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Can diode laser avoid pilonidal sinus excision by the conventional operation?

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Abstract: Background: Pilonidal sinus is a recurrence pathology that affects the gluteal area, cleft part of it. It affects many parts but mainly the sacral area and may present with various forms; from the asymptomatic cyst to severe infection in a form of painful abscess or sinus. The treatment of pilonidal sinus ranges from observation with good hygiene to excision of the sinus left wide incision. Recurrence may follow the excisional procedure and may need more operations. Many conservative ways had been used for the management of the sinus; laser (phototherapy) is one kind that may use. **this paper aims** to test the efficiency of the laser (diode 980nm) in the treatment of the sinus. **material:** a study of forty-seven patients complaining of the simple pilonidal sinus was managed with laser radiation of diode 980nm, ages of the patients 17- 41 year-old with a mean of 29.15 (SD ± 5.16), the length of the track between 30 mm to 70 mm. and the mean is 46.13 mm. (SD ± 10.32) all primary except 10 patients were recurrent after treatment. **result:** the operation was done as a day case, operation time between 6:10 to 14:10 minutes with mean 9:30 minutes. the follow-up of the patients was weekly after seen on 1st postoperative day, with no complication except one infected on 9th day after the operation, which closed on the 21st day after for 10 days with cefixime and metronidazole. the sinus closed in 6 to 30 days with a mean of 12.49. **conclusion:** laser radiation of diode 980nm can use with good efficacy in pilonidal disease management to avoid the excision of the sinus by conventional procedure which lead to tissues damage, and this decrease the cost, hospital stay, time to return to work, morbidity and complication, we can iterate the procedure without further damage.

Keywords: PNS, diode 980 nm, laser light, sinus.

1.Introduction

The pilonidal sinus is an acquired disease caused by dead hair impact intergluteal cleft in the sacrococcygeal area (Figure (1)) affect mainly young personôs [Lime Khanna A. and Rombeau JL. 2011], between second to the fourth decade, and rare after 40-year-old. Its effect the males fourfold than Females (4:1) may due to hair growth in the males but occur in females earlier because of puberty in females [Burney RE. 2018]. The lining of the pilonidal sinus is inflammatory (granulation) tissue and the content of the sinus is dead hairs. Itôs usually affected the Joccur aim dtherSshea bike the interdigital 2 0re1 9 and [Yazar SK. et al. 2018]. A deep collect on content puss, abundant bacteria hairs, debris abscess cavity with and the surrounding area wet conditions and a lot of bacteria, died hairs, scrap and rubbing cause recurrent attacks of infection,

associated with recurrent attacks of pain and discharge [Khanna A. and Rombeau JL. 2011]. Malignancy can occur but is a rare complication of pilonidal sinus, squamous cell carcinoma is presentation if it occurs which carries a bad prognosis [Doll D. et al. 2020]. Herbert Mayo was the first surgeon who described the pilonidal sinus in 1833 [Erkent M. et al. 2018].

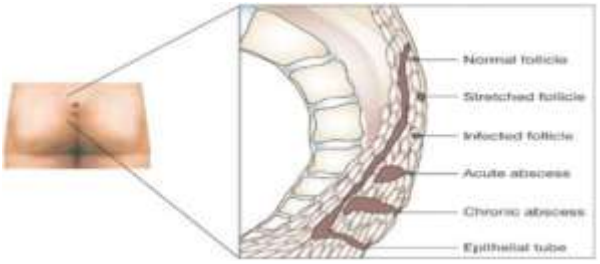


Figure (1): pilonidal sinus.

Pilonidal sinus may be remaining for years as an asymptomatic condition before it ô symptomatic. the presentation of pilonidal sinus ranges between a tiny painless pit and a massive painful collection. This collection may contend clear, cloudy, or bloody fluid. If the sinus is infected, it becomes red in color, tense, tender, and discharges bad odor pus. The infection may present with system symptoms like fever, malaise, or headache. The progress of the disease from asymptomatic to symptomatic is unpredictable [Harries RL. et al. 2018].

