Excision with primary midline closure compared with Limberg flap in the treatment of sacrococcygeal pilonidal disease: a randomised clinical trial

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ABSTRACT

BACKGROUND Although several surgical techniques for treatment of sacrococcygeal pilonidal sinus (SPND) have been described, there is no consensus on the optimal surgical procedure. In this study we compared excision with primary closure and Limberg flap in the treatment of SPND.

METHODS This was a prospective randomised clinical trial in patients with SPND who were randomly allocated to one of two groups: group I (excision and primary closure) and group II (Limberg flap technique). The primary outcome of the trial was recurrence of SPND whereas postoperative complications, return to work and cosmetic results were the secondary outcomes.

RESULTS Sixty patients were included, with a mean age of 24.1 years and mean body mass index (BMI) of 26.8 kg/m². Group I had significantly shorter operation time than group II. Both groups had similar hospital stay and comparable complication rates (43.3% vs 30%; $P = 0.4$). Group I had significantly higher recurrence rate (20% vs 0; $P < 0.02$) and significantly better cosmetic satisfaction score than group II. Being hairy ($P = 0.04$), positive family history ($P = 0.03$), diabetes mellitus ($P = 0.005$) and history of previous surgery for SPND ($P = 0.01$) were the significant predictors for recurrence.

CONCLUSION The Limberg flap is an effective technique for the treatment of SPND with very low recurrence rate and comparable complication rate and hospital stay to excision and primary closure. Excision and primary closure offered the advantages of quicker healing time, earlier resumption of daily activities, better cosmetic results, which may render it more suitable for patients with low risk for recurrence.

KEYWORDS

Pilonidal sinus – Postoperative complication – recurrence – Limberg flap – Midline

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Introduction

Pilonidal sinus is a very common inflammatory disease of the sacrococcygeal region that usually afflicts young and middle-age males with an incidence of 26/100,000.¹ Although the most common site for pilonidal sinus disease is the intergluteal region, it may occur in other sites such as the umbilicus and the finger web, as seen in hairdressers.²

Sacroccoccygeal pilonidal disease (SPND) presents clinically as acute pilonidal abscess, chronic pilonidal sinus and complicated or recurrent pilonidal disease. Different treatments for SPND have been advocated, including nonoperative management, excisional and incisional procedures and flaps.³ Although different surgical procedures have been used for the management of SPND, none of these procedures managed to eliminate postoperative morbidity such

as delayed wound healing and discomfort, neither did they prevent recurrence of pilonidal sinus, which is estimated to occur in 1–43% of patients.⁴

The surgical wound after excision of the pilonidal sinus can be left to heal by secondary intention. Advocates of this technique state that reduced wound tension facilitates healing without recurrence if all sinus tracts are fully excised. Alternatively, the wound may be closed to heal by primary intention. Methods can be broadly categorised as midline closure techniques with the wound lying within the natal cleft or other techniques where the wound is placed outside the midline.¹

Excision and primary closure involve excision of the entire sinus with closure of the wound. This procedure has the advantage of avoiding wound packing and prolonged healing. One problem is that the incision tends to be situated in a deep midline cleft where there is tension and

also the propensity to accumulate hair. Skin flaps have been described to cover the sacral defect left after wide excision; this keeps the scar off the midline and flattens the natal cleft. The techniques available include the cleft closure, Karydakis procedure, V-Y advancement flap, Limberg flap and gluteus maximus myocutaneous flap.⁵

The aim of the present study was to compare two techniques for the treatment of SPND; excision with primary midline closure and Limberg flap as regards recurrence and complications rates, operative time, hospital stay and return to daily activity. Another objective was to determine the predictors for recurrence of SPND, which may help in tailoring surgical treatment for each patient according to their risk for recurrence.

