

Original Research Article

COMPARATIVE STUDY OF CONVENTIONAL VERSUS LASER INTERNAL ANAL SPHINCTEROTOMY IN THE TREATMENT OF ANAL FISSURE

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ABSTRACT

Background: Anal fissure is a common proctological condition producing severe pain and bleeding during defecation. Lateral internal sphincterotomy (LIS) is the surgical gold standard for chronic fissures unresponsive to medical therapy, but is associated with post-operative pain, bleeding and a variable incidence of incontinence. Laser sphincterotomy has been proposed as a minimally invasive alternative. The aim is to compare conventional (open) lateral internal anal sphincterotomy with laser lateral internal anal sphincterotomy in the treatment of chronic anal fissure, with respect to intraoperative time, post-operative pain, complications, recurrence and patient satisfaction.

Materials and Methods: In this prospective comparative study conducted at the Department of General Surgery, Sheth Vadilal Sarabhai General Hospital and Sheth Chinai Prasuti Hospital, Ahmedabad, between February 2024 and December 2025, 170 patients aged 18–75 years with chronic anal fissure unresponsive to conservative management were enrolled and randomised by computerised block randomisation into Group A (conventional open LIS, n = 85) and Group B (diode laser LIS, 980 nm + 1470 nm, n = 85). Intraoperative time, post-operative pain (Visual Analogue Scale, VAS), early and late complications, recurrence and patient satisfaction were compared at 6, 12, 24 and 36 hours and at 2 and 6 weeks.

Results: The two groups were comparable for gender ($P = 0.7577$) and age ($P = 0.7590$). Mean intraoperative time was significantly shorter with laser LIS (12.5 ± 2.8 min) than conventional LIS (23.7 ± 4.1 min; $P < 0.001$). VAS pain scores were significantly lower in the laser group at 6 h (5.08 ± 0.69 vs 5.33 ± 0.84 ; $P = 0.035$), 12 h ($P < 0.001$), 24 h ($P < 0.001$) and 36 h ($P < 0.001$). Early and late complication rates (bleeding, pain, perianal swelling, infection, flatus incontinence) were consistently lower in the laser group, although the differences did not reach statistical significance. Recurrence at 6 weeks was 4.7% in the conventional group versus 1.2% in the laser group. Patient satisfaction (VAS) was significantly higher in the laser group at 2 weeks and 6 weeks ($P < 0.001$ for both).

Conclusion: Laser lateral internal sphincterotomy is a safe and effective alternative to conventional open sphincterotomy for chronic anal fissure, offering significantly shorter operative time, less post-operative pain, a trend towards fewer complications and lower recurrence, and greater patient satisfaction. Larger multicentric studies with longer follow-up are recommended to confirm long-term functional outcomes.

Keywords: Anal fissure; Lateral internal sphincterotomy; Laser sphincterotomy; Diode laser; Post-operative pain; Patient satisfaction.

INTRODUCTION

Anal fissure is a common proctological condition characterised by a linear tear in the anoderm, usually located at the anal verge.^[1] Anal fissures affect approximately 10–15% of the general population, with a lifetime incidence of around 11%.^[2] The condition is more common in women than men and typically occurs in the posterior or anterior midline, just distal to the dentate line; the posterior midline accounts for more than 75–90% of cases, while anterior fissures occur in roughly 10% and are more common in women.^[3]

Fissures are classified as acute (healing within 1–2 weeks) or chronic (persistent beyond 6–8 weeks), and as primary (related to local trauma such as hard stools, prolonged diarrhoea or vaginal delivery) or secondary (associated with Crohn's disease, tuberculosis, HIV, syphilis, malignancy or prior anorectal surgery).^[3,4] The pathophysiology is multifactorial: mechanical trauma from hard stool, hypertonia and spasm of the internal anal sphincter, and secondary ischaemia of the anoderm together perpetuate a cycle of pain, spasm and impaired healing.^[5,6] Patients typically present with sharp defecatory pain lasting minutes to hours, and bright red bleeding is reported in over 70% of cases.^[7,8]