For an asymptomatic patient, meticulous local hygiene is enough. For the cellulitis which presents before liquefication and abscess formation, the treatment should be antibiotics that cover gram-positive and anaerobic with good local hygiene are adequate [Stauffer VK. et al. 2018]. For an abscess when broad-spectrum antibiotics fail to heal the infection, the pus needs to be evacuated by an incision avoiding the cleft (mid-line) of the coccygeal area, with total removal of all content which includes hair, pus, and debris, this operation may be enough to get healing [Kallis PM. et al. 2018]. Excision of the sinus is the usual kind of treatment for pilonidal disease. The excisional procedure for pilonidal sinus is sufficient but the recurrence of the disease is elevated [Erkent PM. et al. 2018]. Hair removal by laser tools is effective to prevent pilonidal sinus development or recurrence. Several kinds of laser lights are used in the management of pilonidal sinuses [Badawy EA. And Kanawat Mn. 2009, Conroy FJ. Et al. 2008, Oram Y. et al. 2010, Lindholt-Jensen CS. Et al 2012, Lindholt-Jensen CS. 2008 and Jain V. and Jain A. 2012]. Diode laser gives a considerable advantage compared with other kinds of the laser due to its easy portable effective machine. The diode laser can be transmitted through fibro-optic. [Mohsdeseh H. et al. 2018]. The objective of the study is assessment of diode 980nm laser radiation for treatment of pilonidal disease, as a minimally invasive procedure and its effect on patient activity, cost, hospital stay, return to his work, and recurrence of the disease.

2.Design of study:

VELAS 6 is the laser system used, was VALAS 6 diode laser 980 nm with power 1-60 W, the guide illumination is laser 650nm transmitted by 600 microns fiber with a conical tip. Between 2016 and 2020, A one surgical center study of 47 patients (42 males and 5 females) with a simple (non branched) pilonidal sinus was managed with laser radiation diode 980nm (VELAS60), the age of the patients was between 17 and 41-year-old (Figure (2)) mean 29.15 years old (SD ± 5.16), 37 patients with primary (no surgical intervention) and 10 recurrent after surgery, the diagnosis clinically mapping was done by sonography which done for all patient to measure the length and exclude branched sinus (Figure (3)). The sinus length ranges from 30 to 70 mm (Figure (4)) with a mean of 46.13 mm. (SD ± 10.32), 15 patients presented with discharging sinus.

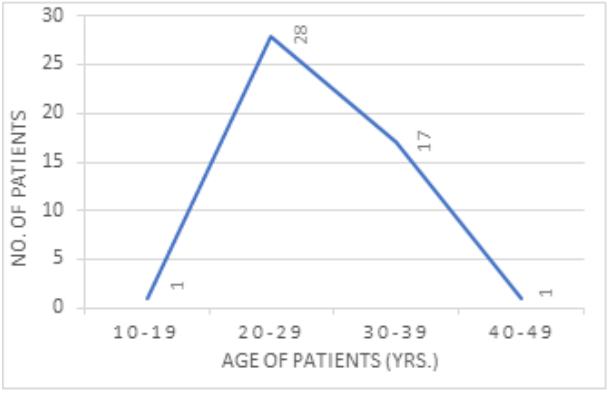


Figure (2): Age of the patients (yrs.)

Several kinds of laser lights are used in the management of pilonidal sinuses [Badawy EA. And Kanawat Mn. 2009, Conroy FJ. Et al. 2008, Oram Y. et al. 2010, Lindholt-Jensen CS. Et al 2012, Lindholt-Jensen CS. 2008, & Jain V. and Jain A. 2012]. Diode laser gives a considerable advantage compared with other kinds of the laser due to its easy portable effective machine. The diode laser can be transmitted through fibro-optic. [Mohsdeseh H. et al. 2018].

3.The objective of the study:

Assessment of diode 980nm laser radiation for treatment of pilonidal disease as a minimally invasive procedure, and its effect on: patient activity, cost, hospital stay, return to work, and recurrence of the disease.



Figure (3): sinogram of sinus.

