

# The Effect of Nasal Functions on the Integrity of Grafts after Myringoplasty

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## Original Investigation

### Abstract

**Objective:** We aimed to evaluate the effects of nasal functions for the integrity of grafts after myringoplasty.

**Methods:** In our study 78 patients who underwent myringoplasty operation between 2011-2013 were included. Group I was defined as the group with an intact tympanic membrane following surgery. Group II was defined as the group with a tympanic membrane perforation following surgery. Group I consisted of 44 and Group II consisted of 34 patients. Subjective and objective measurements of nasal functions, Eustachian tube function (ETF), and allergic status were performed using nasal obstruction symptom evaluation (NOSE) scale, visual analog scale (VAS), and the score for allergic rhinitis (SFAR) questionnaires and acoustic rhinometry and saccharin test. It was investigated whether there was any difference between these two groups in terms of these parameters.

**Results:** There was statistically no significant difference between groups according to the age, sex and the presence of tubal dysfunction and allergic rhinitis ( $p>0.05$ ). In the group of intact tympanic membranes, the likelihood of right ear being the operated one was significantly higher compared to the group of myringoplasty failures ( $p=0.037$ ). The VAS and NOSE scales did not show any significant difference between groups in terms of successful outcome of myringoplasty ( $p>0.05$ ). The nasal congestion index (NCI) and the mucociliary clearance (MCC) did not show any significant difference between groups in terms of successful outcome of myringoplasty ( $p>0.05$ ).

**Conclusion:** This study has shown that nasal functions measured by objective and subjective methods had no effects on the success of myringoplasty.

**Keywords:** Myringoplasty, acoustic rhinometry, mucociliary clearance, tympanic membrane

## Introduction

Myringoplasty is a surgical intervention performed to repair the perforated tympanic membrane (TM) and to eradicate possible future complications of chronic otitis media (COM) with middle ear infections. Several factors have been investigated to predict the successful outcome of this surgery which includes otological, surgical, and patient-related factors (1).

When myringoplasty is planned, usually potential interactions between Eustachian tube function (ETF), the nose, and the nasopharynx are considered (2). It is however interesting to see that no studies have been performed to measure the effect of nasal functions on the success of myringoplasty.

In this study, our objective was to find out the effect of subjective symptom scores, the NCI, the MCC,

and the presence of allergic rhinitis symptoms on the integrity of the graft after myringoplasty.

## Methods

### Study design

The charts of 234 adult subjects who underwent myringoplasty at Otolaryngology Department of Ümraniye Training and Research Hospital between 2011 and 2013 were extracted from our hospital's database. Subjects who had at least 6 months of follow-up were then contacted by telephone and asked whether they would be willing to participate in a study for evaluation of their nasal functions.

Ethics Committee of Ümraniye Training and Research Hospital approved the study, and informed consent was taken from all participants.



**Cite this article as:** Çaypınar Eser B, Şahin Yılmaz A, Şahin Önder S, Zer Toros S, Oysu Ç. The Effect of Nasal Functions on the Integrity of Grafts after Myringoplasty. Turk Arch Otorhinolaryngol 2017; 55: 153-7.

This study was presented at the 29<sup>th</sup> Politzer Society Meeting, 13-17 November 2013, Antalya, Turkey.

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**Received Date:** 19.04.2017

**Accepted Date:** 12.09.2017

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www.turkarchotolaryngol.net

DOI: 10.5152/tao.2017.2518

## Subjects

Inclusion criteria for this study were as follows: (i) adult subjects between 14 and 60 years of age, (ii) a middle ear risk index (MERI) score of 1 (dry perforation, no cholesteatoma, normal ossicular status, no middle ear granulations and no history of previous surgery) (iii) having undergone myringoplasty (with underlay technique using the tragal cartilage, by the same surgeon) between January 2011 and December 2013 at our institution, with a minimum follow-up of 6 months. The integrity of the TM was assessed by microscopic examination during the postoperative sixth-month follow-up. Only the patients operated for unilateral central dry perforations were included in the study. Exclusion criteria included the presence of the following: cholesteatoma, active ear discharge, history of nasal surgery, smoking, upper airway infections, previous history of ear trauma, and patients with bilateral COM.

