

COMPARISON OF PILAT PROCEDURE AND CRYSTALLIZED PHENOL APPLICATION IN PILONIDAL SINUS SURGERY

Erkan Dalbaş¹, Ömer Lütfi Akgül², Abidin Tüzün³, Ercan Gedik⁴

¹Memorial Hospital General Surgery Clinic, Diyarbakır, Turkey.

²Genesis Hospital General Surgery Clinic, Diyarbakır, Turkey.

³Gazi Yaşargil Training and Research Hospital General Surgery Clinic, Diyarbakır, Turkey.

⁴Dicle University Faculty of Medicine Department of General Surgery, Diyarbakır, Turkey.

ABSTRACT

Background: Pilonidal sinus disease (PSD) is an infectious, chronic and benign disorder of the sacrococcygeal area, predominantly encountered in young men. The surgical treatment of PSD has a wide range from minimally invasive interventions to complex flap techniques, however there is no agreement on the surgical approach. Minimally invasive procedures such as crystallized phenol (CP) application, sinusotomy, and pilonidal sinus tract ablation with laser (PiLAT) are easily applied, need a short hospital stay, cause less postoperative pain and minimal tissue loss, and have good cosmetic results. In this study, we aimed to compare the data of PSD patients treated with minimally invasive methods, namely CP and PiLAT. **Material and Methods:** The files of 245 PSD patients who were treated with the CP or PiLAT in our clinic between January 2016 and January 2020 were retrospectively reviewed. The patients were divided into two groups: 120 patients in the CP group and 125 patients in the PiLAT group. Both group were analyzed for age, gender, the number of sinuses, duration of surgery, severity of postoperative pain and need for analgesics, duration of antibiotic use, postoperative complications (infection, hematoma, seroma, cosmetic), time to return to daily activities, satisfaction for procedure, body mass index (BMI) and recurrence rates. **Results:** The patients in the PiLAT group were discharged the next day after the procedure, while the patients in the CP group discharged on the same day ($p < 0.001$). The mean number of sinuses was 2.2 ± 0.25 in the CP group and 3.6 ± 0.81 in the PiLAT group, and the difference was statistically significant ($p < 0.001$). The mean dressing time was 3.1 ± 0.4 days in the PiLAT group, while it was longer, 9.5 ± 2.1 days, in the CP group ($p < 0.001$). **Conclusion:** CP and PiLAT procedures are minimally invasive methods that can be safely used in the treatment of PSD.

Keywords: Crystallized phenol; Minimally invasive; PiLAT; Pilonidal sinus disease; Surgery.

Corresponding Author:

Dr. Erkan Dalbaş, MD.

Affiliation: Memorial Hospital General Surgery Clinic, Diyarbakır, Turkey.

E-mail: erkandalbasi9@gmail.com

ORCID ID: <https://orcid.org/0000-0002-4652-1747>

Copyright © 2012- 2021 Dr Erkan Dalbaş. This is an open access article published under **Creative Commons Attribution -Non Commercial- No Derives 4.0 International Public License (CC BY-NC-ND)**. This license allows others to download the articles and share them with others as long as they credit you, but they can't change them in any way or use them commercially.

*****Published in December 31, 2020.

doi: <https://doi.org/10.46327/msrjg.1.000000000000208>

doi url: <https://doi.org/https://doi.org/10.46327/msrjg.1.000000000000208>

INTRODUCTION

Pilonidal sinus disease (PSD) is an infectious, chronic and benign disorder of the sacrococcygeal area, predominantly encountered in young men [1]. Although its incidence varies by geographical regions, it is approximately 25 per 100,000 individuals. In a study conducted among soldiers in our country, its incidence was found as 9% [2,3]. A number of theories have been put forward regarding the etiology of PSD, however it is not clear, and has

