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ORIGINAL ARTICLE

Recurrence-free survival, but not surgical therapy per se, determines 583 patients' long-term satisfaction following primary pilonidal sinus surgery

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Abstract
Purpose With pilonidal sinus disease (PSD) incidence increasing and patients freely choosing their surgeon, patients' interest issues have been brought forward estimating patient satisfaction following pilonidal sinus surgery. The influence of wound healing time and long-term recurrence rate on patient satisfaction in primary PSD surgery has not been investigated yet.
Methods Five hundred eighty-three patients (German military cohort) were interviewed, compiling wound healing time, aesthetic satisfaction, long-term recurrence-free survival and patient satisfaction having undergone primary open (PO) treatment, marsupialization (MARS) or primary midline closure (PMC) treatment. Recurrence rate was determined by Kaplan-Meier calculation following up to 20 years after primary PSD surgery.
Results Patient satisfaction ranking from 1 to 10 (10= max. satisfied) showed an average satisfaction of 8.2 (range 0–10; 95 % confidence interval (CI) 7891–8250). In-hospital stay time was significantly longer in primary open (PO) and marsupialization (MARS) group as compared to primary midline closure (PMC; $p<0.0001$, Kruskal-Wallis test). Satisfaction was comparable between treatment groups, and was neither linked to in-hospital stay time nor to longer outpatient wound care period or total treatment time. Recurrence-free survival, as seen in the PO and PMC treatment group, revealed a highly significant difference for all patients. Improvement in MARS patients with versus without recurrence was low, as satisfaction with primary treatment was lower as the other groups.
Conclusions Neither choice of surgical treatment nor treatment duration within hospital or after hospital influences patient satisfaction, as long as recurrence-free survival can be provided. Marsupialization was ranked lower in both groups (with or without recurrence), and should be abandoned, as patients are significantly less satisfied with either results, independent of recurrence.

Keywords Body mass index · Quality of life · Patient satisfaction · Pilonidal sinus · Recurrence

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Introduction

Pilonidal sinus disease (PSD) is exceptionally rare in Africa and Asia [1] as its incidence is generally higher in Europe and Northern America. We recently had to acknowledge that the incidence of PSD is increasing

because of reasons yet unknown, as suspected earlier by Allen-Mersh [2]: a tenfold increase of PSD within troops of the German Federal Armed Forces can be seen from 0.3/1000 in 1985 to 2.4/1000 in 2007 [3] as well as an increase within the German non-military population from 29/100.000 in 2000 to 48/100.000 in 2012 (age-standardised data) [4]. There may be genetic co-factors, as PSD has shown to have a familial predominance [5]; however, this does not explain the dramatic changes in numbers and treatments applied, as these families are not outgrowing the other population. Even if one might suspect that the typical adolescent onset of disease (due to suspected hair and skin changes in puberty) [6] is responsible for more disease burden, it is for us to realise that the total numbers of adolescents in Germany is decreasing, while the number of treated PSD is rising [7].

Generation Y has a different perspective and self-esteem, and is asking "why" before they accept anything [8–10]. This may also include surgical procedures proposed for their pilonidal sinus disease. They are mobile and interested, and choose their surgeon and their hospital freely. What procedures should we recommend to these young and demanding people? And why?

Excision and primary open wound treatment is widely applied, as it is fast (for the surgeon) and easy to perform (for the surgeon). Asymmetrical closure (ASY) techniques, like "Limberg" or "Karydakis", although proven with a large body of evidence to produce less recurrences [11], seem to be a voodoo science to most of the surgeons. Flaps and plastic surgery are erroneously associated with suspicious perfusion, endless working hours and numerous revisions (by the surgeon) at high costs. The "old" primary midline closure bears a risk of 40 % recurrence rate after 20 years [12]; it can definitely not be recommended to anybody. Do patients accept extended hospital stay? Do they prefer weeks and months of wet wound care? Is an asymmetrical closure advantageously accepted by patients, as associated with an earlier return to work, though in-hospital time is longer (for the patients) and theatre time triples that of leaving the wound open? What therapeutic burden are patients willing to accept? Or do they tolerate easier several surgical procedures for recurrent disease?

What do young PSD patients want? What satisfies them in the perspective of 10 or 20 years to come, following primary surgical therapy for pilonidal sinus disease therapy, and what are their possible key decision reasons?

This study investigates three treatment groups, their in-hospital and outpatient treatment time, aesthetic results as well as the recurrence rates of the treatment groups, and correlates these with the satisfaction the patients expressed in the long-term follow-up.

