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Does Full Wound Rupture following Median Pilonidal Closure Alter Long-Term Recurrence Rate?

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Key Words

Pilonidal sinus · Primary disease · Recurrence · Long-term recurrence rate · Primary wound closure · Wound dehiscence · Wound rupture · Surgery · Open wound treatment

Abstract

Objective: The purpose of this study was to examine the recurrence rate of wound rupture in primary pilonidal sinus disease (PSD) after median closure. ***Subjects and Methods:*** A total of 583 patients from the German military cohort were interviewed. We compared the choice of surgical therapy, wound dehiscence (if present) and long-term recurrence-free survival for patients with primary open treatment, marsupialization and primary median treatment (closed vs. secondary open, respectively). Actuarial recurrence rate was determined using the Kaplan-Meier calculation with a follow-up of up to 20 years after primary PSD surgery. ***Results:*** Patients with excision followed by primary open wound treatment showed a significantly lower 5- than 10-year recurrence rate (8.3 vs. 11.2%) compared to the patients with primary midline closure (17.4 vs. 20.5%, $p = 0.03$). The 20-year recurrence rate was 28% in primary open wound treatment versus 44% in primary midline closure without wound rupture. In contrast to these findings, long-term recurrence rates following secondary open wound treatment (12.2% at 5 years vs. 17.1% at 10 years) tended to be higher (although not significantly, $p = 0.57$) compared to primary open treatment (8.3% at 5 years vs. 11.2% at 10 years). There was no statistical difference in long-term recurrence rates between secondary open and primary midline closure ($p = 0.7$). Hence, despite only a short wound closure time experienced before wound rupture, the patient does not fully benefit from an open wound treatment in terms of recurrence rate. ***Conclusion:*** The postoperative pilonidal sinus wound rupture of primary midline closures did not significantly increase the 5- and 10-year long-term recurrence rates compared to uneventfully healing primary midline closures.

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Introduction

Pilonidal sinus disease (PSD) primarily affects young male adults by hair protruding into the skin over the sacral bone, which leads to chronic inflammation by foreign body reaction. Consequently, fistulae between the superficial and deeper region of the skin are established, and epithelization prevents any spontaneous remission of disease. Herbert Mayo first reported on PSD in 1833, and in 1847 A.W. Anderson [1] described the disease in the first case report of PSD in a 21-year-old lumberjack with an ulcer containing hair on the lower back. Anderson's attempt to treat the 'pilonidal ulcer' by injections of silver nitrate or mercuric chloride into the fistula as well as simple incision failed. However, by removing a bush of hair from the depth of the ulcer, the secretion of pus was terminated and the patient was healed within 3 weeks [1].

During World War II, it was postulated that driving or primarily sitting activities could induce sinus ('jeeps disease'), because a large number of 77,637 US soldiers suffered from PSD between 1942 and 1945 [2]. While Patey and Scarff [2] strongly assumed that PSD was fully an acquired disease, a very careful study of the incidence within the World War II collective by Favre and Delacroix [3] contradicted this hypothesis. They analyzed 1,006 operated patients in 1964 and proved that the majority of them were from unmotorized troops. In addition, Haworth and Zachary [4] and Chamberlain and Vawter [5] favored a congenital pathogenesis of PSD. This congenital postulate has remained an important topic, as familial strains of pilonidal sinus can be identified these days [6], accounting for more than 90% of all pilonidal disease that begins in the youngest adolescents [7]. However, in the risk group of soldiers, the lifetime risk is not higher than that of the general population [8].

As only complete excision of the tracts can cure PSD, surgery (mostly of wide excision) and primary open wound healing are required. Although open wound healing leads to a lower long-term recurrence rate, senior surgeons did and do not choose primary open treatment [9]. However, young surgeons doing septic surgery prefer this technique because it is fast and easy to perform. Equally important, primary closure could be challenging if large defects were to be closed, and the infection rate could be as high as 30% [10]. Hence, the primary open treatment option is still more commonly used.

Primary midline closure, technically relatively easy to perform, is associated with both higher infection and long-term recurrence rates [11] and thus should be abolished and replaced by a primary closing technique. Thus, asymmetrical techniques as well as flap closures have gained ground in pilonidal sinus treatment [12].

