

Completeness of excision as a measure to prevent pilonidal sinus recurrence

Rakić VS¹, Jovanić I²

ORIGINAL RESEARCH

(1) Clinic for plastic and reconstructive surgery "Estetika Rakic". Ustanicka Street No. 10/2, Belgrade, Serbia.
(2) "Suprema lab" Patohistological diagnostics. Kneza Milosa Street No. 80, Belgrade, Serbia.

Vesna S. Rakić M.D. PhD, Irena Jovanić M.D.

Corresponding author: Vesna S. Rakic MD. Ustanicka Street No. 10/2, Belgrade, Serbia.

rakicdrvesna@gmail.com

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ABSTRACT

Background: There are numerous papers on Pilonidal Sinus (PS) detailing uncertainties regarding its etiology, pathogenesis, diagnosis, pathohistology analysis, and treatment.

Methods: Our goal is to use a retrospective and prospective study to determine the necessity of a routine pathohistological (PH) analysis to demonstrate whether Pilonidal Sinus was completely excised, if the wound can be primarily closed and whether recurrence would be prevented. Criteria for radically removed PS: no components of the disease detected at the specimen margins. Each wound was primarily closed with a local fasciocutaneous flap.

Results: Clinical characteristics of 71 patients suffering from PS were examined. We performed a pathohistological analysis of Pilonidal Sinus specimens and measured the dimensions of the tissue specimens containing the sinus components: 1) pathological embedded follicles over 4mm deep, 2) hair shafts, 3) cysts, 4) squamous epithelium or 5) pits "sacral dimple". There was no recurrence during the 2-7 year follow-up period.

Conclusions: Surgically excised Pilonidal Sinus specimens should include the skin and subcutaneous tissue with superficial fascia, to the muscle fascia with all pathological tissue. A continuous incision should be made from the tip of the coccyx, including all dimples and navicular region of the sinus. Complete excision does not affect the recurrence rate.

Key words: pilonidal sinus, pathohistology, pits, recurrence

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INTRODUCTION

Pilonidal Sinus (PS) is a purulent skin inflammatory process containing hair which occurs predominantly in the natural intergluteal cleft. It is not a common disease (0.04% newly detected cases annually in Germany, 0.02% in England) [1,2]. It is a benign disease, "small surgical pathology", but painful and uncomfortable, which causes absence from work and significantly affects the quality of life of young patients. In addition, recurrence following surgical procedures is reported from 2.6% to even 30% [3,4]. In one series, primary midline closure was associated with recurrence rate of 67.9% after 240 months [5].

PS is a controversial disease where some advocate the idea of it being congenital (incomplete skin fusion in the early embryonic period e.g. Fere 1878), whereas others consider it to be an acquired disease (contributed to by prolonged sitting, obesity and hairiness) [6]. Surgery is the main treatment strategy: the shape of incision is most often vertical or elliptical [2] with and without defect reconstruction [7,8,9].

Retentive folliculitis may be the primary cause of this disease [10]. The pathological process may be triggered by follicular occlusion occurring in the region where apocrine glands are located [11]. PS may appear as one of the conditions within the "follicular occlusion tetrad" which also includes hidradenitis suppurativa, acne conglobata and dissecting cellulitis of the scalp.

Some surgeons suggest routine pathohistological (PH) analysis is not required [2,12,13] since malignant alteration of PS is very rare (less than 100 have been reported). We believe that PH analysis represents a necessary part of this operation. PH analysis for any surgically removed skin lesion is not necessary only to prove or exclude the diagnosis of malignancy. Its purpose is often to determine the boundaries of the benign lesion, to confirm the completeness of excision and to detect systemic disease.

Pathohistological analysis in case of this disease is required for following reasons: a) confirm the completeness of excision; b) suitability for primary wound closure; c) avoid healing by secondary intention; d) further follow-up of the disease; e) for the course of treatment and making a possible decision on subsequent surgery; and f) to establish treatment protocols.