Materials and methods

Study design and setting

This is a prospective randomised trial on patients with SPND who were admitted to the General Surgery Department and Colorectal Surgery Unit of Mansoura University Hospitals within the period of January 2016 to January 2017. Ethical approval for the study was obtained from the Institutional Review Board of Mansoura Faculty of Medicine. All patients gave written informed consent before enrolment into the trial and undergoing the procedures. The protocol of the trial was registered at www.researchregistry.com with unique identifying number of researchregistry3601.

Eligibility criteria

Adult patients of both sexes with primary or recurrent SPND were included to the study. Exclusion criteria for the trial were:

- > acute presentation as pilonidal abscess
- > accidentally discovered SPND with no reported symptoms
- > pregnancy
- > psychiatric disease preventing surgical intervention
- > declined to participate in the study
- > unfit for anaesthesia.

The process of patient recruitment and exclusion is illustrated in the CONSORT flow diagram (Fig 1).

Random sequence generation and blinding

Patients were randomly allocated to one of two equal groups. Group I was treated with excision and midline primary closure and group II was treated with Limberg flap. Randomisation was achieved through computer software and the results were sealed into envelopes. The envelopes were drawn and opened by a nurse. The trial was single blinded as the patients gave consent to participate in the study, yet they were not aware of the type of procedure they will undergo. The assessment of the outcome of both

procedures was done by a surgical resident who was unaware of the nature of the study and group allocation.

Preoperative assessment

All patients were subjected to thorough preoperative evaluation; detailed history, general and local examination and routine preoperative blood tests, including complete blood count, renal and liver function tests, prothrombin time, and random blood glucose.

Demographic data of the patients were collected including age, sex, occupation and BMI. Occupation was defined as the occupation performed two years before the diagnosis of SPND. Complaints including pain, pruritus, bleeding and/or discharge and its duration were recorded. Shower habits of patients were approximately calculated by number of baths per week. Patients were asked about family history of SPND. Body hair ratio was graded subjectively as:

- > hairless: clean intergluteal sulcus with traces of hair
- > mild hairy: few hairs in the intergluteal sulcus
- > hairy: sulcus is full of hair.

Local examination of the natal cleft was done to estimate the number of pits and to determine the clinical staging of SPND according to an established scoring system:⁶

- > stage I: single pit in the midline, no lateral extension
- > stage II: more than one pit in the midline, no lateral extension
- > stage IIa: 2–3 pits in the midline
- > stage IIb: more than three pits in the midline
- > stage III: midline pit/pits plus lateral extension in one direction
- > stage IV: midline pit/pits plus lateral extension in both directions
- > stage R: recurrent SPND following any type of treatment

Surgical procedure

Operations were performed under spinal or general anaesthesia. The patients were placed in the prone Jack-knife position and wide adhesive tapes were used to separate the buttocks. Patients received antibiotics in the form of third-generation cephalosporin before the incision.⁷ The procedures were performed in a standardised stepwise manner, as described in a prior publication.⁸

Group I (excision with midline primary closure)

A vertical elliptical incision encompassing all pilonidal pits was made (Fig 2a) and excision of the sinus was carried out down to the level of the sacrococcygeal fascia (Fig 2b). Tension was released by a limited sharp dissection above the fascia. After haemostasis was ensured using electrocautery, a suction drain was inserted through a separate incision, then the deep fascia was approximated and the

wound was closed in layers (Fig 2c) using polyglactin 0 sutures. Finally, the skin was closed with 2/0 polypropylene interrupted mattress sutures (Fig 2d).

Group II (Limberg flap)

A rhomboid-shaped incision encompassing all pilonidal pits was made (Fig 3a) with a length to width ratio of 60%. The incision was deepened down to the gluteal fascia and the pilonidal sinus was completely excised. Then, a fascio-cutaneous rhomboid flap was transposed from its primary site to the resultant wound without tension (Figs 3b,c). A suction drain was inserted and the skin was sutured with interrupted polypropylene 2/0 sutures (Fig 3d).

