Inferior Turbinate Reduction: Diode LASER or Conventional Partial Turbinectomy?

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Abstract
Hypertrophy of inferior nasal turbinate is one of the most common causes for nasal obstruction (NO). As diode laser has proven to be as effective as any other lasers, our objective was to study various primary outcomes of its use of diode laser like improvement in NO, intraoperative bleeding, postoperative pain, and rapidity of healing. The study was undertaken to compare the various outcomes by diode laser turbinate reduction (LTR) and conventional partial inferior turbinection (PIT). A non-randomized controlled trial was conducted on 2 groups: One group (30 cases) underwent LTR and PIT was performed in the other group (30 cases). The improvement in NO was measured postoperatively up to 6 months. Intraoperative bleeding was measured and postoperative pain scores were assessed each day up to fifth postoperative day. Lastly, rapidity of healing was evaluated until 6 months. Subjective relief of NO was 90.8% in LTR group, whereas it was 65% in PIT group at 6-month follow-up, which was statistically significant (P < .05). Pain scores were higher until 5 days in PIT group compared to LTR group (P = .0001). Intraoperative bleeding mean scores (milliliters) were 8.03 in LTR group compared to 23.29 in PIT group (P = .00001). Rapidity of healing was faster in LTR group with mean scores of 3.03 weeks in comparison to PIT group where it was 6.33 weeks (P = .00001). Compared to the conventional technique, the outcomes were better with diode laser and caused less morbidity.

Keywords
nasal obstruction, diode laser inferior turbinate reduction, partial inferior turbinectomy

Introduction
Hypertrophy of the inferior turbinate is a common entity occurring in patients with allergic rhinitis (AR), vasomotor rhinitis (VMR), chronic rhinosinusitis (CRS), deviated nasal septum, rhinitis medicamentosa and son, and the most common symptom in them is nasal obstruction (NO). If the septal deviations are excluded, inferior turbinate hypertrophy is the main cause of NO. Although not life-threatening, chronic NO significantly impairs patient’s quality of life affecting their daily social and working activities.

Medical measures like antihistaminic, intranasal corticosteroid spray, decongestants, and corticosteroid injection may not succeed all the times and surgery is often indicated in many cases. These nonresponsive cases often require turbinate reduction and the common methods employed are cold knife turbinectomy, laser surgery, cryosurgery, electrocautery, and submucosal resection with lateral displacement.

An ideal treatment should have improvement in NO, less intraoperative bleeding, minimal postoperative pain, fast healing, less synechiae formation, and should not produce atrophic changes in long term. Moreover, it should preserve the physiological function of the turbinate such as regulation of humidification and temperature of the inspired air.

Laser treatment has been widely used recently due to good outcome with minimum morbidity. Various modes of laser are available for inferior turbinate reduction. Carbon dioxide laser is used when there is hyperplastic head of the turbinate, and if the entire length of turbinate is hypertrophied, the Nd:YAG laser has been preferred. Diode laser in addition to Ho:YAG laser is opted for outpatient procedure under local anaesthesia with good long-term results. Although the outcomes using conventional modalities are known since a long time, there are limited studies with the usage of diode lasers for turbinate reduction. Further as it is cost-effective, the present study was undertaken to compare outcomes to diode laser turbinate reduction (LTR) and conventional partial inferior turbinectomy (PIT).
Patients and Methods

Ethical approval was obtained from the Institutional Ethics Committee (Karnataka Institute of Medical Sciences, Hubli, India). The study was a prospective, nonrandomized comparative study.

The inclusion criteria were patients older than 18 years with deviated nasal septum having bilateral NO with “C”-shaped deviated nasal septum with compensatory hypertrophy of the inferior turbinate not responding to medical line of management for a period of 3 months, cases who had moderate degree of NO based on Visual analogue scale. In addition, cases of allergic rhinitis and those operated only under local anaesthesia were included. Exclusion criteria included patients having “S”-shaped deviated nasal septum, splint usage after septoplasty, coagulopathies, immunocompromised individuals, and cases associated with CRS.

As the objective was to compare the 2 modalities of treatment for hypertrophied inferior turbinate (LTR and conventional partial turbinectomy) with respect to various outcome measures a pilot study was conducted initially. A convenient sample of 4 patients in each group was taken and percentage of improvement in NO was recorded. Based on the results, the sample size was calculated and it worked out to be 30 in each group with 5% α-error and 95% power. Rand’s corporation random digital numbers were used to select the mode of surgery.

A detailed history and clinical examination was performed. Necessary hematological investigation and computerized tomogram of paranasal sinuses was performed in all cases.

The severity of the NO was assessed subjectively preoperatively by visual analogue scale (0-10 cm) and were graded as mild (0-3 cm), moderate (4-7 cm), and severe (8-10 cm). As all the cases selected were having moderate degree of NO, postoperatively the NO was scored as below:

1-mild improvement,
2-moderate improvement,
3-significant improvement and
4-complete improvement.