Patients and methods

All patients with primary PSD admitted to three German Armed Forces Hospitals surgical departments (Hamburg, Bad Zwischenahn, 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). Accuracy of diagnosis was confirmed by correlating theatre notes, referral and discharge letters as well as by the International Classification of Disease code independently by two authors (DD and HS [7]). The definition of acute, chronic and incidental PSD was applied as published before [6].

A total of 1960 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. Five hundred eighty-three patients of these 1960 patients were randomly drawn from a pile of 1960 single paper sheets by DD with one patient name and address per page; these patients were subjected to a telephone interview. The number of patients was chosen to achieve a minimum of $n=$ 200 patients in both primary closure and primary open treatment group. The mean follow-up time was 15.4 years (standard deviation (SD) 3.8 years; range 7–26 years), as pilonidal recurrence was shown to recur up to more than 5 years postoperatively [6], with probably only 22,8 % of recurrences arising within the first 5 years following primary surgery [7]. Every single patient (583 of 583) contacted by telephone gave consent and agreed to take part in the interview.

Patients were interviewed using a standardised checklist and asked to rate their satisfaction on wound healing parameters (in-hospital treatment time, outpatient treatment time, pain on dressings, aesthetic 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 having recurrent disease if

- The surgical wound had completely healed after first surgery
- They had sustained no coccygeal trauma after complete wound closure and
- 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 [12]

All epidemiological data were recorded at time of admission for primary PSD surgery.

Data analysis and statistics

After retrospective analysis, data were expressed as median and interquartile range or mean±standard deviation, eventually, 95 % confidence intervals (CI) (mean±2×standard error of the mean) were added. The Wilcoxon test was used to compare categorical and numeric values of two groups, since assumptions of normal distribution were not met. 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 p value adjustment. These statistical analyses were computed using SPSS 15 (SPSS, Chicago, IL, USA) and R version 3.1.0 (http://www.r-project.org). $p<0.05$ was considered statistically significant. All tests were conducted with two-sided alternative hypothesis.

Factors known to influence recurrence rate in PSD: We did not control for body mass index (BMI) as there is no current proof of BMI being linked to neither higher incidence nor higher recurrence rate following PSD surgery [13–16]. We did not control for any treatment preceding surgery [17], as pre-treatment (incision before definite surgery) were not widely applied during that observation time. We controlled for methylene blue application during surgery [18] which is known to lead to a lower recurrence rate. The surgical technique [2, 19] was analysed. The three treatment groups most often applied during the study period of primary open treatment (PO), primary midline closure (PMC; not used any more today, as recurrence rate is unacceptably high) and marsupialization (MARS) were studied.

Eight patients of primary asymmetrical wound closure and one patient with Z-plasty were studied separately. Sedentary lifestyle and hygiene were not controlled for, as earlier postulates from Buie concerning hygiene and "jeep-driving" don't carry any relevance in pilonidal sinus [20, 21]. Intraoperative gentamycin application and smoking habits were not controlled for, as it's proven to have no influence on recurrence rate [7, 22]. The application of drain(s) was not controlled for, as all primary midline patients received 1–2 suction drains as standard. Thus, treatment was identical within the primary midline closure group [23, 24]. Recently, Milone suggested that there may be no influence of drainage on recurrence rate [25].

Results

Five hundred eighty-three male patients were studied. Most of the patients presented with chronically fistulating, chronically remitting or incidental PSD (Table 1). The surgical procedures applied are depicted in the same table. The most common treatment applied is rhomboid excision and primary open treatment in 349/583 patients (60 % primary open, PO), followed by rhomboid excision and primary closure. The primary closure group comprises of n=192/583 midline closure patients (PMC; 33 %); another 8/583 patients had primary asymmetric excision with their wound/scar kept out of the midline of the wound (ASY; 1 %), and 1/583 Z-plasty was done (0.2 %).

