Do Silicone Nasal Septal Splints with Integral Airway Reduce Postoperative Eustachian Tube Dysfunction?

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Abstract

Objective. This study aims to compare the effects of Merocel nasal packs and silicone nasal septal splints with integral airway on the ventilation and pressure of the middle ear when applied intranasally after septoplasty for isolated septal deviation.

Study Design. A prospective, randomized trial.

Setting. A tertiary referral center.

Subjects and Methods. Fifty-one patients who underwent septoplasty for nasal respiratory impairment caused by septal deviation were randomized into 2 groups. After septoplasty, bilateral anterior Merocel nasal packs were applied in one group, while silicone nasal septal splints with integral airway were applied in the other group. Middle ear pressures were compared using preoperative and postoperative tympanometry.

Results. Pathological decrease in the middle ear pressure in at least 1 ear was determined in 17 patients (73.9%) in the Merocel group compared with only 6 patients (21.4%) in the silicone nasal septal splint group at the 48th postoperative hour. In the first 24 hours following surgery, decreases in tympanometric pressures were seen in both groups, but more in the Merocel group. After 24 hours, middle ear pressures continued to decrease in the Merocel group but started to increase in the silicone nasal septal splint group.

Conclusion. Because they allow inhalation through the nose and cause less Eustachian tube dysfunction than Merocel, using silicone nasal septal splints with integral airway instead of packing after septoplasty seems a more reasonable option.

Keywords
Eustachian tube, septoplasty, nasal pack, middle ear pressure

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Materials and Methods

Fifty-one patients who underwent septoplasty for nasal respiratory impairment caused by septal deviation were included in this study, which was approved by the Duzce University ethical committee. Only patients with otoscopically normal tympanic membranes and bilateral normal type A preoperative tympanograms were included. Patients who had turbinate or paranasal sinus pathologies or systemic disorders were excluded. The patients were randomized into 2 groups (Figure 1). After septoplasty, bilateral anterior Merocel nasal packs (10 cm long in each nostril; Pope Epistaxis Packing, Medtronic Xomed, Jacksonville, Florida) were applied in one group, and silicone nasal septal splints with integral airway (in each nostril, sutured to septum; Breathe-Easy, silicone nasal septal splint with integral airway, Invotec, Jacksonville, Florida) were applied in the other group for postoperative packing. Both nasal packs and septal splints were left in place for 2 days.

We measured the alteration in MEP using preoperative and postoperative tympanometry of the patients. All patients underwent preoperative otoscopic examination followed by tympanometry using an Interacoustics AZ-26 impedance audiometer (Interacoustics A/S, Assens, Denmark). Tympanometry was repeated at 24 and 48 hours after the operation just before the removal of nasal packing or splinting and on the seventh postoperative day. One hundred and two ears of 51 patients were examined. The results were separately analyzed for each ear.

The tympanograms were classified in a standard manner similar to that originally described by Jerger. A tympanogram with MEP peak between +50 daPa and –100 daPa was classified as type A. A tympanogram with MEP peak at –100 daPa or more negative was classified as type C. A tympanogram with flattened peak of ≤0.3 mL admittance was classified as type B.

Statistical analyses were performed using commercially available software (SPSS 19, SPSS Inc, an IBM company, Somers, New York). A χ² test was used to compare the categorical variables. All continuous variables were normally distributed according to the Kolmogorov-Smirnov normality test. Therefore, the t test for 2 independent samples was used to compare the continuous variables between the Merocel group (group 1) and the silicone nasal septal splint group (group 2). Repeated-measures 1-way analysis of variance (ANOVA) was used to compare the preoperative and first-, second-, and seventh-day postoperative tympanometric pressures. Repeated-measures 2-way ANOVA was used to compare the alteration of pressures between the 2 groups. Continuous variables were presented as mean and standard deviation. A P value < .05 was considered statistically significant.

Results

Of the 51 patients included in the study, 30 were male and 21 were female, and the average age was 29.06 ± 10.5 years.
Group 1 comprised 23 patients (15 male, 8 female) with an average age of 26.3 ± 9.9 years, while group 2 had 28 patients (15 male, 13 female) with average age of 31.4 ± 10.6 years. There were no statistically significant differences between the 2 groups in terms of age and sex.

