

Minimally Invasive Laser Surgery vs. Common Techniques for Hemorrhoid Treatment: Technology Assessment

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Abstract

Introduction: Hemorrhoids are swollen veins in the lower rectum and anus, rarely dangerous, and typically treated within a few weeks. However, urgent medical care is required to avoid exacerbation of the condition. This study aimed to compare minimally invasive laser surgery with other common hemorrhoid surgical techniques and investigate the main outcome of these techniques.

Data sources: Four databases of PubMed (185), Scopus (59), ISI (143), CRD (10), and other resources (12) were explored.

Study selection: All studies on laser surgery for patients with Grade 2 or 3 hemorrhoids examining pain outcome, reduction of hemorrhoids grade, and patient's quality of life after laser surgery were enrolled in this review.

Results: Finally, 25 eligible articles were enrolled in the study. The results indicated that hemorrhoid was improved in the laser surgery group within the follow-up period with a higher average of quality-of-life self-assessment compared to other techniques. Overall satisfaction was higher in the laser group.

Conclusion: The evidence favored laser treatment in all studies, either clinical trials or studies without control groups. In general, laser surgery is considered an immune treatment for hemorrhoids with fewer postoperative complications such as bleeding, discomfort, and pain. Therefore, other than the cost, the rest of the evidence was in favor of laser surgery, and the laser technique is an appropriate alternative to conventional methods.

Keywords: Hemorrhoid, Laser Surgery, Treatment

Introduction

Hemorrhoids are swollen veins in the lower rectum and anus. When the walls of the rectal veins become swollen and stretched over time, the passing stool irritates them, causing scratches and damage to the vein wall. Hemorrhoids are the most critical and common cause of rectal bleeding that, despite being low risk, need urgent medical care to avoid exacerbation.¹

Hemorrhoids are commonly observed in obese people and sometimes during pregnancy for reasons such as family history and accumulation of pressure in the lower rectum. Also, those who work long standing or sitting are more prone to this disease, aggravated by coughing, sneezing, and vomiting.^{2,3}

This disease has different gradings, most commonly expressed in four levels. In Grade 1, the veins dilate

but never protrude out of the anus. In this case, the only symptom of the disease is bleeding. In Grade 2 hemorrhoids, the veins dilate and protrude out of the anus during defecation and then return spontaneously. In Grade 3, hemorrhoids prolapse but do not return to the position spontaneously and need to be manually returned. Finally, in Grade 4, the protruding hemorrhoids do not return inside the anus and remain prolapsed.⁴⁻⁶

It is estimated that about 50% of people over 50 develop the disease. The available statistics, however, show a smaller percentage, which might be due to not visiting a doctor for religious beliefs or social conditions.⁷ The prevalence of the disease is reported at 4.4% in the US⁸ and about 39% among Australian

adults aged 28 to 85.⁹ Despite hemorrhoid being a common disease with similar signs and symptoms in women and men, it affects women four times more than men.¹⁰ The age of incidence cannot be accurately diagnosed and it is likely to occur at any age. Even children are affected by this disease since the wrong lifestyle is a more potent risk factor than age. In general, hemorrhoids are most common between the ages of 45 and 65. That can be explained by the fact that as age rises, the muscles surrounding the anus (sphincter) weaken and lose their function. Hence, the probability of developing hemorrhoids is related to aging.¹¹

Treatment is based on the symptoms and grade of the disease. Surgical removal of hemorrhoids is limited to large Grade 3 and 4 hemorrhoids.¹ One of the latest technologies for treating hemorrhoids is a new laser procedure called radial laser or shrinkage laser, which removes the lump once emitted.¹² Laser technology has been used in clinical and surgical specialties since the 1960s. The advantages of considering the biological characteristics of this technique include no adverse effects on adjacent tissue, being hemostatic, rapid healing, being bactericidal, and less pain after surgery.¹²

As a minimally invasive technique, the hemorrhoidal laser procedure is performed in two ways: 1. Laser therapy with low-power Infrared coagulation (IRC); 2. A high-powered carbon dioxide (CO₂) laser is used in hemorrhoidectomy.¹³ Depending on its power and duration of use, the laser beam causes tissue shrinkage and removal at different depths.¹⁴ Based on,¹²⁻¹⁴ minimally invasive laser surgery is effective in patients with Grade 2 or 3 hemorrhoids; however, to confirm the effectiveness, it is necessary to compare it with existing methods. Therefore, this study aimed to compare the main outcomes such as pain score, reduction of hemorrhoid grade, and quality of life in patients treated with standard methods.