Postoperative care

Standard postoperative care, including early ambulation and return to normal diet was followed. Postoperative pain was assessed according to visual analogue scale (VAS) 0–10 and early postoperative complications (bleeding and urine

retention) were recorded. Patients were discharged the next day on oral antibiotics and analgesia and were advised to remove hair in the area around the operative site by depilatory creams every three week.

Outcomes

The primary outcome was the recurrence of SPND at 12 months postoperatively. Recurrence was defined as reappearance of pilonidal sinus at the site of surgery as diagnosed by physical examination by the operating surgeon and a surgical resident. Secondary outcomes comprised postoperative pain, complications, operation time, hospital stay, time away from work, time for stitch removal, time for drain removal and cosmetic satisfaction of the patients.

Pain was assessed on the first and fourth postoperative day and at stitch removal using VAS from zero (no pain) to 10 (the worst pain). Postoperative complications included wound infection, which was defined as leakage of purulent secretion through the surgical wound, and seroma, which

Figure 2 Excision of pilonidal sinus with primary midline closure.

Figure 3 Excision of pilonidal sinus with Limberg flap.

was defined as the formation of non-infected serous fluid collection beneath the flap and diagnosed by clinical examination. Time away from work was defined as the date on which patient returned to normal activities including employment and leisure activities from the date of surgery.⁸

Follow-up

Patients were instructed to visit the outpatient clinic twice weekly for two weeks then weekly for another two weeks, and then every three months for at least 12 months. During each visit, complete patient assessment was conducted. Patients were asked about pain at the surgical site and during walking. Clinical examination was performed to detect recurrence of SPND and postoperative complications including wound infection, wound dehiscence, flap necrosis, flap oedema and numbness and hypoesthesia. Drain output and seroma formation were recorded and the suction drain was removed when drainage became less than 20 ml/day. During follow-up, patients were asked to evaluate the cosmetic appearance of the wound by looking at its picture, and to grade their satisfaction with the outcome using VAS ranging from 0 to 10 where 0 means the worst cosmetic outcome and 10 indicates the best cosmetic outcome.⁹

Statistical analysis and sample size calculation

Using power and sample size calculation software, the sample size was calculated based on the analysis of the

primary outcome (recurrence of SPND at 12 months of follow-up). Estimating that the recurrence rate after excision and primary midline closure can reach up to 30% and recurrence after Limberg flap can reach up to 3% according to the published literature,^{10–12} a sample size of 56 patients equally divided on both groups was estimated to be necessary to have a study power of 80% with alpha level set at 5%. To compensate for loss to follow-up and dropout, a sample size of 60 patients was finally included in the study.

Statistical analysis of data was by SPSS version 23. Data was described in the form of mean plus or minus standard deviation for quantitative data, frequency and proportion for qualitative data. For quantitative data, Student's t-test was used to compare between two groups. Chi square test and Fisher's exact test were used for qualitative data. Multivariate analysis of the predictors for recurrence of SPND was performed using binary logistic regression analysis. *P*-value of 0.05 or less was considered statistically significant.

Results

Patient characteristics

Sixty patients with SPND were included: 52 (86.6%) men and 8 (13.3%) women, of a mean age of 24.1 ± 6.7 years and mean BMI of 26.8 ± 3.9 kg/m². The most common complaint was discharge at the natal cleft in 47 (78.3%) patients, followed by pruritus in 25 (41.6%) and sacroccygeal pain in 16 (26.6%); 13 (21.6%) patients had history

Table 1 Preoperative characteristics of the patients studied.

