ORIGINAL ARTICLE

Effects of turbinoplasty versus outfracture and bipolar cautery on the compensatory inferior turbinate hypertrophy in septoplasty patients

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Received 20 December 2017; accepted 17 April 2018
Available online 18 May 2018

Abstract

Introduction: The most common cause of septoplasty failure is inferior turbinate hypertrophy that is not treated properly. Several techniques have been described to date: total or partial turbinectomy, submucosal resection (surgical or with a microdebrider), with turbinate outfracture being some of those.

Objective: In this study, we compared the pre- and postoperative lower turbinate volumes using computed tomography in patients who had undergone septoplasty and compensatory lower turbinate turbinoplasty with those treated with outfracture and bipolar cautery.

Methods: This retrospective study enrolled 66 patients (37 men, 29 women) who were admitted to our otorhinolaryngology clinic between 2010 and 2017 because of nasal obstruction and who were operated on for nasal septum deviation. The patients who underwent turbinoplasty due to compensatory lower turbinate hypertrophy were the turbinoplasty group; Outfracture and bipolar cauteration were separated as the out fracture group. Compensatory lower turbinate volumes of all patients participating in the study (mean age 34.0 ± 12.4 years, range 17–61 years) were assessed by preoperative and postoperative 2 month coronal and axial plane paranasal computed tomography.

KEYWORDS

Turbinate;
Hypertrophy;
Outfracture;
Turbinoplasty

Please cite this article as: Bozan A, Erış HN, Dizdar D, Göde S, Taşdelen B, Alpay HC. Effects of turbinoplasty versus outfracture and bipolar cautery on the compensatory inferior turbinate hypertrophy in septoplasty patients. Braz J Otorhinolaryngol. 2019;85:565–70.

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Peer Review under the responsibility of Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial.

https://doi.org/10.1016/j.bjorl.2018.04.010
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Results: The transverse and longitudinal dimensions of the postoperative turbinate group were significantly lower than those of the out-fracture group \((p=0.004)\). In both groups the lower turbinate volumes were significantly decreased \((p=0.002, p<0.001)\) in order. The postoperative volume of the turbinate on the deviated side of the patients was significantly increased: turbinoplasty group \((p=0.033)\).

Conclusion: Both turbinoplasty and outfracture are effective volume-reduction techniques. However, the turbinoplasty method results in more reduction of the lower turbinate volume than outfracture and bipolar cauteterization.

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**Introduction**

The most common cause of chronic nasal obstruction is septum deviation and lower turbinate pathologies.\(^1\) Inferior turbinate hypertrophy is frequently seen in allergic rhinitis, vasomotor rhinitis, and as compensatory hypertrophy in septum deviation. Lower turbinate hypertrophy on the concave side of the nasal septum is called compensatory hypertrophy.\(^2\) The most common cause of septoplasty failure is inferior turbinate hypertrophy that is not treated properly.\(^3\) Several techniques have been described to date: total or partial turbinectomy, submucosal resection (surgical or with a microdebrider), outfracture, electrocautery, radiofrequency application, argon plasma treatment, and cryosurgery.\(^4\)

None of the turbinate surgical techniques performed with or without septoplasty are perfect. Short- and long-term complications, such as bleeding, bruising, and atrophy, are frequent.\(^5\) Ideally, turbinate surgery should be done without damaging the mucosal surface. This ensures preservation of normal lower turbinate function, rapid healing, and inhibition of atrophic rhinitis.\(^6\) Despite the increasing number of lower turbinate surgical procedures, turbinoplasty, outfracture, and bipolar cautery methods have been used frequently for the last three decades.\(^7\) Turbinoplasty is more difficult and has a higher complication rate than the
outfracture method, despite its high success rate. Lower
 turinate outfracture and bipolar cautery can be
 applied in the same order and more quickly.8

In this study, we compared the pre- and postoperative
lower turbinate volumes using computed tomography (CT)
in patients who had undergone septoplasty and compens-
satory lower turbinate turbinoplasty with those treated with
outfracture and bipolar cauteryization.

Methods

Patient selection

This retrospective study enrolled 66 patients (37 men, 29
women) who were admitted to our otolaryngology
clinic between 2010 and 2017 because of nasal obstruction
and who were operated on for nasal septum deviation. CT
showed septum deviation and contralateral compensatory
lower turbinate hypertrophy. The patients were divided
into two groups. The turbinoplasty group included patients
who underwent septoplasty and turbinoplasty; the outfrac-
ture group underwent septoplasty with compensatory lower
turbinate outfracture and bipolar cauteryization.

