



Treatment of pilonidal disease by phenol application

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ABSTRACT

The literature indicates various approaches regarding the properties of phenol, the target patient group, and the complication and recurrence rates. Although phenol is most frequently used to treat the fistulated form of the disease, it can also be applied for other types. The overall success and complication rates of the application is reported as 62-95% and 0%-2%, respectively. Phenol treatment in pilonidal disease can be used more frequently as an alternative method with acceptable success, complication, and recurrence rates.

Keywords: Non-surgical treatment, phenol, pilonidal disease

INTRODUCTION

Pilonidal disease (PD) is a chronic skin infection containing hair that presents with leakage. Although PD can be diagnosed in the axilla, umbilicus and between fingers, the majority of them are detected in the intergluteal sulcus at the pre-sacral area. Hodges first described pilonidal disease in 1880 by using the words 'pilus (hair)' and 'nidus (nest)' of Latin origin, meaning 'nest of hairs' (1). The incidence of this disease has been reported as 4.6% and is often seen in males at the age of 20-30 (2). PD is frequently encountered in clinical practice and causes serious chronic complaints.

The debate about the etiology of PD continues on whether the disease is congenital or acquired (3-5). New treatment methods of pilonidal sinus have evolved following determination of etiologic physiopathology. In recent years, the cause of PD is accepted as hair from the head, back and gluteal regions that falls into the intergluteal sulcus over time. These are believed to penetrate into the skin and reach the subcutaneous tissue, then microorganisms cause chronic anaerobic inflammation that in turn leads to abscess formation (3, 6). There are various surgical and non-surgical methods for its treatment (3, 4, 7). Approximately 15 different surgical techniques have been defined (5). None of these surgical techniques are defined as 'gold standard'. Despite improvements in surgical treatment of the disease, the delay to return to work due to the prolonged length of hospital stay and healing time increase cost (3, 8, 9). As a result, operated patients might be unsatisfied.

The success of phenol treatment in pilonidal disease is related to its easy application, low cost, and rapid healing process. The initial use of pure phenol was described by Notaras and Goodall under local anesthesia in 1964 as a form of non-surgical treatment (10). The incidence of PD in our country is increasing, and phenol is being used more frequently. Our researchers' contribution to the literature on this issue is growing (9, 11).

There is no standardization for phenol application, and each surgeon manages the procedure according to his/her own experience. The aim of this study was to investigate the properties of phenol used for the treatment of pilonidal disease, the application techniques, overall success and complications rates, as well as to define the patient group by a literature search.

METHOD

A Pubmed search was performed for relevant studies between January 1987-October 2015 with the key words "pilonidal disease, pilonidal sinus and phenol" in English. In addition, a Google Academic search in Turkish was performed. The literature was analyzed to identify eligible studies that included the concentration of phenol, the success rates and the complications. The complications that occurred within 60 days after the procedure were accepted as complications, whereas treatment failure and disease relapse were not considered as complications. Patients younger than 18 years of age and those with a disease outside the pre-sacral region were excluded from the study.

PROPERTIES OF PHENOL

Phenols are a class of compounds consisting of a hydroxyl group (-OH) bonded directly to a benzene ring. Phenol solution [aqueous] is a white crystalline mass that is dissolved in an aqueous solution. Phe-

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nol is colorless if pure and crystalline solid shaped at room temperature. Phenol is a caustic, antiseptic, germicide, and poor sclerosing agent, and has a local anesthetic effect (12). Phenol denatures proteins in the cell membrane at densities higher than %5. As a result, cell membrane and cellular proteins are dissolved. Phenol causes caustic burns on the skin without pain (13). Hairs are made of proteins which consist of keratin in the form of polypeptide. Hair is formed by a dense protein called keratin. Hairs that cause PD are denatured quickly by phenol at high density.

It has been reported that inappropriate debridement and hair that is stuck in the edge of a sinus are responsible for recurrence and poor healing (9, 14). Phenol application, owing to its minor sclerosing effects, provides quick recovery by increasing granulation and fibrosis (9, 13, 15). Due to the anesthetic effect of phenol, patients experience minimal pain in the postoperative period (16, 17).