Materials and Methods

The present study was conducted as a systematic review in 2020. Four databases, including PubMed, Scopus, International Scientific Indexing (ISI), and Center for Review and Dissemination (CRD), were explored to obtain studies on standard hemorrhoid treatment methods. To ensure a comprehensive search, we checked references of the reviewed articles and the WHO International Clinical Trials Registry Platform.

Using the AND and OR operators, we used the following keywords:

“Laser”, “Laser surgery”, “Laser therapy”, “hemorrhoid”, “LHP”, “HeLP”, “laser hemorrhoidoplasty”, “CO₂ laser”, “laser procedure hemorrhoidectomy”, “Nd-YAG laser”

No restrictions were placed on the language and year of publications, and the last search was dated May 15, 2020. The search strategy in the PubMed database was as follows:

("hemorrhoid"[MeSH] AND ("Laser surgery"[All Fields] OR "laser procedure"[All Fields] OR ("laser hemorrhoidoplasty"[All Fields] OR ("laser hemorrhoidectomy" [All Fields] OR "Minimally Invasive Method"[All Fields] AND ("RCT") OR (trial*))).

Study Inclusion and Exclusion Criteria

All studies on laser surgery for patients with Grade 2 or 3 hemorrhoids examining pain outcome, reduction of hemorrhoids grade, and patient's quality of life after laser surgery were selected for this review. Studies that reported emergency hemorrhoid surgery for thrombotic hemorrhoids and Grade 1 or 4 hemorrhoids were excluded.

Selection Criteria and Quality Assessment

All stages, including review of articles, extraction of the required data, and quality assessment, were independently performed by two researchers, and finally, the agreement was reached through group discussion. The criteria affecting study selection included:

- Surgical interventions of Grade 3 and 2 hemorrhoids for postoperative pain outcomes based on the visual analog scale (VAS) and similar scales.
- Use of analgesics.
- Postoperative complications (postoperative hemorrhage and wound, emergency reoperation).
- Patient satisfaction.
- Duration of surgery in minutes.
- Length of hospital stay by a day.
- Postoperative pain.
- Time to the resumption of bowel activity.
- Time to return to work or normal daily activities by day.
- Recurrence of hemorrhoids (number of patients with internal recurrence or hemorrhoidal prolapse in clinical examinations).
- Recurrence of hemorrhoidal bleeding.

Any disagreement over the data was resolved through discussions with the third researcher. A five-point

Jadad scale was used to assess clinical trials. Details of the selected studies are depicted in Table 1.

