

German national guideline on the management of pilonidal disease

I. Iesalnieks¹ · A. Ommer² · S. Petersen³ · D. Doll⁴ · A. Herold⁵

Received: 16 February 2016 / Accepted: 8 June 2016
© Springer-Verlag Berlin Heidelberg 2016

Abstract

Purpose The present national guideline aims to provide recommendations for physicians involved in the treatment of patients with pilonidal disease. It has been published previously as an extended version in German language.

Methods This is a systemic literature review. The present guideline was reviewed and accepted by an expert panel in a consensus conference.

Results Some of the present guideline conclusions were based on low- to moderate-quality trials. Therefore, an agreement was necessary in those cases to provide recommendations. However, recommendations regarding the most frequently used surgical procedures were based on numerous prospective randomized trials.

Conclusions An asymptomatic pilonidal disease does not require treatment. A pilonidal abscess should be incised. After regression of the acute inflammation, a definitive treatment method should be applied. An excision is the standard treatment method for the chronic pilonidal disease. Open wound healing is associated with a low postoperative morbidity rate; however, it is complicated by a long healing time. The minimally invasive procedures (e.g., pit picking surgery) represent

a potential treatment option for a limited chronic pilonidal disease. However, the recurrence rate is higher compared to open healing. Excision followed by a midline wound closure is associated with a considerable recurrence rate and increased incidence of wound complications and should therefore be abandoned. Off-midline procedures can be adopted as a primary treatment option in chronic pilonidal disease. At present, there is no evidence of any outcome differences between various off-midline procedures. The Limberg flap and the Karydakias flap are most thoroughly analyzed off-midline procedures.

Keywords Pilonidal sinus · Pilonidal disease · Pilonidal abscess · Surgery

Introduction

Despite the numerous publications during the last eight decades, considerable discrepancies in the treatment of patients with pilonidal disease still exist all around the world. Moreover, emergence of new treatment modalities (e.g., laser depilation, video-assisted surgery, various minimally invasive procedures) further complicated the clinical decision process. The present German national guideline summarizes all available evidence and provides recommendations on the most important topics on pilonidal care. To date, only American national guidelines are published in English language.

Methods

The principal literature search utilized the MEDLINE database to identify relevant contributions published between 1945 and March 2013. Medical Subject Headings terms were

✉ I. Iesalnieks
iesalnieks_igors@hotmail.com

¹ Department of Surgery, Städtisches Klinikum München Bogenhausen, Engelschalkinger Str. 77, 81925 Munich, Germany

² End- und Dickdarm-Zentrum Essen, Essen, Germany

³ Department of Surgery, Asklepios-Klinik Altona, Hamburg, Germany

⁴ Department of Surgery, St. Marienhospital Vechta, Vechta, Germany

⁵ End- und Dickdarmzentrum Mannheim, Mannheim, Germany

used, as were accompanying entry terms for patient group, interventions, and outcomes. Key words included “pilonidal*” and “sinus.” The literature search was conducted through the PubMed portal in two stages, (1) at the beginning of the review process in April 2013 (2) and at the end of April 2014 to update data with the most recent prospective randomized studies’ results. Searches were limited to studies published in English and German languages and focusing on human subjects.

Titles and abstracts were screened by individual reviewers to identify potentially relevant articles. Thereafter, full publications were read by two principal reviewers (I.I. and A.O.). Reference lists of all eligible articles were checked for other relevant studies. Relevant papers in German language published in journals not listed in the MEDLINE database after 1990 were included, because the guideline was mainly aimed on medical providers in countries with German language (for detailed description of literature search process, see Fig. 1).

Levels of evidence were assessed according to criteria developed by Centre for Evidence-Based Medicine, Oxford, UK [1], for Therapy/Prevention/Etiology/Harm questions and using GRADE criteria [2]. The graduation of recommendations is illustrated by Fig. 2 and Table 1. The conclusions of the current guideline were approved at the consensus meeting in Munich in April 2014. The consensus meeting was facilitated by Mrs. C. Muche-Borowski from the Association of the Scientific Medical Societies in Germany (Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF)). The AWMF affiliates 173 scientific societies from all specialties of medicine. AWMF represents Germany in the Council for International Organizations of

Medical Sciences (CIOMS) and is authorized to issue national guidelines.

The consensus meeting was attended by all authors of the present manuscript and all relevant representatives of local specialist organizations and societies. Surgical societies—Deutsche Gesellschaft der Koloproktologie (DGK), Berufsverband der Coloproktologen Deutschlands (BCD), Chirurgische Arbeitsgemeinschaft für Coloproktologie (CACP), and der Deutschen Gesellschaft für Allgemein- und Viszeralchirurgie (DGAV)—were represented by all five authors of the present manuscript and by E. Berg, Recklinghausen; D. Bussen, Mannheim; A. Fürst, Regensburg; F. Hetzer, Schaffhausen; T.H. Jacobi, Dresden; G. Osterholzer, Munich; R. Ruppert, Munich; O. Schwandner, Regensburg; M. Sailer, Hamburg; T.H.K. Schiedeck, Ludwigsburg; M. Stoll, Hannover, and B. Strittmatter, Freiburg. The dermatological society—Deutsche Dermatologische Gesellschaft—was represented by B.H. Lenhard, Heidelberg; and C. Breitkopf, Münster. The gastroenterologist society—Deutsche Gesellschaft für Verdauungs- und Stoffwechselkrankheiten—was represented by H. Krammer, Mannheim, and M. Schmidt-Lauber, Oldenburg. The strength of the consensus was defined as demonstrated in Table 2. The guideline was named a “S3-guideline” in German version meaning an “evidence- and consensus-based guideline” as opposed to an S1-guideline meaning “informal consensus” and an S2-guideline meaning a “formal consensus.” The current guideline had been published in 2014 [3] in German language in *coloproctology*. However, it did not appear in any PUBMED-cited journal previously. The present manuscript is a shortened English version of the original German guideline; thus, its content was held as close as possible to the German version.

Fig. 1 Literature search history.

†Interdigital, umbilical, etc.
††Mainly descriptive studies with low level of evidence and without any additions to the body of knowledge at the time of publication