In which form and what density should phenol be applied? The answers to these questions have not been clarified in the literature so far. The concentration of phenol solution used in clinical practice varies between 25-80% (15, 18, 19, 20). In addition, several forms of phenol such as cream-gel, liquid and crystalline form can be applied (14, 15, 19, 21). Phenol destroys all biological structures at a density higher than %5. Therefore, a minimum density of 25 % is aimed for the use of phenol application. In a study, low concentrated phenol (%40) has been reported to be as effective as high concentrated phenol (80%), with a lower rate of complications and a faster recovery (19). But most studies indicate that application of high density phenol (%85) yields better results (14, 20, 22).

The size of the sinus is an important factor for the success of this treatment. The volume of the sinus sac is reported to be around 1-5 cm³ (14). As a result of procedures like hair removal from the sinus and curettage of granulation tissue, an amount of bleeding and serous leakage occurs that in turn fills the small sinus sac immediately. As a result, the concentration of phenol applied to the sinus decreases rapidly, and the phenol concentration might not be enough for the chemical cauterization of hair that cause the disease, chronic infection, and debris. Phenol application at a high concentration of 80% overcomes these problems. It has been reported that 80% phenol provides better success rates as compared to 30% phenol (23).

The form of phenol applied varies according to individual clinical experience. A success rate of 86.5% has been reported for cream-gel form of phenol applied to the pre-sacral area (15). The success rates of liquid and crystalline phenol have been reported to be similar (9, 22, 24). Crystalline phenol melts at body temperature, thus showing its effects in the liquid form. The liquid phenol is crystallized at a temperature of 10-15°C. Cold storage of crystallized phenol, its transportation and storage in the operation room may be challenging.

METHOD OF PHENOL APPLICATION

The ideal phenol application method has not yet been defined. Except the initial period of this technique, i.e. after the 1990s, almost all patients were discharged from the hospital at the same day after the procedure (9, 25, 26). The procedure has been done under local anesthesia instead of general anesthesia for the last 20-25 years (9, 18, 27, 28). Some cases with lo-

cal anesthesia combined with sedation has also been reported (11). Majority of the procedures were applied in the same day operating room in the outpatient clinics. The main advantage of this method is its being a same-day surgical procedure. If there are no comorbidities such as DM, prophylactic antibiotics are not recommended (14, 29).

The prone and jack knife positioning can be used for better exposure of the operative site. The position may be changed according to patient and surgeon preference. Hair clipping is performed before application. First, the hair, debris and granulation tissue are extracted from within the sinus under local anesthesia. The remaining and/or unaccessible tissues are further destroyed chemically by phenol application while the sinus cavity is sterilized. It is recommended that any sinus orifice smaller than 3 mm should be enlarged to apply phenol much easier and more comfortably (9, 11). Orifice dilation is often achieved by a clamp, but in some cases either a small incision is done or a 1 cm diamond shaped skin is excised along with the sinus orifice (9, 16, 27, 30, 31).

Expansion of the sinus orifice provides better exposure in all phases of the operation, as well as preventing early closure of the sinus by granulation and epithelialization. The curettage of the sinus is often done in order to remove granulation tissue (24, 31, 32). Some authors use a clamp to evacuate the sinus contents, while others clean the sinus with a gauze sponge (11, 17, 20, 22). Cleaning all the sinus content increases the effectiveness and benefits of phenol application. Management of the hemorrhage and serous leakage within the sinus is also important. These can seriously decrease chemical cauterization effectiveness of the phenol by decreasing its intensity applied to the sinus. It has been reported that microbiologic evaluation of sinus content does not help in understanding either disease etiology or treatment process (16). Sampling for culture and antibiotic susceptibility is required in case of an acute abscess.

Vaseline and antibiotic ointment is often used for skin protection prior to phenol application (14, 26). 70% ethyl alcohol is applied on the skin to neutralize the caustic effect of phenol (11). All the field except the application area must be protected from phenol, especially the perianal region close to the anal verge. Phenol that overflows from the sinus orifice can cause serious complications.

How much and how should phenol be applied into the sinus? The methods are various. There are techniques that adjust the amount of phenol based on sinus volume measurements (14, 16, 31). The amount of phenol in the application is usually determined by injecting a certain amount of phenol solution into the sinus and then by checking the overflow from the other sinus orifice (1, 18, 30). Extra attention must be paid to prevent leakage of the excess phenol to the skin. 2-5 gr crystalline phenol is filled into the sinus with the aid of a clamp, it quickly dissolves at body temperature, the excess phenol drains out of the sinus, and is removed carefully from the region. In some other cases, 1-4 mL of liquid phenol is injected by using a venous catheter into the sinus (14, 16, 17, 19, 21, 30). Phenol impregnated into small piece of cottons can also be used (11, 31). Phenol is kept in the sinus for approximately 1-3 min. Liquid phenol application is repeated 1-4 times.

