

Comparative study of limberg's rotation flap versus karydakis procedure in pilonidal sinus surgery

Nadeem Ahmad¹, Prem Prakash², Shashi Singh Pawar³, Kanchan Sonelal Baitha^{4*}

¹Assistant Professor, Dept. of General Surgery, IGIMS, Patna, Bihar, India

²Additional Professor, Dept. of General Surgery, IGIMS, Patna, Bihar, India

³Assistant Professor, Dept. of Surgical Oncology, IGIMS, Patna, Bihar, India

⁴Assistant Professor, Dept. of General Surgery, IGIMS, Patna, Bihar, India

Received: 13-11-2021 / Revised: 24-12-2021 / Accepted: 03-01-2022

Abstract

Introduction: Pilonidal sinus regularly affects upon young males. Various etiological speculations and treatment techniques have been depicted for treating sacrococcygeal pilonidal disease (SPD), prompting ceaseless discussions about the best treatment methodology. This review was directed to look at the short and long-haul inconveniences and aftereffects of the Limberg flap with that of the Karydakis flap as cosmesis, recurrence and wound mending. **Objectives:** In this forthcoming randomized review, 54 patients with SPD were conceded to go through either the Karydakis flap (n = 27) or the Limberg's flap (n = 27) method amidst July 2019 and July 2020. **Methods:** The mean employable time for the Limberg group (55.15 ± 7.65 minutes) was more limited as compared to the Karydakis group (46.55 ± 9.5 minutes) (P). The inconvenience rate for the the Limberg group (n = 7) [26%] was higher as compared to Karydakis group (n = 4) [14%] (P). The visual simple scale score for post-operative agony at the activity site on the 30th day was higher in the Limberg group as compared to the Karydakis group (3.55 ± 1.25 versus 2.44 ± 1.11 , P .01). The visual simple scale score for cosmesis of scars in the Karydakis group was 7.78 ± 1.92 , while it was 3.47 ± 1.54 in the Limberg group at the third month (P). Length of clinic stay was fundamentally less limited in the Limberg group as compared to the Karydakis group (3.8 ± 1.19 versus $3.40 \pm .94$ days, P<.03). Just four patients in the Karydakis group created repeat (3%), while 9 patients did as in the Limberg group (P <.151). **Conclusion:** Karydakis flap ought to be the favoured strategy than Limberg flap for treating simple SPD for its more limited activity time, lower torment score, more limited length of clinic stay, lower early postoperative inconveniences, and better superficial result. As far as disease repeat, no distinction was found amidst the two careful methods.

Keywords: Karydakis; Limberg; Flap; Pilonidal sinus disease; Complication; Recurrence Sacrococcygeal pilonidal disease

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Sacrococcygeal pilonidal disease (SPD) is long-term contamination and inflammation of the sacrococcygeal area that heavily affects the young adult population. It normally appears in the form of a sinus tract or a cyst that requires frequent drainage in the intergluteal cleft. High complications have consistently tormented upon the different treatment strategies for treating the disease. From skin application to extraction with an essential conclusion or mending with an optional goal of reconstructive methods, for instance, assembling a flap have been depicted, yet a palatable treatment methodology is as yet discussed. Profound natal cleft with apparently having a negative pressurizing environment is identified as a significant etiological variable as it makes a reasonable condition for ongoing irritation. Profound natal cleft permits desquamated cells sweat retention, just as broken hair in light of its suctioning limit. All these elements related to helpless cleanliness advances constant irritation. This idea has prompted the possibility that alongside the careful extraction, straightening of natal cleft and lateralizing the scar from the surgery from midline are the main elements for the elimination of the causative variables of pilonidal sinus disease and for prevention of repetition. This has prompted the improvement of various lateralizing careful flap methods dependent on these standards. For instance, the Karydakis flap, the modified Karydakis flap, the Limberg flap, the adjusted Limberg flap, and numerous other progression flap

techniques for treating SPD. As of late the Limberg and the Karydakis flap strategies have been broadly utilized for their low repeat and confusion rates as contrasted and other flap methodologies.



Karydakis flap technique

Limberg flap technique

A prospective study between Limberg and Karydakis flap can assist in discovering the best procedure with the most elevated rates and least complexities and recurrence rates. A randomized clinical preliminary for comparing long term and short term aftereffects of the Limberg and Karydakis flap strategies was performed.

