

# Outcomes of Two Treatments for Uncomplicated Pilonidal Sinus Disease: Karydakis Flap Procedure and Sinus Tract Ablation Procedure Using a 1,470 nm Diode Laser Combined With Pit Excision

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**Background and Objectives:** An ideal treatment for pilonidal disease should feature a low recurrence rate, minimal incision, and rapid return to daily activities. We compared the outcomes of the well-defined Karydakis technique (KT) and a combination of pit excision (PE) and sinus tract ablation using 1,470-nm diode laser.

**Study Design/Materials and Methods:** In this study, from January 2016 to January 2018, patients diagnosed with uncomplicated early-stage pilonidal sinus disease were enrolled and were treated randomly, using KT ( $n = 28$ ) or a PE/laser ablation technique (PE + LAT;  $n = 30$ ).

**Results:** The mean operative times were 36.4 (25–45) minutes in the KT group and 15.1 (12–20) minutes in the PE + LAT group. Postoperative Visual Analog Scale pain scores were 4.4 in the KT group and 2.1 in the PE + LAT group. The time periods to return to normal daily activities were 2.6 (1–5) days in the PE + LAT group and 12.8 (10–20) days in the KT group. The mean Likert satisfaction scores were 3.8 in the KT group and 4.8 in the PE + LAT group. The groups did not differ in terms of recurrence.

**Conclusions:** Compared with the KT, the PE + LAT was associated with a shorter operative time, a more rapid return to normal activities, less pain, and a higher level of subjective satisfaction. We found that the PE + LAT was better than the KT for patients with early-stage disease. Lasers Surg. Med. © 2020 Wiley Periodicals, Inc.

**Key words:** minimally invasive surgery; laser ablation; 1,470-nm diode laser; pit picking; pilonidal sinus; karydakis

## INTRODUCTION

Pilonidal sinus disease is a chronic disease of the sacrococcygeal region associated with frequent recurrence [1,2]. The disease is most common in post-pubertal subjects aged 15–30 years [3,4]. The incidence of this acquired disease is about 26/100,000 subjects worldwide [4–8]. The disease is threefold to fourfold more common in males than in females [5,6,9]. The prevalence differs by race; the disease is common in Caucasians, rare in Blacks, and very

rare in Asians [4]. Pilonidal sinus disease was first described by Herbert Mayo in 1833 as a congenital condition [4,6], but is now accepted to be an acquired disease [9], given its absence in childhood [1]. Although its cause remains unknown, the increased hormone levels associated with puberty, the growth of thick hair, long periods of sitting, and friction imparted by tight-fitting clothing may be in play. Other risk factors are hirsutism, obesity, and a family history of the disease [6]. As the cause of the disease, hairs falling from head, neck, and back are placed in the intergluteal area and hairs that penetrate the skin initiate foreign body reactions [1,5]. In the affected area, the hairs are moist, sweaty, and unhygienic, readily triggering development of the subcutaneous skin cysts and sinuses characteristic of the disease [9], which (in the gluteal region) present as asymptomatic pits, painful abscesses, or sinuses associated with purulent serous discharge.

Surgical and non-surgical treatments are available, but the optimal treatment remains controversial [5]. No treatment is always successful. Currently, acute abscesses are incised and drained; chronic cases are usually treated by wound opening followed by primary closure [10], construction of a Limberg flap, asymmetric closure using the Karydakis flap [11,12], or minimally invasive techniques such as the Bascom procedure [13] following surgical excision of the sinus tract, and endoscopic pilonidal sinus treatment (E.PSi.T) [14] with inflammatory tissue cauterization using Meinero fistuloscope under direct vision.

Surgical success is evaluated by recovery time, the time to return to daily activities, and the complication and recurrence rates. Currently, surgical outcomes are variable with respect to these measures. In this study, we

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compared the outcomes of sinus tract ablation using a minimally invasive pit excision/laser ablation technique (PE + LAT) with a 1,470-nm diode laser and the commonly used Karydakis technique (KT).

