


ORIGINAL ARTICLE

Holmium:YAG laser and diode laser applications in turbinate reduction

Eren Yilmaz¹, Aytug Altundag²¹Department of Otolaryngology, Acibadem Taksim Hospital, İstanbul, Türkiye²Department of Otolaryngology, Biruni University Faculty of Medicine, İstanbul, Türkiye**ABSTRACT**

Objectives: This study aims to compare the functional outcomes and side effects of the holmium:YAG laser and the diode laser on turbinate reduction.

Patients and Methods: Between January 2025 and December 2025, a total of 30 participants who underwent endoscopic turbinate reduction were included and divided into two groups: the holmium:YAG laser group (7 males, 9 females; mean age: 35.0±11.9 years; range, 19 to 61 years) and the diode laser group (8 males, 6 females; mean age: 33.0±13.8 years; range, 19 to 65 years). Preoperative and six-month postoperative Nasal Obstruction Symptom Evaluation (NOSE) scores, pain and dryness scores, Visual Analog Scale, and threshold, discrimination, and identification (TDI) scores determined with Sniffin' Sticks were compared. The results were analyzed statistically.

Results: Holmium:YAG laser and diode laser concha reduction increased TDI scores in both groups ($p = 0.02$ and $p = 0.03$). Holmium:YAG laser and diode laser provided significant symptomatic improvement ($p = 0.023$ and $p = 0.011$). However, no significant difference was observed between the two methods in terms of TDI scores and symptomatic improvement ($p > 0.05$). Nasal dryness was slightly more common with the diode laser (0.049 and 0.059).

Conclusion: The use of laser systems in nasal surgeries is becoming widespread. Holmium:YAG lasers and diode lasers are frequently used in turbinate reduction.

Keywords: Laser, rhinology, turbinate reduction.

Turbinate hypertrophy, which obstructs airflow in the nasal passages and causes nasal obstruction, is generally treated medically. Vasomotor rhinitis, allergic rhinitis, and compensatory mechanisms are frequently involved in the etiology. Although oral decongestants and antihistamines, steroid nasal sprays, antihistamine sprays, and decongestant sprays are used for treatment, some patients do not benefit from these medications, do not want to use them, or cannot tolerate them. In these patients, turbinate

ablation, which creates a scar and opens the airway, is an important treatment alternative.^[1] Submucosal resection, bipolar cautery, and radiofrequency devices can be used as ablation methods. The use of laser systems in nasal surgery has also increased in recent years. Carbon dioxide (CO₂), potassium titanyl phosphate (KTP), and holmium:yttrium-aluminum-garnet (holmium:YAG) are the most common laser systems used in nasal surgery.^[2] Due to its non-flexible cantilevered structure, CO₂ use is more limited

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Correspondence: Eren Yilmaz, MD.

E-mail: aaltundagkbb@gmail.com

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within the nose, while flexible systems, such as holmium:YAG, KTP laser, and diode laser, which can be delivered internally through an aspirator, are more common.^[3,4] Their use in turbinate surgery has increased, particularly as they are less invasive than conventional methods such as microdebrider, submucosal resection, partial turbinectomy, and cauterization. Furthermore, these laser systems are associated with fewer complications, including bleeding, pain, dryness, and synechiae, compared to traditional reduction techniques. While numerous studies in the literature compare the functional outcomes of laser ablation with other ablation methods, fewer studies compare laser systems.^[2-5]

This study compared the functional outcomes of patients undergoing endoscopic turbinate reduction with the holmium: YAG laser and the diode laser.

PATIENTS AND METHODS

Study design and participants

This retrospective study was conducted at Acibadem Mehmet Ali Aydınlar University, Department of Otolaryngology, between January 2025 and December 2025. A total of 30 participants who underwent endoscopic turbinate reduction were included and divided into two groups: the holmium:YAG laser group (7 males, 9 females; mean age: 35.0±11.9 years; range, 19 to 61 years) and the diode laser group (8 males, 6 females; mean age: 33.0±13.8 years; range, 19 to 65 years). Inclusion criteria were patients with persistent nasal congestion despite medical treatment and no other pathology causing nasal obstruction besides turbinate hypertrophy. Patients with a deviated septum or those requiring concurrent surgical procedures such as septoplasty, endoscopic sinus surgery, or concha bullosa surgery were excluded from the study. Written informed consent was obtained from each patient. The study protocol was approved by the Medical Ethics Committee of Acibadem Mehmet Ali Aydınlar University (Date: 18.12.2025, Approval No: 2025-20/160). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Clinical assessments

Preoperative Nasal Obstruction Symptom Evaluation (NOSE) scores were calculated, and threshold, discrimination, and identification (TDI) were measured with Sniffin' Sticks (Burghart Messtechnik, Wedel, Germany). Nasal dryness was assessed using a Visual Analog Scale (VAS).

