

Does Nasal Septal Deviation Affect the Eustachian Tube Function and Middle Ear Ventilation?

Nazal Septum Deviasyonu, Orta Kulak Ventilasyonu ve Eustachi Tüp Fonksiyonlarını Etkiler mi?

Mesut Kaya¹ , Elif Dağlı² , Savaş Kırat¹ 

¹Otorhinolaryngology Private Practice, Ankara, Turkey

²Department of Otorhinolaryngology, Keçiören Training and Research Hospital, Ankara, Turkey

Original Investigation
Özgün Araştırma

Abstract

Objective: Our aim is to evaluate the effect of nasal septal deviation on the middle ear pressure and Eustachian Tube (ET) functions with regard to the side of deviation.

Methods: A prospective randomized clinical trial was conducted. Overall, 50 patients (22 female, 28 male) undergoing septoplasty because of nasal septum deviation were included. The nasal obstruction symptom evaluation (NOSE) scale was used to evaluate surgical satisfaction. Middle ear ventilation and the ET functions of a total of 100 ears were assessed with basal tympanometry and insufflation tests (Valsalva and Toynbee). The tests were performed on the operation day and eight weeks after surgery. The ears were divided into two groups: the affected side (the side of nasal obstruction) (Group 1) and the contralateral side (Group 2). The study parameters obtained before and after septoplasty were compared.

Results: The NOSE scores decreased after septoplasty (12.48±4.78/7.56±3.4) (p<0.001). There were 20 functional ETs (40%) in the affected side preoperatively, which increased to 36 ears (72%) postoperatively, and functional tubes increased to 35 (70%) from 29 (58%) after surgery in the contralateral side. The changes in the tympanometry results were statistically significant for both the affected side (-33.56 daPA/-21.18 daPA) and contralateral side (29.24daPA /-24.96daPA) (p<0.05), but the alteration in the side of deviation was more evident.

Conclusion: Our study shows that septoplasty may have a beneficial effect on middle ear ventilation and ET functions.

Keywords: Nasal septum, surgery, middle ear ventilation, Eustachian tube

Öz

Amaç: Amacımız, nazal septal deviasyonun tarafı ile orta kulak ventilasyonu ve Eustachi tüpü (ET) işlevleri arasındaki ilişkinin araştırılmasıdır.

Yöntemler: Bu ileriye yönelik randomize çalışmada nazal septum deviasyonu tanısı ile septoplasti yapılan 50 hasta (22 kadın, 28 erkek) çalışmaya dahil edildi. Cerrahi memnuniyeti değerlendirmek için burun tıkanıklığı semptom değerlendirilmesi (NOSE) ölçeği kullanıldı. Yüz kulağın orta kulak ventilasyonu ve ET fonksiyonları bazal timpanometri ve insüflasyon testleri (Valsalva ve Toynbee) ile değerlendirildi. Testler ameliyat gününde ve cerrahiden sekiz hafta sonra yapıldı. Kulaklar etkilenen taraf (deviasyon tarafı) (grup 1) ve karşı taraf (grup 2) olmak üzere iki gruba ayrıldı ve grup 1 çalışma grubunu oluştururken grup 2 kontrol grubu olarak belirlendi. Septoplasti öncesi ve sonrasında elde edilen çalışma parametreleri karşılaştırıldı.

Bulgular: Olguların NOSE skorları septoplasti sonrası düştü (12.48±4.78/7.56±3.4) (p<0.001). Etkilenen taraftaki operasyon öncesi 20 fonksiyonel ET (%40), operasyon sonrası 36 ET'ye (%72) yükseldi. Karşı tarafta ise cerrahiden önce 29 (%58) olan fonksiyonel ET sayısı 35'e (%70) yükseldi. Timpanometri sonuçlarındaki değişim hem etkilenen (-33.56 daPA/-21.18 daPA), hem de karşı tarafta (29.24daPA /-24.96daPA) istatistiksel olarak anlamlı idi (p<0.05). Ancak bu fark etkilenen tarafta daha belirgindi.

Sonuç: Çalışmamız septoplastinin orta kulak ventilasyonunu ve ET fonksiyonları üzerinde iyileştirici bir etkisi olabileceğini göstermektedir.