Table 1. Characteristics of Included Studies

No.	Author	Year	Methodology	Types of interaction and laser
1	Naderan ¹⁵	(2017)	RCT	Milligan-Morgan vs. Diode laser
2	Alsisy ¹⁶	(2019)	Prospective study	Milligan-Morgan vs. 980-nm Diode laser
3	Nikshoar ¹⁷	(2018)	RCT	Infrared Photocoagulation vs. Closed Hemorrhoidectomy
4	He´lio Plapler ¹⁸	(2009)	RCT	Intrahemorrhoidal Diode Laser vs. Hemorrhoidectomy "Cold scalpel" technique (Milligan Morgan)
5	Senagore ¹⁹	(1993)	RCT	Cold Scalpel vs. Nd: YAG Laser
6	Giamundo ²⁰	(2011)	Prospective study	Diode laser vs. procedure rubber band ligation
7	Poskus ²¹	(2020)	RCT	Laser hemorrhoidoplasty (LHP) vs. Excisional Hemorrhoidectomy (EH) and sutured mucopexy (MP)
8	Chia ²²	(1995)	RCT	CO ₂ laser vs. Milligan Morgan
9	Pandini ²³	(2006)	RCT	Milligan–Morgan technique using either the CO ₂ laser or cold scalpel
10	Ghorbanpoor ²⁴	(2014)	RCT	Hemorrhoidectomy by Laser and closed hemorrhoidectomy (Ferguson)
11	Wang JY ²⁵	(1991)	RCT	Nd-YAG laser phototherapy for internal hemorrhoid combined with the CO ₂ laser for external hemorrhoid vs. closed Ferguson hemorrhoidectomy
12	Ferhatoglu ²⁶	(2019)	Prospective study	Laser Hemorrhoidoplasty (LH)
13	Luigi Bruscianno ¹⁴	(2019)	RCT	Laser hemorrhoidoplasty
14	Hodgson ²⁷	(1995)	RCT	Ambulatory hemorrhoidectomy with CO ₂ laser
15	Nicola Crea ²⁸	(2014)	Prospective study	Hemorrhoidal laser procedure(HeLP)
16	Giamundo ²⁹	(2011)	RCT	Doppler-guided hemorrhoidal laser
17	Jahanshahi ³⁰	(2012)	RCT	Diode laser
18	Giamundo ³¹	(2018)	Longitudinal cohort	Doppler-guided hemorrhoidal laser procedure (HeLP)
19	Nardi ³²	(2016)	Prospective	Hemorrhoid laser procedure
20	Faes ³³	(2019)	Prospective	Laser haemorrhoidoplasty
21	Pravin J ³⁴	(2004)	Randomized, prospective	Radiofrequency IRC
22	Edward Ram ³⁵	(2018)	Cohort	Modified doppler guided laser procedure
23	Giamundo ³⁶	(2020)	Prospective	Hemorrhoid laser procedure with suture pexy (HeLPexx)
24	Elisabeth ³⁷	(2012)	Retrospective	Infrared coagulation. IRC
25	Lutfi ³⁸	(2014)	Randomized, prospective	Laser hemorrhoidectomy

Results

A total of 397 studies were retrieved from the target databases [PubMed (185), Scopus (59), ISI (143), and CRD (10)]. Twelve articles were manually searched and enrolled from the WHO International Clinical Trials Registry Platform. Figure 1 depicts the flow of information through the different phases.

Quality Assessment

Based on the evidence obtained in this study, only 13 studies were clinical trials, and the rest were conducted without a control group. Among the clinical trials. Only four studies acquired a Jadad score of >4 out of 5 among the clinical trials. Other studies failed to meet randomization and blinding criteria or did not provide an appropriate report of the results with strong evidence.

Hemorrhoid Laser Procedure vs. Milligan Morgan's Technique

Five studies had compared the two surgical procedures. Laser techniques used included CO₂ lasers^{16,40-42} and laser diodes.^{42,43}

Pain

In three studies, pain at follow-up was measured by the VAS scale, and one study reported postoperative analgesics. Naderan et al. compared pain at 6, 12, and 24 hours after surgery and found no noticeable changes between the two groups in the first six hours. However, 24 hours after surgery the pain score was significantly lower in patients undergoing laser procedures.^{16,42}

Regarding postoperative morphine injection and analgesics, the rate of use was lower in the laser surgery group.¹⁶ The average days of analgesic use after