Table 1 Number of treatments and clinical presentation of pilonidal sinus disease

Diagnosis	Marsupialisation	Primary open	Primary closure	Total
Abscess forming PSD	13	143	28	184
Chron. fistulating PSD	1	179	133	313
Chron. remitting PSD	2	5	13	20
Incidental PSD	17	22	27	66
Total	33	349	201	583

Please note that n=201 points. Primary closure group comprises of n=192 primary midline closure patients (PMC), 8 asymmetrical closures (ASY) and 1 Z-plasty

The three largest treatment groups (PO and PMC with 349 and 192 patients) as well as the MARS group (n=33) were analysed in terms of patient satisfaction; 192/574 patients (33.4 %) expressed maximum satisfaction, while 14/574 patients (2.4 %) were completely unsatisfied (scoring 0). Another 227 patients (39.5 %) were satisfied (scoring 8–9), while 1.6 % of patients scored unsatisfied (1–2). Mid scoring of "still satisfied" (6–7) could be seen in 74/574 resp. 12.9 % of patients, while 3.8 % of patients were "still unsatisfied" with 3–4). Between "unsatisfied" and "satisfied" (score 5) was expressed by 5.1 % of patients. Three quarters of all patients (419/574 in categories 8–10; 73 %) were either maximal or most satisfied 7–20 years following primary PSD surgery (Fig. 1). Mean scoring of all patients was 8.1±2.3; 95 % CI 7.9 and 8.3), being located well within the satisfied area.

Figure 2 compares different surgical therapies versus and associated patient satisfaction. All four surgical options are

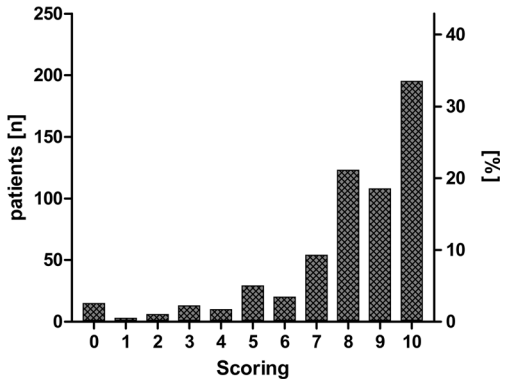

Fig. 1 Long-term patient satisfaction histogram of n=583 patients (10=max. satisfied, while 0=max. dissatisfied)

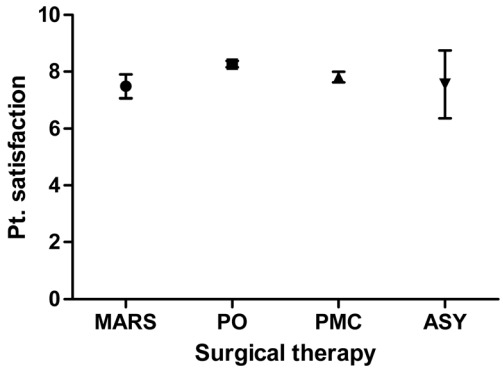

Fig. 2 Surgical therapy and patient satisfaction for treatment groups marsupialization (MARS), excision and primary open treatment (PO), primary midline closure (PMC) and asymmetrical closure (ASY); given as mean±SEM; 10=max. satisfied, while 0=max. dissatisfied

depicted with their ratings. Statistical testing with Kruskal-Wallis shows no difference in rating (p=0.0706). Astonishingly, primary open treatment is ranked with 8.27±2.1 (95 % CI 8.07 and 8.46) best though, despite its known therapeutic length. PMC is following with 7.8±2.6 (95 % CI 7.62 and 8.00) and ASY with 7.6±3.6 (95 % CI 7.36 and 7.75). Marsupialization patients are ranking their long-term satisfaction with 7.5±2.43 (95 % CI 7.29 and 7.67).

To reveal any potential correlation between in-hospital treatment time and patient satisfaction, in-hospital time was analysed. The shortest intervals of around 14 days are seen in the primary closure groups, either midline or asymmetrical closure, that have uneventful wound healing. If wound dehiscence occurs, stay times can be seen between 20 and 28 days, comparable to treatment time of the primary open treatment group. In-hospital time in the marsupialization group was 5.3±2.6 weeks mean; its difference was statistically significant in comparison to all other treatment groups (p<0.0148, pairwise Wilcoxon Test with Holm p value adjustment for multiple testing). Even primary open treatment patients have shorter hospital stay than patients with marsupialization (p=0.0016, pairwise Wilcoxon test with Holm p value adjustment). There is no significant correlation between mean satisfaction level and in-hospital treatment time (Spearman's rho=−0.2492, p=0.4847).