Patients with maxillofacial trauma, paranasal sinus
infections, nasal polyps, septal perforations, acute or chronic
rhinosinusitis, type nasal septum deviation, turbinate bul-
losa, or previous nasal or paranasal surgery were excluded
from the study. Ethics committee approval was obtained
from Istanbul University, Cerrahpaşa Medical Faculty, Ethical
Committee (n° 61328).

Surgical procedure

All patients were operated by the same surgeon under
general anesthesia. First, a septoplasty was performed.
Thirty-two patients (19 men, 13 women; mean age,
36.6 ± 15.0 years, range: 19–61 years) in the turbinoplasty
group underwent compensatory lower turbinate turbi-
noptasty. A superior-to-inferior incision was made on the
anterior surface of the lower turbinate with a n° 15 blade,
working under a 3D endoscopic video image, and this inci-
sion was extended posteriorly along the inferior surface.
The medial side of turbinate was elevated. The turbina-
tel mucosa and turbinate were excised while preserving the
medial flap. Bleeding was controlled with bipolar cautery-
ization. The flap was replaced, packing was placed in both
nasal cavities, and the operation completed. Nasal packing
was removed after 48 h.

The outfracture group comprised 44 patients (18 men,
16 women; mean age, 31.4 ± 9.5 years, range: 17–49 years)
who underwent turbinate outfracture and bipolar cautery-
ization. Using an elevator, the lower turbinate was first
mobilized medially and laterally. Posterior anterior bipolar
cauteryization was then applied to the inferomedial face
of the lower turbinate. Both nasal cavities were filled with
nasal cuffs and the operation completed. Nasal packing was
removed after 48 h.

Patient evaluation

The compensatory turbinate volume of all subjects was
assessed pre- and postoperatively using coronal and axial
plane paranasal CT performed in 1 mm sections from
anterior (nares) to posterior (choana). The volumetric eval-
uations were performed by the same radiologist.

The lower turbinate volumes were calculated in
mm³ using the ellipse formula: longitudinal dimen-
sion (mm) × transverse dimension (mm) × anteroposterior
dimension (mm) × 0.52. The longitudinal and transverse
turbinate dimensions were calculated from the cross-section
through the coronal plane after the uncinate processes. The
longest dimension of the lower turbinate was set as the
anteroposterior dimension in the axial plane.

Statistical analysis

Statistical analysis was performed using STATA/MP 11. The
data were summarized as means and standard deviation.
Pre- and postoperative comparisons were made using paired
t-tests within each group. The independent t-test was used
to compare preoperative groups, while analysis of covari-
ance (ANCOVA) was used to compare postoperative groups
using the preoperative values as covariates. The indepen-
dent t-test was used to compare relative postoperative
changes (%) between groups. Statistical significance was
taken as p < 0.05.

Results

Endoscopic hemorrhage control was performed because of
hemorrhage development on postoperative 4th and 6th days
in postoperative period in only 2 patients in the group of
turbinoplasty. In the other 64 patients, there were no
complications such as postoperative hemorrhage, synechiae
or infection. Nasal endoscopic examinations were performed
at 2 months postoperatively. No signs of septum deviation,
turbinate hypertrophy, or atrophic rhinitis were observed in
the follow-up examinations, and there were no complaints
of nasal obstruction.

The differences in the pre- and postoperative parameters
were significant in the turbinoplasty and outfracture groups
(Table 1).

The transverse and longitudinal dimensions of the lower
turbinate in the turbinoplasty group were significantly
lower than in the outfracture group (p = 0.004). The postoperative
lower turbinate volumes decreased significantly in both the
turbinoplasty and outfracture groups. In the turbinoplasty
group, the mean lower turbinate volume was 4523.5 mm³
preoperatively and 1492.2 mm³ postoperatively (p = 0.002),
versus 4282.2 mm³ preoperatively and 2699.9 mm³ postopera-
tively (p < 0.001) in the outfracture group. Comparing
the turbinoplasty and outfracture groups, the postoperative
volume was significantly lower in the turbinoplasty group
(p = 0.019) (Table 2). In the between-group comparison, the
volume reduction was greater in the turbinoplasty group
(p = 0.037) (Table 2).

The transverse and longitudinal dimensions of the lower
turbinate decreased more in the turbinoplasty group
Table 1  Compensatory turbinate preoperative and postoperative values.