Unimpaired wound healing (residual wound tension, incomplete resection of tracts, infection) is the responsibility of any surgeon on duty. However, with a recurrence rate of 40% at a follow-up of 20 years, primary median closure may induce weeks and months of open wound treatment, carrying a further mid-to-low long-term recurrence rate of 20% at the 20-year follow-up [11]. Hence, the purpose of this study was to investigate whether early wound infection or rupture could alter the long-term recurrence rate in primary PSD after repeated primary midline closures.

Subjects and Methods

All patients with primary PSD admitted to the surgical departments of three German Armed Forces Hospitals (Hamburg, Bad Zwischenahn and Hamm) between 1980 and 1996 were traced by the Institute for Military Medical Statistics and Epidemiology of the German Federal Armed Forces in Andernach (formerly Remagen). After being traced, patient diagnosis proofing and exclusion of non-PSD and recurrent PSD surgery patients were done followed by random selection of 583/1,960 patients for further interview. The patients chosen were subjected to a standardized telephone interview. Accuracy of diagnosis was confirmed by correlating theater notes and referral and discharge letters, as well as by the International Classification of Disease Code independently by one of the authors (D.D.) [13]. The definition of acute, chronic and incidental PSD and their relation to each other/conversion into each other was applied as published previously [7].

A total of 1,960 patients with primary PSD manifestation and first surgical treatment were identified and proved eligible for potential analysis, as these were all primary pilonidal patients without tissue architecture altered by preceding operations. Of these, 583 patients were randomly drawn from a stack of 1,960 single paper sheets by one of the authors (D.D.) with one patient name and address per page. These patients were interviewed by telephone before joining this retrospective cohort study. The number of patients was chosen to achieve a minimum of 200 patients in both the primary closure and primary open treatment groups. The range of follow-up time between surgery and interview was from 7 to 26 years. All patients (n = 583) contacted by telephone gave consent and agreed to take part in the interview.

Patients were interviewed using a standardized checklist and asked to rate their satisfaction on wound healing parameters (in-hospital treatment time, outpatient treatment time, pain on dressings, esthetic impression of healed wound), choice of surgical treatment (primary open, primary midline and marsupialization therapy) as well as their satisfaction about treatment outcome (long-term recurrence rate). Patients were further interviewed about any signs of recurrence and further PSD operations since the initial surgical treatment.

Patients were diagnosed with recurrent disease if the surgical wound had completely healed after the first surgery, if they did not sustain any coccygeal trauma after complete wound closure and if

Table 1. Number of treatments and clinical presentation of PSD

Diagnosis	Marsu-pialization	Primary open	Primary closure	PMC secondary	Total
Abscess-forming PSD	13	143	28	16	184
Chronic remitting PSD	2	5	27	8	34
Chronic fistulating PSD	1	179	133	53	313
Incidental PSD	17	22	13	8	52
Total	33	349	201	85	583

Primary closure group (n = 201): 192 primary midline closure patients, 8 asymmetrical closures and 1 Z-plasty. PMC secondary: secondary open primary median closures – wound rupture or revision needed; this patient group (n = 85) is part of the primary closure patient group (n = 201). PMC = Primary midline closure.

Table 2. Primary healings, partial dehiscence and complete wound ruptures in primary pilonidal sinus median closures (n = 201)

	A	CR	CF	I	Total
Primary healing	13	19	80	5	117
Partial dehiscence	5	1	28	3	37
Complete rupture	10	7	25	5	47
Total	28	27	133	13	201

A = Abscess-forming PSD; CR = chronically remitting PSD; CF = chronically fistulating disease; I = incidental disease.

they met at least one hard (diagnosis by a doctor, surgical reintervention, formation of a new sinus, presence of hair in a sinus opening, and discharge of pus) or two soft (wound redness, swelling, pain, and discharge of fluid) recurrence criteria [14]. All epidemiological data were recorded at the time of admission for primary PSD surgery.

Data Analysis and Statistics

The data are expressed as median and interquartile range or mean ± standard deviation; eventually, 95% confidence intervals (mean ± 2 standard error of the mean) were added. The Wilcoxon test was used to compare categorical and numeric values of the two groups, since assumptions of normal distribution were not met. Actuarial recurrence rates were compared using the log-rank test. The correlation between two quantitative variables was assessed using Spearman's rank correlation test. Categorical and numeric variables in several groups were compared using the Kruskal-Wallis test, partially including a post hoc pairwise Wilcoxon test analysis with Holm's p value adjustment. These statistical analyses were computed using SPSS 15 (SPSS, Chicago, Ill., USA) and R version 3.1.0 (http://www.r-project.org). $p < 0.05$ was considered statistically significant. All tests were conducted with a two-sided alternative hypothesis.

