Pilonidal sinus disease: a 25-year experience and long-term results of different surgical techniques

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Summary

Background The incidence of pilonidal disease is increasing. The choice of surgical approach differs between surgeons and countries. With better understanding of the etiology of the disease, there is a shift toward more successful concepts of treatment. In many cases, management can be challenging owing to the number of previous failed operations.

Objective The aim of this retrospective single-center cohort study was to compare recurrence rates and postoperative wound complications between five treatment arms.

Methods A total of 299 patients who underwent surgery for pilonidal disease between November 1994 and May 2019 were included. Primary endpoint was time to recurrence, secondary endpoint was wound care complication rate.

Results Median follow-up was 85.8 months in 286 patients. An overall recurrence rate of 16.1% was observed at 24 months, 21.4% at 60 months, and 47.4% at 303 months; 24 months postoperatively, there was a range from 10.5% for excision with primary midline closure to 30.0% for the Bascom I procedure. Recurrence in excision with primary midline closure was 71.8% 268 months postoperatively. No statistically significant differences were observed between the five groups (p = 0.54). The highest prevalence of wound complications (46.3%) was in excision with midline closure. Cox regression showed that previous pilonidal operations are an independent prognostic factor for developing recurrence (p = 0.006). Multivariate logistic regression revealed that previous pilonidal operations have a significant predictive value for developing postoperative wound complications (odds ratio = 4.04, 95% confidence interval [1.61–10.18]; p = 0.003).

Conclusion In order to improve surgical outcomes, emphasis should be given to adoption of techniques with high success rates.

Keywords Pilonidal sinus disease · Excision · Off-midline procedure · Disease recurrence · Wound care complications

Introduction

The preferences of surgical approach in the therapy of pilonidal sinus disease differ slightly between surgeons and countries. A recent meta-analysis showed that recurrence rates depend on surgical approach and follow-up time [1]. The impact of geographical factors such as genetic mechanisms responsible for hair growth and hair thickness, healthcare settings, and socioeconomic factors on recurrence rates are revealed in the retrospective study, suggesting that some approaches have extraordinarily good outcomes in specific countries; however, flap techniques remain superior [2]. Postoperative complications
and recurrence significantly impair the quality of life of patients, especially when symptoms are severe. In decades past, excision with primary midline closure or lay open were considered the gold standard; however, these methods are associated with high complication and recurrence rates. In many cases, management can be challenging owing to the number of previous failed operations. In addition, when nonhealing or extended perianal wounds after excisional surgery occur, technical modifications of the subsequent flap procedure need to be done. According to the recently published German guidelines, excision with midline closure should not be performed at all [3].

With better understanding of the etiology of the disease, there is a shift toward more successful treatment concepts. Bascom showed that early epidermal changes are amplified by further deep tissue disruption from moisture, anerobic conditions, hair, and bacteria [4]. Remarkably, in the analysis of hair samples from pilonidal sinus cavities, short hair fragments with rootless sharp cut ends were found [5]. Furthermore, testing of hair from three different body regions suggests that occipital hair is regularly present in pilonidal sinus nests [6]. To improve outcomes, the origin of the disease must be understood. Differential diagnoses such as anal fistula can be excluded by magnetic resonance imaging [7], and more successful methods should be applied. These methods should include strategies to reshape and flatten the gluteal cleft and relocate the incision off the midline. Surprisingly, certain limitations and acceptance of newer techniques appear to impact the choice of the method.

We were interested in differences between surgical groups in regard to recurrence rates and wound care complications. We hypothesized that risk factors such as previous pilonidal operations, abscess incisions, duration of disease, smoking status, and body mass index (BMI) are associated with higher recurrence rates as well as with a higher incidence of wound care complications.

Materials and methods

This study was designed as a retrospective single-center cohort study and conducted at the University Clinic of General Surgery of the Medical University of Vienna. All patients gave informed consent. The Ethics Committee of the Medical University of Vienna approved the study (EC reference: 2019/2020).