Methods

54 sacrococcygeal pilonidal disease patients were selected for this study from July 2019 to July 2020 at Indira Gandhi Institute of Medical Sciences, Patna.

*Correspondence

Dr. Kanchan Sonelal Baitha

Assistant Professor, Dept. of General Surgery, IGIMS, Patna, Bihar, India

Inclusion criteria

Those patients with primary Pilonidal sinus disease with primary or secondary lateral openings who consented to this study. The ages must be 16 years or above.

Exclusion criteria

- Diagnosed case of inflammatory bowel disease
- Recurrent pilonidal sinus disease
- Pregnancy
- Contraindication for spinal/general anesthesia
- Diagnosed cases of ano-rectal malignancies
- Patients with DM, neurological deficiencies and immune-deficiencies

In the wake of giving the spinal anaesthesia, patients were set in an inclined situation with a cushion under waist. For a legitimate exposure of surgical site, the butt was isolated utilizing the micropore careful tape. Like all surgeries, the surgical site was shaved and skin was prepared with 10% povidone-iodine arrangement. Midline sinus openings were tested and infused with methylene blue to outline the essential or spreading parcels.

For the Limberg flap, utilizing a sterile skin-stamping pen a rhombus and flap lines were drawn. Rhombus incorporated the essential and optional sinus openings and sinus plots. Rhombus was extracted keeping the cut lines as vertical as conceivable till the presacral sash was reached. While extracting the rhombus representation of methylene blue was considered as a break of sinus lot and extraction was updated appropriately. A fascio-cutaneous flap was raised and turned to fill the imperfection. On the off chance that the flap was under pressure entry point lines were additionally delivered as needed. In the wake of setting a pull channel, the flap was gotten in its position utilizing 3-0 vicryl stitch for subcutaneous tissue and 3-0 polyamide stitch for the skin. The suction drain was eliminated on the fourth or fifth postoperative day.

For the Karydakias flap, a lopsided circular entry point was made. A lopsided plan of the circular choice was arranged dependent on the auxiliary sinus openings. Another midline is attracted 2 cm corresponding to the first midline and an ellipse was drawn around this vertical line. The cut covered the essential just like every one of the auxiliary openings. The average cut was developed upward and a parallel entry point was extended with an angled edge. Tissue containing the essential, auxiliary sinus openings and sinus lots was extracted subsequent to developing the entry points where it counts to the gluteal sash as portrayed by Karydakias. The flap was stitched with 3-0 vicryl stitch in a subcutaneous plane in 2 layers and 3-0

polyamide for skin, in the wake of putting a pull channel. At last, the stitch line tumbled off the midline. For the two strategies, the pull channel was eliminated on the 4th or 5th postoperative day, contingent upon the measure of assortment. The stitches were taken out amidst the twelfth and fourteenth postoperative days.

Records of patient age, sexual orientation, side effects, usable method, employable time, length of clinic stay, postoperative entanglements like injury contamination and dehiscence, visual simple scale (VAS) scores of postoperative agony (on the day 15th and 30th), restorative disappointment (toward the finish of the third month) and repeats. Pain in surgical site and cosmetic disappointment were evaluated utilizing a visual simple scale score from 1 to 10. All patients went through follow-up assessments for the 3 months later the medical procedure. Short-term follow-ups ruined 3 months, telephonic subsequent meet-ups proceeded past 90 days.

Statistical analyses

Information investigation was acted in meeting with the main analyst of the establishment. A Student's t-test was utilized to think about age, employable time, length of medical clinic stay, resumption of day-by-day ordinary exercises as a parametric test to decide contrasts in two groups. Pearson's examination was utilized to think about inconveniences. A Manne Whitney U measurement investigation was utilized as a non-parametric test to decide contrasts in intergroup examinations of patients' VAS scores, time to stop pain-relieving medications, and time to sit upstanding without torment. P worth of <0.05 was taken as significant.

Ethical considerations

Consent from all the patients had been taken through the help of ethical forms which were provided to them before the study. These forms were submitted to the ethical committee of the Indira Gandhi Institute of Medical Sciences, Sheikhpura, Patna.

Results

Altogether, 54 patients (middle age, 25 years; range 14–45 years) were selected. Of these, 54 patients (90.74%) were males and 5 (9.25%) were females. The Karydakias flap group comprised 27 patients, and the Limberg flap group was made out of 27 patients. During the follow up the most incessant introducing side effects were seropurulent release (77.7%) and torment (31.48%). No distinctions were found amidst the groups for age, sex, and presentation of clinical disease. Clinical presentation and demographic data of the 2 groups are analyzed in Table 1.