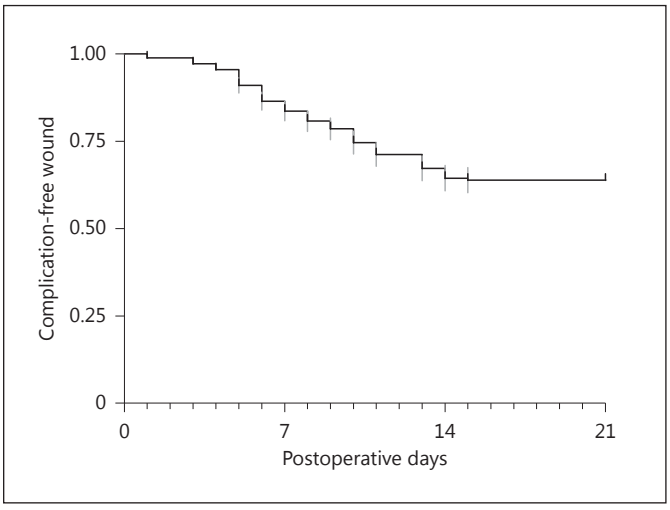

Fig. 1. Wound rupture kinetics following primary pilonidal sinus surgery with excision and median closure (n = 201 patients).

Results

A total of 583 patients received primary surgery for PSD. The most common treatment was the use of (rhomboid) excision and primary open treatment in 349 (60%) followed by (rhomboid) excision and primary closure (table 1) in 201 patients, including 192 (32.9%) midline closure patients, a further 8 patients who had primary asymmetric excision with their wound/scar kept out of the midline of the wound (1%) and 1 patient on whom Z-plasty was performed (0.2%).

Of these 201 patients with primary wound closure, 84 (42%) suffered from wound infection, leading to partial dehiscence or total rupture of the wound site (fig. 1). This reopening was mostly seen between the 3rd and 15th day following the operation. One single wound revision was done on the 30th postoperative day. The dynamics of wound rupture is shown in figure 1 and is as follows: of the 201 with primary wound closure, 117(58%) were primary healings compared to 47 (23%) complete ruptures and 37 (18%) partial dehiscences (table 2). Primary median closure in acute disease was linked to 10/28 (36%) full wound ruptures and 5/28 (18%) partial dehiscences, which was 15/28 (54%) in total. In chronic disease, there were 32/160 (20%) wound ruptures and 29/160 (18%) partial dehiscences, for a total of 61/160 (38%) wound complications.

All primary closed patients with wound revision or wound rupture received open wound treatment following the day of rupture. No secondary surgical closure was

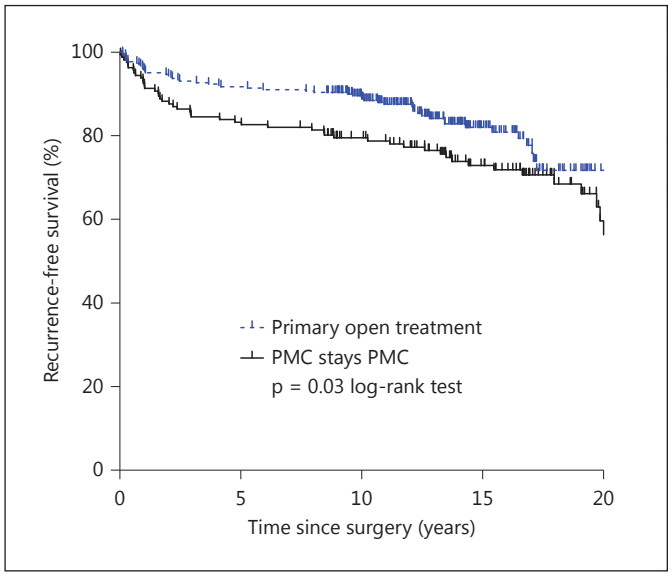

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Fig. 2. Long-term recurrence rates of primary open wound healing in PSD (blue; color in online version only) and primary midline closure PSD (black). Primary open wound healing is associated with a significant lower long-term recurrence rate compared to the primary midline closure (p = 0.03). PMC = Primary midline closure.