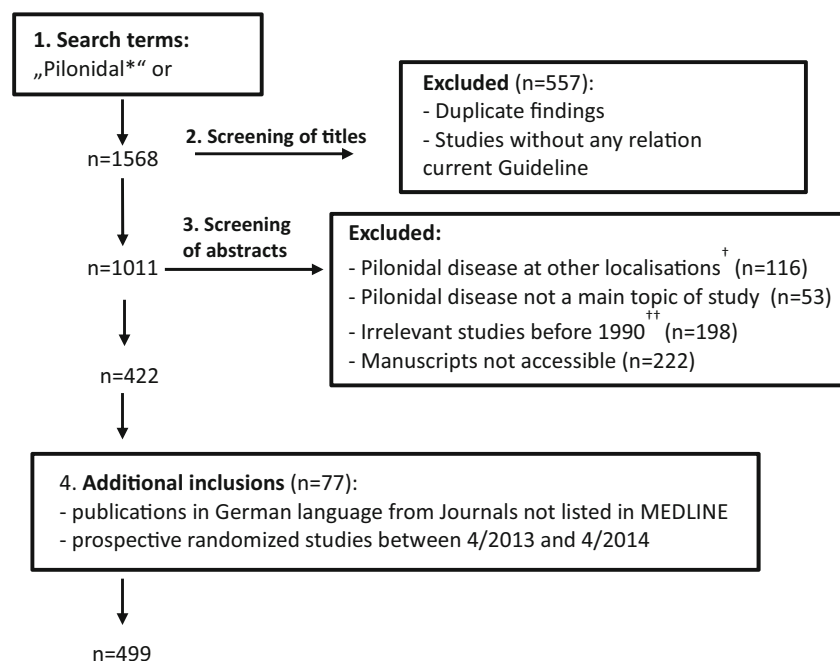
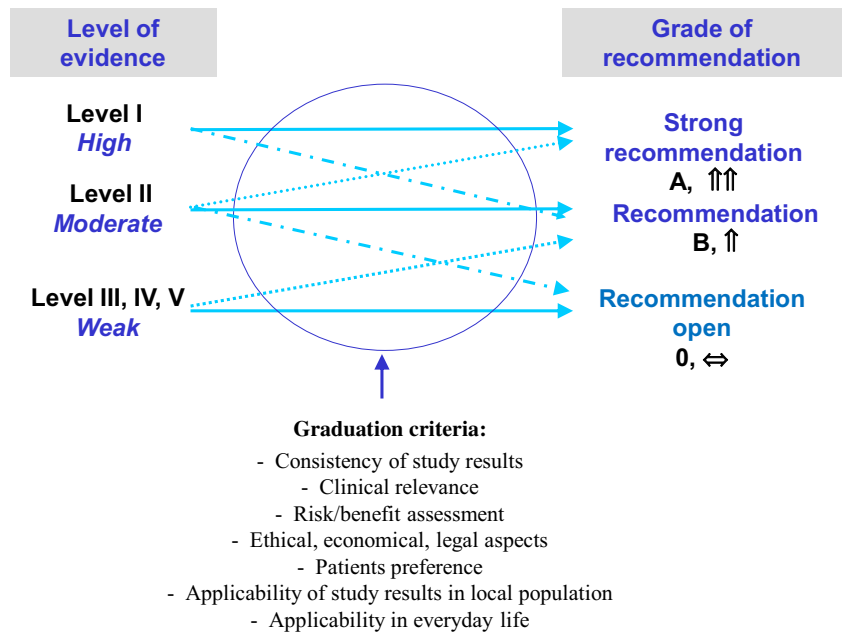


Fig. 2 Transformation process from level of evidence to grade of recommendation.

Recommendations are based not only on the level of evidence of available studies but also on the preferences, applicability, cultural traditions, values, etc.



Treatment of symptomatic and asymptomatic patients

Asymptomatic pilonidal disease is characterized by incidentally detected midline pits causing no complaints to the patient. Treatment of an asymptomatic disease offers no advantages over surgery for symptomatic disease [4] in regard to recurrence rate. Also, no spontaneous disease progression had been observed in a large-scale observational study [5]. Thus, surgery for asymptomatic disease could not be advocated.

Symptomatic disease is unlikely to dissolve spontaneously. Thus, surgery is indicated in symptomatic patients.

Summary and recommendations

Asymptomatic patients should not undergo any treatment. Symptomatic patients should be treated surgically.

Level of evidence: Low.

Consensus strength: Strong consensus.

Acute abscess

Incision and drainage (I+D) is indicated in most cases of acute pilonidal abscess, although a needle aspiration followed by antibiotic treatment had been advocated by some authors [6, 7]. Definitive treatment should be conducted after

regression of local inflammation. A definitive excision could be undertaken at the time of primary treatment in less extended cases. Healing does occur in some cases following I+D [8].

Summary and recommendations

I+D is indicated in most patients with pilonidal abscess.

Level of evidence: Low.

Consensus strength: Strong consensus.

Phenol treatment

Application of liquid or crystallized phenol into the midline pits has been used by some authors to treat pilonidal disease [9–16]. The proposed mechanism of action is a destruction of pit epithelium by phenol [14], thus inducing inflammation and scarring. The treatment could be performed under local anesthesia as outpatient surgery, with reported success rates from 30 to 92 %, although considerable variability in definition of recurrence between studies exists. Patients with pilonidal abscess, purulent discharge, and patients with an extended disease have been excluded by most authors. Also, in some studies [9, 11, 12, 14], the follow-up period did not exceed 2 years. Due to its toxicity [17], treatment by phenol is not allowed by German health authorities (Bundesgesundheitsamt 22.04.1991).

Table 1 Diagram illustrating classification of recommendation

Grade of recommendation	Description	Syntax
A	Strong recommendation	Shall/shall not be done
B	Recommendation	Should/should not be done
0	Recommendation open	Can be considered

Table 2 Definition of consensus strength

Strong consensus	Consent by >95 % of meeting participants
Consensus	Consent by 75–95 % of meeting participants
Majority agreement	Consent by 50–75 % of meeting participants
No consensus	Consent by <50 % of meeting participants

Summary and recommendations

Application of phenol could lead to acceptable healing rates in selected patients. However, the human use of phenol has been banned by German health authorities due to its toxicity.

Level of evidence: Low.

Consensus strength: Strong consensus.

Pit picking

Numerous minimally invasive outpatient procedures to treat pilonidal disease patients have been described since first mention by Lord and Miller 1965 [18]. Despite some variations in technique and discrepant nomenclature, some common features could be identified in all methods: treatment under local anesthesia, removal or destruction of midline pits, and some type of drainage or cleaning of subcutaneous sinus. Each midline pit was excised down to the underlying cavity in the method described by Lord and Miller [18]. The aim was to remove as little normal skin as possible (<1/2 cm to each side of the midline). The subcutaneous cavity was deroofed. No attempt was made to remove the cavity. Hairs were picked by forceps. A similar method was described by J. Bascom 1980 [19] as “follicle removal.” Later, Bascom used the term “pit picking” (www.pilonidal.org) in personal communication. Today, pit picking is the most popular minimally invasive treatment of pilonidal disease in many countries [11, 20–25]. Crucial steps of the procedure are similar to those described by Lord and Millar. The pit picking method has been used by other authors with minimal variations. Gips et al. [26] used trephines instead of knife and cleaned the underlying cavity more intensively. Majeski [24] created a small subcutaneous flap including posterior abscess/sinus boundary to isolate the excised pits from sinus cavity. Olmez [11] used phenol in combination with pit picking.

Significant differences in recurrence definition exist between authors. Also, most reports are retrospective cohort analyses; thus, the true long-term healing rates are difficult to identify. The recurrence rate 1–5 years after surgery is estimated at 20–25 %. The only prospective randomized study was conducted by Nordon [20] and compared pit picking (called “Simple Bascom technique”) to cleft lift. The recurrence rate was 24 % after 36 months of follow-up in pit picking group.

The most important advantages of pit picking and similar techniques are outpatient treatment, quick healing, short convalescence period, and fast return to work (1–3 days in most cases).

Summary and recommendations

Pit picking and its variations could be used in previously untreated patients with minimal disease. The estimated recurrence rate is 20 to 25 %.

Level of evidence: Low.

Consensus strength: Strong consensus.

Grade of recommendation: 0.

