

ORIGINAL ARTICLE

Specimen index may be a predictive factor for recurrence after primary closure of pilonidal disease

Husnu Alptekin, Fahrettin Acar, Mustafa Sahn, Huseyin Yilmaz, M. Ertugrul Kafali, Sinan Beyhan¹

Department of Surgery, Selcuk University Selcuklu Medical School, Konya, ¹Department of Surgery, Bandirma Country Hospital, Balikesir, Turkey

Purpose: The aim of the present study was to evaluate the predictive value of volume of the specimen/body mass index (VS/BMI) ratio for recurrence after surgical therapy of pilonidal disease. **Methods:** Ninety-eight patients with primary pilonidal disease were enrolled in this study. The VS/BMI ratio was calculated for each patient. This ratio was defined as the specimen index (SI). VS, BMI and SI were evaluated to determine whether there is a relationship between these parameters and recurrence of pilonidal disease. In addition, the predictive ability of SI for recurrence was analyzed by receiver operating characteristic (ROC) curve. **Results:** VS and SI were found to be higher in patients with recurrence. ROC curve analysis showed that VS and SI are predictive factors for recurrence in patients treated with primary closure, nevertheless our new index had higher sensitivity and specificity than VS (sensitivity 85.7% vs 71.4% and specificity 90.7% vs 85.1%, respectively). The cut-off level for the greatest sensitivity and specificity for SI was 1.29. **Conclusion:** Recurrence is higher in patients with high VS regardless of the operation method. SI may be a predictive value in patients treated with primary closure.

Key Words: Pilonidal sinus, Recurrence, Body mass index

INTRODUCTION

Pilonidal disease (PD) is a common condition that affects younger patients, and occurs predominantly in the sacrococcygeal region. Incidence is reported as 26 per 100,000 population [1]. It occurs more frequently in young men. The onset is rare before puberty and after the age of 40 years [1,2]. Eradication of the sinus tract and complete healing of the overlying skin are essential principles of surgical treatment. Several treatment modalities have been advocated for PD ranging from conservative non-

surgical treatments to extensive resections followed by flap procedures [3-6]. Although the most preferred surgical procedure is wide excision, the reconstruction step is still controversial [3,4]. Reconstruction procedure is closely related to postoperative morbidity and recurrence. None of reconstruction procedures eliminate the risk of recurrence. Despite the ongoing debates about the best surgical technique for the treatment of PD, it is generally accepted that an ideal surgery should be simple, should not need a prolonged hospital stay, should have a low recurrence rate, should be associated with minimal wound

Received April 10, 2012, Revised July 9, 2012, Accepted August 10, 2012

Correspondence to: Husnu Alptekin
Department of General Surgery, Selcuk University Selcuklu Medical School, 42075 Konya, Turkey
Tel: +90-3322415000, Fax: +90-3322412184, E-mail: halptekin@hotmail.com

© Journal of the Korean Surgical Society is an Open Access Journal. All articles are distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

care, and decrease patients' time off work [7].

High recurrence rate and high infection rate are the main problems for the primary closure technique [8], whereas a number of studies have reported a low recurrence rate after Limberg flap repair [9,10]. On the other hand, morbidity related to infection and recurrence has not been completely eliminated after Limberg flap repair [3-6]. All methods used in PD treatment have different recurrence rates and many factors contribute to recurrence. Body mass index (BMI), volum of the specimen, weight and length of the specimen have been evaluated as risk factors for recurrence. Yet the results of these studies are controversial [5,11-15]. To our knowledge, no study has investigated the ratio between sinus volume and BMI as risk factor for recurrence. For these reasons, we attempted, in this study, to discover a new indicator for risk of recurrence with a better specificity level.

METHODS

Between January 2007 to February 2011, patients who underwent surgery for PD at two hospitals (1 university hospital and 1 country hospital) were evaluated. The study was approved by the local ethical committee. Signed and informed consent was obtained from all patients by the responsible surgeon. The study was designed as a clinical observational study. The surgeons decided on the type of surgery on the basis of personal experience and subjective estimation, and no preferential criterion was employed for the surgical procedure to be used. Patients with an acute pilonidal abscess were treated by a simple incision and with antibiotics before the surgical procedure. One hundred twenty-four patients with primary non-recurrent PD underwent one of two types of surgical procedures (primary closure or classic Limberg flap). The patients treated with other surgical techniques were excluded. Twenty-six of the 124 patients could not be fully followed up. Therefore, 98 patients with a follow up of at least 1 year were enrolled in this study. Fifty-four patients (group PC) were treated with excision and primary closure, whereas another 44 patients (group LF) were treated with excision and classic Limberg flap repair.