Dogru et al. (22) force the excess phenol to drain by pressing onto the sinus 2 minutes after the application. In contrast to other methods, they do not apply any more phenol at the same session. It has been suggested that the sinus should be irrigated with saline solution in order to remove phenol from the area after application (21). Duration of the phenol in the sinus tract is an important factor for success of the application. Many studies have reported the duration of phenol in the sinus as approximately 2-8 min (20, 27, 31, 33). However, in one study, it has been reported that protein structure of the hair was destructed at least 9 min after phenolization (23). In this respect, it should be kept in mind that several publications reported that the hair in the sinuses might not have been broken down entirely. At the end of all applications, the operation was finished by closing the operation area with a gauze, without applying any special dressing.

Every surgeon has his/her own unique approach for postoperative clinical observation. In some studies, patients have been followed-up each week periodically (19, 31, 33). More frequent follow-up schedules have been reported as 1, 3, 5, 7, 15 days after the operation (16). Some surgeons examine the patients in every 3 weeks (20, 24). In some studies, they offer 3 week follow-up periods after 1st, 2nd, and 4th week follow-ups (34). The main objective of this approach is to observe the complications in the early stage, and to repeat the phenol application. It should be noted that patients should be examined by the team of operating surgeons at the designated intervals (We recommend weekly follow-up during the first two months, postoperatively).

PATIENT FEATURES

The medical history, complaints and signs of the disease should be investigated in the initial evaluation and diagnosis of patients. Also, risk factors and comorbidities like diabetes mellitus must be evaluated. In differential diagnosis of pilonidal sinus, it is important to distinguish hidradenitis suppurativa, anal fistulas and fissures, anal condyloma and perianal manifestations of Crohn's disease. Digital rectal examination should be performed for the differential diagnosis of perianal manifestations. Especially in case of difficulty in differentiating fistulas, magnetic resonance imaging (MRI) fistulography, colonoscopy, or probing the fistula tract can be preferred. Sometimes, PD may co-exist with perianal diseases simultaneously. The final diagnosis and treatment priority should be managed specifically in such patients.

Physical examination and medical history are important for treatment planning. It has been reported that presence of recurrent abscess drainage and the number of sinus orifices affect the results of phenolization. In a study, Dag and et al. (14) have identified the presence of three or more orifices in the intergluteal area as a negative risk factor for the failure of the phenolization. The importance of number of sinus orifices are highlighted in a few studies (14, 16, 22). According to Bascom's studies, a deep intergluteal sulcus has a role both in formation of the disease and in wound healing (5). None of the publications related to phenolization has considered this issue when selecting patients. Similarly, obesity has been reported as a risk factor in patients with PD (33, 35). This particular patient group with deep intergluteal sulcus or obesity might not benefit from phenol application.

The status of a sinus affects the decision of phenol application. Patients are evaluated in four different clinical forms of symptomatic disease, those with acute abscess, chronic form, fistulized form, or complex form (4, 36). Pilonidal disease with acute abscess are generally considered as an exclusion criterion in studies on phenol application (14, 17, 31, 37). Similarly, pilonidal disease with acute abscess was excluded from our study. However, some authors advocate that it can also be applied during acute disease process (16, 22, 26, 34). Application of phenol can be more comfortable for both the patient and the doctor after treatment of an acute abscess. The approach to complex PD and relapses is also similar. Nevertheless, successful treatment results with phenol application on these patients have also been reported (34, 38). Phenol is most frequently applied to patients with chronic fistulized form (11, 16, 39). In both surgical and non-surgical treatments of PD, relapses can be a nightmare for surgeons. Phenol application is used by some surgeons after relapse as a last resort. Despite all these, there is need for comprehensive studies to identify the eligible patient group for phenol application.

