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ORIGINAL RESEARCH

Laser Hemorrhoidoplasty: A Less Invasive Alternative to Conventional Hemorrhoidectomy

[1]Dr. Ashwin Siddesh, [2]Dr. Vikram U Sindagikar, [3]Dr. Mallikarjun B Patil, [4]Dr. Vijaya L Patil, [5]Dr. Deepak R Chavan, [6]Dr. Dayanand S Biradar, [7]Dr. Anand Suntan

[1]Final year Postgraduate, [3,4]Professor, [2,5,6]Associate Professor, [7]Assistant Professor, Department of General Surgery, BLDE(DU) Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India

Corresponding Author
Dr. Vikram U Sindagikar
Associate Professor, Department of General Surgery, BLDE(DU) Shri B. M. Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka, India
Email: vikram_114@yahoo.com

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ABSTRACT

Introduction: Hemorrhoids arise from the enlargement and displacement of normal anal cushions, resulting in symptoms. The precise cause is still unclear, prompting various treatment modalities. Laser hemorrhoidoplasty is a relatively new, minimally invasive approach that preserves anal cushion and its function. This study compared laser hemorrhoidoplasty to conventional hemorrhoidectomy by evaluating intra and post-operative variables associated with patient care. **Methodology:** This prospective interventional study, conducted from August 2022 to June 2024, involved 90 patients with symptomatic grade II and III hemorrhoids. The participants were randomly allocated into two groups: 45 patients underwent laser hemorrhoidoplasty (LHP) and the remaining 45 had conventional hemorrhoidectomy (CH). The LHP procedure utilized a Lasotronix 1470nm diode laser. **Results:** The average surgery duration was significantly shorter for the LHP group (12.56 ± 2.08 minutes) compared to the CH group (23.29 ± 3.01 minutes, $p<0.001$). Postoperative pain scores on day 1 were lower in the LHP group (VAS: 3.27 ± 0.78) than in the CH group (VAS: 5.78 ± 0.99, $p<0.001$). This trend continued on day 3 (LHP: 1.04 ± 0.56 vs. CH: 2.44 ± 0.99, $p<0.001$) and day 5 (LHP: 0.04 ± 0.20 vs. CH: 0.53 ± 0.66, $p<0.001$). The average hospital stay was also shorter for the LHP group (1.69 ± 0.63 days) compared to the CH group (3.87 ± 0.96 days, $p<0.001$). Additionally, postoperative urinary retention occurred in 13.3% of CH patients versus only 2.2% of LHP patients ($p=0.049$). **Conclusion:** Patients undergoing laser hemorrhoidoplasty had a quicker surgery, experienced less pain, had faster recovery, and showed significantly better early outcomes compared to those undergoing conventional hemorrhoidectomy.

Keywords: Laser hemorrhoidoplasty, 1470-nm diode laser, anal cushions, postoperative complications of laser hemorrhoidoplasty, laser hemorrhoids surgery.

INTRODUCTION

The anal canal is composed of vascular cushions, which form a complex structural and functional component of the continence mechanism, consisting of blood vessels, connective tissue, and smooth muscle [1]. These cushions play a vital role in providing soft tissue support and helping to keep the anal canal tightly closed [1,2]. Hemorrhoids occur when there is enlargement and distal displacement of these anal cushions, causing symptoms. The estimated prevalence of hemorrhoids in the world ranges from 2.9% to 27.9% [3].

Although various theories have been put forward for the development of the hemorrhoids, the most accepted one remains to be the anal cushion theory; however, the exact etiology of the hemorrhoidal disease remains to be elusive.

While conventional hemorrhoidectomy is the preferred method for treating symptomatic hemorrhoids, its potential postoperative complications (like pain, bleeding, infection, anal incontinence, etc.) have led to the search for alternative approaches. Laser hemorrhoidoplasty is a newer, less invasive procedure that offers the benefit of preserving the function and structure of anal cushions while minimising postoperative complications.

