Effect of Septoplasty on Inferior Turbinate Hypertrophy

Dong Hyun Kim, MD; Hun Yi Park, MD; Ho Sung Kim, MD; Sung Ook Kang, MD; Jung Sub Park, MD; Nam Soo Han, MD; Hyun Jun Kim, MD

Objective: To measure the effect of septoplasty on the volume of inferior turbinate in patients with a deviated nasal septum.

Design: In this retrospective analysis, patients who underwent septoplasty without turbinate surgery from May 1, 2003, through April 30, 2006, were studied. The thicknesses and cross-sectional areas of mucosa and conchal bones were measured with computed tomography before the operations and at least 1 year after the operations.

Setting: University hospital.

Patients: A total of 20 patients who presented with a chief concern of nasal obstruction.

Main Outcome Measures: The thicknesses of the medial mucosa, bone, and lateral mucosa and the cross-sectional area of turbinate before and after septoplasty were compared using the Wilcoxon signed rank test. \( P < .05 \) was considered statistically significant.

Results: The medial mucosa and cross-sectional area of the inferior turbinate on the concave side of the septum were significantly decreased by septoplasty (both, \( P = .01 \)), and the medial mucosa and cross-sectional area of the inferior turbinate on the convex side of the septum were significantly increased by septoplasty (\( P = .01 \)). The thicknesses and cross-sectional areas of the conchal bone on the concave and convex sides of the septum were not affected by septoplasty.

Conclusion: After septoplasty, inferior turbinate hypertrophy, especially in the medial mucosa, may reverse.


As much as 75% to 80% of the general population is estimated to exhibit some type of anatomical deformity of the nose,\(^1\) most commonly a deviated nasal septum. This deviation is often associated with overgrowth of the inferior turbinate, which occupies much of the contralateral nasal cavity.\(^2-4\) Accordingly, turbinate surgery is routinely performed in conjunction with septoplasty in patients with nasal obstruction and septum deviation. However, the indications for turbinate surgery are not well defined, and surgical techniques vary substantially among rhinologic surgeons. A previous study\(^2\) established that hypertrophy of the mucosa and the conchal bone of the inferior turbinate occurs in patients with nasal septal deviation, but data were insufficient to determine whether these changes are permanent or reversible by septoplasty. When performed as an adjunct to septoplasty, inferior turbinate surgery is associated with an increased risk of morbidity, primarily hemorrhage, intranasal adhesions, and atrophic rhinitis. In this study, we measured the inferior turbinate before and after septoplasty to determine whether the changes in the inferior turbinate are permanent or reversed by septoplasty.

METHODS

We reviewed ostial meatal unit computed tomographic (CT) (HiSpeed Advantage model 17710CN1; GE Medical Systems, Milwaukee, Wisconsin) images of 20 patients who had undergone septoplasty without turbinate surgery at our hospital from May 1, 2003, through April 30, 2006. The CT scans were acquired on a 4-channel scanner (Genesis-zeus; GE Medical Systems) with axial and coronal scans. We used a tube voltage of 120 kilovolt peak (kVp) in combination with 200 to 230 mA seconds, a section thickness of 5 mm, and a field of view of 512 \( \times \) 512 mm. Images were taken for evaluation of nasal obstruction. The study group consisted of patients who had not re-
ceived topical corticosteroids, antiallergenic medications, or any adjunctive medical drugs at least 2 weeks before CT. Patients who had received turbinate surgery or septoplasty were excluded from the study.

Conducting CT preoperatively and at least 1 year after septoplasty, we compared the preoperative CT scan with the postoperative scan. The study population consisted of 20 patients (16 men [80%] and 4 women [20%]) between 21 and 66 years of age (mean [SD], 37.2 [12.9] years). All patients in the study had septal deviation that included both cartilage and bony components (perpendicular plate of ethmoid and vomer) (Table 1).

The window width and level of CT were controlled to allow visualization of mucosal and ostial lesions. In all cases, 3-mm-thick high-resolution coronal CT sections were analyzed with μ-View software (version 5.0.5.2; Infinitt, Seoul, Korea). The measurements were made at the anterior, middle, and posterior thirds of the inferior turbinate in coronal sections. For standardization, anterior measurement was performed on the first image in which the entire inferior turbinate bone could be identified. The middle measurement was performed on the last image in which the entire inferior turbinate bone could be identified. All images were magnified to facilitate accurate measurement.

The thicknesses of the medial mucosa, bone, and lateral mucosa were measured separately at the anterior, middle, and posterior aspects of the inferior turbinate on a plane perpendicular to the mucosal surface in the inferior turbinate with the aid of a cursor on the CT scanner screen. The thicknesses before and after septoplasty were compared for the anterior, middle, and posterior aspects of the turbinate. The boundary of the inferior turbinate bone was outlined on bone-window CT images (width, 1500 Hounsfield units [HU]; level, 300 HU) (Figure 2), and the corresponding area was measured using μ-View software. The outline of the inferior turbinate was measured using the soft tissue window (width, 150 HU; level, 40 HU) (Figure 3), and the overall cross-sectional area was measured as for the inferior turbinate bone. A radiologist (H.S.K.) and 2 otolaryngologists (D.H.K. and H.J.K.) who reviewed the CT scans were blinded. The measurements conducted by the radiologist and 2 otolaryngologists were averaged.

