Original Article / Çalışma - Araştırma

Comparison of the effects of radiofrequency ablation and microdebrider reduction on nasal physiology in lower turbinate surgery

Alt konka cerrahisinde radyofrekans ablasyon ile mikrodebrider redüksiyonunun burun fizyolojisi üzerine etkilerinin karşılaştırılması

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ABSTRACT

Objectives: This study aims to compare the effects of radiofrequency ablation and microdebrider reduction in lower turbinate surgery on nasal physiology.

Patients and Methods: Between January 2009 and March 2010, 40 patients with the complaint of nasal obstruction, who were diagnosed with lower turbinate hypertrophy, were randomly assigned into two groups to undergo either radiofrequency (group 1, n=20) or microdebrider (group 2, n=20) treatments. Nasal obstruction, the grade of turbinate hypertrophy and other symptoms were evaluated with subjective nasal obstruction scale and anterior rhinoscopy before the operation, and three days, seven days, four weeks, and eight weeks after the surgical intervention.

Results: The patients in group 2 had a significantly greater symptomatic improvement based on subjective nasal obstruction scale (SNOS) scores than the patients in group 1 ($p<0.01$). Acoustic rhinometry (ARM) measurements without decongestant application showed significant increase in postoperative MCA2 (Minimum Cross-sectional Area/cm^2 2) and Vol 2 (Volume/cm^3 2) ($p<0.01$), while there was no significant change in MCA1 (Minimum Cross-sectional Area/cm^2 1) and Vol 1 (Volume/cm^3 1). There was no statistically significant difference between the two groups with respect to ARM and anterior rhinoscopy (AnR) parameters ($p>0.05$).

Conclusion: Based on these results, both radiofrequency ablation and microdebrider reduction may be considered as minimally invasive, straightforward, and reliable methods that provide sufficient airway passage without disruption of the nasal physiology.

Keywords: Acoustic rhinometry; lower turbinate surgery; microdebrider; radiofrequency.

ÖZ

Amaç: Bu çalışmada alt konka cerrahisinde radyofrekans ablasyon ve mikrodebrider redüksiyon yöntemlerinin nazal fizyoloji üzerine etkileri karşılaştırıldı.

Hastalar ve Yöntemler: Ocak 2009 ve Mart 2010 tarihleri arasında alt konka hipertrofisi tanısı konulmuş ve burun tıkanıklığı yakınması olan 40 hasta randomize olarak radyofrekans (grup 1, n=20) ya da mikrodebrider (grup 2, n=20) ile tedavi edilmek üzere iki gruba ayrıldı. Burun tıkanıklığı, alt konka hipertrofisinin derecesi ve diğer semptomlar subjektif burun tıkanıklığı skalası ve anterior rinoskopi ile ameliyat öncesi ve cerrahi girişim sonrasındaki üçüncü gün, yedinci gün, dördüncü hafta ve sekizinci haftalarda incelendi.

Bulgular: Subjektif nazal obstrüksiyon ölçeği (SNOS) skorlarına dayanarak grup 2'deki hastalarda grup 1'deki hastalardan daha fazla semptomatik iyileşme vardı ($p<0.01$). Dekonjestan uygulamadan yapılan akustik rinometri (ARM) ölçümlerinde, ameliyat sonrası MCA1 (Minimum Kesitsel Alan/cm^2 1) ve Vol 1 (Hacim/cm^3 1)'de önemli değişiklikler olmazken MCA2 (Minimum Kesitsel Alan/cm^2 2) ve Vol 2 (Hacim/cm^3 2)'de belirgin artış görüldü ($p<0.01$). Akustik rinometri ve anterior rinoskopi (AnR) parametreleri ile ilişkili olarak iki grup arasında istatistiksel olarak anlamlı bir farklılık yoktu ($p>0.05$).