Laser hemorrhoidoplasty may be a more effective treatment option for hemorrhoids in their initial grades, as it could lead to better patient satisfaction. This research aims to compare the relative

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effectiveness of laser hemorrhoidoplasty versus conventional hemorrhoidectomy in terms of operative time, postoperative pain, recovery time and complications in treating hemorrhoids.

MATERIALS & METHODS

Study design

A prospective interventional study was conducted from August 2022 to June 2024. The BLDE (DU) Institutional Ethical Committee approved this study, referenced as BLDE(DU)/IEC/660/2022-23.

Study population

The patients included in the study were above 18 years of age and diagnosed with symptomatic grade II and III hemorrhoids. The study included patients who presented to the in-patient department of general surgery at B.L.D.E. (D.U) Shri B.M. Patil Medical College Hospital and Research Centre, Vijayapura.

Sample size

Ninety patients (45 per group) were the required sample to achieve a power of 80% for detecting a difference between the two groups at a two-sided p-value of 0.05 and an effect size of 0.60. This calculation was analysed using G* Power ver.3.1.9.4 software, with an anticipated mean and standard deviation of pain in the laser and conventional groups being 5.93 ± 0.79 and 9.53 ± 0.51 [4], respectively.

Procedures

The patients were divided into two groups: those undergoing laser hemorrhoidoplasty (LHP group) and conventional hemorrhoidectomy (CH group). The patients were allocated into the two groups with the help of random allocation computer software.

Exclusion criteria included patients with prior anorectal operations (except rubber band ligation over three months prior), other anorectal diseases (like anal fissure, fistula, and malignancy), immunocompromised status, inflammatory bowel disease, pregnancy, and acute thrombosed hemorrhoids.

The parameters compared were the operative time (measured in minutes from the time of positioning the patient till the completion of the surgery), postoperative pain score in visual analog scale measured on postoperative days 1, 3, and 5 (with follow-ups via OPD visits or teleconferencing), the duration of hospital stay (from the day of surgery to the day of discharge) and postoperative associated complications such as urinary retention, bleeding per rectum and infection.

Statistical analysis

Data was analysed using IBM SPSS version 20 (IBM Corp., Armonk, NY), with a p-value of <0.05 considered statistically significant. We used independent t-tests for normally distributed continuous variables like age and the Mann-Whitney U test to compare non-normally distributed continuous variables such as operative time, postoperative pain scores, and duration of hospital stay. We used the chi-square test for categorical variables like postoperative complications, which included postoperative bleeding, infection and urinary retention.

Preoperative workup

The presenting complaints and detailed examination of the patients were done and clinical diagnosis based of grades of hemorrhoids according to Goligher's classification of hemorrhoids [5] were given. A routine workup of all subjects was done according to the hospital policy and was taken for the procedure after attaining written consent.

Materials for laser hemorrhoidoplasty

Materials used included the Lasotronix 1470nm (Lasotronix India Pvt. Ltd Rupnagar, Punjab 140001) diode laser machine, foot pedal to activate the laser and hemorrhoidal laser probe with laser fiber (Figure 1).

