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ORIGINAL ARTICLE

Surgical preference and outcomes in pilonidal sinus disease: a national multicenter study evaluating complications, recurrence, and quality of life (PISI TURKEY)

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Abstract

Background Pilonidal sinus disease (PSD) is common in young adults, yet real-world data integrating quality of life (QoL) with surgical outcomes are limited. We aimed to describe national surgical practice for PSD in Turkey and to compare complications, recurrence, and QoL between excision-based and non-excisional (minimally invasive) procedures.

Methods This was a retrospective analysis of a prospectively maintained nationwide database including adults undergoing first surgery for PSD in 41 centers between January 2019 and January 2020. Sociodemographic and clinical data, perioperative variables, complications, and recurrence were recorded. QoL was assessed using the EQ-5D-5L (including EQ-VAS) and pain using a 10-point visual analog scale (VAS) at baseline and at postoperative day 1, day 7, 6 months, and 12 months. Patients were grouped according to surgical approach: simple excision, excision + flap and non-excisional procedures.

Results Data from 1369 patients were analyzed (simple excision, $n = 194$; excision + flap, $n = 983$; non-excisional, $n = 192$). Overall, postoperative bleeding occurred in 12.3%, wound infection in 9.2%, and wound separation in 10.2% of patients, with wound separation being more frequent after excision + flap than non-excisional procedures. Recurrence at 12 months was observed in 51 patients (3.7% overall), with rates of 3.1% in the simple excision group, 4.1% in the excision + flap group, and 2.6% in the non-excisional group ($p = 0.545$). Median pain VAS decreased from 4 (IQR 2–6) at baseline to 0 (0–0) at 12 months in all groups ($p < 0.001$ within groups). EQ-VAS improved by a median of 18 (IQR 8–40) points in the simple excision group, 15 (6–30) in the excision + flap group, and 29 (15–40) in the non-excisional group ($p < 0.001$ between groups).

Conclusions In this nationwide real-world cohort, non-excisional procedures were associated with shorter operative time, shorter hospital stay, fewer wound-related complications, and greater early improvements in QoL and patient satisfaction compared with excision-based procedures, without an apparent increase in 12-month recurrence. Given the retrospective design, baseline imbalances between groups, and limited follow-up, these findings should be confirmed in prospective comparative studies with longer follow-up.

Keywords Pilonidal sinus · Quality of life · Pain · Minimally invasive surgical procedures · Recurrence

Introduction

Pilonidal sinus disease (PSD) is a common condition of the sacrococcygeal region that predominantly affects adolescents and young adults, especially males. While the global prevalence is approximately 26 per 100,000 individuals, studies from Turkey have reported substantially higher rates of 6.6% among young adults aged 17–28 years [1, 2]. PSD can significantly impact quality of life (QoL), causing chronic pain, discomfort, and recurrent infections that may

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limit daily activities and productivity, ultimately leading to psychological stress and reduced overall well-being [1, 3].

Management of PSD varies greatly as a result of physician practices and the availability of numerous treatment methods [3]. Treatment approaches differ in invasiveness, morbidity, complication risks, and effectiveness in preventing recurrence. Non-surgical strategies focus on minimization of disease activity, including hygiene improvements, removal of hair, lifestyle modifications, and phenol and fibrin injections to promote closure of pilonidal sinuses [3–6]. The goals of these interventions are to enable a swift return to normal activities while preventing complications such as infection, bleeding, recurrence, and wound healing problems. Despite extensive literature, including systematic reviews and randomized trials, there is still no consensus on the optimal treatment approach [1, 7, 8]. Furthermore, comprehensive observational multicenter real-world data incorporating patient-reported outcome measures and QoL assessments across diverse populations remain limited [9, 10]. As a result, treatment selection often varies according to surgeon preference and local expertise, necessitating additional research to clarify optimal interventions in terms of both clinical outcomes and patient satisfaction.

We therefore aimed to investigate surgeons' preferences for PSD surgery in Turkey and to assess real-world outcomes (QoL, pain, complications, and recurrence) between excision-based and non-excisional (minimally invasive) procedures.

Materials and methods

Setting and ethics

This was a retrospective analysis of a prospectively maintained multicenter database on PSD in Turkey from January 2019 to January 2020, coordinated by the PISI TURKEY research group (also known as "Pilonidal sinus disease study: A national survey").

