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RESEARCH ARTICLE

Efficacy and Safety of Crystallized Phenol in the Treatment of Pilonidal Sinus Disease
Crystallized Phenol for Pilonidal Sinus Disease

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ABSTRACT

Aim: Pilonidal sinus is a common condition in general surgery practice, with various treatment options available. Treatment effectiveness varies based on individual patient characteristics, and recurrence rates of up to 30% have been reported. Crystallized phenol has gained attention as a minimally invasive method due to its low morbidity and enhanced patient comfort. This study aimed to examine the clinical effectiveness of crystallized phenol and factors influencing recurrence.

Method: This retrospective cohort study included 82 patients aged 18 years and older treated between September 2022 and September 2024. Data on age, body mass index (BMI), gender, sinus number, hospital stay, return to normal activities, follow-up duration, and complications were collected. Patients were followed up at 1 and 30 days post-procedure and for an average of 2 years. Recurrence rates were recorded through clinic examination.

Results: Eighty-two patients (54 men) were included in the study. The mean age was 25.9±8.1 years, and the mean BMI was 28.7±3.9, with 17.6% of patients classified as obese. Crystallized phenol was applied under spinal anesthesia in 63 cases (76.8%). At the end of the follow-up period, a 10% recurrence rate was observed.

Conclusion: Crystallized phenol is a minimally invasive, low-complication treatment that enables a quick return to daily life. High BMI and sinus pit number were identified as significant factors for recurrence. Similar recurrence rates were observed across centers, highlighting the consistency of the method. Further prospective randomized controlled trials are needed to confirm these findings.

Keywords: Crystallized phenol, pilonidal sinus, recurrence

Introduction

Pilonidal sinus disease (PSD) is an acquired condition of the sacrococcygeal region, where hair-containing debris penetrates the natal cleft, causing chronic inflammation and recurrent infection. Despite its benign nature, PSD imposes a substantial healthcare burden, with an annual incidence of 26-100 per 100,000 and a rising global trend.[1,2] It predominantly affects young men, with peak incidence in the early 20s and a male-to-female ratio of at least 2:1.[3] Risk factors include family history, hirsutism, obesity, and prolonged sitting.[4]

The accepted pathophysiology involves hair shafts acting as foreign bodies, triggering a granulomatous reaction, follicular obstruction, and sinus formation.[5,6] Clinically, PSD ranges from asymptomatic pits to painful abscesses and chronic draining sinuses, leading to work or school absenteeism and impaired quality of life. Although hygiene and depilation are essential, surgery remains the primary treatment. Traditional excision techniques offer low recurrence but carry risks of wound complications and prolonged healing. Off-midline flaps (e.g., Limberg, Karydakis) reduce wound morbidity but lack clear

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superiority across all outcomes. Minimally invasive methods -including phenol injection, unroofing, and video-assisted and endoscopic approaches- aim to balance efficacy with faster recovery and lower morbidity.[7]

Phenol, a low-cost sclerosing agent with antiseptic and anesthetic properties, can be applied in outpatient settings. Crystallized phenol yields single-session success rates of 60%-70% and >90% with multiple sessions, although recurrence remains variable.[8] As recurrence is a key concern, evaluating phenol therapy across diverse populations may help identify clinical or contextual predictors of treatment failure.

This multicenter study evaluates crystallized phenol therapy by assessing (i) recurrence rates, (ii) complication profiles, and (iii) clinical and sociodemographic predictors of recurrence.

Materials and Methods

Study Design and Setting

This retrospective multicenter cohort study analyzed the medical records of patients who underwent crystallized phenol therapy for PSD between September 2022 and September 2024. Patients were identified using the International Classification of Diseases, 10th revision, codes L05.0 and L05.9 (pilonidal cyst and sinus with/without abscess) using clinical portal databases.

Data were collected from two institutions with a shared surgical approach and identical treatment protocols: two private hospitals in Ankara and İstanbul, serving a predominantly urban population with high socioeconomic status.

Patient Selection

Eligible participants were adults diagnosed with primary PSD who had no prior surgical excision, flap reconstruction, or endoscopic intervention. Patients were excluded if, during admission, they exhibited signs of active infection (e.g., abscess or cellulitis), were receiving immunosuppressive therapy or had a diagnosis of diabetes mellitus, possessed incomplete medical records, or were lost to follow-up (defined as missing one or more scheduled visits), as shown in the patient selection diagram in Figure 1.