<table>
<thead>
<tr>
<th></th>
<th>Turbinoplasty</th>
<th>Out fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-P (mm)</td>
<td>48.1 ± 4.8</td>
<td>39.4 ± 4.9</td>
</tr>
<tr>
<td>Transverse (mm)</td>
<td>11.4 ± 2.2</td>
<td>6.2 ± 1.5</td>
</tr>
<tr>
<td>Longitudinal (mm)</td>
<td>17.8 ± 2.9</td>
<td>11.5 ± 2.5</td>
</tr>
<tr>
<td>Volume (mm³)</td>
<td>4523.5 ± 1548.2</td>
<td>1492.2 ± 594.8</td>
</tr>
</tbody>
</table>

Mean and standard deviation were defined for each subgroup. Statistically significant results are shown in bold.

A-P, Anterior-Posterior; Preop preoperative, Postop postoperative; mm, millimeter.

Table 2  Changes in turbinate measures.

<table>
<thead>
<tr>
<th></th>
<th>Turbinoplasty</th>
<th>Out fracture</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop A-P (mm)</td>
<td>48.1 ± 4.8</td>
<td>43.7 ± 6.6</td>
<td>0.188</td>
</tr>
<tr>
<td>Postop A-P (mm)</td>
<td>39.4 ± 4.9</td>
<td>38.2 ± 6.6</td>
<td>0.490</td>
</tr>
<tr>
<td>Decrease longitudinal (mm)</td>
<td>0.17 ± 0.11</td>
<td>0.13 ± 0.05</td>
<td>0.336</td>
</tr>
<tr>
<td>Preop transvers (mm)</td>
<td>11.4 ± 2.2</td>
<td>12.1 ± 2.2</td>
<td>0.576</td>
</tr>
<tr>
<td>Postop transvers (mm)</td>
<td>6.2 ± 1.5</td>
<td>9.6 ± 2.7</td>
<td>0.004</td>
</tr>
<tr>
<td>Decrease transvers (mm)</td>
<td>0.45 ± 0.12</td>
<td>0.22 ± 0.08</td>
<td>0.001</td>
</tr>
<tr>
<td>Preop longitudinal (mm)</td>
<td>17.8 ± 2.9</td>
<td>14.9 ± 2.8</td>
<td>0.08</td>
</tr>
<tr>
<td>Postop longitudinal (mm)</td>
<td>11.5 ± 2.5</td>
<td>12.8 ± 2.6</td>
<td>0.004</td>
</tr>
<tr>
<td>Decrease longitudinal (mm)</td>
<td>0.36 ± 0.09</td>
<td>0.14 ± 0.08</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Preop volum (mm³)</td>
<td>4523.5 ± 1548.2</td>
<td>4282.6 ± 2094.2</td>
<td>0.811</td>
</tr>
<tr>
<td>Postop volum (mm³)</td>
<td>1492.2 ± 594.8</td>
<td>2699.9 ± 1942.1</td>
<td>0.019</td>
</tr>
<tr>
<td>Decrease volum (mm³)</td>
<td>0.63 ± 0.34</td>
<td>0.41 ± 0.12</td>
<td>0.037</td>
</tr>
</tbody>
</table>

Mean and standard deviation were defined for each subgroup. Statistically significant results are shown in bold.

A-P, Anterior-Posterior; Preop preoperative, Postop postoperative; mm, millimeter.

Figure 1  Preoperative and postoperative volume changes of the groups.

Compared with the outfracture group (p = 0.001 and p < 0.001, respectively) (Table 2).

In the turbinoplasty group, the turbinate volume had an average reduction of 56% and 36% in the out-fracture group (Fig. 1).

The lower turbinate volumes on the side of the deviation were significantly increased in both the turbinate and out-fracture groups postoperatively (p = 0.0002, p = 0.0297, respectively) (Table 3).

Discussion

A compensatory turbinate develops to protect the more-involved nasal passage from cold, dry air. The most common site is the inferior turbinate. There is thickening of the turbinate bones, and an increase in the spongiform structure and orientation to the midline. Mucosal hypertrophy is also present. Many techniques have been described to reduce the volume in lower turbinate hypertrophy. In some of these techniques, the aim is only to decrease the mucosal volume, while in others the mucous membrane and bone volume are both reduced. There is no consensus regarding the best lower turbinate reduction technique. Although less invasive methods have become popular over the last 20 years, more invasive procedures, such as turbinoplasty, remain important because of their high success rates.