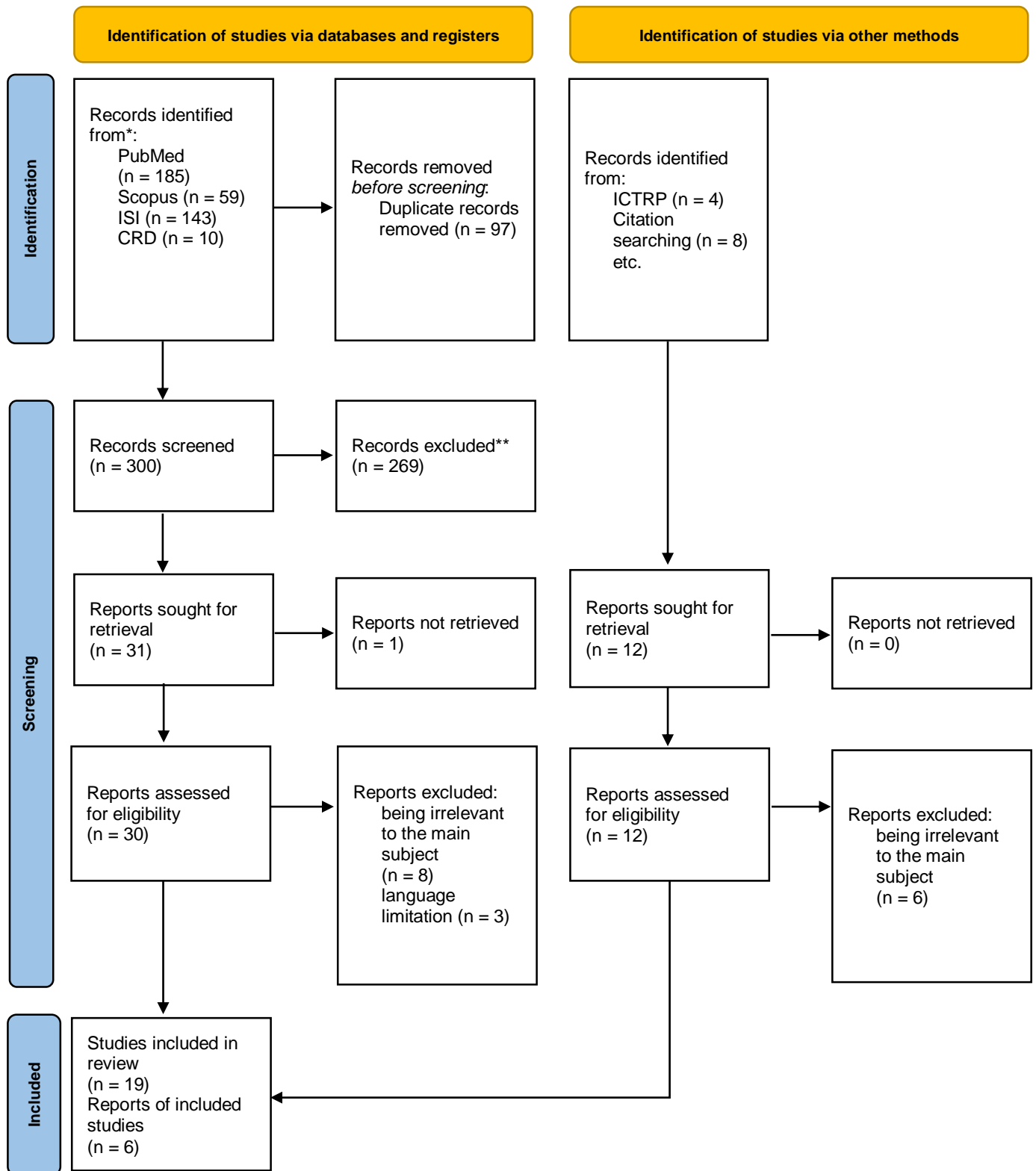


Figure 1. PRISMA 2020 Flow Chart for Study Selection and Review³⁹

hospital discharge were also lower in the laser surgery group. The study⁴³ examined the mean pain in the first 28 days, in which the pain score, number, and days of analgesic use were considerably lower in the laser

surgery group compared to the Milligan Morgan surgery group. However, both groups reported decreased pain intensity within 28 days after surgery. In the study,⁴¹ the cold scalpel method was used to

perform Milligan Morgan. Based on the VAS scale, the pain score was higher in the laser surgery group in the first six days. Comparing the two groups from 7 to 12 days after surgery, Milligan Morgan's technique recorded a higher pain score. However, the dipyrene and diclofenac (oral analgesics) were on the same day 14 after surgery. This study also measured pain scores at the first bowel movement, which was lower in the laser surgical treatment. The study⁴⁰ investigated the need for morphine and reported lower medications to use in the laser group.