METHODS

This retrospective study assessed the necessity of routine PH demonstration of complete PS excision in determining whether the wound can be primarily closed and whether recurrence could be prevented. Criteria for complete PS excision: no disease detected at the specimen margins. Presence of PS components was determined: 1) pathological embedded follicles over 4mm deep, 2) hair shafts, 3) cysts, 4) squamous epithelium or 5) pits "sacral dimple".

Each wound was primarily closed with a local fasciocutaneous flap (advancement, transposition, rotation).

Each patient underwent training on how to bathe with liquid shampoo and water, defecate in a semi-squatting position, maintain hygiene diligently, spray the wound with Octenisept and constantly keep it dry, place sterile gauze on the wound to cover the wound and surrounding region. Sitting and sleeping on their back and bending to the floor were forbidden for 2 weeks while heavy physical work for 4 weeks. Patients were trained to use the assistance of another person when bathing and changing clothes.

RESULTS

During the period between 2014 and 2018, we operated on 71 patients ranging in age from 15 to 46 years, 68% aged 21-35 years. The male to female ratio was 9:1 (Table 1).

| CLINICAL FEATURES OF SINUS PILONIDALIS | | | | | PATHOLOGICAL FEATURES OF SPECIMENS | | | | | | | PATHOLOGICAL STRUCTURES BELOW THE PITS (mm) | | | | |
|--|--------|-----|---------------|--------------|------------------------------------|----|----|-----------|------------|------------|------|---|----------|------|------------|----------------------|
| Case | Gender | Age | Duration/mons | Previous op. | R1 | R2 | R3 | Margins | Epithelium | Hair foll. | Cyst | Pits | Follicle | Cyst | Hair foll. | Dept of normal foll. |
| 1 | M | 29 | 144 | 0 | 95 | 30 | 22 | scar/inf. | yes | / | | 5 | / | 13 | / | 1.5 |
| 2 | M | 27 | 6 | 0 | 60 | 20 | 24 | close | / | yes | | 5 | / | / | / | 1.5 |
| 3 | M | 46 | 48 | 0 | 70 | 13 | 15 | scar/inf. | / | / | yes | 0 | / | 5 | / | 2 |
| 4 | M | 36 | 36 | 0 | 55 | 40 | 13 | no | yes | yes | yes | 0 | / | / | / | 2.5 |
| 5 | M | 29 | 2 | 0 | 50 | 37 | 25 | no | yes | yes | yes | 2 | / | / | / | 3.5 |
| 6 | M | 34 | 48 | 0 | 100 | 17 | 34 | scar/inf. | yes | / | | 3 | / | 9 | / | 2 |
| 7 | M | 23 | 1 | 0 | 63 | 10 | 25 | no | yes | yes | yes | 2.5 | / | / | / | 3 |
| 8 | M | 19 | 48 | 0 | 60 | 40 | 24 | no | yes | yes | | 3 | 7 | / | / | 1 |
| 9 | M | 29 | 24 | 0 | 60 | 8 | 22 | no | / | yes | | 2.5 | / | / | / | 2.5 |