Many studies have examined the effectiveness of radiofrequency application in lower turbinate surgery, and other techniques have been evaluated in non-septoplasty patients. Veit et al. did not evaluate lower turbinate volumes despite comparing lower turbinate reduction methods during septoplasty.

We measured the turbinate volume using CT and compared the volume after outfracture and bipolar cauteterization, which caused only mucosal volume loss, with that of turbinoplasty, which resulted in mucosal and bone volume
loss during septoplasty. Other studies have measured the volume using CT (10) or magnetic resonance imaging.\textsuperscript{13,17}

Turbinoplasty is a successful method despite postoperative synechia, drying, and nasal discharge problems.\textsuperscript{16,18} In our study, postoperative desiccation and nasal discharge was not followed up in the turbinoplasty patients.

Büyükli and Zhang\textsuperscript{19,20} reported that the outfracture method was effective for expanding the nasal passages in lower turbinar hypertrophy. With turbinate bipolar cauterization, superficial thermal ablation creates scar tissue and fibrosis, and obliterates the venous sinuses. In one study, the results at 2 months after bipolar cauterization were successful in 76% of the cases.\textsuperscript{11} In our study, the lower turbinar volume in the outfracture group decreased significantly and the patients’ complaints of nasal obstruction disappeared. In both groups, the improvement in the nasal obstruction was likely related to both the lower turbinar reduction and correction of the septum deviation.

Various studies have compared the effectiveness of lower turbinar surgical techniques using objective tests such as acoustic rhinomanometry, mucociliary function tests, and acoustic rhinometry.\textsuperscript{15,21,22}

Can et al.\textsuperscript{11} have studied the effects of radiofrequency ablation in patients undergoing lower turbinate submucosal resection and found that the volume reduction was significant in both groups, but it was greater with radiofrequency ablation. In our study, the postoperative axial, transverse, and longitudinal lower turbinar dimensions were decreased significantly in both groups.

Changes in lower turbinar volume have been assessed after applying different reduction methods. Demir et al.\textsuperscript{12} found that the lower turbinar volume decreased by 25% after thermal radiofrequency ablation. Can et al.\textsuperscript{11} reported a 42.4% volume reduction after submucosal resection. We observed greater volume reduction in the turbinate group (67.1\%) than the outfracture group (36.9\%), indicating that hypertrophic mucosa and bone formation with compensatory hypertrophy constitutes a significant volume. Furthermore, the decrease in the transverse and longitudinal dimensions of the lower turbinar was significantly (p < 0.001) greater in our turbinate group compared with the outfracture group, and the loss in the turbinate group could be attributed to bone tissue loss. Turbinoplasty method results in a greater volume decrease and can be selected for lower turbinar in which the bone mass produces a significant volume, while outfracture and bipolar cauterization, which has a lower risk of complications, can be performed in patients with more moderate lower turbinar hypertrophy.

Lower turbinate outfracture and bipolar cauterization are less invasive than turbinoplasty, while the risk of perioperative bleeding is greater than with turbinate ablation. While hemorrhage, synechiae, and mucosal discharge can occur after turbinate ablation, these effects are not observed after outfracture and bipolar cauterization. In addition, turbinate ablation is suitable for bleeding control under an endoscopic view. Consequently, turbinate ablation takes longer to perform than outfracture and bipolar cauterization. In our series, no peri- or postoperative complications were recorded in either group, but this may be due to the small number of subjects.

In a comparison of the pre- and postoperative lower turbinate volumes of patients who underwent radiofrequency ablation of the lower turbinate, Bahadir et al.\textsuperscript{10} stated that the postoperative volumes of six lower turbinate were increased, which might have been due to the stage of the nasal cycle. In our study, the significant increase in the volume of the uninvolved lower turbinate (p = 0.033) on the deviated side in the turbinate group might have been due to a process other than the nasal cycle following correction of the deviation.

### Conclusion

Both turbinate ablation and outfracture are effective volume reduction techniques. However, the turbinate ablation method causes more reduction of the lower turbinate volume than outfracture and bipolar cauterization.

### Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### Informed consent

Informed consent was obtained from all individual participants included in the study.

The English in this document has been checked by at least two professional editors, both native speakers of English. For a certificate, please see: http://www.textcheck.com/certificate/eqNE75.

### Conflicts of interest

The authors declare no conflicts of interest.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Lower turbinate volumes on deviated side.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turbinoplasty</td>
</tr>
<tr>
<td>Volume (mm(^3))</td>
<td>1967.8 ± 426.1</td>
</tr>
</tbody>
</table>

Statistically significant results are shown in bold.
References