been believed to be an acquired disease. It is a member of the follicular occlusion tetrad consisting of hidradenitis suppurativa, acne conglobata, dissecting cellulitis of the scalp and PSD [4]. It is supposed that follicular obstruction in the apocrine glands triggers the pathological process that causes the disease [5]. Stiff body hair, poor hygiene and personal care, sitting for a long time, family history, obesity, and a deep natal cleft are risk factors for PSD [6,7]. The surgical treatment of PSD has a wide range from minimally invasive interventions to

complex flap techniques, however there is no agreement on the surgical approach [8]. Concerning the surgical approach for PSD, the main goal is to perform an easy-to-apply procedure causing minimal damage to tissues, needing a short hospital stay, causing less postoperative pain, having a low recurrence rate, and enabling return to social life in a short time [9,10]. Minimally invasive procedures such as crystallized phenol (CP) application, sinusectomy, and pilonidal sinus tract ablation with laser (PiLAT) are easily applied, need a short hospital stay, cause less postoperative pain and minimal tissue loss, and have good cosmetic results [11]. Phenol is an aromatic hydrocarbon compound, and is acidic. It is in crystalline form, and colorless at the room temperature. At body temperature, it turns into liquid and darkens in color. It has antiseptic, anesthetic and sclerotic effects. It can be used in liquid or crystalline form. It has been used in a number of centers for the treatment of PSD [12]. Another minimally invasive method is laser application, which is increasingly used in the medical field today. The laser probe is introduced through the expanded sinus orifice into the pouch, and the epithelium is destructed with the laser, and at the same time, the laser obliterates the sinus tract by shrinking it. Laser ablation of the pilonidal sinus tract is an easy-to-use method, and is getting more popular [13].

In this study, we aimed to compare the data of PSD patients treated with minimally invasive methods, namely CP and PiLAT.

MATERIAL AND METHODS

The files of 263 PSD patients who were treated with the CP or PiLAT in our clinic between January 2016 and January 2020 were retrospectively reviewed. Patients with recurrent PSD, the ones who had chronic systemic disorders, had previous drainage of pilonidal sinus abscess, and the ones who could not be contacted by phone or e-mail were excluded from the study, and at the end, 245 patients were included. The patients were divided into two groups: 120 patients in the CP group and 125 patients in the PiLAT group. Both group were analyzed for age, gender, the number of sinuses, duration of surgery, severity of postoperative pain and need for analgesics, duration of antibiotic use, postoperative complications (infection, hematoma, seroma, cosmetic), time to return to daily activities, satisfaction for procedure, body mass index (BMI) and recurrence rates. The patients treated in both groups were given detailed information about the treatment to be applied. An informed consent form was obtained from all patients. In the CP and PiLAT

groups, the procedures were performed by the same surgeon with the same equipment. Patient satisfaction was determined using a Likert scoring scale postoperatively (1: totally unsatisfied; 2: unsatisfied; 3: neutral; 4: satisfied; and 5: very satisfied). Postoperative pain was examined 24 hours after the procedure, with a visual analog scale (VAS; VAS 0: There's no pain ---VAS 10: Extremely severe pain). The mean follow-up period was 24 months (12-36 months). The patients that did not have outpatient follow-up records were invited to the clinic by phone. All patients were asked to use a depilatory cream to remove the hair from the proximal border of the sacrum until distal gluteal region, one day before the procedure. The patients were prescribed cefuroxime axetil 1 g/day, and paracetamol 500 mg p.o. after discharge. The patients were told to take daily showers, starting the next day after the procedure, then apply nitrofurazone cream over the surgical area. Patients in both groups were examined in the outpatient clinic on the 7th, 15th, 30th, 45th and 60th days after the procedure. Then, the patients were contacted by phone every six months, and the ones who had complaints were invited to the hospital. Laser epilation was recommended to all patients three months after the procedure, to prevent future recurrences. At the end of 8 weeks, the patients who had a sinus and a pouch with hair inside, in the area of surgery, were regarded to have a recurrence.