## MATERIALS AND METHODS

In total, 58 patients (11 females and 47 males) diagnosed with early-stage pilonidal sinus disease between January 2016 and January 2018 were enrolled consecutively at a single center and were treated randomly using KT or PE + LAT. Our study was a retrospective analysis of prospectively collected data. The primary outcomes of our study were the time to return to daily activities and recurrence rate, and the secondaries were operative time, postoperative pain level, and subjective cosmetic satisfaction.

Patients with three linear sinus pits were considered to have early-stage disease. Patients with recurrent disease and sinus abscesses were excluded. Patient data were obtained from hospital records. Standard patient questionnaires were administered. Two months after surgery, the presence of an external opening or a (persistent and recurrent) secretion from surgical wounds or from external orifice were defined as failure of the procedures and the recurrence of the disease.

All patients were informed in detail about the potential risks and benefits of both operations and they gave written informed consent prior to operation. The study protocol was reviewed and approved by the local ethical committee of the Istanbul Gelisim University, and met all the necessary governmental criteria.

Patients were randomized to KT or PE + LAT group using true random number generator by True Random Number Service® (School of Computer Science and Statistics at Trinity College, Dublin, Ireland). We used the KT to treat 28 patients and the PE + LAT to treat 30 patients. We recorded age, sex, operative time, postoperative pain level, duration of hospital stay, time to

return to daily activities, subjective cosmetic satisfaction, and the recurrence rate. A Visual Analog Scale (VAS; 0, no pain and 10, very severe [unbearable] pain) was used to measure postoperative pain. Pain was evaluated in the morning of the first day after surgery, before discharge. Patient satisfaction was evaluated 6 weeks later using a Likert-scale (1, totally unsatisfied; 2, unsatisfied; 3, neutral; 4, satisfied; and 5, very satisfied).

## Procedure

All patients in the PE + LAT group received oral antibiotics 1 week prior to surgery, which was performed in the prone position under general anesthesia. The gluteal region was shaved and cleaned with povidone iodine. The external sinus orifices were excised via 4-mm punch biopsy scalpel with a 1 mm skin margin. ("pit-picking"; Fig. 1). The pilonidal sinus tract was swept with a special brush to ensure that the tract was completely cleared of bristles and debris (Fig. 2). Then, a 1,470-nm diode laser probe (Ceralas®, Biolitec Biomedical Technology, Jena, Germany) was routed through the sinus to the top of the sinus path (Fig. 3), and activated to deliver approximately 12–14 W energy (Table 1). During activation, the probe was retracted along the sinus tract at an approximate rate of 1 cm/6 s. The energy homogeneously destroyed the internal inflamed tissue and seal the tract. The procedure was repeated for all sinuses, and the sinus paths were closed completely. Each tract was obliterated using an average of four pulses (total, 324 J; pulse duration, 6 s; pulse energy, 13.5 W × 6 s = 81 J). We confirmed the procedural success by checking that the probe could not be directed into the sinus tract through the sinus opening. We cooled the operative site by applying ice for 5 minutes. External openings were not closed. Wound closure involved only gauze placement. Patients were allowed to take paracetamol (three 500 mg tablets daily) if needed. Patients were discharged the next day with a simple dressing that was not replaced. On day 3, the dressing was removed and patients were allowed to shower. Oral antibiotics were continued for 1 week. In the early postoperative