Surgical technique

Endoscopic turbinate reduction was performed in the first group under general anesthesia using a Medilas® H Solvo Holmium:YAG Laser (Dornier MedTech, Munich, Germany) 2100 nm at 0.8 watts and 6 Hz. In the second group, a Lasotronicx® Smart M 980 nm diode laser (Lasotronicx, Piaseczno, Poland) with 8 watts of continuous wave energy was used. Postoperative pain and nasal dryness were assessed using a VAS. At six months, NOSE scores were recalculated, and TDI scores were re-measured. Postoperative parosmia durations were evaluated.

Sniffin' Sticks

The psychophysical testing of olfactory function was performed using the validated Sniffin' Sticks test, for which odorants were presented in commercially available felt-tip pens.^[6,7] First, the pen's cap was removed by the experimenter for approximately 3 sec for odor presentation, and then the tip of the pen was placed about 1-2 cm in front of the nostrils. The test consisted of one threshold and two suprathreshold subtests, namely a test for thresholds of phenylethyl alcohol, a test for odor discrimination (16 triplets with two different odors), and one for odor identification (16 common odors, presented in a four-alternative, forced-choice procedure). The maximum score of each subtest was 16, resulting in a maximum composite score of 48 TDI score.^[8] Normosmia is described for TDI composite scores of more than 30.3, with a cutoff between functional anosmia and hyposmia at 16.5.^[9]

Nasal Obstruction Symptom Evaluation

The NOSE is a valid, reliable, and responsive instrument that is brief, easy to complete, and has potential use for outcomes studies in adults with nasal obstruction. All patients were asked one week before surgery about their complaints of nasal bloating or fullness, nasal congestion, difficulty breathing through the nose, difficulty sleeping, and inadequate breathing with exertion. For each question, they were asked to select one of the following options: No problem (0 points), very mild (1 point), moderate (2 points), poor (3 points), or very poor (4 points). The results were scored between 0 and 20.^[10]

Nasal dryness and pain

Patients' complaints of nasal dryness were assessed using a VAS. Patients were asked to rate their nasal dryness on a scale of 0 to 10, with 0 being not at all and 10 being very severe, before and after surgery. Patients' postoperative pain was assessed using a VAS.

Table 1. Demographic data of patients

Surgical group	Holmium:YAG laser		Diode laser
	n	Mean±SD	n
Age (year)		35.0±11.9	33.0±13.8
Sex			
Female	9		6
Male	7		8
Complication			
Major epistaxis	0		1
Minor epistaxis	1		1
Pain	11		10

SD, standard deviation.

Patients were asked to describe their pain on a scale ranging from 0 (none at all) to 10 (very severe).^[11]

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean±standard deviation. The independent t-test was used for intergroup comparisons, while the paired t-test was utilized for intragroup (preoperative vs. postoperative) comparisons. A *p*-value < 0.05 was considered statistically significant.

RESULTS

Postoperative pain was observed in 21 patients while an equal number of participants experienced other complications. All of these were nosebleeds. One of the patients who experienced bleeding underwent holmium:YAG laser (on Day 9), and two underwent diode laser (on Days one and 18). Two of these nosebleeds were simple bleeds treated in an outpatient setting, while one patient in the diode laser group required a second operation for a nosebleed. The bleeding originating from the turbinate tail was easily controlled with cauterization, as shown in Table 1. All patients had early olfactory loss, but olfactory functions returned to normal at six months

postoperatively, except for one patient. Hyposmia persisted at six months in one patient who received a diode laser (TDI: 27). The mean preoperative TDI scores of the patients were 28.4 in the holmium:YAG laser group and 28 in the diode laser group, and there was no statistically significant difference (*p* = 0.412). In the sixth month postoperative measurements, the holmium:YAG laser and diode laser scores were 35 and 33.4, respectively (*p* = 0.345). However, there were significant changes in postoperative TDI scores in both the holmium:YAG laser group and the diode laser group (*p* = 0.02 and *p* = 0.03). A normal distribution was observed between the preoperative NOSE scores and nasal dryness VAS scores of the holmium:YAG laser and diode laser groups, and there was no significant difference (*p* = 0.423 and *p* = 0.634). In patients treated with holmium:YAG laser, preoperative and six-month postoperative nose scores were 16 and 4.9, respectively (*p* = 0.023). In the diode laser group, these scores were 14.5 and 2.6, respectively (*p* = 0.011). Postoperative pain VAS scores were 1.8 in both groups (*p* = 0.654). Postoperative nasal dryness VAS scores were 3 for the holmium:YAG laser group and 4.8 for the diode laser group (0.059 and 0.049). Statistically, there is mild evidence that diode lasers may cause nasal dryness (*p* = 0.49), as shown in Table 2.