Surgical Procedures

Crystallized phenol method (CP): The patients were taken in the local anesthesia operating room, and placed in prone position. The surgical area was cleansed with 10% povidone iodine. A local anesthetic solution was infiltrated around the sinus orifice (lidocaine hydrochloride 20 mg/ml + epinephrine 0.0125 mg/ml). Then, the sinus orifices were enlarged with a clamp, and the hairs inside were removed. The epithelium of the cyst was debrided with a curette. Nitrofurazone cream (Furacin 2%) was applied around the orifices of the sinus to protect surrounding tissues from the caustic effect of phenol (**Figure 1**). CP liquefied at the body temperature. Pressure was applied with a sponge, and waited for 90 seconds. Then the debris that drained out in liquid form was cleaned. The pouch was debrided again with curette. The patients were discharged after the procedure. CP application was repeated in the presence of a sinus on the 30th day follow-up visit. The cost of the procedure was around \$ 70 per patient.



Figure 1: Crystallized phenol application:Outer mouths of all orifice have been expanded and hair lumps in the tracts were removed



Figure 2 : PiLAT procedure

PiLAT method: An ALFA TM diode laser was used. The diode laser emits 30-50 joules/cm of energy at a wavelength of 1470 nm, and the energy used is 10 W. The patients had surgery under spinal anesthesia and in prone position. The surgical region was cleaned with 10% povidone iodine. First, all orifices were enlarged with a clamp. The hairballs in the tracts were removed with a clamp (**Figure 2**). Then the debris was cleaned with a curette. Hydrogen peroxide solution diluted with isotonic saline was injected into the tracts through the orifices, then irrigated with 0.9% NaCl to remove the remaining hair and debris. The laser probe was then introduced through the orifice, and advanced to the top of the sinus tract. Energy applied was 10 W. The laser probe radiated energy at 360 degrees, and pulled back 1 cm every 5 seconds, to homogeneously seal and close the entire tract. This procedure was applied for all sinuses and sinus tracts, and all tracts were sealed. Then the tract's sealing was checked by trying to advance the probe again. After the procedure, the area was cooled with ice. External orifices were left open. The surgical area was covered with a sponge after applying a cream containing silver sulfadiazine. The patients were discharged the next day. The cost of this procedure was approximately \$ 300.

Statistical Analysis

The statistical analyzes were done with SPSS package program (Statistical Package for the Social Sciences ver. 10.0, SPSS Inc, Chicago, Illinois, USA). Continuous variables were expressed as mean \pm standard deviation. Categorical variables were expressed as percent (%). Normally distributed parameters were compared between groups using Student's t test. Parametric variables that did not show normal distributions were compared between the groups using MannWithney U test. Fisher's chi-square test was used to compare the categorical variables. $p < 0.05$ was considered as statistically significant.

RESULTS

There were 120 patients, 90 (75%) males and 30 (25%) females, in the CP group. Their mean age was 27.21 ± 8.45 years. In the PiLaT group, 88 (70.4%) of 125 patients were males and 37 (29.6%) of them were females, and their mean age was 26.74 ± 6.42 years. There was no significant difference between two groups in terms of age or gender ($p=0.18, p=0,31$). The demographic data of the patients are summarized in **Table I**.

Table I: Demographic data of patients

	CP (n=120)	PiLaT (n=125)	* pvalue
Gender			
Male	90 (75%)	88 (70.4 %)	
Female	30 (25 %)	37 (29.6 %)	0,31
Age	27.21 ± 8.45	26.74 ± 6.42	0,18

* $P < 0.05$ considered statistically significant

The patients in the PiLAT group were discharged the next day after the procedure, while the patients in the CP group discharged on the same day. The mean number of sinuses was 2.2 ± 0.25 in the CP group and 3.8 ± 0.81 in the PiLAT group, and the difference was statistically significant ($p < 0.001$). The duration of surgery was 15.45 ± 2.45 minutes in the PiLAT group and 14.35 ± 3.24 minutes in the CP group, and the difference was not statistically significant ($p > 0.05$). In both groups, the patients returned to their daily lives the next day after the procedure. VAS scores were similar in two groups ($P > 0.05$). The early postoperative period VAS pain score was 2.2 ± 0.5 in the PiLAT group, and 2 ± 0.3 in the CP group. A single dose of 500 mg paracetamol was sufficient for analgesia in both groups. The mean analgesic use was 2.1 ± 0.3 days in the PiLAT group, and 1.9 ± 0.5 days in the CP group, and the difference between the groups was not significant ($P > 0.05$). Complications such as abscess, hematoma or bleeding were not observed in any of