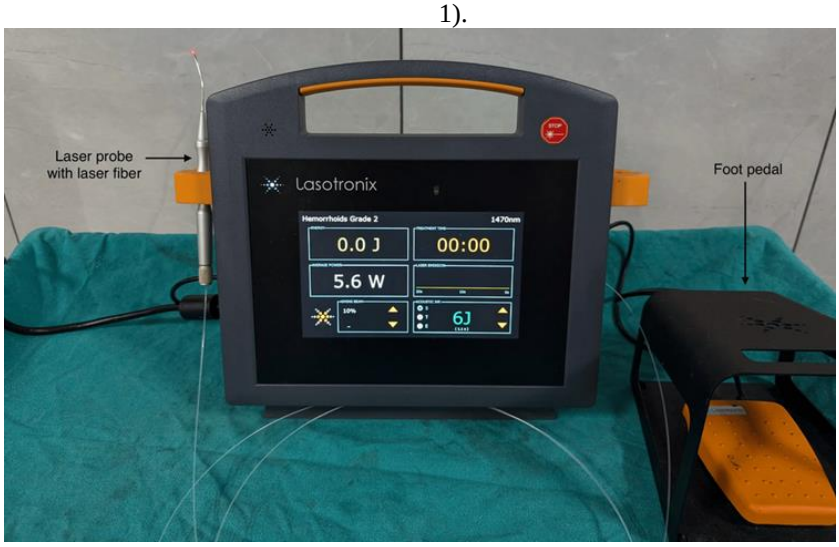

Figure 1: Image showing equipment required for laser hemorrhoidoplasty

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Surgical techniques

Laser Hemorrhoidoplasty

The patient was initially put in a lithotomy position, and an 8-watt diode laser with a 1470 nm wavelength was employed, emitting a continuous pulse. A 0.6 mm thick sharp tip conical fiber probe is utilised to administer laser energy doses ranging from 150-200 joules per hemorrhoidal segment, tailored to the hemorrhoid's size. First, the laser energy is delivered 2 cm above the hemorrhoidal mass by hovering above the mass intraluminally in the anal canal to cause vasospasm of the hemorrhoidal vessels. Following this, the laser energy is delivered at the apex of the hemorrhoids to coagulate and ablate the feeding hemorrhoidal vessel, and later, the energy is delivered into the hemorrhoidal mass (Figure 2) to ablate the hemorrhoidal mass, ultimately resulting in the shrinkage of the hemorrhoidal tissue.

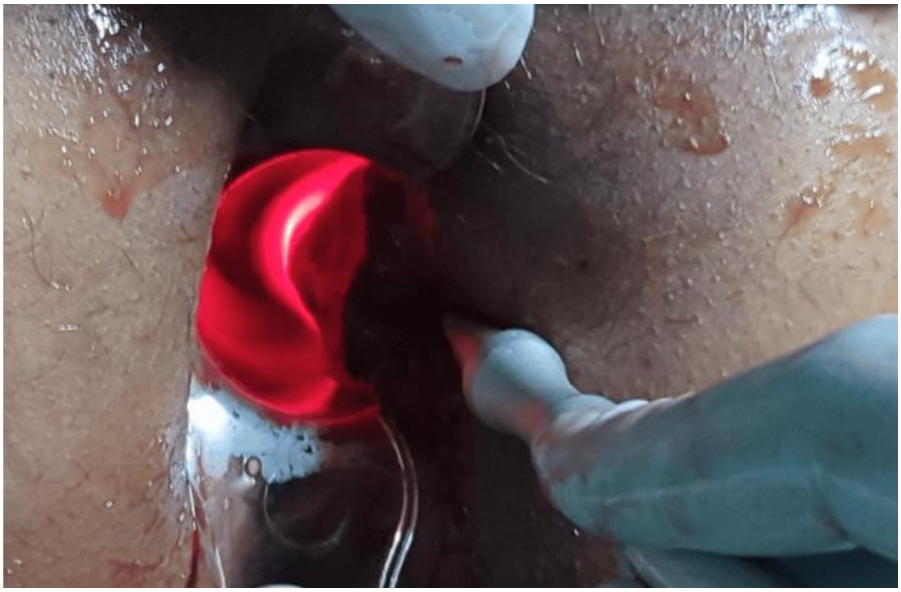

Figure 2: Image shows intrahemorrhoidal delivery of laser energy

To mitigate lateral thermal spread, an iced glove finger is applied within the anal canal after completing all the steps of laser energy delivery for the hemorrhoidal mass. This process is systematically repeated for each of the hemorrhoids.

Conventional Hemorrhoidectomy

This included either Milligan Morgan's open hemorrhoidectomy or Ferguson's closed hemorrhoidectomy.