All procedures were performed following a standardized protocol by two general surgeons, each with over 5 years of independent surgical practice and specific experience in managing PSD. Both surgeons had received training in crystallized phenol application in the same university hospital. The application technique, patient positioning, and post-procedure care protocols were standardized and consistently applied across both centers to minimize interoperator variability.

Surgical Procedure

Patients were placed in the prone position, and the gluteal cleft was shaved and disinfected with an antiseptic solution.

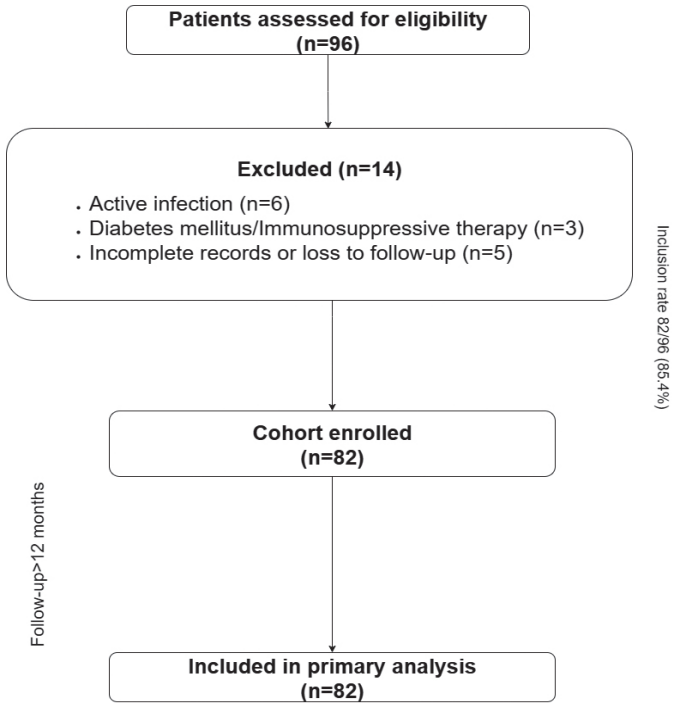

Figure 1. Patient flow diagram

If the procedure was performed in an office setting, local anesthesia (2% lidocaine with epinephrine) was administered, whereas in the operating room, it was performed under general/spinal anesthesia. The sinus tract was cleaned and thoroughly irrigated with 0.9% saline. Crystallized phenol was applied directly into the sinus tract. Treatment sessions were repeated at 3-week intervals if necessary, up to a maximum of two sessions per patient. Post-procedure care included guidance on wound hygiene, daily showering, avoidance of tight clothing, and minimizing prolonged sitting.

Crystallized phenol (pure solid form) was used in all procedures. Approximately 3-5 g of phenol was applied per session depending on the size and number of sinus tracts.[9] Phenol crystals were gently placed into the tract using a blunt-tipped applicator under direct visualization, ensuring complete filling without exerting excessive pressure. In cases with multiple pits, the same total dose was distributed proportionally. Prior to application, the surrounding skin was protected with ointment to avoid chemical burns. All procedures were performed with gloves and goggles to prevent phenol exposure. No dose-response analysis was performed regarding recurrence or complications.

All patients underwent clinical examination on postoperative day 1 and at the end of the first month. Long-term follow-up was conducted at 12 months post-treatment, either through in-person visits. For the purposes of this study, only the first documented recurrence per patient was recorded and included in the analysis.

The following variables were systematically extracted from medical records: age, sex, body mass index (BMI), smoking status, disease duration, number of sinus pits, presence of abscess, operation time, anesthesia technique, and follow-up duration. Early postoperative infection, skin necrosis, and phenol-related chemical burns are accepted as surgical complications. Development of a new sinus tract or abscess in the same anatomical region following documented healing is confirmed as recurrence clinically. Complete epithelialization within 3 months of the initial treatment session is accepted healing.

Statistical Analysis

All analyses were performed using SPSS Statistics version 28.0 (IBM Corp., Armonk, NY, USA). Normality of continuous variables was assessed using the Shapiro-Wilk test, with the results presented as mean ± standard deviation (SD). Group comparisons employed Student's t-test or the Mann-Whitney U test for continuous data and the chi-square (χ^2) test or Fisher's exact test for categorical variables. Independent predictors of recurrence were identified using stepwise logistic regression analysis (significance level: $p<0.05$).