| 10 | M | 36 | 24 | 0 | 32 | 15 | 17 | no | yes | yes | | 5 | / | / | 6 | 1.5 |
| 11 | M | 40 | 144 | 0 | 110 | 50 | 25 | scar/inf. | yes | / | | 11 | / | / | / | 1 |
| 12 | M | 40 | 36 | 0 | 85 | 30 | 14 | no | yes | yes | | 1.5 | / | 4.5 | / | 1.5 |
| 13 | F | 17 | 1 | 0 | 35 | 25 | 22 | close | yes | yes | | 2 | / | / | / | 1.5 |
| 14 | M | 16 | 2 | 0 | 60 | 25 | 22 | no | yes | yes | yes | 4 | / | 8 | 8 | 1 |
| 15 | M | 21 | 60 | 0 | 58 | 25 | 23 | close | yes | yes | | 2.5 | / | 9 | / | 1 |
| 16 | M | 23 | 12 | 0 | 80 | 50 | 27 | scar/inf. | yes | yes | | 7 | 8 | 9 | / | 4 |
| 17 | M | 27 | 120 | 0 | 140 | 30 | 15 | scar/inf. | / | yes | | 7 | / | / | / | 2.5 |
| 18 | M | 33 | 5 | 0 | 80 | 16 | 22 | no | yes | yes | yes | 3.5 | / | / | 4.5 | 1.5 |
| 19 | M | 33 | 24 | 0 | 93 | 22 | 14 | no | yes | / | yes | 6 | / | / | / | / |
| 20 | M | 29 | 60 | 0 | 95 | 35 | 17 | close | yes | yes | | 3.5 | / | 9 | / | 2 |
| 21 | M | 33 | 60 | 0 | 100 | 35 | 22 | scar/inf. | yes | / | | 4 | / | 7.5 | / | 1 |
| 22 | M | 22 | 2 | 0 | 47 | 13 | 15 | scar/inf. | yes | yes | | 3 | / | 4 | / | 2 |
| 23 | M | 44 | 120 | 0 | 60 | 23 | 20 | scar/inf. | yes | yes | yes | 0 | / | / | / | / |
| 24 | F | 37 | 12 | 0 | 57 | 11 | 18 | no | yes | yes | yes | 3.5 | 4.5 | 5 | / | 2.5 |
| 25 | M | 31 | 96 | 0 | 90 | 50 | 16 | no | yes | yes | | 11 | / | 5 | 6 | 3 |
| 26 | M | 26 | 72 | 0 | 44 | 15 | 22 | no | / | yes | | 4.5 | / | / | / | 3.5 |
| 27 | M | 41 | 1 | 0 | 43 | 27 | 16 | no | / | yes | | 5 | / | / | / | 1.5 |
| 28 | M | 35 | 1 | 0 | 47 | 28 | 24 | no | yes | yes | yes | 4 | / | 6 | / | 1 |
| 29 | M | 19 | 1 | 0 | 45 | 35 | 24 | close | yes | yes | | 5 | / | 10 | / | 1.5 |
| 30 | M | 26 | 24 | 0 | 95 | 33 | 18 | yes | / | yes | | 4 | / | / | / | 3 |
| 31 | M | 26 | 1 | 0 | 47 | 23 | 19 | no | yes | / | | 0 | / | / | / | / |
| 32 | M | 16 | 3 | 0 | 55 | 27 | 19 | no | / | yes | | 2 | / | / | / | 2 |
| 33 | M | 37 | 36 | 0 | 67 | 35 | 17 | no | / | yes | | 5 | / | / | 7 | 1 |
| 34 | F | 35 | 180 | 0 | 70 | 47 | 27 | no | / | / | | 5 | / | / | / | 1 |
| 35 | M | 26 | 1 | 0 | 65 | 25 | 22 | no | / | yes | | 4 | 5 | / | 5 | 4 |
| 36 | M | 21 | 3 | 0 | 75 | 20 | 18 | no | yes | yes | yes | 4 | 8 | / | 5 | 3 |
| 37 | M | 36 | 6 | 0 | 65 | 22 | 20 | no | / | yes | | 3 | / | / | 4 | 2 |
| 38 | F | 28 | 12 | 0 | 60 | 31 | 27 | no | / | / | yes | 8 | / | / | 9 | 2 |
| 39 | M | 31 | 12 | 0 | 120 | 32 | 26 | no | / | yes | yes | 5 | 6 | / | 6 | 4 |
| 40 | M | 23 | 12 | 0 | 120 | 50 | 36 | no | yes | yes | yes | 11 | 6 | 17 | 16 | 4 |