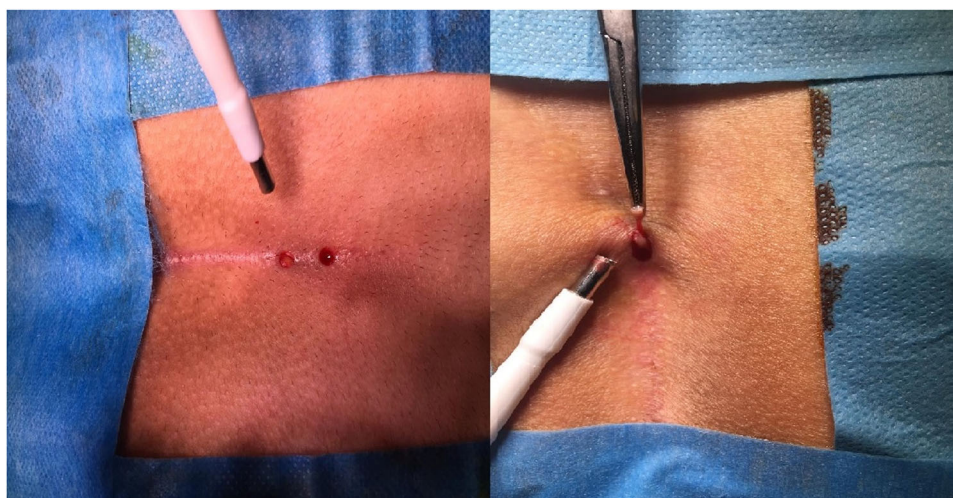


Fig. 1. Punch biopsy needle (No: 4 mm). Pit excision (pit picking) and extraction of excised pit.



Fig. 2. The pilonidal sinus tracts are cleaned from hair and debris by mean of a brush.

period, regular follow-up visits were scheduled until the sinus pits had closed and epithelialisation was evident (average, 4 [2–6] weeks) (Fig. 4). After that, all patients were examined during follow-up every 6 months. The mean follow-up time was 25 (15–39) months. At the end of April 2019, we contacted all the patients by phone to make sure that no recurrence had appeared after the last visit.

In the KT group, a standard, asymmetric ellipsoid incision was created and the sinus tracts, all primary sinus tract openings in the midline (“pits”) were removed completely over the sacral fascia. The flap was mobilized to achieve natal cleft lateralization (Fig. 5). The subcutaneous tissue was closed in two to three layers using 2-0



Fig. 3. Fiber optic diode laser probe.

Vicryl sutures. The operation completed without leaving dead spaces and didn't need a drain. The skin was closed with 4-0 polypropylene sutures using a vertical mattress stitch. Follow-up was similar to that of the PE + LAT group. Postoperatively, we recorded pain, analgesic need, and dressing changes; all patients were discharged the day after surgery.

### Statistical Analysis

Between-group comparisons were made using the SPSS software (ver. 20.0 for Windows; IBM Corp., Armonk, NY). The results are shown as percentages, means with standard deviations, or means with ranges. Differences in the mean operative time, VAS pain score, Likert-scale satisfaction score, and time to return to daily activities were assessed using the unpaired Student's *t* test.  $P < 0.05$  were considered to reflect the statistical significance.

### RESULTS

We treated 11 females and 47 males with a mean age of  $26.9 \pm 8.4$  (15–49) years; mean ages were 25.8 (15–41) years in the KT group and 27.9 (15–49) years in the in the PE + LAT group. Overall, 78.6% of patients in the KT group were male and 21.4% were female; the proportions in the PE + LAT group were 83.3% and 16.7%, respectively. Neither age nor the sex distribution differed significantly between groups (both  $P = 0.449$ ; Table 2). The mean operative time was significantly shorter in the PE + LAT group (15.1 [12–20] minutes) than in the KT group (36.4 [25–50] minutes;  $P < 0.000$ ; Table 3). We recorded no bleeding, infection, or abscess development in any patient. Postoperatively, patients treated with the PE + LAT were allowed to sit; their mean VAS pain score at discharge was  $2.1 \pm 0.8$  (1–4). Oral painkillers were adequate. Patients treated with the KT were not allowed to sit postoperatively; their VAS pain score was  $4.4 \pm 1.3$  (2–6). Parenteral and oral non-steroidal anti-inflammatory drugs were prescribed. The VAS score was significantly lower in the PE + LAT group than in the KT group ( $P < 0.000$ ; Table 3). The mean time to return to normal daily activities was significantly shorter in the PE + LAT group ( $2.6 \pm 1.1$  [1–5] days) than in the KT group ( $12.8 \pm 2.9$  [10–20] days;  $P < 0.000$ ). After 6 weeks, the mean Likert-scale satisfaction score was significantly higher in the PE + LAT group than in the KT group ( $4.8 \pm 0.5$  vs.  $3.8 \pm 0.8$ ;  $P < 0.000$ ; Table 3).