Variable	Group 1 ^a	Group 2 ^b	P-value
Age, years (mean ± SD)	25.1 ± 7.4	23.8 ± 5.9	0.47
Sex (male/female)	25/5	27/3	0.7
BMI, kg/m ² (mean ± SD)	27.4 ± 3.9	26.5 ± 4.4	0.4
Preoperative duration of SPND, months (mean ± SD)	16.1 ± 5.2	14.1 ± 4.4	0.17
Clinical presentation, <i>n</i> (%):			
Discharge	25 (83.3)	22 (73.3)	0.5
Pain	7 (23.3)	9 (30)	0.7
Pruritus	12 (40)	13 (43.3)	1
Bleeding	1 (3.3)	1 (3.3)	1
Pits, <i>n</i> (mean ± SD)	1.6 ± 0.7	1.4 ± 0.5	0.2
Previous abscess drainage (%)	6 (20)	7 (23.3)	0.75
Stage of SPND, <i>n</i> (%):			
I	4 (13.3)	5 (16.6)	1
II	11 (36.6)	13 (43.3)	0.07
III	7 (23.3)	6 (20)	0.75
IV	1 (3.3)	1 (3.3)	1
R	7 (23.3)	5 (16.6)	0.74

BMI, body mass index; SD, standard deviation; SPND, sacrococcygeal pilonidal disease.
^a Primary midline closure.
^b Limberg flap.

Table 2 Risk factors for sacrococcygeal pilonidal disease.

Variable	Group 1 ^a	Group 2 ^b	P-value
Body hair ratio, <i>n</i> (%):			
Hairless	7 (23.3)	7 (23.3)	1
Mild hairy	14 (46.6)	11 (36.6)	0.6
Hairy	9 (30)	12 (40)	0.5
Baths per week, <i>n</i> (%):			
< 3/week	20 (66.6)	24 (80)	0.3
< 3/week	10 (33.3)	6 (20)	0.3
Family history, <i>n</i> (%):			
Positive	5 (16.6)	4 (13.3)	1
Negative	25 (83.3)	26 (86.6)	1
Comorbidities, <i>n</i> (%):			
Diabetics	7 (23.3)	3 (10)	0.2
Smokers	16 (53.3)	18 (60)	0.7
Sitting hours/day, <i>n</i> (%):			
> 6 hours	19 (63.3)	25 (83.3)	0.1
≤ 6 hours	11 (36.6)	5 (16.6)	0.1

^a Primary midline closure.
^b Limberg flap.

of drainage of pilonidal abscess and 12 (20%) had previous surgery for pilonidal sinus. There were no significant differences between the two groups regarding their characteristics, clinical presentation of and risk factors for SPND (Tables 1 and 2).

Operation time and complications

The mean operation time was significantly longer in the Limberg flap group (51.6 ± 6.4 compared with 31.6 ± 6.5 minutes, $P < 0.0001$) whereas the hospital stay was comparable among the two groups (1.5 ± 0.6 days after Limberg flap compared with 1.2 ± 0.6 days after primary closure, $P = 0.05$). There were no statistically significant differences between the two groups regarding early and late postoperative complications. The total complication rate was 43.3% after Limberg flap compared with 46.6% after primary closure ($P = 0.79$; Table 3).

Postoperative pain and amount of drainage

No significant differences in postoperative pain were noted between the two groups (mean VAS on the first day: 6.9 ± 0.7 after Limberg flap vs 6.6 ± 1 after primary closure, $P = 0.1$). The amount of drainage was significantly less after primary closure than after Limberg flap (637 ± 182.6 ml vs 815 ± 169.2 ml, $P = 0.0002$); however, the time for drain removal was similar in the two groups (17.5 ± 5.5 days for Limberg flap vs 15.6 ± 3.4 days for primary closure, $P = 0.11$; Table 3).

Table 3 Outcome of primary midline closure and Limberg flap for sacroccocygeal pilonidal disease.