Ninety-two subjects agreed to participate the study. On the day of allocation, subjects underwent microscopic examination of their TMs. Those with an intact TM after myringoplasty were allocated to Group I. The auditory evaluation was not taken into consideration. Group II was defined as the group with failed myringoplasty, that is, persistent with perforation of the TM. Fourteen patients were excluded, as 10 patients had a history of nasal surgery and four patients had upper airway infections.

## Evaluation of subjects

After a detailed medical history, nasal obstruction symptom evaluation was performed with NOSE and VAS symptom scales. All subjects underwent a complete ear nose and throat examination. Nasal mucociliary clearance was evaluated with the saccharin test. NCI was assessed with acoustic rhinometry before and after application of a nasal decongestant.

## Subjective evaluation of allergic rhinitis

All patients completed a standardized validated questionnaire (SFAR) developed by Annesi-Maesano et al. (3). SFAR encompassed eight features of allergic rhinitis, and a SFAR value over 7 was defined as presence of allergic rhinitis.

## Subjective evaluation of Eustachian tube function (ETF)

Function of Eustachian tubes of the subjects' healthy ears were observed microscopically with Valsalva maneuver. The patient was asked to swell his/her cheeks by forcible expiration with the mouth closed and nostrils pinched. We aimed to obtain the movement of healthy TM with the flowing of air passage to the middle ear by this maneuver to determine the function of Eustachian tube.

## Subjective evaluation with NOSE and VAS scales

Nasal obstruction symptom evaluation was performed with the NOSE scale. In this scale, a score of 0 means no nasal obstruction and a score of 100 means the most severe nasal obstruction (4, 5).

The VAS scale is a 10-cm horizontal line. The word "none" was placed at the left end of the scale, and "very severe" was placed at the right end of the scale for predicting air hunger.

## Objective evaluation of NCI with acoustic rhinometry

The objective size of the nasal cavity was assessed with acoustic rhinometry before and 10 minutes after applying topical nasal decongestant. We applied oxymetazoline hydrochloride two or three times in each nostril. Rhinometrics (RhinSCAN, Interacoustics Inc; Denmark) was used. NCI was calculated as follows:

$$NCI = ([\text{post-decongestant measurement} - \text{baseline predecongestant measurement}] / (\text{baseline predecongestant measurement} \times 100))$$

## Objective evaluation with saccharin test

The nasal mucociliary activity was evaluated with saccharin time measurement for both sides as follows: subjects were seated and positioned with the head slightly extended. A saccharin granule was placed 2 cm inside the right nostril by the tester. Subjects were requested to maintain their position and were not allowed to breathe deeply, cough, talk, sniff, or sneeze. They were instructed to swallow every 30 s/min with a chronometer. The time in minutes, the patients first perceived the sweet taste of the saccharin was recorded. The mean and standard deviation of saccharin test were obtained.

## Statistical analysis

Statistical calculations were performed with Statistical Package for the Social Sciences 22.0 program (IBM Corp.; Armonk, NY, USA). Paired-samples t test, Pearson's chi square test, and Mann-Whitney U test were used in the assessment of parameters. The statistical significance level was established at  $p < 0.05$ .

## Results

Seventy-eight subjects were available for analysis. The average age ( $\pm$ standard deviation) of the subjects was  $30.44 \pm 12.69$  y with an age range of 14 to 58 y. There were 29 male subjects and 49 female subjects. Forty-four subjects were available to be included in Group I. Group II consisted of 34 patients. Postoperative evaluation period for Group I was  $15.5 \pm 5.5$  months after surgery and  $17.3 \pm 8.35$  months for Group II. There was no significant difference between two groups in terms of the evaluation period ( $p > 0.569$ ).

## Age and sex

There was no significant difference between groups according to age ( $p = 0.789$ ), sex ( $p = 2.65$ ), and MERI (middle ear risk index).

## Allergic rhinitis

There was no significant difference between groups according to presence of allergic rhinitis ( $p = 0.143$ ) (Table 1).

## Eustachian tube function

There was no significant difference between groups according to presence of tubal function ( $p = 0.294$ ) (Table 1).