THE SUCCESS OF PHENOL APPLICATION

There is no consensus on the definition of success and failure of phenol application for pilonidal disease. Improvement is defined as ceasing of the leakage and epithelization of the sinus tract. Some studies have published approaches based on symptomatic healing (21). Table 1 outlines the success rates of phenol application. In our study, we evaluated success rates as well as factors affecting successful outcome. According to the present literature, regardless of the characteristics of the patient, the overall success rate is reported as 62-95% in pilonidal disease (Table 1). The number of applications at different time periods is suggested as the most important data affecting outcome. The success rate of phenol application increases with multiple procedures. (20, 24, 27). Removal of residual hair and sinus curettage at different periods increase success rates. The number of sinus orifices that provide drainage and the width of the orifices have also been reported as factors that correlate with success rates (14, 22). These factors should be further analyzed, and management should be carefully planned before phenol application.

In some studies, phenol application has been reported to be as successful as surgical treatments for PD (18, 22). Treatment of PD with phenol should be accepted as a better choice according to these success rates and benefits. In a study from Konya/Turkey, the rate of phenol application has been reported as more than 90% at training and research hospitals (40). The popularity of phenol treatment increases among patients and doctors due to its ease of application, faster return to work, low cost, and low complication rates.

Generally, it has been reported that recurrence rates with phenol treatment are higher than that of surgical treatment. In this patient group, re-application of the operation discourages surgeons and brings extra stress regarding the possibility of second and third failures. Phenol is applied as a last resort in practice. Successful results have been reported for the recurrence of PD by repeated phenol applications (34). The recurrence rate in our study was 0-13.9%; however, follow-up periods were short. There are studies indicating that a follow-up of 5 to 10-years is the gold standard to evaluate results (37, 41).

Table 1. Results of phenol application in PD

Author	n	Number of applications per patient	Healing rate (%)	Complications (%)	Relapse (%)	Follow-up periods (Month)
Ataallah (2015) (27)	76	1 1.1 (1-3)	74 86	-	-	16
Girgin (2014) (24)	48	1 2 (1-6)	64.5 94.5	0 0	0 0	22
Akan (2013) (18)	42	1	88	12	12	26
Girgin (2012) (20)	42	1 1-8	61.9 90.5	-	0 0	24
Dag (2012) (14)	76	1-3	67	15.2	2	25
Ölmez (2012) (32)	83	3	86.7	-	-	20
Sakçak (2010) (19)	112	1	77.7	11.7	4.2	34
Aygen (2010) (34)	36	3.7 (1-7)	91.7	8.3	13.9	54
Kayaalp (2010) (31)	30	1	70	10	13.3	14
Kaymakcioglu (2005) (16)	143	1	92	16	8.3	24
Dogru (2004) (22)	41	1-6	95	0	5	24
Schneider (1994) (25)	42	1	60	13	-	-
Kelly (1988) (21)	54	1 (1-5)	70	4.5	-	-
Hegge (1987) (26)	48	1-9	94	-	6.3	36

PD: pilonidal disease; Number of applications per patient: the average number of injections applied at different times; -: no data

Doll noted that only %60 of recurrences develop within the first two years, and thus recurrences should be evaluated in the suggested periods rather than only focusing on short term results (37). Accordingly, none of the studies in table 1 meets this criteria.

THE COMPLICATIONS OF THE APPLICATION

Complication rates of phenol application are reported within acceptable limits, approximately 0-15.2%. Table 1 shows the complication rates from various studies. The most frequent morbidities of phenol application are irritant contact dermatitis and superficial cellulitis (9, 11, 14, 31). The anal region and the area out of the surgical field should be protected during the procedure to prevent the devastating effects of phenol. It might cause severe burns that may not be immediately painful, due to its anesthetic properties. Burns are easily treated with antibiotic ointment and analgesic tablets within 2-4 days. The surgical team should keep in mind the powerful caustic effect of phenol. Cellulitis and abscess are the other frequent complications of phenol application, which can be treated by superficial antibiotic ointment, oral antibiotics and drainage. In some studies, it is recommended that slight pressure should be periodically applied on the sinus to prevent debris formation within the sinus (23). One of the most beneficial parts of phenol application is the fact that patients can tolerate it easier than other methods, and that the recovery is fast. The complications do not exert a negative effect on quality of life.