After a mean follow-up time of 25 (15–39) months; recurrence rates were 1 (3.6%) in the KT group and 1 (3.3%) in the PE + LAT group. The groups did not differ in terms of recurrence ( $P = 0.737$ ; Table 3). In the PE + LAT group, serous discharge from the sinus orifices usually ceased within 3 days. In one patient, serous discharge continued for 3 weeks and then ceased spontaneously after dressing. Two patients evidenced early epithelialization of the sinus orifices (in the first days after surgery); orifice closure was associated with minimal serous fluid accumulation (about 1–2 ml) and pain. The thin epithelial layer covering the orifice was re-opened with the help of a stylet, the fluid was evacuated by applying pressure to the cavity and the

**TABLE 1. Ceralas®, Biolitec Biomedical Technology, Jena, Germany**

Ceralas diode laser®	
Technical parameters	
Wavelength	1,470 nm
Optical output	15 W
Guide beam	635 nm brightness adjustable Max. 4 mW
Working mode	CW, Pulse, Segment, ELVeS® Signal, Derma
Pulse length/time	0.01–99.9 sec
Power source	100–240 V <sub>AC</sub> , 50–60 Hz

expected discharge was achieved. The healing process was then completed.

## DISCUSSION

An ideal treatment for pilonidal sinus disease should be simple and effective. A short hospitalization period, ready acceptability, minimal tissue loss, minimal pain, few dressing changes, a low recurrence rate, and excellent aesthetic results are required [4,15]. Many methods have been used to treat pilonidal sinus disease, but none has eliminated the risk of recurrence. The primary closure technique is associated with a high recurrence rate (38%); wide excision with wound opening has a low recurrence rate (5%) [4]. Asymmetric incision/closure techniques, such as the KT (8% recurrence), the Bascom flap (8% recurrence), and the Limberg flap (1.5–5.3% recurrence), are also employed [4]. Pilonidal sinus disease is particularly common in young males [16]. The age and sex distributions of our patients are consistent with those reported in the literature.



Fig. 4. Postoperative results after 4 weeks.

The last 10 years have seen marked increased interest in the use of a laser for the treatment of pilonidal disease. A neodymium-doped yttrium aluminum garnet (Nd-YAG) laser was formerly used for hair removal in those with pilonidal sinus disease. Oram et al. [17] removed hair using an Alexandrite laser operating at 755 nm; the recurrence rate was 13%. Lindholt-Jensen et al. [18] used a 1,064-nm Nd-YAG laser to treat intergluteal clefts and sinus orifices; the recurrence rate was 19%. The results were good, but several laser sessions were required [19].

The idea that the pits played an important role in the pathogenesis of pilonidal disease, in the following years led to the spread of minimally invasive procedures in the treatment. In a study, Meinero et al. [14] described a new minimal invasive technique (E.PSi.T). Eleven pilonidal sinus patients were treated by video-endoscopic technique. Later, Emile et al. [20] reported in their meta-analysis that failure of this technique was (8.04%).

Tract destruction by a 1,470-nm diode laser is commonly used to treat anal fistulae; the outcomes of large patient series have been published [21–23]. Fistula-tract Laser Closure (FiLaC™) procedures are described in the literature to treat complex anal fistulas. It consists of sealing the fistula lumen by means of diode laser energy. Wilhelm et al. [23] achieved successful results in the first-line treatment for anal fistula repair using 1,470 nm diode laser. Giamundo et al. [24] described the modification of the FiLaC procedure previously described by Wilhelm, in which the closure of the internal orifice was performed with an advancement flap before laser treatment of the fistula tract. Their long-term results with a diode laser at 1,470 nm wavelength confirmed the encouraging short- and middle-term results of the previous study on FiLaC.