The procedure was done as a day case operation, the patients have informed the procedure (laser surgery) and Postoperative Instructions that each patient, after operation instructed to fill follow up chart, fellow up time which should be 6 months after surgery. The fellow up of all patients for pain, infections of the site of surgery (sinus), the time needed for complete healing (closure), and recurrence of the sinus.

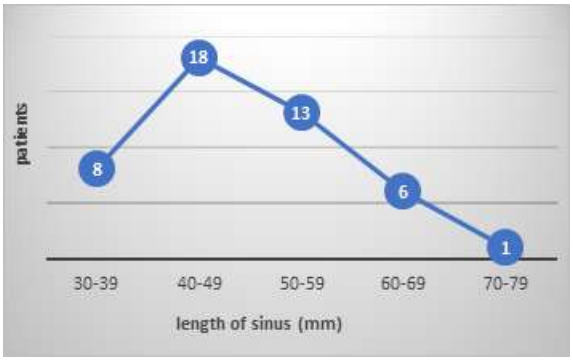


Figure (4): The length of sinus

4.Preparatory procedure

To get perfect parameters to prepare the laser machine to give good results for coagulation of the sinus tract, we used excised sinus for this experiment as a vitro procedure. We use different power of the laser and different rate of withdraw of the probe and after each experiment, we laid the tract open and microscopic examined the inner surface of each tract to reach the best results of coagulation of granulation tissue of the lining of the pilonidal sinus and charring and carbonization, the yellow-brown color of the coagulation of tissue is the indicator of good results. Different results were obtained as shown in table (1).

The results obtained from the Preparatory procedure; to reach the perfect parameters for the treatment of sinus were mentioned in table (2), After this experiment, we choose the power of 5 watts with the continuous mode at a rate of 5 mm/min. which gave satisfactory results as a parameter of choice for laser machines in our study.

Table (1): laser parameters used

Tract no.	Power density used (watts/cm^2)	Speed of retrograde traction (mm/min.)
1	1591	1
2	1591	5
3	1190	2
4	1190	5
5	955	1
6	955	5

5. Operative procedure:

After all protective precaution to prevent the laser hazards was taken, the procedure starts with put the patient in the prone position, the anesthesia was local using 1% xylocaine infiltration and disinfectant the operative area with povidone, laser procedure start with introducing of 600 um optic fiber in the tract of the sinus which simple (not branched), then fire the laser system with power 5 watts in continuous mode with the retrograde pulling of the optic fiber in a rate of 5 mm./min. to give a power density of 994 watts/cm^2, the rate of pulling the optic fiber fixed except external opening when extra 10 seconds

for treatment of the orifice as illustrated in figure (5).

Table (2): Results of applying different laser parameters

Tract no.	Power watts (W)	Speed of retrograde (mm./min.)	Result
1	10	1	Sever charring and carbonization.
2	10	5	Moderate charring and carbonization.
3	7	2	Carbonization of tissue still noted.
4	7	5	Deep-brown colour with multiple carbonization points.
5	5	1	Deep-brown colour with scattered carbonization points.
6	5	5	Brown to deep yellow colour with no carbonization

6. Statistical analysis:

The study tested statistically by means of the t-test for continuous variables. The healing time of the sinus in days was tested with length of sinus, calculated Ordinary least-square linear regression was used to examine changes in the rate of healing for the length, SPSS version 25 was used.

7. Results:

The operation is done as a day case, operation time between 6.10 to 14.10 minutes with a mean of 9.30 minutes. Post-operative pain assessment was done in the follow-up era, no pain during the procedure for all patients, but during follow up there was moderate pain (6/10) treated by oral analgesia in 33 patients (70%) for 3 days, no pain after 3 days.