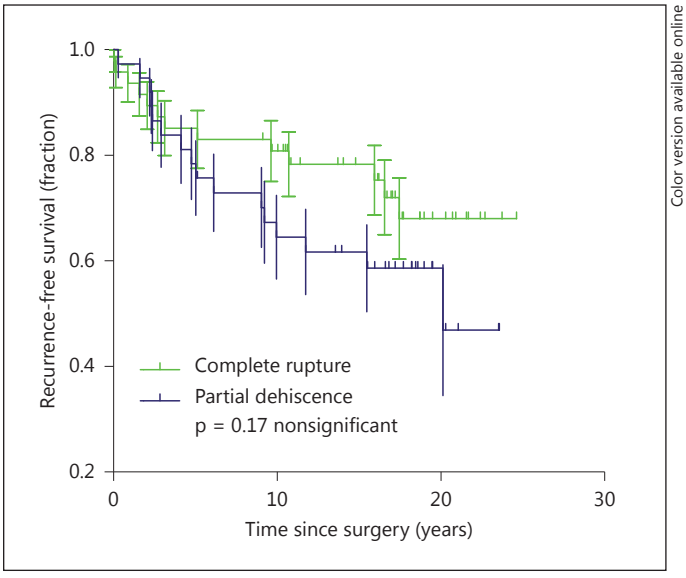

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Fig. 4. Recurrence-free survival for complete rupture and partial dehiscence following pilonidal closure. Although the curves are not statistically different, there is a trend pointing to a lower recurrence rate following complete rupture (which is followed effectively by open wound treatment, a treatment linked to a lower recurrence rate compared to median closure.

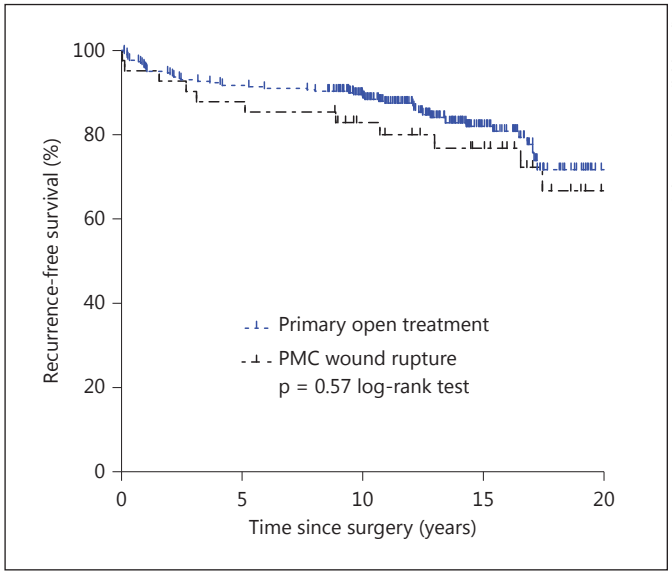

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Fig. 3. Kaplan-Meier recurrence rates of primary open wound healing (blue; color in online version only) vs. primary closure with wound rupture/secondary open wound healing (black). Even though the long-term recurrence rate of secondary open wound healing lies above primary open wound healing, no statistical difference can be seen (p = 0.57). PMC = Primary midline closure.

attempted. Overt infection was not seen in any wound, but excision of suspicious tissue was linked to histological proof of tract remnants in 2 patients with early wound rupture. There was a significantly lower 5- and 10-year recurrence rate for primary open wound healing (fig. 2; p = 0.03, log rank test) compared to primary midline closure. The 5-, 10- and 15-year recurrence rates of the primary open wound healing were 8, 11 and 18%. Recurrence rates of uneventful primary midline closures were 17, 21 and 27%, respectively.

Comparing the Kaplan-Meier curves of patients with primary midline closure experiencing wound complications, wound rupture/revision and consecutive secondary open wound healing, there was no statistical difference regarding recurrence rates, as shown in figure 3 (p = 0.57, log-rank test). However, the 5-, 10- and 15-year recurrence rates of secondary open wound healing differed from primary open wound healing (12 vs. 8%, 17 vs. 11% and 23 vs. 18%, respectively; fig. 3). As a result of analyzing the timespan between the operation and reopening of a primary midline closure, patients were divided into early and late wound complications (early: up to day 10; late: between days 11 and 21). Early complications occurred nearly as often as late complications, and the recurrence rate was not influenced if wound complications arose ear-

lier or later during the treatment. Interestingly, partial wound dehiscence that was allowed to remain partial showed a trend towards a larger recurrence rate compared to full wound rupture (fig. 4).

