

The effect of tobacco smoking on septoplasty outcomes: a prospective controlled study

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Abstract

Background: We evaluated the effects of tobacco smoking on functional outcomes of septoplasty and complication rates.

Methods: In total, 183 patients (127 males, 56 females) who had septum deviations and underwent septoplasties from January 2012 to December 2013 were evaluated. Subjects were divided into three groups: non-smokers (Group A), light smokers (< 20 cigarettes/day, Group B), and heavy smokers (> 20 cigarettes/day Group C). Nasal Obstruction Symptom Evaluation (NOSE) scoring was used to evaluate the effects of tobacco smoking on septoplasty outcomes. Clinical evaluations were performed preoperatively and at one and six months postoperatively. Complications were evaluated during the clinical examinations.

Results: No significant differences were seen between the preoperative and 1-month postoperative NOSE scores, the 1- and 6-month postoperative NOSE scores, or the preoperative and 6-month postoperative NOSE scores among the groups ($p = 0.352$, 0.737 , and 0.344 , respectively). The overall complication rate also did not differ among the three groups ($p = 0.860$).

Conclusions: Active smoking status does not affect operation outcomes and does not increase the postoperative complication rate among patients undergoing septoplasty. Although we should advise our patients to stop smoking because of its known harmful effects, smoking may not be a selection criterion for septoplasty. Hippokratia 2015; 19 (3): 219-224.

Keywords: Nasal septum, quality of life, tobacco, smoking, complication

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Introduction

Smoking, active or passive, has been related to several diseases of the human respiratory system¹. Although the relationship between smoking and respiratory system diseases has been extensively addressed, the effects of smoking on upper respiratory system surgeries have not been widely evaluated². With respect to the nasal portion of the upper respiratory system, smoking has been found to be a risk factor for sinonasal carcinoma, nasal polyposis, and sinusitis, and in children for the development of otitis media¹. In the present study, we investigated smoking and non-smoking patients' situations after septoplasty.

Thousands of chemicals in tobacco smoke affect ciliary function in the respiratory tract. Previous studies have indicated that cigarette smoking negatively affects ciliary beat frequency, ciliogenesis, and the nasal mucociliary transport rate, and results in soft tissue thickening and an increased number of goblet cells². Among these chemicals, aldehydes are irritants that damage respiratory defense mechanisms. As an example, acrolein (propenal) is toxic to cilia and weakens the clearance mechanism¹.

Septoplasty is one of the most common and earliest-

learned surgical procedures in otolaryngology practice. It has been estimated that one-third of the population has some nasal obstruction and 25% of them require a surgical operation³. Previous studies have shown that the surgery results are affected by many different factors. Age-related results have been studied previously. Subjects of younger ages demonstrate better quality of life (QOL) compared to older individuals⁴. Sedaghat et al claimed that clinical assessment of patients with nasal obstruction and deviated septum was needed after septoplasty⁵. Consequently, symptom scales and/or QOL questionnaires became more useful methods for postoperative evaluations than objective tests. Several studies have reported septoplasty outcomes, but no prospective study on the relationship between smoking and septoplasty outcomes has been reported in the English-language literature. In this study, we evaluated the effects of smoking on functional outcomes and complication rates in septoplasty.

Materials and Methods

A prospective study was performed at the department of Otolaryngology of Bakırköy Training and Research Hospital, between January 2012 and December 2013, a

24-month period. The study protocol was approved by the hospital's ethics committee (No: 2012/16/03). Written informed consent was obtained from each patient.

All patients who were referred to the otolaryngology department with nasal obstruction and were diagnosed to have septal deviation underwent septoplasty and were enrolled in the study. Inclusion criteria were: age ≥ 18 years, presence of septal deviation resulting in chronic nasal obstruction, and the presence of persistent symptoms after at least one month of topical nasal steroid management. Exclusion criteria were: age < 18 years, cessation of smoking, self-reported asthma/allergic rhinitis symptoms, turbinate hypertrophy on physical examination, chronic sinusitis, chronic rhinitis, previous nasal surgery, and septal deviation that needed an additional procedure, such as a rhinoplasty/open technique septoplasty/nasal septal reconstruction or endoscopic sinus surgery. We also excluded patients who were ex-smokers, lost to follow-up, or changed their smoking habits (ceased, increased, or decreased) during the study period.