Sonuç: Nazal fizyolojiyi bozmadan yeterli havayolu pasajı sağlayan radyofrekans ablasyon ve mikrodebrider redüksiyon yöntemlerinin her ikisinin sonuçlarına dayanılarak; bu yöntemler minimal invaziv, kolay anlaşılır ve emniyetli yöntemler olarak kabul edilebilir.

Anahtar Sözcükler: Akustik rinometri; alt konka cerrahisi; mikrodebrider; radyofrekans.

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Chronic nasal obstruction is a very common complaint caused by numerous disorders and lower turbinate hypertrophy is one of the most common causes that lead to chronic nasal obstruction. The lower turbinates are respiratory epithelium lined structures attached to the lateral nasal wall with a bony structure inside. They play a role in adjusting the temperature of the respired air and its humidification, and filtering of the particles.[1] Turbinate hypertrophy results in various symptoms including nasal obstruction, mouth breathing, dryness in the mouth and pharynx, uncomfortable sleep, snoring and sleep apnea.[2]

Acoustic rhinometry (ARM) is a method that can measure the volume of the nasal cavity and detect the site and severity of nasal obstruction by sending acoustic signals to the nasal cavity and analyzing the severity, phase, and delay times of the signals reflected back.[3] It is currently a popular method for determining the location and level of nasal pathologies, and also for objective measurement of the effects and efficacies of medical and surgical treatments.[4]

Surgical treatment may be an option in the management of lower turbinate hypertrophies when medical treatment has failed. The various methods that have been used include turbinectomy, submucous turbinectomy, cryotherapy, radiofrequency turbinoplasty, turbinectomy with microdebrider, vidian neurectomy, potassium titanyl phosphate (KTP) laser turbinoplasty, and CO_2 laser turbinoplasty.[1]

Radiofrequency ablation (RfA) uses heat energy generated from radiofrequencies to induce ionic movement in the tissue. In time, the area surrounding the submucosal necrosis is replaced by fibroblasts. Wound contraction with fibrosis leads to a decrease in submucosal volume. This condition results in a decrease in submucosal volume, and nasal obstruction is decreased without injury to the mucosa that covers the turbinates.[5]

Microdebrider turbinate reduction (MdR) is another surgical method used in turbinate hypertrophies. In ideal turbinate surgery, reduction of both the erectile submucosal tissue and the bony turbinate should be targeted, while preserving turbinate integrity and function. Microdebrider turbinate reduction preserves turbinate integrity and causes less injury to the mucosa with acceptable morbidity rates.[1]

The aim of this study is to analyze the symptoms of nasal obstruction, nasal passage and physiology by using subjective nasal obstruction scale (SNOS), ARM, anterior rhinoscopy (AnR) before and after RfA and MdR techniques, and to compare the postoperative outcomes of both methods.

PATIENTS AND METHODS

This prospective randomized study was carried out in a tertiary referral center that was approved by the local ethics committee with an approval number of 56/G. All patients received detailed information prior to surgery, and written consents were obtained. The study was conducted in accordance with the principles of the Declaration of Helsinki. Forty patients (20 males, 20 females; mean age 38.65±13.56 years; range 17 to 64 years) who presented to our ear nose and throat (ENT) clinic with chronic nasal obstruction symptoms and diagnosed with lower turbinate hypertrophy were included into the study. Including the right and the left sides of lower turbinates in all patients, a total of 80 lower turbinates were operated. Patients with other possible causes for nasal obstruction, including chronic sinusitis, nasal polyposis, septal deviation, and concha bullosa, were excluded. The underlying cause of obstruction was allergic rhinitis in 12 patients, and chronic hypertrophic rhinitis in 28 patients.

