balanced across techniques. Open excision had the shortest operative time, whereas rhomboid (off-midline) flap and primary closure achieved faster healing and earlier return to work than open excision. Recurrence was lowest after open excision, while pain scores, hospital stay, and most complications did not differ meaningfully between groups—reflecting the contemporary observation that pilonidal surgery involves a trade-off between speed of recovery and long-term durability.[6,7]

Operative time

Our data show shorter operative time for open excision relative to flap reconstruction. This is consistent with recent reviews indicating that off-midline flap procedures generally require longer operative times than simple excision or minimally invasive approaches because of flap design, inset, and drain placement.[6]

Healing time and return to work

We observed substantially faster healing and earlier return to work with rhomboid flap and primary closure compared with open excision. Classic evidence demonstrates that open healing prolongs wound management but reduces long-term recurrence compared with midline closure[8], while flap-based (off-midline) repairs

shorten healing and time off work versus laying open or direct closure.[9] Together with modern summaries, these data support our functional findings.[6,8,9]

Table 3. Complications and Recurrence by Surgical Technique

Complication	Overall	Primary closure	Rhomboid Flap	Open technique	*P* [a]
Wound infection	70 (23.3%)	24 (24.0%)	20 (20.0%)	26 (26.0%)	.594
Seroma	39 (13.0%)	12 (12.0%)	15 (15.0%)	12 (12.0%)	.767
Hematoma	75 (25.0%)	28 (28.0%)	27 (27.0%)	20 (20.0%)	.363
Dehiscence	94 (31.3%)	28 (28.0%)	33 (33.0%)	33 (33.0%)	.679
Recurrence	40 (13.3%)	17 (17.0%)	18 (18.0%)	5 (5.0%)	.011

Categorical variables are presented as n (%). [a] χ^2 test.

Table 4. Patient Satisfaction by Surgical Technique

Satisfaction	Overall	Primary closure	Rhomboid Flap	Open technique	*P* [a]
Highly satisfied	181 (60.3%)	61 (61.0%)	67 (67.0%)	53 (53.0%)	.1273
Moderately satisfied	91 (30.3%)	34 (34.0%)	28 (28.0%)	29 (29.0%)	.6132
Low satisfied	20 (6.7%)	3 (3.0%)	5 (5.0%)	12 (12.0%)	.0277
Not satisfied	8 (2.7%)	2 (2.0%)	0 (0.0%)	6 (6.0%)	.0275

Categorical variables are presented as n (%). [a] χ^2 test.

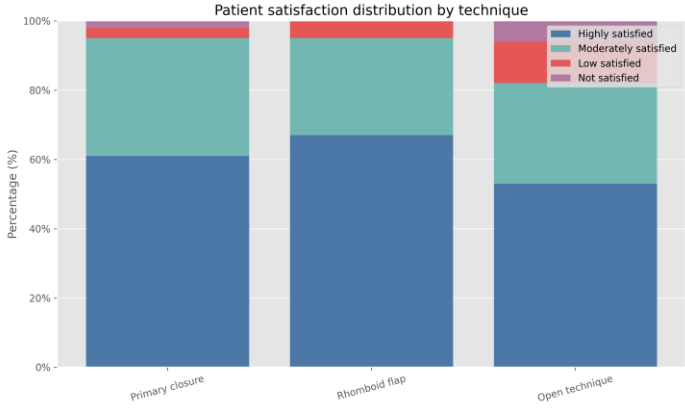

Figure 4. Patient satisfaction distribution by technique (stacked percentages).

Recurrence

In our cohort, open excision demonstrated the lowest recurrence, whereas closed techniques (primary closure and rhomboid flap) showed higher recurrence rates. Landmark randomized controlled trial syntheses have demonstrated that open healing reduces recurrence compared with midline closure, and that off-midline closure techniques reduce recurrence compared with midline closure—principles reflected in recent European and Dutch guidelines that discourage midline closure and recommend off-midline techniques when surgical closure is performed.[8,10,11] Consequently, several contemporary guidelines discourage primary midline closure and recommend off-midline techniques whenever closure is required due to their lower recurrence and complication rates.

Our findings are consistent with these reported trade-offs: greater long-term durability with open healing but slower recovery, versus faster recovery with off-midline closure with a potential recurrence risk depending on case selection and duration of follow-up.[6,8,10,11] The lower recurrence observed with the open technique in our cohort may be explained by the absence of midline tension and the gradual flattening of the natal cleft during secondary healing, which may reduce hair accumulation and subsequent sinus formation.

