ORIGINAL CONTRIBUTION

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# Septoplasty outcome in patients with and without allergic rhinitis*

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SUMMARY

***Objective:*** *To assess the effect of allergic rhinitis (AR) on septoplasty outcome in terms of subjective and objective measurements and clarify whether patients with nasal septum deviation (NSD) and allergic rhinitis (AR) benefit from septoplasty to the same extent as patients who do not have allergic rhinitis.*

***Study design:*** *A prospective study, with consecutive sampling of all patients undergoing septoplasty from June 2005 to February 2007, conducted in a tertiary care otorhinolaryngologic clinic.*

***Methods:*** *One hundred and seventy-six patients underwent septoplasty over the study period. Follow-up data were obtained from one hundred and forty-nine subjects. All participants underwent active anterior rhinomanometry (AAR) and assessed the severity of their symptoms based on a Nasal Obstuction Symptom Evaluation (NOSE) Scale prior to and following septoplasty. Patients were divided into two groups according to AR status. Comparisons were made between symptoms and rhinomanometry data.*

***Results:*** *Following septoplasty, subjective improvement in breathing (decreased NOSE scores) was observed for both groups, the decrease being significantly more substantial in the NSD group. Airflow, as measured during active anterior rhinomanometry, increased in the deviated side following septoplasty in both groups. In the NSD group the increase was significantly higher than in the NSD and AR group.*

***Conclusion:*** *The surgeon should proceed with caution when managing patients with allergic rhinitis and nasal septum deviation. These patients are more likely to be less satisfied after septoplasty compared to patients without allergy. Adequate medical management of allergic rhinitis should be the first priority for these cases.*

*Key words: septoplasty, allergic rhinitis, rhinomanometry*

## INTRODUCTION

Difficulty in nasal breathing is probably the most common complaint in rhinologic practice. Among the major causes are nasal septum deviation (NSD) and allergic rhinitis (AR). About 80% of the general population has a deviated nasal septum to some degree [(1)]. On the other hand, allergic rhinitis is a form of allergy with high prevalence in Western societies [(2)]. Treatment of NSD is surgical with high success rate, in terms of patient satisfaction, particularly if the deformity is localized in the caudal septal end or the valve area [(3,4)]. Treatment of AR is a much more complex issue, including medication, avoidance of the causative allergen, desensitization and the use of a variety of surgical techniques, which mainly aim at the reduction of the size of the inferior turbinates [(5,6)]. When allergic rhinitis and nasal septum deviation coexist, the patient may undergo septoplasty combined with some form of volume reduction of the inferior turbinates [(5,6)].

When deciding on the best therapeutic strategy for patients with nasal pathology one must have a tool for the assessment of subjective symptoms. The Nasal Obstruction Symptom Evaluation (NOSE) Scale is a disease-specific quality of life instrument for use in nasal obstruction, developed by Stewart et al. [(7).] Moreover, an objective assessment of nasal airway patency can be provided by active anterior rhinomanometry. Among other methods of evaluation of nasal obstruction,

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including acoustic rhinometry and peak inspiratory nasal flow, active anterior rhinomanometry is reliable, simple to perform and equally accurate [8,9].

The co-existence of NSD and AR often present a therapeutic challenge for the physician. The aim of this study is to assess the outcome of septoplasty using self-assessment and objective measures and to examine the extent to which this outcome is affected by allergic rhinitis status.

## MATERIALS AND METHODS

### *Subjects*

The study was conducted in a tertiary referral center - Department of Otorhinolaryngology, University Hospital of Heraklion, Crete, Greece, between June 2005 and February 2007. It was approved by the Institutional Review Board. One hundred and seventy-six patients who were due to undergo septoplasty enrolled in the study during this time period. Patients with nasal septal deviation were chosen based on their complaint about difficulty in nasal breathing and diagnosis of NSD was made based solely on rhinoscopic findings. Patients diagnosed with allergic rhinitis, had clinical findings in addition to elevated serum specific IgE against at least one of the tested allergens. Clinical diagnosis of AR was based on standard criteria [10]. AR subjects were included regardless of recent local medication use, but patients receiving systemic steroids were excluded from the study. Patients undergoing other simultaneous surgical procedures, such as inferior turbinate reduction or rhinoplasty were also excluded. All subjects were interviewed the day before surgery, and an informed consent was obtained. Septoplasty was performed under either local or general anesthesia by one of three senior ENT surgeons.