Following medical evaluation, the patients were admitted to the hospital on the day of surgery. All procedures were performed under spinal anesthesia in the prone position. The operative field was prepared by separating the buttocks with an adhesive tape. Dissection was performed using electrocautery. All patients received cefazolin (1 g intravenously) for prophylaxis immediately before the operation. The extent of the sinus tract was delineated by infusing each sinus opening with diluted methylene blue dye. After excision of specimen was completed, the lesion was reinjected with methylene blue and the specimen was then examined to see if removal had been complete.

In group PC, the sinus was resected *en bloc* through a longitudinal incision. The incision was elliptical with its lateral margins equidistant from the midline at a level that would allow apposition of the wound edges. The incision was carried vertically down to the presacral fascia. Minimal dissection of the subcutaneous adipose tissue over the fascia was done along the length of the defect edges. It should be possible to achieve proper approximation of tissues in the midline. The fat was closed with interrupted 3-0 absorbable sutures in three layers to minimize tissue traction. At the first layer, fat masses were sutured to each other and to the underlying presacral fascia (Fig. 1). The skin edges were closed with interrupted polypropylene, taking care to achieve accurate apposition of

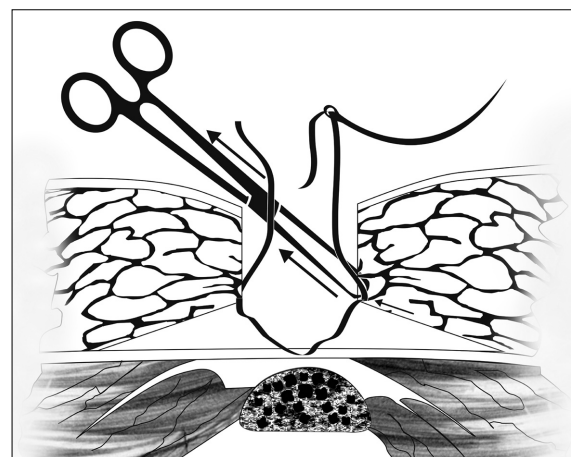


Fig. 1. Illustration of first layer suture in patient who underwent primary closure. Fat mass was sutured to each other and to underlying presacral fascia.

the skin edges. Prophylactic cavity drainage was not performed in this group.

In group LF, the sinus was resected *en bloc* with a rhomboid excision. The rhomboid incision including the sinus and its extensions were made down to the presacral fascia. The Limberg flap was then prepared from the right or left gluteal region. The constructed flap, incorporating the gluteal fascia, was mobilized on its inferior edge and transposed medially to fill the Limberg defect. The subcutaneous layer was approximated with 3-0 absorbable interrupted sutures over a vacuum drain. The skin was closed with polypropylene sutures. The drains were removed after drainage decreased to less than 10 mL/day.

Follow-up was by review in the outpatient departments and telephone survey. Patients were reexamined at 5 days, 2 weeks, 1 and 3 months postoperatively. After the third month, patients were contacted by phone and asked whether they had any problems. Finally, all patients were interviewed by phone in February 2011.

Age, gender, skin color, BMI, occupation, hairy characteristics, location of sinus orifices, volume of the specimen (VS), duration of surgery, mean hospital stay, postoperative complications, hypoesthesia, time off work, and recurrence were recorded for each patient. Postoperative infection was defined as the development of cellulitis and/or purulent discharge from the wound edges. In the case of wound infection, the wound was drained by the removal of a few sutures, covered with daily dressings, and oral cefuroxime was given for 7 days. Time off from work was subjectively defined by each patient. In order to define the postoperative time off work, the patients were asked when they felt would be convenient to start their daily activities.

A measuring cylinder was used to measure the VS. Firstly, we poured a known amount of water into a measuring cylinder and then placed the specimen into the water and ensured that it was completely submerged. We noted the increase in the height of the water. The increase in volume from the original volume of water was accepted as VS. We calculated the VS/BMI ratio for each patients. The VS/BMI ratio was defined as the specimen index (SI).

