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Comparison of Radiofrequency Thermal Ablation and Microdebrider-Assisted Turbinoplasty in Inferior Turbinate Hypertrophy: A Prospective, Randomized, and Clinical Study

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Original Investigation

Abstract

Objective: To compare the effectiveness of radiofrequency thermal ablation with those of microdebrider-assisted turbinoplasty, we designed a prospective, randomized clinical study.

Methods: Forty patients suffering from nasal obstruction due to bilateral inferior turbinate hypertrophy were enrolled. Half of the patients were operated by radiofrequency thermal ablation, while the other half underwent microdebrider-assisted turbinoplasty. The outcomes of both techniques were compared in terms of symptomatology, nasal patency, and mucociliary transport.

Results: A statistically significant difference existed between the two groups with respect to nasal obstruction and the frequency of obstruction at the first post-operative week and first and third post-operative months ($p<0.05$). Rhinomanometry detected a significant decrease in nasal resistance values in both surgical groups compared to the preoperative values. The mucociliary transport time was significantly prolonged in the first postoperative week and first post-operative month in microdebrider-assisted inferior turbinoplasty group.

Conclusion: Both radiofrequency thermal ablation and microdebrider-assisted turbinoplasty are effective techniques for treating inferior turbinate hypertrophy. The treatment modality should be individually determined, and parameters such as tissue healing, volume reduction, and mucociliary activity must be taken into account.

Keywords: Turbinate, hypertrophy, surgical treatment, radiofrequency, microdebrider

Introduction

Nasal obstruction is a common complaint in the field of rhinology and interferes with the quality of life. Chronic nasal obstruction may affect the quality of life, and extranasal symptoms such as headache, fatigue, and sleep disorders may affect the patient (1). Nasal obstruction caused by extensive hypertrophy of the inferior turbinates is common. Various medical and surgical methods have been proposed for the treatment of inferior turbinate hypertrophy (ITH). Compared to other techniques, radiofrequency thermal ablation (RFTA) is supposed to be safer and more practical (2).
In this study, we aimed to compare the effectiveness of RFTA with those microdebrider-assisted inferior turbinoplasty (MAIT) along with a review of the current literature.

Methods

This prospective, randomized, and single-blind study was conducted by the Otorhinolaryngology Department of Karadeniz Technical University School of Medicine between September 2007 and June 2008. This study was performed after receiving approval from Karadeniz Technical University School of Medicine Institutional Review Board (2007/41). Forty patients suffering from nasal obstruction due to ITH unresponsive to topical steroids for at least 3 months were enrolled. Informed consent forms were taken from patients before surgery.

The diagnosis of ITH was confirmed by performing a physical examination. Patients with a septal deviation, a tumor, nasal polyposis, acute or chronic sinusitis, nasal valve problems, ciliary dysfunction, uncontrolled diabetes mellitus, or hypertension or those using systemic steroids were excluded. Subsequent to the nasal examination, anterior active rhinomanometry was performed before and after decongestion. Patients with decreased total nasal resistance (TNR) values and improvement in nasal

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patency after decongestion were enrolled. In total, 20 patients were operated by RFTA and 20 were operated by MAIT. Randomization was accomplished using the draw method.

For RFTA, a combination of lidocaine (1%) and epinephrine (1/100,000) was applied in both inferior turbinates under endoscopic guidance. The active tip of probe (10 mm) (Gyrus ENT Somnoplasty; Model 735000, Tokyo, Japan) was submucously introduced to the anterior, medial, and inferior portions of the inferior turbinate. An additional RFTA was performed for patients with hypertrophy of the posterior part of the turbinate (75°C, 8 W and 450 J total of 1350 J). When the mucosa began to whiten during application, the probe was extruded to minimize the mucosal injury. The operation time was less than 10 minutes on average and nasal packing was not required. Amoxicillin (500 mg per.os, three-times a day), paracetamol (500 mg p.o, three-times a day), and saline nasal irrigations were postoperatively administered. Patients were discharged on the same day of the operation.