A patient assessment form was prepared prior to the study to record the patients' personal information, habits, overall health status, and symptoms. SNOS (none-0, mild-1, moderate-2, severe-3, and total-4) was used for subjective assessment of nasal obstruction. In order to measure the grade of turbinate hypertrophy, the patients were also evaluated with AnR before the operation and at postoperative visits. The sizes of the turbinates were classified as grade I-III. In grade I, the turbinates were not hypertrophic and the nasal passage was patent; in grade II, the turbinates were mildly hypertrophic and caused nasal obstruction, yet they did not totally occlude the nasal passage; in grade III, the nasal passage was totally obstructed due to turbinate hypertrophy.

Acoustic rhinometry measurements were carried out with Rhinostream SRE 2000

(Interacoustics A/S, Drejervaenget 8 DK-5610, Assens, Denmark) equipment. The measurements were separately made by the same observer on both nasal passages, before and after the application of decongestant. Acoustic rhinometry measurements of both nasal cavities were also performed in all patients before the operation and eight weeks after. Mean values for MCA (Minimum cross sectional area/cm^2) and Vol (Volume/cm^3) were measured with ARM, at 0.00-2.20 cm (described as MCA1-Vol 1) and 2.20-5.40 cm (described as MCA2-Vol 2) of the nasal passage.

The 40 patients included into the study were randomly separated into two groups. In group 1 there were 9 males and 11 females, mean age was 40.55±7.4. In group 2 there were 11 males and 9 females, mean age was 36.75±6.20. The lower turbinates were treated with RfA in group 1, and MdR in group 2. All operations were performed in a single session, under local anesthesia and while the patient was in semi-sitting position.

Radiofrequency ablation was applied via an Ellman Surgitron FFPF EMC (Elman International Inc., Hewlett, NY, USA) generator. The active part of the device was placed into the turbinate while the protective part was kept in sight. In coagulation mode and power setting at 3.5 (17 watt), radiofrequency was applied to the upper, middle, and lower parts of the turbinate until blanching of the mucosa was observed or the device gave an acoustic warning (average 20 seconds). No nasal packing was applied. Cotton pledges soaked in adrenaline and saline were placed into the nasal cavities for 10 minutes in order to prevent possible postoperative bleeding. After the procedure, the patients were observed for five minutes in the recovery room, and then transferred to the floor. Patients without any complications were discharged approximately one hour after the procedure.

Microdebrider turbinate reduction was performed with the XPS 3000 Microdebrider (XOMED Medtronic, Jacksonville, FL, USA) device. Approximately four milliliters of prilocaine was applied submucosally to the lower turbinate, tumefying the turbinate medially. A vertical incision was made with a number 15 blade on the caudal edge of the lower turbinate. The medial aspect of the bony turbinate was exposed, a sharp dissection was performed on this plane beginning from the anterior part and advancing posteriorly. A submucosal pocket was formed. The microdebrider (XOMED Medtronic 2.9 mm inferior turbinate blade) was placed into this pocket, and submucosal tissues were debrided. The microdebrider was used in 3000 rpm mode. Care was taken to avoid injury to the mucosa. The cavity left after debridement was inspected with a 0° rigid endoscope (Karl Storz GmbH & Co. KG, Tuttlingen, Germany). Without closing the incision, the turbinate mucosa was lateralized with an elevator and approximated to the turbinate bone. Finally, anterior nasal packing was applied. Patients without any complications were sent home on the same day. The nasal packing was removed 48 hours after the surgical intervention. Antibiotics, decongestants, and analgesics (Co-trimoxazole 1 g tablet bid, cetirizine-pseudoephedrine tablet bid, dexketoprofen tablet bid) were prescribed to all patients. Also, nasal lavage with isotonic ringer's solution (Sioswo nasal spray) three times a day for 10 days, was initiated.

The patients were scheduled for follow-up on postoperative days 3 and 7, and weeks 4 and 8. During each visit, turbinate size (grade I-III) was evaluated, and nasal obstruction was assessed with SNOS. On the eighth week visit, acoustic rhinometry was performed in addition to these tests, before and after application of decongestant.