Statistical analysis

Categorical variables were analyzed by chi-square test;

continuous variables were analyzed by the Mann-Whitney U test. Statistical significance was defined as a P-value of less than 0.05. ROC analysis was used to observe predictive values. ROC curves for the VS and SI were generated. Areas under the curve (AUC) and the associated P-value were determined. Sensitivity and specificity of SI and VS were also measured.

RESULTS

Ninety-eight patients (85 men and 13 women) with a mean age of 25.8 ± 3.1 years who underwent primary closure or classic Limberg flap repair for PD were enrolled in the study. There were no statistically significant differences between the groups with respect to sex distribution, age, BMI and follow-up time. Significant differences were found between group PC and group LF in terms of duration of surgery ($P < 0.001$), hospital stay ($P < 0.001$), time off work ($P = 0.026$) and hypoesthesia ($P = 0.039$). There were no statistically significant differences between the groups with respect to postoperative complication rates and recurrence rates (Table 1). Patients were analyzed according to their skin color characteristics, occupation and hirsute characteristics as risk factors for recurrence. The locations of sinus orifices were also examined. These re-

Table 1. Baseline characteristics and clinical outcomes of the patients

Characteristic	Group PC (n = 54)	Group LF (n = 44)	P-value
Age (yr)	24.2 ± 7.2	23.6 ± 7	0.778
Male/female	44/10	41/3	0.089
Duration of surgery (min)	29.3 ± 5.1	51.6 ± 6.8	0.000
Hospital stay (day)	1.6 ± 0.7	2.8 ± 0.8	0.000
Time off work (day)	9.7 ± 3.4	11.8 ± 4.6	0.026
Follow-up (mo)	18.9 ± 11.4	21.3 ± 10.8	0.277
Hypoesthesia	2 (3.7)	8 (18.2)	0.039
Wound infection	4 (7.4)	4 (9.0)	0.922
Partial dehiscence	5 (9.2)	4 (9.0)	0.669
Recurrence	6 (11.0)	4 (9.0)	0.742
Body mass index (kg/m ²)	25.5 ± 3.2	26.3 ± 3.1	0.126
Volume of the specimen (cm ³)	21 ± 8.3	40.3 ± 32	0.000
Specimen index	0.82 ± 0.32	1.46 ± 0.98	0.000

Values are presented as mean ± SD or number (%).

PC, primary closure; LF, Limberg flap repair.

sults failed to show any statistical significance (Table 2). The recurrence rate and type of surgery were not found to differ between the two hospitals (data not shown).

During the follow-up, recurrence was observed in 10 patients (6 patients in group PC, and 4 patients in group LF). These recurrences occurred in the fourth month in 2 patients, eighth month in 7 patients, and first year in 1 patient. In group PC, the mean follow-up period was 21.2 ± 12.2 months for patients with recurrence and 18.6 ± 11.4 months for patients without recurrence ($P = 0.606$). In group LF, the mean follow-up period was 18.3 ± 10.9 months for patients with recurrence and 21.7 ± 10.9 months for patients without recurrence ($P = 0.554$).

When BMI, VS and SI were evaluated, VS and SI were found to be higher in patients with recurrence, in both groups (Table 3). The ability of VS and SI to predict re-

currence was further examined by ROC curve analysis. In group PC, AUC for SI was 0.94 (95% confidence interval [CI], 0.874 to 0.995) with a standard error of 0.031; and for VS was 0.89 (95% CI, 0.807 to 0.967) with a standard error of 0.041 (Fig. 2). ROC analysis demonstrated that the best predictive value of SI and VS was 1.29 and 30.5, respectively. With these cut-off values, sensitivity and specificities were 85.7% and 90.7% for SI and 71.4% and 85.1% for VS, respectively (Table 4). In group LF, AUC for SI was only 0.76 ($P = 0.079$) and for VS was only 0.69 ($P = 0.213$).

