

Pilonidal sinus: Surgical outcome of lay open versus primary closure technique

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Abstract :

OBJECTIVES: To compare the outcome of lay open versus primary closure technique of pilonidal sinus (PNS) in terms of bleeding, infection, hospital stay, wound healing and recurrence.

METHODOLOGY: This study was conducted at the surgical outpatient clinic in Hyderabad, India during the period February 2013 to February 2016. The study included Sixty four cases of pilonidal sinus. The choice of surgical procedure was given to the patient with consent form. Patients were followed up till 1 years for post complications and recurrence. Statistical analysis was done using chi square test.

RESULTS: Out of 64 patients, 53 were male (83 %) and 11 were female (17%) with the mean age of 28+/-6 years. 37% patients opted lay open procedure and 27% primary closure technique. 44% of patients presented with painless discharging sinus and 31% showed only sinus without discharge. In terms of duration of stay in hospital in lay open method is of 4 Days and 2 days for primary closure technique. The statistical analysis showed significant p value. In terms of healing, it took an average of 6 weeks for wound epithelisation in lay open technique and 3 weeks in primary closure techniques. Post operative bleeding noted in 22% of patient with lay open technique and wound infections noted in 22% of patient with primary closure method. The rate of recurrence after 1 year of follow up, 5% of cases showed recurrence with lay open method and 15% of case with primary closure. The statistical analysis showed no significant p value.

CONCLUSION: The present study concludes that primary closure can also be considered as a choice of surgical technique in treatment of pilonidal disease.

Keywords - lay open method, primary closure, pilonidal sinus disease, postoperative bleeding, recurrence, surgical management.

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I. Introduction

The term pilonidal sinus is derived from the latin name where "pilo means hair" and "nidus meaning nest" and forms a sinus track and thus called as pilonidal sinus. Pilonidal sinus disease was first described by Herbert Mayo in 1833 and further Hodges in 1880 named and is diagnosed by the finding of a characteristic epithelial track (the sinus) situated in the skin of the natal cleft, a short distance behind the anus and generally containing hair. His theory in terms of origin follows: "Short, loose hairs from the surface, in people of un-clean habits, accumulate in a postanal dimple, excoriate the skin and work their way into the deeper tissues, causing a sinus"[1].

Buie noted its prevalence in male, military recruits who drove jeeps and thus characterized it as "jeep disease." Pilonidal disease was most notable during World War II when an estimated 80,000 soldiers became afflicted and lost significant time from active duty[2]. John P in 1961 defined pilonidal sinus as "A pit of variable depth lined by epithelium or granulation tissue, -which may lead to a cavity, often containing hair and which is liable to formation of abscess and secondary sinuses"[3]. When the cavity is present it is often referred to as a pilonidal cyst. Pilonidal sinus is a common health problem of the sacrococcygeal region, it occurs mainly in young men [4]. It is acquired chronic disease located in the natal cleft, with its etiology based on the presence of hair follicles in the gluteal crease. Accumulation of hair over time, along with dirt and sweating of the area, leads to the creation of a subcutaneous cyst in the intergluteal region. Natural progression of the disease leads to the formation of sinus, as the cyst tries to exude itself [5,6]. This disease has a considerable impact on the quality of work life. This disease has shown association with certain occupancies involving a lot of time sitting, such as truck drivers, student and office workers. Pilonidal sinus disease has got a higher social impact due to its location and presentation, with pain in the sacrococcygeal region being the most common clinical symptom [7].

The etiology of pilonidal sinus is controversial. The question concerning the origin of these lesions has been a subject of debate for more than 100 years. The earliest writers considered the lesions to be Developmental defect. Two theories were proposed for cause of pilonidal sinus, one is developmental and other

is acquired theory. Developmental theory describes the cause as there are epidermal rests with hair embedded below the dermis in the midline as a result of failure of fusion. Acquired theory suggest that local trauma, poor hygiene, excessive hairiness and presence of deep natal cleft could be the cause of pilonidal sinus. The most popular theory today, Karydaki hypothesis claims that one or a combination of three factors is necessary for the pathogenesis [8,9].