RESULTS

On analysing the data obtained, the age of patients in the LHP group averaged 45.71 ± 15.8 years, while 48.15 ± 14.4 years was the average age in the CH group patients, as shown in Table 1. Overall, males were 83.3%, and females were 16.7%. A total of 87 patients (96.6%) presented with bleeding per rectum as their principal symptom.

Table 1: Mean age Comparison

	LHP		**CH**		**Independent t test**	**Significant value**
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**		
Age in years	45.71	15.8	48.15	14.4	-0.76	P = 0.44
Statistically insignificant						

A total of 33 patients and 57 patients in our study had a clinical diagnosis of grade II hemorrhoids and grade III hemorrhoids, respectively. The LHP group consisted of 18 patients with grade II haemorrhoids (40%) and 27 patients with grade III haemorrhoids (60%). The CH group included 15 patients with grade II hemorrhoids (33.3%) and 30 patients with grade III hemorrhoids (66.7%) (Figure 3).

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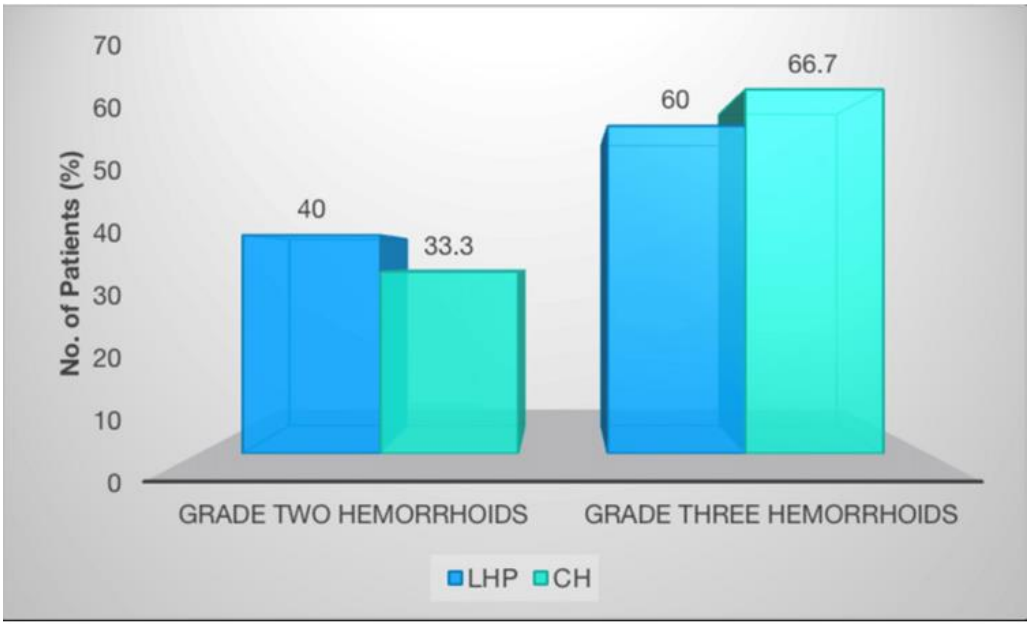

Figure 3: Image shows the distribution of hemorrhoid grades across treatment groups

We first assessed the operative time of the procedure, and Table 2 shows that the LHP group had a mean operative time of 12.56 ± 2.08 minutes, while in the CH group, it was 23.29 ± 3.01 minutes with a p-value <0.001.