In the MAIT group, after local anesthetic infiltration (1% lidocaine, 1/100,000 epinephrine) to the inferior turbinates, a 4–5-mm vertical incision was made through the anterior portion of the inferior turbinate using a number 15 scalpel. A submucosal tunnel was created medial to the conchal bone under endoscopic guidance. Four millimeters straightforward tru-cut microdebrider (XOMED Medtronic; Jacksonville, FL, USA) type rotating at 3000 rpm was inserted into the incision, and the submucosal tissue of the turbinate was trimmed out. During this procedure, bleeding was controlled with bipolar cautery, and particular attention was paid to preserve the mucosal flap. Incisions were not sutured. The operation time was less than 5 minutes for both sides. Nasal packing was routinely performed (Merocell; Medtronic, Jacksonville, FL, USA) for both sides for approximately 48 hours. All procedures were performed by the same surgeon (FA).

A symptomatic evaluation was made pre- and postoperatively in the first week and first and third months using a 10-cm visual analog scale (VAS). Inferior turbinate edema, secretion, and crusting were evaluated in the same time courses after surgery under endoscopic guidance. Rhinomanometry (Rhinostream SRE 2000; Rhinometrics, Lynge, Denmark) was used for the objective evaluation of nasal patency. Anterior active rhinomanometry (AARM) was performed at 24°C in the sitting position, and patients were allowed to rest for at least 30 minutes. Nasal resistance values were separately noted for both nasal cavities before decongestion and 10 minutes after decongestion. TNR values were calculated using a value of 150 Pascals as the reference point.

Nasal mucociliary transport was evaluated by the saccharin test performed preoperatively and postoperatively at the first week and first and third months. With patients in the upright, seated position, one quarter of the saccharin tablet (Sakarin tablet; Münir Şahin, İstanbul, Turkey) was placed on the anterior tip of the inferior turbinate, and the time required for the patient to feel a sweet taste was determined.

Statistical analysis

We used the Kolmogorov–Smirnov test to compare the TNR values between the groups. For normally distributed values, Student's t-test was used, whereas for variables that are not normally distributed, the Mann–Whitney U test was utilized. The time variant with normal distribution was evaluated with a post-hoc paired t-test in repeated measurements. Otherwise, Freidman analysis (post-hoc Wilcoxon test) was used. Qualitative data were compared with the chi-square test. A value of $p<0.05$ was accepted as the significance level.

Results

Twenty patients were operated by MAIT and 20 by RFTA. There was no statistically significant difference between the two groups in terms of age and gender ($p>0.05$).

In the MAIT group, nine patients were males and 11 were females. The patients' mean age was 31.20±11.31 years. In the RFTA group, 12 patients were males and eight were females. Their mean age was 33.10±14.20 years.

Nasal symptoms were assessed using the 10-cm VAS (Table 1). There was a statistically significant difference between the two groups in the first week and first and third month postoperative evaluations with respect to nasal obstruction and the frequency of obstruction ($p<0.05$).

There was no statistically significant difference between the two groups regarding the improvement of nasal discharge and sneezing. Nasal discharge and sneezing symptoms significantly improved in both groups postoperatively. There was a statistically significant decrease in headache and snoring symptom scores in the MAIT group compared to the preoperative values. However, in the RFTA group, this result was not observed. There was no statistically significant difference in relief between the MAIT and RFTA groups comparing the relief in using postnasal drip. Similarly, no postoperative improvement in postnasal drip was observed in both groups compared to the preoperative values (Table 1).

Total nasal resistance was assessed with anterior active rhinomanometry before and after decongestion (Table 2). Rhinomanometry test results showed a significant decrease in before-decongestion nasal resistance values in both surgical groups compared with the preoperative values. In contrast, compared to the after-decongestion values in the MAIT group there was a significant decrease between pre- and postoperative TNR values; however, the decrease in the RFTA group was not significant. Consequently, considering the decrease in TNR values, both techniques were effective, but neither technique was superior to the other.

Turbinate edema, secretions, and crusting were assessed preoperatively and at the first postoperative week and first and third postoperative months under endoscopic guidance. A four-point grading scale ranging from zero to three (0, absent; 1, mild; 2, moderate; and 3, severe) was used for this assessment (Table 3).