Subjects were divided into three groups according to the number of cigarettes smoked per day. Non-smokers were grouped as group A, subjects who smoked fewer than 20 cigarettes were group B (light smokers), and subjects who smoked more than 20 cigarettes were group C (heavy smokers)⁶. A single pack of cigarettes contains 20 cigarettes.

We used the Nasal Obstruction Symptom Evaluation (NOSE) scoring to evaluate the negative effects of smoking on septoplasty outcomes⁷. Our clinic nurses obtained the NOSE score for each patient preoperatively and also at one and six months postoperatively (Table 1). All physicians were blinded to patients' NOSE scores. The patients underwent a complete ENT examination involving nasal endoscopy preoperatively and also at one and six months postoperatively. All patients were additionally evaluated for the following possible complications: hemorrhage, nasal septal hematoma, abscess formation, hyposmia, anosmia, palatal sensory impairment, columellar retraction, oronasal fistula, vestibulitis, nasal synechiae, and nasal septal perforation. Smokers who developed complications had a weekly follow-up. Topical antibiotic ointment was used for mucosal injuries. Systemic antibiotics were stopped when the nasal splint was taken off. Patients who had complications were advised again to quit smoking after the operation. When reporting the complication rates, the 6-month complications were re-

ported as new complication events.

Sample size calculation

As no previous study had evaluated the effects of smoking on septoplasty outcomes with QOL questionnaires, we used for sample size calculation the closest study available, by Rudmik et al which evaluated the effects of smoking on endoscopic sinus surgery outcomes using the Rhinosinusitis Disability Index (RSDI) and Chronic Sinusitis Survey (CSS)⁸. When the difference in QOL scores was 15–30%, with α set at 0.05, the probability of type I error at 0.01, and powered at 0.8, a minimum sample size of 60 per group was needed.

Statistical analysis

For statistical analyses, the Number Cruncher Statistical System software was used (NCSS 2007, Statistical Software, UT, USA). The median values of total power were calculated from the filtered raw data for each of the three groups at each benchmark. Data were evaluated by descriptive statistical methods (mean, standard deviation, median, interquartile range). In addition to the multiple-group repeated-measures Friedman test, comparisons between groups used the Kruskal-Wallis test, subgroup comparisons were performed using Dunn's multiple comparison test, qualitative comparisons of data were performed using the χ^2 test, and qualitative data on recurrence were evaluated with McNemar's test. Results with a p-value < 0.05 and appropriate 95% confidence intervals (CI) were considered statistically significant.