the groups. After 24 months of follow-up, the number of patients who were considered to have recurrence was 5 (4%) in the PiLaT group, and 9 (7,5%) in the CP group, and the difference was not statistically significant ($p > 0.05$). The mean dressing time was $3,1 \pm 0,4$ days in the PiLAT group, while it was longer, $9,5 \pm 2,1$ days, in the CP group ($p < 0.001$). The number of patients with recurrent CP application was 12 (10%) and in two of them, the sinus was closed after five sessions at most. The two groups were similar in terms of cosmetic results. The mean Likert satisfaction score was 4.3 ± 0.4 in the PiLAT group, and 4.2 ± 0.6 in the CP group, and the difference was not significant ($p > 0.05$). The mean BMI was 27.4 ± 1.4 kg/cm² in the PiLAT group, 26.9 ± 1.8 kg/cm² in the CP group, and the difference was not statistically significant ($p > 0.05$). The BMI of patients with recurrence in both groups were >30 kg/cm². Intergroup comparisons are summarized in **Table II**.

Table II: Outcomes of patients in both groups

Outcomes	CP (n=120)	PiLaT (n=125)	p* value
Mean operative time (minutes)	14.35 ± 3.24	15.45 ± 2.45	0.54
VAS pain score (0-10)	2.2 ± 0.5	2.1 ± 0.81	0.64
Satisfaction score (1-5)	4.2 ± 0.6	4.3 ± 0.4	0.80
Sinus score	2.2 ± 0.25	3.8 ± 0.81	$p < 0.001$
Dressin time (Day)	9.5 ± 2.1	3.1 ± 0.4	$P < 0.001$
Duration of A.T**(Day)	1.9 ± 0.5	2.1 ± 0.3	0.50
Recurrence (%)	5 (4 %)	9 (7.5%)	0.62

* $p < 0.05$ considered statistically significant; **A.T: analgesic therapy.

DISCUSSION

Although benign, PSD has a chronic course, and negatively affects the quality of life. The age and gender distribution of the patients in our study were compatible with the literature data. Even if PSD is controlled with conservative methods, its curative treatment is surgery [14]. The surgical options range from simple drainage to complicated flaps. The most successful method should have high patient satisfaction, and the lowest recurrence and complication rates [15,16]. In determining the ideal PSD surgery, the type of anesthesia, the cost of the procedure and the time to return to daily life are significant factors [17]. Minimally invasive methods are increasingly used in the treatment of PSD, due to their simple applicability, short hospital stay, low recurrence rates, rapid return to daily life, and good cosmetic outcomes [18]. Various studies have reported that minimally invasive methods such as CP and PiLAT are effective in the treatment of PSD. In our previous study, we compared the results of PiLAT and Limberg flap (LF) in PSD patients. In that study, we found the PiLAT group superior than

the LF group in terms of postoperative pain, analgesic need, surgery time, patient satisfaction, cosmetic outcomes, hospital stay and return to daily life. During the 12-month follow-up period, the recurrence rate was 4% in the PiLAT group and 3% in the LF group [19]. In this study, we compared the data of two minimally invasive methods, PiLAT and CP, in the treatment of PSD. Dessily et al. performed laser ablation therapy to patients with primary PSDs. The mean surgery time was 9.4 minutes. Complete recovery rate was 94%, and recurrence was 15.2%. Complications were seen in 15% of the patients. In our study, the recurrence rate was smaller (3%), however the duration of the procedure was longer [13]. In the study conducted by Paspas et al., patients were discharged on the same day. The mean duration of surgery was 24 minutes, which was shorter in our study. Among all, 92.8% of the patients returned to their daily activities after hospital discharge, and the recurrence rate was 2.9%. These data are compatible with the data of both groups in our study [20]. In the study conducted by Georgiou, PiLAT was applied to 60 patients diagnosed with PSD. The mean procedure duration was 32.3 minutes. In the first