Eligibility

Adult patients who underwent surgery for both primary and recurrent pilonidal sinus disease from November 1994 to May 2019 were included in the study. Exclusion criteria were patients under the age of 18 years, patients with emergency surgery for pilonidal abscess, simultaneous hidradenitis suppurativa, sinus pilonidalis squamous cell carcinoma, and fistulizing rectal cancer. Surgical techniques with less than 10 cases and repetitive procedures in case of recurrent disease were eliminated from further analysis. In the few patients undergoing the same procedure twice, only the first procedure was included in order to maintain statistical independence of observations within treatment procedures and thus validity of p-values.

We reviewed the routinely recorded data of the Vienna General Hospital AKIM and collected BMI, patient age, sex, smoking status, duration of disease, number of previous pilonidal operations, abscess incisions, and postoperative wound care complications. Five treatment arms were compared: excision with primary midline closure, excision with marsupialization, Karydakis flap, Dufourmentel flap, and Bascom I procedure. Three groups of different techniques, i.e., split thickness skin graft (n=2), excision and lay open (n=6), and excision with negative pressure wound therapy (n=1), were eliminated from analyses due to a small sample size. Eight repetitive surgeries in patients with recurrence were also eliminated: excision and primary midline closure (n=1), excision and marsupialization (n=7).

Outcomes

The first endpoint of the study is the time to recurrence and the evaluation of risk factors for time to recurrence in five investigated subgroups. A recurrence was defined as new disease occurring after the wound was completely healed. The secondary outcome was postoperative wound care complication rate among the five analyzed treatment arms. Complications were divided into three groups: mild, severe, and none. Examples of mild complications were surgical site infection (SSI), local superficial dehiscence, and seroma. Severe complications were dehiscence or abscess with drain placement, or revisional surgery requiring a hospital stay. For statistical analyses, only the occurrence of complications in the five treatment arms was of interest.

Follow-up

Disease recurrence was assessed either by a visit at the outpatient ward or by telephone interview. Data on postoperative wound care complications were collected from our internal patient database. To minimize recall bias and to avoid any confusion in terms of interpretation and clinical manifestation of recurrence, especially in patients with lower health literacy, we conducted the calls using a standardized questionnaire.
### Table 1  Summary data: patient baseline characteristics of five different treatment arms