This study was approved by the institutional review board of Acıbadem Mehmet Ali Aydınlar University Medical Research Ethics Committee (ATADEK) (approval number: 2025-09/77, dated: 12.06.2025). All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients prior to treatment initiation.

Results

A total of 96 patients were screened for eligibility. Fourteen patients were excluded, six due to active infection, three due to diabetes mellitus or ongoing immunosuppressive therapy, and five due to incomplete medical records or loss to follow-up. Ultimately, 82 patients met the inclusion criteria and were included in the final analysis. A flowchart summarizing the screening and inclusion process is presented in Figure 1.

Between September 2022 and September 2024, crystallized phenol ablation was applied to 82 consecutive patients with primary PSD across two centers. The cohort was 65.9% men (n=54) and 34.1% (n=28) women, with an overall median age of 25.8 years. The mean ± SD) height, weight, and BMI were 177±7 cm, 85.4±12.6 kg, and 28.7±3.9 kg/m^2, respectively; 17.6% (n=14) of patients met the criterion for obesity (BMI >30 kg/m^2). A single sinus pit was identified in 60 patients, whereas 16, 4, and 2 patients presented with two, three, and four pits, respectively, indicating a moderate spectrum of anatomical complexity. Of the 82 patients, 56 (68.3%) were current smokers, whereas 26 (31.7%) had never smoked. Recurrence was documented in five smokers (8.9%) and in three non-smokers (11.5%). Fisher's exact test showed no significant association between smoking status and treatment failure (p=0.70), indicating that cigarette use was not an independent determinant of recurrence in this cohort (Table 1).

All patients presented with pain. Beyond this ubiquitous symptom, 13 individuals (15.9%) reported active discharge from the sinus tract, and 6 (7.3%) had previously undergone abscess drainage. Only 15 patients (18.3%) were evaluated at the time of their initial diagnosis; the remaining 67 (81.7%) had experienced symptoms for 8±1 months (mean ± SD, as shown in Table 1) prior to crystallized phenol treatment.

Median follow-up was 24 months (interquartile range: 22-25), during which recurrence was systematically assessed in all patients (n=82). Recurrence was defined as the appearance of a new sinus tract or abscess in the same anatomical region following complete healing. Overall, eight recurrences (10%) were documented. Among the eight patients who experienced recurrence, three (37.5%) were classified as early recurrences (<6 months) and five (62.5%) as late recurrences (>6 months). All eight recurrences were detected during clinical evaluations. No multiple recurrences were observed during the study period.

Recurrence was observed in 3 of the 28 female patients (10.7%) and in 5 of the 54 male patients (9.3%). Fisher's exact test demonstrated no significant association between sex and recurrence (p =0.92). Recurrence risk varied markedly across BMI; no failures were recorded in the underweight group (n=12, BMI ≤18.5 kg/m^2), whereas 3 of the 56 patients with BMI 18.6-29.9 kg/m^2 relapsed (5.4%). By contrast, 5 of the 14 patients with obesity (35.7%) experienced recurrence.

Table 1. Demographic characteristics of patients (n=82)

Sex (n, %)	
Male	54 (65.9%)
Female	28 (34.1%)
Age, years (mean ± SD)	25.9±8.1
Height, cm (mean ± SD)	177±7
Weight, kg (mean ± SD)	85.4±12.6
Body mass index, kg/m^2 (mean ± SD)	28.7±3.9
Pit number (n, %)	1 (n=60, 73.1%) 2 (n=16, 19.5%) 3 (n=4, 4.8%) 4 (n=2, 2.4%)
Smoking status (n, %)	
Smoker	56 (68.3%)
Non-smoker	26 (31.7%)
Disease duration, months (mean ± SD)	8±1

SD: Standard deviation

The χ^2 test confirmed a significant association between BMI and recurrence (p=0.0013). When the data were dichotomized, obesity conferred a 12-fold increase in risk: 35.7% versus 4.4% for patients without obesity [odds ratio (OR) = 12.0, 95% confidence interval (CI): 2.45-59.15; p=0.003]. Overall analysis identified obesity as a significant predictor of recurrence following crystallized phenol ablation in PDS. Six of the eight patients experiencing recurrence had presented initially with more than one sinus opening, whereas only two recurrences arose in individuals with a solitary tract (p<0.05). All recurrences were managed successfully by excisional surgery without further sequelae.