week, 90% of the patients had a VAS pain score of 0. Analgesics were used only for two days in 11.6% of the patients. Of all, 92% of the patients recovered primarily. This rate was found as 96% in our study. Patient satisfaction was found as 98%. Sixty-five percent of the patients returned to their daily activities in the first 24 hours. All these data are compatible with the CP and PiLAT groups in our study [21].

Body hair is an important factor in PSD etiology. Pronk et al. showed that laser epilation was more effective than other methods in preventing recurrence after surgery. In our study, we recommended laser epilation after recovery to our patients in both groups. Studies which showed laser epilation as the first-line treatment option and performed on small patient groups reported improvement in 75% of the patients [22, 23].

Girgin et al. applied 6-8 laser epilation sessions before the CP procedure, then performed CP. 61.9% of the patients recovered after the first application, 78.5% of them recovered after three applications. They applied a maximum 8 sessions of CP. All patients recovered with repeated applications. In our study, we applied maximum five CP application sessions, and was applied to 10% of the patients [24]. Yüksel and Üstüner compared minimally invasive methods, sinusectomy and CP application, in the treatment of PSD. The recurrence rate was 4.5% in CP application, however it was found as zero in sinusectomy method. CP application was found to be superior in terms of bleeding. The recurrence rate in CP application was 7.5% in our study. The time to return to daily activities after the procedure are compatible with our study one day [25]. Geçim et al. did not find any significant difference in terms of recurrence between endoscopic method and CP application in the treatment of PSD [26].

Akan et al. compared CP application with LF surgery, which is a flap technique. They showed that CP application was successful in parameters such as hospital stay, cosmetic outcomes, wound problems, infection and seroma formation. Recurrence was more common in CP (12%) patients, however the difference was not statistically significant. In our study, we found the recurrence rate as 7.5% in the CP group and 4% in the PiLAT group [27]. Bayhan et al. compared CP application with modified LF surgery. They found the recurrence rate as 18.9% in the CP group. This rate was 6.8% in the modified LF group. They found a strong correlation between obesity and wound infection and recurrence. In our study, the BMI of the patients who had recurrence was $> 30 \text{ kg/cm}^2$ [28].

The benefit of using antibiotics after PDS surgery is controversial. In a study, the authors stated that

amoxicillin / clavulanic acid administered for five days after PSD surgery reduced infection rate. However, others emphasized that the use of antibiotics had no effect on wound healing [26,29,30]. In our study, patients were administered antibiotics after the procedure, however further studies with a control group are needed to prove whether antibiotics are beneficial.

CONCLUSION

In the literature review, we determined that this study is the first to compare CP and PiLAT procedures. The advantages of PiLAT application are that it is more effective in patients with numerous sinuses, the recurrence rate is smaller although it is not statistically significant, a single session is sufficient, and the need for dressing is less. The advantages of CP application are: it is not expensive, it can be applied with local anesthesia, and the patients are discharged on the same day after the procedure. In conclusion, we think that CP and PiLAT procedures are minimally invasive methods that can be safely used in the treatment of PSD due to their easy application, rapid wound healing, good cosmetic results, short procedure times, low pain and high satisfaction scores, and since the patients return to daily lives in a short time. Further multi-center, randomized controlled studies are needed for more detailed data.

CONFLICTS OF INTEREST

The authors have no ownership or commercial interest in any product or concept mentioned in this article. There are no conflicts of interest to declare. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The study has never been published before.

ETHICS COMMITTEE APPROVAL:

This study was approved by Gazi Yaşargil Education and Research Ethics Committee with the number 735.