Outpatient treatment time, that can exceed hospital stay time at large, was analysed for the different treatment groups. Average outpatient interval with marsupialization was 14.7±22.8 weeks (95 % CI 6.7 and 22.6; n=33), whereas average interval for primary open treatment was 9.6±13.4 weeks (95 % CI 8.1 and 11.1; n=349). Due to the large spread within wound healing between patients in both groups, statistical tests do not show significance (p=0.1551 Wilcoxon test). If secondary open wound healing is needed following primary closure attempt, this therapy does not exceed the primary open wound treatment time. Any advantage of shorter OPD treatment time for marsupialization as compared to primary open treatment cannot be deduced from this analysis.

The *total* treatment time (sum of in-hospital time and outpatient treatment time, given in weeks) ranged from 2 to 108 weeks. It does not correlate with patient satisfaction (Spearman's rho=−0.0235, p=0.583). A Pearson correlation analysis (Pearson's correlation coefficient=−0.1098, p=0.0102) gave a significant result, but is not feasible, since the assumptions of normally distributed residuals to a linear model are not satisfied (with the satisfaction levels being categorical data).

What factors do influence patient satisfaction, if not time patients need for surgery, wound care or time away from work? Figure 3 displays recurrence status if present/absent and patient scoring. Analysing patient satisfaction and recurrence status, patients without recurrence (n=446) do show significantly higher satisfaction levels (8.49, (95 % CI 8.4, 8.6)) than patients with recurrence (n=137) (6.7, (95 % CI 6.4,7.0)) (p<0.0001, Wilcoxon test).

Analysing the recurrence share within the scoring range patients used 8–22 years following surgery, it can be seen (Fig. 4) that in patients scoring 0–3, there are more than 5 recurrences per 10 patients to be seen. (scoring "1" is beneath that expectation but taken not too seriously as n=3). With increased scoring recurrence rate, share decreases below 0.3 and 0.2 associated with ratings of 8 and above.

Actually, time since surgery has no influence on patient satisfaction in this study, as scoring is stable between mid-term (10 years) and long-term (20 years) follow-up patients (p=0.24, Kruskal-Wallis test; Fig. 5. The overall satisfaction does neither change over the years within the recurrencies group (Spearman's rho=−0.037 p=0.68) nor in the without recurrencies group (Spearman's rho=0.0077, p=0.87). However, patients without recurrencies exhibit higher mean satisfaction levels still years after the operation than patients with recurrencies (p=0.0033, pairwise Wilcoxon test).

Analysing the influence of surgical therapy versus recurrence rate and patient satisfaction, therapies tend to be scored equally if recurrence status is not taken into account (Table 2, right-sided row; total). As marsupialization scores least, primary open treatment scores best (as seen first in Fig. 2).

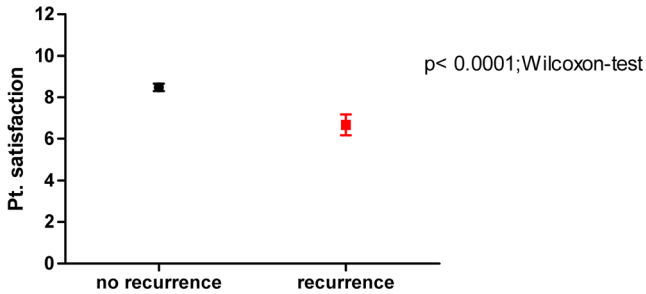

Fig. 3 PSD recurrence status and patient satisfaction; values given as mean±SD

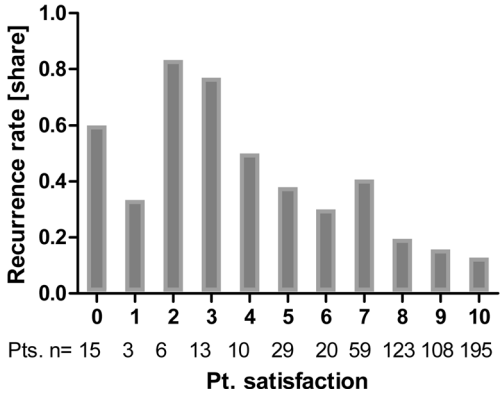

Fig. 4 Percentage of recurrences within patients groups scaling at different satisfaction levels

Table 2 Recurrence status, surgical therapy and related patient satisfaction

Surgery	No recurrence	Recurrence	Total	*p* value*
MARS	7.5±2.4	7.5±2.3	7.5±2.4	0.9659
PO	8.6±1.8	7±2.6	8.3±2.1	<0.0001
PMC	8.5±1.8	6.3±3.2	7.8±2.6	<0.0001
ASY	8.1±3.1	3±0**	7.6±3.4	***
Total	8.5±1.9	6.7±2.9	8.1±2.3	<0.0001

*Wilcoxon test

***n*=1 patient value

***Not enough samples

Comparing the scorings now for recurrence and non-recurrence dependent on the surgical therapy, surgical therapy seems to have no bigger effect *as long the patient experiences any recurrence*. If recurrence occurs, scoring drops more than 20 % in the therapy groups of PO and PMC. Only MARS—with decreased scoring already beforehand—scores the same value, which is still lower than any of the other treatment group totals. This is depicted in Fig. 6.