Sinusectomy

Sinusectomy was first described by Soll et al. [27] 2008 as “limited excision”. The method was named “sinusectomy” by the same authors in their follow-up study 2011 [28]. The midline pits and sinus are closely excised with the scalpel or scissor following the methylene-marked track. Sinusectomy is performed under local anesthesia in most cases [28]. The main difference to pit picking and its variations is a complete excision of the sinus tract. The main difference to the traditional excision surgery is a close tracing of the tract instead of wide excision. Others have described similar methods under different nomenclature [29–32]; however, there is a considerable scarcity of data given the fact that only few author groups published on the procedure since its first description 2008.

The reported recurrence rates after a follow-up period of 20 to 43 months are promising: 1.6–7 %. The method is limited to patients with less than three pits. Two prospective randomized studies from Egypt [30, 32] compared sinusectomy (“sinus excision”) to traditional excision with or without marsupialization. In one study [32], sinus tracts could not be traced in 13 % of patients, which led to a conversion to wide excision technique. The recurrence rate was 0 % after 10 months in one [30] and 3 % after >15 months in a second [32] study.

Summary and recommendations

Sinusectomy (and similar procedures) is a promising minimally invasive method limited to patients with one to three midline pits. However, there is still a considerable scarcity of data to draw definite conclusions.

Level of evidence: Low.

Consensus strength: Strong consensus.

Excision and open wound healing

Open healing is the method most frequently used in the world, also in Germany. Despite some technical variations, basic steps are similar in most cases: marking sinus tracks by methylene blue followed by a complete excision of all marked tracks leaving an open wound to secondary healing. The method is simple, easy to learn, and reproducible. The main

disadvantage is a time to complete healing of 1.5 to 3 months and a delayed return to work. There is a wide variety in published recurrence rates: from as low as 2–6 % [32–39] to 15–35 % [40–48]. The discrepancies between reported recurrence rates are most likely explained by patient selection (including or excluding previously operated patients) and varying recurrence definitions. The recurrence rates tend to be relatively low if only “a new pilonidal disease after complete wound healing” is considered to be a recurrent disease [49–52]. However, numerous patients undergo repeat surgery for unhealed wounds after excision and open healing. The recurrence rate increases considerably when those cases are included into calculation [53–55]. In most included studies, the follow-up period rarely exceeded 20–36 months. The reported recurrence rates varied between 2 and 21 % in studies with follow-up period of at least 50 months [39, 55].

Numerous randomized studies with a follow-up period of 12 to 36 months compared open healing to midline closure [40, 50, 56, 57] and three compared open healing to off-midline techniques—Z-plasty [34], the Limberg flap [44], and the Karydakis flap [58]. Increased recurrence rate [44, 58], prolonged healing time [34, 58], and delayed return to work [58] were reported after open healing as compared to off-midline procedures. Nevertheless, a Cochrane report by Al-Khamis 2010 [59] did not assert clear advantages of off-midline procedures over open healing. However, studies of Keshavari [58] and Jamal [44] appeared after the Cochrane review was published 2010.

Summary and recommendations

Open healing is still considered to be a “golden standard”¹ in Germany. Prolonged wound healing and delayed return to work as compared to *off-midline* procedures are drawbacks. The method is simple and easy reproducible.

Level of evidence: High.

Grade of recommendation: A.

Consensus strength: Strong consensus.

Marsupialization

Excision and marsupialization were first described by Abramson 1954 [60]. The idea of marsupialization is to reduce the midline defect after sinus excision. The width of the resulting wound left to open healing is 1–2 cm. The reported incidence of the recurrent disease is low—0 to 10 % [47, 61, 62], although the follow-up period was not mentioned in some studies [47, 62]. Time to healing was shown to be 3–4 weeks [63, 64], and the time to return to work 0.5–1.5 months [35, 55, 61]. Three randomized studies compared marsupialization to other

methods—midline closure [65], sinusectomy [30], and the Limberg flap [66]. The recurrence rate after a follow-up period between 10 and 24 months was lower after marsupialization as compared to midline closure, but it was comparable to the Limberg flap. However, there was a faster return to work after the Limberg flap.

Summary and recommendations

Disadvantages of the open healing are not completely eliminated by marsupialization. The consensus group agreed that marsupialization should be abandoned due to postoperative pain and unfavorable cosmetic results.

Level of evidence: Low.

Consensus strength: Strong consensus.

Midline closure

Parallel to open healing, midline closure is the second most frequently used treatment of pilonidal disease worldwide. The surgical technique is a complete excision of methylene blue marked tracks followed by a two-layer midline wound closure. The healing time is shortened significantly as compared to open healing [59]; however, there is a considerable incidence of wound dehiscence ranging between 14 and 74 % [38, 67–78]. Several randomized studies compared midline closure to open healing [40, 50, 56, 57]. The recurrence rate after 12 to 36 months was increased after midline closure in all those studies; however, the difference was statistically significant only in one [40]. Some recent randomized trials compared midline closure to Limberg flap [67, 75, 78–80] demonstrating increased wound dehiscence rate (11–23 % after midline closure vs. 0–15 % after Limberg flap) and recurrence rate (4–45 % vs. 0–4 %) in patients undergoing midline closure. Recent meta-analysis recommended to abandon the midline closure due to frequent wound problems and increased recurrence rate [59].

Summary and recommendations

Midline wound closure should be abandoned due to a high rate of wound dehiscence and high recurrence rate.

Level of evidence: High.

Consensus strength: Strong consensus.

Grade of recommendation: A.

Frequently used off-midline procedures

The term “off-midline procedure” is used for various surgical methods, which all result in a wound closed away from midline. It includes plastic procedures and advancement flaps.

The shift from complete excision as the preferred method to treat pilonidal disease to a change of local healing conditions began after World War II. David H. Patey [81] proposed in 1946: “No longer need such emphasis be laid on the extent of the primary excision. The main emphasis in treatment

¹ The statement “Open healing is golden standard in Germany” was based purely on consensus and not on scientific data. Ninety-three percent of participants of consensus meeting voted to include this sentence despite a lack of data supporting this declaration.

becomes transferred to securing healing of a chronic infective condition.” John Bascom [82] supposed that moisture and anaerobic conditions in the depth of the natal cleft create an environment friendly to bacteria and result in maceration of the epidermis, loss of its natural barrier function, and impaired wound healing. Various techniques aiming at a wound closure away from the depth of the natal cleft have been used since the 1950s [83, 84]. Three off-midline procedures gained the most popularity: the Karydakias flap [85], the Limberg flap [86], and cleft lift [82]. The off-midline procedures avoid the disadvantages of open healing. The recurrence rates 12–36 months following off-midline procedures are reported to range between 0 and 6 % in most publications [20, 41, 79, 87–98]. The incidence of wound complications—mostly seroma and wound dehiscence—varies between 8 and 45 %. In the classic Limberg flap as it was used until the beginning of the new millennium, the lower part of the suture line was placed in the natal cleft leading to wound breakdown and recurrences in some cases. A modification of the procedure was established recently and is used by most authors today. In the modified Limberg flap, the excision is extended laterally 2–2.5 cm to the midline, avoiding any contact of the wound to natal cleft [89, 99, 100].