Results

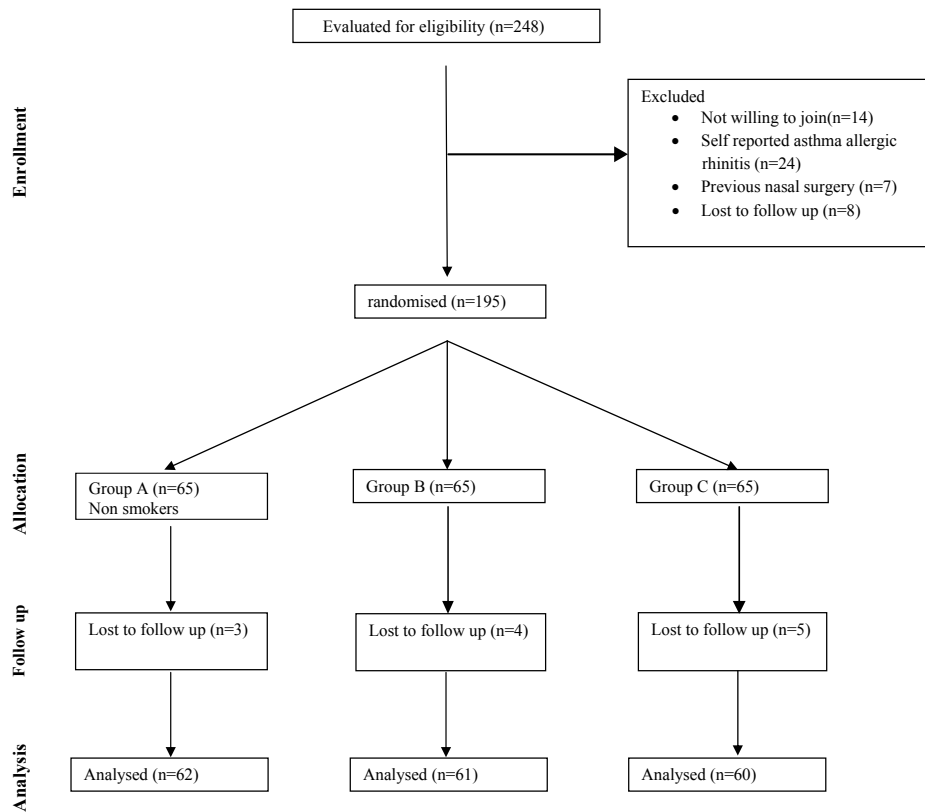
In total, 183 patients (127 male, 56 female) were enrolled. The study's CONSORT flow diagram is presented in Table 2. No significant difference in age or gender was observed among the three groups ($p=0.147$ and $p=0.451$, respectively).

When the preoperative smoking duration was compared, there were no significant differences in smoking duration between groups B and C (11.12 ± 7.94 vs. 11.87 ± 7.53 , respectively; $p=0.471$). When the NOSE scores were evaluated, preoperative scores differed among groups ($p=0.013$). Preoperative NOSE scores were significantly lower in group A than groups B and C ($p=0.048$ and $p=0.018$, respectively). When groups B and C were compared, there were no significant differences ($p=0.915$). Postoperative 1-month NOSE score levels

Table 1: The Nasal Obstruction Septoplasty Effectiveness (NOSE) scale (Over the past 1 month, how much of a problem were the following conditions for you).

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

Table 2: The consort diagram of the study evaluating the effect of smoking on septoplasty outcomes.



Group A: Non smokers, Group B: Light smokers (<20 cigarettes per day), Group C: Heavy smokers (>20 cigarettes per day).

differed among the groups (p =0.045). The scores were significantly lower in group A than group B (p =0.043). Comparisons between groups A and C and between groups B and C did not show significant differences (p =0.184 and p =0.796, respectively). Postoperative 6-month NOSE scores did not differ between the groups (p =0.789; Table 3, Figure 1).

When the change in NOSE score was assessed as a percentage between preoperative and postoperative one month, between postoperative one month and postoperative six months, and between preoperative and post-

operative six months, the scores of the groups showed no significant differences (p =0.352, p =0.737, and p =0.344, respectively; Table 4).

All patients underwent a complete ENT examination involving nasal endoscopy preoperatively and also at one and six months postoperatively, and complications were recorded (Table 5). When complications were compared, the three groups showed no significant difference at postoperative one or six months (p =0.421 and p =0.135, respectively). The overall complication rate also did not differ between groups (p =0.860; Figure 2).

Table 3: The comparison of NOSE scores between study groups (Group A: Non smokers, Group B: Light smokers (<20 cigarettes per day), Group C: Heavy smokers (>20 cigarettes per day).

NOSE		Group A	Group B	Group C	p
Preop	Mean ± SD	11.29 ± 4.32	13.03 ± 3.89	13.33 ± 4.12	0.013
	Median (IQR)	11 (8-14.25)	12 (11-16.5)	14 (11-16)	
Postop one-month	Mean ± SD	Mean ± SD	6.34 ± 4.23	5.87 ± 3.97	0.045
	Median (IQR)	4 (1.75-7)	6 (3-9)	6 (3.25-7.75)	
Postop six-month	Mean ± SD	4.37 ± 4.79	4.9 ± 4.52	4.48 ± 4.15	0.789
	Median (IQR)	2.5 (0-8)	3 (1-8)	4 (0.25-7)	
p		0.0001	0.0001	0.0001	

SD: standard deviation, IQR: interquartile range.