### Side of operated ear

There was a significant difference for the success of myringoplasty according to the side of the operated ear. In the group of intact TMs, the likelihood of right ear being the operated ear was significantly higher compared to the group of myringoplasty failure ( $p=0.037$ ) (Table 1).

### VAS and NOSE scales

The VAS and NOSE scales did not show any significant difference between groups in terms of successful outcome of myringoplasty (VAS:  $p=0.846$ ; NOSE:  $p=0.979$ ) (Table 2).

### Nasal congestion index

NCI of both the operated side and the non-operated side did not show any significant difference between groups in terms of successful outcome of myringoplasty ( $p=0.274$ ) (Table 2).

### Mucociliary clearance

The mucociliary clearance of both the operated side and the non-operated side did not show any significant difference between groups in terms of successful outcome of myringoplasty ( $p=0.387$ ) (Table 2).

### Discussion

Myringoplasty is the surgical method of choice for dry central perforations. The outcome of myringoplasty may vary depending on otological, surgical, and patient-related factors. Recognition of patients who are not prone to have a favorable outcome is important for the surgeon, as failures may result in significant effects on the health-related quality of life (6).

It is not uncommon for patients with chronic ear problems to have coexistent nasal pathologies that can cause or even worsen the disease (7). However, studies on the effect of nasal disorders on the success of tympanoplasty are limited. A recent study by Callioglu et al. (8) has shown that allergic rhinitis may decrease the graft success rate, although the difference was not statistically significant. But no study has evaluated the effect of the NCI on graft integrity.

In this study, we tried to find out whether we would be able to find a difference in nasal functions of patients with a favorable outcome of myringoplasty and those with an unfavorable outcome. First of all, we have looked for a difference in two groups in terms of their demographics. There was not an effect of the age or sex of the patient on the success of surgery. A study by Pinar et al. (9) has evaluated prognostic factors in tympanoplasty. Similar to our results, neither age nor the sex of the patients was independent prognostic factors.

Allergic rhinitis plays a significant role in the otolaryngologists' practice. Salvinelli et al. (10) suggested that allergic rhinitis may be a cause of failures in tympanoplasty. It is however surprising that no study was ever done to find out whether the presence of allergic rhinitis led to an unfavorable outcome for patients undergoing this type of surgery. The role of allergic rhinitis in

**Table 1.** Comparison of demographics, the presence of allergic rhinitis and the operated side in two groups

		Success (n=44)	Failure (n=34)
		Mean±SD	Mean±SD
Age		28.98±12.06	32.32±13.42
MERI score		1	1
		n (%)	n (%)
Sex	Male	14 (31.8)	15 (44.1)
	Female	30 (68.2)	19 (55.9)
History of allergic rhinitis	Yes	9 (20.5)	12 (35.3)
	No	35 (79.5)	22 (64.7)
Tubal function	Present	18 (40.9)	10 (29.4)
	Absent	26 (59.1)	24 (70.6)
Operated ear	Right	26 (59.1)	12 (35.3)
	Left	18 (40.9)	22 (64.7)

\*Student-t test; \*Pearson's chi square test; \* $p<0.05$ ; MERI : middle ear risk index

**Table 2.** Comparison of subjective and objective measurements of nasal function in two groups

		Success (n=44)	Failure (n=34)
VAS	Min-max (median)	0-21 (2.0)	0-32 (0.0)
	Mean±SD	3.89±5.04	5.00±8.19
NOSE	Min-max (median)	0-21 (2.5)	0-32 (3.0)
	Mean±SD	4.59±5.68	4.85±6.84
NCI (non-operated side)	Min-max (median)	-200-100 (15)	-353-100 (2.33)
	Mean±SD	11.21±47.7	-8.68±76.7
NCI (operated side)	Min-max (median)	-230-100 (14,2)	-353-100 (6)
	Mean±SD	-7.92±72.3	11.8±45.5
MCC (non-operated side)	Min.-max. (median)	1-32 (7.0)	2-28 (7.0)
	Mean±SD	8.80±6.54	7.47±5.34
MCC (operated side)	Min.-max. (median)	1-30 (12.0)	3-33 (9.5)
	Mean±SD	12.41±6.76	11.76±7.61

Mann-Whitney U Test; VAS: visual analog scale; NOSE: nasal obstruction symptom evaluation; NCI: nasal congestion index; MCC: mucociliary clearance rate

establishing COM has been studied in 68 adult patients who were candidates for ear surgery and 184 controls were evaluated for the presence of allergic rhinitis. The study did not show a significant difference in the prevalence of AR in the COM patients compared with the controls (11). In our study, we have not found any difference between two groups in terms of having allergic rhinitis symptoms. However, one limitation of our study is that we have not used any skin or blood tests to verify the diagnosis of allergic rhinitis of our patients. Whether the presence

of allergic rhinitis would affect the outcome of myringoplasty remains to be investigated.