The statistical analyses of the results were performed with NCSS (Number Cruncher Statistical System) 2007 and PASS 2008 statistical software (Utah, USA). While evaluating the data, in addition to complementary statistical methods, Student t-test, Mann-Whitney U test, paired sample t-test, and Wilcoxon sign test were used for qualitative data. Quantitative data were compared with chi-square test. Level of significance was set at $p<0.05$.

RESULTS

There was no statistically significant difference between the two groups with respect to age and sex ($p>0.05$). Preoperative subjective nasal obstruction scores also did not show a significant difference (Table 1). Compared to preoperative measurements, SNOS scores in group 1 showed a mean increase of 0.72±0.75 units on postoperative

Table 1. Subjective nasal obstruction scale assessment according to the groups

	Group 1	Group 2	
	Mean±SD	Mean±SD	*p*
Preoperative	2.62±0.62	2.75±0.70	0.652
Postoperative day 3	3.35±0.80	1.37±0.70	0.001*
Postoperative day 7	2.60±0.84	0.90±0.70	0.001*
Postoperative week 4	1.75±0.83	0.67±0.61	0.001*
Postoperative week 8	1.05±0.63	0.65±0.62	0.005*

SD: Standard deviation; Student t-test was used Wilcoxon signed rank test; * p<0.01.

day 3, which was significant (p<0.01), whereas the changes on postoperative day 7 were not significant (p>0.05). On postoperative weeks 4 and 8, mean decreases in SNOS scores were 0.87±0.91 and 1.57±0.71, respectively. These results were highly statistically significant (p<0.01) (Table 1). Compared to the preoperative values, SNOS scores In group 2 showed a mean decrease of 1.37±0.92 units on day 3, 1.85±0.97 on day 7, 2.07±0.97 on week 4, and 2.10±1.01 on week 8; all of these changes were statistically highly significant (p<0.01) (Table 1). SNOS measurements were lower in group 2 at all assessment times (p<0.01) (Table 1). Although nasal obstruction decreased in both groups, the improvement attained in group 2 was found to be more effective according to the subjective evaluation (Table 1).

Based on the physician assessment with AnR, both groups showed a highly significant decrease in postoperative turbinate grades (p<0.01). In group 1, before the operation 42.5% of the patients had grade II and 57.5% had grade III hypertrophy, and on postoperative week 8, 87.5% of them had grade I, and 12.5% had grade II turbinate hypertrophy (Table 2). In group 2, before the operation 50% had grade II, 50% had grade III turbinate hypertrophy, and on postoperative week 8 97.5% had grade I, 2.5% had grade II turbinate hypertrophy (Table 2). There were no statistically significant differences between the two groups with respect to preoperative and postoperative turbinate hypertrophy grades (p>0.05).

Subjective assessment was performed by both the physician (AnR) and the patient (SNOS). In both groups, there were significant decreases in the turbinate grades and the patients' nasal obstruction symptoms 8 weeks after the operation (Figure 1).

According to the ARM performed for objective evaluation, the changes in MCA1 and Vol 1 levels, which show the nasal isthmus of the nose at 0.00-2.20 cm, were not statistically significant (p>0.05). In MCA2 and Vol 2 levels that show the 2.20-5.40 cm 'lower turbinate' levels of the nose, comparison of the preoperative before decongestant

Table 2. Assessment of turbinate hypertrophy in the groups with anterior rhinoscopy

	Group 1		Group 2		
Turbinate grade on AnR	n	%	n	%	*p**
Preoperative					
Grade I	17	42.5	20	50.0	0.501
Grade II	23	57.5	20	50.0	
Postoperative (week 8)					
Grade I	35	87.5	39	97.5	0.201
Grade II	5	12.5	1	2.5	

AnR: Anterior rhinoscopy; Chi square test † Wilcoxon signed rank test * p<0.01.