CONCLUSION

Phenol application is a safe procedure for the treatment of pilonidal disease. It offers a good quality of life and satisfaction to patients (17, 23). The rate of cosmetic problems is high with

surgical methods (18). Phenol application does not change the anatomic structure of the affected area. Despite the increase in published studies on this issue, almost all of them except two have a retrospective design (16, 23). The ideal treatment of PD should be; a simple procedure with short length of hospital stay, improved pain and comfort, performed under local anesthesia if possible, cost-effective, associated with low complication and high success rates, and should be applicable by all surgeons. Although there is no treatment that can fulfill all the listed requirements, the management plan is based on these criteria.

In conclusion, treatment of pilonidal disease with phenol application is an acceptable method that can be readily applied with relevant success and complication rates. Less invasive treatments should be planned as first-line treatment, and be applied before surgery. This approach is an alternative treatment method to surgery that suggests high success rates with less postoperative pain and more comfort. Phenol application is one of the most popular procedures among techniques used for the treatment of pilonidal disease. Multi-center prospective randomized studies should be performed on the treatment of PD by phenol application.

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References

- Hodges RM. Pilonidal sinüs. *Boston Med Surg J* 1880; 103: 485-486. [CrossRef]
- Aysan E, İlhan M, Bektas H, Kaya EA, Sam B, Buyukpinarbasili N, et al. Prevalence of sacrococcygeal pilonidal sinus as a silent disease. *Surg Today* 2013; 43: 1286-1289. [CrossRef]
- Hendren S, Hammond K, Glasgow SC, Perry WB, Buie WD, Steele SR, et al. Clinical practice guidelines for ostomy surgery. *Dis Colon Rectum* 2015; 58: 375-387. [CrossRef]
- Tezel E. Pilonidal hastalığın cerrahi tedavisi. *MN Medikal-Nobel* 2009; 5-17.
- Bascom J. Pilonidal disease: origin from follicles of hairs and results of follicle removal as treatment. *Surgery* 1980; 87: 567-572.
- Karydakís GE. New approach to the problem of pilonidal sinus. *Lancet* 1973; 2: 1414-1415. [CrossRef]
- Kanat BH, Sözen S. Disease that should be remembered: Sacrococcygeal pilonidal sinus disease and short history. *World J Clin Cases* 2015; 3: 876-879. [CrossRef]
- Nordon IM, Senapati A, Cripps NP. A prospective randomized controlled trial of simple Bascom's technique versus Bascom's cleft closure for the treatment of chronic pilonidal disease. *Am J Surg* 2009; 197: 189-192. [CrossRef]
- Kayaalp C, Aydın C. Review of phenol treatment in sacrococcygeal pilonidal disease. *Tech Coloproctol* 2009; 13: 189-193. [CrossRef]
- Goodall P. The aetiology and treatment of pilonidal sinus. A review of 163 patients. *Br J Surg* 1961; 49: 212-218. [CrossRef]
- Arık MK, Borazan E. Pilonidal sinüste minimal invaziv cerrahi ile kombine fenol uygulamalarımız. *Anatol J Clin Investig* 2011; 5: 165-168.
- Cengiz T. Endodonti 4. Baskı, Barış Yayınları, İzmir, 267, 1996.
- CA Lahoud, JA March, DD Proctor. Campho-Phenique ingestion: an intentional overdose. *South Med J* 1997; 6: 647-648. [CrossRef]
- 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. [CrossRef]
- Aksoy HM, Aksoy B, Egemen D. Effectiveness of topical use of natural polyphenols for the treatment of sacrococcygeal pilonidal sinus disease: a retrospective study including 192 patients. *Eur J Dermatol* 2010; 20: 476-481.
- 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: 21-24. [CrossRef]
- Topuz O, Sözen S, Tükenmez M, Topuz S, Vurdem UE. Crystallized phenol treatment of pilonidal disease improves quality of life. *Indian J Surg* 2014; 76: 81-84. [CrossRef]
- 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.