Group means were compared for statistical significance using the Wilcoxon signed rank test and SAS statistical software (SAS version 8.1; SAS Institute Inc., Cary, North Carolina). Results are presented as means (SDs). P < .05 was considered statistically significant.

### RESULTS

On the concave side of the septum, septoplasty significantly decreased the thickness of the medial mucosa of the inferior turbinate by 1 mm (P = .01) and decreased the mean dimensions of inferior turbinate by 18 mm² (P = .01). On the convex side of the septum, septoplasty significantly increased the thickness of the medial mucosa of the inferior turbinate by 1 mm (P = .01) and increased the mean dimensions of inferior turbinate by 14 mm² (P = .01). Septoplasty did not change the thickness or mean dimensions of inferior conchal bone on the concave or convex side of the septum (Table 2 and Table 3).

### COMMENT

Otorhinolaryngologists have long recognized that when the nasal septum is deviated toward one side the excess space in the opposite nasal cavity is occupied by hypertrophic nasal turbinate. Hypertrophy of the contralateral inferior turbinate is thought to be compensatory to deflection of the nasal septum because the hypertrophy protects the more patent passage from excess airflow, which has drying and crusting effects on nasal mucous membranes. However, enlargement of the inferior turbinate significantly increases nasal airway resistance, contributing greatly to symptoms of nasal airway obstruction. An alternative explanation concerns primary unilateral growth of the turbinate bone, which can be genetic or can be caused by trauma in early life. Unilateral growth of the turbinate bone may exert pressure on the growing nasal septum during childhood and adolescence and eventually cause it to bend toward the other side of the nose. Although most physicians have adopted the first theory, observations of increased bone growth rather than mucosal growth lend credibility to the second theory. Nevertheless, to our knowledge, no published scientific evidence substantiates either theory, and the association between the 2 phenomena has not yet been determined.

Since the first surgical procedure for turbinate reduction, performed by Hartmann in the 1890s, many other techniques have been developed. However, inferior turbinate surgery as an adjunct to septoplasty is associated with increased morbidity, primarily hemorrhage, intranasal adhesions, and atrophic rhinitis. The incidence of hemorrhage in patients undergoing septal surgery alone is less than 2% as opposed to 6% in patients undergoing septal surgery with turbinate surgery. The incidence of adhesions increases from 5% to 17% with the addition of turbinate surgery to a septal surgical procedure.
The incidence of atrophic rhinitis is 5% to 49% with turbinectomy surgery.9,10 Because the turbinates play an important role in nasal physiology by warming and humidifying inspired air, the increased airflow and macro-turbulence throughout the nasal cavities after turbinectomy surgery represent the pathophysiologic basis of nasal drying and crusting.7

The primary goal of therapy is to maximize the nasal airway for as extended a period as possible while minimizing complications of therapy, such as nasal drying,
hemorrhage, and atrophic rhinitis. Although appropriate treatment is of great importance to patients with nasal obstruction, more scientific data are needed to fully justify the benefits of turbinate surgery. The present indications for turbinate surgery are based on empirical criteria and have resulted in extensive, unnecessary, or insufficient surgery without objective evaluation. Inappropriate selection of surgery as a therapeutic option and inappropriate choice of surgical modality seem to be major causes of patient dissatisfaction.

This study has several limitations, including the lack of evaluation of the nasal cycle. However, we showed that hypertrophy of the inferior turbinate was modified by septoplasty. In particular, hypertrophy of the medial mucosa was reversed and the mucosa adapted to the new spatial conditions created by the septoplasty. According to the Poiseuille law, which states that flow through a tube is proportional to the fourth power of the radius or to the square of the cross-sectional area of the tube, a 10% increase in the cross-sectional area of the nasal passage will result in a 21% increase in airflow through the nose. The reversal of enlargement of turbinate soft tissue of the inferior turbinate can have large effects on nasal airflow. Therefore, we propose further study evaluating whether turbinate surgery can be conducted as a staged operation with septoplasty in patients with mucosal hypertrophy of the inferior turbinate. Although we identified that

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### Table 2. Thickness of the Medial and Lateral Mucosa and Conchal Bone Before and After Septoplasty

<table>
<thead>
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<th>Area</th>
<th>Concave</th>
<th>Convex</th>
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<tbody>
<tr>
<td></td>
<td>Preoperative Thickness, Mean (SD), mm</td>
<td>Postoperative Thickness, Mean (SD), mm</td>
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<tr>
<td>Anterior (n=20)</td>
<td>0.36 (0.65) [0.06 to 0.67]</td>
<td>0.90 (2.1) [2.0 to 2.2]</td>
</tr>
<tr>
<td>Middle (n=20)</td>
<td>0.38 (0.70) [0.05 to 0.70]</td>
<td>0.90 (2.1) [2.0 to 2.2]</td>
</tr>
<tr>
<td>Posterior (n=20)</td>
<td>0.47 (0.82) [0.08 to 0.85]</td>
<td>0.90 (2.1) [2.0 to 2.2]</td>
</tr>
<tr>
<td>Total (N=60)</td>
<td>0.32 (0.68) [0.13 to 0.52]</td>
<td>0.90 (2.1) [2.0 to 2.2]</td>
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### Table 3. Mean Dimensions of Inferior Turbinate and Inferior Conchal Bone Before and After Septoplasty