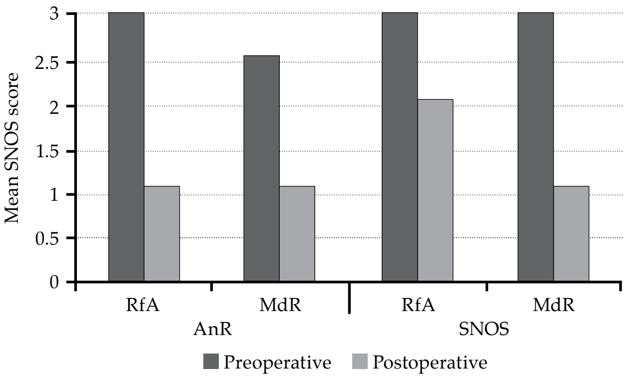

Figure 1. *The distribution of turbinate grades according to anterior rhinoscopy (preoperative-postoperative 8th week) and subjective nasal obstruction scale (preoperative-postoperative 8th week). RfA: Radiofrequency ablation; AnR: Anterior rhinoscopy; MdR: Microdebrider turbinate reduction; SNOS: Subjective nasal obstruction scale.*

versus postoperative before decongestant measurements showed mean increases of 0.24±0.19 and 2.79±1.98 units respectively in group 1, and 0.25±0.18 and 2.20±1.11 units respectively in group 2. These changes between preoperative and postoperative values were statistically highly significant within each group ($p<0.01$) (Table 3). The changes in MCA2 and Vol 2 grades measured as preoperative after decongestant versus postoperative after decongestant, and preoperative after decongestant versus postoperative before decongestant, were not statistically significant ($p>0.05$) (Figure 2, and Figure 3). There were no significant differences between the two groups with respect to preoperative and postoperative MCA2/Vol 2 values (Table 3).

There were no major complications in either group. In group 1, 10 patients (50%) had mild degree of pain during the surgery and for the following three days. Slight bleeding from the injection sites was observed during the operation. None of the patients experienced any bleeding that would require packing. In eight patients (40%) crusting occurred especially in the probe entry sites. In two of these eight patients (10%), crusting continued for two more weeks. In one patient (5%), crusting persisted after eight weeks, along with necrosis of the turbinate bone and resultant purulent discharge. This patient healed completely with antibiotic treatment and frequent dressing changes. In group 2, four patients (20%) had bleeding, seven (35%) had mucosal tear, and six (30%) had crusting. The bleeding stopped easily with standard anterior packing. None of the patients had persistent hemorrhage, crusting, synechia, or loss of mucosal tissue. Overall, compared to RfA complication rates were higher with MdR.

Table 3. Minimum cross-sectional area 2 and volume 2 evaluations according to the groups

	Group 1	Group 2	
	Mean±SD	Mean±SD	*p**
MCA2			
Preoperative			
Predecongestant	0.40±0.16	0.48±0.22	0.082
Postdecongestant	0.68±0.25	0.76±0.27	0.139
Postoperative (week 8)			
Predecongestant	0.67±0.25	0.75±0.26	0.133
Postdecongestant	0.69±0.24	0.78±0.27	0.110
Volume 2			
Preoperative			
Predecongestant	3.90±1.54	3.70±1.32	0.536
Postdecongestant	6.83±2.59	6.04±1.42	0.094
Postoperative (week 8)			
Predecongestant	6.74±2.58	6.17±1.28	0.177
Postdecongestant	6.75±2.83	6.27±1.20	0.325

SD: Standard deviation; MCA2: Minimum cross-sectional area 2; Student t test was used bPaired samples t test; * p<0.01.