### *IgE measeurements*

The specific IgE measurements, with the use of C.A.R.L.A.® (Capture Assay Radim Liquid Allergen, RADIM SpA, Rome, Italy) RAST, were considered to be elevated when ≥ 0.5 IU/ml (≥ class 1). Specific IgE measurements were determined for the following allergens: dust mites *(Dermatophagoides pteronyssinus and D. farinae)*, cat and dog epithelia, olive, *Aspergillus fumingatus, Alternaria alternata, Parietaria judaica*, and ragweed.

### *Self-assessment measure: the NOSE scale*

During interview, demographic data were recorded and patients were asked to complete the Nasal Obstruction Symptom Evaluation scale (NOSE) (Table 1), which is a validated, disease-specific quality of life instrument for use in nasal obstruction [7]. According to this scale, patients were asked to evaluate the severity of their nasal congestion, their difficulty in nasal breathing, their difficulty in breathing during their sleep and their difficulty in breathing overall. The severity of their symptoms was recorded based on a scale from 0 to 4, 0 standing for absence of the symptom and 4 for severe problem. Possible scores ranged from 0 to 20 and higher scores implied a greater subjective degree of obstruction (5 questions, each rated on a 5-point Likert scale). Patients completed the NOSE questionnaire on the day before and approximately 4 weeks after the septoplasy procedure.

### *Rhinoscopy and endoscopy*

All patients underwent anterior rhinoscopy and nasal endoscopy using a 30o rigid Hopkins endoscope for a more detailed description and evaluation of the nasal anatomy. Recorded data included the side of maximum deviation (right/left), the severity of septal deviation (1: <25% obstruction, 2: 25-50% obstruction, 3: 50-75% obstruction, 4: >75% obstruction), the site of maximum deviation based on the five-area division by Cottle. The specific IgE measurements, with the use of C.A.R.L.A.® (Capture Assay Radim Liquid Allergen, RADIM SpA, Rome, Italy) RAST, were considered to be elevated when ≥ 0.5 IU/ml (≥ class 1). Specific IgE measurements were determined for the following allergens: dust mites *(Dermatophagoides pteronyssinus and Farinae)*, cat and dog epithelia, olive, Aspergillus fumingatus, *Alternaria alternata, Parietaria judaica*, and ragweed [11]. The co-existence of allergic rhinitis was determined by history and RAST tests. In our data analysis we classified nasal deviation as anterior, when maximum deviation was located at areas 1, 2, and 3 (naris, anterior nasal valve and nasal bones area, respectively), and posterior when it was located in areas 4 and 5 (anterior and posterior part of inferior nasal concha, respectively).

Table 1. The NOSE scale.

Over the past month, how much of a problem were the following conditions for you?
Please circle the most correct response

| | | Not a problem | Very mild problem | Moderate problem | Fairly severe problem | Severe problem |
|---|---|---|---|---|---|---|
| 1 | Nasal congestion or stuffiness | 0 | 1 | 2 | 3 | 4 |
| 2 | Nasal blockage or obstruction | 0 | 1 | 2 | 3 | 4 |
| 3 | Trouble breathing through nose | 0 | 1 | 2 | 3 | 4 |
| 4 | Trouble sleeping | 0 | 1 | 2 | 3 | 4 |
| 5 | Unable to get enough air through my nose during exercise or exertion | 0 | 1 | 2 | 3 | 4 |

*Anterior rhinomanometry measurements*

In addition, all patients underwent active anterior rhinomanometry, using the ATMOS 300 Rhinomanometer (Atmos, Lenzkirch, Germany), based on the requirements of the International Standardization Committee on rhinomanometry [11]. Subjects were tested before and after decongestion with the use of oxymetazolin hydrochloride nasal spray 1% with a 20 min interval. Each test was performed with the patient seated in a comfortable position. Unilateral nasal resistance was calculated according to the formula: resistance = pressure / flow. For each nostril the mean airflow was read at 150 Pa, according to the guidelines of the International Committee on Rhinomanometry [12,13]. Nasal airflow was considered to be normal if it exceeded 330 $cm^3$ / sec [14]. Only the inspiratory flows were taken into account. It is noted that a strong positive correlation exists between inspiratory and expiratory values [15].