Complications and pain

We found similar complication rates (infection, seroma, hematoma, dehiscence) and no differences in pain (Day 1/Day 3) between techniques. The PITSTOP multicenter cohort reported less pain and fewer complications after minimally invasive procedures, yet a higher early treatment failure rate, illustrating heterogeneity when comparing technique families and emphasizing standardized outcome reporting.[7,6]

Patient satisfaction

The rhomboid flap group had the highest proportion of high levels of satisfaction, consistent with evidence that off-midline flap reconstruction often yields favorable patient-reported outcomes (e.g., comfort, cosmesis, activity resumption) compared with laying open/direct closure.[6,9]

Context with minimally invasive and laser techniques

Although our dataset focused on primary closure, rhomboid flap, and open excision, contemporary studies show minimally invasive and laser-based treatments can accelerate recovery and reduce complications, but may incur higher early failure or residual disease compared with flap reconstructions in some series.[7,12] A 2024 comparative study found fewer complications and faster recovery with laser ablation than with direct closure or flap reconstruction, albeit with more residual disease—underscoring the need to individualize care based on disease complexity and patient priorities.[13]

Table 5. Outcomes Stratified by Disease Type Within Each Surgical Technique

Variable	Primary Closure Primary/Recurrent	*P* [a]	Rhomboid Flap Primary/Recurrent	*P* [a]	Open Technique Primary/Recurrent	*P* [a]
Age (years)	40.84 ± 15.08 / 42.06 ± 12.83	.741	39.65 ± 12.89 / 40.93 ± 15.30	.787	39.60 ± 13.24 / 37.53 ± 13.89	.481
BMI (kg/m²)	30.66 ± 5.59 / 28.76 ± 5.62	.187	30.20 ± 5.34 / 28.20 ± 5.35	.170	30.58 ± 5.39 / 28.87 ± 5.95	.262
Number of sinus openings	4.31 ± 1.75 / 4.06 ± 1.78	.552	3.68 ± 1.76 / 4.40 ± 2.13	.205	4.00 ± 1.73 / 4.73 ± 1.62	.111
Operative time (min)	52.95 ± 12.54 / 52.65 ± 12.51	.960	54.24 ± 14.61 / 55.00 ± 13.76	.850	43.00 ± 10.09 / 42.67 ± 9.61	.981
VAS pain Day 1	5.59 ± 1.57 / 5.12 ± 1.65	.292	5.56 ± 1.42 / 5.60 ± 1.40	.910	5.45 ± 1.44 / 5.40 ± 1.72	.810
VAS pain Day 3	0.75 ± 1.09 / 0.53 ± 0.87	.479	0.71 ± 1.10 / 0.80 ± 1.08	.692	0.60 ± 0.97 / 0.73 ± 1.16	.770
Length of hospital stay (days)	1.75 ± 1.21 / 1.18 ± 0.73	.036	1.69 ± 1.27 / 1.73 ± 1.33	.995	1.65 ± 1.11 / 1.80 ± 1.52	.966
Time to complete healing (days)	36.52 ± 4.71 / 36.76 ± 4.97	.840	30.29 ± 5.39 / 31.13 ± 5.26	.530	75.07 ± 9.16 / 79.60 ± 8.16	.075
Time to return to work (days)	36.01 ± 4.98 / 36.59 ± 4.47	.603	36.24 ± 4.89 / 38.73 ± 4.20	.074	54.62 ± 5.91 / 52.47 ± 6.25	.240

Values are presented as mean ± SD. BMI; body mass index; VAS; visual analog scale. [a] Kruskal–Wallis test

Subgroup analysis (primary vs recurrent disease)

Subgroup analyses revealed no material differences between primary and recurrent disease for operative time, pain, or healing within each technique, except shorter hospital stay in recurrent cases treated by primary closure. This aligns with guideline perspectives that technique selection—particularly avoiding midline closure—may influence outcomes more than disease chronicity per se.[10,11] Population analyses further indicate recurrence dynamics are earlier and more frequent in children, whereas young adults exhibit recurrence rates similar to older adults—relevant when extrapolating pediatric data.[14,15]

Clinical implications

Our results support modern recommendations to avoid midline closure, use off-midline when closing, and recognize that open excision may minimize recurrence at the cost of prolonged recovery.[8,10,11] For patients prioritizing fast recovery and satisfaction, off-midline flap (e.g., rhomboid) is attractive; for those prioritizing long-term durability (with wound care resources available), open healing remains valid.[6,8,10,11] Minimally invasive/laser approaches should be considered in selected cases after transparent discussion of early failure/residual disease.[7,12,13]

Strengths and limitations

Strengths include balanced baselines and comprehensive outcomes (healing, return to work, recurrence, complications, satisfaction). Limitations include the retrospective design, selection bias in technique allocation, and absence of minimally invasive/laser arms, limiting direct comparisons with MIS-focused cohorts. The lack of detailed disease severity parameters is a limitation of this retrospective analysis. Future work should adopt prospective designs, standardized definitions, and longer follow-up, as emphasized by recent reviews and guidelines.

CONCLUSION

This study demonstrates that surgical technique selection for pilonidal sinus disease involves a clear trade-off between recurrence prevention and speed of recovery. Open excision provided the lowest recurrence rate but was associated with prolonged healing and delayed return to work, whereas rhomboid flap and primary closure achieved faster wound healing, shorter time off work, and higher patient satisfaction, albeit with higher recurrence compared to open healing. Pain scores, hospital stay, and complication rates were similar across techniques.