Variable	Group 1 ^a	Group 2 ^b	P-value
Operative time, minutes (mean $\pm$ SD)	31.6 $\pm$ 6.5	51.6 $\pm$ 6.4	< 0.0001
Hospital stay, days (mean $\pm$ SD)	1.2 $\pm$ 0.6	1.5 $\pm$ 0.6	0.05 ^c
Recurrence, <i>n</i> (%)	6 (20)	0	0.02 ^c
Immediate complications, <i>n</i> (%):			
Urine retention	1 (3.3)	3 (10)	0.61
Bleeding	0	1 (3.3)	1
Delayed complications, <i>n</i> (%):			
Wound infection	6 (20)	1 (3.3)	0.11
Flap oedema	3 (10)	2 (6.6)	1
Wound dehiscence	2 (6.6)	1 (3.3)	1
Numbness and hypesthesia	2 (6.6)	5 (16.6)	0.43
Total complications, <i>n</i> (%):	14 (46.6)	13 (43.3)	0.79
Pain VAS, (%):			
First day	6.6 $\pm$ 1	6.9 $\pm$ 0.7	0.1
Fourth day	2.7 $\pm$ 0.9	3.1 $\pm$ 1.1	0.1
Stitch removal	1.5 $\pm$ 0.5	1.5 $\pm$ 0.7	1
Drain amount (ml)	637 $\pm$ 182.6	815 $\pm$ 169.2	0.0002
Time: (days):			
To drain removal in days	15.6 $\pm$ 3.4	17.5 $\pm$ 5.5	0.11
To stitch removal in days	12.6 $\pm$ 2.2	14.4 $\pm$ 2.1	0.002 ^c
To walk pain-free in days	4.7 $\pm$ 2.4	6.2 $\pm$ 1.3	0.0039 ^c
To return to work in days	17 $\pm$ 3.3	20 $\pm$ 2.5	0.0002 ^c
Cosmetic satisfaction VAS (%)	7.8 $\pm$ 1.2	5.4 $\pm$ 1.5	< 0.0001 ^c
Overall patient satisfaction (%)	23 (76.6)	26 (86.6)	0.5
Follow-up, months (mean $\pm$ SD)	17.03 $\pm$ 4	16.4 $\pm$ 3.7	0.53

SD, standard deviation; VAS, visual analogue scale.
^a Primary midline closure.
^b Limberg flap.
^c VAS.

Recurrence and return to work

The excision and primary closure group attained significantly shorter time for stitch removal, drain removal, walking pain-free and return to work. On the other hand, recurrence of SPND occurred in six patients after primary closure whereas none of the patients who underwent Limberg flap experienced recurrence and this difference was statistically significant ($P = 0.02$; Table 3).

Cosmetic outcome

Cosmetic VAS score in the Limberg flap group was significantly lower than in the primary repair group (6.3 ± 1.3 vs

7.8 ± 1.2 ; $P < 0.0001$). On the other hand, both groups were comparable with regard the overall patient satisfaction about the procedure (76.6% vs 86.6%, $P = 0.5$).

Analysis of risk factors for recurrence

Univariate analysis of the risk factors for SPND recurrence revealed that hairy patients ($P = 0.04$), positive family history ($P = 0.05$), diabetes mellitus ($P = 0.005$) and history of previous surgery for SPND ($P = 0.01$) were the significant predictive factors for recurrence. On multivariable binary logistic regression analysis, hairy patients (odds ratio, OR, 11; $P = 0.02$), positive family history (OR 8; $P = 0.02$),

Table 4 Univariate and multivariate analysis of the predictors of recurrence.

Variable	Non-recurrent (n = 54)	Recurrent (n = 6)	P-value ^a	Odds ratio	P value ^b
Body hair:					
Clean	14	0			
Mild hairy	24	1			
Hairy	16	5	0.04	11.8	0.02
Baths/week:					
< 3/week	40	4			
> 3/week	14	2	0.65	–	–
Family history:					
Positive	6	3			
Negative	48	3	0.03	8	0.02
Comorbidities:					
Diabetes mellitus	6	4	0.005	16	0.004
Smoking	29	5	0.22		
Body mass index:					
18.5–25	19	1			
25–30	28	1			
30–35	7	4	0.01	2.7	0.37
Sitting:					
> 6 hours/day	38	6			
≤ 6 hours/day	16	0	0.18	–	–
Previous surgery for pilonidal sinus	8	4	0.01	11.5	0.009
Preoperative duration in month	15.4 ± 4.7	12 ± 3.8	0.09	–	–
Pits (n)	1.5 ± 0.6	1.6 ± 0.7	1	–	–
^a P-value of univariate analysis by chi-square test.					
^b P-value of multivariate analysis by binary logistic regression test.					