Table 1. Demographic characteristics of 2 treatment groups

Characteristics p*	Karydakias (n=27)	Limberg (n=27)
Age (y)	23.45 ± 7.4	24.50 ± 7.2
Male/Female	25/2	24/3
Symptoms		
Purulent discharge	22	20
Pain	7	10

Data are expressed as mean SD or as numbers.

*P values <.05 were considered statistically significant

In the Limberg group, wound diseases in 3, and wound dehiscence in 4. Despite 1 of the injuries, rest recuperated totally with moderate treatment during the first month. The 1 patient required auxiliary stitching under local anaesthesia during the first month for wound dehiscence. Flap ischemia was not noted in both groups.

In the Karydakias group, wound contaminations in 2, and wound dehiscence in 2 were noted. Every one of them was mended totally with moderate treatment. No measurably huge contrast was seen in the circumstance of admittance to typical day-by-day movement, VAS score for torment at the activity site on the tenth day, repeat rate amidst the Karydakias and Limberg flap groups (P > .05).

Genuinely significant differences were recognized amidst the 2 treatment strategies for activity time, the number of difficulties, VAS

score for torment at the activity site on the 30th day, VAS score for the restorative fulfilment of the scars at the third month, length of medical clinic stay. The mean employable time for the Karydakias group (46.55 ± 9.5 minutes) was more limited as compared to the Limberg group (55.15 ± 7.65 minutes) (P =.01). The number of complexities in the Karydakias group (n=4[14%]) was lower as compared to the Limberg group (n=7[26%]) (P =.029). The VAS score for postoperative torment at the activity site on the 30th day was lower in the Karydakias group as compared to the Limberg group (2.44 ± 1.11 versus 3.55 ± 1.25, P=.01). The VAS score for fulfilment with the corrective appearance of the scars in the Karydakias group was 7.08 ± 1.75, while it was 3.16 1.40 in the Limberg group at the third month (P =.01). Length of medical clinic stay was altogether more limited in the Karydakias group as compared to the Limberg group (3.77 ± 1.03 versus 4.18 ± 1.30 days, P =.03). Albeit just 1 patient

(3.7%) in the Karydakis group created repeats inside 4 to a year, 2 patients (7.4%) created repeats inside 3 to 10 months in the Limberg

group; be that as it may, the thing that matters was not huge (P .151). The clinical results of the 2 groups are thought about in Table 2.

Table 2. Clinical outcomes of Karydakis and Limberg flap procedures for SPD

Outcome p*	Karydakis (n = 27)	Limberg (n = 27)
Operative time (min)	46.55 ± 9.5	55.15 ± 7.65
Length of hospital stay (d)	3.77 ± 1.03	4.18 ± 1.30
Resumption of normal daily activity (d)	9.29 ± 1.27	9.4 ± 1.29
VAS score for pain		
Postoperative day 10	6.13 ± 1.67	6.11 ± 1.70
Postoperative day 30	2.44 ± 1.11	3.55 ± 1.25
VAS score for cosmesis after 3 month	7.78 ± 1.92	3.47 ± 1.54
Number of complications	4(14%)	7(26%)
Wound dehiscence	2	4
Wound infection	2	3
Recurrence	1(3.7%)	2(7.4%)

Data are expressed as mean SD or as number (percentage).

*P values < .05 were considered statistically significant.

Discussion

The rate of SPD has been accounted to be somewhere in the range of .026% and .7%. A few elements like obesity, driving, profound natal split, male gender, young age, poor hygiene, increasing rates of illness. The etiopathogenesis of SPD is as yet a debatable topic. Despite the fact that speculations for the event of a pilonidal sinus have been founded on an embryologic beginning, the disease has generally been acknowledged to be brought about by an aggregation of hair entering the skin and to be a procured condition. The justification for the enormous acknowledgment of the obtained hypothesis might be the high repeat rates of up to 30% later than the most extreme nearby extractions of pilonidal disease, which recommends that a pilonidal sinus is a procured new disease rather than the ingenuity of some current sinuses.