Table 1. Visual analog scale scores of patients with inferior turbinate hypertrophy

		Preop	1st Postop week	1st Postop month	3rd Postop month	p
Nasal obstruction	Microdebrider	6.69±1.67	2.50±1.46	2.45±2.68	1.96±1.83	0.0005
	Radiofrequency	5.99±1.60	6.02±2.42	4.45±1.92	4.69±2.14	0.007
	p	0.191	0.0005	0.010	0.0005	
Frequency of obstruction	Microdebrider	7.69±1.91	3.32±2.71	2.36±2.41	1.82±1.64	0.0005
	Radiofrequency	7.76±1.61	7.03±2.08	4.52±2.53	4.91±2.67	0.001
	p	0.908	0.0005	0.009	0.0005	
Nasal discharge	Microdebrider	3.23±3.12	2.25±2.66	1.90±2.13	1.41±1.48	0.026
	Radiofrequency	2.27±2.72	3.50±2.75	2.40±2.68	2.08±2.15	0.03
	p	0.307	0.153	0.515	0.256	
Sneezing	Microdebrider	4.17±3.31	3.13±3.20	2.43±2.46	1.85±2.06	0.007
	Radiofrequency	3.52±2.80	3.44±2.58	2.22±2.40	2.08±1.69	0.025
	p	0.507	0.738	0.792	0.696	
Headache	Microdebrider	3.94±3.41	1.41±1.68	1.39±2.06	0.81±1.22	0.002
	Radiofrequency	3.04±2.99	2.86±2.75	2.11±2.52	1.77±1.95	0.114
	p	0.384	0.51	0.330	0.072	
Snoring	Microdebrider	5.00±3.39	2.36±2.08	1.71±2.33	1.23±1.35	0.001
	Radiofrequency	3.07±3.53	2.45±3.04	1.97±3.01	1.87±2.24	0.089
	p	0.087	0.909	0.758	0.279	
Postnasal dripping	Microdebrider	4.94±3.02	3.81±2.75	2.92±2.93	2.60±2.35	0.071
	Radiofrequency	3.01±3.23	2.62±2.75	2.17±2.36	1.88±1.99	0.058
	p	0.059	0.178	0.379	0.300	

Turbinate edema significantly decreased in both groups after surgery. In the first postoperative week, there was a significant difference between the MAIT and RFTA groups; turbinate edema was larger in amount in the RFTA group. Similarly, there was a significant difference between the two groups according to secretion and crusting findings in the first postoperative week. Nasal secretion was more in the RFTA group, while crusting was more in the MAIT group. In both groups, turbinate edema and secretion findings significantly decreased in the postoperative period.

The nasal mucociliary transport time was evaluated preoperatively and at the first postoperative week and first and third postoperative months using the saccharin test (Table 4). Compared to the RFTA group, the mucociliary transport time was significantly prolonged in the first postoperative week and first postoperative month in the MAIT group. However, in the third postoperative month, there was no statistically significant difference between the two groups in the nasal mucociliary transport times.

Table 2. Total nasal resistance (TNR, Pa/cm^3/s) values

	Preop	Postop 3rd month	p
TNR (before decongestion)			
Microdebrider	0.34±0.18	0.24±0.06	0.021
Radiofrequency	0.28±0.07	0.25±0.06	0.001
p	0.213	0.618	
TNR (after decongestion)			
Microdebrider	0.20±0.03	0.18±0.03	0.0005
Radiofrequency	0.19±0.04	0.18±0.04	0.357
p	0.287	0.673	

Discussion

Inferior turbinate hypertrophy is usually observed in allergic rhinitis, vasomotor rhinitis, and septal deviation. Medical treatment with antihistamines, systemic decongestants, topical decongestants, or topical corticosteroids often provide only slight improvement, and patients often benefit from surgical reduction of the inferior turbinates (3). A variety of surgical techniques such as partial turbinectomy, turbinoplasty, submucosal turbinectomy, microdebrider submucosal resection, cryotherapy, submucous electrosurgery, and laser turbinectomy have been reported (4). An ultrasonic bone aspirator was used to manage the hypertrophic inferior turbinate caused by bone enlargement (5).