| 41 | M | 40 | 1 | 0 | 80 | 20 | 20 | no | / | / | yes | 5 | / | / | 6 | 2 |
| 42 | M | 18 | 1 | 0 | 75 | 30 | 23 | no | yes | / | yes | 10 | 11 | / | 12 | 2.5 |
| 43 | M | 27 | 36 | 0 | 90 | 30 | 27 | no | / | / | yes | 9 | 10 | / | 10 | 2.5 |
| 44 | M | 34 | 24 | 0 | 90 | 18 | 20 | no | / | / | yes | 5 | / | 13 | 14 | 4 |
| 45 | M | 26 | 12 | 0 | 80 | 30 | 27 | no | / | / | yes | 9 | / | / | 10 | 3 |
| 46 | F | 29 | 30 | 0 | 68 | 30 | 15 | no | yes | / | yes | 4 | / | / | / | 2.5 |
| 47 | F | 29 | 72 | 0 | 115 | 37 | 34 | no | yes | yes | yes | 5 | 6 | / | 6 | 2 |
| 48 | M | 30 | 84 | 0 | 110 | 50 | 83 | no | yes | yes | yes | 9 | 8 | 8 | 8 | 3 |
| 49 | M | 20 | 30 | 0 | 85 | 29 | 28 | no | / | yes | yes | 7 | / | 8 | 8 | 2 |
| 50 | M | 15 | 20 | 0 | 85 | 35 | 23 | no | yes | yes | yes | 9 | / | / | 10 | 3 |
| 51 | M | 19 | 24 | 1 | 108 | 35 | 29 | no | / | yes | / | 12 | / | / | 13 | 2 |
| 52 | M | 27 | 24 | 2 | 62 | 20 | 18 | scar/inf. | / | yes | / | 6 | / | / | / | 1 |
| 53 | M | 27 | 48 | 3 | 85 | 15 | 17 | scar/inf. | / | yes | / | 0 | / | / | / | / |
| 54 | M | 27 | 12 | 1 | 115 | 37 | 30 | no | / | / | / | 9 | / | / | 10 | 2 |
| 55 | F | 29 | 132 | 2 | 75 | 15 | 22 | no | / | yes | / | 8 | 6 | / | / | 2 |
| 56 | M | 30 | 60 | 1 | 50 | 28 | 24 | no | yes | yes | / | 2 | / | / | / | 2.5 |
| 57 | M | 27 | 12 | 1 | 120 | 50 | 42 | no | yes | yes | / | 0 | / | / | / | / |
| 58 | M | 27 | 2 | 1 | 100 | 18 | 15 | no | / | yes | / | 7 | / | / | / | / |
| 59 | M | 40 | 6 | 2 | 48 | 25 | 27 | no | / | / | / | 7 | / | / | / | / |
| 60 | M | 28 | 15 | 10 | 70 | 10 | 22 | no | yes | yes | t | 5 | / | / | / | 2 |
| 61 | M | 40 | 24 | 2 | 110 | 17 | 28 | no | yes | yes | yes | 13 | / | 28 | 8 | 4 |
| 62 | M | 44 | 48 | 1 | 65 | 25 | 21 | no | / | yes | / | 10 | / | / | 11 | 3 |
| 63 | M | 21 | 12 | 1 | 60 | 31 | 18 | no | / | yes | / | / | / | / | / | / |
| 64 | M | 30 | 60 | 2 | 90 | 25 | 35 | no | yes | yes | yes | 0 | / | / | / | / |
| 65 | M | 33 | 12 | 1 | 40 | 25 | 17 | no | / | yes | / | 0 | / | / | / | / |
| 66 | M | 34 | 12 | 1 | 95 | 26 | 22 | no | yes | yes | / | 0 | / | / | / | / |
| 67 | M | 44 | 120 | 3 | 58 | 42 | 37 | no | yes | yes | / | 8 | / | / | / | 1.5 |
| 68 | M | 23 | 36 | 4 | 60 | 45 | 42 | no | / | / | / | 0 | / | / | / | / |
| 69 | M | 27 | 12 | 2 | 45 | 42 | 20 | scar/inf. | yes | yes | yes | 0 | / | / | / | / |
| 70 | M | 23 | 12 | 1 | 62 | 8 | 17 | close | / | yes | / | 6 | / | / | / | 2.5 |
| 71 | M | 31 | 12 | 5 | 155 | 90 | 25 | scar/inf. | yes | yes | / | 0 | / | 12 | / | 2 |