Karydakis proposed that three elements identified with the advancement of this disease: the trespasser, comprising of free hair; a power that causes hair inclusion; and weakness of the skin to hair addition at the profundity of the natal cleft are solid confirmations supporting the procured hypothesis. Numerous surgeries for SPD have been grown, however, an absolute treatment approach with low intricacy and repeat rates has not been achieved yet. Simple extraction and essential conclusion or painful injury recuperating don't straighten the natal cleft and can't forestall the entrance inclination of hair to the skin at profundities of the natal parted and may prompt more quiet distress, a high midline repeat rate, and longer hospitalization. Day medical procedure with straightforward opening, curettage, brushing, or phenol infusion might eliminate hair and fix the sinus, however, the midline wound might require a little while to mend, and a critical repeat rate is noticed on account of the open entryway for hair addition.

Subsequent to explaining the procured idea of the ill, an ideal activity ought to be straightforward and have low confusion and repeat rates by straightening the natal parted with an off-midline conclusion; it ought to be related with negligible torment and wound consideration to diminish downtime from work and make the strategy savvier while forestalling a delayed clinic stay. Considering this broadly acknowledged idea, surgeries for SPD have changed for flap methods by broad specialists who treat SPD. The hypothetical point of a flap method is to straighten and lateralize the natal cleft, which ought to take out inclining etiopathogenetic factors for the pilonidal sinus and keep away from middle repeats. Flap strategies, for example, the V-Y progression or the Z-plasty procedure cover the injury imperfection by moving full-thickness skin and subcutaneous tissue into the midline deformity, yet they have been believed to be overtreatment for pilonidal sinus in view of huge tissue removals utilizing complex techniques. In late many years, the Karydakis and Limberg flap strategies have had low difficulty and repeat rates (0%–4.6%) contrasted and other flap systems and have acquired popularity.[2,5,8

– 13]. We accept that reviews looking at the Karydakis and Limberg flap methods might assist with settling the continuous discussions in regards to the best care treatment for SPD.

Ersoy et al detailed a randomized clinical review looking at momentary consequences of the Karydakis and the Limberg flap strategies in 100 patients. The review announced no complexities other than wound disease except for a fundamentally higher injury contamination rate later the Karydakis method (26%) contrasted and the Limberg flap (8%); wound disease rates were 2.9% for the Karydakis flap and 5.9% for the Limberg flap[13]. In our review, confusion rates (wound contamination and dehiscence) were altogether lower for the Karydakis flap (14%) than the Limberg flap (26%) strategy (P = 0.29).

The main boundaries for contrasting pilonidal sinus medical procedure results are the complexities during the early period and repeats during the late period. Tragically, no review has looked at the drawn-out aftereffects of the Karydakis and Limberg flap strategies. In our review, 2 repeats (7.4%) were created in the Limberg flap group, which would, in general, be higher than those in the Karydakis flap group (n = 1 [3.7%]), albeit the thing that matters was not critical (P = .151).

Based on our experience, the natal parted could be straightened, and tissue could be approximated without pressure, yet stitch openings and scars inside the intergluteal sulcus couldn't be moved horizontally from the midline, and the lower and upper shaft of the flap remained inside the intergluteal sulcus during the Limberg flap technique. All repeats happened at the lower flap shaft scar, and the stitches left there were in a great climate for perspiring, maceration, and infiltration of hairs during the early postoperative period in the Limberg group. Notwithstanding a straightened natal parted, victories utilizing the Karydakis technique might originate from the perception that the incisional line, scar, and all stitch line openings could be effortlessly moved along the side from the midline and that a positive climate for repeat could have stayed away from.

Mentes et al and some different creators have expressed a requirement for changing the Limberg flap method later their underlying experience. They revealed that the site of repeat, which was situated at the lower flap post, remained inside the intergluteal sulcus and demonstrated that this site was the most fragile mark of the Limberg flap. Subsequently, they altered the flap recreation by fitting the rhomboid extraction lopsidedly to put the lower flap shaft horizontal to the intergluteal sulcus and accomplished lower confusion and repeat rates. In such a manner, a significant review was directed by Can et al. They utilized a changed Limberg flap and contrasted it and a Karydakis flap, and the in general early intricacy and repeat rates in the groups were not measurably unique. In our review, the quantity of postoperative early difficulties in the Limberg group was higher as compared to the Karydakis group, however, the repeat rates amidst

the 2 groups were not fundamentally unique. Based on this information, it very well may be believed that a change of the Limberg technique may just decrease the early entanglement rate

contrasted and that of the Karydakakis system. The clinical results of these 3 investigations are momentarily thought about in Table 3.