Table 2: Comparing the Operative Time

	LHP		**CH**		**Mann Whitney U test**	**Significant value**
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**		
Operative time in minutes	12.56	2.084	23.29	3.012	1.0	**P < 0.001**
Statistically significant						

After analysing the postoperative pain data as presented in the Table 3, the LHP group showed significantly lower postoperative pain on day 1 than the CH group (VAS score: 3.27 ± 0.78 vs. 5.78 ± 0.99, p < 0.001). The LHP group also had lower postoperative pain scores on day 3 (VAS score: 1.04 ± 0.56) compared to the CH group (VAS score: 2.44 ± 0.99, p < 0.001). Additionally, on day 5 also, the LHP group reported lower postoperative pain scores (VAS score: 0.04 ± 0.20) compared to the CH group (VAS score: 0.53 ± 0.66, p < 0.001) (Figure 4). It was also found that the duration of pain lasted longer in the CH group. After assessing the postoperative pain, we considered the duration of hospital stay, which was significantly shorter in the LHP group. As shown in Table 3, the mean time spent in the hospital, from the day of surgery to the day of discharge, for the LHP group was 1.69 ± 0.63 days and 3.87 ±0.96 days for the CH group, with a p-value <0.001.

Table 3: Comparing Postoperative Pain Scores and Duration of Hospital Stay

Postoperative pain in VAS (Visual Analog Scale)	**LHP**		**CH**		**Mann Whitney U test**	**Significant value**
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**		
DAY 1	3.27	.780	5.78	.997	59.5	**P <0.001**
DAY 3	1.04	.562	2.44	.990	267.5	**P <0.001**
DAY 5	.04	.208	.53	.661	603.5	**P <0.001**

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Duration of Hospital stay in days	1.69	.633	3.87	.968	49.5	**P<0.001**
Statistically significant						

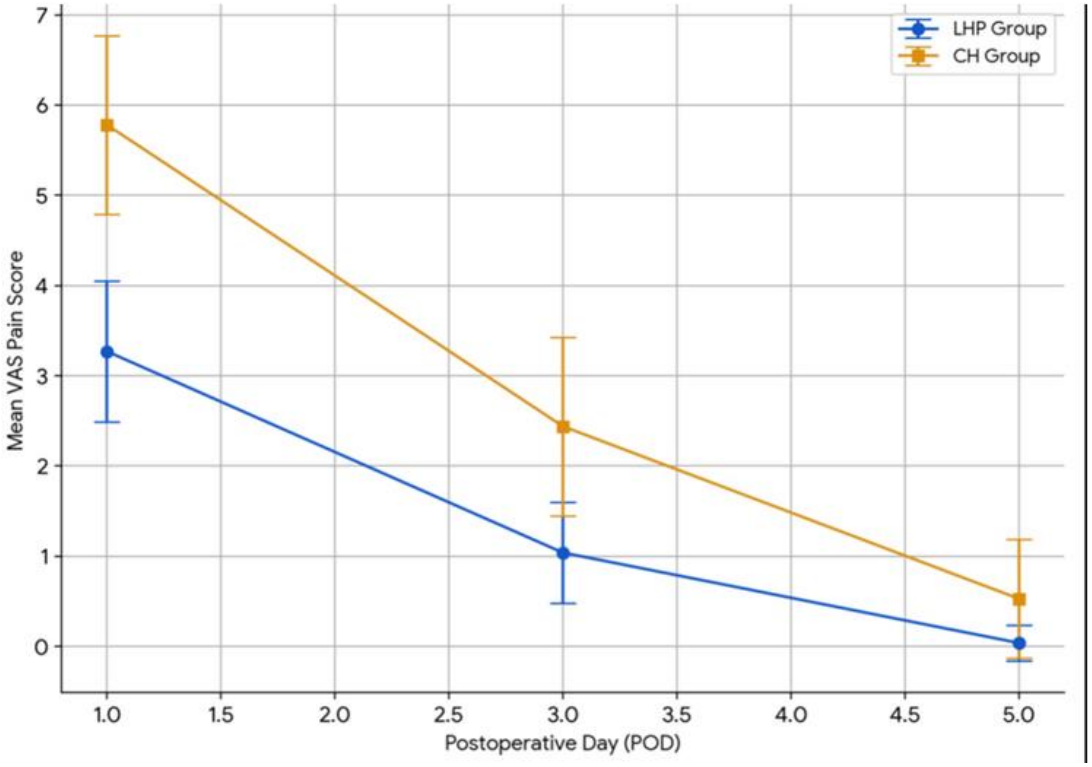

Figure 4: Graphical Representation of Mean Postoperative Pain (Visual Analog Scale) Score over Time for LHP and CH Groups