| Demographic variables | Excision and primary midline closure (n = 61) | Excision and marsupialization (n = 108) | Karydakis flap (n = 65) | Dufourmentel flap (n = 49) | Bascom I procedure (n = 16) |
|-----------------------|---------------------------------------------|----------------------------------------|------------------------|---------------------------|------------------------------|
| **Age (years), n (%)** |                                            |                                        |                        |                           |                              |
| 18–29                 | 44 (72.1)                                   | 69 (63.9)                              | 36 (55.4)              | 31 (63.3)                 | 11 (68.8)                    |
| 30–49                 | 14 (23.0)                                   | 35 (32.4)                              | 22 (33.8)              | 17 (34.7)                 | 5 (31.3)                     |
| ≥ 50                  | 3 (4.9)                                     | 4 (3.7)                                | 7 (10.8)               | 1 (2.0)                   | 0                            |
| **Median (min; max)** | 26 (18;81)                                  | 26 (18;55)                             | 28 (18;77)             | 26 (18;53)                | 24.5 (19;45)                 |
| **BMI (kg/m²), n (%)** |                                            |                                        |                        |                           |                              |
| < 25.0                | 30⁵ (52.6)                                  | 46⁵ (46.5)                             | 16 (24.6)              | 21 (42.9)                 | 5⁵ (55.6)                    |
| 25.0–29.9             | 23⁵ (40.4)                                  | 35⁵ (35.4)                             | 31 (47.7)              | 16 (32.7)                 | 3⁵ (33.3)                    |
| ≥ 30                  | 4⁵ (7.0)                                    | 18⁵ (18.2)                             | 18 (27.7)              | 12 (24.5)                 | 1⁵ (11.1)                    |
| **Median (min; max)** | 24.8 (19.6;39.8)                            | 25.7 (18.5;38.1)                       | 27.5 (19.8;53.0)       | 26.8 (18.9;39.8)          | 24.8 (21.5;31.3)             |
| **Sex, n (%)**        |                                            |                                        |                        |                           |                              |
| Male                  | 49 (80.3)                                   | 94 (87.0)                              | 57 (87.7)              | 34 (69.4)                 | 12 (75.0)                    |
| Female                | 12 (19.7)                                   | 14 (13.0)                              | 8 (12.3)               | 15 (30.6)                 | 4 (3.5)                      |
| **Smoking, n (%)**    |                                            |                                        |                        |                           |                              |
| Yes                   | 35⁶ (59.3)                                  | 63⁶ (62.4)                             | 41 (63.1)              | 35 (71.4)                 | 6⁶ (60.0)                    |
| No                    | 24⁶ (40.7)                                  | 38⁶ (37.6)                             | 24 (36.9)              | 14 (28.6)                 | 4⁶ (40.0)                    |
| **Duration of the disease (months), n (%)** |                                            |                                        |                        |                           |                              |
| ≤ 12                  | 27⁷ (47.4)                                  | 52⁷ (50.0)                             | 19 (29.2)              | 18 (36.7)                 | 1⁷ (71.4)                    |
| > 12                  | 30⁷ (52.6)                                  | 52⁷ (50.0)                             | 46 (70.8)              | 31 (63.3)                 | 4⁷ (28.6)                    |
| **Median (min; max)** | 21 (1;240)                                  | 18 (1;240)                             | 36 (6;444)             | 36 (1;180)                | 12 (1;120)                   |
| **Abscess, n (%)**    |                                            |                                        |                        |                           |                              |
| Yes                   | 38 (62.3)                                   | 66 (61.1)                              | 23 (35.4)              | 34 (69.4)                 | 12 (75.0)                    |
| No                    | 23 (37.7)                                   | 42 (39.9)                              | 42 (64.6)              | 15 (30.6)                 | 4 (25.0)                     |
| **Previous PO, n (%)**|                                            |                                        |                        |                           |                              |
| No                    | 44 (72.1)                                   | 81 (75.0)                              | 45 (69.2)              | 24 (49.0)                 | 12 (75.0)                    |
| Yes 1                 | 12 (19.7)                                   | 18 (16.7)                              | 10 (15.4)              | 12 (24.5)                 | 4 (25.0)                     |
| Yes > 1               | 5 (8.2)                                     | 9 (8.3)                                | 10 (15.4)              | 13 (26.5)                 | 0                            |

**BMI** body mass index, **PO** pilonidal operation

⁵Missing data

### Statistical analysis

Categorical data were described using absolute and relative frequencies and group differences were tested by chi-square test or Fisher’s exact test in case of sparse data. For continuous data, the median, minimum, and maximum were calculated due to non-normally distributed data. Group differences for continuous data were calculated by Kruskal–Wallis test. Kaplan–Meier curves were estimated to visualize time to recurrence and log-rank test was performed to assess differences between groups. Cox proportional hazard regression was applied to model prognostic factors for time to recurrence. All p-values are two-sided and p ≤ 0.05 is considered statistically significant. All calculations were performed using SAS (Version 9.4, SAS Institute Inc. ©, Cary, NC, USA).

This manuscript has been designed in accordance with the STROBE guidelines [8].

### Results

A total of 382 patients underwent surgery for pilonidal sinus disease at the University Clinic of General Surgery of the Medical University of Vienna in the period between November 1994 and May 2019. After exclusion of 83 patients (Fig. 1), 299 patients were assessed for eligibility. A fraction of the excluded patients with emergency surgery (n = 22) involves those who received either an abscess incision and definitive treatment (4 excisions with lay open and 5 excisions with marsupialization) or an abscess incision and drainage in the operating room (n = 13). The vast majority of our acute cases were managed at the outpatient ward. Among operations for chronic pilonidal disease, 61 excisions with primary midline closure, 108 excisions with marsupialization, 65 Karydakis flap procedures, 49 Dufourmentel flaps, and 16 Bascom I procedures were performed. The percentage breakdown of applied techniques is shown in Fig. 2.