Off-midline procedures were shown to be associated with better wound healing and lower rates of recurrence than midline closure in the Cochrane Review 2010 [59]. The same meta-analyses demonstrated faster wound healing than after excision and open healing. As mentioned above, recent prospective randomized studies [44, 58] demonstrated significantly reduced recurrence rates after the Karydakias flap and Limberg flap, respectively, compared to open healing. Six randomized studies compared the Karydakias flap to the Limberg flap [89, 96, 101–103]—the recurrence rates were similar for both procedures in five of six studies. The wound healing was better after the Karydakias flap in two studies [89, 96] and after the Limberg flap in two studies [100, 102]. In two studies [89, 103], more patients were satisfied with cosmetic results after the Karydakias flap than after the Limberg flap. Prospective randomized studies comparing cleft lift to the Karydakias flap and Limberg flap are lacking.

Summary and recommendations

Off-midline procedures are associated with lower recurrence rates than midline closure and shorter time to complete wound healing and faster return to work than open healing. There are no significant outcome differences between three most frequently used off-midline procedures—the Karydakias flap, cleft lift, and the Limberg flap. One of these three procedures should be chosen if an off-midline procedure is the desired surgical option. The modified Limberg flap should be preferred over the classic Limberg flap.

Level of evidence: High.

Consensus strength: Strong consensus.

Grade of recommendation: A.

Rarely used off-midline procedures

Numerous other off-midline procedures exist—V-Y-flap [104, 105], Z-plasty [84, 106], the Dufourmentel flap [107, 108], diverse rotational flaps [109–111], etc. The natal cleft is obliterated and the wound lateralized by all methods. The majority of reported results are similar to that after the Karydakias flap, the Limberg flap, and cleft lift. There is a lack of randomized studies, and almost all reports are retrospective series.

Summary and recommendations

Rarely used off-midline procedures play only a limited role in Germany.

Level of evidence: Low.

Consensus strength: Strong consensus.

Method of anesthesia

In a randomized study by Naja [112], 60 pilonidal patients undergoing excision and open healing or excision and midline closure were assigned to receive general or local anesthesia. Patients in the general anesthesia group spent significantly more time in the recovery room than did patients in the local anesthesia group. Sixty-seven percent of the patients in the local anesthesia group were discharged on the day of surgery compared to only 17 % of patients in the general anesthesia group. Pain scores performed during the 3-day follow-up period favored the local anesthetic technique. Authors concluded that local anesthesia is a “successful alternative” to general anesthesia. Schmittner et al. [113] conducted a similar randomized study comparing spinal to general anesthesia in pilonidal patients undergoing excision and open healing. The only differences between both groups were found at the day of surgery: patients in spinal anesthesia group were able to eat and drink earlier by 2–3 h than patients receiving general anesthesia.

Unfortunately, there are no randomized studies comparing different anesthesia techniques in patients undergoing off-midline procedures. Bertelsen [114] reported on 83 patients undergoing cleft lift under local tumescent anesthesia. Conversion to general anesthesia was necessary in only one patient. The time used to infiltrate the area was about 20 min. Ninety percent of patients were discharged at the day of surgery. Nevertheless, the vast majority of authors perform their off-midline procedures under general anesthesia.

Summary and recommendations

There are no significant differences between general or regional anesthesia beyond the immediate perioperative period. Patients’ preference should be taken into account when discussing mode of anesthesia.

Level of evidence: Low.

Consensus strength: Strong consensus.

Antibiotic prophylaxis

Sondenaa et al. [115] conducted a randomized study to assess the efficacy of preoperative prophylactic antibiotics in 51 patients undergoing midline closure. Preoperative one-dose cefoxitin was compared to placebo. The overall wound complication rate was 61 %, and no difference in wound complication rate was observed between antibiotic prophylaxis and placebo. Anaerobic bacteria have been recognized to play a crucial role in wound healing in the gluteal cleft [94]. Unfortunately, authors of the abovementioned randomized trial did not use antibiotics against anaerobic bacteria.

There is a lack of further reliable prospective randomized trials addressing antibiotic prophylaxis. Nevertheless, most authors use a single-dose preoperative prophylaxis containing antibiotics against anaerobic microorganisms [55, 89, 90, 94, 98, 116].

Summary and recommendations

There is a lack of current randomized studies addressing preoperative and/or postoperative antibiotic prophylaxis. A single-dose antibiotic prophylaxis is used by most authors and could be recommended empirically.

Level of evidence: Low.

Consensus strength: Strong consensus.

Table 3 Summary of recommendations

Subject	Recommendation	Level of evidence	Consensus strength	Grade of recommendation
Treatment of symptomatic and asymptomatic patients	Asymptomatic patients should not undergo any treatment. Symptomatic patients should be treated surgically.	Low	Strong	
Acute abscess	Mere incision is preferred for most patients.	Low	Strong	
Treatment by phenol	Phenol is not approved for treatment in human beings in Germany due to presumed toxicity.	Low	Strong	
Pit picking	Pit picking and similar minimally invasive procedures could be used in patients with limited primary disease.	Low	Strong	0
Sinusectomy	A promising minimally invasive procedure, however, the experience is still limited.	Low	Strong	
Excision and open wound healing	Prolonged wound healing and delayed return to work as compared to off-midline procedures. The method is simple and easy reproducible. Thus, open healing should be regarded as standard procedure yet.	High	Strong	A
Marsupialization	Consensus group agreed that marsupialization should be abandoned due to postoperative pain and unfavorable cosmetic results.	Low	Strong	
Midline closure	Midline wound closure should be abandoned due to increased rate of wound dehiscence and high recurrence rate.	High	Strong	A
<i>Off-midline</i> procedures	<i>Off-midline</i> procedures are associated with lower recurrence rate than midline closure and shorter time to complete wound healing and faster return to work than open healing.	High	Strong	A
Rarely used <i>off-midline</i> procedures	There are no significant outcome differences between three most frequently used off-midline procedures—the Karydakis flap, cleft lift, and the Limberg flap. Results of some rarely used off-midline procedures—V-Y flap, the Dufourmental flap, and Z-plasty—are comparable to the Karydakis flap, cleft lift, and the Limberg flap.	Low	Strong	
Method of anesthesia	There are no significant differences between surgeries under general or regional anesthesia beyond immediate peri-procedural period.	Low	Strong	
Antibiotic prophylaxis	A single dose of antibiotic prophylaxis should be given preoperatively.	Low	Strong	
Wound drainage	The present data are inconclusive. Hence, no formal recommendation to the use of wound drainage could be made.	Low	Strong	0
Postoperative hair removal	Postoperative shaving should not be performed. The use of postoperative laser depilation could not be recommended due to a lack of reliable data.	Low	Strong	

Wound drainage

Several prospectively randomized studies addressed the use of subcutaneous drainage in pilonidal patients undergoing various procedures with primary wound closure. Tochhi [117] included 103 patients undergoing midline closure with or without drain. A significant increase of wound complications (42 vs. 6 %) was noted in the no-drainage group. Contrary, in a similar study including 803 patients undergoing midline closure, Milone [118] did not find any difference between groups (11 vs. 9 %). Similarly designed randomized study by Gurer [119] revealed more wound complications in no-drainage group (32 vs. 8 %) in 50 patients undergoing the Karydakis flap. However, a significantly increased rate of wound complications in the drainage-group was noted by Colak [120] in a randomized study including 101 patients undergoing the Limberg flap. Finally, the wound complication rate was similar in 55 patients undergoing the Limberg flap with or without subcutaneous drain in a randomized study by Kirkil [121].

Summary and recommendations

No conclusion regarding use of subcutaneous drainage in patients undergoing wound closure could be drawn from the current data.