Table 2. Data and statistical values obtained from the research

Surgical technique	NOSE			TDI scores			Nasal dryness			Pain
	Pre	Post	<i>p</i>	Pre	Post	<i>p</i>	Pre	Post	<i>p</i>	
Holmium:YAG laser	16	4.9	0.023	28.4	35	0.02	1.2	3	0.059	1.7
Diode laser	14.5	2.6	0.011	28	33.4	0.03	1.4	4.9	0.049	1.6
<i>p</i> value	0.423	0.236		0.412	0.345		0.634	0.312		0.654

NOSE, Nasal Obstruction Symptom Evaluation; TDI, threshold, discrimination, and identification.

DISCUSSION

The holmium:YAG laser is a pulsatile laser system with a wavelength of 2.1 μm that operates in the infrared spectrum. The diode laser, on the other hand, operates in the near-infrared spectrum and has a wavelength of 980 nm. Both systems utilize fiber probes. A significant advantage of these techniques is that the fiber optic systems, which allow for use by being advanced through the aspirator system, allow for the aspiration of secretions, blood, and smoke generated during the procedure. The diode laser system uses a continuous wave system, while the holmium:YAG laser uses a pulsatile system. The penetration depth of the holmium:YAG laser is 0.2 mm, while that of the diode laser can reach up to 3.5 mm. Therefore, extra caution should be exercised when using the diode laser.^[12]

In our patients, postoperative nasal dryness was more common in the diode laser group. We believe this is related to the laser's depth of penetration. Due to the pulsatile nature of the holmium:YAG laser, the small bursts it creates in the tissue frequently cause contamination of the camera tip. Therefore, we had to frequently clean the camera tip and perform saline irrigation during the procedure. No such bursts were observed during the procedure with the diode laser, and we required less camera cleaning and saline irrigation. When complications were examined, no significant difference was observed between the two groups. The crusting time was similar in both groups.

Regardless of the laser system used, both systems are less invasive than other methods used for turbinate reduction (microdebrider, submucosal resection, partial turbinectomy, and cauterization). Bleeding, pain, dryness, and synechiae are less common. Janda et al.^[5,13] suggested that the type of laser used does not significantly affect postoperative success and that success depends on the application method and the selected energy level. When complications were examined, the ones reported with the diode laser included minor bleeding, loss of smell, and nasal dryness.

The main complications reported with the holmium:YAG laser were pain, nasal dryness, minor bleeding, and loss of sensation in the nose.^[13-15]

The efficacy and complications of both techniques were found to be similar in our study. Eleven patients treated with holmium:YAG laser experienced postoperative pain, one patient had minor bleeding, and three had nasal dryness. One patient treated

with diode laser experienced minor bleeding, and one patient experienced major bleeding requiring intervention in the operating room. No additional intervention was required for the minor bleeding that occurred with either technique; the bleeding was easily controlled with decongestant sprays. However, one patient treated with diode laser experienced major bleeding on the 18th postoperative day, necessitating intervention in the operating room. With both techniques, olfactory functions were significantly affected in the early postoperative period, but olfactory functions returned to normal in the long-term evaluation, and no permanent loss of olfactory function was observed in any of our patients. However, the patient with preoperative hyposmia persisted with hyposmia six months postoperatively. Nasal synechiae were not observed in any of our patients. We believe this is largely due to the laser system's less invasive nature, as well as the fact that patients did not undergo concurrent septum surgery. The effectiveness of both laser systems on nasal congestion was found to be similar. These laser systems, which have been shown to be effective in long-term outcomes, can be used as an alternative to conventional methods. Low cost, the ability to perform with local anesthesia, and short procedure times are key advantages of these techniques. While the primary disadvantage of laser systems appears to be the initial cost of the device, their long lifespan and ease of application in the outpatient setting effectively offset this investment. Compared to traditional methods, the lower risk of bleeding and the elimination of nasal packing are also significant advantages.^[16] Furthermore, the larger size of the holmium:YAG laser may be a disadvantage for some surgeons. The diode laser, on the other hand, is small enough to be carried in a bag.

The small number of patients is the most important limitation of this study. Furthermore, the effects of the procedures were determined through patient questioning; no objective measurement method was used.

In conclusion, according to this research, the holmium:YAG laser appears to be more advantageous only in terms of nasal dryness, but a more definitive judgment requires a larger and more homogenized patient population. Laser systems are increasingly used in rhinologic procedures and offer significant advantages over traditional methods. According to this research, holmium:YAG laser and diode laser, frequently used in turbinate reduction, have similar efficacy and side effect profiles.

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