<table>
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<tr>
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<td>Preoperative Dimension, Mean (SD), mm²</td>
<td>Postoperative Dimension, Mean (SD), mm²</td>
</tr>
<tr>
<td>Anterior (n=20)</td>
<td>18.49 (28.27) [5.26 to 31.72]</td>
<td>24.16 (31.2) [10.24 to 38.27]</td>
</tr>
<tr>
<td>Middle (n=20)</td>
<td>14.74 (28.33) [1.24 to 28.23]</td>
<td>21.30 (30.2) [8.24 to 34.33]</td>
</tr>
<tr>
<td>Posterior (n=20)</td>
<td>17.15 (24.15) [5.85 to 28.46]</td>
<td>23.60 (32.6) [10.24 to 36.96]</td>
</tr>
<tr>
<td>Total (N=60)</td>
<td>18.11 (28.70) [10.04 to 26.18]</td>
<td>24.43 (32.4) [10.04 to 36.84]</td>
</tr>
</tbody>
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<tr>
<td></td>
<td>Preoperative Dimension, Mean (SD), mm²</td>
<td>Postoperative Dimension, Mean (SD), mm²</td>
</tr>
<tr>
<td>Anterior (n=20)</td>
<td>1.96 (4.63) [0.21 to 4.12]</td>
<td>2.40 (6.90) [0.74 to 4.07]</td>
</tr>
<tr>
<td>Middle (n=20)</td>
<td>1.68 (4.04) [1.22 to 2.57]</td>
<td>2.07 (6.6) [-3.11 to 2.66]</td>
</tr>
<tr>
<td>Posterior (n=20)</td>
<td>-0.42 (5.59) [-3.03 to 2.20]</td>
<td>1.65 (4.97) [0.67 to 3.97]</td>
</tr>
<tr>
<td>Total (N=60)</td>
<td>0.73 (4.68) [0.59 to 2.04]</td>
<td>1.90 (6.45) [2.00 to 1.63]</td>
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Abbreviation: CI, confidence interval.
septoplasty without turbinate surgery induced a reduction in mucosal thickness, especially that of the medial mucosa, we did not identify how long this effect takes to occur. Illum14 reported that, 5 years after surgery, the impact of turbinate reduction was reduced and the satisfaction of patients with the procedure was similar to that of patients who underwent septoplasty only. It was postulated that the reduction of mucosal edema after septal surgery is likely the result of diminished submucosal blood circulation.15 The tendency of the turbinate to adapt and fit into the new spatial conditions created after septoplasty14 is associated with bone resorption, a process that probably develops many months and even years after surgery.3 We consider that the effect reported by Illum14 is probably related to the phenomenon that septoplasty induces a reduction of mucosal thickness even without turbinate surgery. To determine whether the conchal bone is changed after septoplasty, what changes in the conchal bone and mucosa of the inferior turbinate exist, and how long this phenomenon takes to develop, additional follow-up studies at regular intervals and for a longer period are needed.

If septoplasty is successfully performed, the distance between the nasal septum and the inferior turbinate on the concave side of septum becomes smaller. After septoplasty, the tendency of decreasing thickness of the inferior turbinate on the concave side of the septum may partially relieve nasal obstruction, although the tendency of increasing thickness of inferior turbinate on the convex side of the septum may partially aggravate nasal obstruction. However, this phenomenon may not develop immediately but rather over time. Thus, when performing septoplasty for patients with nasal septum deviation, we have to consider a method that simultaneously reduces the volume of both the mucosa and the conchal bone of the inferior turbinate to maintain good airway in the nasal cavity after surgery. According to our results, turbinate surgery, by reducing the volume of lateral mucosa of the inferior turbinate and the conchal bone while preserving the medial mucosa of the inferior turbinate, may be useful because the medial mucosa may change after septoplasty. Nevertheless, further comparison of the various current techniques for change of turbinate surgery with septoplasty is needed to confirm this.

In conclusion, we identified the change of inferior turbinate hypertrophy after septoplasty. We found that inferior turbinate hypertrophy, especially in the medial mucosa, may reverse.

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Author Contributions: All of the authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: H. J. Kim. Acquisition of data: D. H. Kim, H. Y. Park, H. S. Kim, Kang, J. S. Park, Han, and H. J. Kim. Analysis and interpretation of data: D. H. Kim, H. S. Kim, and H. J. Kim. Drafting of the manuscript: D. H. Kim, H. Y. Park, H. S. Kim, Kang, J. S. Park, and Han. Critical revision of the manuscript for important intellectual content: H. J. Kim. Statistical analysis: D. H. Kim and Kang. Study supervision: H. J. Kim.

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REFERENCES