DISCUSSION

The principal findings of this study is that SI was a better predictor of recurrence in patients treated with primary closure. The main aim of primary closure is rapid healing. But different recurrence rates (9 to 25%) have been reported after primary closure [16,17]. A meta-analysis comparing healing by primary closure and open healing

Table 2. Factors assessed for recurrence

	Patients	Recurrence	P-value
Skin color			0.993
Brunette	70	7	
Auburn	19	2	
Light colored	9	1	
Occupation			0.950
Office worker	31	3	
Driver	19	2	
Student	10	0	
Housewife	5	0	
Other	33	5	
Hairy characteristics			0.618
Widespread	79	7	
Sparsely haired	19	3	
Location of orifices			0.574
Midline	85	9	
Right lateral	4	1	
Left lateral	6	-	
Midline + left lateral	3	-	

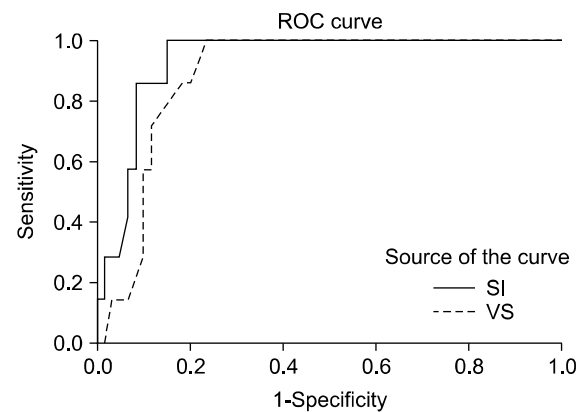


Fig. 2. Receiver operating characteristic (ROC) curves for specimen index (SI) and volume of the specimen (VS) in group primary closure. The area under the curve was 0.94 and 0.89, respectively.

Table 3. BMI, VS and SI results of groups, and relationship with recurrence

	Patients underwent PC			Patients underwent LF		
	Recurrence (+) (n = 6)	Recurrence (-) (n = 48)	P-value	Recurrence (+) (n = 4)	Recurrence (-) (n = 40)	P-value
BMI	23.4 ± 1.2	25.7 ± 3.2	0.108	28.4 ± 6.6	26 ± 2.5	0.161
VS	34.2 ± 4.2	19.3 ± 7.1	0.000	103.7 ± 87.3	33.9 ± 9.2	0.000
SI	1.45 ± 0.12	0.74 ± 0.24	0.000	3.34 ± 2.5	1.3 ± 0.38	0.000

BMI, body mass index; VS, volume of the specimen; SI, specimen index; PC, primary closure; LF, Limberg flap repair.

Table 4. Sensitivities, specificities and cut-off points with corresponding AUC for VS and SI as predictive factors of recurrence in patients treated with primary closure

	Cut-off point	Sensitivity	Specificity	Accuracy	AUC
VS	30.5	71.4%	85.1%	81%	0.89
SI	1.29	85.7%	90.7%	91%	0.94

AUC, area under the curve; VS, volume of the specimen; SI, specimen index.

after surgery for PD showed that recurrence was less likely to occur after open healing [18]. In all kinds of excision plus flap procedures for PD, recurrence rates are between 1% and 7% in the literature [3,4,19,20].

In this study, two groups were different in terms of prophylactic drain usage. It was reported that routine drain use has no effect on recurrence rate and postoperative complication rate after primary closure [15,21]. There has been a tendency to use drains after Limberg flap transposition and prophylactic cavity drainage to prevent complications being recommended [22]. Our technique of excision and primary closure with a triple layer of interrupted sutures builds a thick, fat pad between the sacrum and skin. The 3 layers of stitches in subcutaneous tissues also stabilize fat-on-fat and facilitates wound opposition with no remaining dead space. Thus, prophylactic cavity drainage was routinely performed in group LF, whereas no drain was used in group PC.

In this study, the two groups were similar in terms of wound infection and dehiscence rates. Wound infection was encountered in 7.4% and 9% of patients in group PC and group LF, respectively. Partial wound dehiscence was encountered in 9.2% and 9% of patients in group PC and group LF, respectively. This compares well with the published series [17,19,23]. In addition, all of our patients experiencing complications were improved completely with antibiotics, simple drainage and daily dressing.