AUTHORS CONTRIBUTION

Conceptualisation of the study, data acquisition, analysis and interpretation, and writing: Erkan Dalbaşı. Ömer Lütfi Akgül, Abidin Tüzün; interpretation and critical revision: Ercan Gedik, Erkan Dalbaşı. All authors agree with the submission.

REFERENCES

1. 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: 868-871. doi: 10.1136/bmj.39517.808160.BE
2. Sondena K, Andersen E, Nesvik I, et al. Patient characteristics and symptoms in chronic pilonidal sinus disease. *Int J Colorect Dis* 1995; 10:39-42. doi: 10.1007/BF00337585
3. Akinci OF, Bozer M, Uzunkoy A, Duzgun SA, Coskun A: Incidence and aetiological factors in pilonidal sinus among Turkish soldiers. *Eur J Surg* 1999; 165(4): 339– 42. doi: 10.1080/110241599750006875
4. Vasanth V, Chandrashekar BS. Follicular occlusion tetrad. *Indian Dermatol Online J.* 2014;5: 491–3. doi: 10.4103/2229-5178.142517
5. Yuksel M.E. Pilonidal sinus disease can be treated with crystallized phenol using a simple three-step technique. *Acta Dermatovenerol APA.* 2017;26:15-1. doi: 10.15570/actaapa.2017.4
6. Tokac M, Dumlu EG, Aydin MS, Yalcin A, Kilic M. Comparison of modified Limberg flap and Karydakias flap operations in pilonidal sinus surgery: prospective randomized study. *Int Surg* 2015;100(5):870–877. doi: 10.9738/INTSURG-D-14-00213.1
7. Chintapatla S, Safarani N, Kumar S, Haboubi N. Sacrococcygeal pilonidal sinus: historical review, pathological insight and surgical options. *Tech Coloproctol* 2003; 7: 3-8. doi: 10.1007/s101510300001
8. 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;190:388-392. doi: 10.1016/j.amjsurg.2004.08.068
9. Tavassoli A, Noorshafiee S, Nazarzadeh R. Comparison of excision with primary repair versus Limberg flap. *Int J Surg* 2011; 9: 343-346. doi: 10.1016/j.ijvsu.2011.02.009
10. Petersen S, Koch R, Stelzner S, Wendlandt TP, Ludwig K. Primary closure techniques in chronic pilonidal sinus: a survey of the results of different surgical approaches. *Dis Colon Rectum* 2002; 45: 1458-1467. doi: 10.1007/s10350-004-6451-2
11. Isik A, Eryilmaz R, Okan I, et al. The use of fibrin glue without surgery in the treatment of pilonidal sinus disease. *Int J Clin Exp Med.* 2014;7:1047-1051.
12. Dag A, Colak T, Turkmenoglu O, Sozutek A, Gundogdu R. Phenol procedure for pilonidal sinus disease and risk factors for treatment failure. *Surgery* 2012; 151: 113-117. doi: 10.1016/j.surg.2011.07.015
13. M. Dessily, M. Dziubeck, E. Chahidi, V. Simonelli. The SiLaC procedure for pilonidal sinus disease: long-term outcomes of a single institution prospective study. *Techniques in Coloproctology.* *Tech Coloproctol.* 2019 Dec;23(12):1133-1140. doi: 10.1007/s10151-019-02119-2.
14. Segre D, Pozzo M, Perinotti R, Roche B The treatment of pilonidal disease: guidelines of the Italian Society of Colorectal Surgery (SICCR). *Tech Coloproctol* 2015;19:607–613. doi: 10.1007/s10151-015-1369-3
15. Sahasrabudhe P, Panse N, Waghmare C, Waykole P. V-y advancement flap technique in resurfacing postexcisional defect in cases with pilonidal sinus disease-study of 25 cases. *Indian J Surg* 2012; 74: 364-370. doi: 10.1007/s12262-011-0403-6