Clinically, pilonidal sinus may be asymptomatic for some time prior to presentation. The majority of patients only present with the onset of symptoms, usually pain and discharge. Occasionally a painless lump or swelling may be discovered by the patient while washing, or the characteristic midline pits may be found during a routine physical examination [10]. The symptoms of pilonidal sinus are quite characteristic of inflammations elsewhere - pain, redness, heat, and swelling with an irritating, seropurulent discharge. Drainage of the acutely inflamed cyst, whether by incision, trauma, or spontaneous rupture, gives relief from the pressure symptoms, but this is often followed by the aggravating, continuous or intermittent drainage which causes excoriation of the surrounding skin. Symptomatic disease usually presents as an acute pilonidal abscess, a chronic pilonidal abscess or complex pilonidal disease.

In case of acute pilonidal abscess, the patient notices increasing discomfort and swelling over a few days and the pain may be severe by the time of presentation. On examination there is a localized fluctuant swelling in the midline of the natal cleft with overlying cellulitis. The area is the exquisitely painful to touch and often simply the act of separating the buttocks to examine the area is intolerable for the patient.

In chronic pilonidal disease, it is common for patients to present with chronic pain and discharge, often with a history of upto two years. On examination a single, or occasionally, multiple sinuses may be seen. Tufts of hair or other debris, such as clothing fibres, are often visible arising from the sinus. Localized oedema, swelling and inflammation may be present masking the underlying sinus [10].

Complex or recurrent pilonidal disease is due to reinfection in the neighboring hair follicles or chronic infection from entry of hair and debris into a postoperative wound.

The principles of Pilonidal Sinus treatment are total excision of the sinus tract, tension free and durable closure of the resultant defect with well vascularized tissue, obliteration of the intergluteal sulcus, and prevention of recurrence. A close relationship exists between success of wound closure and postoperative morbidity and recurrence in the surgical treatment of Pilonidal sinus. Although various methods of management has been described that includes both surgical and non surgical as the most commonest.

Surgical or Operative management:

The number and variety of published techniques are testament to the complexity of treating PNS and the fact that no single procedure is superior in all respects. It is universally agreed that the most effective emergency management of a pilonidal abscess is simple incision and drainage. However, surgical management of chronic and recurrent disease is more controversial. Numerous studies have been put forward advocating one treatment over another, but many of these studies are weighed down by lack of control groups or short follow-up.

The majority of procedures can be classified in one of the four categories below:

- Incision and drainage
- Excision and healing by secondary intention
- Excision and primary closure
- Excision with reconstructive flap techniques.

Incision and drainage: This is a simple procedure that involves making an elliptical incision in the abscess just off the midline. The mouth of the wound should be of sufficient width to allow packing of the entire wound cavity. Curettage to remove dead or infected tissue in the wound improves the rate of healing, with 90% completely healed at one month, compared to just 58% healed at 10 weeks in the absence of curettage [11].

Following a single incision and drainage procedure, 40-60% will go on to develop a PNS requiring further surgery [12]. Pits or sinuses can be excised as part of an incision and drainage procedure, but these can be obscured by oedema and are often overlooked at the initial assessment. The recurrence rate can be reduced to about 15% if a second procedure to excise pits and sinuses is performed after five to seven days [11].

Healing by secondary intention has the advantage of allowing free drainage of infected material and debris. However the patient will require regular wound care and the discomfort of packing until the wound has closed. In a retrospective study mean number of days off work following incision and drainage was 20 [13].

Wide excision and healing by secondary intention: Wide excision of an elliptical wedge of skin and subcutaneous tissue down to the pre-sacral fascia is designed to remove all the inflamed tissue and debris allowing the wound to granulate from its base. The excised dimensions should be of sufficient width at both the mouth and base of the wound to allow packing with ease. The base itself should be relatively flat and of almost comparable size to the mouth of the wound. A narrow V-shaped wound without a flat base is more difficult to

pack and tends to bridging and subsequent infection. The procedure necessitates general anaesthesia and hospital stay for a few days postoperatively. The principal advantage is a low recurrence rate, but the downside is a lengthy healing time (8-10 weeks) [14] and high direct and indirect costs associated with inpatient care, follow-up wound care and days lost from work. Despite this there is a role for wide excision in those with extensive chronic disease and following failed primary closure surgical technique. show different stages in the healing of chronic disease in a young male treated by wide excision.