In this study, the mean hospital stay was found to be significantly longer in patients treated with Limberg flap ($P < 0.001$). In our study, the hospital stay for patients treated with primary closure was shorter than 4.8 days as reported by Mahdy [19]. The hospital stay for patients treated with Limberg flap was also in accordance with the literature [19,20]. In our study, hypoesthesia was encountered in

3.7% of patients in group PC and 18.2% of patients in group LF. This difference was statistically significant ($P = 0.039$). Time off work was significantly shorter for patients treated with primary closure as compared with patients treated with Limberg flap repair (9.7 ± 3.4 days vs. 11.8 ± 4.6 days, respectively).

In our study, the recurrence rate was 11% in group PC and 9% in group LF. The relationship between BMI and recurrence or postoperative complications are controversial [5,12,14]. Kaymakcioglu et al. [24] determined that volume of the sinus tract was to be the factor significantly effecting recurrences.

Limberg flap has a lower incidence of recurrence compared to primary closure. In this study the incidence of recurrence was similar between the two groups [25]. The results of this study showed that recurrence is higher in patient with high VS regardless of the operation method as large volumes of tissue excised resulted in a greater recurrence rate. Furthermore, larger volumes of tissue were excised during LF compared to PC suggesting in itself that the two groups were not similar in respect to their pilonidal sinus disease. In patients with extensive disease, the volume of tissue to be excised will be greater in removing all branches of the sinus tract. The high VS refers to extensive disease. The VS in recurrent patients that underwent primary closure seems to equal the VS of non-recurrent patients in the flap reconstruction group (34.2 ± 4.2 vs. 33.9 ± 9.2). In this study, the mean values of VS and SI were significantly lower for the patients without recurrence than those with recurrence, in both groups. The ability of VS and SI to predict recurrence was examined by ROC curve analysis. VS and SI had the least AUC in patients treated with Limberg flap. This finding clearly indicates that VS and SI are not predictive factors for recurrence in patients treated with Limberg flap. On the other hand, ROC curve analysis showed that VS and SI are predictive factors for recurrence in patients treated with primary closure (AUC for SI was 0.94 and for VS was 0.89), nevertheless our new index had higher sensitivity and specificity than VS (sensitivity 85.7% vs. 71.4% and specificity 90.7% vs. 85.1%).

The limitations of our study includes a relatively small sample size and short follow-up period (average, 19.98

months). However, recurrence of PD occurs mostly in the first 9 months after the treatment [8,26]. In our study, 9 of 10 recurrences occurred in the first 8 months of treatment, and the difference of mean follow-up period was not significant for patients with recurrence and without recurrence. Another interesting finding was the difference in VS and SI between the groups. The choice of the surgical technique was probably biased and dictated by the extent of the PD. The VS and SI values were significantly higher in group LF compared with group PC. As mentioned in the "METHODS" section, no preferential criterion was employed for the surgical procedure to be used, the surgical procedure being chosen by the surgeon at his own preference. We speculate that the surgeons have preferred the flap transposition as treatment choice when faced with advanced disease.