Logistic regression was performed with recurrence as the dependent variable and the three covariates that showed either clinical relevance or a univariable signal: obesity, anatomical complexity, and sex. Following adjustment, obesity remained a strong independent predictor of failure, conferring an almost 12-fold increase in risk (OR =12.0, 95% CI: 2.45-59.15; p=0.003). Likewise, the presence of multiple pits independently elevated the likelihood of recurrence more than seven-fold (OR =7.4, 95% CI: 1.6-34.0; p=0.011). By contrast, sex had no significant effect (OR =1.1, 95% CI: 0.2-3.9; p =0.92). These findings indicate that elevated BMI and greater anatomical complexity are the principal determinants of treatment failure following crystallized phenol ablation, whereas patient sex does not appear to influence outcome in this population group (Table 2).

Spinal anesthesia was chosen in 63 cases (76.8%), local anesthesia in 14 (17.1%), general anesthesia in 4 (4.9%), and intravenous sedation in 1 (1.2%). All same-day discharges occurred in patients treated under local infiltration anesthesia (n=14) or intravenous sedation (n=1). By contrast, every patient who received spinal (n=63) or general anesthesia (n=4) was observed in hospital for 1 night before discharge. Mean operative time for the whole cohort was 38.8±10.9 minutes (n=82). When stratified by anesthetic technique, procedures performed under spinal anesthesia (n=63) lasted 42.6±9.5 minutes, whereas those performed with local infiltration, general anesthesia, or intravenous sedation (n=19) averaged 26.3±2.1 minutes. This indicates that spinal anesthesia prolongs

Table 2. Univariable and multivariable analysis of factors associated with recurrence following crystallized phenol ablation for pilonidal disease

Variable	Recurrence/total (%)	Univariable analysis			Multivariable analysis*		
		OR	95% CI	p-value	OR	95% CI	p-value
Sex	—	—	—	0.92	—	—	—
Male	5/54 (9.3%)	—	—	—	—	—	—
Female	3/28 (10.7%)	1.2	0.3-4.8	—	1.1	0.2-3.9	0.92
BMI category	—	—	—	0.0013	—	—	—
Underweight (≤18.5 kg/m^2)	0/12 (0%)	—	—	—	—	—	—
Normal/overweight (18.6-29.9 kg/m^2)	3/56 (5.4%)	—	—	—	—	—	—
Obese (≥30 kg/m^2)	5/14 (35.7%)	9.8	2.0-48.0	—	—	—	—
BMI (Dichotomized)	—	—	—	0.003	—	—	—
Non-obese (<30 kg/m^2)	3/68 (4.4%)	—	—	—	—	—	—
Obese (≥30 kg/m^2)	5/14 (35.7%)	12.0	2.45-59.15	—	12.0	2.45-59.15	0.003
Anatomical complexity	—	—	—	<0.05	—	—	—
Single pit	2/60 (3.3%)		—	—		—	—
Multiple pits	6/22 (27.2%)	—	—	—	7.4	1.6-34.0	0.011

OR: Odds ratio, CI: Confidence interval, BMI: Body mass index

Note: Fisher's exact test was used for sex comparison; the chi-square test was used for BMI categories.

*Binary logistic regression with recurrence as the dependent variable. Reported ORs are adjusted; 95% confidence intervals and two-sided p-values are provided. Reference categories: BMI<30 kg/m^2, single pit, female.

Table 3. Anesthesia technique distribution, operation time, and hospital stay

Operative time, minutes (mean ± SD)	38.8±10.9	p-value
Spinal anesthesia (n = 63)	42.6±9.5	
Local/sedation/general anesthesia (n = 19)	26.3±2.1	p<0.001
Anesthesia technique (n, %)	Spinal (n=63, 76.8%) Local (n=14, 17.1%) General (n=4, 4.9%) Sedation (n=1, 1.2%)	
Hospital stay (n, %)		
Same day discharge	15 (18.2%)	
Overnight stay (1 night)	67 (81.7%)	

SD: Standard deviation

operative time by roughly one-third, an effect attributable to additional regional-block set-up and patient positioning requirements (p<0.001) (Table 3). No perioperative or early postoperative complications, reinterventions, or unplanned readmissions were recorded.

Discussion

This study contributes to the growing body of evidence supporting the use of crystallized phenol as a minimally invasive and cost-effective treatment option for PSD, particularly in appropriately selected patients. By evaluating a large, well-documented cohort with uniform technique application in two distinct clinical settings, we aimed to assess both the efficacy and safety of this approach. Our findings demonstrate a low short-term recurrence rate and minimal complication profile, reinforcing the viability of crystallized phenol as an outpatient procedure. Recurrence may be influenced not only by anatomical or technical factors but also by contextual variables such as hygiene practices and education levels. These observations underline the importance of individualized treatment planning and highlight the potential value of phenol therapy in low-resource settings or among patients seeking nonsurgical management.