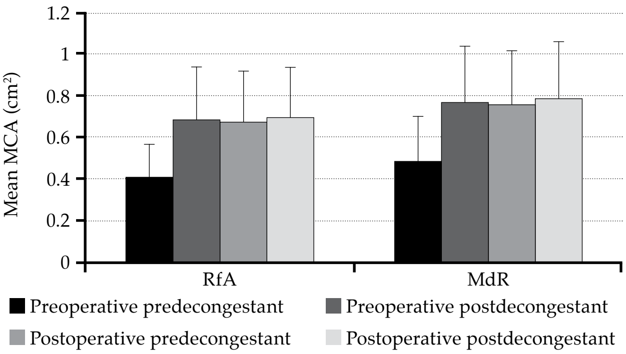

Figure 2. *The distribution of minimum cross-sectional area 2 according to groups. MCA: Minimum cross sectional area; RfA: Radiofrequency ablation; MdR: Microdebrider turbinate reduction.*

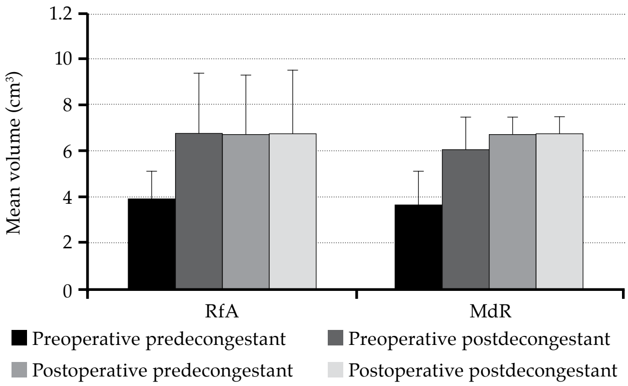

Figure 3. *The distribution of volume 2 according to groups. RfA: Radiofrequency ablation; MdR: Microdebrider turbinate reduction.*

DISCUSSION

The use of radiofrequency for the management of nasal obstruction caused by lower turbinate hypertrophy has become increasingly popular after its first application by Li et al.[6] Histologic studies showed that thermal ablation causes submucosal fibrosis and tissue hardening, and thereby subsequent volume reduction. Histologically, the entry site of the electrode heals within 24-48 hours and submucosal healing takes 3-8 weeks.[7]

Although MdR is a relatively novel technique, it is used extensively in the ENT field. It was first used by Yanez[8] on lower turbinate hypertrophies. Microdebrider turbinate reduction can be applied to the lower turbinate internally, externally, or both. In internal application, soft tissue is excised by moving the probe inserted into the submucosal pocket. In external application, the hypertrophic or degenerated mucosa on the middle aspect of the turbinate is removed by excision. All applications are performed under control with endoscopic vision to cause minimal mucosal injury. Lorenz and Maier[9] reported that Microdebrider-assisted inferior turbinoplasty is a minimally invasive method for reducing inferior turbinate size and maintaining mucosal integrity. It has the advantages of short healing time, only a mild decrease in mucociliary clearance, only minor postoperative problems, and a good functional outcome.

This study compared these two methods. Although nasal obstruction symptoms decreased significantly after the operation in both groups, the symptoms worsened initially on the third postoperative day in group 1. This was considered to be due to edema and congestion during the early period after surgery. Li et al.[10] reported that slight edema was seen during the first 24-48 hours following radiofrequency, which resulted in a temporary increase in nasal obstruction symptoms. Our findings showed that the reduction in the size of the turbinates began after the first week, and continued until the eighth week in group 1, on the other hand, symptoms decreased beginning from the first postoperative control in group 2. Cingi et al.[11] compared the microdebrider and radiofrequency methods, and found that severity of nasal obstruction grades improved significantly during the first week after the operation, in the microdebrider group. However, a statistically significant improvement in nasal obstruction grades was only observed during the first month after the operation in the radiofrequency group. This was presumed to be due to the absence of congestion and edema in MdR, which are otherwise seen after RfA by the thermal effect. Submucosal excision of the hypertrophed tissues, and reduction of the turbinate laterally by anterior packing may have also contributed. Lee and Lee[12] reported that there were no differences between the two groups at three and six months after the operation. However on the postoperative 12th month, there was higher patient satisfaction in the MdR group. In a study by Vijay et al.[13] all the preoperative symptoms were significantly improved up to six months in group RfA as well as group MdR, but there were three cases of recurrence at sixth months of postoperative period in group RfA. They recommend MdR in view of long-term symptom relief and lesser recurrence.