Excision and primary closure: Closure of the wound is more cosmetically acceptable for some patients and is associated with a shorter healing time and time off work. However, this potential benefit is offset by the need for bed rest for up to one week in hospital [15] coupled with a higher risk of postoperative infection. When infection intervenes the wound must be laid open and healing time is longer than if the wound had been treated by secondary intention in the first place. The scar can be sited over the midline or displaced laterally with one year recurrence rates of 18% and 10% respectively. In a recent prospective study failure of primary healing was significantly associated with early recurrence of disease. In the same study the use of preoperative antibiotics did not influence the recurrence rate [11].

Bascom has proposed a method to incise, drain and curette a chronic abscess through a lateral incision combined with excision of any midline pits with a minimal amount of surrounding tissue. A section of the wall of the abscess cavity opposite the incision is raised as a flap and used to close the communication between the midline pits and the abscess cavity. This is accomplished by suturing the flap to the underside of the skin bridge formed between the incision and the midline. In a recent study of 218 patients treated with Bascom's procedure as day cases, 6% developed a postoperative abscess requiring drainage and 10% had recurrence requiring further surgery at mean follow up of 12.1 months (range 1-60 months) [16,17].

Excision with reconstructive procedures: These procedures are more technically demanding and are probably best performed by a plastic surgeon. Their use is generally restricted to recurrent complex pilonidal disease. The theory behind the majority of procedures is to reshape and flatten the natal cleft to reduce friction, local warmth, moisture and hair accumulation. Karydakos pioneered a procedure raising a flap to overlap the midline with the scar sited to one side to reduce postoperative hair entry [18]. Alternative techniques use a flap of both skin and muscle or a Z-plasty flap to close the defect following excision. All these techniques require general anaesthesia and a week or more of bed rest in hospital [15].

Non operative:

Phenol injection: In Europe it is much more common to treat pilonidal sinuses with phenol injections than it is in the United States. Both chronic pilonidal disease and acute pilonidal abscess (after incision and drainage) may be managed by phenol injection. In this procedure, 80% phenol is injected into the sinus, left there for 1 minute, and then expressed out of the cavity. The sinus is then curetted. This can be repeated as many as three times, for a total of 3 minutes of phenol exposure during a single treatment. The treatments may be repeated every 4-6 weeks as necessary, as wound healing progresses. Paraffin jelly may be used to protect the skin from the phenol, which destroys the epithelium. [15,16,17].

Fibrin glue

A newer medical therapy that is applied after simple curetting of the sinus tract is fibrin glue. The glue is applied to each individual tract after curettage, and the excess is then wiped away. Early data showed a reduction in time to return to work [18].

Laser

Laser ablation of the pilonidal sinus is receiving interest as well [19].

Radiofrequency Ablation

Radiofrequency ablation (RFA) techniques have also been studied in an attempt to reduce the pain associated with the procedures [20].

Recurrence :

Recurrence can be divided into two groups: early and late. Early recurrence is usually due to failure to identify one or more sinuses at incision and drainage, which was not followed by a second-look procedure. Late recurrence is usually due to secondary infection caused by residual hair or debris that was not removed at operation, inadequate wound care or insufficient attention to depilation [21,22].

The present study was conducted to evaluate the factors like recurrence, bleeding, hospital stay and complications that occur in lay open and primary closure technique.

II. Material And Methods

All the procedures were performed in accordance with the ethical standards and the consent was taken with in the guidelines of the surgical department. Prior to the enrollment of the patient for the surgery, procedure was explained informing all possible complication and post operative care plan.

The period From February 2013 to February 2016, a total of 64 patients were included, of which 53 were male and 11 were female. All the patients were admitted as elective cases.

Exclusion criteria included diabetic patients, previously operated cases else where coming with recurrence & who were lost to followup.

Baseline investigations like full blood count, blood urea, random blood sugar and viral screening was performed in all patients. X ray chest and ECG were done in selected cases to assess their fitness for anesthesia.