Level of evidence: Low.

Consensus strength: Strong consensus.

Grade of recommendation: 0.

Postoperative shaving/depilation

Postoperative shaving or use of a depilatory cream has been advocated by most authors and was the standard of care over the course of many decades [67, 116, 122], although there was a serious lack of strong evidence supporting any long-term hair removal. Moreover, Petersen et al. [123] noted a significantly increased recurrence rate in patients performing razor shaving after pilonidal surgery (midline closure or open healing, $n = 504$) as compared to those who did not (30 vs. 20 %, $p < 0.01$). Some smaller retrospective case series [124–126] showed favorable results adding a depilation by alexandrite laser to pilonidal surgery. However, the only prospective randomized study comparing patients undergoing the Karydakis flap with or without postoperative laser depilation demonstrated significantly increased recurrence rate and higher postoperative pain scores in patients performing laser depilation [127].

Summary and recommendations

Postoperative shaving should not be performed. The use of postoperative laser depilation could not be recommended due to a lack of reliable data.

Level of evidence: Low.

Consensus strength: Strong consensus.

Comments

Open healing or midline closure following the excision of pilonidal disease was the mainstay of pilonidal treatment for several decades. Despite the increasing number of novel surgical and nonsurgical techniques published in the literature, most surgeons in Germany still prefer one of these traditional methods to treat their patients. The aim of the current guideline was to assess the current evidence regarding traditional and newer treatment methods. Unfortunately, the level of evidence on most topics is moderate or low since the vast majority of publications are retrospective case series. Although numerous prospective randomized trials addressing various surgical procedures have been conducted during the last two decades, most of these studies are lacking a power calculation and do not describe allocation concealing. Most prospective randomized trials have been performed in countries with Mediterranean population (Middle East and Southern Europe) questioning the applicability of the results to Western population. Also, there is still a paucity of prospective randomized trials comparing open healing to off-midline closure. Many recommendations of the current guideline were based mainly on agreement since the level of evidence was low with a wide room for interpretation. Thus, open wound healing was not abandoned by current guideline despite growing criticism during the last decades. A summary of the guideline is shown in Table 3.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Research involving human participants and/or animals Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors. Therefore, no informed consent had to be obtained prior to preparation of current manuscript.

References

1. Phillips, B, Ball C, Sackett D, Badenoch D, Straus S, Haynes B, Dawes M (2009) Oxford Centre for Evidence-based medicine—levels of evidence. www.cebm.net/index.aspx?o=1025
2. Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, Guyatt GH, Harbour RT, Haugh MC, Henry D, Hill S, Jaeschke R, Leng G, Liberati A, Magrini N, Mason J, Middleton P, Mrukowicz J, O'Connell D, Oxman AD, Phillips B, Schünemann HJ, Edejer T, Varonen H, Vist GE, Williams JW Jr, Zaza S, GRADE Working Group (2004) Grading quality of evidence and strength of recommendations. *BMJ* 328:1490
3. Ommer A, Berg E, Breikopf C, Bussen D, Doll D, Fürst A, Herold A, Hetzer F, Jacobi TH, Krammer H, Lenhard BH, Osterholzer G, Petersen S, Ruppert R, Schwandner O, Sailer M, Schiedeck THK, Schmidt-Lauber M, Stoll M, Strittmatter B,