Anahtar sözcükler: Nazal septum, cerrahi, orta kulak ventilasyonu, Eustachi tüpü

Introduction

The Eustachian Tube (ET) is a tube that connects the middle ear cavity and the nasopharynx and provides middle ear ventilation. The physiologic pressure depends on the air transition through the ET and gas diffusion between the middle ear mucosa and systemic circulation. A

functional ET is crucial for balancing the middle ear pressure (1, 2).

Various methods can be used to assess ET functions. One of them is sonotubometry. It is based on the measurement of sound waves that can pass through the ET; however, performing the method



ORCID IDs of the authors:

M.K. 0000-0001-7494-4811;
E.D. 0000-0002-3480-917X;
S.K. 0000-0001-5742-6633.

Cite this article as: Kaya M, Dağlı E, Kırat S. Does Nasal Septal Deviation Affect the Eustachian Tube Function and Middle Ear Ventilation?. Turk Arch Otorhinolaryngol 2018; 56(2): 102-5.

Corresponding Author/Sorumlu Yazar:
Mesut Kaya; mesutkaya78@yahoo.com

Received Date/Geliş Tarihi: 12.07.2017
Accepted Date/Kabul Tarihi: 06.02.2018

© Copyright 2018 by Official Journal of the Turkish Society of Otorhinolaryngology and Head and Neck Surgery Available online at www.turkarchotolaryngol.net

© Telif Hakkı 2018 Türk Kulak Burun Boğaz ve Baş Boyun Cerrahisi Derneği Makale metnine www.turkarchotolaryngol.net web sayfasından ulaşılabilir.

DOI: 10.5152/tao.2018.2671

is challenging (3). The other method is the manometric test that has limitations such as insufficient evaluation of ET functions when the tympanic membrane is intact (4). We used tympanometry and insufflation tests (the Valsalva and Toynbee maneuvers) in this study because they are easy to perform and have been widely used for the clinical evaluation of ET functions and also in academic research.

The relationship between the middle ear mucosa, ET, and nasal cavities has been the subject of various studies. An insufficient ventilation of the ET is thought to be an important cause of middle ear inflammatory diseases. It is advocated that nasal, paranasal, and nasopharyngeal pathologies affect the tube functions, and nasal obstruction causes an impairment in the ET functions (5). However, the study results concerning this topic are controversial (6, 7). Some authors suggested that ear surgery should be performed months after septoplasty; however, some of them proposed that concurrent nasal and middle ear surgery shows a similar success rate as middle ear surgery alone (6, 7).

In this prospective study, our aim was to analyze the effect of nasal septal deviation on ET functions with the use of tympanometry and insufflation tests before and after septoplasty.

Methods

This prospective observational study was performed between March 30, 2015, and December 1, 2015, at a tertiary care academic center, previously approved by the Clinical Research Ethics Committee of Turgut Ozal University (No. 99950669/281). All participants were informed about the study, and written informed consents were obtained. Overall, 50 patients over the age of 18 with nasal septal deviation were included in the study. The patients who had tympanic membrane perforation, serous otitis, nasal polyps, allergic rhinitis, chronic sinusitis, or active upper respiratory tract infection and those who previously underwent septoplasty, endoscopic sinus surgery, or tympanoplasty were excluded. Of the 50 patients included, 44% were female (n=22) and 56% were male (n=28). The patients' age ranged between 18 and 50 years, with a mean value of 32.9±9. All patients underwent septoplasty.

Septoplasty procedures were performed by two senior surgeons whose techniques were the same. Silicone splints with airway were used, and they were removed on the 2nd postoperative day. Surgical satisfaction was evaluated with the nasal obstruction symptom evaluation (NOSE) scale, which is a 0–4 point scale (0: not a problem; 1: very mild problem; 2: moderate problem; 3: fairly bad problem; and 4: severe problem). NOSE was used to assess the following symptoms: swelling or fullness in the nose, nasal congestion, difficult breathing through the nose, difficulty in sleeping, and inability to breathe comfortably through the nose during exercise or effort (8, 9). Patients' aural fullness sensation was investigated through questionnaires preoperatively and eight weeks after surgery. A tympanometric evaluation of ET was performed with Interacoustics AZ 26 (Interacoustics A/S, Assens, Denmark). The first tympanometry was performed on the morning of the operation day. Initially, basal tympanogram was obtained. Then, tympanometric peak pressures (TPPs)

were analyzed after the Valsalva and Toynbee maneuvers to assess ET function. ET was considered to be functional when 10 decapascals (daPa) or a greater change in TPP was observed; if the alteration was less than 10 daPa, the ET function was considered to be poor. Measurements were repeated eight weeks after the operation. Ears were classified as the affected side (Group 1) and contralateral side (Group 2), and comparisons were made accordingly.