All patients were subjected to surgical procedure by giving them the choice of surgical technique- open or closed after explaining the pros and cons of each procedure.

Surgical technique:

Lay open Method

Patients opting for open technique were treated with excision and then the wound was left open to heal by secondary intention. Patients were placed in prone position with gluteal region retracted with plaster tapes to the sides, after cleaning the skin with Betadine Solution & draping ,methylene blue injected through the sinus opening to visualize and stain the tracts, an elliptical incision was given to include all the sinus tracts. If any sinuses were situated laterally, the incision was extended to include that. Dissection was carried down to the fascia covering the coccyx, the cyst was usually removed intact. Hemostasis was secured with diathermy. The wound was then left open, followed by application of sterile dressing soaked in Pyodine. Over this, a firm dry dressing of gauze is applied and secured. The wound was examined on the second post-op day. Daily bath irrigations and gauze dressings were changed regularly every day. Patients were kept in hospital for at least four days and were then seen in out-patient according to the follow-up schedule.

Primary closure method

patients choosing closed technique were treated with excision followed by primary closure of the wound. Patients were prepared as for open procedure. An elliptical incision was given to include all the sinus tracts. Hemostasis was secured with electrical diathermy. The defect was then assessed for capacity to be closed primarily. Vicryl sutures were put deep down to reach the sacral fascia. Finally, the skin was closed with prolene sutures. A firm gauze dressing was then applied. Post-operatively, patients were nursed on their backs and were advised to keep their movements in bed to minimum. They were advised to follow better toilet manners and avoid fecal contamination of wound. The patients were usually discharged on the second post-op day with the same advice of wound care. Then they were followed as out-patients according to the schedule

Pre-operative Intravenous antibiotic prophylaxis against gram positive, gram negative and anaerobes were given to all patients. Patients with open wounds were instructed of daily sitz bath, dressing, oral antibiotics and analgesics. Sutures were removed between 10th and 12th post op day ,oral antibiotic were given for 1 week and analgesia as per the requirement

All the patients were followed at 5th day, 10th day, 3weeks, 2 months and 6 months& 1 yr after surgery. At each visit, wound was examined, and positive findings were noted.

Data was analyzed using online Statistical test, Chi square test was applied, and P value was calculated. The p value less than 0.05 was considered significant.

III. Results

A total of 64 patients met the inclusion criteria and were eligible for the surgery. All 64 patients were managed for PNS during the above-mentioned time period. Almost all the patients who presented to the outpatient department were chronic pilonidal sinus.

Table 1 shows the mean age of the patients accounted 26-30yrs accounted for 28%, followed by age group 21 to 25 years (25%) and 31 to 35 years (19%).

Table 2 shows sex distribution. Out of 64 patients, 53 were male (83%) and 11 were female (17%). The male and female ratio was 6:4.

Table 3 shows Risk factor distribution Sedentary occupational seen in percentage (67%) of patients ,86 % of the cases were hairy individual and non-hairy were 14 %, obesity of 69% was noted in the present study.

Table 4 shows pilonidal sinus in relation to presenting complaint. 44% of the patients presented with painless discharge and 25% presented with pain and discharge and 31% presented with only sinus without discharge.

Table 5 shows comparison of lay open and closed method in terms of healing time and duration of hospital stay.

Table 6 shows post operative wound complication in lay open and primary closure method.

Table 7 shows recurrence in the present study after 1 year of follow up.

Table 1: Age Distribution

Age group	No of cases	Percentage
16-20	7	11%
21-25	16	25%
26-30	18	28%

31-35	12	19%
36-40	8	12%
41-50	3	5%
TOTAL	64	

Table 2: Sex Distribution

Sex	No of cases	Percentage
Male	53	83%
Female	11	17%

Table 3: Risk factor Distribution

	Present	Percentage	Absent	Percentage
Sedentary occupation	43	67 %	21	33%
Hairy	55	86%	9	14%
Obesity	44	59%	20	31%

Table 4: Pilonidal sinus in relation to presenting complaint

Complaint	Number of cases	Percentage
Discharge sinus alone	28	44%
Pain with discharging sinus	16	25%
Only sinus	20	31%