Table 1. Clinical and Pathological features of PS specimens

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Twenty (28%) of our patients had previously had 1 to 10 PS operations (3.3 operations on average) whereas 72% (51) had never had PS surgery. Up until the arrival to our clinic, pilonidal disease had lasted from 1 month to 15 years. PH analysis was performed in all patients.

Operations were mainly performed as one-day surgical interventions, under local anesthesia and analgesia. Reconstruction of the defect with a local fasciocutaneous flap was routinely performed. Interventions lasted between 30 and 65 minutes and they required no more than a two-hour postoperative hospital recovery. Absorbable 1-0, 3-0 and individual non-absorbable sutures 2-0 or 3-0 were used. General anesthesia, drainage, and 24-hour hospitalization were applied in 10 out of 71 patients, where surgical interventions lasted between 2 and 3 hours.

Complications are presented in the Table 3. No recurrence was observed during the follow-up period of 2 to 7 years.

| Complications | Number of patients | % |
|--|--------------------|------|
| Bleeding | 0 | 0 |
| Infection | 0 | 0 |
| Recurrence | 0 | 0 |
| Seroma | 2 | 2.8 |
| Prolonged healing in advancement flaps | 11 | 15.4 |
| Partial necrosis of the flap | 2 | 2.8 |
| Reoperation | 0 | 0 |

Table 2. Post-operative complications

Pathohistological results:

1. Specimen shape was in most cases elliptical in the distal region (caudal), and of variable shape in the proximal (cranial) region, depending on the width of the skin and subcutaneous tissue section affected by the process (Figure 1a).
2. Specimen structure: it includes the skin and entire subcutaneous tissue with superficial fascia to the muscle fascia with pathological structures which constitute the pilonidal sinus in continuity. We always removed the midline since it was assumed that pathological structures were located along the midline deep to the pits and sinuses (Figure 1e).
3. Specimen dimensions: R1 – the length of the specimen from the tip of the coccyx to the navicular region of the sinus 32mm-155mm, 76mm on average; R2 – the width of the specimen including the intergluteal line, 10 mm-80mm, 30mm on average; and R3 – the thickness of the specimen from the epidermal-dermal line to the gluteal muscle fascia, 14-83mm, 24mm on average (Figure 1a).

4. Pathohistological structures in subcutaneous tissue in 71 specimens (Table 1). Pathological content refers to the presence of one or more structures in the subcutaneous tissue: pilonidal cyst, hair follicles, hair shaft, squamous epithelium, or pits in the intergluteal line.

86% of patients underwent surgery performed as one-day surgical procedures.

While many patient follow-up reports show follow-up processes lasting about one year (7), no recurrence was observed in this series during 2-7 years follow-up. Prolonged healing along the centerline of the incision was observed in 11 patients (15%) attributed to poor hygiene, damp conditions, and failure to perform epilation as recommended (Figure 3). In case of these patients, it can be confirmed that there was no recurrence because PH analysis showed that the sinus was completely excised. In these cases, wounds healed within 4 weeks.

The incision distance from the centre, intergluteal line, where the process was located, was taken as an important measure of radicality, together with the appearance of skin lesions and palpation, where the tissue was hard due to chronic inflammation and fibrosis. Despite the large size of the specimen, scarring or inflammation in the resection line was found in 28% of cases (distance from the intergluteal line was ½ of 13, 13, 15, 17, 20, 23, 30, 35, 42, 50, 50, 80, 90 mm), there were no recurrences in this group. In a further 8.6% of specimens, the pathological content was at the distance less than 1 mm (the distance from the intergluteal line ½ from 8 mm, 20, 25, 25, 35, 35). This data raises the question of whether small, sparing resections can be effective in the long run.