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 22 (IBM Corp., Armonk, NY, USA) was used for statistical assessment. The Shapiro–Wilks test was used for testing normality. A paired t-test was used for the comparison of preoperative and postoperative results because the distribution of data was normal. Confidence in all tests was determined as 95%, and a p-value less than 0.05 was considered to be statistically significant.

Results

The patients underwent septoplasty; no additional surgery was performed. The mean NOSE score was 12.48±4.78 before surgery and 7.56±3.4 after surgery. The postoperative change in NOSE score after eight weeks was statistically significant (p<0.001) (Table 1). The number of patients who had a functional ET in the affected side (Group 1) and the contralateral side (Group 2) before and after surgery are listed in Table 1. Changes were statistically significant for both groups (p<0.05), but the increase in the number of functional ET is more evident in Group 1 (Table 1).

The tympanic membranes of the patients were normal. Basal tympanometric pressures were within reference ranges before and after surgery. No patient complained of aural fullness sensation before or after surgery. The basal middle ear pressure value was -33.56±39.66 daPa in the affected side (Group 1), and -29.24±44.42 daPa at the contralateral side (Group 2).

After septoplasty, the middle ear pressure was -21.18±30.72 daPa in Group 1 and -24.96±41.74 daPa in Group 2. A statistically significant result was found in both groups (p<0.05) (Table 2).

In the evaluation of TPPs obtained after the Valsalva maneuver, there was no statistically significant change for the contralateral side of the deviation (p=0.12), whereas a significant change was observed in the side of deviation (p<0.05) (Table 2). The post-

Table 1. NOSE values and the number of functional ET* before and after surgery

	Before Surgery	After Surgery	p
NOSE**	12.48±4.78	7.56±3.4	<0.001
Functional ET* of Group 1	20	36	<0.05
Functional ET* of Group 2	29	35	<0.05

Values presented in mean±SD

*ET: Eustachian tube; ** NOSE: nasal obstruction symptom evaluation

Table 2. Statistical evaluation of tympanometric measurements before and after septoplasty

	Group 1			Group 2		
	Basal	Valsalva	Toynbee	Basal	Valsalva	Toynbee
Preoperative	-33.56±39.66	-29.72±38.8	-50.92±41.73	-29.24±44.42	-21.8±36.75	-49.6±49.38
Postoperative	-21.18±30.72	-12.6±33.98	-54.44±33.80	-24.96±41.74	-18.44±24.07	-43.8±49.84
p	<0.05	<0.05	0.19	<0.05	0.12	0.18

operative change in TPPs obtained after the Toynbee maneuver were not significant for the affected side ($p=0.19$) or contralateral side ($p=0.81$) (Table 2).

Discussion

In daily practice, many patients admitted to otorhinolaryngology clinics suffer from middle ear ventilation problems concomitant with nasal obstructive pathologies. The goal of this study was to answer the hypothesis whether septum deviation that causes nasal obstruction really affects the ET function and middle ear ventilation.