diabetes mellitus (OR 16; $P = 0.004$) and history of previous surgery for SPND (OR 11; $P = 0.009$) were identified as independent predictors for recurrence (Table 4).

Discussion

The ideal method for treatment of SPND should be characterised with minimal tissue injury, minimal postoperative morbidity, short hospital stay, satisfactory cosmetic results, rapid resumption of daily activities, low cost and low recurrence rate. However, although numerous operative and nonoperative treatment methods have been described, no treatment comprises all of these features.^{8,15,14}

Excision and primary closure technique is a simple rapid procedure; however, tension on the suture line and hair accumulation the deep midline cleft can limit the overall success of the procedure and can lead to high recurrence rates.¹⁵ In an attempt to overcome the problems of primary closure technique, the Limberg flap technique¹⁶ was introduced and gained popularity due to its simplicity and low recurrence and complication rates.^{17,18}

In addition to the Limberg flap technique, other flap procedures have been described in the literature with satisfactory outcomes. One of the most popular flap procedures is the Karydakis flap, which achieved excellent results with recurrence rates less than 1% at 24 months of follow-up.¹⁹ The V-Y flap is another flap procedure for SPND that achieved similar recurrence rate to Limberg flap, yet with longer time needed for resumption of daily activities.²⁰ Recently, the Muzi tension-free procedure was described to have low recurrence rate (0.4%), short operation time, minimal postoperative pain, early recovery and high patient satisfaction.²¹ An alternative to Limberg flap is the rotational gluteal flap which relies on the same surgical principles, yet avoids the geometric rhomboid shape of Limberg flap, thus attains better cosmetic outcome.²²

It was postulated that SPND is correlated with male sex hormones, therefore, the disease mainly afflicts young and middle-age males in the second and third decades of life.¹⁷ In line with this observation, 85% of the patients in the present study were males aging between 15 and 30 years. Furthermore, the mean BMI of patients in our trial was

above average and around one-third of patients had abundant body hair, in concordance with previous studies that documented the role of body weight and the local hair distribution in the development of SPND.^{18,25}

In this study, we compared two commonly performed techniques for SPND: excision with primary midline closure and Limberg flap technique. The safety and efficacy of any procedure for SPND are judged by the overall complication and recurrence rates. We found both procedures to have comparable complication rates, implying comparable safety profiles of the two techniques, yet the Limberg flap was superior to the primary closure technique with regard to recurrence of SPND.

Wound complications are common after surgery for SPND and include infection, seroma collection and dehiscence. Although wound infection occurred in 20% of patients in the primary closure group, compared with 5.3% in the Limberg Flap group, this difference was not statistically significant. Infection was properly managed with oral antibiotics and daily dressing. Similarly, wound dehiscence occurred at a similar rate in both groups and was treated with secondary suture. The rates of wound complications, namely infection, after surgery for SPND vary from 0% to 8%, depending on certain factors such as drain placement and BMI,^{24,25} yet there is no documented correlation between wound infection and the type of procedure performed.^{24,26}

More serious complications of SPND surgery include flap necrosis, which can occur due to ischaemia/pressure necrosis or tension at the suture line.²⁷ Since no tension was posed on the suture line in the Limberg flap procedure owing to transposition of flap, none of the patients who had a Limberg flap experienced flap necrosis. On the other hand, patients who underwent Limberg flap had more dissection to create a tension-free flap which resulted in a higher rate of hypesthesia compared with the primary closure group.