The preferences in choice of technique evolved over the investigated time period. Excisional surgeries were in a leading position until 2007. In 2003, for the first
Fig. 1 Study profile

Fig. 2 Percentage breakdown of applied techniques in the treatment of pilonidal disease in chronic cases ($n = 299$) in the period from November 1994 to May 2019

Fig. 3 Yearly spectra of applied techniques in the treatment of pilonidal disease in chronic cases ($n = 299$) in the period from November 1994 to May 2019
time, a flap technique, in particular the Dufourmentel flap, was adopted. Later, between 2008 and 2011, this was the most frequently performed procedure. The first off-midline procedure, namely the Karydakis flap, was carried out in 2008 and has been on the rise since 2012. A minimally invasive Bascom I procedure did not find broader use, except for in 2016. A graphical display of yearly spectra of performed techniques is shown in Fig. 3.

The analyzed patient population demonstrated a representation of mostly younger males, whilst the proportion of patients younger than 30 years varied between 55.4 and 72.1% among the cohorts. There was no significant difference in median BMI between the five treatment arms, which ranged from 24.8 to 27.5 kg/m². However, in the Karydakis flap subgroup, 47.7% of patients had overweight and 27.7% had obesity. Furthermore, all groups consisted of 60.0% or more smokers. With the exception of the Karydakis flap group, there were relatively high rates of abscess incisions in patient history taking, with values from 62.3% for excision with primary midline closure to 75.0% for the Bascom I procedure. The highest median disease duration was seen in flap groups, with 36 (6;444) months for Karydakis flap and 36 (1;180) months for Dufourmentel flap. The Dufourmentel flap subgroup also demonstrated the highest fraction of patients with previous operations, with 51% of patients having had one or more failed pilonidal procedure. Baseline characteristics of chronic cases are summarized in Table 1.

Recurrence-free survival

Kaplan–Meier estimator displays the recurrence-free survival for the five surgical techniques as shown in Fig. 4. From the 299 patients, 286 were included in the analysis (95.7%) and 13 lacked follow-up data. We see widely varying follow-up times among different procedures resulting from the year when the technique was adopted for the first time. No statistically significant differences were observed ($p=0.54$). Median follow-up was 85.8 months in 286 patients and an overall recurrence rate of 16.1% was observed at 24 months, 21.4% at 60 months, and 47.4% at 303 months; 24 months postoperatively, there was a range from 10.5% for excision with primary midline closure to 30.0% for the Bascom I procedure. Unsurprisingly, the recurrence rate in excision with primary midline closure was as high as 24.7% at 60 months and 71.8% at last follow-up 268 months postoperatively. Patients undergoing excision and marsupialization showed the fourth lowest recurrence rate at 24 months (13.7%) and the lowest recurrence rate at 60 months (18.1%). Among Karydakis flap patients, a recurrence rate of 17.8% was observed at

Fig. 4 Kaplan–Meier estimator showing recurrence-free survival for five performed surgical techniques and patients at-risk for every 12 months. $P$-value for log rank test is 0.54.
Table 2  Comparison of recurrence-free survival and follow-up periods among five treatment arms

| Surgical method                          | No postoperative information (%) | 24 months | 60 months | At last FU | Lost to FU before 01.01.2020 (n) | Median FU (months) |
|-----------------------------------------|----------------------------------|-----------|-----------|------------|---------------------------------|-------------------|
| Excision and primary midline closure    | 7                                | 89.5      | 75.3      | 28.2% at 268 months            | 18 incl. 2 deaths | 100.1                          |
| (n=61)                                  |                                  |           |           |            |                                 |                   |
| Excision and marsupialization           | 4                                | 86.3      | 81.9      | 63.9% at 303 months            | 33 incl. 1 death  | 106.8                          |
| (n=108)                                 |                                  |           |           |            |                                 |                   |
| Karydakis flap                          | 1                                | 82.2      | 80.2      | 80.2% at 126 months            | 15                | 45.4                           |
| (n=65)                                  |                                  |           |           |            |                                 |                   |
| Dufourmentel flap                       | 0                                | 80.4      | 80.4      | 67.9% at 210 months            | 8                 | 123.7                          |
| (n=49)                                  |                                  |           |           |            |                                 |                   |
| Bascom I procedure                      | 1                                | 70.0      | 35.0      | 35.0% at 65 months             | 5                 | 44.2                           |
| (n=16)                                  |                                  |           |           |            |                                 |                   |
| Total                                   | 13                               | 83.9      | 78.6      | 52.6% at 303 months            | 79                | 85.8                           |
| (n=299)                                 |                                  |           |           |            |                                 |                   |