We considered all MEPs ≤–100 daPa (by definition classified as type C tympanograms) pathological. Pathological decreases in the MEP of at least 1 ear were determined in 17 patients (73.9%) in group 1 compared with only 6 patients (21.4%) in group 2 at the 48th postoperative hour. This difference between the 2 groups was statistically significant. Six patients in group 1 and 22 patients in group 2 exhibited no significant change in MEP following septal surgery and nasal packing or splinting.

At the 48th postoperative hour, bilateral type C tympanograms were obtained for 12 patients and unilateral type C tympanograms were obtained for 5 patients in group 1, but type B tympanograms were not seen in any of the patients. Day 7 tympanometries (performed 5 days after removing the nasal packs) revealed normal type A tympanograms for all ears in group 1.

In group 2, 3 patients developed a unilateral C-type tympanogram and 3 patients developed bilateral C-type tympanograms in the 48 hours following surgery. Five days after splint removal, all patients reverted to a normal A type tympanogram. No patient developed a type B tympanogram during the period of study.

In the first 24 hours following surgery, decreases in tympanometric pressures were seen in both groups, but more in group 1 (Figures 2 and 3). After 24 hours, MEP continued to decrease in group 1 but started to increase in group 2, almost reaching preoperative values by the 48th hour. These pressure differences between the 2 groups were statistically significant (Table 1). All tympanometric pressures returned to preoperative values by the seventh postoperative day for both groups.

For both groups, no otoscopic or tympanometric evidence of middle ear effusion was seen in any patient, including those with type C tympanograms. Subjective temporary aural fullness developed in 5 patients in group 1 and 2 patients in group 2, but this completely resolved in all patients after removal of the packs and splints. No other patients reported any untoward symptoms.

**Discussion**

The Eustachian tube is part of the organ system composed of nose, nasopharynx, middle ear, and mastoid air cells. It is a functional passage between the middle ear and nasopharynx and provides ventilation of the middle ear. When the tube opens during swallowing, air reaches the middle ear, equalizing the pressure across the external and internal surfaces of the tympanic membrane.

The Eustachian tube is frequently involved in pathological processes affecting the nasal, paranasal, and nasopharyngeal cavities.7 The report by Salvinelli et al8 shows that chronic nasal obstruction is a frequent cause of Eustachian tube dysfunction, which can lead to middle ear hypoventilation and suffering. In one of their studies, Bonding and Tos7 reported that situations affecting nasal and nasopharyngeal structure, such as infectious mononucleosis, tonsillectomy, and nasal packing application, caused Eustachian tube dysfunction. They examined 15 patients with anterior nasal packing after septal surgery and found that 7 (46%) developed significant negative MEP, which resolved on removal of the packs. In another report, McCurdy4 demonstrated a negative pressure ≤100 daPa in only 25% of 99 ears 3 days after applying bilateral anterior nasal packing. Thompson and Crowther3 reported the development of a type C tympanogram in at least 1 ear in 34 of the 63 patients (54%) who underwent septum surgery. In our study, a type C tympanogram was obtained in at least 1 ear in 73.9% of patients with Merocel nasal packing and in 21.4% of patients with silicone nasal septal splints with integral airway within 48 postoperative hours after septoplasty.

There are varying explanations for temporary Eustachian tube dysfunction in patients with nasal packing. Some authors think that this is the result of mechanical obstruction caused by the packs at the entrance of the Eustachian tube.7 Others believe that inflammatory reaction and edema in the...
nasopharyngeal mucosa as a result of packing and/or surgical trauma cause Eustachian tube dysfunction. Johannessen and Poulsen studied 27 patients who had nasal packing left in situ for at least 5 days. They attributed the subsequent Eustachian tube dysfunction to edema of the nasopharyngeal mucosa since the MEP tended to revert to normal prior to pack removal. Thompson and Crowther believe that Eustachian tube dysfunction after septal surgery is most likely due to a combination of the effect of surgery and of the nasal packing. Another possible cause is occlusion of the tube because of excessive secretions by seromucous glands in the pharyngeal section of the Eustachian tube. The results of our study support the mechanical obstruction theory suggested by Bonding and Tos, because a higher degree of Eustachian dysfunction was seen in the first 48 postoperative hours among patients in whom Merocel packing extending to the nasopharynx was used even if all patients underwent the same surgical process. Besides, in patients with silicone nasal septal splints, the MEP tended to decrease in the first 24 hours and almost reached preoperative values in the 48th postoperative hour. Perhaps different outcomes may have been obtained had we used 6 cm instead of 10 cm of Merocel packing.