Table 5: Comparison of lay open and closed method in terms of healing time and duration of hospital stay

Variables	Method	Mean/sd	95% CI	T value	P value
Duration of Hospitalization in Days	Open n = 37	4 / 2	1.7365-6.2632	4.7719	< 0.05
	Closed n =27	2 / 1	0.8683-3.1316		
Healing time in weeks	Open (n =37)	6 / 1.5044	1.8683-4.1316	9.0223	<0.05
	Closed (n =27)	3 / 1	4.3291 -8.2690		

Table 6: Post operative wound complication in lay open & primary closure method

Complication	Open	Percentage	Closed	Percentage	Chi square test	P value
Bleeding	8	22%	1	5%	4.1468	Significant
Wound infection	6	16%	6	22%	0.3696	Not significant
No complication	23	62%	20	74%	1.2011	Not significant

Table 7: Recurrence in the present study after 1 year of follow up

	Open	Percentage	Closed	Percentage	Chi Square test	P value
Recurrence	2	5%	4	15%	1.6266	Not significant
No recurrence	35	95%	23	85%		

IV. Discussion

Since the first description of the disease by mayo in 1833 and the first description of treatment by Anderson in 1847, many articles have been published on the subject and various procedures have been advocated to treat pilonidal sinus disease, but until now, no consensus has emerged [10,23].

The ideal treatment should heal the sinus tract and the overlying skin and most importantly should prevent recurrence. The procedure should be simple and minimally invasive in order to shorten hospital stay and period off from work or school, to reduce pain, post operative care and the cost with the best aesthetic result [10,24].

Nonoperative methods used to treat pilonidal disease include improved perineal hygiene, natal cleft shaving, laser epilation and phenol application [25, 26, 27]. An ideal Surgical procedure is still a matter of debate though there are various studies going on the subject.

The present study showed the conditions affecting younger population, the results are comparable to the study done by sha STA et al who noted 63.3% of the patient were in age group less than 30 yrs [28]. In a study by Salah et al who noted the distribution of the disease in age group 19 to 32 yrs [29]. In another study done by Priyadarshini et al who noted 21 to 31 years as the age group with maximum number of cases [30].

The sex distribution in present study showed male and female ratio of 4:1. In a similar study done by salah et al and sha STA et al showed a ratio of 6:1. However, the present study showed male domination [28, 29].

The risk factors mentioned earlier were accounted to the present study that included sedentary lifestyle, obesity and presence of abundant hair in gluteal cleft space. The present study showed 67% having sedentary life style 69% obese and 86% showing presence of abundant hair. A similar study by priyadarshini et al which showed 44% as obese and 34% having abundant hair supporting the current study [30].

The mean period of hospitalization in present study in lay open method is 4 days and 2 days in primary closure. The findings were subjected to statistical analysis of which the results showed significant p value (table 5). In a study by Sha STA et al, mean hospital of 5 days in lay open method and 3 days in primary closure group comparable to present study [29].

In the present study, the mean period required for complete wound epithelization is 6 weeks in lay open technique and 3 weeks in primary closure patients. The results showed a significant p value (table 5) with close similarity with the study by sha STA et al who observed 6 weeks in lay open method and 3 weeks in primary closure method. In a meta analysis study by Iain Jd Mc Cullian and Julie bruce observed quicker healing in primary closure group.

In the post operative complications, one of the main complication bleeding was noted to be 22% in open method and 5% in wound closure by primary procedure. The statistical analysis revealed a significant p value and the chi square test of 4.1468. the rate of wound infection is 16% in open method and 22% in closed method of which Statistical analysis showed insignificant p value with chi square test of value 0.3696. However, our results were in contrast with the results of sha STA et al who noticed wound infection rate of 25% in lay open method and no sign of infection in primary closure. In a systemic review and meta analysis by Iain Jd Mc Culliam and Julie bruce noted infection to be higher in open healing and couldnt come to a conclusion as to which technique is effective in reducing the infection. Therefore, their study showed statistically insignificant values [29,31]. The technique as a cause for infection couldn't be concluded as noted from the various studies.