First-line management of anal fissure is conservative — dietary fibre, adequate hydration, sitz baths and topical agents such as 0.2% glyceryl trinitrate or 2% diltiazem, which relax the internal sphincter and reduce spasm.^[9] Botulinum toxin injection is a further pharmacological option with healing rates of 60–80%, though recurrence can reach 42%.^[10] When conservative and pharmacological measures fail, surgery is indicated. Lateral internal sphincterotomy (LIS), first described by Eisenhammer in 1951, remains the gold-standard operation: division of a portion of the internal anal sphincter lowers resting anal pressure, relieves spasm and achieves healing rates exceeding 95% within three weeks, with recurrence below 10%.^[11,12] However, LIS carries a recognised risk of post-operative incontinence, reported in 5–15% of patients (up to 30% for transient flatus incontinence in some series), together with post-operative pain and bleeding that can limit patient acceptability.^[3]

Concerns about the morbidity of conventional LIS have prompted interest in minimally invasive alternatives, of which laser sphincterotomy is the most recent. Laser energy (CO₂ or diode) allows precise division of sphincter fibres with simultaneous coagulation, offering the theoretical advantages of reduced intraoperative bleeding, minimal tissue trauma, faster wound healing, reduced post-operative pain and quicker return to normal activity.^[13] While laser technology is well established in the management of haemorrhoids, fistulae and other anorectal conditions, its specific role in the surgical treatment of anal fissure remains incompletely defined, and comparative data against conventional

sphincterotomy are still limited. The present study was therefore designed to prospectively compare conventional (open) lateral internal anal sphincterotomy with laser lateral internal anal sphincterotomy for chronic anal fissure, in order to determine which technique offers superior perioperative and short-term outcomes.

Aim: To compare conventional and laser internal anal sphincterotomy in the treatment of anal fissure and determine which offers superior outcomes.

Objectives

- To compare intraoperative time and intraoperative bleeding between conventional lateral internal anal sphincterotomy (Group A) and laser lateral internal anal sphincterotomy (Group B).
- To compare post-operative pain and post-operative bleeding between the two groups.
- To compare patient's acceptance (satisfaction) of the two treatment modalities.

Management algorithm for anal fissure

The stepwise approach to management of anal fissure, from conservative measures through pharmacotherapy to surgery, is summarised in [Figure 1].

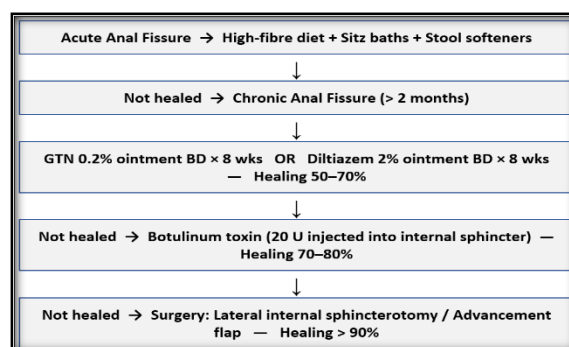


Figure 1: Stepwise algorithm for the management of anal fissure

Pathophysiological cycle of chronic anal fissure

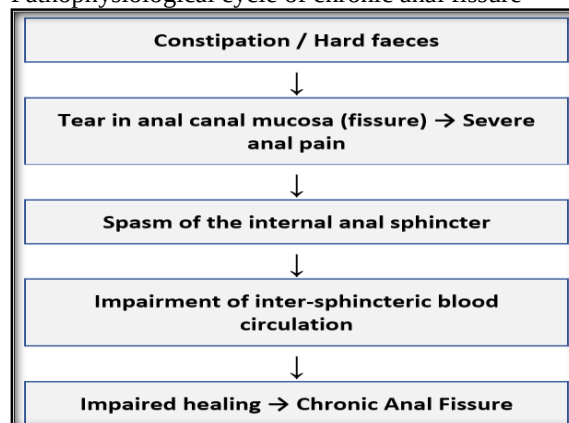


Figure 2: Self-perpetuating cycle of pain, sphincter spasm and ischaemia underlying chronic anal fissure.