Despite the fact that the prevalence of nasal septal deviation reaches up to 80%, only a minority of affected individuals suffer from nasal obstruction (10). For this reason, we used the NOSE questionnaire, which is a specific and reliable tool to evaluate nasal obstruction in adults (8, 9). We included patients whose NOSE results were higher than 10. Many researchers studied about the alterations of ET functions after septoplasty. Some authors suggest that septoplasty does not have an influence on ET functions, whereas the others report an improvement in ET functions postoperatively. Davari and Behnoud (11) evaluated the ET functions of 70 patients undergoing septoplasty. They found no significant changes in the middle ear pressure. Also, they found no significant change in the ET functionality. On the other hand, many studies demonstrate an improvement in the middle ear ventilation and ET functions after septoplasty. Low and Willatt (12) reported the outcome of 40 patients undergoing septoplasty. The mean TPP was significantly decreased after surgery ($p<0.001$). Deron et al. (13) used a tubal compliance manometric test during the Valsalva maneuver to elucidate the relationship between deviated nasal septum surgery and tubal functions. An improvement in the tubal opening pressure was observed for the deviated side and contralateral side in the early and late post-septoplasty period. A prospective study performed by Salvinelli et al. (6) subjected the evaluation of ET functions with the Toynbee and Valsalva maneuvers before and after nasal septal surgery in 40 patients. The tube functional tests significantly improved after the operation. In a more recent study, Akyıldız et al. (5) observed higher rates of ET dysfunction in patients with nasal septal deviation, and they detected an improvement in the results after septoplasty.

Unlike in the existing literature, we performed both tympanometry and Eustachian tube function tests and separately evaluated the ears by classifying them as the affected side and contralateral side in our study. Although we observed a conspicuous

improvement in the affected side, we did not observe any significant change in the tubal function tests of the contralateral ears. One limitation of this study is that our follow-up period, which was eight weeks, was relatively short. However, our result emphasizes that there is a significant difference between the tympanometric results of deviated and non-deviated sides of the nasal septum regardless of time.

The effect of the intranasal splint type on the function of ET had also been a point of discussion. In a study by Serefican et al. (14), there were 60 septoplasty candidates who were randomly divided into two groups: one group was applied merocel and the other was applied intranasal splint with airway. The internal nasal splint with airway group did not show any middle ear pressure alteration, whereas the merocel group showed increased values of the middle ear pressure after septoplasty. Similar to our study, Yılmaz et al. (15) suggested the use of silicon intranasal splints with airway because they allow inhalation through the nose and cause less ET dysfunction than merocel packings. We used intranasal splints with airway in our study to minimize the influence of nasal package on the ET opening pressure.

It is well known that ET dysfunction and middle ear hypoventilation decrease the success rate of middle ear surgeries. Maier and Krebs (16) posted a study about nasal surgery requirements and the timing of the surgery before tympanoplasty. They performed dynamic tubal examination with the dual-impedance method for 50 patients undergoing septoplasty to monitor ET functions. Tube functions of the preoperative and postoperative (1st, 6th, and 8th weeks) period were evaluated and compared. Dynamic tube parameters were outside the normal range before surgery; they worsened in the 1st weeks, and normalization was observed between the 6th and 8th weeks after the operation. As a result, Maier and Krebs suggested that septoplasty should be performed before the chronic otitis surgery. On the contrary, Akyıldız et al. (17) proposed that patients with NSD generally had poor ET function; however, this did not affect the outcome of tympanoplasty.

According to the results of our study, patients with isolated nasal septum deviation had lower middle ear pressure and worse ET functions at the side of deviation; however ET functions and middle ear pressure remained within the reference ranges. After septoplasty, the number of functional ET increased and a statistically significant improvement in the middle ear pressure occurred. Before planning the middle ear surgery, we recommend a full examination of the rhino-tubal unit. Clinicians should be aware of septum deviation if the ear problem is found in the deviated side.

Conclusion

Nasal septum deviation is the most frequent cause of nasal obstruction, and it may have a negative effect on middle ear ventilation. The clinicians should be aware of the septal pathologies in patients with frequent otologic problems.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Turgut Özal University (No. 99950669/281).

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

Peer-review: Externally peer-reviewed.

Author Contributions: Concept -M.K., E.D., S.K.; Design -M.K., E.D., S.K.; Supervision -M.K.; Resource -S.K.; Materials -E.D., S.K.; Data Collection and/or Processing -E.D., S.K.; Analysis and/or Interpretation -M.K., E.D., S.K.; Literature Search -M.K., E.D.; Writing -M.K., E.D.; Critical Reviews -M.K., E.D., S.K.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Etik Komite Onayı: Bu çalışma için etik komite onayı Turgut Özal Üniversitesi Etik Kurulu'ndan alınmıştır (99950669/281).

Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Yazar Katkıları: Fikir M.K., E.D.,S.K.; Tasarım - M.K., E.D., S.K.; Denetleme - M.K.; Kaynaklar - S.K.; Gereçler - E.D., S.K.; Veri Toplanması ve/veya İşlemesi - E.D., S.K.; Analiz ve/veya Yorum - M.K., E.D., S.K.; Literatür Taraması - M.K., E.D.; Yazıyı Yazan - M.K., E.D.; Eleştirel İnceleme - M.K., E.D., S.K.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

References

1. Choi SH, Han JH, Chung JW. Pre-operative evaluation of Eustachian tube function using a modified pressure equilibration test is predictive of good postoperative hearing and middle ear aera-

- tion in type 1 tympanoplasty patients. *Clin Exp Otorhinolaryngol* 2009; 2: 61-5. [CrossRef]
2. Takahashi H, Sato H, Nakamura H, Umeki H. Correlation between middle ear pressure regulation functions and outcome of type-I tympanoplasty. *Auris Nasus Larynx* 2007; 34: 173-6. [CrossRef]
3. Lildholdt T, Brask T, Hvidegaard T. Interpretation of sonotubometry. A critical view of the acoustical measurement of the opening of the Eustachian tube. *Acta Otolaryngol* 1984; 98: 250-4. [CrossRef]
4. Bluestone CD, Cantekin EI. Current clinical methods, indications and interpretation of Eustachian tube function tests. *Ann Otol Rhinol Laryngol* 1981; 90: 552-62. [CrossRef]
5. Akyıldız MY, Özmen ÖA, Demir UL, Kasapoğlu F, Coşkun HH, Basut OI, et al. Impact of septoplasty on Eustachian tube functions. *J Craniofac Surg* 2017; 28: 1929-32. [CrossRef]
6. Salvinelli F, Casale M, Greco F, D'Ascanio L, Petitti T, Di Peco V. Nasal surgery and Eustachian tube function: effects on middle ear ventilation. *Clin Otolaryngol* 2005; 30: 409-13. [CrossRef]
7. Schuman TA, Labadie RF. Concurrent nasal surgery and tympanoplasty in adults. *Ear Nose Throat J* 2010; 89: 28-32.
8. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hanley MT. Development and validation of the nasal obstruction symptom evaluation (NOSE) scale. *Otolaryngol Head Neck Surg* 2004; 130: 157-63. [CrossRef]
9. Onerci Celebi O, Araz Server E, Yigit O, Longur ES. Adaptation and validation of the Turkish version of the Nasal Obstruction Symptom Evaluation scale. *Int Forum Allergy Rhinol* 2018; 8: 72-6. [CrossRef]
10. Roblin DG, Eccles R. What, if any, is the value of septal surgery? *Clin Otolaryngol Allied Sci* 2002; 27: 77-80. [CrossRef]
11. Davari R, Behnoud F. Study the effect of nasal obstruction surgery (septoplasty) on Eustachian tube function and middle ear pressure. *J Ardebil Univ Med Sci* 2014; 14: 322-30.
12. Low WK, Willatt DJ. The relationship between middle ear pressure and deviated nasal septum. *Clin Otolaryngol Allied Sci* 1993; 18: 308-10. [CrossRef]
13. Deron P, Clement PA, Derde MP. Septal surgery and tubal function: early and late results. *Rhinology* 1995; 33: 7-9.
14. Şerefican M, Yurttaş V, Oral M, Yılmaz B, Dağlı M. Is middle ear pressure affected by nasal packings after septoplasty? *J Int Adv Otol* 2015; 11: 63-5. [CrossRef]
15. Yılmaz MS, Guven M, Buyukarslan DG, Kaymaz R, Erkorkmaz U. Do silicone nasal septal splints with integral airway reduce postoperative Eustachian tube dysfunction? *Otolaryngol Head Neck Surg* 2012; 146: 141-5. [CrossRef]
16. Maier W, Krebs A. Is surgery of the inner nose indicated before tympanoplasty? Effects of nasal obstruction and reconstruction on the Eustachian tube. *Laryngorhinootologie* 1998; 77: 682-8. [CrossRef]
17. Akyıldız MY, Özmen ÖA, Demir UL, Kasapoğlu F, Coşkun HH, Basut OI, et al. Should nasal function be considered prior to tympanoplasty? *J Int Adv Otol* 2018; 14: 53-7. [CrossRef]