In conclusion, the results of this study indicated that recurrence is higher in patients with high VS regardless of the operation method. SI can be a predictive value in patients treated with primary closure. If primary closure is chosen for treatment of PD, SI should be less than 1.29. If it is higher than 1.29, the wound should be left to heal by open method or should be closed with a flap procedure to minimize risk of recurrence.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Sondenaa K, Andersen E, Nesvik I, Soreide JA. Patient characteristics and symptoms in chronic pilonidal sinus disease. *Int J Colorectal Dis* 1995;10:39-42.
2. Dwight RW, Maloy JK. Pilonidal sinus; experience with 449 cases. *N Engl J Med* 1953;249:926-30.
3. Arumugam PJ, Chandrasekaran TV, Morgan AR, Beynon J, Carr ND. The rhomboid flap for pilonidal disease. *Colorectal Dis* 2003;5:218-21.
4. Yilmaz S, Kirimlioglu V, Katz D. Role of simple V-Y advancement flap in the treatment of complicated pilonidal sinus. *Eur J Surg* 2000;166:269.
5. Cubukcu A, Gonullu NN, Paksoy M, Alponat A, Kuru M, Ozbay O. The role of obesity on the recurrence of pilonidal sinus disease in patients, who were treated by excision and Limberg flap transposition. *Int J Colorectal Dis* 2000;15:173-5.
6. Quinodoz PD, Chilcott M, Grolleau JL, Chavoïn JP, Costagliola M. Surgical treatment of sacrococcygeal pilonidal sinus disease by excision and skin flaps: the Toulouse experience. *Eur J Surg* 1999;165:1061-5.
7. Solla JA, Rothenberger DA. Chronic pilonidal disease. An assessment of 150 cases. *Dis Colon Rectum* 1990;33:758-61.
8. Zimmerman CE. Outpatient excision and primary closure of pilonidal cysts and sinuses. Long-term follow-up. *Am J Surg* 1984;148:658-9.
9. Ertan T, Koc M, Gocmen E, Aslar AK, Keskek M, Kilic M. Does technique alter quality of life after pilonidal sinus surgery? *Am J Surg* 2005;190:388-92.
10. Akca T, Colak T, Ustunsoy B, Kanik A, Aydin S. Randomized clinical trial comparing primary closure with the Limberg flap in the treatment of primary sacrococcygeal pilonidal disease. *Br J Surg* 2005;92:1081-4.
11. Anderson JH, Yip CO, Nagabhushan JS, Connelly SJ. Day-case Karydakís flap for pilonidal sinus. *Dis Colon Rectum* 2008;51:134-8.
12. Sakr M, El-Hammadi H, Moussa M, Arafa S, Rasheed M. The effect of obesity on the results of Karydakís technique for the management of chronic pilonidal sinus. *Int J Colorectal Dis* 2003;18:36-9.
13. Arda IS, Guney LH, Sevmis S, Hicsonmez A. High body mass index as a possible risk factor for pilonidal sinus disease in adolescents. *World J Surg* 2005;29:469-71.
14. Madbouly KM. Day-case Limberg flap for recurrent pilonidal sinus: does obesity complicate the issue? *Am Surg* 2010;76:995-9.
15. Popeskou S, Christoforidis D, Ruffieux C, Demartines N. Wound infection after excision and primary midline closure for pilonidal disease: risk factor analysis to improve patient selection. *World J Surg* 2011;35:206-11.
16. Williams RS. A simple technique for successful primary closure after excision of pilonidal sinus disease. *Ann R Coll Surg Engl* 1990;72:313-4.
17. Gilani SN, Furlong H, Reichardt K, Nasr AO, Theophilou G, Walsh TN. Excision and primary closure of pilonidal sinus disease: worthwhile option with an acceptable recurrence rate. *Ir J Med Sci* 2011;180:173-6.
18. McCallum IJ, King PM, Bruce J. Healing by primary closure versus open healing after surgery for pilonidal sinus: systematic review and meta-analysis. *BMJ* 2008;336:868-71.
19. Mahdy T. Surgical treatment of the pilonidal disease: primary closure or flap reconstruction after excision. *Dis Colon Rectum* 2008;51:1816-22.
20. Akin M, Leventoglu S, Menten BB, Bostanci H, Gokbayir H, Kilic K, et al. 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* 2010;40:757-62.
21. Gurer A, Gomceli I, Ozdogan M, Ozlem N, Sozen S, Aydin R. Is routine cavity drainage necessary in Karydakís flap

- operation? A prospective, randomized trial. *Dis Colon Rectum* 2005;48:1797-9.
22. Topgul K, Ozdemir E, Kilic K, Gokbayir H, Ferahkose Z. Long-term results of limberg flap procedure for treatment of pilonidal sinus: a report of 200 cases. *Dis Colon Rectum* 2003;46:1545-8.
 23. Muzi MG, Milito G, Cadeddu F, Nigro C, Andreoli F, Amabile D, et al. Randomized comparison of Limberg flap versus modified primary closure for the treatment of pilonidal disease. *Am J Surg* 2010;200:9-14.
 24. Kaymakcioglu N, Yagci G, Simsek A, Unlu A, Tekin OF, Cetiner S, et al. Treatment of pilonidal sinus by phenol application and factors affecting the recurrence. *Tech Coloproctol* 2005;9:21-4.
 25. Kim JK, Jeong JC, Lee JB, Jung KH, Bae BK. S-plasty for pilonidal disease: modified primary closure reducing tension. *J Korean Surg Soc* 2012;82:63-9.
 26. Bissett IP, Isbister WH. The management of patients with pilonidal disease: a comparative study. *Aust N Z J Surg* 1987;57:939-42.