The study received approval from the Ethics Committee of Gazi University Faculty of Medicine (approval date February 22, 2021; no. 198). Consent for participation was waived because the study was carried out on pseudonymized patient data.

Participants

We sought to include all patients aged ≥ 18 years who underwent first surgical treatment for PSD in the participating centers. Excluded from the study were patients with a history of previous surgery for PSD, those younger than 18 years, patients with significant comorbidities (e.g., diabetes mellitus, inflammatory bowel disease, hidradenitis suppurativa, connective tissue disease), pregnant women, those with sealant hypersensitivity, and subjects with incomplete data (Fig. 1).

Data collection and instruments

Participating centers and data curation strategy

Participating centers received invitations via email. If the response was positive, they were required to assemble a team of up to six investigators, consisting of one supervising faculty member or specialist physician, four physicians or research assistants, and one medical student. As such, only tertiary healthcare institutions were contacted, except for rare cases in which some secondary institutions could assemble such a research team. These team members were tasked with identifying eligible patients, planning data collection processes, collecting baseline and follow-up data, and transferring information. Additionally, an independent data validator, either a physician or medical student who was not involved in the data collection, was assigned at each center to verify that all eligible patients were included and to ensure data completeness and accuracy. The PISI TURKEY Research Group was responsible for identifying and approving investigators. Only datasets that were at least 95% complete for each patient were included into the national analysis.

Recorded data

A patient data record form including sociodemographic data, body mass index (BMI), smoking and comorbidity status, PSD type, type and duration of operation, postoperative antibiotic use, drainage after operation, the duration of mobilization, hospital stay and return to normal activities after operation, analgesic use after the operation, complications, infection and recurrence status after the operation, visual analog scale (VAS) pain scores, and the 5-level (5L) classification system of the Euro QoL (EQ)-5 Dimension (5D) (EQ-5D-5L) scores (postoperative) were prepared and sent to the primary researchers.

All data were gathered from hospital computerized database records, patient charts, and through phone calls with patients. Collected data were entered into the Research Electronic Data Capture (REDCap) system [11, 12], a web-based data collection platform, and data files were hosted by Gazi University in Ankara, Turkey.

A supervising consultant surgeon at each hospital oversaw study conduct and was responsible for overall quality assurance of data submission. Local lead investigators were contacted with specific details about missing data when necessary. In addition, independent data validators at participating centers checked their datasets

