The Use of Nd: YAG Laser for Inferior Turbinectomy, A comparative Study

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ABSTRACT
Nasal obstruction resulting from inferior turbinate hypertrophy (ITH) was treated with Nd YAG laser inferior turbinectomy (Laser IT). The effectiveness of the procedure was assessed and compared with both Functional Endoscopic turbinoplasty (Turbinoplasty) and conventional partial turbinectomy (Conventional IT).

Materials and methods: A retrospective analytic study was carried out for 53 patients suffering inferior turbinate hypertrophy. Twenty patients underwent Nd: YAG Laser IT (Group 1), 24 patients underwent Turbinoplasty (Group 2) and 9 patients underwent Conventional IT (Group 3). Improvement in nasal symptoms and signs were assessed. Intraoperative bleeding, as well as hospital stay and postoperative medications and instrumentation, were compared between the three groups.

Results: The symptoms of sneezing, hyposmia, and rhinorhoea were significantly reduced postoperatively among patients in the three groups and there were no differences statistically between them. Nd YAG Laser turbinectomy group showed marked reduction in blood loss (Average = 12 ml/patient) compared to the Turbinoplasty group (average = 181 ml/patient) and Conventional IT group (average 201 ml/patient). Hospital stay was much less in laser IT group (average = 0.05 days) compared to group 2 (1.2 days) and group 3 (1.3 days). Only one patient in laser IT group needed nasal packing whereas all patients in the other two groups needed nasal packing routinely.

Conclusions: Nd YAG laser IT was effective in reducing the symptoms and signs of nasal obstruction, as well as other nasal symptoms without significant complications. Nd: YAG laser is recommended as an alternative method, when applicable in treating patients with nasal obstruction resulting from hypertrophied inferior turbinate.

INTRODUCTION
During the last few decades, laser technology enabled innovative advancements in the field of medicine, in general, and has revolutionized surgery in many fields amongst which the field of Otolaryngology 1,2.

Lasers are more precise than any other surgical tool, owing to this character lasers are increasingly used in fine surgeries. As it is targeted precisely to diseased tissues, while sparing the nearby normal tissues,
less inflammatory reaction is expected at surgical site, hence less side effects. This has enabled a considerable number of laser assisted surgical procedures to be carried at an outpatient basis. One more advantage of laser surgery in general is that the heat produced by lasers sterilizes the surgery site, thus reducing the risk of infection.

Laser surgery is used to perform one or more of the following effects on tissues:

- Cut or destroy tissue that is abnormal or diseased without harming healthy, normal tissue.
- Shrink or destroy tumors and lesions.
- Cauterize blood vessels to prevent excessive bleeding.

Laser beam is characterized by certain parameters; they at the end describe the amount of energy delivered at the tissue, penetration depth and effects on neighboring tissues. Knowing this is of paramount importance as each type of laser is suitable for certain tissues to act upon.

Laser is a very suitable tool in otolaryngology (ORL) and is used in many surgeries in this field. Table (1) shows brief description of the commonly performed lasers and procedures using laser as a surgical tool.

Since the early 80s, various types of lasers have been used for the reduction of hyperplastic inferior nasal turbinates.

Nasal obstruction is a very common complaint in the practice of Otolaryngology due to many causes. Using laser in nasal surgery gives better accessibility to areas that cannot be reached by conventional surgical methods. In addition to a more precise debulking property, and is therefore ought to be associated with less postoperative pain and in most cases less hospital stay, this will save lots of hospital resources and will be more convenient to the patients.

**Study objectives:**

This study aimed to:

1. Identify the optimal parameters for partial inferior turbinectomy using the Nd:YAG laser, supplied by Dornier Company - Germany.
2. Verify patient’s improvement (symptoms and signs) following Nd: YAG Inferior

### Table 1: types of lasers used for common conditions in ORL surgeries

<table>
<thead>
<tr>
<th>Types of laser used in ORL</th>
<th>Common conditions treated by laser surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal surgery: CO2, Nd:YAG, Ho: YAG, Diode and KTP Lasers</td>
<td>Nasal and paranasal polypi, hypertrophied turbinates, concha bullosa media, Synechia, cicatricial stenosis and granulation, Septum spear and septal crest, telengectasia and capillary hemangioma, adenoids and choanal atresia.</td>
</tr>
<tr>
<td>Larynx and Hypopharynx: CO2 and KTP Lasers</td>
<td>Vocal cord tumours, hemangioma of the larynx, glottic web (iatrogenic or congenital), Partial laryngectomy and hypopharyngeal tumours.</td>
</tr>
<tr>
<td>Middle ear surgery: CO2 Laser</td>
<td>Laser assisted stapedectomy and Laser myringotomy</td>
</tr>
</tbody>
</table>
Turbinectomy (laser IT) and compare these results with those obtained following Functional Endoscopic Inferior Turbinectomy (FESS IT) and Conventional partial turbinectomy (Conventional IT).