Discussion

Our retrospective study compared five different surgical approaches in the therapy of pilonidal disease in terms of recurrence rates and wound care complications. Recurrence rates vary between different methods depending on follow-up time. We found out that previous failed pilonidal operations are an independent prognostic factor for recurrence and development of wound complications.

Wound care complications

In 284 out of 299 patients, the information on wound care complications in postoperative follow-up was available. A total of 93 patients (32.7%) experienced a postoperative complication. There were 79 mild (27.8%) and 14 severe (4.7%) complications. The highest prevalence of wound care complications (46.3%) was in the subgroup of excision with primary midline closure. In the comparison of Dufourmentel flap (27.1%) versus Karydakis flap (39.1%) there was no statistically significant difference in the rate of complications between the groups ($p=0.19$). The fewest complications were experienced by patients in the excision and marsupialization group (23.9%). There were only mild complications in Bascom I patients, at a rate of 33.3%. Wound care complication rates are presented in Table 4.

From 284 patients with wound care complication data, 70 patients’ reports lacked demographic data, leaving 214 patients to be included in multivariate logistic regression. This revealed that previous failed pilonidal operations in the patient history have significant predictive value for developing postoperative wound care complications (odds ratio = 4.04, 95% confidence interval [1.61–10.18]; $p=0.003$) as shown in Table 3.
recognized by Bascom as the primary source of surgical failure [4]. Therefore, flattening of the natal cleft and bringing the incision off midline play a crucial role in the management of the disease. Although radical excision was earlier considered as a goal of treatment [15], it now can no longer be advocated. This paradigm shift represents a pivotal change for the choice of treatment strategy. Opponents of flap techniques often highlight their own subjective positive experience with excisional procedures. The reasons for the resistance to change could be comfort with the status quo and temporary incompetence caused by a shallow learning curve when learning without an experienced mentor. In our study, the group of patients with recurrent pilonidal disease comparing two treatment arms, namely excisional method and Karydakis flap, showed a 43% 1-year recurrence rate in the first group and 3% in the second group (p<0.0001) [9]. Consequently, patients with recurrent pilonidal disease would have the most to gain from off-midline procedures. Comparing our two flap groups, the Dufourmentel flap demonstrated similar recurrence rates to the Karydakis flap at 24 and 60 months. The meta-analysis by Stauffer compared different techniques in 89,583 patients and demonstrated that advancement flaps (Karydakis and Bascom cleft lift) and rhomboid flaps (Limberg and Dufourmentel) have comparable results with respect to recurrence rate [1]. They reported 0.6% at 24 months for advancement flaps and 1.8% at 24 months for rhomboid flaps. The evidence suggests that a modified version of the Limberg flap, where a caudal pole is placed 1–2 cm laterally to the midline, should be preferred over the classical one [16, 17]. A survey analyzing 92 certified institutions in Switzerland and Austria revealed that among flap techniques, in 70.7% a Limberg flap and in only 17.2% a modified Limberg flap was performed (advancement flaps were analyzed separately as an off-midline group) [18]. We experienced a considerably high overall wound care complication rate (39.1%) and the highest rate of severe wound care complications (7.8%) in the Karydakis flap group. In most cases, wound dehiscence in caudal, cranial, or both portions occurred. After taking a closer look, we found out that the overall complication rate was as high as 46.9% until 2017 (23 out of 49 patients) and decreased to 13% in the period between 2018 and 2019 (2 out of 15 patients). The Karydakis flap group (n=65) consisted of 63.1% smokers and 75.4% patients with overweight or obesity. The evidence demonstrated that risk factors such as smoking and BMI >25.0 kg/m² are associated with higher rates of wound care complications in patients with pilonidal disease [11, 19, 20]. One of the key principles of construction of advancement flaps is complete wound lateralization. If the final suture line or its caudal portion ends up in the midline, some additional skin needs to be excised [12, 21, 22]. Although, the minimally invasive procedures are associated with higher recurrence rates, their benefits are well known. From a cost standpoint, they are