Past studies have shown a role for the protective and pressure-regulating functions of the Eustachian tube in preserving middle ear health (10). It has been stated that the results of the ETF tests can be used to predict the success of myringoplasty in adults with persistent perforations (12). In another study, ETF in subjects with COM were preoperatively evaluated with saccharin and methylene blue test, and it was shown that type 1 tympanoplasty was successful in 94% with normal ETF and in 68% with partial dysfunction (13). In our study, we found no significant difference between groups in terms of the presence of Eustachian tube dysfunction. One limitation is that we used the Valsalva maneuver for evaluation of the movement of the other intact TM as our only method of measurement of Eustachian tube dysfunction. However, a study by Doyle et al. (14) has shown that ETFs for the right and left Eustachian tubes are not independent. These investigators have also shown that ETF parameters measured at a single time may not be representative of measures of those parameters at other times. This may be the reason why we failed to find a significant difference between the two groups. The effect of subjective measurement of nasal airflow on the outcome of myringoplasty has not been investigated previously. In our study, we did not find any difference between groups in terms of VAS and NOSE scores.

Nasal congestion index has been defined as the status of reversible congestion of the nasal mucosa as measured by peak flowmetry and acoustic rhinometry following nasal application of a topical decongestant (15). By measuring the NCI, the erectile function of the nasal lining can also be measured. We hypothesized that a dysfunction of the nasal mucosa could exist in patients with an unsuccessful outcome of myringoplasty. However, we failed to find any significant difference between subjects in terms of their response to nasal decongestant as measured by acoustic rhinometry.

The mucociliary function in subjects with COM has been investigated in previous studies. Cingi et al. (16) found functional reduction in mucociliary transport time by using Tc 99m on the affected side of unilateral COM patients. When surgical outcome was correlated with mucociliary transport, the normal transport time percentage was found to be considerably higher in the success group (50%) than in the failure group (22%) (17). In a similar study, it has been shown that the outcome of middle ear surgery would be a success in normal EFT, whereas in partial dysfunction, the outcome needs not necessarily be a failure (13). In our study, the mucociliary clearance values did not show statistically significant difference between two groups.

Our study has one major limitation. Our subjects were selected from the patients we have already operated and not every subject was willing to undergo testing of their nasal functions postoperatively. For that reason, the number of subjects was smaller

than we expected. Therefore, the power of our study may not be sufficient to state that nasal functions do not have any effect on the outcome of myringoplasty. Again there may be a significant selection bias of patients, as the study was not designed prospectively. However, we believe further studies are definitely necessary to enlighten the ongoing belief that nasal functions play a major role in the outcome of myringoplasty.

## Conclusion

In this small study, we failed to show an effect of subjective nasal symptom scores, the NCI, the mucociliary clearance rate, ETF, and allergic rhinitis on the integrity of grafts after myringoplasty. Further studies with larger samples are necessary to help the otolaryngologist predict the outcome of myringoplasty operations depending on nasal functions of the patients.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Ümraniye Training and Research Hospital (23.12.2014-18496).

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

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept - B.Ç.E.; Design - A.Ş.Y., S.Ş.Ö.; Supervision - S.Z.T., Ç.O.; Resource - S.Ş.Ö., B.Ç.E.; Materials - S.Ş.Ö., B.Ç.E.; Data Collection and/or Processing - S.Ş.Ö., B.Ç.E.; Analysis and/or Interpretation - A.Ş.Y.; Literature Search - S.Z.T.; Writing - S.Ş.Ö., B.Ç.E., A.Ş.Y.; Critical Reviews - S.Z.T., Ç.O.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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

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