Mohamed et al did a comparative study using three different surgical interventions i.e wide excision and left wound open, limited wide excision and left wound open and excision with primary closure. They observed significant difference in terms of hospitalization and operative time but they didn't observe any significant difference in terms of complications among all three groups [32].

The rate of recurrence after 1 year of follow up, showed 5% of cases suffered from recurrence with lay open method and 15% of patients who underwent primary closure technique. The statistical analysis showed chi square value of 1.6266 and no significant p value. In a study by sha STA et al who noted higher recurrence in open than in primary closure [29]. In another study by Iain Jd Mc Cullain and Julius bruce indicated 58% lower risk of recurrence in lay open method [31].

In a similar study done by khamis et al in 2010, reported that open excision and healing by secondary intention results in fewer recurrences but is associated with long hospital stay and long healing time and more acute post operative pain [33].

R. Dudink on his comparative analysis of 63 patients found that close technique is better than open technique. The primary management should be close technique. While open technique with wide local excision should be avoided [34].

V. Conclusion

In our study of 64 patients we conclude that the present study is limited to final conclusions in regard to the surgical technique for pilonidal disease. However, the primary closure technique can be used as it is comfortable for the patient in getting back to daily routine life within few days. The period of hospital stay, complete wound epithelization is significantly shorter in wound that were closed primarily and concluded the same in various other studies as well. The rate of complication especially infection was noted in few other studies and is not related to a particular surgical technique. It is quite evident in various studies about the recurrence rate that is noted to be higher in the wounds that are closed primarily, and the present study showed higher recurrence too yet statistically insignificant.

Pilonidal sinus disease continues to present many therapeutic challenges. However, treatment must be adapted to the extent and severity of disease as the evidence supports that both open and closed operative approaches showed no major difference in complication rates. Open approaches with limited sinus excision are effective for patients with limited disease. If closed techniques are to be used, evidence supports in placing the closure off the midline. Therefore, diligent, long-term postoperative follow-up and careful attention to wound care are essential to avoid further complications.

References

- [1]. Hodges RM. Pilonidal sinus. *Boston Med Surg J* 1880; 103: 485-586.
- [2]. Buie LA. Jeep disease. *South Med J* 1944;37:103-109
- [3]. John j. Franckowiak, m.d., raymond j. Jackman, m.d. The Etiology of Pilonidal Sinus, From the Mavo Clinic and Mayo Foundation Rochester, Minnesota
- [4]. De Parades V, Bouchard D, Janier M, Berger A. Pilonidal sinus disease. *J Visc Surg.* 2013;150:237-247.
- [5]. S. Petersen, G. Aumann, A. Kramer, D. Doll, M. Sailer, G. Hellmich, Short-term results of Karydakis flap for pilonidal sinus disease, *Tech. Coloproctol.* 11 (3) (2007) 235e240.
- [6]. Imccallum, P.M. King, J. Bruce, Healing by primary versus secondary intention after surgical treatment for pilonidal sinus, *Cochrane database Syst. Rev.* 4 (2007) CD006213.