Crystallized phenol application for PSD has been widely utilized in outpatient settings under local anesthesia. Reported complication rates remain low (typically under 15%), with most adverse events limited to minor infections or localized skin irritation. Clinical resolution rates range between 67% and 100%, with recurrence rates reported to be below 20% when the procedure is correctly applied. These outcomes are consistent with the recommendations of the American Society of Colon and Rectal Surgeons, which supports the use of phenol therapy as a minimally invasive alternative with high efficacy and low morbidity when executed using proper techniques. The favorable safety profile and cost-effectiveness of phenol treatment make it an attractive first-line option, particularly in settings where surgical resources are limited or patient preference favors non-excisional management.[10]

Recent evidence supports the efficacy of phenol-based treatments across different patient populations. A prospective cohort study utilizing phenol solution reported an overall recurrence rate of 8.3% at 2-year follow-up, with sinus tract volume and sinus number identified as significant predictors of recurrence.[11] Consistent with these findings, the present study also observed a higher recurrence rate among patients with multiple sinus openings, suggesting that disease extent may play a critical role in long-term outcomes following crystallized phenol application. This reinforces the importance of careful pre-procedural assessment and may inform patient selection criteria for optimizing treatment success.

The temporal pattern of recurrence underscores the importance of extended follow-up in pilonidal disease research. Meta-analyses have demonstrated that recurrence rates can increase dramatically over time: primary midline closure shows recurrence rates of 7% at 24 months, 16.8% at 60 months, and 67.9% at 240 months. By contrast, advancement and rotational flaps demonstrate more stable long-term outcomes, with recurrence rates increasing modestly from 0.2% to 1.9% and 0.4% to 5.2% at 12 and 60 months, respectively. Notably, phenol therapy shows an intermediate pattern, with recurrence rates rising from 1.9% at 12 months to approximately 40% at 60 months, emphasizing the need for long-term surveillance.[12] Future clinical trials should be designed with longer-term follow-up for a more reliable conclusion to be drawn. Although these methods were not part of our treatment protocol, understanding their long-term recurrence trajectories helps contextualize the necessary duration of follow-up in minimally invasive pilonidal sinus interventions, including crystallized phenol application.

Compared with traditional excisional techniques, crystallized phenol therapy offers distinct advantages in terms of recovery time, morbidity, and cost. Patients who require surgery for

PSD may undergo excision and primary repair, excision with healing by secondary intention, or excision with marsupialization, based on surgeon and patient preference. For patients requiring more extensive surgical intervention, several established techniques demonstrate favorable outcomes. The Limberg rhomboid flap, which excises all sinuses to the presacral fascia while flattening the gluteal cleft, has shown excellent long-term results, with recurrence rates of 0%-6%.[13] In a randomized controlled study, the Karydakis procedure achieved a 6% recurrence rate, 20% wound morbidity, and 98% overall healing rate at a follow-up of 3 years.[14] Karydakis's personal series of over 6,000 patients demonstrated recurrence rates of less than 2%, with wound complications in 8%.[15]

When compared directly with excision and primary closure, phenol application has shown nonsignificantly lower recurrence rates, suggesting comparable efficacy with reduced morbidity. The appeal of phenol therapy lies in its ability to avoid the complications associated with more extensive surgical interventions. Although local anesthesia could be considered the preferred approach for most patients undergoing this minimally invasive treatment, traditional surgical approaches require general anesthesia, extensive healthcare costs, and prolonged hospitalization and are frequently associated with wound complications and unsatisfactory cosmetic outcomes. By contrast, phenol application can be performed in an outpatient setting with minimal anesthesia requirements and reduced recovery time. The use of phenol solution involves one or more injections into the sinus tract until filled, with cautious protection of the surrounding normal skin, removal of sinus hairs and debris with forceps, as well as local shaving. Small case series have demonstrated success rates ranging from 60% to 95%. Even in the setting of recurrent chronic sinus disease, phenol injection and local depilatory cream application on a weekly basis have shown low subsequent recurrence rates (0%-11%) at extended follow-up.[16,17]

