

Original Article

Comparison of Submucosal Diathermy And Endoscopic Diode Laser Assisted Turbinoplasty In Inferior Turbinate Hypertrophy

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Abstract

Objective: To compare the clinical outcomes and postoperative recovery associated with submucosal diathermy (SMD) and endoscopic diode laser-assisted turbinoplasty (DLAT) in patients with bilateral inferior turbinate hypertrophy (ITH).

Methodology: This quasi-experimental study was conducted at Rawal General and Dental Hospital, Islamabad, between January and June 2024. A total of 60 patients with bilateral ITH who did not respond to medical therapy were included. Patients were alternately allocated according to the order of enrolment into Group A (SMD) or Group B (DLAT). Nasal airway function was assessed using the Nasal Obstruction Symptom Evaluation (NOSE) score at baseline and during a 12-week follow-up. The secondary outcomes included operative time, intraoperative bleeding, postoperative pain, postoperative complications, mucosal recovery, and patient satisfaction.

Results: Both groups showed improvement in NOSE scores; however, the DLAT group demonstrated greater improvement at 12 weeks, with significantly lower scores than the SMD group (10.1 ± 8.1 vs. 30.9 ± 12.6 ; $P < .001$). DLAT was associated with less mild intraoperative bleeding (6.7% vs. 23.3%), lower postoperative pain (2.8 ± 0.6 vs. 4.2 ± 0.8), and greater patient satisfaction (86.7% vs. 63.3%), whereas SMD required less operative time.

Conclusion: Both SMD and endoscopic DLAT were associated with symptom improvement in patients with ITH. The DLAT was associated with more favourable postoperative outcomes and greater patient satisfaction.

Keywords: Diathermy; Endoscopy; Laser Therapy; Treatment Outcome; Turbinate Hypertrophy.

Introduction

Inferior turbinate hypertrophy (ITH) is a leading cause of persistent nasal obstruction in otolaryngology, adversely impacting the quality of life by disrupting normal respiration, diminishing olfactory function, and interfering with sleep.¹ This condition commonly results from chronic rhinitis, allergies, recurrent infections, environmental irritants, or anatomical factors such as a deviated nasal septum.² Although pharmacological interventions, particularly intranasal corticosteroids and antihistamines, are effective for many, some patients exhibit inadequate response, necessitating surgical management.³ The primary goal of surgery for ITH is to reduce turbinate volume while preserving the mucosal lining to ensure the maintenance of nasal physiology.⁴ Among the available techniques, submucosal diathermy (SMD) and diode laser-assisted turbinoplasty (DLAT) are frequently utilised. SMD employs a high-frequency electrical current to induce submucosal coagulation and fibrosis, leading to tissue shrinkage. It remains an affordable and technically simple procedure, frequently performed in outpatient settings, especially in resource-constrained settings.⁵ However, SMD can lead to adverse outcomes, including bleeding, mucosal trauma, postoperative crusting, and a comparatively high risk of recurrence.⁶

In comparison, DLAT employs laser energy to precisely remove hypertrophied tissue while sparing the surrounding mucosal linings. Conducted with endoscopic assistance, the procedure provides greater accuracy, reduced intraoperative bleeding, faster

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Data Availability Statement: De-identified individual participant data and statistical analysis code supporting the findings of this study will be made available from the corresponding author upon reasonable request, subject to appropriate ethical, privacy, and institutional requirements. Requests should include a scientifically justified purpose and will be reviewed by the corresponding author and relevant institutional authorities, where required.

Institutional Review Board Approval

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postoperative recovery, and a decreased risk of complications, such as adhesions and crusting.⁷ Nonetheless, the broader use of this technique may be constrained by the need for specialised equipment and skilled operators, making it less accessible in under-resourced settings.⁸ The objective of this study was to compare the clinical outcomes and postoperative recovery associated with SMD and DLAT in individuals diagnosed with bilateral inferior turbinate hypertrophy.

Methodology

This quasi-experimental study was conducted in the Otolaryngology Department at Rawal General and Dental Hospital, Islamabad, between January and June 2024. This study was reported in accordance with the Transparent Reporting of Evaluations with Nonrandomised Designs (TREND) statement. This study was not registered in a clinical trial registry before participant enrolment; therefore, no clinical trial registration number is available. Ethical approval was obtained from the hospital ethics committee (Ref. No. RIHS/007063), and informed written consent was obtained from all patients. Individuals aged 18–55 years with persistent nasal obstruction were included if bilateral IT was confirmed through nasal endoscopy and radiological assessment. All patients continued to experience nasal obstruction symptoms despite receiving intranasal corticosteroids or antihistamines for a minimum of three months. Eligible patients were those without additional sinonasal conditions who provided informed consent to undergo one of the two surgical procedures: submucosal diathermy or diode laser-assisted turbinoplasty. Additionally, patients were required to adhere to all planned postoperative follow-up. Patients were excluded if they had a history of nasal surgery, nasal polyposis, or marked septal deviation requiring septoplasty. Patients with coagulopathies, chronic rhinosinusitis, poorly controlled systemic diseases, or known allergies to local anaesthetic agents were also excluded. Pregnant or lactating women and those with psychological or neurological disorders that could affect compliance or follow-up were considered ineligible for the study.