*The septoplasty procedure*

A hemitransfixion incision was performed; subperichondral and subperiostal tunnels were developed as required and deviated cartilage or bone were resected and reimplanted whenever possible, with preservation of the continuity of the caudal and dorsal parts of the septal cartilage. Any bony crests were also resected. A tamponade was placed and removed after one or two days. During this period intravenous antibiotics were administered. All patients received standard postoperative care with frequent nasal saline douches and administration of local ointment containing acid borique, paraffin and lanoline oil. Subjects were put on follow-up, and NOSE questionnaire and rhinomanometry were conducted at about four weeks postoperatively. Patients with postoperative complications, such as haematoma or synechiae, were excluded from the study.

*Statistical analysis*

Univariate comparisons of pre-operative patient characteristics were made between patients with and without allergic rhinitis. Continuous variables were compared using the independent samples t-test or non-parametric Mann-Whitney test as appropriate. Possible differences in the degree of NSD between the two groups were assessed using the chi-squared test for trend. Methods appropriate for paired data were applied to assess the degree of change in airflow measurements and NOSE scores after septoplasty, both overall and according to allergic rhinitis status. Partial correlation coefficients were calculated to assess correlation between the subjective and objective measures both pre- and post-operatively, accounting for allergic rhinitis status. Finally, multiple regression models were applied to assess whether the percentage change in airflow (dependent variable) differed according to allergic rhinitis status, adjusting for age, sex, and NSD side. A 5% significance level was used throughout. The statistical package used was SPSS 16.0.

RESULTS

Of the 176 patients who underwent septoplasty during the study period, 164 agreed to participate in the study (response rate of 93%). Fifiteen patients either failed to return for follow-up or presented with post-operative complications. Therefore, complete data were available for 149 subjects. Among these, 62 were allergic rhinitis patients and 87 were non-allergic. One hundred and thirteen (76%) of the patients undergoing septoplasty were male while 36 (24%) were female. Allergic and non-allergic rhinitis groups were not found to differ at baseline to a statistically significant extent, with regard to age, gender, NSD location (anterior/posterior), NSD side (left/right), or degree of NSD. In addition, the NOSE score (mean 12 ± SD of 2.6 and 11 ± SD of 2.8 in allergic and non-allergic rhinitis groups, respectively, $p = 0.24$) and airflow measurements in each nostril did not differ significantly between groups. After decongestion, increased airflow was observed in both left and right nostrils.

Follow-up was performed approximately 28 days after the procedure and consisted of the same testing as pre-operatively. Following septoplasty, a general decrease in NOSE scores was observed (median decrease 7 units, Wilcoxon signed ranks test, $p < 0.0001$). Only two patients (1.3%) had an increased NOSE score after septoplasty. There was extremely strong evidence that the average decrease was greater in patients who did not have allergic rhinitis (3.5 units, 95% CI 3.0 to 4.1, $p < 0.0001$), after adjusting for possible confounders, as can be seen in Table 2.

Table 2. Regression of NOSE score following septoplasty on patient group (AR, not AR), nature of deviation (anterior/posterior), NSD side (left/right), age, sex and baseline NOSE score (n=149).

| | **b1** | **95% CI for b** | **p-value** |
|---|---|---|---|
| Allergic rhinitis absent | -3.5 | -4.1 to –3.0 | < 0.0001 |
| Posterior nasal septal deviation | 0.2 | -0.4 to 0.7 | 0.547 |
| Right side NSD | -0.3 | -0.8 to 0.3 | 0.320 |
| Age (per 10 years) | 0.003 | -0.2 to 0.2 | 0.983 |
| Female sex | 0.04 | -0.6 to 0.7 | 0.903 |
| Baseline NOSE score | 0.3 | 0.2 to 0.4 | < 0.0001 |

When the measurements were considered separately according to the side of septal deviation, the increase in airflow on the given side following septoplasty (e.g. right NSD, right nostril) was found to be significantly higher in non-allergic rhinitis patients (Table 3). Patients with left side septal deviation without allergic rhinitis, showed a statistically significant greater post-op increase of the airflow on the left side when compared to those with allergic rhinitis (62.8 ± 4.9 % increases in the non-allergy group, 44.6 ± 4.8 % in the allergy group, adjusted p-value 0.015). A similar result was observed in patients with nasal deviation on the right side (57.7 ± 4.9 % increase in the non-allergy group, 37.6 ± 4.4 % in the allergy group, adjusted p-value 0.027). NOSE scores, on the other hand, were not found to be correlated with airflow measurements in each nostril neither before nor after septoplasty.