- Iesalnieks I (2014) S3-Leitlinie: sinus pilonidalis. *Coloproctology* 36:272–322
4. Doll D, Friederichs J, Boulesteix AL, Düsel W, Fend F, Petersen S (2008) Surgery for asymptomatic pilonidal sinus disease. *Int J Color Dis* 23:839–844
 5. Doll D, Friederichs J, Dettmann H, Boulesteix AL, Duesel W, Petersen S (2008) Time and rate of sinus formation in pilonidal sinus disease. *Int J Color Dis* 23:359–364
 6. Hussain ZI, Aghahoseini A, Alexander D (2012) Converting emergency pilonidal abscess into an elective procedure. *Dis Colon rectum* 55:640–645
 7. Khalil PN, Brand D, Siebeck M, Hallfeldt K, Mutschler W, Kanz KG (2009) Aspiration and injection-based technique for incision and drainage of a sacrococcygeal pilonidal abscess. *J Emerg Med* 36:60–63
 8. Jensen SL, Harling H (1988) Prognosis after simple incision and drainage for a first-episode acute pilonidal abscess. *Br J Surg* 75:60–61
 9. Dogru O, Camci C, Aygen E, Girgin M, Topuz O (2004) Pilonidal sinus treated with crystallized phenol: an eight-year experience. *Dis Colon rectum* 47:1934–1938
 10. Kaymakcioglu N, Yagci G, Simsek A, Unlu A, Tekin OF, Cetiner S, Tufan T (2005) Treatment of pilonidal sinus by phenol application and factors affecting the recurrence. *Tech Coloproctol* 9:21–24
 11. Olmez A, Kayaalp C, Aydin C (2013) Treatment of pilonidal disease by combination of pit excision and phenol application. *Tech Coloproctol* 17:201–206
 12. Aksoy HM, Aksoy B, Egemen D (2010) Effectiveness of topical use of natural polyphenols for the treatment of sacrococcygeal pilonidal sinus disease: a retrospective study including 192 patients. *Eur J Dermatol* 20:476–481
 13. Aygen E, Arslan K, Dogru O, Basbug M, Camci C (2010) Crystallized phenol in nonoperative treatment of previously operated, recurrent pilonidal disease. *Dis Colon rectum* 53:932–935
 14. Kayaalp C, Olmez A, Aydin C, Piskin T, Kahraman L (2010) Investigation of a one-time phenol application for pilonidal disease. *Med Princ Pract* 19:212–215
 15. Kelly SB, Graham WJ (1989) Treatment of pilonidal sinus by phenol injection. *Ulster Med J* 58:56–59
 16. Sakçak I, Avşar FM, Coşgun E (2010) Comparison of the application of low concentration and 80 % phenol solution in pilonidal sinus disease. *JRSM Short Rep* 1:5
 17. Bruce RM, Santodonato J, Neal MW (1987) Summary review of the health effects associated with phenol. *Toxicol Ind Health* 3:535–568
 18. Lord PH, Millar DM (1965) Pilonidal sinus: a simple treatment. *Br J Surg* 52:298–300
 19. Bascom J (1980) Pilonidal disease: origin from follicles of hairs and results of follicle removal as treatment. *Surgery* 87:567–572
 20. Nordon IM, Senapati A, Cripps NP (2009) A prospective randomized controlled trial of simple Bascom's technique versus Bascom's cleft closure for the treatment of chronic pilonidal disease. *Am J Surg* 197:189–192
 21. Senapati A (2003) Failed pilonidal surgery: new paradigm and new operation leading to cures. *Tech Coloproctol* 7:211
 22. Iesalnieks I, Deimel S, Kienle K, Schlitt HJ, Zülke C (2011) Pit-picking surgery for pilonidal disease. *Chirurg* 82:927–931
 23. Colov EP, Bertelsen CA (2011) Short convalescence and minimal pain after out-patient Bascom's pit-pick operation. *Dan Med Bull* 58:A4348
 24. Majeski J, Stroud J (2011) Sacrococcygeal pilonidal disease. *Int Surg* 96:144–147
 25. Maghsoudi H, Nezami N, Ghamari AA (2011) Ambulatory treatment of chronic pilonidal sinuses with lateral incision and primary suture. *Can J Surg* 54:78–82
 26. Gips M, Melki Y, Salem L, Weil R, Sulkes J (2008) Minimal surgery for pilonidal disease using trephines: description of a new technique and long-term outcomes in 1,358 patients. *Dis Colon rectum* 51:1656–1662
 27. Soll C, Hahnloser D, Dindo D, Clavien PA, Hetzer F (2008) A novel approach for treatment of sacrococcygeal pilonidal sinus: less is more. *Int J Color Dis* 23:177–180
 28. Soll C, Dindo D, Steinemann D, Hauffe T, Clavien PA, Hahnloser D (2012) Sinusectomy for primary pilonidal sinus: less is more. *Surgery* 150:996–1001
 29. Kement M, Oncel M, Kurt N, Kaptanoglu L (2006) Sinus excision for the treatment of limited chronic pilonidal disease: results after a medium-term follow-up. *Dis Colon rectum* 49:1758–1762
 30. Oncel M, Kurt N, Kement M, Colak E, Eser M, Uzun H (2002) Excision and marsupialization versus sinus excision for the treatment of limited chronic pilonidal disease: a prospective, randomized trial. *Tech Coloproctol* 6:165–169
 31. Ortiz HH, Marti J, Sitges A (1977) Pilonidal sinus: a claim for simple track incision. *Dis Colon rectum* 20:325–328
 32. Mohamed HA, Kadry I, Adly S (2005) Comparison between three therapeutic modalities for non-complicated pilonidal sinus disease. *Surgeon* 3:73–77
 33. Al-Homoud SJ, Habib ZS, Abdul Jabbar AS, Isbister WH (2001) Management of sacrococcygeal pilonidal disease. *Saudi Med J* 22:762–764
 34. Fazeli MS, Lebaschi AH, Adel MG, Kazemeini AR (2008) Evaluation of the outcome of complete sinus excision with reconstruction of the umbilicus in patients with umbilical pilonidal sinus. *World J Surg* 32:2305–2308
 35. Füzün M, Bakir H, Soylu M, Tansuğ T, Kaymak E, Harfancioğlu O (1994) Which technique for treatment of pilonidal sinus—open or closed? *Dis Colon rectum* 37:1148–1150
 36. McCallum JJ, King PM, Bruce J (2008) Healing by primary closure versus open healing after surgery for pilonidal sinus: systematic review and meta-analysis. *BMJ* 336:868–871
 37. Reboa G, Gipponi M, Testa T, Giannini G, Scala M, Dalla Costa R, Strada P (2007) Regenerative medicine for the definitive surgical repair of pilonidal sinus. A new method of wound reconstruction. *In Vivo* 21:529–534
 38. Søndena K, Andersen E, Søreide JA (1992) Morbidity and short term results in a randomised trial of open compared with closed treatment of chronic pilonidal sinus. *Eur J Surg* 158:351–355
 39. Testini M, Piccinni G, Miniello S, Di Venere B, Lissidini G, Nicolardi V, Bonomo GM (2001) Treatment of chronic pilonidal sinus with local anaesthesia: a randomized trial of closed compared with open technique. *Color Dis* 3:427–430
 40. Al-Hassan HK, Francis IM, Neglén P (1990) Primary closure or secondary granulation after excision of pilonidal sinus? *Acta Chir Scand* 156:695–699
 41. Gendy AS, Glick RD, Hong AR, Dolgin SE, Soffer SZ, Landers H, Herrforth M, Rosen NG (2011) A comparison of the cleft lift procedure vs wide excision and packing for the treatment of pilonidal disease in adolescents. *J Pediatr Surg* 46:1256–1259
 42. Gidwani AL, Murugan K, Nasir A, Brown R (2010) Incise and lay open: an effective procedure for coccygeal pilonidal sinus disease. *Ir J Med Sci* 179:207–210
 43. Iesalnieks I, Agha A, von Breitenbuch P, Schlitt HJ, Fürst A (2006) Chirurgische Behandlung des sinus pilonidalis. *Viszeralchirurgie* 41:399–406
 44. Jamal A, Shamim M, Hashmi F, Qureshi MI (2009) Open excision with secondary healing versus rhomboid excision with Limberg transposition flap in the management of sacrococcygeal pilonidal disease. *J Pak Med Assoc* 59:157–160
 45. Matter I, Kunin J, Schein M, Eldar S (1995) Total excision versus non-resectional methods in the treatment of acute and chronic pilonidal disease. *Br J Surg* 82:752–753