Patient satisfaction is not influenced by recurrencies in treatment MARS (p=0.89, Wilcoxon test, 8 of 33 cases with recurrence, 25 without). Patient satisfaction is influenced by recurrencies in treatment groups of PO (p<0.0001, Wilcoxon test) and PMC (p<0.0001, Wilcoxon test). With ASY (n=9), there was only one case of recurrence (Z-Plastik); therefore, no statistical test was applied.

Testing for any influence of obesity on satisfaction, satisfaction was evenly distributed amongst the treatment groups. There was no influence of BMI on patient satisfaction independent on recurrence status and therapy (data not shown). BMI and recurrence were without evidence of correlation as shown by Sievert et al. recently [7].

Age at time of surgery does not influence patient satisfaction; while patients younger than 20 years seem to score lower than average (7.4±2.9, compared to average 8.1±2.3) and patients older than 40 seem to score higher (8.9±2.3), only a weak general trend can be deduced from this (Spearman's rho 0.09, p=0.03). Military rank has no significant influence on satisfaction (p=0.22, Kruskal-Wallis test) .

Aesthetic scoring was ranked lowest in MARS patients (6.6±2.7), higher with PO treatment (7.2±2.2) and highest following PMC surgery (7.7±2.2). Nevertheless, all patients scored between 6.5 and 8 for aesthetics, not showing significant impact with low effect (p=0.63, Kruskal-Wallis test).

Pain scores during hospital treatment were 6.0±2.7 in the MARS group, paralleled by pain scorings of 6.1±2.7 in the PO group (p=1, pairwise Wilcoxon test with Holm p value correction). Closed wound treatments were scored 2 points lower at around 4 with PMC at 4.6±2.8 and ASY at 3.9±2, 3. Thus, pain alone is not a reason for lower MARS satisfaction, as pain scoring is equal to the PO group (p=0.115, pairwise Wilcoxon test with Holm p value correction), where patients are much more satisfied. Overall, the pain score between all different groups differ significantly (p<0.0001, Kruskal-Wallis test). Specific significant differences are observed between MARS and PMC (p=0.039, pairwise Wilcoxon test with Holm p value correction), as well as between PO and PMC (p<0.0001, same test).

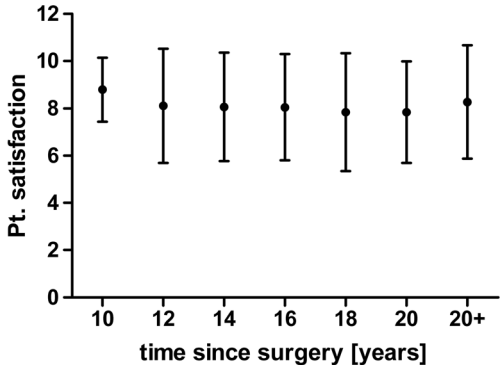

Fig. 5 Patient satisfaction and time since surgery (in years). Please note that observation/interval time since surgery exceeds 20 years

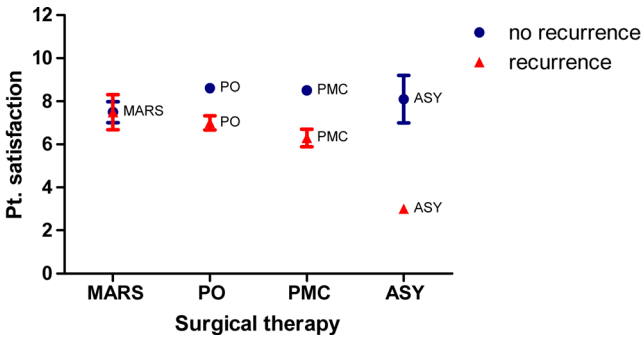

Fig. 6 Patient satisfaction and surgical options studied—this is depicted separately for status of recurrence "no recurrence" with *blue* and "yes, recurrent disease" with *red triangles*

Discussion

The aim of this study was to investigate the influence of wound healing parameters (in-hospital treatment time, outpatient treatment time, pain on dressings, aesthetic impression of healed wound) and choice of surgical treatment (primary open, primary midline and marsupialization therapy) as well as the influence of treatment outcome (long-term recurrence rate) on patient satisfaction. We applied the appropriate statistical tools for various long-term follow-up periods of a cohort with non-normally distributed variables.