Table 3  Risk factors for recurrence of pilonidal disease wound care complications. Bold values indicate statistical significance

| Risk factors for recurrence | Cox regression | Multivariate logistic regression |
|----------------------------|----------------|---------------------------------|
| Abscess incision (yes vs. no) | 1.25 (0.66–2.34) | 1.40 (0.72–2.71) |
| Previous operations (yes vs. no) | 2.84 (1.35–5.99) | 1.50 (1.26–1.81) |
| Duration of disease (<12 months vs. >12 months) | 0.99 (0.98–1.00) | 0.99 (0.98–1.00) |
| BMI (<25 vs. ≥25 kg/m²) | 1.01 (0.95–1.07) | 0.69 (0.26–1.86) |
| Smoking (yes vs. no) | 0.38 (0.21–0.69) | 0.38 (0.21–0.69) |
| Surgical group (excision & midline closure vs. Karydakis flap) | 1.48 (0.61–3.64) | 0.69 (0.26–1.86) |
| Surgical group (excision & marsupialization vs. Karydakis flap) | 0.80 (0.35–1.82) | 0.80 (0.35–1.82) |
| Surgical group (Dufourmentel vs. Karydakis flap) | 0.69 (0.26–1.86) | 0.69 (0.26–1.86) |

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time efficient, usually require no hospital stay, and do not significantly disrupt patients’ activities. In our analysis, we had only 16 Bascom I operations. No conclusions can be drawn due to this small number of patients. This group showed the highest recurrence rate at 24 and 60 months, at 30 and 65%, respectively. The retrospective study by Gips on 1358 patients demonstrated a recurrence rate of 6.5% at 1 year and 13.2% at 10 years postoperatively; mean time to recurrence was 2.7 years [23]. A German retrospective study on 153 patients reported a recurrence rate of 28% at 24 months postoperatively and median time interval to recurrence of 2.8 months [24]. Their study also revealed a significant predictive value of disease duration >6 months and BMI >25.0 kg/m² for development of recurrence [23]. Similar results were reported in the study by Bascom, with mean time to complete healing of 3 weeks [25]. The last investigated group, excision with marsupialization showed a recurrence rate as high as 13.7% at 24 months, 18.1% at 60 months, and an overall wound care complication rate of 23.9%. Two of the major concerns in this method are prolonged healing and significant postoperative pain.

Conclusion

To achieve better results, we need to deliver the right treatment at the right time. The emphasis should be given to adoption of techniques with high success rates. In order to improve surgical outcomes, it is imperative to respect the key principles of their construction. Well-designed prospective studies focusing on both treatment strategies—minimally invasive techniques as well as flap procedures—are necessary.

Author Contribution

All authors contributed to the study conception and design. All authors read and approved the final manuscript.

Table 4  Prevalence of wound care complications among five treatment arms

| Wound care complications | Surgical method | No (n=299) | Mild (n=299) | Severe (n=299) | Lost to follow-up (n=299) |
|--------------------------|-----------------|-----------|-------------|---------------|-------------------------|
| Bascom I procedure (n=16) | 10 (66.7) | 5 (33.3) | 0 | 1 |
| Dufourmentel flap (n=49) | 35 (72.9) | 10 (20.8) | 3 (6.3) | 1 |
| Karydakis flap (n=65) | 39 (60.9) | 20 (31.3) | 5 (7.8) | 1 |
| Excision and marsupialization (n=108) | 78 (75.7) | 20 (19.4) | 5 (4.8) | 5 |
| Excision and primary midline closure (n=61) | 29 (53.7) | 24 (44.4) | 1 (1.9) | 7 |

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Declarations

Conflict of interest

M. Bubenova, M. Mitilboeck, C. Kulina-Cosentini, B. Teley, and E. Cosentini declare that they have no competing interests.

Ethical standards

The Ethics Committee of the Medical University of Vienna approved the study (EC reference: 2019/2020).

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