46. Rabie ME, Al Refeidi AA, Al Haizae A, Hilal S, Al Ajmi H, Al Amri AA (2007) Sacrococcygeal pilonidal disease: sinotomy versus excisional surgery, a retrospective study. *ANZ J Surg* 77:177–180
47. Solla JA, Rothenberger DA (1990) Chronic pilonidal disease. An assessment of 150 cases. *Dis Colon rectum* 33:758–761
48. Stansby G, Greatorex R (1989) Phenol treatment of pilonidal sinuses of the natal cleft. *Br J Surg* 76:729–730
49. Greenberg R, Kashtan H, Skornik Y, Werbin N (2004) Treatment of pilonidal sinus disease using fibrin glue as a sealant. *Tech Coloproctol* 8:95–98
50. Al-Salamah SM, Hussain MI, Mirza SM (2007) Excision with or without primary closure for pilonidal sinus disease. *J Pak Med Assoc* 57:388–391
51. Popeskou S, Christoforidis D, Ruffieux C, Demartines N (2011) Wound infection after excision and primary midline closure for pilonidal disease: risk factor analysis to improve patient selection. *World J Surg* 35:206–211
52. Gaston EA, Wilde WL (1965) Epidermoid carcinoma arising in a pilonidal sinus. *Dis Colon rectum* 8:343–348
53. Doll D (2007) Sinotomy versus excisional surgery for pilonidal sinus. *ANZ J Surg* 77:599–600
54. Iesalniaks I, Deimel S, Schlitt HJ (2013) Karydakias flap for recurrent pilonidal disease. *World J Surg* 37:1115–1120
55. Iesalniaks I, Fürst A, Rentsch M, Jauch KW (2003) Erhöhtes Rezidivrisiko nach primärem medianen Wundverschluss bei Patienten mit Pilonidalsinus. *Chirurg* 74:461–468
56. Kronborg O, Christensen K, Zimmermann-Nielsen C (1985) Chronic pilonidal disease: a randomized trial with a complete 3-year follow-up. *Br J Surg* 72:303–304
57. Lorant T, Ribbe I, Mahteme H, Gustafsson UM, Graf W (2011) Sinus excision and primary closure versus laying open in pilonidal disease: a prospective randomized trial. *Dis Colon rectum* 54:300–305
58. Keshvari A, Keramati MR, Fazeli MS, Kazemeini A, Meysamie A, Nouritaromlou MK (2015) Karydakias flap versus excision-only technique in pilonidal disease. *J Surg Res* 198:260–266
59. Al-Khamis A, McCallum I, King PM, Bruce J (2011) Healing by primary versus secondary intention after surgical treatment for pilonidal sinus. *Cochrane Database Syst Rev* :CD006213
60. Abramson DJ, Cox PA (1954) The marsupialization operation for pilonidal cysts and sinuses under local anesthesia with lidocaine; an ambulatory method of treatment. *Ann Surg* 139:341–349
61. Aydede H, Erhan Y, Sakarya A, Kumkumoglu Y (2001) Comparison of three methods in surgical treatment of pilonidal disease. *ANZ J Surg* 71:362–364
62. Ersoy OF, Karaca S, Kayaoglu HA, Ozkan N, Celik A, Ozum T (2007) Comparison of different surgical options in the treatment of pilonidal disease: retrospective analysis of 175 patients. *Kaohsiung J Med Sci* 23:67–70
63. Meban S, Hunter E (1982) Outpatient treatment of pilonidal disease. *Can Med Assoc J* 126:941
64. Watters N, Macdonald IB (1958) Marsupialization of pilonidal sinus and abscess: a report of 50 cases. *Can Med Assoc J* 79:236–240
65. Gencosmanoglu R, Inceoglu R (2005) Modified lay-open (incision, curettage, partial lateral wall excision and marsupialization) versus total excision with primary closure in the treatment of chronic sacrococcygeal pilonidal sinus: a prospective, randomized clinical trial with a complete two-year follow-up. *Int J Color Dis* 20:415–422
66. Karakayali F, Karagulle E, Karabulut Z, Oksuz E, Moray G, Haberal M (2009) Unroofing and marsupialization vs. rhomboid excision and Limberg flap in pilonidal disease: a prospective, randomized, clinical trial. *Dis Colon rectum* 52:496–502
67. Abu Galala KH, Salam IM, Abu Samaan KR, El Ashaal YI, Chandran VP, Sabastian M, Sim AJ (1999) Treatment of pilonidal sinus by primary closure with a transposed rhomboid flap compared with deep suturing: a prospective randomised clinical trial. *Eur J Surg* 165:468–472
68. Baier PK, Baumgartner U, Furtwängler A, Holzinger F, Schöffel U (2002) Therapy of the pilonidal sinus—primary wound closure or open wound after excision. *Zentralbl Chir* 127:310–314
69. Brieler HS (1997) Infected pilonidal sinus. *Langenbecks Arch Chir Suppl Kongressbd* 114:497–500
70. Denkers D, Girona J (1996) Der abszedierte sinus pilonidalis der Steißbeinregion—Möglichkeiten der chirurgischen Versorgung. *Coloproctology* 18:257–259
71. Doll D, Evers T, Matevossian E, Petersen S (2009) Outcome of chronic pilonidal disease treatment after ambulatory plain midline excision and primary suture. *Am J Surg* 197:693–694
72. Dudink R, Veldkamp J, Nienhuijs S, Heemskerk J (2011) Secondary healing versus midline closure and modified Bascom natal cleft lift for pilonidal sinus disease. *Scand J Surg* 100:110–113
73. Holmebakk T, Nesbakken A (2005) Surgery for pilonidal disease. *Scand J Surg* 94:43–46
74. Lee SL, Tejjirian T, Abbas MA (2008) Current management of adolescent pilonidal disease. *J Pediatr Surg* 43:1124–1127
75. Muzi MG, Milito G, Cadeddu F, Nigro C, Andreoli F, Amabile D, Farinon AM (2010) Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg* 200:9–14
76. Muzi MG, Milito G, Nigro C, Cadeddu F, Farinon AM (2009) A modification of primary closure for the treatment of pilonidal disease in day-care setting. *Color Dis* 11:84–88
77. Nursal TZ, Ezer A, Calişkan K, Törer N, Belli S, Moray G (2010) Prospective randomized controlled trial comparing V-Y advancement flap with primary suture methods in pilonidal disease. *Am J Surg* 199:170–177
78. Tavassoli A, Noorshafie S, Nazarzadeh R (2011) Comparison of excision with primary repair versus Limberg flap. *Int J Surg* 9:343–346
79. Akca T, Colak T, Ustunsoy B, Kanik A, Aydin S (2005) Randomized clinical trial comparing primary closure with the Limberg flap in the treatment of primary sacrococcygeal pilonidal disease. *Tech Coloproctol* 92:1081–1084
80. Okuş A, Sevinç B, Karahan O, Eryılmaz MA (2012) Comparison of Limberg flap and tension-free primary closure during pilonidal sinus surgery. *World J Surg* 36:431–435
81. Patey DH, Scarff RW (1946) Pathology of postanal pilonidal sinus; its bearing on treatment. *Lancet* 2:484–486
82. Bascom JU (1987) Repeat pilonidal operations. *Am J Surg* 154:118–122
83. Monro RS (1967) A consideration of some factors in the causation of pilonidal sinus and its treatment by Z-plasty. *Am J Proctol* 18:215–225
84. Monro RS, McDermott FT (1965) The elimination of causal factors in pilonidal sinus treated by Z-plasty. *Br J Surg* 52:177–181
85. Karydakias GE (1973) New approach to the problem of pilonidal sinus. *Lancet* 2:1414–1415
86. Gwynn BR (1986) Use of the rhomboid flap in pilonidal sinus. *Ann R Coll Surg Engl* 68:40–41
87. Akinci OF, Coskun A, Ozgonul A, Terzi A (2006) Surgical treatment of complicated pilonidal disease: limited separate elliptical excision with primary closure. *Color Dis* 8:704–709
88. Bessa SS (2007) Results of the lateral advancing flap operation (modified Karydakias procedure) for the management of pilonidal sinus disease. *Dis Colon rectum* 50:1935–1940
89. Bessa SS (2013) Comparison of short-term results between the modified Karydakias flap and the modified Limberg flap in the