- Sakçak I, Avşar FM, Coşgun E. Comparison of the application of low concentration and 80% phenol solution in pilonidal sinus disease. *JRSM Short Rep* 2010; 30: 1-5. [CrossRef]
- Girgin M, Kanat BH, Ayten R, Cetinkaya Z, Kanat Z, Bozdağ, A et al. Minimally invasive treatment of pilonidal disease: crystallized phenol and laser depilation. *Int Surg.* 2012; 97: 288-292. [CrossRef]
- Kelly SB, Graham WJ. Treatment of pilonidal sinus by phenol injection. *Ulster Med J* 1989; 58: 56-59.
- Dogru O, Camci C, Aygen E, Girgin M, Topuz O. Pilonidal sinus treated with crystallized phenol: an eight-year experience. *Dis Colon Rectum* 2004; 47: 1934-1938. [CrossRef]
- Emiroglu M, Karaali C, Salimoglu S, Sert I, Ugurlu L, Aydın C. Comparison of the application of low (30%) and high (80%) Phenol in the Treatment of Pilonidal Sinus Disease; the early results of a prospective randomized study. *Int Surg* 2016; 101: 127-132. [CrossRef]
- Girgin M, Kanat BH. The results of a one-time crystallized phenol application for pilonidal sinus disease. *Indian J Surg* 2014; 76: 17-20. [CrossRef]
- Schneider IH, Thaler K, Köckerling F. Treatment of pilonidal sinuses by phenol injections. *Int J Colorectal Dis* 1994; 9: 200-202. [CrossRef]
- Hegge HG, Vos GA, Patka P, Hoitsma HF. Treatment of complicated or infected pilonidal sinus disease by local application of phenol. *Surgery* 1987; 102: 52-54.
- Ataallah W, Coşkun Ş, Coşkun M, Solmaz A, Yegen C, Gencosmanoglu R. The impact of crystalline phenol application as a minimal invasive treatment modality for pilonidal sinus disease. *Turk J Colorectal Dis* 2015; 25: 28-33.
- Milone M, Musella M, Di Spiezio Sardo A, Bifulco G, Salvatore G, Sosa Fernandez LM, et al. Video-assisted ablation of pilonidal sinus: a new minimally invasive treatment—a pilot study. *Surgery* 2014; 155: 562-526. [CrossRef]
- Byrne DS, Caldwell D. Phenol cauterization for ingrowing toenails: a review of five years' experience. *Br J Surg* 1989; 76: 598-599. [CrossRef]
- Baqir QK. The role of phenol injection in the treatment of pilonidal sinus disease. *Bas J Surg* March 2009; 15: 78-80.
- Kayaalp C, Olmez A, Aydın C, Piskin T, Kahraman L. Investigation of a one-time phenol application for pilonidal disease. *Med Princ Pract* 2010; 19: 212-215. [CrossRef]
- Ölmez A, Kayaalp C, Aydın C. Treatment of pilonidal disease by combination of pit excision and phenol application. *Tech Coloproctol* 2013; 17: 201-206. [CrossRef]
- Harlak A, Mentés O, Kilic S, Coskun K, Duman K, Yılmaz F. Sacrococcygeal pilonidal disease: analysis of previously proposed risk factors. *Clinics* 2010; 65: 125-131. [CrossRef]
- Aygen E, Arslan K, Dogru O, Basbug M, Camci C. Crystallized phenol in nonoperative treatment of previously operated, recurrent pilonidal disease. *Dis Colon Rectum* 2010; 53: 932-935. [CrossRef]
- Cubukçu A, Gönüllü 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: 173-175. [CrossRef]
- Bascom J, Bascom T. Utility of the cleft lift procedure in refractory pilonidal disease. *Am J Surg* 2007; 193: 606-609. [CrossRef]
- Doll D. 5- and 10-year recurrence rate is the new gold standard in pilonidal sinus surgery benchmarking. *Med Princ Pract* 2010; 19: 216-217. [CrossRef]
- Mentes O, Bagci M, Bilgin T, Ozgul O, Ozdemir M. Limberg flap procedure for pilonidal sinus disease: results of 353 patients. *Langenbecks Arch Surg* 2008; 393: 185-189. [CrossRef]
- Doll D, Friederichs J, Boulesteix AL, Düsel W, Fend F, Petersen S. Surgery for asymptomatic pilonidal sinus disease. *Int J Colorectal Dis* 2008; 23: 839-844. [CrossRef]
- Karahan Ö, Eryılmaz MA, Sevinç B, Köksal H, Aksoy N, Aksoy F. Konya'da pilonidal sinüs tedavisindeki değişim. *Genel Tıp Derg* 2010; 20: 133-136.
- Doll D, Krueger CM, Schrank S, Dettmann H, Petersen S, Duesel W. Timeline of recurrence after primary and secondary pilonidal sinus surgery. *Dis Colon Rectum* 2007; 50: 1928-1934. [CrossRef]