## DISCUSSION

The most common complaint in rhinologic practice is difficulty in nasal breathing, and nasal septal deviation and allergic rhinitis are among the most common causes [1]. The clinician often faces therapeutic dilemmas when managing a patient who suffers from both disease entities. In such cases, when the deviated septum completely obstructs the nasal chamber the answer is obvious. When the deformity is less pronounced, on the other hand, the therapeutic decision is more complex. Unfortunately history and physical examination, although imperative, are usually not sufficient to provide a definite anwser [16]. In general, available diagnostic tools can be categorized as subjective, including patient history, the Nasal Obstruction Evaluation Scale (NOSE) [7], questionnaires incorporating a visual analogue scale [17], the Fairley nasal symptom score, the Nottingham health profile and the General health questionnaire [18,19], and objective, such as rhinomanometry, acoustic rhinometry [20], computed tomography and peak inspiratory nasal flow [21].

In the present study, in order to assess subjective symptoms we employed the Nasal Obstruction Symptom Evaluation (NOSE) Scale, which is a disease-specific quality of life instrument for use in nasal obstruction, developed by Stewart et al. [7]. Its major advantage is that it is superior to history in evaluating the subjective symptoms in the most accurate possible way with regard to difficulty in breathing, whereas other scales, such as the Fairley nasal symptom score, are not equally reliable [17].

For the objective assessment of nasal patency, the method we utilized was active anterior rhinomanometry (AAR), which is a method known for at least 30 years. It is an easy to perform method compared to posterior or passive anterior rhinomanometry and probably more accurate [22]. Over the years, a number of investigators have used rhinomanometry to document the pre- to post-operative reduction in mean airway resistance values in patients who underwent septoplasty [23-25]. The major drawback of this method is that it has failed to correlate the values of nasal airflow and resistance to the subjective scores of nasal obstruction or predict the patients' postoperative satisfaction, leading to rather limited use in clinical practice [16]. On the other hand there has not been any study correlating the differences in nasal air flows in both untreated and decongested nasal state with the differences in the subjective scores of nasal obstruction. It has been clearly demonstrated that the location of the septal deformity is strongly related to both surgical outcome and airway resistance [16]. Other examinations such as acoustic rhinometry or peak inspiratory nasal airflow although extensively studied, have not been incorporated into clinical practice, either because of lack of accuracy or cost [26].

The best management of patients with nasal septal deviation is still under debate. There are no evidence-based guidelines for which patients to operate on and which patients will benefit the most. Treatment of choice for NSD is septoplasty, although other surgical techniques, such as submucous resection, have been used with less favorable results [4,27]. Septoplasty is one of the most frequently performed surgical procedures in otorhinolaryngology and its selection relies largely on clinical judgment alone. Practice based on experience alone is not regarded satisfactory neither from a scientific nor from a legal point of view. A significant number of patients report to be less satisfied following surgery, thus providing proof of the limitations of clinical selection criteria [28]. The initial improvement of nasal ventilation felt in the first months or years after surgery is progressively devaluated by the patients with the passing of time, particularly if other causes for nasal obstruction, such as chronic rhinitis and rhinosinusitis, also coexist [29]. On the other hand, some investigators believe that, regardless of the magnitude of septal deviation, most patients benefit from its surgical correction because it eliminates a possible contributing factor to the pathogenesis of chronic rhinosinusitis [30]. Nevertheless, inappropriate selection of surgery as a therapeutic option and inappropriate choice of surgical modality do seem to be major causes for dissatisfaction [31].

Allergic rhinitis (AR) significantly reduces quality of life (QOL), interferes with both attendance and performance at school and work [32,33] and results in substantial financial costs [34]. AR is common and affects over 20% of the population. The prevalence of AR has increased over the last three decades [35]. Subjects at most risk are those with atopy, with a family history of rhinitis, first-born children and immigrants [36]. AR is the predominant form in children, but accounts for about a third of rhinitis cases in adults. The allergic profiles of the Cretan population have been previously studied [37,38]. Treatment of allergic rhinitis consists of patient education, allergen avoidance, pharmacotherapy, immunotherapy and surgery. The latter mainly aims at the reduction of the inferior turbinates [5,6].