- [7]. A.E. Humphries, J.E. Duncan, Evaluation and management of pilonidal disease, *Surg. Clin. N. Am.* 90 (1) (2010) 113e124. Table of Contents.
- [8]. Boscom J Pilonidal disease: Long term results of follicle removal, *Disease of colon and rectum* 1983;26;800-7
- [9]. Kronbag O Christiansen kzimmermann-Nielson C: Chronic pilonidal sinus disease: randomized trials with complete three year follow up *Br. J Surg.* 1985; 72; 303-304.
- [10]. Solla JA, Rothenberger DA. Chronic pilonidal disease. An assessment of 150 cases. *Dis Col Rec* 1990; 33(9): 758-61.
- [11]. Sb kelly ,wjh graham .treatment of pilonida sinus by phenol injection.the ulster medical journal ,volume 58,No 1pp56-59 april 1986
- [12]. Cuneyt kayaalp et al .fibrin sealant use in pilonidal sinus :systematic review ,world j gastrointestinal surgery 2016 march 27 :8(3):266-273
- [13]. Michel dessily et al .pilonidal sinus destruction with a radial laser probe:technique and first belgian experince ,acta chirurgica belgica ,2017 ,vol 117 ,no 3 ,164-168
- [14]. Pravin j gupta ,radiofrequency sinus excision :better alternative to marsupialization technique in sacroccygeal pilonidal sinus disease, *journal of the national medical association* , vol97 ,no 7, july 2005.
- [15]. Berry DP. Pilonidal sinus disease. *J Wound Care* 1992; 1(3): 29-32.
- [16]. Lineaweaver WC, Brunson MB, Smith JF, Franzini DA, Rumley TO. Squamous carcinoma arising in a pilonidal sinus. *J Surg Oncol.* 1984;27:39-42.
- [17]. Bascom JU. Pilonidal disease: Correcting over treatment and under treatment. *Contemporary Surg.* 1981;18:13-28.
- [18]. Bisset IP, Isbister WH. The management of patients with pilonidal disease: a comparative study. *Aust NZ J Surg* 1987; 57(12): 939-42.
- [19]. Kronberg I, Christensen KI, Zimmerman-Nielson O. Chronic pilonidal disease: a randomised trial with complete three year follow up. *Br J Surg* 1986; 72: 303-04.
- [20]. Jones DJ. ABC of colorectal diseases. Pilonidal sinus. *BMJ* 1992; 305: 410-12.
- [21]. Karydakis GE. New approach to the problem of pilonidal sinus. *Lancet* 1973; 2: 1414-15.
- [22]. Allen-Marsh TG. Pilonidal sinus: finding the right track for treatment. *Br J Surg* 1990; 77: 123-32.
- [23]. Da Silva JH. Pilonidal cyst: cause and treatment. *Dis Colon Rectum.* 2000;43:1146-1156.
- [24]. Kaya B, Eris C, Atalay S. Et al. Modified Limberg transposition flap in the treatment of pilonidal sinus disease. *Tech Coloproctol.* 2012;16:55-59.
- [25]. Doody DP, Pilonidal cyst disease. In: Mattei P, editor. *Fundamentals of pediatric surgery.* New York (NY): Springer Science & Business Media, LLC, 2011:467-474.
- [26]. Topuz O, S € ozen S, T € ukenmez M, et al. Crystallized € phenol treatment of pilonidal disease improves quality of life. *Indian J Surg.* 2014;76:81-84.
- [27]. Garcia C, Ibanez N, Abrisqueta J. Laser epilation prior ~ to pilonidal sinus surgery. *Lasers Med Sci.* 2015;30:2401-2402.
- [28]. Shah STA, Tahir M, Nasir M, Paracha SA, Wahab K. Outcome of open versus closed technique for surgical treatment of chronic pilonidal sinus: A randomized controlled trial. *Khyber Med Univ J* 2013;5(3): 146-151.
- [29]. Salah G .Ziada , Ayman M , Elwan & Hazem A,Megahed .Comparative study between open surgical Excision & cleft lift procedure for treatment of pilonidal sinus .AAMJ, Vol111 ,No3 July 2013 -Suppl 2
- [30]. Siddhartha Priyadarshi, Bharat Bhushan Dogra, Ketak Nagare, Karan V. S. Rana, Raveesh Sunkara, Ashwani Kandari A comparative study of open technique and Z-plasty in management of pilonidal sinus. *Medical Journal of Dr. D.Y. Patil University |* September-October 2014; 7(5)574-578.
- [31]. Iain J D mccallum, Peter M King, Julie Bruce. Healing by primary closure versus open healing after surgery for pilonidal sinus: systematic review and meta-analysis. *bmj.com.*2008;1-18.
- [32]. Mohamed HA, Kadry I, Adly S. Comparison between three therapeutic modalities for non complicated pilonidal sinus disease. *Surgeon.* 2005; 3: 73-7.
- [33]. Al-Khamis A, mccallum I, King PM, Bruce J. Healing by primary versus secondary intention after surgical treatment for pilonidal sinus. *Cochrane Database Syst Rev* 2010; (1)CD006213
- [34]. Dudink R, Veldkamp J, Nienhuijs S, Heemskerk J. Secondary healing versus midline closure and modified Bascom natal cleft lift for pilonidal sinus disease. *Scandinavian Journal of Surgery.* 2011; 100: 110-3.

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