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Original Research Article

Comparative study of laser ablation versus conventional surgery in the management of pilonidal sinus disease

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ABSTRACT

Background: Pilonidal sinus disease (PSD) is conventionally managed through surgical excision (SE) followed by either direct closure (DC) or flap reconstruction. Laser ablation has recently been recognized as a minimally invasive alternative; however, comparative data remain limited.
Methods: This retrospective analysis involved 288 patients who received treatment for PSD at a single academic institution from 2010 to 2021.
Results: Laser treatment resulted in a significantly reduced operation time (18.2±6.8 min) and decreased sick leave duration (7.1±7.8 days) when compared to the DC and FC groups.
Conclusions: The findings indicate that laser ablation serves as a safe and also effective first-line PSD treatment, facilitating quicker recovery and reducing complications. Further long-term, randomized studies are necessary to validate its superiority.

Keywords: Complications, Direct closure, Flap reconstruction, Laser ablation, Pilonidal sinus disease, Recurrence, Surgical outcomes

INTRODUCTION

PSD, an inflammatory condition, classically located in the sacrococcygeal region. The cause is not wholly understood, but it is largely thought of as an acquired condition.[1] The disease's etiology involves hairs from the head, then neck and also back entering the natal cleft, leading to a foreign body reaction.[2] PSD chiefly affects males aged 15 to 30. Contributing threat factors include being overweight, extended periods of sitting, dense body hair, a deep natal cleft and hereditary susceptibility. Personal hygiene has minimal impact on the development of PSD, despite the presence of risk factors. PSD can occur with or without symptoms. Signs may involve pain or discomfort when sitting, a feeling of dampness or drainage in the cleft between the buttocks and the development of abscesses.[3] Multiple treatment approaches for "PSD exist, such as excision with primary closure and flap techniques and endoscopic pilonidal sinus treatment (EPSIT) and video-assisted ablation of the pilonidal sinus (VAAPS) and crystallized phenol application", along with laser ablation. There is currently no universally accepted treatment approach.[4] Standard treatments for PSD include excision with midline closure, off-midline closure using various subcutaneous flaps and excision with healing via secondary intention.[5]

Minimally invasive techniques for treating PSD have increased in prevalence in recent years. Techniques used include sinotomy and sinusectomy and the destruction of skin pits and sinus tracts, along with cavities through phenol application or endoscopic ablation.[6] Minimally invasive techniques reduce trauma and accelerate recovery times post procedures. Recent studies show positive results for laser ablation in treating sinus tracts.[7] However, few studies exist that compare laser treatment to other methods.[8] Despite various treatment options, the best approach for managing PSD is still unclear. This

study evaluates the outcomes of laser treatment and SE with DC and SE with flap closure (FC) over medium and long terms.

METHODS

Study participants

This is a retrospective study that received approval from the institutional review board and included all patients who had surgery for pilonidal sinus disease at a single academic hospital, namely Ahalia Hospital Branch-1, Abu Dhabi, UAE, from January 2010 to December 2021.

Patients were divided into three groups based on the surgical technique used: laser ablation, DC and flap reconstruction. Introduced in September 2019, the laser technique became the main treatment option. Patients with open wounds or those planned for delayed closure were excluded from the study.

Inclusion criteria

Patients identified with primary or recurrent pilonidal sinus disease, aged 16 years or older, who underwent surgical excision with direct closure, flap reconstruction or laser ablation at the institution between 2010 and 2021 were included in the study.

Surgical indications and operative technique

Surgical indications were determined in the outpatient clinic based on current symptoms. Technique selection depended on disease severity and collaborative decision-making. Procedures were done in the prone position using local, spinal or general anesthesia (GA), with preoperative cefuroxime prophylaxis at 1.5 g. Laser ablation used a 13 W diode laser at a speed of 1 mm/s.

Data analysis

Data were collected from medical records, including demographics, operative details and postoperative outcomes. Key outcomes included healing without events, residual disease (RD) at two months, recurrence, complications and re-operations.

Statistical analyses used SPSS version 25.0. Continuous variables were reported as mean±SD and gauged utilizing the Mann–Whitney U test; categorical variables were gauged with Pearson's chi-squared test. A p value under 0.05 was considered statistically significant.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board. Informed consent was obtained from all patients prior to treatment and inclusion in the analysis.

RESULTS

Patient demographics and baseline characteristics

A total of 288 patients received surgical treatment for pilonidal sinus disease throughout the study period. A total of 84 patients (29.2%) received laser ablation, 112 patients (38.9%) underwent excision with DC and 92 patients (31.9%) were treated with excision and FC. Table 1 summarizes the demographic and baseline clinical characteristics of the three groups. The average age of the study population was 29.0±9.7 years, with no statistically noteworthy variance observed between the groups (p=0.17).