Conventional versus laser sphincterotomy: a comparative overview

[Table 1] summarises the principal differences between conventional and laser sphincterotomy

techniques as reported in the literature, providing the rationale for the present comparative study.

Table 1: Conventional vs. Laser Sphincterotomy

Parameter	Conventional LIS (Open/Closed)	Laser Sphincterotomy
Technique	Division of internal anal sphincter with scalpel/electrocautery	CO2 or diode laser (980–1470 nm) vaporisation/division with simultaneous haemostasis
Energy source	None; scalpel or diathermy	CO2 laser (10,600 nm) or diode laser (5–15 W, continuous wave)
Operating time	20–30 minutes	Often shorter due to reduced bleeding and precise dissection
Pain relief	Significant relief over 1–2 weeks	Earlier relief; VAS drop > 70% within 1 week in several series
Healing rate	90–98% within 4–6 weeks	Comparable; some series report faster re-epithelialisation (2–4 weeks)
Recurrence	~2–7% (long-term data available)	< 5% in short-term follow-up; long-term data limited
Bleeding/haematoma	Mild–moderate (2–5%)	Minimal, due to coagulative effect
Incontinence	8–30% (usually mild, flatus/soiling)	Very low in short-term reports (0–2%)
Hospital stay	1–3 days	Often < 24–48 h; day-care feasible
Return to activity	1–2 weeks	Often 5–7 days
Cost/availability	Widely available, inexpensive	Higher cost; limited availability

MATERIALS AND METHODS

Study design and setting: This was a prospective comparative study conducted in the Department of General Surgery, Sheth Vadilal Sarabhai General Hospital and Sheth Chinai Prasuti Hospital, a tertiary care centre in Ahmedabad, India, between February 2024 and December 2025. Institutional Ethics Committee approval was obtained prior to commencement, and written informed consent was obtained from all participants in a language they understood.

Study population: Patients of either gender aged 18–75 years with anal fissure not responding to conservative management were eligible for inclusion.

Inclusion criteria

- Patients aged 18–75 years, either gender, with anal fissure not responding to conservative management.
- Patients providing informed consent.

Exclusion criteria

- Age < 18 years or > 75 years.
- Pregnant women.
- Fissure secondary to other diseases such as Crohn's disease, ulcerative colitis or anal warts.
- Patients unwilling to participate.

Sample size

Sample size was calculated using the standard formula for estimating a population proportion:

$$SS = (Z\text{-score})^2 \times p(1-p) / e^2$$

With a 95% confidence level ($Z = 1.96$), an expected prevalence (p) of 0.11 based on prior population-based data,² and a margin of error (e) of 0.05. This yielded a minimum sample size of 150.44, adjusted to 165 after allowing for an anticipated 10% loss to follow-up. During the study period 170 patients were enrolled and divided into two groups of 85 each according to the intervention performed.

Randomisation and pre-operative preparation

Patients were allocated to the conventional treatment group (Group A) or the laser treatment group (Group B) using a computerised block randomisation technique, overseen by hospital staff not otherwise involved in the study to ensure allocation

concealment and minimise selection bias. A detailed history and proctoscopic examination were performed to confirm the diagnosis and exclude other anorectal pathology. Routine haematological and biochemical investigations were obtained together with anaesthetic fitness clearance. Patients were kept nil by mouth for six hours before surgery and received a laxative the preceding evening.

Anaesthesia and positioning

All procedures were performed under regional anaesthesia (spinal, caudal or pudendal nerve block), with patients positioned in lithotomy, left lateral or prone posture according to anaesthetist preference and procedural requirement. The perianal region was prepared with povidone-iodine solution and draped under strict aseptic precautions.

Operative technique

Group A (conventional open LIS): Gentle anal dilatation was performed to expose the inter-sphincteric groove. A 0.5–1 cm curvilinear incision was made in the left lateral quadrant (3 or 9 o'clock position). The internal anal sphincter was identified by blunt dissection, separated from surrounding tissue and divided with a scalpel. Approximately the lower one-third to one-half of the sphincter fibres were released until palpable spasm was relieved. Haemostasis was achieved by gauze pressure or cautery, and the wound was left open for secondary healing under sterile dressing.