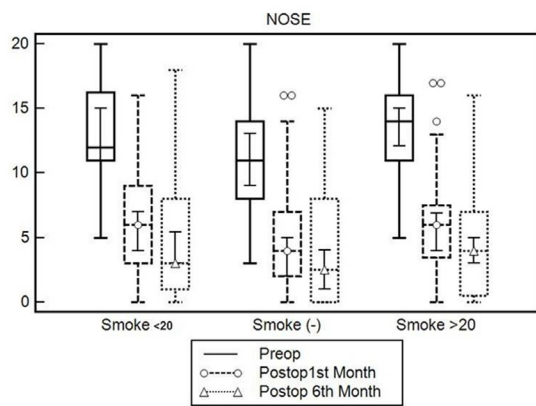


Figure 1: Pre- and postoperative scores of the Nasal Obstruction Septoplasty Effectiveness (NOSE) questionnaire ($p < 0.0001$).

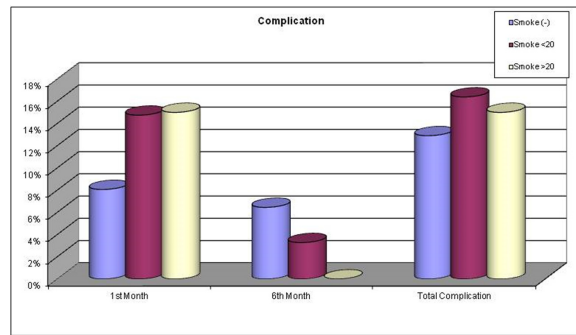


Figure 2: Comparison of complication rates according to the groups (Group A: Non smokers, Group B: Light smokers (<20 cigarettes per day), Group C: Heavy smokers (>20 cigarettes per day).

Table 4: The comparison of NOSE Alterations (%) between study groups (Group A: Non smokers, Group B: Light smokers (<20 cigarettes per day), Group C: Heavy smokers (>20 cigarettes per day).

NOSE alteration %		Group A	Group B	Group C	p
Preop	Mean ± SD	59.05 ± 36.41	51.8 ± 28.58	57.97 ± 22.65	
1 st month	Median (IQR)	66.67 (37.94-86.16)	50 (31.67-77.78)	50 (44.70-78.33)	0.352
Preop	Mean ± SD	58.3 ± 48.55	61.75 ± 33.81	68.15 ± 26.54	
6 th month	Median (IQR)	73.08 (34.80-100)	72.73 (36.67-89.90)	66,6 (47.50-98.53)	0.344
1 st month	Mean ± SD	10.08 ± 78.72	18.89 ± 67.84	19.02 ± 70.64	
6 th month	Median (IQR)	23.21 (-3.85-54.17)	33.33 (-11.81-66.67)	28.57 (-5.36-72.92)	0.737

SD: standard deviation, IQR: interquartile range.

Table 5: The detected complications at 1th month and 6th month visit according to study groups (Group A: Non smokers, Group B: Light smokers (<20 cigarettes per day), Group C: Heavy smokers (>20 cigarettes per day).

Complication		Group A		Group B		Group C	
1 th month	None	57	91.94%	52	85.25%	51	85.00%
	Septal perforation	0	0.00%	3	4.92%	3	5.00%
	Synechia	1	1.61%	3	4.92%	2	3.33%
	Hypoesthesia	3	4.84%	0	0.00%	2	3.33%
	Vestibulitis	1	1.61%	1	1.64%	2	3.33%
	Epistaxis	0	0.00%	2	3.28%	0	0.00%
6 th month	None	58	93.55%	59	96.72%	60	100.00%
	Septal perforation	1	1.61%	0	0.00%	0	0.00%
	Synechia	1	1.61%	1	1.64%	0	0.00%
	Vestibulitis	1	1.61%	0	0.00%	0	0.00%
	Epistaxis	1	1.61%	1	1.64%	0	0.00%

Discussion

Smoking remains a worldwide public health problem. According to the Global Adult Tobacco Survey Turkey Report (2010) 31.2% of adults (~16 million people) aged ≥ 15 years were smoking in Turkey at that time⁸. Such a high rate requires us to consider the effects of smoking on the outcomes of upper respiratory system surgery.