The average BMI in the laser group (LG) was 26.2±5.1, which was lower than that of the DC group (DCG) at 28.7±5.7 and the FC group (FCG) at 31.0±10.9; however, this difference did not reach statistical significance (p=0.08). The occurrence of type 1 and type 2 diabetes mellitus was minimal and similar among the group. Smoking prevalence was notably lower in the LG (21.4%) compared to the DC (48.2%) and FC (53.3%) groups (p<0.001), indicating a potential selection bias or variations in patient characteristics. The LG exhibited the highest average number of fistulous tracts at 2.7±1.5, followed by the flap group at 2.6±1.4 and the DCG at 2.0±1.7 (p=0.02). The mean follow-up duration for the LG was significantly shorter at 14.1±6.9 months, in contrast to the DCG at 81.5±35.6 months and the FCG at 85.7±28.1 months (p<0.001), indicating the recent implementation of laser technology.

Intraoperative and postoperative outcomes

Table 2 presents the intraoperative and immediate postoperative outcomes. The average operative time in the LG was significantly reduced (18.2±6.8 minutes) when compared to the DC (33.8±16.2 minutes) and FC (59.5±17.3 minutes) groups (p<0.001). A significant majority of laser ablation procedures (94.0%) were conducted as outpatient surgeries, in contrast to the lower rates observed in the DC (71.4%) and FC (71.7%) groups. Spinal anesthesia was utilized in 73.8% of the LG and 51.8% of the DCG, whereas GA was the primary choice in 66.3% of the FCG.

Local anesthesia was infrequently utilized, observed in only 11.9% of laser cases and an even lower percentage in the other groups. Postoperative antibiotic administration was markedly reduced in the LG (6.0%) relative to the DC (46.4%) and FC (90.2%) groups (p<0.001). The average duration of sitting prohibition was significantly reduced following laser ablation (0.1±0.3 weeks) compared to DC (2.3±1.0 weeks) or FC (3.3±1.0 weeks) (p<0.001). Patients in the LG had a significantly shorter mean sick leave of 7.1±7.8 days, in contrast to the DCG at 25.8±25.6 days and the FCG at 31.4±13.8 days (p<0.001). The average number of postoperative follow-up visits was greater in the LG

(3.7±4.1), suggesting a more careful follow-up protocol for this newer technique.

Healing, complications and recurrence

The main outcome, eventless healing (characterized by complete healing sans RD or recurrence or even complications), was attained in 67.9% of patients inside the LG, 66.1% inside the DCG and 53.3% in the FCG (p=0.04). RD within two months posr surgery was most prevalent in the LG (26.2%), in contrast to the DC (8.0%) and FC (8.7%) groups (p<0.001). The complication rate in the LG was greatly lower at 13.1% compared to 27.7% in the DCG and 34.8% in the FCG (p=0.002). Infection rates were comparable among all groups; however, hematoma and wound dehiscence occurred exclusively in the conventional surgery groups. The requirement for reoperation showed no noteworthy variances between the groups. Post two months, recurrence rates were lowest in the LG at 3.6%, intermediate in the DCG at 7.1% and highest in the FCG at 10.9%. However, these variances were not statistically noteworthy (p=0.09).

Table 1: Baseline patient characteristics.

Characteristic	Laser (n=84)	Direct closure (n=112)	Flap closure (n=92)
Patients, N (%)	84 (29.2%)	112 (38.9%)	92 (31.9%)
DM1, N (%)	2 (2.4%)	4 (3.6%)	5 (5.4%)
DM2, N (%)	2 (2.4%)	3 (2.7%)	4 (4.3%)
Smoking, N (%)	18 (21.4%)	54 (48.2%)	49 (53.3%)
Age, mean±SD (years)	26.6±8.7	29.3±9.8	31.1±10.2
BMI, mean±SD (kg/m²)	26.2±5.1	28.7±5.7	31.0±10.9
No. of fistulas, mean±SD	2.7±1.5	2.0±1.7	2.6±1.4
Follow-up, mean±SD (months)	14.1±6.9	81.5±35.6	85.7±28.1

Table 2: Intraoperative and postoperative data.

Characteristic	Laser (n=84)	Direct closure (n=112)	Flap closure (n=92)
Operation time (min), mean±SD	18.2±6.8	33.8±16.2	59.5±17.3
Day surgery, N (%)	79 (94.0%)	80 (71.4%)	66 (71.7%)
Local anesthesia, N (%)	10 (11.9%)	5 (4.5%)	2 (2.2%)
Spinal anesthesia, N (%)	62 (73.8%)	58 (51.8%)	29 (31.5%)
General anesthesia, N (%)	12 (14.3%)	49 (43.8%)	61 (66.3%)
Anesthesia-missing info, N	0	6 (5.4%)	0
Postop antibiotics, N (%)	5 (6.0%)	52 (46.4%)	83 (90.2%)
Prohibition to sit (weeks), mean±SD	0.1±0.3	2.3±1.0	3.3±1.0
Sick leave (days), mean±SD	7.1±7.8	25.8±25.6	31.4±13.8
No. of controls, mean±SD	3.7±4.1	2.0±2.8	1.8±2.9

Table 3: Healing, RD, recurrence and complications.