The greater decrease in NOSE score in the non-AR group post-operatively compared to the AR group, as found in the present study, agrees with clinical experience that has been previously documented [8]. This finding may be attributed to the fact that regardless of the final surgical outcome, patients with allergic rhinitis may exhibit more crusting, swelling and discomfort during the early post-operative period or may need additional medication to control their allergy. Another feasible explanation would be the wrong attribution of symptoms by the clinician to the deviated septum pre-operatively when in fact these symptoms are more related to allergic status.

As far as rhinomanometric data are concerned there is an increase in airflow in both groups post-operatively. Interestingly, when the side of deviation is not taken into account no statistically significant differences are noted in each group following septoplasty. When the side of deviation is taken into account, on the other hand, there appears to be a

significant difference not only pre- and post-operatively in each group, but also between the groups. In patients with nasal septal deviation on the left side, airflow in the left nostril before decongestion increases postoperatively 44,6 ± 4,8% in the allergic rhinitis group, whereas in the non-AR group the increase is 62,8 ± 4,9% and the difference among the two groups is statistically significant ($p < 0,015$). The same is observed if the right side is taken into account (37,6 ± 4,4 % in the allergic rhinitis group and 52,7 ± 4,9 % in the non allergic group) (Table 3). The above data agree with those of Pirilä et al. [8] who employed active anterior rhinomanometry and acoustic rhinometry on patients undergoing septoplasty. They found significant increases of airflow on the deviated side and slight decreases on the contralateral side following septoplasty, although these results had not been correlated with the allergic status [8].

Table 3. Increase in airflow measurement following septoplasty, as a percentage of pre-treatment measurement, by NSD side (left or right).

| Changes | Allergic rhinitis | Without allergic rhinitis | p-value[1] |
|---|---|---|---|
| | Mean (SE) | Mean (SE) | |
| **Subjects with left NSD (n=74), left nostril** | | | |
| Increase before decongestion, (% of initial airflow) | 44.6 (4.8) | 62.8 (4.9) | 0.011 |
| Increase after decongestion, (% of initial airflow) | 33.1 (3.3) | 40.5 (3.3) | 0.122 |
| **Subjects with right NSD (n=75), right nostril** | | | |
| Increase before decongestion, (% of initial airflow) | 37.6 (4.4) | 52.7 (4.9) | 0.038 |
| Increase after decongestion, (% of initial airflow) | 29.4 (3.3) | 36.9 (3.5) | 0.147 |

[1] Independent samples t-tests were used to compare mean changes between the patients with and without allergic rhinitis.

Based on the prementioned data from both objective and subjective measurements, a conclusion with major impact on patient management is reached. Coexistence of allergic rhinitis with nasal septum deviation seems to place patients in a less favorable prognostic group as far as surgical outcome and patient satisfaction are concerned. This conclusion is similar to the usual, undocumented, clinical observation that patients without allergic rhinitis undergoing septoplasty tend to be more satisfied post-operatively. Other authors, such as Stewart et al. [7] have found that patient satisfaction following septoplasty did not correlate with their allergic rhinitis, although this may be attributed to the small sample size used in the study. Bohlin et al. [23] have shown that after proper patient selection, based on active anterior rhinomanometry and anterior rhinoscopy, 84% of the patients were satisfied 10 years post-operatively, while the decrease in nasal resistance after the operation remained the same after 10 years [39]. The present study suggests that allergic rhinitis should be strongly considered during patient selection for septoplasty.

A major limitation of this study is the short period of follow-up. The average of four weeks may account in both ways. First, since it is the early post-operative period and healing of the surgical wound is still under way, patients may have scored better in the NOSE questionnaire if they were examined after a longer period. On the other hand, the post-operative time of four weeks is generally considered enough to judge the surgical outcome and longer periods of follow-up have not shown significant differences in patient satisfaction [23]. Another weakness of the study is the exclusive use of anterior active rhinomanometry, which may be reliable for objective assessment of nasal patency, but it does not closely correlate with subjective estimation of patency and is not superior to other methods such as acoustic rhinometry [30,40]. Other diagnostic tools, such as peak inspiratory nasal flow measurement, have been shown to correlate well with subjective assessment of nasal patency [41], but their clinical application remains poor. The use of multiple tools for the objective assessment of nasal patency may eventually provide stronger evidence for our conclusion. Nevertheless, it becomes clear that the surgeon should proceed with caution when managing patients with both allergic rhinitis and nasal septum deviation. These patients are more likely to be less satisfied after septoplasty compared to patients without allergy. Adequate medical management of allergic rhinitis should be the first priority for these cases.

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