Emerging minimally invasive techniques offer promising alternatives to traditional excisional surgery. Endoscopic pilonidal sinus treatment is performed under direct vision, allowing for the removal of all infected tissues and the lining of the sinus cavity.[18] However, endoscopic techniques require specialized equipment and expertise, limiting their widespread adoption. Recent reviews report failure rates of 8.04%. Complications including hematoma, infection, persistent discharge, and failure of healing across the study ranged from 0% to 11.1%. The mean return to work and normal activities was remarkably short at 2.9±1.8 days.[19] Although there are other minimally invasive techniques that involve curettage of the pilonidal sinus with local injection of fibrin glue or phenol, such techniques are performed in a blind manner without allowing the interior of the sinus cavity to be visualized, which may lead to incomplete debridement and cleaning of hairs and infected tissues inside the sinus.

Laser treatment has become popular in recent years, with both laser and crystallized phenol applications emerging as effective minimally invasive alternatives in the management of PSD, offering favorable outcomes in terms of recurrence rates, complication profiles, and patient satisfaction. Crystallized phenol provides the distinct advantage of being an outpatient procedure, enabling early return to daily activities with minimal postoperative care. By contrast, laser therapy is typically associated with fewer treatment sessions and a shorter overall recovery period. The choice between these modalities should be guided by patient preferences, clinical presentation, and the availability of institutional resources. As interest in less invasive strategies continues to grow, both laser and phenol-based approaches have garnered increasing attention in the recent literature, underscoring the need for prospective, comparative studies to better define their respective roles and long-term efficacy.[20]

A comprehensive analysis by Kumar et al.[21] of 983 studies spanning 8 decades revealed significant gaps in the pilonidal disease literature. Notably, only 12% of identified primary research articles were randomized controlled trials, indicating a heavy reliance on observational studies. This mapping review confirmed the absence of clearly superior surgical interventions for PSD, highlighting the need for high-quality comparative studies.

Our findings support the continued use of crystallized phenol therapy as a first-line treatment for PSD, particularly in patients seeking minimal invasive intervention with rapid recovery. The technique's cost-effectiveness and outpatient applicability make it especially valuable in resource-limited settings. However, patients should be counseled regarding the potential need for repeat treatments and long-term surveillance for recurrence. Healthcare providers should consider environmental, occupational, and lifestyle factors when selecting treatment modalities and planning follow-up care. This personalized approach may optimize treatment success and reduce long-term recurrence rates.

Several limitations warrant consideration when interpreting our findings. The retrospective design may have introduced selection bias and limited the detection of rare adverse events, and the relatively short follow-up period may have led to long-term recurrence rates being underestimated. Future research should prioritize long-term prospective studies with 5-10-year follow-up periods to establish definitive recurrence patterns. Additionally, patient-reported outcome measures and quality-of-life assessments were not systematically collected, limiting our understanding of treatment impact from the patient perspective. Standardized outcome measures, including

patient-reported outcomes and quality-of-life indices, should be incorporated into study protocols. Lastly, the study population was drawn exclusively from two urban private hospitals, potentially limiting the generalizability of our findings to rural settings or public healthcare institutions with differing patient profiles and healthcare access.

Conclusion

Crystallized phenol therapy represents an effective, minimally invasive treatment option for PSD with acceptable recurrence rates and minimal morbidity. Although long-term recurrence remains a concern, the technique's advantages in terms of patient comfort, cost-effectiveness, and outpatient applicability support its continued use in appropriate patients. In our case series, obesity and the presence of multiple sinus openings independently predicted recurrence following crystallized phenol therapy. This is consistent with previous reports demonstrating that elevated BMI may impair wound healing and contribute to higher recurrence rates, whereas greater anatomical complexity increases the likelihood of residual tracts following minimally invasive interventions. Future research should focus on identifying optimal patient selection criteria and developing strategies to minimize long-term recurrence while maintaining the technique's inherent advantages.

Ethics

Ethics Committee Approval: This study was approved by the institutional review board of Acıbadem Mehmet Ali Aydınlar University Medical Research Ethics Committee (ATADEK) (approval number: 2025-09/77, dated: 12.06.2025).

Informed Consent: Written informed consent was obtained from all patients prior to treatment initiation.

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.K., Ç.B., Concept: B.K., Ç.B., Design: B.K., Ç.B., Data Collection or Processing: B.K., Ç.B., Analysis or Interpretation: B.K., Ç.B., Literature Search: B.K., Ç.B., Writing: B.K., Ç.B.

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