Characteristic	Laser (n=84)	Direct closure (n=112)	Flap closure (n=92)
Eventless healing*, N (%)	57 (67.9%)	74 (66.1%)	49 (53.3%)
Residual in 2 months, N (%)	22 (26.2%)	9 (8.0%)	8 (8.7%)
Recurrence post 2 months, N (%)	3 (3.6%)	8 (7.1%)	10 (10.9%)
Any complication^, N (%)	11 (13.1%)	31 (27.7%)	32 (34.8%)
Infection, N (%)	10 (11.9%)	15 (13.4%)	19 (20.7%)
Hematoma, N (%)	0	5 (4.5%)	7 (7.6%)
Dehiscence, N (%)	0	23 (20.5%)	15 (16.3%)
New operation, N (%)	16 (19.0%)	17 (15.2%)	14 (15.2%)

*Eventless healing=no RD or recurrence or even complications, ^ A single patient may experience multiple complications.

DISCUSSION

The study demonstrated that laser ablation led to a significantly reduced operative time, shorter hospital stays, lower postoperative antibiotic consumption and a faster return to normal activities compared to excision with direct or flap closure. The findings correspond with a growing body of evidence supporting the efficacy and safety of laser techniques in treating PSD. A recent meta-analysis involving 1,214 patients found that 84.4% achieved healing after primary laser treatment, with mean complication and recurrence rates of 12.7% and 7.6%, respectively. This highlights the efficacy and positive safety profile of this method.[9] A systematic review

revealed a pooled healing rate of 81.9% for recurrent cases, with a trend of decreasing healing rates observed over longer follow-up periods, underscoring the need for extended monitoring to thoroughly assess long-term outcomes.[10] The results align with the observations of Romic et al, who reported a reappearance rate of 14.5% post a median follow-up of 5.2 years in patients treated with radial laser surgery. This indicates that laser ablation presents a reasonable long-term recurrence risk, especially considering the procedure's minimally invasive nature.[11] A substantial single-center study demonstrated that the LaPSe (Laser-assisted pilonidal sinus excision) technique resulted in a recurrence rate of merely 1.4% at six months, supporting the efficacy of laser-based methods as a primary treatment for PSD.[12]

Research comparing laser ablation with other minimally invasive treatments, such as crystallized phenol application, shows that laser ablation results in faster wound healing and less postoperative pain, while both techniques exhibit high treatment success in specific cases.[13] The rapid recovery and decreased morbidity associated with laser ablation are particularly important for the young, working-age population most affected by PSD. The data revealed a significantly reduced restriction on sitting and a lower incidence of sick leave in the LG, consistent with recent studies emphasizing the importance of minimizing interruptions to patients' daily routines.[14]

The lower overall complication rate observed in our laser cohort is consistent with existing literature, which shows that wound-related complications such as hematoma and dehiscence are more common in conventional surgical groups.[15] Our results indicate particular constraints associated with laser ablation. The occurrence of RD at two months was higher in the LG compared to excisional techniques. This observation is consistent with findings from other studies and is likely affected by factors including the learning curve, patient selection and challenges in managing more complex or extensive diseases through minimally invasive techniques.[16] However, the ability to conduct laser procedures repeatedly and the low occurrence of serious complications make this a viable option in numerous clinical contexts, especially when contrasted with the higher morbidity linked to open surgery.

In the study, the LG showed the lowest recurrence rates at two months; however, the short follow-up period for these patients may not provide an accurate representation of long-term recurrence rates. The literature acknowledges this limitation and recent reviews recommend conducting high-quality randomized controlled trials with extended follow-up to better assess the durability of laser ablation outcomes.[9,16] The efficacy of adjunctive techniques such as pit picking and laser hair removal remains subject to ongoing research. Research suggests that the efficacy of pit picking combined with laser ablation may not differ significantly.[10] Laser ablation in PSD management offers several advantages, including reduced operative time, lower complication rates, improved cosmetic outcomes and a faster return to normal activities.[9,14] In low-risk patients with less extensive disease, the benefits are particularly pronounced, as the likelihood of achieving complete ablation is optimized.

CONCLUSION

Laser treatment for pilonidal sinus disease showed reduced operation times, lower complication rates, along with faster recovery when likened to conventional open surgical techniques. The rate of RD was elevated; however, the overall incidence of eventless healing remained similar. Due to its minimally invasive characteristics and positive recovery outcomes, laser ablation shows potential as a primary treatment option; however, further long-term randomized studies are required.

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