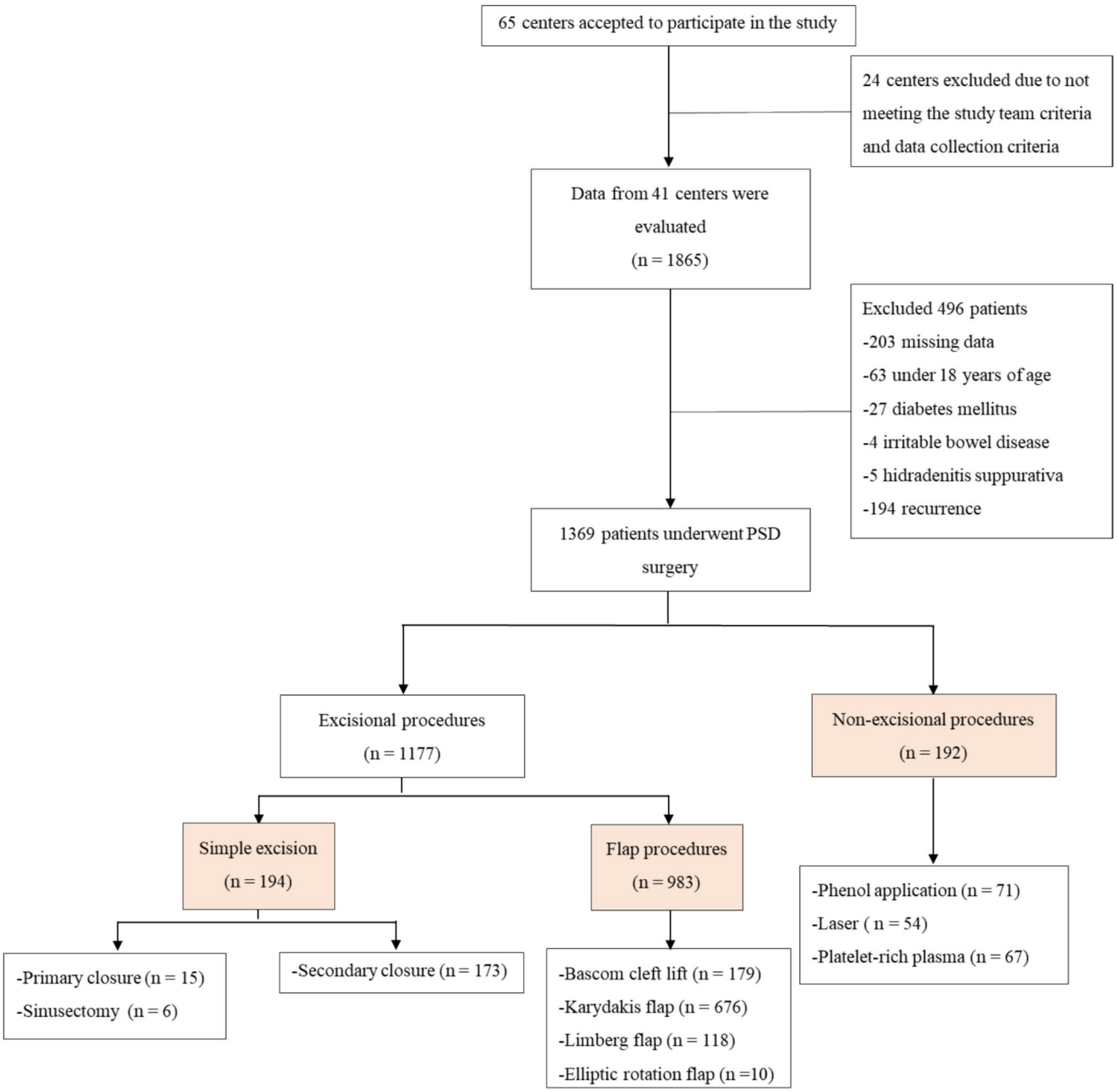

Fig. 1 Flowchart of the study

by verifying that all eligible patients were included and ensuring data completeness and accuracy. When incorrect data were identified, validators were asked to amend these entries in the study database. If any data points remained missing despite the aforementioned measures, these data points were excluded from the relevant analyses without excluding the patients themselves. Owing to the exceptionally low level of missing data, this approach was deemed sufficient, and no additional sensitivity analyses were performed.

Definitions

The severity of PSD was classified using the Tezel classification system [25]. This system categorizes sacrococcygeal PSD based on anatomical location and clinical presentation, aiding in treatment decisions based on disease severity and clinical characteristics. Type I, asymptomatic pits within the navicular area with no history of abscess or drainage; type II, presence of an acute pilonidal abscess; type III, pits within the navicular area with a history of

abscess or previous drainage; type IV, advanced disease with sinus openings extending beyond the navicular area, frequently involving multiple abscess formations and drainages; type V, recurrent pilonidal sinus following previous surgical treatment. Recurrence was defined as the reappearance of pits and the presence of hair in the wound after complete wound healing. We divided the patients into the following three groups according to the intervention:

1. Simple excision group: Patients who underwent primary closure, sinusectomy, and secondary closure were included in this group.
2. Excision + flap group: All patients who had undergone flap procedures were included in this group.
3. Non-excisional group: Patients undergoing crystallized phenol application or laser application and those who received platelet-rich plasma treatment were included in this group (Fig. 1).

Evaluation of quality of life and pain after the operation

QoL was evaluated with the EQ-5D-5L system, before the operation and on the 7th day, 6th month, and 12 months after the operation. Postoperative data for this scale were obtained by calling patients at corresponding time points. The EQ-5D-5L is a self-report scale that assesses five dimensions [13], namely mobility, self-care, usual daily activities, pain/discomfort, and anxiety/depression. "Mobility" ranges from being able to walk comfortably to being bedridden; "self-care" ranges from being able to care for oneself comfortably to being unable to dress and bathe oneself; "usual daily activities" ranges from being able to carry out routine daily activities comfortably to being unable to do anything; "pain" ranges from having no pain to having extreme pain and discomfort; and "anxiety/depression" ranges from feeling completely well to feeling extremely anxious or depressed. Each dimension is rated on a five-point Likert scale (the mildest response equates to 1 point, the most severe to 5 points). By summing the scores of each dimension, one obtains the total EQ-5D-5L scores. The scale also includes a VAS (EQ-VAS) with responses ranging from 0 to 100, corresponding to the worst to the best "health status", respectively. The reliability and validity study for the Turkish language and community norms was conducted by Kahyaoğlu Süt et al. [14].