- management of pilonidal sinus disease: a randomized controlled study. *Dis Colon rectum* 56:491–498
90. Kitchen PR (1996) Pilonidal sinus: experience with the Karydakias flap. *Br J Surg* 83:1452–1455
 91. Moran DC, Kavanagh DO, Adhmed I, Regan MC (2011) Excision and primary closure using the Karydakias flap for the treatment of pilonidal disease: outcomes from a single institution. *World J Surg* 35:1803–1808
 92. Morden P, Dronowski RA, Geiger JD, Hirschl RB, Teitelbaum DH (2005) Comparison of Karydakias versus midline excision for treatment of pilonidal sinus disease. *Pediatr Surg Int* 21:793–796
 93. Sözen S, Emir S, Güzel K, Ozdemir CS (2011) Are postoperative drains necessary with the Karydakias flap for treatment of pilonidal sinus? (Can fibrin glue be replaced to drains?) A prospective randomized trial. *Ir J Med Sci* 180:479–482
 94. Bascom J, Bascom T (2002) Failed pilonidal surgery: new paradigm and new operation leading to cures. *Arch Surg* 137:1146–1150
 95. Guner A, Boz A, Ozkan OF, Ileri O, Kece C, Reis E (2013) Limberg flap versus Bascom cleft lift techniques for sacrococcygeal pilonidal sinus: prospective, randomized trial. *World J Surg* 37:2074–2080
 96. Ates M, Dirican A, Sarac M, Aslan A, Colak C (2011) Short and long-term results of the Karydakias flap versus the Limberg flap for treating pilonidal sinus disease: a prospective randomized study. *Am J Surg* 202:568–573
 97. Anderson JH, Yip CO, Nagabhushan JS, Connelly SJ (2008) Day-case Karydakias flap for pilonidal sinus. *Dis Colon rectum* 51:134–138
 98. Cihan A, Ucan BH, Comert M, Cesur A, Cakmak GK, Tascilar O (2006) Superiority of asymmetric modified Limberg flap for surgical treatment of pilonidal disease. *Dis Colon rectum* 49:244–249
 99. Akin M, Leventoglu S, Mentec BB, Bostanci H, Gokbayir H, Kilic K, Ozdemir E, Ferahkose Z (2010) Comparison of the classic Limberg flap and modified Limberg flap in the treatment of pilonidal sinus disease: a retrospective analysis of 416 patients. *Surg Today* 40:757–762
 100. Arslan K, Said Kokcam S, Koksall H, Turan E, Atay A, Dogru O (2014) Which flap method should be preferred for the treatment of pilonidal sinus? A prospective randomized study. *Tech Coloproctol* 18:29–37
 101. Can MF, Sevinc MM, Hancerliogullari O, Yilmaz M, Yagci G (2010) Multicenter prospective randomized trial comparing modified Limberg flap transposition and Karydakias flap reconstruction in patients with sacrococcygeal pilonidal disease. *Am J Surg* 200:318–327
 102. Ersoy E, Devay AO, Aktimur R, Doganay B, Ozdoğan M, Gündoğdu RH (2009) Comparison of the short-term results after Limberg and Karydakias procedures for pilonidal disease: randomized prospective analysis of 100 patients. *Color Dis* 11:705–710
 103. Tokac M, Dumlu EG, Aydin MS, Yalcin A, Kilic M (2015) Comparison of modified Limberg flap and Karydakias flap operations in pilonidal sinus surgery: prospective randomized study. *Int Surg* 100:870–877
 104. Neşşar G, Kayaalp C, Seven C (2004) Elliptical rotation flap for pilonidal sinus. *Am J Surg* 187:300–303
 105. Eryilmaz R, Okan I, Coskun A, Bas G, Sahin M (2009) Surgical treatment of complicated pilonidal sinus with a fasciocutaneous V-Y advancement flap. *Dis Colon rectum* 52:2036–2040
 106. Sharma PP (2006) Multiple Z-plasty in pilonidal sinus—a new technique under local anesthesia. *World J Surg* 30:2261–2265
 107. Lieto E, Castellano P, Pinto M, Zamboli A, Pignatelli C, Galizia G (2010) Dufourmental rhomboid flap in the radical treatment of primary and recurrent sacrococcygeal pilonidal disease. *Dis Colon rectum* 53:1061–1068
 108. Quinodoz PD, Chilcott M, Grolleau JL, Chavoïn JP, Costagliola M (1999) Surgical treatment of sacrococcygeal pilonidal sinus disease by excision and skin flaps: the Toulouse experience. *Eur J Surg* 165:1061–1065
 109. Lahooti M, Taheri PA, Nezami BG, Assa S (2008) Sacrococcygeal pilonidal sinus treated by a new fascio-cutaneous flap. *Dis Colon rectum* 51:588–592
 110. Polat C, Gungor B, Karagul S, Buyukakincak S, Topgul K, Erzurumlu K (2011) Is oval flap reconstruction a good modification for treating pilonidal sinuses? *Am J Surg* 201:192–196
 111. Krand O, Yalt T, Berber I, Kara VM, Tellioglu G (2009) Management of pilonidal sinus disease with oblique excision and bilateral gluteus maximus fascia advancing flap: result of 278 patients. *Dis Colon rectum* 52:1172–1177
 112. Naja MZ, Ziade MF, El Rajab M (2003) Sacrococcygeal local anaesthesia versus general anaesthesia for pilonidal sinus surgery: a prospective randomised trial. *Anaesthesia* 58:1007–1012
 113. Schmittner MD, Dieterich S, Gebhardt V, Weiss C, Burmeister MA, Bussen DG, Viergutz T (2013) Randomised clinical trial of pilonidal sinus operations performed in the prone position under spinal anaesthesia with hyperbaric bupivacaine 0.5 % versus total intravenous anaesthesia. *Int J Color Dis* 28:873–880
 114. Bertelsen CA (2011) Cleft-lift operation for pilonidal sinuses under tumescent local anesthesia: a prospective cohort study of peri- and postoperative pain. *Dis Colon rectum* 54:895–900
 115. Søndena K, Nesvik I, Gullaksen FP, Furnes A, Harbo SO, Weyessa S, Søreide JA (1995) The role of cefoxitin prophylaxis in chronic pilonidal sinus treated with excision and primary suture. *J Am Coll Surg* 180:157–160
 116. Mahdy T (2008) Surgical treatment of the pilonidal disease: primary closure or flap reconstruction after excision. *Dis Colon rectum* 51:1816–1822
 117. Tocchi A, Mazzoni G, Bononi M, Fornasari V, Miccini M, Drumo A, Colace L (2008) Outcome of chronic pilonidal disease treatment after ambulatory plain midline excision and primary suture. *Am J Surg* 196:28–33
 118. Milone M, Musella M, Salvatore G, Leongito M, Milone F (2011) Effectiveness of a drain in surgical treatment of sacrococcygeal pilonidal disease. Results of a randomized and controlled clinical trial on 803 consecutive patients. *Int J Color Dis* 26:1601–1607
 119. Gurer A, Gomceli I, Ozdogan M, Ozlem N, Sozen S, Aydin R (2005) Is routine cavity drainage necessary in Karydakias flap operation? A prospective, randomized trial. *Dis Colon rectum* 48:1797–1799
 120. Colak T, Turkmenoglu O, Dag A, Akca T, Aydin S (2010) A randomized clinical study evaluating the need for drainage after Limberg flap for pilonidal sinus. *J Surg Res* 158:127–131
 121. Kirkil C, Büyük A, Bülbüller N, Aygen E, Karabulut K, Coşkun S (2011) The effects of drainage on the rates of early wound complications and recurrences after Limberg flap reconstruction in patients with pilonidal disease. *Tech Coloproctol* 15:425–429
 122. Eryilmaz R, Sahin M, Alimoglu O, Dasiran F (2003) Surgical treatment of sacrococcygeal pilonidal sinus with the Limberg transposition flap. *Surgery* 134:745–749
 123. Petersen S, Wietelmann K, Evers T, Hüser N, Matevossian E, Doll D (2009) Long-term effects of postoperative razor epilation in pilonidal sinus disease. *Dis Colon rectum* 52:131–134
 124. Conroy FJ, Kandamany N, Mahaffey PJ (2008) Laser depilation and hygiene: preventing recurrent pilonidal sinus disease. *J Plast Reconstr Aesthet Surg* 61:1069–1072
 125. Ganjoo A (2011) Laser hair reduction for pilonidal sinus—my experience. *J Cutan Aesthet Surg* 4:196
 126. Oram Y, Kahraman F, Karıncaoğlu Y, Koyuncu E (2010) Evaluation of 60 patients with pilonidal sinus treated with laser epilation after surgery. *Dermatol Surg* 36:88–91
 127. Demircan F, Akbulut S, Yavuz R, Agtas H, Karabulut K, Yagmur Y (2015) The effect of laser epilation on recurrence and satisfaction in patients with sacrococcygeal pilonidal disease: a prospective randomized controlled trial. *Int J Clin Exp Med* 8:2929–2933