The sample size was calculated prospectively using the WHO sample size calculator based on an alpha level of 0.05, 80% statistical power, and an expected standardised effect size of 0.51. The effect size was derived from the between-group outcome reported by a previous study, using the reported group mean values of 5.20 ± 1.54 for SMD and 4.00 ± 1.54 for DLAT.⁹ The standardised mean difference was calculated as the difference between the group means divided by the pooled standard deviation, yielding an effect size of approximately 0.51.

A total of 60 patients were allocated to the two treatment groups using a non-random sequential allocation method. Patients were assigned alternately according to their order of enrolment, with the first enrolled patient assigned to Group A, the second to Group B, and subsequent patients allocated in the same alternating sequence until each group included 30 participants. The principal investigator prepared the group allocation plan. Group A underwent SMD, whereas Group B underwent DLAT. Patients were allocated alternately according to their order of enrolment, with a predetermined and predictable allocation sequence; therefore, allocation concealment was not implemented. The study was open-label, and neither the participants, surgeons, nor outcome assessors were blinded. These methodological characteristics were considered when interpreting subjective outcomes, including the NOSE and postoperative VAS pain scores. All surgeries were conducted under general anaesthesia, selected based on clinical judgment and patient preference.

For SMD, a monopolar electrocautery generator (Taktvoll ESG-100; Taktvoll, Beijing, China) with an insulated 24-gauge needle was used in the coagulation mode at a power setting of 50 W. The needle was introduced into the submucosal plane at multiple sites along the longitudinal axis of the inferior turbinate from anterior to posterior. Coagulation was applied during withdrawal of the needle for several seconds at each site or until visible localised mucosal blanching was observed while attempting to preserve the superficial mucosa. In the DLAT group, a 980-nm diode laser (G box by Giga Laser, Wuhan, China) equipped with a 600- μ m flexible quartz fibre was used under endoscopic guidance. The laser was operated in continuous-wave contact mode at an output power of 10 W. Laser energy was delivered directly on the mucosal surface of the inferior turbinate from the posterior edge to the anterior edge in a straight line for 40-second application per side, corresponding to a calculated energy delivery of approximately 400 J per side. Nasal packs were placed in both groups for 6 h.

Preoperative and postoperative symptoms were assessed using the Nasal Obstruction Symptom Evaluation (NOSE) score. Secondary outcomes included operative time, intraoperative bleeding (graded subjectively), postoperative pain (VAS score), crusting, synechiae formation, and mucosal healing. Follow-up evaluations were conducted at 1, 4, and 12 weeks postoperatively.

Data were analysed using SPSS v. 25. Continuous variables are presented as mean $\pm$ SD, and categorical variables are presented as frequencies and percentages. Between-group comparisons of continuous variables were performed using the independent t-test, and the corresponding mean differences with 95% confidence intervals (CIs) were reported. Categorical data were compared using the chi-square test, and risk differences with 95% confidence intervals (CIs)

were calculated to quantify the magnitude of between-group differences. All statistical tests were two-sided, and a p -value $\leq .05$ was considered significant.

Results

A total of 60 patients diagnosed with bilateral ITH were included in this study. The mean age of the participants was 33.1 ± 5.9 years. The demographic and baseline characteristics were comparable between the two groups, with no statistically significant between-group differences in age, sex, baseline NOSE score, or symptom duration (Table 1).

Table 1: Demographic and baseline characteristics of patients

Variable	Group A: SMD (n=30)	Group B: DLAT (n=30)	P value
Age (mean $\pm$ SD, years)	32.4 $\pm$ 6.1	33.7 $\pm$ 5.8	0.47
Gender (M/F)	17/13	16/14	0.79
Baseline NOSE score (mean $\pm$ SD)	69.4 $\pm$ 17.4	72.4 $\pm$ 16.2	0.56
Duration of symptoms (months)	14.2 $\pm$ 3.6	13.9 $\pm$ 3.4	0.65

At postoperative week 1, the NOSE scores were comparable between the groups (Table 2). By week 12, the DLAT group demonstrated a greater reduction in NOSE scores than the SMD group (Figure 1). Both groups demonstrated improvements in NOSE scores during the postoperative follow-up period. The groups showed comparable postoperative NOSE scores at week 1, while the DLAT group demonstrated greater sustained improvement by the 12-week follow-up (Figure 1). Postoperative pain assessed using the VAS on day 1 was significantly lower in the DLAT group than in the SMD group (Table 2).