The ideal surgery for inferior turbinates should provide the least side effects and uneasiness and must protect physiological functions of the nose such as humidification and warming the inspired air. The main goal in turbinate surgery is reduction in the submucosal conchal volume while protecting mucosa (6). Variety in surgical methods reminds that there is no consensus for

Table 3. Endoscopic findings of inferior turbinates

		Preop	Postop 1st week	Postop 1st month	Postop 3rd month	p
Edema	Microdebrider	1.0 (0–2)	1.0 (0–2)	0.0 (0–2)	0.0 (0–1)	0.003
	Radiofrequency	0.0 (0–1)	2.0 (0–3)	0.0 (0–1)	0.0 (0-1)	0.0005
	p	0.077	0.001	0.919	0.435	
Secretion	Microdebrider	0.5 (0–2)	1.0 (0–2)	0.0 (0–1)	0.0 (0–1)	0.001
	Radiofrequency	0.0 (0–1)	1.0 (0–3)	0.0 (0–1)	0.0 (0–1)	0.0005
	p	0.294	0.005	0.727	0.382	
Crusting	Microdebrider	0.0 (0–1)	2.0 (0–3)	1.0 (0–2)	0.0 (0–2)	0.0005
	Radiofrequency	0.0 (0-0)	1.0 (0–2)	0.0 (0–2)	0.0 (0-0)	0.0005
	p	0.317	0.011	0.142	0.152	

Table 4. Mucociliary transport time measures (minutes)

Saccharin test	Preop	Postop 1st week	Postop 1st month	Postop 3rd month	p
Microdebrider	15.1±5.4	23.4±5.8	19.6±4.2	15.9±3.9	0.0005
Radiofrequency	14.3±5.7	14.3±5.1	16.0±5.4	15.7±4.2	0.028
p	0.673	0.0005	0.024	0.909	

the optimal surgical technique (7). Recently, RFTA and MAIT are more popularized since these minimal invasive procedures protect the mucosa.

Radiofrequency thermal ablation is a reliable method that can be performed even in office settings. However, relapses are likely to occur in the long-term follow-up, similar to other techniques of inferior turbinate surgery. In RFTA, the principle is to transfer low-frequency energy into the submucosa by a specially designed electrode. The transferred energy triggers an ionic agitation in the tissue and causes a temperature rise, thus forming a thermal lesion in the submucosa. During the healing period, contraction of tissues due to fibrosis leads to a decrease in the total volume of the turbinate (8). The reduction in turbinate volume can be considered to be inadequate by a radiofrequency electrode with a 10-mm long active portion in cases of a severely hypertrophied inferior turbinate head. Similarly, in cases of hypertrophy of both the submucosa and the conchal bone, reduction can be thought to be inadequate. However, it is obvious that the inferior turbinate volume can be reduced to the desired amount by a microdebrider under endoscopic vision, irrespective of whether the submucosal or bony turbinate hypertrophy exists. In our study, the insignificance between post and pre-operative after-decongestion TNR values in the RFTA group can be explained by the ineffectiveness of RFTA in bony turbinate hypertrophy.

It has been shown in several studies that RFTA decreases the severity and frequency of nasal obstruction in 81–100% of cases by reducing the turbinate volume (2, 9, 10). Li et al. (2) used this technique in 22 patients who had not previously benefited from any medical therapy and reported a 58.5% decrease in nasal obstruction in 21 patients at the end of the second postoperative month. In a similar study, the nasal breathing of 100% of patients improved after 2 months (9). The long-term results of RFTA were first reported in 2006. This prospective, randomized, single-blind, and placebo-controlled trial showed that RFTA was efficient in the management of ITH in the long term as well (8). A study applied monopolar and bipolar RFTA to 150 patients and concluded that both techniques were effective and that there was no significant difference in the third and 20th postoperative months regarding the recurrence of symptoms (11).

An array of adverse effects not termed as complications were reported in RFTA (8-10). Nasal obstruction experienced in the first postoperative week is common, but it regresses over time. Similarly, in our study, a significant increase in symptoms due to nasal obstruction was noted in the first postoperative week, but later, a decrease was observed. Mild pain that can be relieved by analgesics is usually encountered. Faintness during RFTA has been reported in the literature (8). Another adverse effect reported in the literature is numbness in the maxillary teeth (8, 11). In our study, no adverse effects other than mild postoperative pain, nasal congestion, and crusting were observed.

Radiofrequency thermal ablation is advantageous as it is a minimally invasive method that can be performed in office settings. The operation time is short, and nasal dressing is not required. Thermal injury is less when compared to laser and cautery. Postoperative crusting is minimal, and usually, routine nasal care is not required. It takes a shorter time for the patient to return home and work (9, 10, 12). We found that the differences between the two groups in relation to secretion and crusting in the first postoperative month were significant. Secretion was found to be more prevalent in the RFTA group, whereas crusting was higher in the MAIT group. In both groups, conchal edema and secretion were found to be significantly decreased in the third postoperative month.