Pain severity was evaluated with a 10-level VAS scale, before the index operation and on the 1st day, 7th day, 6th month, and 12th month after the operation (no pain, 0 points; very little pain, 2 points; little pain, 4 points; significant pain, 6 points; severe pain, 8 points; unbearable pain, 10 points).

Statistical analysis

Data collected on the REDCap system was once again assessed for accuracy and validatory purposes before creation of the final dataset. This dataset was then transferred to an SPSS database, and SPSS software was used to extract descriptive data and perform statistical analyses (SPSS v25.0, IBM, NY, USA). Histogram and Q-Q plots were used to determine whether continuous variables were normally distributed. Categorical data were presented with relative and absolute frequencies (*n*, percentage). Descriptive statistics were presented by using mean ± standard deviation for continuous variables meeting parametric assumptions, while non-parametric variables were described with median (25th percentile–75th percentile). Between-group comparisons of continuous variables were performed with one-way analysis of variance (ANOVA) and Kruskal–Wallis test. Between-group comparisons of categorical variables were performed with appropriate chi-square tests or the Fisher-Freeman-Halton test. Within-group comparisons (repeated measurements) of non-normally distributed continuous variables and ordinal variables were performed with the Friedman's analysis of variance by ranks. Pairwise comparisons were adjusted with the Bonferroni correction method. Missing data points were handled using complete case analysis, with only datasets that were at least 95% complete were included in the final analysis.

Results

All centers approached for participation accepted to contribute data to the study. Unfortunately, all data collected by 24 of these centers were excluded as they were incomplete or did not meet criteria set by the study team and/or the standards for data collection. Consequently, the data eligible for inclusion were from 1865 patients across 41 centers. Among these patients, 496 were not included in the analyses due to meeting exclusion criteria. Ultimately, the analyses were conducted on data from a total of 1369 patients admitted by 41 centers (Fig. 1).

The overall median age was 25 (21–32) years and 80.50% ($n = 1102$) of patients were male. Procedure distributions were as follows: 194 (14.17%) patients underwent simple excision, 983 (71.80%) underwent excision + flap procedures, and 192 (14.02%) underwent non-excisional procedures. The most frequently performed procedure was the Karydakis procedure ($n = 676$), followed by the Bascom cleft lift ($n = 179$) and the secondary closure ($n = 173$) approaches. Patients in the non-excisional group were significantly younger than the other two groups ($p = 0.003$) and this group also had a higher percentage of female sex ($p = 0.007$) (Table 1, Fig. 1).

Table 1 Summary of preoperative variables with regard to surgical approach for PSD

	Total ($n=1369$)	Surgical approach			p
		Simple excision ($n=194$)	Excision + flap ($n=983$)	Non-excisional ($n=192$)	
Age	25 (21–32)	27 (21–33)[a]	25 (21–32)[a]	24 (20–29.5)[b]	0.003
Sex					
Male	1102 (80.50%)	163 (84.02%)	800 (81.38%)	139 (72.40%)	0.007
Female	267 (19.50%)	31 (15.98%)[a]	183 (18.62%)[a]	53 (27.60%)[b]	
Body mass index, kg/m^2	25.95 ± 3.47	26.18 ± 3.59	26.03 ± 3.49	25.38 ± 3.19	0.058
Occupation					
Not working/retired	102 (8.22%)	8 (4.97%)	81 (8.94%)	13 (7.47%)	0.255
Student	409 (32.96%)	47 (29.19%)	303 (33.44%)	59 (33.91%)	
Desk job	194 (15.63%)	22 (13.66%)	146 (16.11%)	26 (14.94%)	
Other jobs	536 (43.19%)	84 (52.17%)	376 (41.50%)	76 (43.68%)	
Smoking	663 (48.43%)	100 (51.55%)	472 (48.02%)	91 (47.40%)	0.636
Classification					
Type III	949 (69.32%)	136 (70.10%)	678 (68.97%)	135 (70.31%)	0.905
Type IV	420 (30.68%)	58 (29.90%)	305 (31.03%)	57 (29.69%)	

Descriptive statistics are presented as mean ± standard deviation for normally distributed continuous variables, median (25th percentile–75th percentile) for non-normally distributed continuous variables and frequency (percentage) for categorical variables. Letters denote between-group pairwise comparison results

[a]Significantly different from "b"

[b]Significantly different from "a"

PSD pilonidal sinus disease

Recurrence at 12 months was documented in 51 patients (3.7%) overall, with rates of 3.1% in the simple excision group, 4.1% in the excision + flap group, and 2.6% in the non-excisional group ($p=0.545$). Pain VAS decreased to 0 (IQR 0–0) at 12 months in all groups, and EQ-VAS improved in all groups, with the largest median improvement observed in the non-excisional group (Table 3).