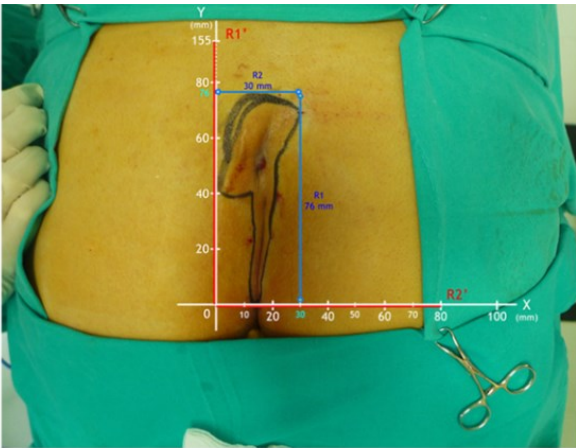


Figure 1a

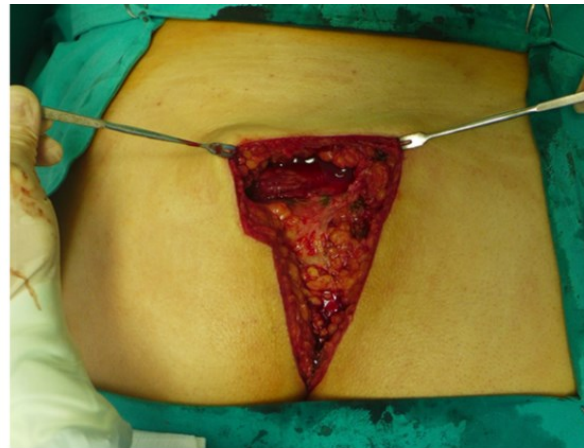


Figure 1b



Figure 1c



Figure 1d

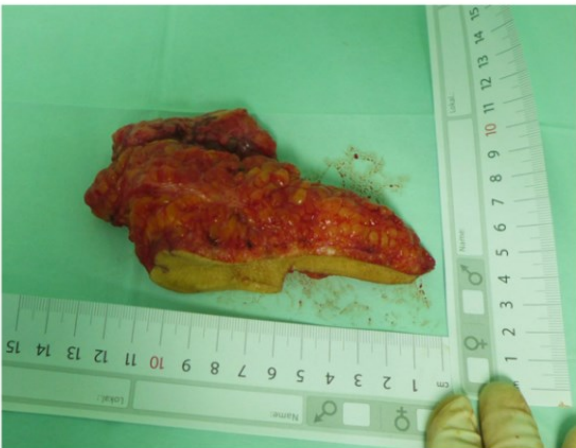


Figure 1e



Figure 1f

Figure 1 (a-f) Pilonidal sinus surgical features

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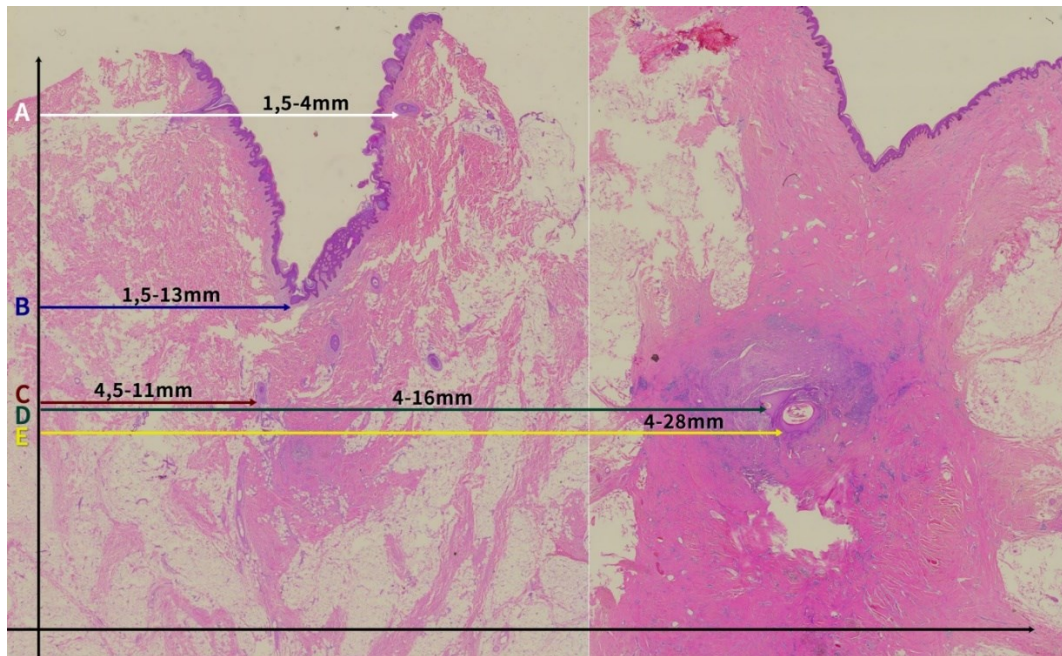