Table 3. Results of different studies treatment techniques for PSD

Study rate %	Methods	Patients n	Wound infection rate %	Recurrence
Ates et al	Karydakakis flap versus Limberg flap	135/134	2.9/5.9	3.1/6.9
Can et al	Modified Limberg flap versus	72/73	3.9/4.4	5.4/4.8
Arslan et al	Limber flap versus modified Limberg flap versus Karydakakis flap	96/91	2.1/6.6	6.9/11
Present study	Comparative study of Limberg's flap vs Karydekis procedure in Pilonidal sinus surgery.	27/27	11.1/7.4	7.4/3.7

Activity time and postoperative torment are vital for the adequacy of a careful strategy. Usable time for the Limberg flap (55.15 ± 7.65 minutes) was longer as compared to the Karydakakis flap (46.55 ± 9.5 minutes) in our review (P .001). Albeit no critical contrasts were seen in the VAS score for postoperative torment at the activity site on the fifteenth day amidst the 2 groups, it was fundamentally lower in the Karydakakis group as compared to the Limberg group on the 30th day (P .01). The Limberg flap procedure is a complex technique in view of enormous tissue relocations, which bring about deadness and disappointment with the corrective appearance of the scars at the activity site. In a past report, Eryilmaz et al., who assessed the presence of flap scars, revealed that as numerous as 40% of patients were not satisfied with the presence of Limberg flap scars. In our review, the VAS score for fulfilment with the corrective appearance of the scars in the Karydakakis group was 7.78 ± 1.92 , though it was 3.47 ± 1.54 in the Limberg group (P<.01), what's more, the corrective appearance of the scars might be more significant for women than men.

Conclusion

The Karydakakis flap technique is preferred over the Limberg flap technique for treating simple and essential SPD as a result of its more limited length of emergency clinic stay, less operative time, better pain score, low postoperative inconvenience rate like injury contamination and wound dehiscence, and better superficial result and acknowledgment. All things considered, no huge distinction was found amidst the 2 surgeries in this review. The aftereffects of our review suggest the Karydakakis procedure as a favoured treatment of the illness. It is an effectively dominated and reproducible careful method.

References

- Schoeller, T., Wechselberger, G., Otto, A., & Papp, C. (1997). Definite surgical treatment of complicated recurrent pilonidal disease with a modified fasciocutaneous VY advancement flap. *Surgery*, 121(3), 258-263.
- Petersen, S., Koch, R., Stelzner, S., Wendlandt, T. P., & Ludwig, K. (2002). Primary closure techniques in chronic pilonidal sinus. *Diseases of the colon & rectum*, 45(11), 1458-1467.
- Søndena, K., Andersen, E., Nesvik, I., & Søreide, J. A. (1995). Patient characteristics and symptoms in chronic pilonidal sinus disease. *International journal of colorectal disease*, 10(1), 39-42.
- Ahmed, A. K., McCallum, I., King, P. M., & Bruce, J. (2010). Healing by primary versus secondary intention after surgical treatment for pilonidal sinus. *Cochrane database of systematic reviews*, (1).
- Karydakakis, G. E. (1992). Easy and successful treatment of pilonidal sinus after explanation of its causative process. *Australian and New Zealand Journal of Surgery*, 62(5), 385-389.
- Bascom, J. (1998). Skin flaps for pilonidal disease. *Annals of plastic surgery*, 41(3), 338.
- Nursal, T. Z., Ezer, A., Çalışkan, K., Törer, N., Belli, S., & Moray, G. (2010). Prospective randomized controlled trial

comparing V-Y advancement flap with primary suture methods in pilonidal disease. *The American journal of surgery*, 199(2), 170-177.