In patients who underwent PIT, the whole length of inferior turbinate from anterior to posterior end was clamped and crushed with long artery forceps. The mucosa and submucosa were then resected using angled scissors. On the other hand, in the diode laser inferior turbinate reduction group, output of laser was set at 6 W and energy delivered in a continuous and contact mode via a 600 µm quartz fibre. Under 0° endoscopic guidance, fiber tip was pierced at 4 to 5 points till bone depth along the medial border of inferior turbinate from anterior to posterior end, and each point was vaporized for 10 to 15 seconds. In both the modalities, nose was packed with absorbable gelatine sponge.

Intraoperative bleeding was assessed by measuring the weight of the patties (converted from gram to millilitre) used for hemostasis and the amount of blood collected in the suction jar together in terms of milliliter.

Postoperative pain was assessed by questionnaire method each day for 5 days postoperatively and their response was graded on a 0 to 6 scale. We devised the following scoring system to assess the pain intensity that suits our study:

0-no pain
1-mild pain no analgesics were required
2-mild pain requiring non-narcotic analgesics for less than 2 days
3-mild–moderate pain requiring non-narcotic analgesics for more than 2 days
4-severe pain responding to non-narcotic analgesics
5-severe pain needing narcotic analgesics for less than 2 days
6-severe pain needing narcotic analgesics for more than 2 days

All the patients received oral amoxicillin/ciprofloxacin for 5 days. Non-narcotic analgesics used were oral paracetamol, diclofenac sodium, and in case of severe pain not subsiding with the use of above, narcotic analgesics-like tramadol was considered.

Rapidity of healing was assessed at the end of first week, second week, 1 month, 3 months, and 6 months. Time taken for complete healing of turbinectomy site was noted. Patients were observed for crusting at the end of 7 days, synechiae formation at the end of 3 months and atrophic changes at the end of 6 months postoperatively.

Statistical Analysis

The data were analyzed using statistical software SPSS version 20.0. Before analysis, the Kolmogorov-Smirnov Z test was used to assess the normality of all variables that is, the percentage of improvement in NO, intraoperative bleeding, and rapidity of healing. All variables showed a normal distribution (P < .05) in LTR and PIT groups. Then unpaired t test was performed for comparison of 2 groups and paired t test was applied within the groups. But nonparametric test, that is, Mann-Whitney U test was applied for comparison of 2 groups and Wilcoxon matched pairs test was applied within the groups for pain scores. The statistical significance was set at 5% level of significance (P < .05).

Objectives

Primary objectives were to compare the efficacy of diode LTR and conventional PIT in terms of:

1-subjective relief of NO.
2-amount of intraoperative blood loss
3-postoperative pain and
4-rapidity of healing

Secondary objectives were to compare the complications like crusting, synechiae formation, and atrophic changes following surgery by the abovementioned 2 methods.
Discussion

In this nonrandomized prospective comparative study, 2 of the most commonly employed methods of inferior turbinate reducto
namely LTR and PIT (cold knife) were compared with repect to the abovementioned primary and secondary objectives. The preferred conventional methods are inferior turbino-gra, submucus turbinectomy, lateral out fracture, partial, and total turbinectomy. Few studies analyzed the use of lasers and also compared various modes of laser therapy like CO\textsubscript{2}, Ho:
YAG, and diode.\textsuperscript{14,15} They found that LTR offers no significant benefits over conventional methods in the long term. Nasal airway obstruction caused by mucosal swelling is the principle indication for laser treatment of the turbinate. However, if the NO is due to enlarged bony turbinate conventional surgery is indicated.\textsuperscript{16,17} However, LTR has significant advantages over conventional methods both in terms of efficacy and ease of treatment as observed in the present study.

The relief of NO was better with LTR group. In the initial follow-up period, the NO has been correlated largely to the postoperative edema and nasal crusting, and hence, a follow-up period for 6 months is a more reliable indicator.\textsuperscript{18} In yet another study longer postoperative oedema and crusting following diode laser treatment (3-4 weeks) was observed compared to Ho:YAG (1-2 weeks only). However, no difference in long-term significance was observed between both forms of laser.\textsuperscript{14} In another study using diode laser on 76 patients with AR and VMR where nasal turbinate reduction was performed,\textsuperscript{=}86% and 76% improvement in NO was observed after 6 months and 1 year, respectively.\textsuperscript{18} However, in the present study, the percentage of relief of NO was 90% with LTR group as compared to 65% in PIT group at the end of 6 months follow-up. Crusting was more with PIT group at the end of 1 week in our study which could be one of the factors responsible for NO.

In a trial involving 26 patients with AR and 24 patients with VMR, it was found that following diode laser reduction, the nasal cavity volume increased by 11.4% and 7.6%, respectively, at the end of 1-year follow-up.\textsuperscript{18} In another study by Takeno et al, it was found that NO was relieved following laser surgery owing to the increased nasal dimensions which was evident on acoustic rhinometry as early as one month following surgery.\textsuperscript{19} However, the improvement in NO was not quantified using acoustic rhinometry in the present study.