Dessily et al. [4] used a 1,470-nm diode laser to treat pilonidal sinus disease and suggested that this should be the treatment of choice. Pappas et al. [8] showed that use of a 1,470-nm diode laser to treat pilonidal sinus disease was associated with low morbidity and a low recurrence rate in 237 cases. The use of the diode laser provided protection of the Rima Ani surface and prevention of wound healing disturbances and at the same time provided a high success rate.

We combined pit excision with 1,470-nm diode laser ablation of the sinus tracts. We compared our results to those of the KT, which is associated with a low recurrence rate and is cosmetically acceptable. The laser completely destroyed the pilonidal cysts and sinus tracts; probe insertion via the sinus orifices did not wound the skin. When destroying a sinus tract, the flexible laser catheter was moved slowly from the external orifice to the end of the tract. Then, 1,470 nm energy was delivered radially (over 360°) along the entire sinus tract. The radial laser tip destroyed inflamed epithelial tissue of the inner tract wall in a controlled manner; the power delivered was 10–14 W, which penetrated to a tissue depth of 2–3 mm [22]. The tissue collapsed in on itself because of fibrotic reconstruction, closing the tract. A laser wavelength of 1,470 nm allowed optimal shrinkage and protein denaturation and closed the tract [23]. The associated

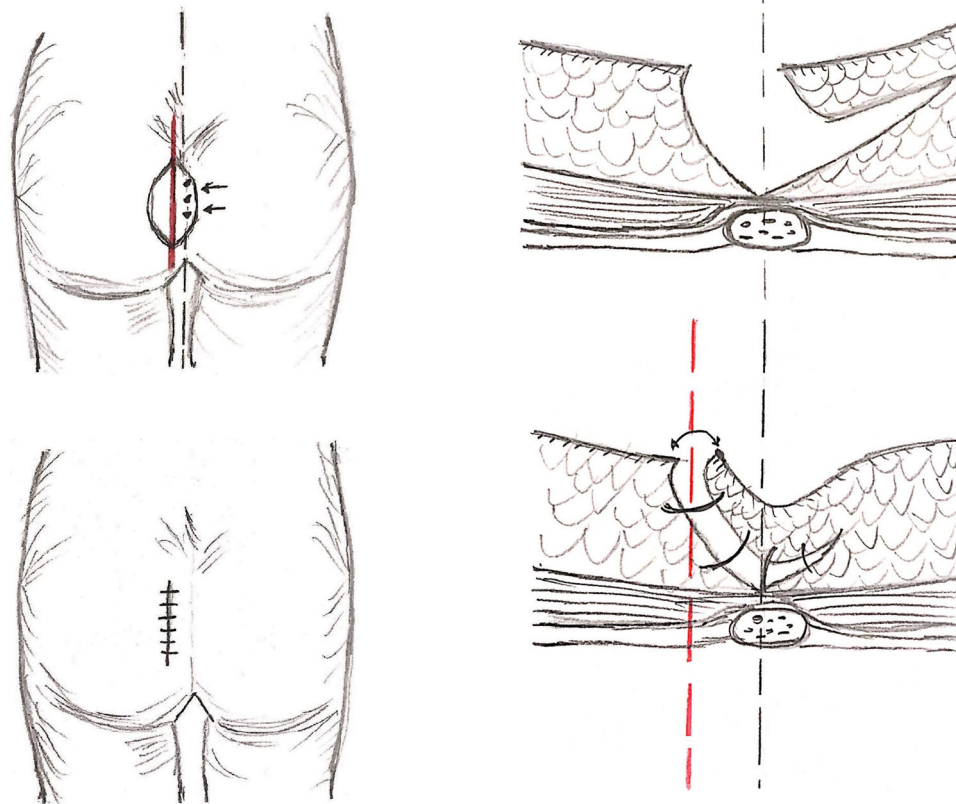


Fig. 5. Karydakís flap technique (The suture line was lateralized and the natal cleft transposition was provided).