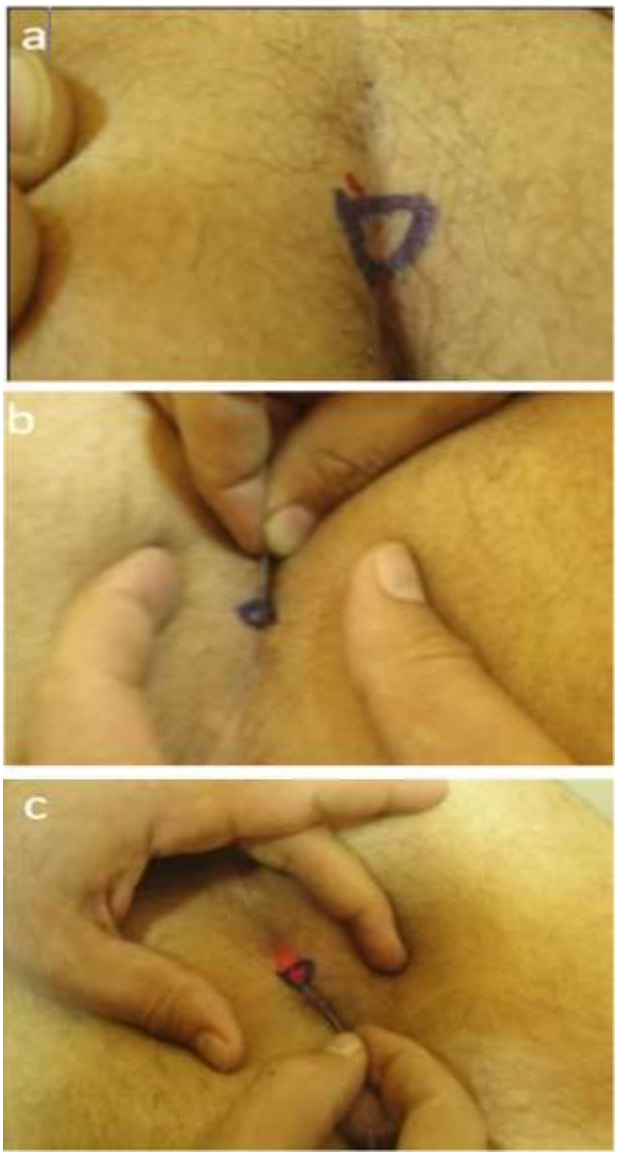


Figure (5): measure of sinus tract.

Three patients were complained of site infection (pain, swollen, redness, and edema) in 5-7 days postoperatively all treated with oral antibiotics and analgesia

Healing time (closure) of sinuses range between 6 and 30 days as in figure (6) the mean was 12.49 days SD ± 4.70

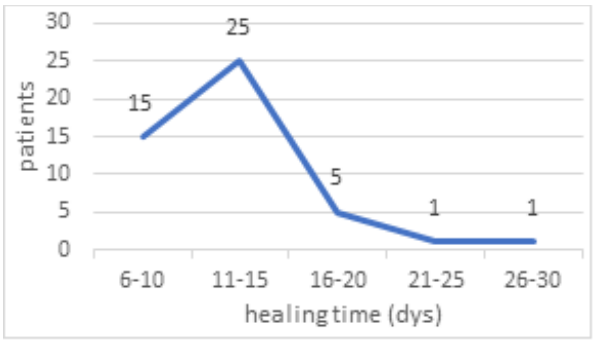


Figure (6): Healing time (days)

The pilonidal sinus was more common in males (n=42, 89%) than female (n=5, 11%). The healing process was highly correlated with length of sinus ($p<0.000$)

8. Discussion:

Pilonidal disease is a chronic inflammation that is caused by foreign material reactions most commonly occur in the coccygeal area or any hair-collecting regions [Kuckelman PJ. 2018]. The incidence of pilonidal disease is about 26/100000/year for the population, but the peak incidence in the range of mid of the second decade to mid of the third decade and rare after forty [Banasiewicz T. et al. 2013]. There is a debate about the origin of the cyst or sinus, congenital or acquired [Ekici U. et al. 2019]. The risk factors for the development of the sinus may be related to hormones that increase at puberty, obesity, or hair density and distribution [Cevik M. et al. 2018, Wells K. and Pendola M. 2019]. Management of pilonidal sinus depends on the stage of the pathology of the sinus, asymptomatic good care, and local hygiene is enough but in chronic, recurrent sinus aggressive surgical procedure may be needed. The perfect treatment for the disease is to eradicate the cause of sinus development (hair) and this leads to rapid healing, which makes the patient return back to his/her normal work rapidly. The conventional treatment of pilonidal sinus is a surgical procedure with a considerable risk of recurrent sinus or infection [Ypsilantis E. et al. 2016, Khalilieh S, et al. 2021 and Garg P. 2018].