Antibiotic prophylaxis was most frequent in the excision + flap group (72.23%), followed by simple excision (59.79%) and the non-excisional group (34.38%) ($p<0.001$). Operation duration showed the same trend, with excision + flap being the longest procedure and non-excisional being the shortest ($p<0.001$). The excision + flap group had significantly higher frequencies of drainage, postoperative narcotic use, and non-steroidal anti-inflammatory drug (NSAID) use ($p<0.001$ for each); whereas the simple excision and non-excisional groups were similar in terms of these characteristics. All patients who underwent non-excisional treatment regained mobilization within 24 h and almost 40% were discharged within the first postoperative day. None of the patients in the other two groups were discharged within 24 h, but the majority were discharged within the second postoperative day. There were fewer postoperative complications among patients undergoing a non-excisional approach (wound site infection $p=0.033$ and wound separation $p<0.001$), and these individuals also returned to normal daily activities sooner ($p<0.001$). Recurrence occurred in only 2.6% of non-excisional interventions (versus 3.09% and 4.07%); however, differences in recurrence were not statistically significant (Table 2).

All three interventions improved VAS pain, EQ-5D-5L, and EQ-VAS scores. Non-excisional procedures were found to cause significantly less pain in the early recovery period (1st and 7th days; $p<0.001$ for both), but results were similar at longer time frames. Similarly, EQ-5D-5L total scores demonstrated earlier improvement (from the 7th day) among recipients of non-excisional interventions, while the first significant improvement from baseline was observed at the 6th month for both other groups. Detailed comparisons of EQ-5D-5L subdimensions are described in Table 3.

In terms of EQ-VAS as a measure of patient satisfaction, recipients of non-excisional interventions consistently experienced better scores in postoperative evaluations despite having significantly lower (worse) scores at baseline compared to the simple excision and excision + flap groups (Table 3).

Discussion

Surgical excision stands as the established gold standard for definitive treatment of PSD. Nonetheless, the occurrence of postoperative pain, infections, extended wound healing periods, and delayed return to work are encountered. Given

Table 2 Intraoperative and postoperative variables with regard to surgical approach for PSD

	Total ($n=1369$)	Surgical approach			p
		Simple excision ($n=194$)	Excision + flap ($n=983$)	Non-excisional ($n=192$)	
Antibiotic prophylaxis	892 (65.16%)	116 (59.79%)[a]	710 (72.23%)[b]	66 (34.38%)[c]	< 0.001
Duration of operation, min	35 (25–50)	25 (20–35)[a]	40 (30–60)[b]	10 (10–20)[c]	< 0.001
Drainage	499 (36.45%)	4 (2.06%)[a]	495 (50.36%)[b]	0 (0.00%)[a]	< 0.001
Narcotic use for pain	239 (17.46%)	18 (9.28%)[a]	211 (21.46%)[b]	10 (5.21%)[a]	< 0.001
NSAIDs use for pain	1028 (75.09%)	104 (53.61%)[a]	834 (84.84%)[b]	90 (46.88%)[a]	< 0.001
Mobilization					
< 24 h	1336 (97.59%)	185 (95.36%)	959 (97.56%)	192 (100.00%)	0.005
≥ 24 h	33 (2.41%)	9 (4.64%)[a]	24 (2.44%)[ab]	0 (0.00%)[b]	
Length of stay in hospital, days					
< 24 h	74 (5.41%)	0 (0.00%)[a]	0 (0.00%)[a]	74 (38.54%)[b]	< 0.001
1 day	1184 (86.49%)	186 (95.88%)[a]	881 (89.62%)[b]	117 (60.94%)[c]	
2 days	84 (6.14%)	5 (2.58%)[a]	78 (7.93%)[b]	1 (0.52%)[a]	
≥ 3 days	27 (1.97%)	3 (1.55%)	24 (2.44%)	0 (0.00%)	
Postoperative complications					
Bleeding	168 (12.27%)	30 (15.46%)	119 (12.11%)	19 (9.90%)	0.238
Wound site infection	126 (9.20%)	15 (7.73%)[ab]	102 (10.38%)[a]	9 (4.69%)[b]	0.033
Wound separation	140 (10.23%)	7 (3.61%)[a]	132 (13.43%)[b]	1 (0.52%)[a]	< 0.001
Systemic infection	2 (0.15%)	0 (0.00%)	2 (0.20%)	0 (0.00%)	1.000
Return to normal activities, days	7 (4–20)	5 (3–8)[a]	14 (5–21)[b]	1 (0–3)[c]	< 0.001
Recurrence	51 (3.73%)	6 (3.09%)	40 (4.07%)	5 (2.60%)	0.545