**TABLE 2. Demographic Features of Patients**

	Karydakís technique <i>n</i> = 28	Pit excision + Laser ablation technique <i>n</i> = 30	Total <i>n</i> = 58	<i>P</i> value
Gender*				
Female	6 (21.4%)	5 (16.7%)	11 (19%)	
Male	22 (78.6%)	25 (83.3%)	47 (81%)	<b>0.449</b>
Age* (years)	25.8 ± 7.9 (15–41)	27.9 ± 8.9 (15–49)	26.9 ± 8.4 (15–49)	<b>0.328</b>

Continuous variables are described as the mean ± standard deviation (range) and categorical variables are described as *n* (%).

\**P* < 0.05 was considered statistically significant.

**TABLE 3. Outcomes of Karydakís Technique Compared With Pit Excision + Laser Ablation Technique**

Outcomes	Karydakís technique <i>n</i> = 28	Pit excision + Laser ablation technique <i>n</i> = 30	<i>P</i> value
Mean operative time (min)	36.4 ± 6.8 (25–50)	15.1 ± 2.0 (12–20)	<b>0.000*</b>
VAS pain score (0–10)	4.4 ± 1.3 (2–6)	2.1 ± 0.8 (1–4)	<b>0.000*</b>
Likert satisfaction score (1–5)	3.8 ± 0.8 (2–5)	4.8 ± 0.5 (3–5)	<b>0.000*</b>
Mean time off work (day)	12.8 ± 2.9 (10–20)	2.6 ± 1.1 (1–5)	<b>0.000*</b>
Recurrence* (%)	1 (3.6%)	1 (3.3%)	<b>0.737</b>

\**P* < 0.05 was considered statistically significant.

hyperthermia was minimal and reversible [25]. Dessily et al. [4] used 2% (w/v) xylocaine to induce local anesthesia and reduce heat-triggered inflammation of the surrounding tissues. We operated under general anesthesia; we did not induce local anesthesia. However, we applied ice for 5 minutes to all operative sites.

The "pit-picking" procedure of Iesalnieks et al. [26] was successful in selected pilonidal sinus cases; the recurrence rate was 17%. The basic principle of the pit-picking operation was the destruction of the sinus openings, whereas not the complete destruction of the sinus tract [26]. We engaged in pit-picking prior to laser ablation, thus the advantages of both techniques were combined. In this way, we tried to achieve complete recovery and reduce recurrence by removing all epithelial regions of the sinus holes by making a 0.4 cm circular incision with punch biopsy scalpel around the opening.

The recurrence rate in our PE + LAT group was similar to that reported by Dessily et al. [4] (2.9%), but lower than reported by Pappas et al. [8] (9.7%), as we and Dessily et al. selected patients with early-stage disease, whereas Pappas et al. did not. However, analysis of the study subgroups of Pappas et al. [8] showed that patients with stages 2 and 3 disease required secondary laser treatment because of relapse, whereas those with stage 1 (early) disease did not; thus, the outcomes differed by disease stage. However, the operative time, postoperative pain level, time to resumption of daily activities, and postoperative satisfaction were all significantly better in the PE + LAT group ( $P < 0.000$ ). The small surgical wounds, lack of tissue loss, absence of a requirement for suturing or application of tension, lesser pain, minimal wound complications, and lack of need for dressing allowed rapid return to normal daily activities. Another advantage of the PE + LAT is that the procedure can be repeated if necessary; retreatment is similar to primary treatment because of the lack of initial tissue loss, and wide excision is not required. Although our follow-up period was relatively short, the recurrence rates were low and similar in the two groups. Both techniques are safe for the treatment of early-stage pilonidal sinus disease, the PE + LAT is better than the KT.

## CONCLUSION

There are limitations to the conclusions that can be drawn from this study because of the number of patients and the follow-up period is short in terms of detecting recurrence. Although minimally invasive treatments for pilonidal sinus disease are currently preferred, more data are required. If the long-term results are good, extensive surgical procedures can be replaced by new minimally invasive procedures. Although many treatments for pilonidal sinus disease are available, the ideal treatment is related to the clinical stage. At this point; 1,470 nm diode laser sinus tract ablation combined with pit excision seems to be a good alternative among other minimally invasive techniques and superior to conventional techniques.

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