A comparison of the surgical outcomes is presented in Table 2. The SMD procedure required significantly less operative time. Mild intraoperative bleeding and postoperative crusting were more frequent in the SMD group. Although synechiae formation was also observed more frequently following SMD, the difference between the groups was not statistically significant. No postoperative infections were observed in either group. Overall, DLAT was associated with improved mucosal recovery and fewer postoperative adverse outcomes.

Table 2: Comparison of surgical outcomes between groups

Outcome measure	Group A: SMD (n=30)	Group B: DLAT (n=30)	Mean difference/Risk difference, A – B (95% CI)	P value
Operative time (min)	12.3 $\pm$ 3.2	23.6 $\pm$ 3.7	-11.3 (-13.1 to -9.5)	< 0.001
Intraoperative bleeding (Mild)	7 (23.3%)	2 (6.7%)	16.7% (-0.9% to 34.2%)	0.041
Postoperative pain (VAS Day1)	4.2 $\pm$ 0.8	2.8 $\pm$ 0.6	1.4 (1.03–1.77)	< 0.001
Crusting at week 1	11 (36.7%)	4 (13.3%)	23.3% (2.2% to 44.4%)	0.034
Synechiae formation	5 (16.7%)	1 (3.3%)	13.3% (-1.5% to 28.1%)	0.091
Postoperative NOSE score at week 1	49.8 $\pm$ 14.7	50.4 $\pm$ 11.3	-0.6 (-7.4 to 6.2)	0.860

Based on the structured questionnaire, a greater proportion of patients in the DLAT group reported being very satisfied with the surgical outcome than those in the SMD group (86.7% [26/30] vs. 63.3% [19/30], respectively). Patients in the DLAT group also resumed their routine activities earlier, with most returning within one week after surgery, whereas recovery generally required 10–14 days in the SMD group. No postoperative infections or late complications were observed in either group during the 12-week follow-up.

Figure 1 shows the decline in NOSE scores from baseline to the 12-week postoperative follow-up in both groups. Although both groups demonstrated improvement during the postoperative follow-up period, the DLAT group showed a greater reduction in NOSE scores at the 12-week assessment, indicating greater sustained symptomatic relief. At baseline, the mean NOSE scores were comparable between the SMD and DLAT groups, with a mean difference of -3.0 points (95% confidence interval [CI]: -11.7 to 5.7; $P = .492$). No significant between-group differences were observed at postoperative week 1 (mean difference: -0.6 points; 95% CI: -7.4 to 6.2; $P = .860$) or week 4 (mean difference: 1.1 points; 95% CI: -4.5 to 6.7; $P = .695$). However, at the 12-week follow-up, the mean

NOSE score was significantly lower in the DLAT group than in the SMD group (10.1 ± 8.1 vs. 30.9 ± 12.6), with a between-group mean difference of 20.8 points (95% CI: 15.3 to 26.3; $P < .001$), indicating a greater sustained improvement in nasal obstruction symptoms following DLAT.

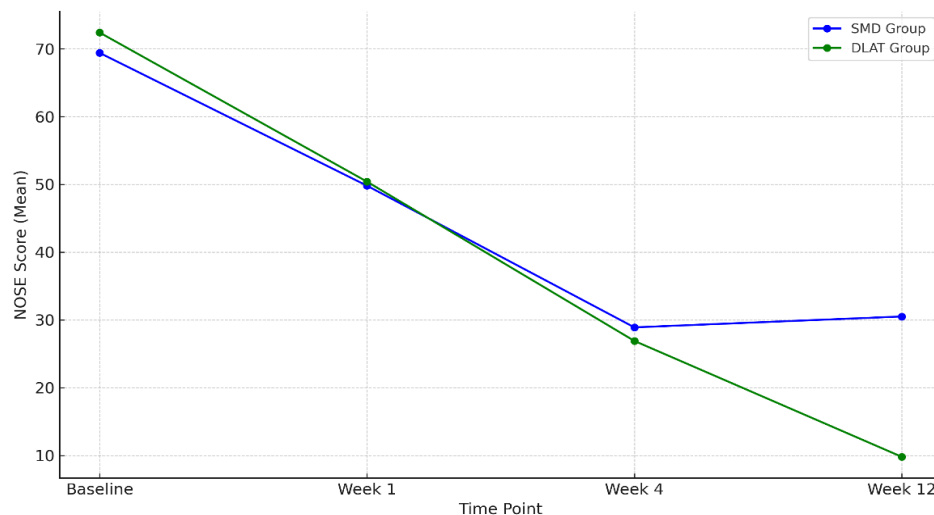


Figure 1: Comparison of pre- and postoperative NOSE scores in both groups

Discussion

This study aimed to compare SMD and endoscopic DLAT in terms of efficacy and postoperative outcomes. Our findings show that while both methods improve nasal patency, DLAT offers superior results with fewer complications and greater satisfaction.