Comparison of preoperative and postoperative AnR results were significant within each group ($p<0.01$). Intergroup comparison showed that the results were too close and the differences were insignificant ($p>0.05$).

In acoustic rhinometry measurements, MCA1 and Vol 1 values showed that the first 0.00-2.20 cm of the nasal passage was not affected significantly from radiofrequency or microdebrider treatments. This could be due to the slight effect on the mucosa by the decongestant and/or its affection from turbinate decongestion only minimally. In a study by Chih-Wen et al.,[14] after decongestant application the MCA1 values increased by 5%, and MCA2 by 85%.

The main effects of RfA and MdR observed on MCA2 and Vol 2 measurements represented that the inferior turbinate level in the nose was between 2.20-5.40 cm. The postoperative increases in decongestant free measurements showed that patients benefited from RfA and MdR. The lack of difference in decongestant measurements suggested that maximal drug dependent size reduction had been attained, and the applications did not provide further reduction. Values attained with preoperative decongestant drugs were measured without the use of postoperative decongestant. RfA and MdR surgery eliminated the patients' topical decongestant needs and the possible 'rhinitis medicamentosa' risk. Bäck et al.[15] evaluated the outcomes of RfA by ARM, and found that there was a clear increase in postoperative nasal volume, also there were no differences between preoperative and postoperative vasoconstrictor effect.

Kızılkaya et al.[16] compared RF with microdebrider with respect to efficacy of the method and mucosal integrity. Their results showed that RF surgery was as effective as microdebrider in decreasing nasal obstruction, and it also preserved nasal functions. Lee and Lee[12] reported that long-term results of microdebrider were more effective and satisfactory, and ARM results were found to be significantly better in the microdebrider group. In a study by Liu et al.,[17] MdR was more effective than RfA at relieving nasal symptoms and decreasing total nasal resistance and saccharin transit time one to three years postoperatively in patients with persistent allergic rhinitis and who had substantial nasal obstruction. In our study there were no statistically significant differences between the two groups with respect to ARM and AnR parameters, on the other hand the improvement attained in the MdR group was found to be more effective according to subjective evaluation (SNOS).

Microdebrider turbinate reduction had higher complication rates than RfA. Radiofrequency applied in coagulation mode controls both the intraoperative and the postoperative hemorrhage, and obviates the need for additional nasal packing. It is less invasive, and causes minimal mucosal injury and crusting. The need for packing in MdR for control of hemorrhage and closure of the submucosal dead space decreases postoperative patient comfort, and prolongs hospitalization. The higher rate of complications in MdR suggested that it is a more invasive and demanding procedure, therefore requires greater physician experience. The lack of any major complications with both techniques, preservation of mucosal integrity and nasal physiology were satisfactory with respect to efficacy and reliability. Lee and Lee[12] compared the microdebrider and radiofrequency methods, and found that there were no differences with respect to operation time, crusting, postnasal discharge, and bleeding. Vijay et al.[13] reported that in group MdR, there was some accidental mucosal tear leading to postoperative complication like postoperative bleeding, synechia or mucosal adhesion, but there was no statistically significant difference with the RfA group.

In conclusion, RfA and MdR were effective and reliable surgical methods in the management of lower turbinate hypertrophies. They were successful in treating nasal obstruction without compromising nasal functions and mucosal integrity, and they have low morbidity and complication rates, are minimally invasive, and easily performed under local anesthesia. Maximum gain was achieved in all patients without a major complication, and the health qualities of the patients were increased. The results of our study are consistent with others, and the efficacy of both methods has been demonstrated.

Declaration of conflicting interests

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