Group B (laser LIS): A diode dual-wavelength laser system (980 nm + 1470 nm) was used in continuous-wave mode at 8–10 W. After exposing the anal canal with a bivalve speculum, the inter-sphincteric groove was infiltrated with saline. A 0.5 mm incision was made at the 4 o'clock position and the internal sphincter was hooked with right-angled forceps. Laser energy was applied laterally to medially to divide the lower one-third to one-half of the sphincter fibres, with simultaneous coagulation ensuring minimal bleeding. Fibrotic scar tissue and sentinel tags, where present, were excised with the laser. The wound was left unsutured and dressed with sterile gauze.

Outcome measures

- Intraoperative time — recorded from completion of draping to application of dressing.
- Intraoperative blood loss — gravimetric method (swab weight before/after use; 1 g = 1 mL).
- Post-operative pain — Visual Analogue Scale (VAS) at 6, 12, 24 and 36 hours.
- Post-operative bleeding — assessed by dressing soakage.
- Early and late complications — assessed at 2 weeks and 6 weeks (bleeding, pain, perianal swelling, flatus/stool incontinence, infection, pruritus ani, recurrence).
- Patient satisfaction — assessed by VAS at post-operative, 2-week and 6-week visits.

Statistical analysis: Data were entered in Microsoft Excel and analysed using SPSS version 22.0 (IBM

Corp., Armonk, NY). Continuous variables (operative time, blood loss, pain scores) were expressed as mean $\pm$ standard deviation and compared using Student's t-test. Categorical variables (gender, complications) were expressed as frequencies and percentages and compared using the Chi-square test or Fisher's exact test where appropriate. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 170 patients with anal fissure were enrolled and equally divided into Group A (conventional lateral internal sphincterotomy, n = 85) and Group B (laser lateral internal sphincterotomy, n = 85).

Demographic profile.

Table 2: Distribution of patients by gender ($\chi^2 = 0.0952$; P = 0.7577).

Gender	Group A (N=85) n (%)	Group B (N=85) n (%)
Male	49 (57.6)	47 (55.3)
Female	36 (42.4)	38 (44.7)

Table 3: Distribution of patients by age group ($\chi^2 = 0.5515$; P = 0.7590).

Age group	Group A (N=85) n (%)	Group B (N=85) n (%)
18–39 years	33 (38.8)	29 (34.1)
40–59 years	45 (52.9)	47 (55.3)
≥ 60 years	7 (8.2)	9 (10.6)

Gender and age distributions were comparable between the two groups, with a male preponderance (~55–58%) and the majority of patients (53–55%)

aged 40–59 years in both arms, confirming successful randomisation.

Post-operative pain (VAS)

Table 4: Mean VAS pain score in Group A and Group B at different time intervals.

Time point	Group A (Conventional LIS)	Group B (Laser LIS)	P-value
6 hours	5.33 $\pm$ 0.84	5.08 $\pm$ 0.69	0.035
12 hours	4.29 $\pm$ 0.92	3.72 $\pm$ 0.74	< 0.001
24 hours	3.46 $\pm$ 0.83	2.94 $\pm$ 0.85	< 0.001
36 hours	2.53 $\pm$ 0.76	2.04 $\pm$ 0.79	< 0.001

Post-operative pain scores were significantly lower in the laser group at every recorded time point, with the difference widening from 6 through 36 hours.

Intraoperative time

Table 5: Mean intraoperative time in Group A and Group B.

Parameter	Group A (Conventional LIS)	Group B (Laser LIS)	P-value
Mean intraoperative time (min)	23.7 $\pm$ 4.1	12.5 $\pm$ 2.8	< 0.001

Early post-operative complications

Table 6: Early post-operative complications ($\chi^2 = 4.3853$; P = 0.1116).

Complication	Group A n (%)	Group B n (%)
Bleeding	12 (14.1)	0 (0.0)
Pain	14 (16.5)	6 (7.1)
Perianal swelling	8 (9.4)	2 (2.4)

Post-operative complications at 2 weeks

Table 7: Post-operative complications at 2 weeks ($\chi^2 = 3.1635$; P = 0.3671).