- Urhan, M. K., Küçükkel, F., Topgul, K., Özer, İ., & Sari, S. (2002). Rhomboid excision and Limberg flap for managing pilonidal sinus. *Diseases of the colon & rectum*, 45(5), 656-659.
- Kapan, M., Kapan, S., Pekmezci, S., & Durgun, V. (2002). Sacrococcygeal pilonidal sinus disease with Limberg flap repair. *Techniques in coloproctology*, 6(1), 27-32.
- Tekin, A. (2005). A simple modification with the Limberg flap for chronic pilonidal disease. *Surgery*, 138(5), 951-953.
- Akinci, O. F., Coskun, A., & Uzunköy, A. (2000). Simple and effective surgical treatment of pilonidal sinus. *Diseases of the Colon & Rectum*, 43(5), 701-706.
- Bozkurt, M. K., & Tezel, E. (1998). Management of pilonidal sinus with the Limberg flap. *Diseases of the colon & rectum*, 41(6), 775-777.
- Ersoy, E., Devay, A. O., Aktimur, R., Doganay, B., Özdoğan, M., & Gündoğdu, R. H. (2009). Comparison of the short-term results after Limberg and Karydakakis procedures for pilonidal disease: randomized prospective analysis of 100 patients. *Colorectal Disease*, 11(7), 705-710.
- Eryilmaz, R., Okan, I., Coskun, A., Bas, G., & Sahin, M. (2009). Surgical treatment of complicated pilonidal sinus with a fasciocutaneous VY advancement flap. *Diseases of the colon & rectum*, 52(12), 2036-2040.
- Akinci, Ö. F., Bozer, M., Uzunköy, A., Düzgün, Ş. A., & Coşkun, A. (1999). Incidence and aetiological factors in pilonidal sinus among Turkish soldiers. *The European journal of surgery*, 165(4), 339-342.
- Armstrong, J. H., & Barcia, P. J. (1994). Pilonidal sinus disease: the conservative approach. *Archives of Surgery*, 129(9), 914-918.
- Berry, D. P. (1992). Pilonidal sinus disease. *Journal of wound care*, 1(3), 29-32.
- Akinci, O. F., Kurt, M., Terzi, A., Atak, I., Subasi, I. E., & Akbilgic, O. (2009). Natal cleft deeper in patients with pilonidal sinus: implications for choice of surgical procedure. *Diseases of the colon & rectum*, 52(5), 1000-1002.
- Surrell, J. A. (1994). Pilonidal disease. *The Surgical clinics of North America*, 74(6), 1309-1315.
- da Silva, J. H. (2000). Pilonidal cyst. *Diseases of the colon & rectum*, 43(8), 1146-1156.
- Allen-Mersh, T. G. (1990). Pilonidal sinus: finding the right track for treatment. *Journal of British Surgery*, 77(2), 123-132.
- Al-Jaberi, T. M. (2001). Excision and simple primary closure of chronic pilonidal sinus. *European Journal of Surgery*, 167(2), 133-135.
- Abu Galala, K. H., Salam, I. M., Abu Samaan, K. R., El Ashaal, Y. I., Chandran, V. P., Sabastian, M., & Sim, A. J. (1999). Treatment of pilonidal sinus by primary closure with a transposed rhomboid flap compared with deep suturing: a prospective randomised clinical trial. *The European journal of surgery*, 165(5), 468-472.

24. Aydede, H., Erhan, Y., Sakarya, A., & Kumkumoglu, Y. (2001). Comparison of three methods in surgical treatment of pilonidal disease. *ANZ journal of surgery*, 71(6), 362-364.
25. Kitchen, P. R. B. (1996). Pilonidal sinus: experience with the Karydakias flap. *Journal of British Surgery*, 83(10), 1452-1455.
26. Anyanwu, A. C., Hossain, S., Williams, A., & Montgomery, A. (1998). Karydakias operation for sacrococcygeal pilonidal sinus disease: experience in a district general hospital. *Annals of the Royal College of Surgeons of England*, 80(3), 197.
27. Menten, B. B., Leventoglu, S., Cihan, A., Tatlicioglu, E., Akin, M., & Oguz, M. (2004). Modified Limberg transposition flap for sacrococcygeal pilonidal sinus. *Surgery today*, 34(5), 419-423.
28. Cihan, A., Ucan, B. H., Comert, M., Cesur, A., Cakmak, G. K., & Tascilar, O. (2006). Superiority of asymmetric modified Limberg flap for surgical treatment of pilonidal disease. *Diseases of the colon & rectum*, 49(2), 244-249.
29. Can, M. F., Sevinc, M. M., 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. *The American journal of surgery*, 200(3), 318-327.
30. Eryilmaz, R., Sahin, M., Alimoglu, O., & Dasiran, F. (2003). Surgical treatment of sacrococcygeal pilonidal sinus with the Limberg transposition flap. *Surgery*, 134(5), 745-749.

Conflict of Interest: Nil Source of support: Nil