Discussion

In this study, there was a significantly lower 20-year recurrence rate of primary open pilonidal sinus surgery compared to uneventful primary midline closure healing. If wound rupture of a primary median closure occurred, and the wound was treated secondarily open, the long-term recurrence rate stayed high at the primary median closure rate but did not exceed this level. The postoperative pilonidal sinus wound rupture did not fully decrease its long-term recurrence rate to that of the primary open treatment rate, although the 'closed' wound time was only for a few days. Interestingly, as a trend, partial wound dehiscence seems to have a worse outcome compared to full wound rupture.

The long-term recurrence rate in pilonidal sinus surgery has not been investigated thoroughly, and although wound complications are common, especially in primary midline closure, most of them go unreported. Sondenaa et al. [15] in 2002 proved that wound complications were an independent predictor of recurrence with an odds ratio of 4.6 following earlier reports of Godall [16] and Notaras [17]. The authors confess, though, that multiple studies not linking postoperative infection and recurrence rate do exist, as demonstrated by al-Hassan et al. [18] and Vogel and Lenz [19]. Interestingly, the review by Milone et al. [20] of 1,003 patients underlines a significant link between complication and recurrence, and that of Fitzpatrick et al. [21], analyzing a smaller military cohort, agrees.

In our cohort from three army hospitals, surgical procedures were only accompanied by antibiotic cover if the surgeon decided that it was necessary. The high infection rate of 42% (our cohort) is experienced elsewhere and was the reason for other investigations of systematic pre-, peri- and postoperative antibiotic cover applied either systematically or locally. Doll et al. [22] and Brückner and Volmerig [23] could not find any influence of locally applied gentamycin fleece on recurrence rate, but only on wound dehiscence rate in primary median closure patients. Wound drain use to prevent fluid collection as a promotor of wound dehiscence was investigated by Milone et al. [24] in 803 consecutive pilonidal sinus patients. Although there was a trend, no statistical difference between patients with and without drains was found. Thus, either preoperative bacterial colonization in chronic PSD did not cause postoperative wound complications and recurrence or the antibiotic targeting of the bacteria responsible for impaired wound healing and recurrence was insufficiently targeted. A recent study of Ardelt et al. [25] was able to demonstrate a significant shift in the microbial flora in recurring PSD towards the Gram-positive range as well as a tendency towards the aerobic range. Hitherto, these bacterial changes did not alter the recurrence rate or time to recurrence in repeated disease, as 4th recurrences tend to recur not much earlier than 2nd or 1st recurrences [14]. Therefore, bactericidal influence and postoperative infection may not be the only postoperative factors modulating long-term recurrence rates [26].

Pilonidal sinus recurrence is understood to be due to the following mechanisms known so far:

1 Incomplete excision of tracts may lead to recurrence, as visualization of the tracts through dye insertion into the tracts before excision leads to a lower recurrence rate.
2 Prolonged incomplete or instable wound healing. Wound tension and extensive mobilization compromising skin perfusion may lead to poor or prolonged healing. Chronic wounds as they heal are more prone to result in unstable scars, with a breach of surface at a later stage with minor trauma. In these patients, it is difficult to distinguish between a repetitive rupture and recurrent disease, as both may be accompanied by the local inflammation and serosanguineous secretion found in recurrent disease [27]. Large excisions of sinus, especially with proximity to the anus, will take an exceptionally longer time to fully close. While the cranial wound part is already healed, the caudal one will not close over months, and the rate of reexcision is elevated. Of course, hair may enter every open wound and insert itself into the subcutaneous tissues, with longer healing leaving more time for hair insertion.
3 New insertion of hair in the midline scar. There is increasing evidence that surgically placing the scar out of the midline leads to a lower recurrence rate, independent of the asymmetrical technique used. Primary midline closure shows the highest long-term recurrence at 20 years following surgery (40%) [11], while asymmetrical treatment is more advantageous [12]. Nevertheless, it is still hard to explain why primary open wound healing shows a much smaller 20-year recurrence rate than primary midline closure, as both have a midline scar. Comparative histologies of both

scar types or tensile skin strength testing have not been done so far.