Complication	Group A n (%)	Group B n (%)
Bleeding	7 (8.2)	0 (0.0)
Pain	18 (21.2)	7 (8.2)
Flatus incontinence	1 (1.2)	0 (0.0)
Infection	2 (2.4)	0 (0.0)
Stool incontinence	0 (0.0)	0 (0.0)

Pruritus ani	0 (0.0)	0 (0.0)
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Post-operative complications at 6 weeks

Table 8: Post-operative complications at 6 weeks ($\chi^2 = 0.6857$; $P = 0.8766$).

Complication	Group A n (%)	Group B n (%)
Infection	1 (1.2)	0 (0.0)
Flatus incontinence	1 (1.2)	0 (0.0)
Stool incontinence	0 (0.0)	0 (0.0)
Pruritus ani	1 (1.2)	0 (0.0)
Recurrence	4 (4.7)	1 (1.2)

Pain was the most frequent complication at every stage of follow-up, consistently more common after conventional sphincterotomy, though group differences for complication rates did not reach

statistical significance at any single time point. Recurrence at 6 weeks was numerically lower after laser sphincterotomy (1.2%) than after conventional sphincterotomy (4.7%).

Patient satisfaction

Table 9: VAS score for patient satisfaction with respect to treatment.

Time point	Group A (Conventional LIS)	Group B (Laser LIS)	P-value
Post-operative	7.74 $\pm$ 0.64	7.95 $\pm$ 0.85	0.0706
At 2 weeks	8.18 $\pm$ 0.55	8.73 $\pm$ 0.49	< 0.001
At 6 weeks	8.61 $\pm$ 0.69	8.99 $\pm$ 0.34	< 0.001

Patient satisfaction increased progressively in both groups over the follow-up period. Although the difference was not statistically significant immediately post-operatively, satisfaction was significantly higher in the laser group by 2 weeks and remained significantly higher at 6 weeks.

DISCUSSION

Anal fissure is a common anorectal disorder in which hypertonicity of the internal anal sphincter and reduced local perfusion delay healing of the anodermal tear. While conservative measures suffice for most acute fissures, chronic or recurrent fissures often require surgery, with lateral internal sphincterotomy regarded as the gold standard because it reliably lowers sphincter pressure, relieves symptoms and promotes healing. Concerns about post-operative pain, bleeding and incontinence associated with the conventional technique have driven interest in minimally invasive alternatives such as laser sphincterotomy, which is theorised to reduce tissue trauma through precise, coagulative division of sphincter fibres. This study compared these two techniques prospectively in 170 patients with chronic anal fissure.

Demographic findings: A slight male preponderance was observed in both groups (57.6% in Group A and 55.3% in Group B; $P = 0.7577$), consistent with several previous reports. Pandey et al,^[14] reported 58.7% male patients, and Rahman et al,^[15] reported a male-to-female ratio of 1.08:1, although other studies have found near-equal gender distribution, suggesting both sexes are equally susceptible when predisposing factors such as constipation are present. The majority of patients in both groups were aged 40–59 years, with no significant inter-group difference ($P = 0.7590$), consistent with Fateh et al. (mean age 41.2 $\pm$ 9.23

years),^[16] Rahman et al,^[15] (39.14 $\pm$ 8.77 years) and Pandey et al. (42.8 $\pm$ 12.7 years).^[14]

Post-operative pain: Post-operative pain is a key determinant of recovery and satisfaction after sphincterotomy. In this study, VAS pain scores were significantly lower in the laser group at every time point studied (6, 12, 24 and 36 hours), with the gap widening over time. This is consistent with Verma et al,^[1] who reported significantly lower VAS scores with laser LIS between 6 and 48 hours, and with Vaghasiya et al,^[17] and Fateh et al,^[16] all of whom documented significantly lower post-operative pain with laser techniques. The reduced pain associated with laser sphincterotomy is likely attributable to its minimally invasive nature, precise tissue incision, superior haemostasis and minimal collateral thermal injury, resulting in reduced post-operative inflammation and oedema.