Figure 2 Depth of histopathological structures from the epidermal-dermal line to their base: a) normal follicle depth; b) depth of the pits; c) depth of the follicles underneath the pits; d) depth of cysts; e) hair shafts underneath the pits



Figure 3 Postoperative appearance

Pathological structures and their depth (follicles, squamous epithelium, hair shafts, cysts and pits) were also assessed. First of all, midline pits had all characteristics of the normal skin, all skin layers, and normally embedded follicles touching the hypoderm whose base was at 1.5-4mm away from the epidermal-dermal line. We inferred that these pits were congenital since they did not have any characteristics of the skin altered by any pathological process. Then we noticed the connection between the folds and the deeply embedded follicles which were once whole, intact by the inflammation (12 follicles), sometimes ruptured. The intact follicles underneath the intact skin of the pits could be encountered at the depth of 4.5-11mm. If we sum up the depth of the pits and the depth of normal follicles underneath such pits, it can be inferred that the depth of these follicles measured from the skin surface was significant, i.e. from 6-24 mm (Figure 2).

This suggests a developmental error occurring in the third month of intrauterine life when follicles are generally embedded. This suggests that our patients have a pathoanatomic predisposition to develop folliculitis under the influence of various factors, which is called pilonidal sinus if it appears in the natal cleft.

Microscopic characteristics of the resection margins: The resection margins were completely clear in 71.8% of the specimens. No recurrence of the disease was identified in these patients. Scarring and an inflammatory infiltrate were discovered along the resection margins in 28.2%, 13 of the specimens, but no recurrence of the disease was identified.

DISCUSSION

This paper confirms that completeness of excision has no impact on pilonidal sinus recurrence: no recurrence in 71.8% with complete excision and 28.2% with incomplete excision. A limitation of this study is its relatively small size (71 patients). Surgeons need to distinguish between prolonged wound healing and recurrence. We also identified that pathologists have little time to analyze benign disease.

This paper fills the void in the literature in describing all pathological structures in the PS specimen, on the position of pathological structures in relation to the epidermal-dermal line, and macroscopic features of the resection margins. Some specify that the excision must be elliptical [7] or, asymmetrical [3] as described by Karydakakis. In our practice, we followed the principle that the complete removal of a benign change (pilonidal sinus included) should be perpendicular to the body surface affected. The skin and subcutaneous tissue must include entire skin and subcutaneous tissue with superficial fascia to the muscle fascia (Figure 1b,c,d,e,f).

From one to all 5 pilonidal structures were identified depending on the stage of the pathological process (follicles, squamous epithelium, hair shafts, cysts and pits). Scarring and inflammatory infiltrate were discovered along the resection margins in 28.2% of specimens, but no recurrence of the disease was

identified. Prolonged healing along the centerline of the incision was observed in 11 patients (15%). There were no recurrences over a follow-up period of 2-7 years.