We opted for a follow-up between 7 and 28 years after surgery to discover as much recurrences and to discover any time-dependent factors of patient satisfaction if present to achieve the most reliable data possible in this setting. We focused on primary PSD, as previous surgery alters the soft tissues and outcome parameters. We could show that—astonishingly—there is no time-dependent increase in patient satisfaction ("forgetting odd moments"). There is only a smaller than thought satisfaction difference between therapies per se. Patients are equally satisfied if treated primary open or with primary midline closure, if they stay recurrence negative. A pronounced decrease in patient satisfaction is seen due to recurrent disease presentation, as can be found in all main three treatment groups PO, PMC and ASY; MARS treatment scores at a total low independent of surgical outcome.

Thus, long hospital time and longer wound healing time are willingly accepted ex post, if the therapeutic result is absence of recurrent disease. Patients are dissatisfied with the results of any surgical technique, if they experience recurrent disease. Pain during wound treatment and cosmesis has no influence on patient satisfaction in the long term, as long as they are recurrence-free over the next 20 years. In terms of patient satisfaction, we did not see an effect of age at surgery on satisfaction scoring.

With its retrospective design and thus well-known and inherent weaknesses, our study has unavoidable limitations and methodological setbacks, which are inherent if choosing a retrospective design. To study long-term effects 20 years after primary surgery, we opted for a retrospective design—only to finish the study within reasonable time [12, 26]. The telephone interview enabled us to circumvent the 8–12 % alexia/agraphia rate estimated for Germany. As we executed our standardised telephone interview, an acceptance rate of 100 % was possible. This is unusually successful for a surgical procedure from between 1 and 2.5 decades ago.

Asking people about a surgical procedure 7–22 years ago, there is not always full remembrance at hand. Indeed, we did ask them about their judgement of the results of the procedure they experienced, and what remnants or residues they experience at the time of interview. So while recognition of details may sure have been fading, judgement of procedure results does not, which is one of our unexpected study findings.

The military cohort is surely not a fully representative study population though, as multimorbid patients are not seen within in the military. Smoking seems more present in the young, and especially pronounced in the military cohort with two thirds being smokers [7].

The surgical methods applied in this study have been commonly used in civil hospitals in the past as well [19], and seem to be continuously applied in Germany and Denmark and other states [27]. In fact (and unfortunately), flap procedures are still more the exemption than the treatment of rule in PSD disease [28].

Reflecting surgical procedures, technique must change. While primary open treatment is still a good treatment option but decreasing (20 % recurrence rate after 20 years), primary median closure should be fully abandoned, with its recurrence rate of 40 % 20 years after surgery. Marsupialization is obsolete either, as it is too painful and poses no advantage compared to primary open treatment. Flap procedures will be done more often, and these will be done in small hospitals as well. Acute disease will be converted into chronic disease by deroofing the abscess, followed by lower recurrence elective asymmetrical / flap procedures [17]. Razor depilation is obsolete [29], as it produces more split hair, and laser depilation is on the rise [30, 31]. These co-treatments will reduce the recurrence rate already dropping [3], and will consecutively probably enable further patient satisfaction.

Conclusions

Patients choose their surgeon, and they do tolerate a lot. But they will not tolerate a failure of surgical care, especially if this is deducible to surgical decision making.

Following a long-term follow-up of 7–22 years after primary surgery, patient satisfaction was not linked to in-hospital stay time, a longer outpatient wound care period or total treatment time aka early return to work. Pain and aesthetics played a minor role. However, long-term recurrence-free survival, as seen in the PO and PMC treatment group, made a highly significant positive difference for all patients.

Neither choice of surgical treatment or treatment duration within hospital or after hospital bothers the patient satisfaction, as long as recurrence-free survival can be provided. Any and all surgical efforts should thus focus on achieving this goal.

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Authors' contributions Statistical analysis and calculations were done by PK and DD. Manuscript editing and interpretation of data were done by DD, MML, PK and EM. Manuscript writing was done by DD, EM, MML and PK. Graphic design was done by DD, MML and PK. Data acquisition was done by TE and DD.

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