3. To compare postoperative discomfort and hospital stay after Nd: YAG laser IT, FESS IT and Conventional IT.

MATERIALS AND METHODS:

Study subjects and sample size:
Patients who have allergic or vasomotor rhinitis, and are planned to undergo reduction of the inferior turbinate, were selected.

Patients who complain mainly of bilateral nasal obstruction were included.

Exclusion criteria:
- Patients who have headaches and/or rhinorhoea without nasal obstruction.
- Patients with nasal polyps.
- Patients with previous nasal surgery.

Procedure:
Partial inferior turbinectomy was done for three groups:
• Group 1 includes 20 patients who were operated on by Nd: YAG laser. The procedure was carried out under local anaesthesia for 19 patients. 1 patient underwent laser inferior turbinectomy under general anaesthesia.
• Group 2 includes 24 patients who underwent Turbinoplasty. Patients were selected to match the age, sex and duration of symptoms of the former group; they were selected from the outpatient clinic of ENT Khartoum Teaching Hospital. The procedure was carried out under general anaesthesia.
• Group 3 includes 9 patients who were operated on by conventional surgical tools used for classical partial inferior turbinectomy; they were matched with group 1 in age, sex and duration of symptoms. The procedure was carried out under general anaesthesia.

Data collection and analysis:
Data was collected by data sheet and analyzed by master sheet. Statistical significance (P value) was calculated using the Chi square test.

RESULTS:

Patients’ description:
Patients in this study were categorized into three groups, as mentioned above. Each group was subjected to a different surgical modality. Their ages ranged from 18 to 52 years. Males were 31 and females were 22.

Laser was applied to group 1 in the form of continuous wave (cw) Nd: YAG laser in a contact mode. The power applied to debulk the inferior turbinate was between 9 and 11 Watts as in figure (1). When laser was applied in a power range less than 9 Watts, it was found to be insufficient to cause coagulation of bleeding vessels. Higher power, more than 11 Watts, causes discomfort and pain to the patient, probably due to an increased penetration depth of laser beam.

Improvement in nasal symptoms and signs among different groups of patients is drawn in figures 2, 3 and 4.

All patients of Group 1 experienced no nasal obstruction. The results were 90% and 81.8% in Group 2 and Group 3, respectively. Statistically, there was no difference between Group 1 and Group 2, but the difference was significant between Group 1 and Group 3. Note that all patients among different groups experienced no nasal obstruction 4 weeks post-operatively, as seen in the shaded columns.

Among Group 1, 95% of patients showed improvement in sneezing, while the improvement was 96.2% in Group 2 and 88.9% in Group 3. The differences between the three groups were statistically insignificant.

The improvement in the three groups, post-operatively, with regard to odor perception was 90% among laser group, 91% and 88.9% in turbinoplasty group and conventional group, respectively. Statistically there was no significant difference between the three groups of patients.

Figures (5), (6) and (7) show the average amount of blood loss intra-operatively, hospital stay and the necessity of nasal packing among the three groups of patients, respectively.
**Fig 1:** The power of Nd: YAG laser applied in a continuous mode to debulk the inferior turbinate.

**Fig 2:** Improvement of nasal stuffiness among different groups of patients immediately post-operatively.

**Fig 3:** Comparison between the three groups of patients, with regard to improvement in sneezing, in a period of 4 weeks after inferior turbinectomy.
Fig 4: Percentage of patients who improved post-operatively with regard to odor perception.

Fig 5: The average amount of blood loss/patient during surgery.

Fig 6: The average duration of post-operative hospital stay following each procedure.
The blood loss was 12 mL in laser group, 181 mL in Turbinoplasty group and 201 mL in the conventional group. The difference is statistically highly significant between Group 1 and each of the two groups.

The hospital stay was 0.05 day in Group 1, 1.2 days in Group 2 and 1.3 in group 3. The difference was statistically significant between group 1 and each of the two different groups.