Descriptive statistics are presented as median (25th percentile–75th percentile) for non-normally distributed continuous variables and frequency (percentage) for categorical variables. Letters denote between-group pairwise comparison results

[a]Significantly different from "b" and "c"

[b]Significantly different from "a" and "c"

[c]Significantly different from "a" and "b"

[ab]No significant difference from others

NSAID non-steroidal anti-inflammatory drugs, *PSD* pilonidal sinus disease

these postoperative issues, ongoing research is focusing on the development of novel and non-excisional techniques [15]. As medical technology advances, novel instruments such as lasers, video cameras, and phenol application, along with innovative techniques, are increasingly employed in the treatment of PSD [15]. Over the past 30 years, surgical techniques aimed at lateralizing and flattening the natal cleft, while ensuring adequate tissue coverage of the defect without risking tension along the suture line, have emerged. These techniques, such as off-center flaps (including the Limberg, Karydakis, B modified Bascom technique, and ZV flaps), have been claimed to demonstrate improved outcomes [16, 17]. On the other hand, they also expose patients to a notable risk of morbidity and are associated with prolonged hospital stays, increased hospital expenses, and delayed return to work [18]. As such, the optimal surgical method for treating PSD remains a subject of debate [19]. The results of the present study showed that the Karydakis flap is by far the most preferred procedure for the treatment of PSD by surgeons in Turkey. Nonetheless, all three interventions examined in this study yielded significant improvements in the examined outcomes over time, but non-excisional procedures were found to provide greater improvements in pain and QoL scores, especially in the early postoperative period. In addition, non-excisional procedures reduced complications and the need for antibiotic prophylaxis, shortened operation duration and hospital stay, and allowed for earlier mobilization and return to normal activities. Interestingly, those who underwent non-excisional procedures had marginally higher anxiety/depression scores and higher total EQ-5D-5L scores at 6 and 12 months. This may be due to the perception of a higher risk of recurrence in non-excisional procedures.

Stauffer et al. [20] authored a comprehensive review encompassing all available data on PSD treatment, starting from the initial documented description of the condition in 1833. Data regarding recurrence and follow-up durations across all surgical treatments for PSD were extracted from 102 randomized controlled trials involving a total of 11,700 patients. They noted a correlation between

Table 3 Summary of postoperative VAS scores and EQ-5D-5L scores with regard to surgical approach for PSD