Conclusion: Surgically excised pilonidal sinus specimens should include the skin and subcutaneous tissue with superficial fascia, to the muscle fascia encompassing all pathological structures (follicles, squamous epithelium, hair shaft, cyst and pits). A continuous incision from the tip of the coccyx, including all pits and navicular region of the sinus was followed by fasciocutaneous flap closure. Histological completeness of excision had no impact on pilonidal sinus recurrence.

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MULTIMEDIA

N/A

REFERENCES

1. Ardelit M, Dennler U, Fahrner R et al. Puberty is a major factor in pilonidal sinus disease: Gender-specific investigations of case number development in Germany from 2007 until 2015. *Chirurg*. 2017 Nov; 88(11):961-967. doi: 10.1007/s00104-017-0463-7.
2. Chintapatla S, Safarani N, Kumar S et al. Sacrococcygeal pilonidal sinus: historical review, pathological insight and surgical options. *Tech Coloproctol*. 2003 Apr; 7(1):3-8. PMID: 12750948. doi: 10.1007/s101510300001
3. Dragoni F, Moretti S, Cannarozzo G et al. Treatment of recurrent pilonidal cysts with nd-YAG laser: report of our experience. *J Dermatolog Treat*. 2018 Feb; 29(1):65-67. PMID: 28521574. doi: 10.1080/09546634.2017.1329513
4. Muhammad Nawaz, Anjum Almana, General Hospital Dammam, Kingdom of Saudi Arabia, Karydakias Flap in the Management of Pilonidal Sinus Disease: 15 years Single Author Experience Karydakias Flap 15 year experience Vol 6 No 1 (2020): Pilonidal Sinus Journal
5. Petrović J, Dimitrijević I, Krivokapić Z. Minor vs complete excision of pilonidal sinus - early postoperative period. *Acta Chir Iugosl*. 2012; 59(2):81-5. PMID: 23373363
6. Duman K, Ozdemir Y, Dandin O. Pilonidal sinus disease Etiological factors, pathogenesis and clinical features. *Arch Clin Exp Surg*. 2016; 5:228-232. doi: 10.5455/aces.20151019114717
7. Arer IM, Yabanoglu H, Caliskan K. Tension-free primary closure for the treatment of pilonidal disease. *Ann Ital Chir*. 2015; 86:459-63. PMID: 26567718
8. Chaput B, Herlin C, Jacques J et al. Management of Pilonidal Sinus Disease with the Aesthetically Shaped Parasacral Perforator Flap: Multicenter Evaluation of 228 Patients. *Plast Reconstr Surg*. 2019 Oct; 144(4):971-980. PMID: 31568314 Clinical Trial. doi: 10.1097/PRS.0000000000006087.

9. Velotti N, Manigrasso M, Di Lauro K et al. Minimally Invasive Pilonidal Sinus Treatment: A Narrative Review. *Open Med (Wars)*. 2019 Aug 7; 14:532-536. eCollection 2019. PMID: 31428682. doi: 10.1515/med-2019-0059.
10. Søndena K, Pollard ML. Histology of chronic pilonidal sinus. *APMIS*. 1995 Apr; 103(4):267-72. PMID: 7542011. doi: 10.1111/j.1699-0463.1995.tb01105.x
11. Vasanth V, Chandrashekar BS. Follicular occlusion tetrad Indian. *Dermatol Online J*. 2014 Oct-Dec; 5(4): 491–493. PMCID: PMC4228650. doi: 10.4103/2229-5178.142517
12. Boulanger G, Abet E, Brau-Weber AG et al. Is histological analysis of pilonidal sinus useful? Retrospective analysis of 731 resections. *J Visc Surg*. 2018 Jun; 155(3):191-194. doi: 0.1016/j.jvisc Surg.2017.10.013. Epub 2017 Nov 13.
13. Midtgaard HG, Eiholm S. Pilonidal disease is a benign condition. *Ugeskr Laeger*. 2012 Nov 12; 174(46):2855-9. PMID: 23153466