In the literature, there are comparative studies on the effects of RFTA on mucociliary transport. Surgical procedures used in the treatment of ITH can cause mucosal damage (13). The saccharin test is one of the various methods that have been used to assess mucosal damage in the literature. In our study, the saccharin test was used to investigate the effect of RFTA and MAIT on mucociliary transport.

It was proposed that the saccharin test is a useful method in evaluating the effectiveness of nasal mucociliary transport because of its simplicity and reproducibility (14). In our study, we detected a significantly prolonged interval between preoperative mucociliary transport time (MCTT) and first postoperative week and month MCTT after MAIT. However, there was no significant difference between the preoperative and third postoperative month MCTT. The elongation observed in the first postoperative week and first postoperative month was probably due to the mucosal damage of the inferior turbinate caused by the end of microdebrider. After the operation, first week and first month, MCTT in microdebrider group was significantly longer than radiofrequency group. This was similar to the literature, suggesting that RFTA causes less damage to the mucosa. Studies evaluating the mucosal changes in the early postoperative period after RFTA showed the presence of intact ciliated cells having normal-frequency beats in the surface epithelium even in the first postoperative week. (15). Duran and Ulkü (16) showed that mucociliary transport time did not significantly change after RFTA. In another study studying the late effects of thermal ablation on nasal mucosa, ciliated cells and goblet cells of the epithelium were seen to be intact on transmission electron microscopy 1 year after the operation (13). In our study, preoperative mucociliary transport times measured before the operation were not prolonged at the end of the three follow-up periods.

There are reports regarding the effects of radiofrequency on symptoms other than nasal obstruction such as the management of rhinorrhea, sneezing, and itching of the nose and eyes (17). Because the submucosal layer is considered as the active zone where allergic reactions take place, it is supposed that rhinorrhea and congestion reduce due to the resultant decrease in the contact area for allergens, the destruction of submucosal glands, and the obliteration of small vessels due to scar formation (18). Because the local immune responses and histochemical mediators are inhibited, symptoms of itching and sneezing are expected to heal. However, further research is needed. In our, study runny nose and sneezing symptoms were identified in both groups statistically with a significant reduction during the postoperative evaluation. Patients with the hypertrophic turbinate bone covered with thin mucosa are not ideal candidate for microdebrider-assisted submucosal resection, where mucosal protection is intended. Because thick, calcified bone is hard to debridate, mucosal tears may occur (19-21). This handicap can be overcome either using smaller diameter debrider ends or new tips delivered for protecting the medial mucosal flap. RFTA is not effective in bone hypertrophy. In our RFTA group, bone hypertrophy accompanying submucosal hypertrophy can be the reason for the insignificant decrease in rhinomanometry results.

There are various subjective methods evaluating nasal passage. However, objective methods are needed. Rhinomanometry was defined as an objective method evaluating nasal passage. Mc Caffry et al. (22) showed that there is a positive correlation between nasal resistance and symptoms of nasal obstruction in a study including 1000 patients suffering from chronic rhinitis. Huang and Cheng (23) reported a significant decrease in nasal resistance in patients at the end of the first year after endoscopic MAIT. Chen et al. (24) also reported a significant decrease in nasal resistance in 160 patients who had concha submucosal resection and MAIT one and three years respectively after the surgery. Our study had similar results about decreasing nasal resistance with both surgical methods. In conclusion, in terms of reducing nasal resistance, both methods were successful, but neither was superior over the other (25, 26).

In rhinology, rhinomanometry is valuable in understanding the reasons of increased or decreased nasal complaints for post-operative patients. Rhinomanometry has scientific value in terms of "evaluating impacts of certain surgical techniques" (27, 28). In our study, rhinomanometry results were statistically significant before and after surgery. In addition, patient satisfaction was higher in those with significant reduction in the nasal resistance of the obstructed side after septum and turbinate surgery.

Conclusion

Both RFTA and MAIT seem to be effective techniques in the treatment of inferior turbinate hypertrophies. The treatment modality should be individually determined, and parameters such as tissue healing, volume reduction, and mucociliary activity must be taken into account.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Karadeniz Technical University (2007/41).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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