	Surgical approach			*p*
	Simple excision ($n=194$)	Excision + flap ($n=983$)	Non-excisional ($n=192$)	
Visual analog scale score				
Baseline	4 (2–6)	4 (2–6)	4 (2–4)	0.471
1st day	4 (2–4)[a]	4 (2–6)[b]	2 (0–4)*[c]	< 0.001
7th day	2 (2–2)*[a]	2 (2–4)*[a]	2 (0–2)*[b]	< 0.001
6th month	0 (0–0)*	0 (0–0)*	0 (0–0)*	0.198
12th month	0 (0–0)*	0 (0–0)*	0 (0–0)*	0.218
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 2 (− 4 to − 2)	− 4 (− 6 to − 2)	− 4 (− 4 to − 2)	0.368
EQ-5D-5L mobility				
Baseline	2 (1–3)	2 (1–2)	2 (1–2)	0.898
7th day	2 (1–2)[a]	2 (1–2)[b]	1 (1–2)*[c]	< 0.001
6th month	1 (1–1)*[a]	1 (1–1)*[a]	1 (1–1)*[b]	0.045
12th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.132
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 1 (− 2 to 0)	− 1 (− 1 to 0)	− 1 (− 1 to 0)	0.997
EQ-5D-5L self-care				
Baseline	2 (1–3)[a]	2 (1–2)[ab]	1 (1–2)[b]	0.015
7th day	2 (1–2)[a]	2 (1–2)[b]	1 (1–1)*[c]	< 0.001
6th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.074
12th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.073
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 1 (− 1 to 0)[a]	− 1 (− 1 to 0)[ab]	0 (− 1 to 0)[b]	0.049
EQ-5D-5L usual activities				
Baseline	2 (1–3)	2 (1–2)	2 (1–2)	0.397
7th day	2 (1–2)[a]	2 (1–2)[b]	1 (1–2)*[c]	< 0.001
6th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.216
12th month	1 (1–1)*[a]	1 (1–1)*[a]	1 (1–1)*[a]	0.011
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 1 (− 2 to 0)	− 1 (− 1 to 0)	− 1 (− 1 to 0)	0.292
EQ-5D-5L pain/discomfort				
Baseline	2 (1–3)	2 (1–3)	2 (2–3)	0.176
7th day	2 (1–2)[a]	2 (1–2)[b]	1.5 (1–2)*[a]	< 0.001
6th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.235
12th month	1 (1–1)*	1 (1–1)*	1 (1–1)*	0.366
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 1 (− 2 to 0)	− 1 (− 2 to 0)	− 1 (− 2 to − 1)	0.088
EQ-5D-5L anxiety/depression				
Baseline	2 (1–3)[a]	2 (1–2)[a]	2 (1–3)[b]	0.001
7th day	1 (1–2)*[a]	1 (1–2)*[b]	1 (1–3)*[b]	0.033
6th month	1 (1–1)*[a]	1 (1–1)*[a]	1 (1–2)*[b]	< 0.001
12th month	1 (1–1)*[a]	1 (1–1)*[a]	1 (1–2)*[b]	< 0.001
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 1 (− 2 to 0)	− 1 (− 1 to 0)	− 1 (− 1 to 0)	0.083
EQ-5D-5L total score				
Baseline	9.5 (6–13)	9 (6–11)	10 (7–12)	0.364
7th day	8 (5–10)[a]	9 (6–11)[b]	6 (5–10)*[a]	< 0.001
6th month	5 (5–5)*[a]	5 (5–5)*[a]	5 (5–6)*[b]	< 0.001
12th month	5 (5–5)*[a]	5 (5–5)*[a]	5 (5–6)*[b]	< 0.001

Table 3 (continued)

	Surgical approach			*p*
	Simple excision (*n* = 194)	Excision + flap (*n* = 983)	Non-excisional (*n* = 192)	
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	− 4 (− 7 to − 1)	− 4 (− 6 to − 1)	− 4 (− 7 to − 2)	0.388
EQ-VAS				
Baseline	76 (55–85)[a]	76 (64–85)[a]	70 (53.5–82)[b]	< 0.001
7th day	80 (73–86)*[a]	80 (71–89)*[a]	85.5 (70.5–94)*[b]	0.001
6th month	92 (87–98)*	91 (84–100)*	93 (84.5–100)*	0.051
12th month	95 (90–100)*[a]	95 (89–100)*[a]	98 (93–100)*[b]	< 0.001
p (within groups)	< 0.001	< 0.001	< 0.001	
Change[(1)]	18 (8–40)[a]	15 (6–30)[a]	29 (15–40)[b]	< 0.001

Descriptive statistics are presented as median (25th percentile–75th percentile) for non-normally distributed continuous variables

[(1)]Difference between 12th month and baseline; negative values represent decrease and positive values represent increase

*Significantly different from baseline. Letters denote between-group pairwise comparison results

[a]Significantly different from "b" and "c"

[b]Significantly different from "a" and "c"

[c]Significantly different from "a" and "b"

[ab]No significant difference from others

EQ-5D-5L 5-level (5L) classification system of the Euro quality of life (EQ) dimension (5D), *PSD* pilonidal sinus disease, *VAS* visual analog scale