Intraoperative time: Mean intraoperative time was significantly shorter with laser LIS (12.5 $\pm$ 2.8 minutes) than conventional LIS (23.7 $\pm$ 4.1 minutes; $P < 0.001$). This may reflect the efficiency of the laser technique, which permits a cleaner incision with simultaneous coagulation and obviates the need for extensive dissection or separate haemostatic manoeuvres, whereas the conventional approach typically requires additional time for tissue handling and bleeding control.

Complications and recurrence: The overall incidence of post-operative complications — pain, bleeding, perianal swelling, infection and transient incontinence — was consistently higher in the conventional LIS group at every stage of follow-up (early, 2 weeks, 6 weeks), although these differences did not reach statistical significance, likely reflecting the relatively low absolute event rates for individual complications and the study's sample size. Nonetheless, a clear directional trend favoured the laser technique: for example, no bleeding was reported in the laser group at any stage, compared

with 14.1% early and 8.2% at 2 weeks in the conventional group. Recurrence at 6 weeks was lower with laser sphincterotomy (1.2%) than conventional sphincterotomy (4.7%), suggesting that the precise, coagulative division of sphincter fibres with the laser may cause less collateral trauma to the anal mucosa, thereby supporting more complete healing. These findings parallel those of Verma et al,^[1] who reported markedly fewer early complications (pain, bleeding, haematoma) with laser LIS than open LIS, and Vaghasiya et al,^[17] who found substantially lower rates of perianal swelling, pruritus ani and flatus incontinence with laser LIS.

Patient satisfaction: Patient satisfaction, assessed by VAS, increased progressively in both groups over the follow-up period, but was significantly higher in the laser group from 2 weeks onward. This is consistent with the lower pain scores and lower complication trend observed with laser sphincterotomy and mirrors the findings of Maurice et al,^[19] who reported earlier discharge, quicker return to activity and greater surgical precision with laser therapy compared with conventional LIS.

Comparison with existing literature: The findings of this study are broadly consistent with the existing body of literature comparing laser and conventional sphincterotomy. Sanchez Romero et al.²⁰ and Kiyak et al.²¹ established the long-term safety profile of open LIS, with recurrence around 7.5% and incontinence rates of 5–15%, comparable to the 4.7% recurrence observed in our conventional arm. Fateh et al,^[16] and Haidaran & Haidaran,^[22] demonstrated the efficacy and low complication rates of laser therapy for acute and chronic fissures respectively. More recent randomised comparisons, including Verma et al,^[1] Maurice et al,^[19] Vaghasiya et al,^[17] Cordeiro Time et al,^[23] and Zakaria et al,^[24] have consistently reported reduced post-operative pain, shorter hospital stay and comparable or superior healing with laser sphincterotomy relative to conventional LIS, supporting the results of the present study.

Limitations

- Single-centre design, which may limit generalisability of the findings.
- Relatively short follow-up duration (6 weeks), restricting assessment of long-term recurrence, late complications and sphincter function.
- Post-operative pain assessment, though standardised (VAS), remains inherently subjective and may be influenced by individual pain tolerance and analgesic use.
- Potential confounding from variation in surgeon expertise, laser equipment settings and patient comorbidities.

Future multicentric studies with larger sample sizes, longer follow-up and objective assessment tools (e.g., anorectal manometry) are recommended to validate and extend these findings.

CONCLUSION

Both conventional and laser lateral internal sphincterotomy are effective and safe procedures for the management of chronic anal fissure. However, laser sphincterotomy offers distinct clinical advantages: significantly less post-operative pain, significantly shorter operative time, and a trend towards fewer early and late complications and lower recurrence, together with significantly greater patient satisfaction from 2 weeks onward. These benefits are likely attributable to the minimally invasive nature of the laser technique, which enables precise sphincter division, superior haemostasis and minimal tissue trauma. Laser lateral internal sphincterotomy may therefore be considered a favourable alternative to conventional sphincterotomy in terms of perioperative outcomes, with comparable safety and efficacy. Larger multicentric studies with longer follow-up are warranted to confirm these findings and to evaluate long-term functional outcomes, including recurrence and continence status.

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