Postoperative Complications

The rate of postoperative complications was 10% for both groups, and there was no apparent difference between wound healing and return to normal activities in the two groups.⁴⁰ During the postoperative three-month follow-up, both groups were satisfied with the surgery and its outcomes.⁴¹ No considerable difference was reported between the two groups regarding the complication of urinary retention, progression of hemorrhoids, and increased clinical symptoms in one year. In addition, the two groups were not different in symptoms such as bleeding, pain, itching, and the need for reoperation.⁴² The reported scars or acrochordons in patients with laser surgery improved within a week without surgical treatment.⁴³

Hemorrhoid Laser Procedure vs. Rubber Band Ligation

One study compared a minimally invasive hemorrhoid laser procedure (HeLP) with the system using a plastic band. In this randomized clinical trial, 60 patients were randomly treated and followed up for six months.⁴⁴

Pain

Measuring pain scores using the VAS scale, patients in the HeLP group had significantly less pain in 1 to 3 days after surgery using fewer analgesics.⁴⁴

Reduction of Hemorrhoids Grade

According to the results of proctoscopy at a 6-month follow-up, a reduction of hemorrhoids by at least one grade was observed in most patients in the HeLP group.⁴⁴

Quality of Life

In 90% of the patients in the HeLP group, the symptoms improved over six months, and the mean

self-assessed quality of life score (VAS, 0–10) was lower in the Rubber Band Ligation (RBL) group at the 6-month follow-up. Overall satisfaction in the laser group was 90%, and no side effects were reported for either group.⁴⁴

Hemorrhoid Laser Procedure vs. Open Surgery

In,²¹ laser hemorrhoidoplasty (LHP), sutured mucopexy (MP), and excisional hemorrhoidectomy (EH) were compared with a total of 121 patients.

Pain

A comparison of postoperative pain over one week indicated that LHP and MP groups experienced less pain. The duration of analgesic use was shorter in these two groups.²¹

Quality of Life

Patients with laser surgery returned to normal activities twice as often as the other groups. The SF-36 Health Survey scores were higher in EH. The severity of defecation symptoms improved in all groups after one year. After one year, the patients in the LHP group evaluated their surgery better than the EH and MP groups.²¹

Hemorrhoid Laser Procedure vs. Closed Hemorrhoidectomy (Ferguson)

In two randomized clinical trials, 96 patients with Grade 3 internal hemorrhoids underwent either closed hemorrhoidectomy (Ferguson) or laser surgery.^{17,24}

Pain

Postoperative pain was measured using the Visual Analogue Scale (VAS). The mean postoperative pain scores in closed and laser hemorrhoidectomy were measured in the first 24 hours, one week, one month, and two months after surgery. Pain score was significantly lower in the laser hemorrhoidectomy group at all four follow-up times.^{17,24}

Complications

Postoperative bleeding and urinary retention in the first 24 hours and the first week were less in laser surgery compared to a closed hemorrhoidectomy. However, the cost of the laser procedure was higher.²⁴ Also, it lasted less for the patients undergoing laser procedures to return to work¹⁷

Evaluation of the Impacts of Laser Hemorrhoidoplasty

Three thousand two hundred twenty-four patients with Grade 2 and 3 hemorrhoids were evaluated for postoperative pain and complications and the use of analgesics.

Pain

Five studies reported the highest pain score on the first day. The pain score in the first 24 hours was found to be 0 to 2 in studies using the VAS scale^{14,29,33} and 0 to 1 with the VRS scale.^{26,28} All five studies reported low postoperative pain over 24 hours.

According to the Crea et al. study, the postoperative pain in the first 24 to 36 hours was expressed as "average" for 18% of the patients for whom oral analgesics were administered.²⁸ Two studies that used the VAS scale reported pain in the first three days after surgery,^{14,29} both of which used the VAS scale.