recurrence rates and both the surgical technique employed and the duration of follow-up. The highest recurrence rate, 67.9%, was observed 240 months after primary midline closures. They determined that the Karydakis and Bascom cleft lift procedures consistently exhibited the lowest recurrence rates across all follow-up periods, followed by rhomboid flaps and other flap techniques. We found strikingly lower recurrence frequencies which were similar across treatment groups. This is likely a result of shorter follow-up in our study and improvements in interventional techniques over time. In the PITSTOP study, 59% of patients with PSD underwent major excisional procedures, the majority undergoing the Karydakis procedure followed by Bascoms cleft lift, consistent with our results. The PITSTOP study found that the recurrence rates at 6 months for the major excisional procedures and non-excisional procedures were 15% and 27%, respectively, in contrast to the fact that non-excisional procedures yielded slightly better recurrence rates in our study [1]. In accordance with our study, the PITSTOP study showed that the complication rates were generally similar across the three excisional groups, but notably lower in patients who underwent non-excisional procedures. Major excisional procedures were associated with greater complication risk, while non-excisional procedures were linked with lower levels of pain and earlier return to daily activities [1]. Contrary to the treatment success results in the PITSTOP study, our findings showed that excision was not superior to non-excisional procedures and recurrence rates were similar [1]. Also, non-excisional procedures yielded better QoL outcomes and fewer wound-related complications in our study.

Improving QoL is a major consideration in the management of PSD. Previous studies have suggested that diathermy outperforms excision in terms of postoperative pain, recovery, and QoL [21]. Ertan et al. concluded that flap techniques yielded superior results relative to primary closure [22]. Even though our data showed significant superiority of flap techniques over simple excision in terms of resource use, wound infection and separation, and return to normal daily activities, there were no paramount differences in QoL subdomains. The results of a meta-analysis of randomized controlled trials indicated that rhomboid flap excision could have lower risk for recurrence, albeit the difference was marginally non-significant. Despite reporting a few other advantages (lower frequencies of wound infection and dehiscence), outcomes were similar in terms of pain scores, hospitalization, and return to work [23]. These findings were also in line with the results of our study, suggesting that both excision-based procedure groups yielded similar outcomes.

Our observed 12-month recurrence rate of 3.7% is lower than that reported in several international series. This finding should be interpreted with caution. First, a 12-month follow-up period is unlikely to capture the full burden of long-term recurrence in PSD. Second, recurrence was assessed by telephone interview rather than standardized clinical examination, which may lead to underrecognition of asymptomatic or mild recurrent disease. Third, we included only first-time

PSD surgeries and excluded patients with prior operations, which may also contribute to lower recurrence estimates. Also, compared with excision-based procedures, patients undergoing non-excisional procedures were younger and more often female, which may have influenced both the choice of procedure and outcomes. Therefore, our recurrence data are best viewed as early to mid-term postoperative outcomes rather than definitive long-term results.

The retrospective analysis of a prospectively collected database is inherently subject to residual confounding and missing data. Surgical allocation was not randomized; surgeons may have preferentially selected younger and female patients, or those with perceived less extensive disease, for non-excisional procedures, introducing allocation bias. However, this limitation was unavoidable as a result of ethical considerations, because treatment decisions were based on contemporary evidence and clinical judgment. Participating centers were predominantly institutions with an interest in PSD, which may not fully represent all surgical units in Turkey or other countries. Follow-up assessments were performed by telephone, which may introduce recall and reporting bias, particularly for recurrence and patient-reported outcomes. Finally, the 12-month follow-up period used in the study may not be sufficient to assess the long-term effectiveness of certain surgical procedures [24]. In particular, a longer follow-up period may be necessary to accurately evaluate recurrence rates. Additionally, confounding factors such as disease severity likely influenced both treatment choice and outcomes, limiting direct comparisons between groups.

Relatively rare surgical procedures (e.g., endoscopic surgeries and PSD surgery with hook circulators) were not examined. The wide variety of specific surgical procedures made it necessary to create intervention groups to facilitate data analysis. Therefore, individual surgical procedures were not compared with each other.

Conclusions

Our nationwide data from Turkey reveal that excisional flap procedures (led by the Karydakis procedure) were preferred in the treatment of PSD. Non-excisional procedures were able to provide a lower complication rate, better QoL (particularly in the early postoperative period), lower pain scores, and greater satisfaction without increasing the risk for recurrence. The findings of the present study reveal that non-excisional procedures appear to have promise in becoming the primary treatment option for PSD. However, they should be considered hypothesis-generating, and larger, comprehensive studies with longer follow-up and detailed stratification by disease severity are needed before firm conclusions can be drawn.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical approval All aspects of the research adhered to the ethical standards of the institutional and national research ethics committees, as well as the 1964 Helsinki Declaration and its subsequent amendments. The study received approval from the Ethics Committee of Gazi University Faculty of Medicine (approval date February 22, 2021; no. 198).

Consent to participate Consent for participation was waived because the study was carried out on pseudonymized patient data.

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