16. Hosam R, Yasser A, Waleed A, Ibrahim A, Mokhtar F, Mohammed F. Rhomboid flap versus primary closure after excision of sacrococcygeal pilonidal sinus (a prospective randomized study). *EJS* 2010; 29: 4.
17. Ölmez A, Kayaalp C, Aydın C. Treatment of pilonidal disease by combination of pit excision and phenol application. *Tech Coloproctol* 2013; 17: 201-206. doi: 10.1007/s10151-012-0903-9
18. Meinerio P, Stazi A, Carbone A, Fasolini F, Regusci L, La Torre M. Endoscopic pilonidal sinus treatment: a prospective multicentre trial. *Colorectal Dis* 2015; 18:164–170. doi: 10.1111/codi.13322
19. Dalbaşı E, Akgül O.L. Comparison of Limberg Flap and PiLaT Procedure in Primary Pilonidal Sinus Treatment: Our Single Central Results. *Analytical and Quantitative Cytopathology and Histopathology.* 2020;42: 148-154.
20. Pappas AF, Christodoulou DK. A new minimally invasive treatment of pilonidal sinus disease with the use of a diode laser: a prospective large series of patients. *Colorectal Dis.*2018;20(8):207–214. doi: 10.1111/codi.14285
21. Georgios K. Georgiou. Outpatient laser treatment of primary pilonidal disease : the PiLaT Technique. *Tech Coloproctol.* 2018 Oct;22(10):773-778. doi: 10.1007/s10151-018-1863-5
22. Pronk AA, Eppink L, Smakman N, Furnee EJB. The effect of hair removal after surgery for sacrococcygeal pilonidal disease: a systematic review of the literature. *Tech Coloproctol* 2018;22:7–14. doi: 10.1007/s10151-017-1722-9
23. Fj Conroy, Kandamany N, Mahaffey PJ Laser depilation and hygiene: preventing recurrent pilonidal sinus disease. *J Plast Reconstr Aesthet Surg* 2008; 61:1069–1072. doi: 10.1016/j.bjps.2007.06.022
24. Girgin M, Kanat BH, Ayten R, et al. Minimally invasive treatment of pilonidal disease: crystallized phenol and laser depilation. *Int Surg.* 2012;97:288e292. doi: 10.9738/CC130.1
25. Yüksel E, Üstüner M.A. Comparison of Sinusectomy and Crystallized Phenol Procedure in Pilonidal Sinus Surgery. *Acta Oncologica Turcica* 2020;53-3;485-491. doi: 10.5505/aot.2020.33602
26. Gecim IE, Goktug UU, Celasin H, Endoscopic pilonidal sinus treatment combined with crystalized phenol application may prevent recurrence, *Dis Colon Rectum,* 2017, 60(4), 405–407. doi: 10.1097/DCR.0000000000000778
27. Akan K, Tihan D, Duman U, Özgün Y, Erol F, Polat M. Comparison of surgical Limberg flap technique and crystallized phenol application in the treatment of pilonidal sinus disease: a retrospective study. *Ulusal*

- Cer Derg 2013; 29: 162-166. Doi: 10.5152/UCD.2013.2457
28. Bayhan Z, Zeren S, Aydın S.A, Ucar B.I, Yumun H.N.A, Mestan M. Crystallized phenol application and modified Limberg flap procedure in treatment of pilonidal sinus disease: A comparative retrospective study. *Asian Journal of Surgery* (2016) 39, 172-177. doi: 10.1016/j.asjsur.2015.12.007
 29. Chaudhuri A, Bekdash BA, Taylor AL. Single-dose metronidazole vs 5-day multi-drug antibiotic regimen in excision of pilonidal sinuses with primary closure: a prospective, randomized, double-blinded pilot study. *Int J Colorectal Dis.* 2006;21:688–692. doi: 10.1007/s00384-005-0064-7
 30. Lundhus E, Gjøde P, Gottrup F, Holm CN, Terpling S. Bactericidal antimicrobial cover in primary suture of perianal or pilonidal abscess: a prospective, randomized, double-blind clinical trial. *Acta Chir Scand.* 1989;155:351–354.