The pain score was reported to be 1.8 after one week, and 7% of the patients received anti-inflammatory medicines for over a week to relieve pain.³⁶ After this period, the pain score fell to zero using both VAS and VRS criteria.^{14,28} Pain score after one week was zero in 82.3% of the participants in the Ram et al. study.³⁵

Also, the study³⁶ reported zero pain scores after three weeks. Based on,^{14,28,33,35,45} pain was null in 95% of the participants one month after surgery, remaining the same at 6 and 12 months. Three days after surgery, only 9.5% of the patients required analgesics,³¹ while it was 35% in the first 24 hours.³² According to,⁴⁵ oral analgesics continued for up to 10 days following treatment with radiofrequency laser.

Reduction of Hemorrhoids Grade

Four studies reported a reduction in hemorrhoids grade. The results of²⁹ indicated that 77% of the patients had a reduction in hemorrhoids grade from 3 to 2 and from 2 to 1 within a month.²⁸ found a reduction of one degree in 85% of the patients. According to,³³ the return of hemorrhoidal prolapse to grade 1 was seen in all patients within 30 days. The study³⁵ reported a noteworthy reduction in hemorrhoids grade, of which 37% was for hemorrhoids grade 2 and 62% for grade 3.

Quality of Life

Among the enrolled studies,^{29,31,36} had assessed the

quality of life by self-assessed quality of life score (VAS 0-10). Time to return to normal activities was also reported in.^{14,24,28,29,33,35} The quality of life in all patients improved up to 93% three months after surgery, not to be changed in subsequent follow-ups.²⁹ In the study,³¹ the quality of life before and after the surgery was reported as 4.63 and 8.99, respectively. In the study,³⁶ the effect of laser surgery on quality of life was considered, being 3.35 and 0.6 before and after the surgery, respectively. Time to return to work was mentioned in different studies ranging from less than one day,^{28,35} 1-2 days^{14,29,33} to 3 days.²⁴

Other Outcomes

however, the study²⁸ found the recurrence of hemorrhoids to be 5% within two years. The study¹⁴ reported no reproduction in an average of 8.6 months.

Symptom Improvement

Two studies described the reduction in hemorrhoid symptoms, including bleeding, pain, prolapse, and edema.^{35,36} Most studies reported 80 to 100% symptom improvement.^{26,28,29,31,33}

Satisfaction

Although a few studies considered satisfaction, the satisfaction index was reported to be above 96% in the existing studies, and the participants had recommended the procedure to other patients.^{14,33,36,45}

Discussion

There are a variety of approaches for the treatment of hemorrhoids, and one is selected based on the surgeon's experience, available facilities, patient's willingness, and treatment costs. Naturally, each method can be associated with unwanted side effects. Careful examination of these complications and comparison of the outcomes makes one method to be favored over the others. A treatment approach in this regard is laser hemorrhoidectomy. The use of lasers in treating gastrointestinal diseases became common in the mid-1970s. Today, three types of lasers are widely used, including CO₂, argon, and ND: YAG lasers.

Based on the evidence obtained in this study, only 13 studies were clinical trials, and the rest were conducted without a control group. Among the clinical trials, only four studies acquired a Jadad score of >4 out of 5. Other studies failed to meet randomization and

blinding criteria or did not provide an appropriate report of the results with strong evidence. However, the evidence favored laser surgery in all studies, both clinical trials and those without control groups. Because the results of all the studies on using lasers with various wavelengths, either poorly- or well-designed, favored laser surgery compared to other methods, the laser technique might be an appropriate alternative to conventional methods. To summarize the obtained evidence, the diversity of treatment techniques leads to confusion in selecting one method. Each of these techniques improves the patient's condition with varying degrees of success and side effects. New procedures seek less pain after surgery. The HeLP technique has recently been considered for clinical applications. In all the studies, the evidence favored laser surgery regarding postoperative pain. However, in addition to reducing postoperative pain,⁴⁶ listed the benefits of laser procedure as being antibacterial, rapid healing, no effect on the structure of the adjacent tissues, along with fewer complications of bleeding and anal stenosis after surgery.