No patient in laser group needs nasal packing after inferior turbinectomy, while all the patients in the other two groups need nasal packing.

DISCUSSION
Surgical management of the enlarged inferior turbinates is done by different surgical tools. Controversy still exists as to the best or most appropriate method for surgical reduction of the inferior turbinate.

The followings are different surgical modalities for turbinate hypertrophy\textsuperscript{11, 12, 13}:
1. Cryoturbinection
2. Diathermy coagulation (monopolar or bipolar)
3. Radiofrequency ablation
4. Partial or total reduction of the turbinates with a conchotome or scissors (conventional)
5. Functional Endoscopic Nasal Surgery (FESS). The procedure is named as turbinoplasty if carried on to reduce the mucosa of the inferior turbinates.
7. Coblation assisted partial turbinectomy

The trend should be toward less invasive technique that can potentially be performed in the clinic setting, rather than in the operating room.

Regarding improvement in nasal obstruction, Nd YAG IT showed 100% success rate. The difference between Nd YAG IT (100%) and Turbinoplasty (90.8%) is statistically insignificant in contradistinction to conventional surgery results (81.8%). It is claimed that sensation of nasal obstruction in the immediate postoperative period in conventional inferior turbinate reduction is due to mucosal edema following this relatively traumatic type of surgery. The availability of pre and postoperative rhinomanometric evaluation will be helpful as an objective measurement of nasal symptoms.

Improvement of sneezing was satisfactory in all groups, it is a bit less following Nd: YAG IT compared to Turbinoplasty and Conventional inferior turbinectomy although the difference is not significant statistically. This could be due to the fact that laser is a very precise surgical tool with minimal mucosal affection compared to the other two tools.

Surgical turbinate intervention demonstrates benefit in controlling symptoms of allergic rhinitis other than nasal obstruction. We advocate Nd: YAG Inferior Turbinectomy, as an adjuvant modality of treatment in cases of allergic and vasomotor rhinitis, that are refractory to pharmaco- and immuno-
Although laser ablation of the turbinate was found to be effective in improving nasal obstruction; however, it disturbed the mucociliary function significantly in a study carried by Sapci, Tarik, Sahin, Betul and Karakuls, Ahmet et al. when compared with the partial turbinectomy technique.

Most of the patients showed improvement in odor perception; this coincides with improvement in nasal obstruction as it is the proposed etiological factor for hyposmia and anosmia.

Marked reduction of blood loss intraoperatively, when performing Nd: YAG IT, was noted. The results of our study are in agreement to those achieved by Janda Philip, Ronald and Baum Gartner et al. This is a great advantage of laser Surgery. Blood loss estimate is much higher in Turbinoplasty and in conventional IT, the latter two are comparable to each other in this regard.

All patients treated by Functional Endoscopic Turbinoplasty and conventional surgery need nasal packing for 24 hrs, at least, and hence antibiotic cover. Only one patient ‘a diabetic, 52 yrs old male’ needed nasal packing in the Nd: YAG group, this was on the 3rd day post-operatively as he developed epistaxis and consequently was given antibiotic therapy to guard against infection.

Nd: YAG laser IT was carried as day case surgery, where surgery is performed as an outpatient procedure under topical anesthesia, they leave hospital 2 hrs post-operatively. This is a great advantage over Turbinoplasty and conventional surgery, where both are performed only under general anesthesia.

The post-operative period following Nd: YAG laser IT is usually uneventful and no patient complained of crusting, dryness or foul odor.

The main disadvantage of Nd YAG laser IT is that patients should be highly selected. They should have only inferior turbinate hypertrophy and no other lesions, such as deviated nasal septum and/or nasal polypi.

In this regard conventional methods with or without FESS (Functional Endoscopic Sinus Surgery) are superior, as all these pathologies can be corrected at one session since it is carried under general anesthesia.

CONCLUSIONS

From the obtained results we found that Nd: YAG Inferior Turbinectomy has many advantages over Turbinoplasty and conventional turbinectomy.

Inferior turbinectomy using laser is minimally invasive; it can be done under local anesthesia, it is carried as a day case surgery with much less blood loss and usually there is no need for nasal packing post operatively. For all these reasons it is more convenient to the patients.

The outcome of laser inferior turbinectomy depends on good selection of the patients, they should have only inferior turbinate hypertrophy as a cause of nasal obstruction, and otherwise they won’t benefit much from this procedure.

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