4 New insertion of hair in the unscarred midline. The depth of the natal cleft predisposes to recurrence, and cleft lifting procedures as proposed by Bascom [for details, see 28] seem to aid healing, although no long-term follow-ups are available yet.

Thus, it is difficult to understand why primary median wound rupture leads to an improvement in recurrence rate, not fully approaching the level of primary open wound treatment. The degree of bacterial colonization should not be different from primary open treatment and is thus highly unlikely to play a pivotal role. There may be several other reasons that may be responsible but have not yet been proven. Primary wound closure intention may hinder surgeons from radically excising all suspicious tissues, as a larger wound is more difficult to close. Thus, unexcised tract remains or hair remnants may be reasons for a slightly higher recurrence rate in secondary open wounds compared to primary open wounds. In two early pilonidal wound revisions we found deep tract remnants histologically proven – and this within 2 weeks following primary surgery. It is highly unlikely that these tracts were generated within 2 weeks without any opening visible at the skin level, thus inadequate excision may have contributed to the recurrence rate.

Since the incidence of PSD is rising while its recurrence rate is falling [8], there may be factors yet unidentified that promote a reduction in the recurrence rate. Uncompromised excision, closure without tension and the avoidance of scars within the midline (where hair may pierce again into the healing skin scar) may contribute to the excellent long-term recurrence rates that asymmetrical and flap procedures are linked to [12] – an effect not seen in tract denaturation with phenol. Frankly speaking, the vast majority of patients are still treated by primary open treatment, as surgeons try to avoid flap procedures. Thus, a major shift in therapy of this surgical generation may not fully explain the effects of the decreasing recurrence rate, even if recent analysis shows that the type of surgery per se is not of major interest for patients. In terms of long-time satisfaction, only recurrence-free survival matters [29].

Our data was derived from the German military medical service and consists of a large population of selected young men aged 23.7 ± 3.9 years (mean ± SD) without essential comorbidities. Thorough documentation and interviewing enabled us to determine recurrences up to 20 years later [7]. Nevertheless, a limitation of our study is the fact that only the cohorts of three military hospitals between 1980 and 1996 are included. However, our complete coverage of the full patient cohort allowed us a very detailed view on recurrence rate-modifying factors such as intraoperative methylene blue use, surgical therapy, familial history/patient age, primary versus recurrent disease, and elective and two-stage versus one-stage procedures [6, 9] and to control for these. Interestingly, recurrence rates of all three military hospitals were identical when comparing mean patient age, usage of methylene blue as a tracer, types of surgical wound treatment and recurrence rates. Another limitation of this study is the retrospective design with its known limitations and setbacks, which we had to accept to gain such long postoperative follow-up periods. For this study, we chose a postoperative period of 7–26 years (mean 15.4 years), as pilonidal recurrence was shown to recur up to more than 5 years postoperatively [7], with probably 75% of recurrences arising within the first 5 years following primary surgery [30]. The 5-year recurrence rate was seen to give an adequate and reliable picture of recurrences in pilonidal sinus and should thus be seen as the gold standard in pilonidal recurrence reporting [31].

Our study confirmed that conversion from a primary midline closure to a secondary open wound treatment led to a wound treatment of 8–12 weeks for complete healing. Compared to partial wound rupture not fully opened, our data point in the direction that an early and full opening of the wound site may be beneficial for the long-term recurrence rate. This remains a future subject to be answered by an adequately tailored prospective study. Concluding, we can reassure primary midline patients with secondary open wound healing that they are not at higher risk for recurrences compared to uneventful primary midline healing. If partial dehiscence occurs, it should be converted into a full wound opening and secondary wound treatment to avoid an unwanted new hair nest formation.

Conclusion

Postoperative pilonidal sinus wound rupture of primary midline closures did not significantly increase the 5- and 10-year long-term recurrence rates compared to uneventful healing primary midline closures. Despite only a short wound closure time experienced before wound rupture, patients did not fully benefit from an open wound treatment in terms of recurrence rate. In primary open wound treatment, the 20-year recurrence rate was much lower than that of primary midline closure

without wound rupture over the same period. Partial dehiscences might need full wound opening and open treatment, as the recurrence rate could be higher with partial wound healing attempts. Further study is needed to clarify this.

Disclosure Statement

The authors have no conflicts of interest to declare.

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