Moreover, ease of laser application, short hospital stays, decreased use of medications, satisfaction in postoperative follow-ups, and reduced time to return to normal activities were mentioned as the advantages of laser surgery.^{14,33,40,41,45}

A reduction in hemorrhoid grade was observed in 77% of patients after surgery. Accordingly, a one-degree reduction was reported over three months, leading to a specific change in the classification of patients based on hemorrhoid grade before and after surgery.^{28,29} Many studies showed that over a long time (> six months), all patients had symptom reduction compared to the preoperative period.^{14,26,28,31,33,35} Also, since the laser did not cause any anatomical deformity, in case of recurrence of hemorrhoids, other methods could be used for re-treatment.^{28,29,33}

Because a low-power laser is a fast, safe, effective, painless, and appropriate technique for cases of hemorrhoid recurrence, this method is recommended compared to conventional methods.^{47,48} It is pointed out that although a low-power laser is commonly used for low-grade hemorrhoids, it can also be a safe alternative to invasive procedures regarding clinical outcomes.¹⁷

Although²⁹ described rubber band ligation as a safe, effective, easy, and common method for hemorrhoid

treatment, the time to return to work was shorter in patients undergoing HeLP. In addition, the disease's recurrence probability in the rubber band ligation was reported to be relatively high.²

Despite the evidence in favor of laser procedure regarding pain relief, it should be noted that pain after one week was the same in both HeLP and rubber band ligation.⁴⁴ Moreover, the RBL method was far more appropriate for prolapse treatment, and HeLP was more effective for patients with persistent bleeding.^{30,42,46}

Evidence shows that laser surgery is effective, particularly in a short time, and is associated with faster symptom improvement, reduction of hemorrhoidal prolapse, higher patient satisfaction, and quality of life.^{29,33} However, a disadvantage of this method is the high recurrence rate in the long run, leading to reoperation in some cases.^{28,33,42}

Although the cost of laser hemorrhoidoplasty is higher than conventional methods, it requires a shorter hospital stay, a shorter duration of surgery, and fewer complications that offset the high cost of the laser. Other treatment methods may increase costs due to hospitalization expenses, anesthesia medications, operating room, and multiple surgical sessions.^{14,29}

Various studies affirm that the cost of laser hemorrhoidectomy is much higher than the usual Milligan-Morgan method, which involves maintaining, purchasing, and recharging the laser device. On the other hand, the laser is easy to use and learn by the surgeons, which affects the cost-effectiveness of laser surgery.^{19,29,30-32,42}

Finally, the main goal of colorectal surgeons in cases of hemorrhoids is to treat the symptoms and improve the patient's quality of life. Although HeLP is a treatment option for any grade of hemorrhoids, it is not recommended in cases of severe prolapse. Selecting an appropriate method is based on the hemorrhoid grade, symptoms, prolapse, and the patient's willingness. In general, this surgical procedure is associated with low levels of pain, few complications, and no changes in anal anatomy. Therefore, minimally invasive methods are recommended if the prolapse is moderate in preoperative examinations, given that surgeries such as Milligan Morgan are very intrusive.^{29,49}

Conclusion

Despite the evidence, the use of lasers for hemorrhoid surgery is not yet a routine treatment. One of the

reasons for this is the higher cost of laser procedures. However, since laser procedure is associated with fewer complications, shorter time to return to normal activities, and more patient comfort, it can be considered cost-effective in economic evaluation. Conducting a complete Health Technology Assessment (HTA) study emphasizing economic evaluation to evaluate the HeLP method thoroughly is recommended. However, studies show that lacking or low-quality evidence will limit the financial assessment.

Conflict of Interest

The authors declare no conflicts of interest.

Ethical Approval

The current research was approved by the university's ethical committee (Code: IR.SSU.SPH.REC.1400.202).

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