Nasal packing is a relatively common procedure used after septoplasty to prevent a postoperative septal hematoma and to maintain mucoperichondrial flap position on the septal cartilage. There are various packing materials described in the literature, including different types of gauzes, cellulose and foam, absorbable gelatin sponges, Merocel, and polyethylene oxide gel. There appears to be no consensus in the literature about the ideal material for or duration of packing. Many physicians do not use packing due to the low incidence of heavy bleeding following septoplasty. Those who do not use packing prefer silicone splints and transseptal suture techniques as an alternative application. Postoperative pain, mucosal injury, worsening of breathing due to sleep disorders, displacement and aspiration of the packing material, toxic shock syndrome, and postoperative infections are complications associated with nasal packing.

Most of these packings not only cause pain and the sensation of a mass in the nose, but they also cause higher rates of temporary Eustachian dysfunction. Silicone nasal septal splints with integral airway cause less pain and enable the patient to inhale through the nose immediately after the operation, increasing postoperative patient comfort. In addition, the results of our study corroborate that it causes less mass effect, creates less mechanical obstruction of the Eustachian tube entrance, and brings about less temporary Eustachian tube dysfunction. Transseptal sutures are also valid alternatives to nasal packing and have gained a broader application area for preventing such complications as septal hematoma, postoperative pain, and bleeding in addition to reducing Eustachian tube dysfunction. Yildirim et al observed statistically significant MEP reductions in patients with nasal packing compared with patients who underwent nasal septal suturing and concluded that nasal septal suturing causes less Eustachian dysfunction.

Cost-effectiveness is also an important issue for nasal-packing materials. The Merocel nasal pack is cheaper (a 10-cm pack costs $12) than the silicone nasal septal splint (a pack is approximately $15) in Turkey. Health insurance companies generally reimburse the cost of nasal packs in our country.

### Table 1. Tympanometric Pressures of 2 Groups Measured Preoperatively and on the First, Second, and Seventh Day Postoperatively

<table>
<thead>
<tr>
<th>Tympanometric pressures (right ear)</th>
<th>Preoperative</th>
<th>Postoperative first day</th>
<th>Second day</th>
<th>Seventh day</th>
<th>P value</th>
<th>P value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merocel (n = 23)</td>
<td>−29.39 ± 9.99</td>
<td>−83.13 ± 58.48</td>
<td>−121.48 ± 90.05</td>
<td>−23.65 ± 9.41</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>.012</td>
</tr>
<tr>
<td>Splint (n = 28)</td>
<td>−25.57 ± 13.61</td>
<td>−47.00 ± 30.67</td>
<td>−36.00 ± 38.04</td>
<td>−26.14 ± 14.99</td>
<td>.268</td>
<td>.012</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tympanometric pressures (left ear)</th>
<th>Preoperative</th>
<th>Postoperative first day</th>
<th>Second day</th>
<th>Seventh day</th>
<th>P value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merocel (n = 23)</td>
<td>−27.30 ± 13.19</td>
<td>−96.70 ± 74.04</td>
<td>−101.65 ± 84.89</td>
<td>−27.65 ± 13.10</td>
<td>&lt;.001</td>
<td>.016</td>
</tr>
<tr>
<td>Splint (n = 28)</td>
<td>−21.86 ± 23.39</td>
<td>−46.57 ± 39.51</td>
<td>−42.00 ± 29.62</td>
<td>−25.86 ± 22.00</td>
<td>.325</td>
<td>.732</td>
</tr>
</tbody>
</table>

aResults of the comparison between 2 groups.
bResults of the comparison among preoperative, postoperative first-, second-, and seventh-day measures.
cResults of the comparison between 2 groups according to alterations of pressures.

### Conclusion

Our prospective randomized study demonstrated that Merocel packings extending to the nasopharynx used after septoplasty caused temporary Eustachian dysfunction and a greater decrease in MEP compared with silicone nasal septal splints with integral airway, which have less mass effect. In our opinion, because they allow inhalation through the nose and cause less Eustachian tube dysfunction than Merocel, using silicone nasal septal splints with integral airway instead of packing after septoplasty seems a more reasonable option.
Author Contributions

M. Sinan Yilmaz, corresponding author, wrote the manuscript, design of study; Mehmet Guven, wrote the manuscript, design of study; Deniz Gin Buyukarslan, collection of data; Recep Kaymaz, collection of data; Unal Erkorkmaz, analysis of data.

Disclosures

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References