These findings support current guidelines recommending avoidance of midline closure and favoring off-midline flap techniques when closure is performed. Open healing remains a valid option for patients prioritizing long-term durability and recurrence prevention, provided they accept longer recovery. Emerging minimally invasive and laser-based approaches may further optimize outcomes but require careful patient selection and long-term evaluation.

Future research should focus on prospective, multicenter trials comparing traditional and minimally invasive techniques, incorporating standardized outcome measures and patient-reported metrics to guide individualized treatment strategies.

Etik Komite Onayı: Çalışma, Sohag Üniversitesi Tıp Fakültesi Tıbbi Araştırma Etik Kurulu (MREC) tarafından onaylanmıştır (tarih: 5 Ocak 2015, numara: SUV-MED-REC-2015-0123).
Hasta Onamı: Bu araştırma, hastalarla doğrudan temas kurulmaksızın, rutin olarak toplanan klinik verilerin geriye dönük analizi şeklinde gerçekleştirilmiştir.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir-M.T.; Tasarım- M.T.; Denetleme- M.T.; Kaynaklar-M.T.; Veri Toplanması ve/veya İşlemesi- M.T., A.A., N.A.Z.; Analiz ve/veya Yorum- M.T., A.A., N.A.Z.; Literatür Taraması- M.T., A.A., N.A.Z.; Yazıyı Yazan- M.T., A.A., N.A.Z.; Eleştirel İnceleme- M.T., A.A., N.A.Z.
Teşekkürler: Yazarlar, hasta bakımı ve veri toplama konusunda yardımları için Sohag Üniversitesi Hastanesi'ndeki cerrahi ekibe ve hemşirelik personeline teşekkür eder. Ayrıca, hasta dosyalarına erişimi kolaylaştırdığı için tıbbi kayıtlar departmanının desteğini de takdirle karşılıyoruz.
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
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Ethics Committee Approval: The study was approved by Medical Research Ethics Committee (MREC), Faculty of Medicine, Sohag University (date: January 5, 2015, number: SUV-MED-REC-2015-0123).
Informed Consent: This research was conducted as a retrospective analysis of routinely collected clinical data, with no direct patient contact.
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REFERENCES

1. Brown SR, Hind D, Strong E, et al. Real-world practice and outcomes in pilonidal surgery: Pilonidal Sinus Treatment Studying the Options (PITSTOP) cohort. *Br J Surg.* 2024;111(3):znae009.
2. Gil LA, Deans KJ, Minneci PC. Management of pilonidal disease: a review. *JAMA Surg.* 2023;158(8):875-883.
3. Oetzmann von Sochaczewski C, Doll D. Recurrence rates of pilonidal sinus disease are high in children and recurrences occur exceedingly early. *Surgeries.* 2024;5(3):726-737.
4. Emral AC, Gülen M, Ege BE. Evaluating efficacy and outcomes: comparison of laser treatment and crystallized phenol in pilonidal sinus disease. *Front Surg.* 2024;11:1494382.
5. Hull TL, Wu J. Pilonidal disease. *Surg Clin North Am.* 2020;100(6):1139-1154.
6. Iesalnieks I, Ommer A, Petersen S, et al. German national guideline on the management of pilonidal disease. *Colorectal Dis.* 2021;23(7):1793-1803.
7. Milone M, Velotti N, Manigrasso M, et al. Long-term follow-up for pilonidal sinus surgery: a review of literature with meta-analysis. *Tech Coloproctol.* 2018;22(10):689-698.
8. Al-Khamis A, McCallum I, King PM, Bruce J. Healing by primary closure versus open healing after surgery for pilonidal sinus: systematic review and meta-analysis. *BMJ.* 2010;340:c216.
9. Berthier C, Bérard E, Meresse T, et al. Flap reconstruction vs laying open or direct suture for pilonidal sinus: meta-

analysis of randomized studies. *Int Wound J.* 2019;16(6):1365-1379.
10. Ojo D, Gallo G, Kleijnen J, et al. European Society of Coloproctology guidelines for the management of pilonidal disease. *Br J Surg.* 2024;111(10):znae237.
11. Huurman EA, de Raaff CAL, Sloots PCEJ, et al. Dutch national guideline on the management of intergluteal pilonidal sinus disease. *Br J Surg.* 2024;111(12):znae281.
12. Dessily M, Charara F, Gagnière J, et al. Endoscopic pilonidal sinus treatment: a multicenter prospective study of 250 patients. *Colorectal Dis.* 2019;21(6):719-726.
13. Tyrväinen E, Nuutinen H, Savikkomaa E, et al. Laser ablation vs simple excision vs flap reconstruction in pilonidal sinus. *Lasers Med Sci.* 2024;39:52.
14. Stauffer VK, Luedi MM, Kaufmann M, et al. Common surgical procedures in pilonidal sinus disease: a meta-analysis and comprehensive study on recurrence. *Sci Rep.* 2018;8:3058.
15. Oetzmann von Sochaczewski C, Hackmann T, Heitmann H, et al. Pilonidal sinus recurrence in young adults—similar to children or adults? *Surgeries.* 2025;6(3):60.