Lastly, we assessed various postoperative complications in each group. Table 4 showed that the CH group had 12 patients (26.6%) with postoperative bleeding per rectum as compared to 5 patients (11.1%) in the LHP group (p=0.141) and 3 patients (6.7%) in the CH group developed infection post-operatively compared to none in the LHP group (p=0.078).As shown in Table 4, postoperative urinary retention occurred more frequently in the CH group (13.3%) than in the LHP group (2.2%), and this was statistically significant with a p-value of 0.049.

Table 4: Comparing Postoperative Bleeding and Postoperative Infection and Postoperative Urinary Retention

		LHP	**CH**	**Total**	**Chi-square test**	**Significant value**
Postoperative Bleeding						
	Number of patients	5	12	17	3.921	P=0.141
	Percentage	11.1%	26.6%	37.7%		
Postoperative Infection						
	Number of patients	0	3	3	3.103	P=0.078
	Percentage	0.0%	6.7%	3.3%		

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	Statistically insignificant					
Postoperative Urinary Retention						
	Number of patients	1	6	7	3.873	**P=0.049**
	Percentage	2.2%	13.3%	7.8%		
Statistically significant						

DISCUSSION

Hemorrhoids are the most prevalent anal canal condition globally, with more than half of the population expected to experience hemorrhoid-related symptoms at some point in their lives [6]. The theory of displacement of the cushions remains to be the most accepted one now. The superior hemorrhoidal artery gives rise to corpus cavernosum recti (CCR) which is the principal vascular component of the anal cushions, and the latest treatment modalities all aim to preserve these anal cushions; however, still, the conventional hemorrhoidectomy, wherein excision of the hemorrhoidal mass is carried out remains to be the gold standard despite early complications associated with it.

There were no statistically significant results when the demographic parameters and symptoms between the two study groups were compared, thus reinforcing the study's inclusion of patients with similar characteristics for comparison in each study group. Grade 3 internal hemorrhoids were the most common diagnosis in both the LHP group and the CH group.

Plapler, through his studies on monkeys, achieved significant shrinkage of hemorrhoidal mass using laser energy [7]. Laser hemorrhoidoplasty is a relatively new technique that requires standardisation to be thoroughly recommended for routine use. Laser hemorrhoidoplastly is based on photoablation, photocoagulation, and photo vaporization principles. Photoablation refers to the disruption of H-O (hydrogen-oxygen atom) bonds on the application of laser, leading to the release of hydrogen ions with audible crackling. The process wherein the blood vessels supplying the haemorrhoids are effectively sealed off due to protein denaturation is referred to as photocoagulation. As the blood absorbs the laser energy, the water content evaporates at temperatures ranging from 80 - 90°C. This is referred to as photo vaporisation. All these mechanisms collectively aim to induce immediate tissue shrinkage, reduce blood supply to the hemorrhoidal mass, and promote fibrosis, ultimately restoring the anal cushions [8].

Our findings support previous research studies by Durgun C et al. [9] that demonstrated reduced operative time and immediate postoperative pain with laser hemorrhoidoplasty. This suggests that LHP may offer significant advantages in patient recovery and comfort. The shorter operative time in the LHP group allowed for the procedure to be completed with a lower dose of anaesthetic drug, adding to early postoperative recovery. Studies have shown laser hemorrhoidoplasty as a daycare procedure [10]. However, in the CH group, the surgery took a considerably longer time because the hemorrhoidal mass had to be excised with caution to avoid damaging the external sphincters.