The SMD remains a widely used, cost-effective, and efficient approach. By delivering thermal energy to the submucosa, it causes coagulation and fibrosis, effectively reducing turbinate volume.⁹ However, its limitations include poor precision and the risk of mucosal injury. In our study, crusting occurred in 36.7% of patients with SMD, aligning with findings by Madeed et al., who highlighted delayed healing and higher complication rates associated with SMD.⁹

Conversely, DLAT offers better visualisation and selective tissue ablation without mucosal damage. Its mechanism, which targets haemoglobin and water, facilitates coagulation with minimal bleeding. Bastawy and Ghalla reported similar benefits, highlighting better haemostasis and patient comfort with diode lasers.¹⁰ Abdullah and Singh also noted long-term symptom relief with fewer side effects due to minimal tissue trauma, a finding echoed by Zhang et al., who observed reduced revision rates in laser-based procedures.^{11,12}

Preservation of the nasal mucosa is critical to avoid crusting and synechiae and to maintain physiological functions. Adim et al., supported this, showing that less mucosal violation leads to lower complication rates.¹³ Maniaci et al., further affirmed DLAT's efficacy of DLAT in chronic rhinitis, attributing its benefits to mucosal preservation and minimal invasiveness.¹⁴ Smith et al., also advocated for its use amid infectious outbreaks due to reduced aerosol generation and quicker operating time.¹⁵

Al Sumairi et al., reported longer symptom-free intervals and lower recurrence rates with diode laser techniques, findings that are broadly consistent with the favourable postoperative outcomes observed in our study.¹⁶ In our cohort, patient satisfaction was higher in the DLAT group than in the SMD group (86.7% vs. 63.3%). Lau et al., also highlighted the safety, portability, and precision of diode lasers, which may contribute to improved postoperative recovery and earlier resumption of normal activities.¹⁷

Postoperative discomfort is an important factor. In our study, patients with DLAT experienced less pain and congestion. Shinde et al., attributed this to limited thermal damage and improved healing.¹⁸ SMD In contrast, SMD leads to greater mucosal necrosis and delayed healing. Kumar et al., emphasised the balance between efficacy and tissue conservation, recognising DLAT as a technique that achieves both.¹⁹

Other alternatives, such as microdebrider-assisted turbinoplasty, have also been explored. Khan et al., reported favourable outcomes, although the method is more equipment-dependent and invasive.²⁰ As Maniaci et al., pointed

out, surgical technique and surgeon expertise play a crucial role regardless of the method used.²¹ Raza et al., emphasised precise, conservative resection for optimal airway outcomes, while Harju and Numminen stressed the importance of patient selection and symptom severity.^{22,23} Martinez et al., also showed that turbinate surgery can positively affect related functions, such as Eustachian tube performance.²⁴

This study had several limitations. First, the quasi-experimental design and non-random sequential allocation may have introduced selection bias and limited our ability to establish a definitive causal relationship between the surgical intervention and the observed outcomes. The absence of allocation concealment and blinding may also have increased the risk of performance and assessment bias, particularly for patient-reported outcomes such as the NOSE score, postoperative pain, and satisfaction scores. Second, the study was conducted at a single centre with a relatively small sample size, which may limit the generalisability of the findings to broader patient populations and different clinical settings. Third, the follow-up period was limited to 12 weeks and may not have been sufficient to evaluate long-term symptom control, recurrence, or delayed postoperative complications. In addition, some outcomes, including intraoperative bleeding, mucosal recovery, and time required to resume routine activities, were assessed using subjective or non-standardised measures, which may have affected the precision and reproducibility of the findings. Furthermore, the study was not registered in a public clinical trial registry before participant enrolment, which limits transparency regarding prespecified outcomes and may reduce the methodological credibility of the findings.

Conclusions

Both SMD and endoscopic DLAT were associated with symptom improvement in patients with ITH. In this study, DLAT was associated with more favourable postoperative outcomes and greater patient satisfaction. Further multicentre studies with longer follow-up periods are needed to evaluate the comparative effectiveness and long-term outcomes of these techniques

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All authors approved the final version to be published & agreed to be accountable for all aspects of the work.

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