Laser turbinate reduction group had very minimal intraopera- tive bleeding compared to PIT group. Disadvantage with the conventional technique was mucosal injury leading to intraoperative and postoperative bleeding which can affect long-term success rates.\textsuperscript{20,21}

Patients in LTR group evidenced less pain on all the days, and at the end of 5 days, no pain was noticed. In contrast, PIT group still had pain by the end of day 5 which is comparable with the study by Elwany and Harrison.\textsuperscript{4}

The regeneration of nasal mucosa was faster in LTR group compared to PIT group probably due to less mucosal injury involved with the former.

### Table 1. Comparison of LTR and PIT With Respect to % of Improvement in NO at Different Treatment Times By t Test.

| Groups | Changes From 7 Days to 7 Days | Changes From 7 Days to 15 Days | Changes From 7 Days to 1 Month | Changes From 7 Days to 2 Months | Changes From 7 Days to 3 Months | Changes From 7 Days to 6 Months | Changes From 15 Days to 1 Month | Changes From 15 Days to 2 Months | Changes From 15 Days to 3 Months | Changes From 15 Days to 6 Months |
|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| LTR    | 60.0 (12.5)     | 69.2 (18.2)     | 84.2 (13.9)     | 87.5 (12.7)     | 90.8 (12.3)     | 90.8 (12.3)     | 9.2 (10.8)      | 24.2 (10.4)     | 27.5 (10.1)     | 30.8 (12.6)     |
| PIT    | 43.3 (16.0)     | 62.5 (14.3)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     | 65.0 (15.5)     |

% changes in LTR 15.3%, \textsuperscript{a}P < .05, \#applied paired \textsuperscript{t} test. 

| t value | \textsuperscript{a}P < .05, \#applied paired \textsuperscript{t} test. |
|--------|-----------------|
| 4.5033 | .0001 \textsuperscript{a} |
| 1.5773 | .0001 \textsuperscript{a} |
| 1.2023 | .0001 \textsuperscript{a} |
| 4.5033 | .0001 \textsuperscript{a} |

Abbreviations: LTR, laser turbinate reduction; NO, nasal obstruction; PIT, partial inferior turbinectomy.
Elwany compared 4 different techniques of turbinate reduction like PIT, inferior turbinoplasty, and cryoturbinectomy and laser turbinectomy with 20 cases in each group. They observed synechiae formation as the only complication in laser turbinectomy which was observed in 1 of 20 cases, whereas it was 1 of 30 cases in the present study. On the contrary, there were 6 of 30 cases in PIT group.

Numerous studies have reported development of atrophic rhinitis associated with conventional procedures, which was not so in the present study where we did not find a single case in both the groups.

To conclude, laser surgery offers distinctive advantages over conventional techniques in terms of better results and less morbidity. LTR satisfies most of the criteria to fulfill to be an ideal treatment of choice in addition to preserving physiological functions. Diode laser being as good as any other laser for turbinate reduction is an effective choice for deserving cases. Although not as cost-effective as conventional methods, better quality of life with laser definitely makes it an important tool to replace the era of cold knife in turbinate surgeries in the modern day world.

Results

Of 30 cases in LTR group, 14 (46.67%) were males and 16 (53.33%) were females. Similarly, out of 30 cases in PIT group 20 (66.67%) were males and 10 (33.33%) were females. The difference was not found to be statistically significant ($\chi^2 = 2.4443, P = .1184$). The mean age of total cases was 24.900 ± 7.505, the mean age in LTR group was 24.767 ± 8.266, and in PIT group was 25.033 ± 6.800.

Comparison of LTR and PIT with respect to percentage of improvement in NO at different times of follow-up revealed a significant difference except at 15 days at 5% level of significance ($P < .05$). The mean percentage of improvement in NO scores was significantly higher in LTR group as compared to PIT group (Table 1).

However, a significant difference was also observed between LTR and PIT groups with respect to change in percentage of improvement in NO from 7 days to other time intervals ($P < .05$). A significant percentage change in improvement in NO was observed at all follow-up times with respect to seventh postoperative day in LTR group when compared to PIT group (Table 1). The mean scores of percentage of improvement in NO at different time points are presented in Figure 1.

A significant difference was observed between LTR and PIT groups with respect to pain scores at all postoperative days (up to 5 days) at 5% level of significance. The mean pain scores were significantly higher in PIT as compared to LTR group (Table 2).

However, a significant difference was also observed between LTR and PIT groups with respect to change in pain from POD0 to other time intervals. A significant decrease in pain was observed from postoperative day 0 to day 5 in LTR in comparison to PIT group (Table 2). The mean scores of pain at different time points are presented in Figure 2.

A significant difference was observed between LTR and PIT groups with respect to intraoperative bleeding ($t = -15.3743, P = .0001$) at 5% level of significance. The mean scores of bleeding were significantly higher in PIT group as compared to LTR group (Table 3).

We observed a significant difference between LTR and PIT groups with respect to the time taken in weeks for healing at 5% level of significance. The mean time taken for healing was significantly higher in PIT group as compared to LTR group (Table 4).

Crusting was more with PIT group in comparison to LTR group observed at the end of 7 days. Synechiae were found more in PIT group at the end of 3 months. Further no atrophic changes were observed in both the groups at the end of 6 months.
Declaration of Conflicting Interests

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