The pain experienced during laser hemorrhoidoplasty was primarily due to the photoablation of tissues, causing localised inflammation. The patients in the LHP group of our study had significantly less post-operative pain on days 1 and 3 than the CH group ($p<0.001$), making recovery comfortable and quick in the laser hemorrhoidoplasty group. Thus, the patients could be discharged early and needed less analgesia than the CH group, which required wound care for the open wounds during their stay in the hospital. The postoperative day 5 pain scores were almost identical between the two groups. However, four patients showed increased VAS (visual analogue scale) scores in the CH group, which attributed to the statistically significant value ($p<0.001$).These findings of our research were consistent with the previous study by Gambardella et al. [11] which showed that post operative day 3 and day 5 pain scores (in VAS) in the laser hemorrhoidoplasty group were significantly ($p<0.001$) lower than the conventional group. Our findings also supported the views of Maloku H et al. [12], where the pain scores in the laser hemorrhoidoplasty group on postoperative day 7 were dominantly lower ($p<0.05$) when compared with the open hemorrhoidectomy. These results contribute to the growing body of evidence supporting the efficacy and potential benefits of laser hemorrhoidoplasty as a less invasive and more comfortable treatment option for patients with hemorrhoids.

Our research findings align with previous studies by S. Faes et al. [13] and A. Jain et al. [14], where the patients undergoing laser hemorrhoidoplasty had a mean duration of hospital stay of 1 day and 2 days, respectively. This further emphasised the advantages of laser hemorrhoidoplasty regarding shorter hospital stays and faster return to normal function. The reduced pain and elimination of wound care associated with laser hemorrhoidoplasty are key factors contributing to these positive outcomes, providing additional evidence for the benefits of this minimally invasive treatment approach.

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Our study had significant postoperative urinary retention in the CH group (p=0.049), which corroborated with the findings of Abdelhamid et al. [15], demonstrating significantly higher postoperative urinary retention (18.18%, p=0.010) in the conventional hemorrhoidectomy group compared to the laser hemorrhoidoplasty group. The same study also noted no other significant difference in other post-operative complications. This result contributes to the growing evidence supporting the potential advantages of laser hemorrhoidoplasty in terms of reduced postoperative complications.

Laser hemorrhoidoplasty had low postoperative infection rates of 0.6% and 0.58% in previous studies by Karahaliloğlu et al. [16] and Jahanshahi et al. [17] respectively, however our study had no postoperative infection in the LHP group, highlighting the bactericidal role of laser energy. In line with the earlier research by E Ram et al. [18] and Asmz Rahman et al. [19] our study further demonstrates the efficacy and safety of laser hemorrhoidoplasty for treating grade 2 and 3 hemorrhoids. Similar to these studies, we also observed low complication rates (like postoperative - bleeding, urinary retention and infection) and quicker onset of symptom relief in the laser hemorrhoidoplasty group compared to the conventional hemorrhoidectomy group.

Given our recent understanding of the anal cushions' structure and its physiological role in maintaining continence, it is crucial to preserve these structures during the treatment of hemorrhoids. These cushions are relatively restored with laser hemorrhoidoplasty, and their role in treating hemorrhoids cannot be neglected.

Limitations

Firstly, our study included a comparison between a small sample size. It also lacked long-term follow-up post-laser hemorrhoidoplasty to account for its delayed complications and recurrence rates, which may play a role in deciding the treatment of choice for hemorrhoids.

CONCLUSION

In the era of minimal invasive surgery for treating hemorrhoids, laser hemorrhoidoplasty (LHP) offers the advantage of quicker surgery, less pain and faster recovery with fewer complications as compared to conventional hemorrhoidectomy for grades II and III hemorrhoids. The findings of our study further reinforce the potential benefits of laser hemorrrhoidoplasty as a valuable treatment option and may be a promising approach for improving patient quality of life. Our study also underscored the favourable early outcomes of laser hemorrhoidoplasty over conventional hemorrhoidectomy, making it the preferred choice in treating grades II and III hemorrhoids.

Further studies are needed to test the long-term outcomes of laser hemorrhoidoplasty and explore the potential advantage of combining it with suture ligation of the hemorrhoidal pedicle to address the risk of recurrence.

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