Despite the kind of management of pilonidal sinus, the recurrent incidence of the sinus is high [Milone M. et al. 2018]. The etiological factor for the development of pilonidal sinus is the hair. With the advance in the technology of laser epilation some years ago, that relapse rates can be decreased by hair epilate when accompanying surgical treatment. Recurrence rates after surgical treatment have been in a range of 1 - 38 %. [Kelati A. et al. 2018, and Mutus HM. et al. 2018].

The use of diode laser leads to destroying the sinus wall (granulation tissue) by coagulation with little effect to the around normal tissue. In the current study, the wavelength of the diode laser was 980 nm, power of 5 watts at a rate of 0.5cm/min. gave a density of 994 w/cm^2 which has the power to penetrate about 1.5mm depth that is enough to destroy the sinus wall (granulation tissue) [Melanic M. et al. 2019]. will lead to an increase in the temperature of affected tissues between 50 and 100 degrees; this led to protein denaturation [Noor MM. 2018]. (Denaturized protein turns pale as in our preliminary study). It has bactericidal effects in the infected field [Sadony DM and Montasser K. 2019].

In the current study, all patients were discharged a few hours after the operation (day case), in comparison with open surgery which takes longer. Almost all patients were restful in daily activities like sitting and walking and could return to their normal work. This was because of the less pain, and minimal morbidity. Other kinds of laser used in the treatment of pilonidal sinus like Nd: YAG and Ruby showed less pain. Short hospitalization and early return to work [Lyons AB. et al. 2020]. The comparison of the diode laser therapy and conventional in considering the complexity of procedures, hospital stays time, cost, drugs, and the operation may repeat for wound infection or dehiscence in case of latter [Georguo GK. 2013]. The results when working on the sinus with the presence of infected debris [Dia S. et al. 2018].

Benedetto and Lewis [Benedetto AV and Lewis AT. 2005], mention in their study that two cases of pilonidal sinus treated with an 800 nm diode laser, resulting in a long period of free of disease. also, Khan et al. showed in their study (19 patients) the recurrence of pilonidal sinus after alexandrite laser (long-pulsed) therapy was significantly longer than after conventional surgery [Khan A. et al. 2016]. Pappas AF, Christodoulou DK., [Pappas AF and Christodoulou DK. 2018] notify that other wavelength of diode tried to manage the pilonidal sinus like 1470 nm with a low recurrence rate in

237 patients. F. Demircan et al., [Firat Demircan et al. 2015] were mentions in the retrospective random study, the recurrence rate after surgery and surgery followed by laser hair removal were 4% and 20%, respectively, so the result is different from our study or other retrospective studies. Concerning the recurrences rate after laser therapy following surgical treatment of the disease, we are assessing the short-term complication because of short post-operative follow-up. But Ratto et al. mention in their study that no recurrent in two years follow-up which assesses the long-term recurrence [Ratto C. et al. 2000]. We select the diode laser system for treatment of pilonidal sinus due to its efficacy by coagulation of granulation tissue in 360 degree through the tip of the optical fiber and the amount of the energy-time of exposure, but because the time of retrograde pulling of fiber fixed and the power was fixed (5 W) so the energy deposited is related to the length of sinus and the extra time at the orifice is to manage the pouting granulation tissues which lead to the closure of the external opening of the pit, with a parameter used in this study no damage to surround tissue expected to occur, and we can repeat the procedure as no gross damage could happen. Diode laser system small portable, and laser light transfer with easy handle optical fiber, the hazard of the laser can avoid by special goggles.

7. Conclusions:

Diode 980nm laser can use with good efficacy in pilonidal disease management to avoid the excision of the sinus by conventional procedure and damage of surrounding tissues, and this decrease the cost, hospital stay, time to return to work, morbidity and complication, we can iterate the procedure without further damage.

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