Recurrence is the most important outcome of SPND surgery and the ideal procedure should have low or virtually no recurrence rates. Recurrence most commonly occurs in the first year after surgery,²⁸ which is why we opt to follow all patients for at least 12 months postoperatively. No patients in the Limberg flap group experienced recurrence on follow-up whereas 20% of patients in the primary closure group presented with recurrence, in line with a meta-analysis of randomised trials comparing primary closure and Limberg flap, which documented a lower trend towards recurrence in favour of Limberg technique.²⁹

Reasons for the significant difference in the recurrence rates can be attributed to the tension-free nature of the Limberg flap technique, obliteration of dead space resulting after sinus excision with a well-vascularised flap, and flattening and elimination of the deep midline cleft.^{11,27,30} Recurrence after primary midline closure may be attributed to deepening of the natal cleft, which helps to increase anaerobic bacterial content. The vacuum effect created between the buttocks also serves to draw hair and debris into the subcutaneous tissue of the natal cleft as Bascom highlighted.³¹

Drainage of the operative site after SPND surgery is a vital component of surgical management. Many studies applied closed suction drainage to reduce complication rates by avoiding the formation of potential space and subsequently seroma and hematoma.^{32,35} In contrast, other authors have suggested that 'the use of drains is unnecessary because hematoma and seroma can be prevented through a meticulous and patient haemostasis'. These authors thought that the drain use increased analgesia requirement, risk of wound infection and hospitalisation period.^{34–36} Although the volume of postoperative drainage after Limberg flap was significantly greater than the primary closure group, this did not result in delayed drain removal after Limberg flap procedure. The greater volume of drainage after Limberg flap technique was probably due to more tissue handling and mobilisation than in the primary closure method.

Other factors that play a role in the selection of the type of operation for SPND are hospital stay and time to return to work since longer hospitalisation and delayed return to routine daily activities may lead to negative social and financial consequences. In the current study, the primary closure group attained significantly shorter period to resume daily activities and return to work, shorter time to stitch removal, and to walk free of pain, which reflects quicker recovery after the primary closure technique, probably owing to the small sized defect and minimal dissection used in primary closure compared with the larger wound and stitch line of Limberg flap.³⁷ In contrast, Harwood et al.²⁹ reported no significant differences between the two procedures with regards hospital stay and time to return to work.

Patient-centred outcomes are also important to be assessed after surgery for SPND, particularly patient satisfaction and the cosmetic outcome of the procedure. In this study, the overall patient satisfaction about the procedure they underwent was similar in both group; however, primary closure achieved significantly higher cosmetic satisfaction score than Limberg flap, in agreement with other studies.^{5,58} Many patients can be dissatisfied with the geometric shape of the Limberg flap compared with the linear scar of primary closure.²²

On analysis of the risk factors for recurrence, we found hirsute body nature, infrequent bathing, smoking, high BMI, sitting more than six hours per day, previous surgery for SPND, preoperative duration of SPND greater than 12 months and more than two pits were significant predictors for recurrence. It may be plausible to treat patients with one or more of these risk factors with a flap procedure rather than primary midline closure, as they entail higher risk for recurrence. High-risk patients should be followed closely at regular time points postoperatively to detect and treat recurrent sinuses in a timely manner.

Limitations of the present study include the relatively small number of patients included and short follow-up, since SPND is anticipated to recur many years after the primary surgery. The single-blinded nature of the study is another limitation since the operating surgeons were aware of the nature of the study and type of procedures

included. It is also important to note that this trial was a single institution study, hence a multicentre trial is required to draw more solid conclusions.

Conclusion

The Limberg flap is an effective technique for the treatment of SPND, with very low recurrence rate and comparable complication rate and hospital stay to excision and primary closure. On the other hand, excision and primary closure offered the advantages of quicker healing time, earlier resumption of daily activities and work, better cosmetic results, but with higher recurrence rate which may render it more suitable for patients with low risk for recurrence of SPND.

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