We performed this prospective study to evaluate the effects of smoking on septoplasty outcomes. We did not find any significant differences between heavy or light smoking and non-smoking subjects in NOSE scores or complications.

We used the NOSE scale, first proposed by Stewart et al, to study the effects of smoking on septoplasty outcomes⁷. This scale is rapid, valid, and reliable and used mainly to evaluate nasal obstructions⁹. Previous studies have demonstrated that this scale correlates well with nasal examinations and computed tomography findings and is useful for the evaluation of septoplasty operations¹⁰.

Previous studies have focused mainly on the effects of smoking on the nasal mucosa and its structure and function. A recent study indicated that smoking significantly reduced nasal mucociliary clearance, the number

of ciliated cells and goblet cells, ciliary motility, and time of ciliary movement in ciliated cells¹¹. These changes were not permanent. Ex-smokers demonstrated similar properties as non-smokers, suggesting that ex-smokers recovered to normal function.

However, there are few data on the effects of smoking on septoplasty outcomes. Karaman et al. evaluated the effects of smoking on nasal mucociliary clearance (MMC) time with a saccharine test in 60 subjects (20 non-smoking subjects who underwent septoplasty, 20 smoking subjects who underwent septoplasty, and 20 normal subjects without nasal pathology)¹². The test was performed one day before surgery and three months after surgery. Compared to the smoking group, both preoperative and postoperative nasal MCC time decreased significantly in the non-smoking group. The increase in MMC time reflects additional harm to the nasal ciliary mucosa from smoking. However, this study did not evaluate functional outcomes. Although an increase in MMC time in the smoking group was demonstrated, it remains unknown whether this increase resulted in functional impairment (e.g. whether this increase resulted in nasal obstruction).

In a more recent study, Hong et al investigated predictive factors that influenced septoplasty outcomes¹³. Forty-nine subjects were evaluated regarding age, gender, smoking, allergies, and degree of septal deviation. The degree of nasal obstruction was measured with a visual analog scale and NOSE scoring. Nasal volume was measured with acoustic rhinometry. Emotional factors were also assessed using a stress questionnaire and Beck's depression index (BDI). The results indicated that subjective outcomes were not affected by smoking status. Only baseline NOSE scores were related to subjective improvement.

The effects of smoking on endoscopic sinus surgery have been assessed in previous studies. Rudmik et al .reported that active smoking status (500 non-smokers and 33 smoking subjects, who had similar preoperative Lund-Mackay scores) did not alter postoperative recovery in QOL after endoscopic sinus surgery⁶. To assess health-related QOL, they used the Rhinosinusitis Disability Index (RSDI) and Chronic Sinusitis Survey (CSS). Smokers and non-smokers both showed similar improvements in endoscopy scores and health-related QOL. However, another study found that cigarette smoking affected the long-term outcomes of endoscopic sinus surgery¹⁴. One previous study compared smokers with non-smoking men complaining of snoring and showed that there were no significant differences between smokers and non-smokers with regard to improvements in patient symptoms¹⁵.

In a 2012 review, Reh et al reported the results of a literature search on rhinosinusitis and smoking¹⁶. In total, 29 papers were reviewed to analyze the impact of smoking on surgical results. They reported that active smoking status was not a contraindication for ESS.

Kjaergaard et al evaluated 2,523 subjects who sought medical care for upper respiratory system problems¹⁷.

They evaluated the effects of smoking on self-reported upper airway health. Smokers had significantly more complaints regarding nose and sinus problems and reported more headaches, snoring, sleep apnea, and coughing^{2,17}. The authors stated that although they observed strong associations between smoking and upper respiratory system problems, they were unable to conclude that smoking caused or exaggerated upper airway health problems.

Operative success is difficult to assess because of discrepancies between objective tests, such as acoustic rhinometry, and postoperative QOL assessment/symptom scales. For this reason, some surgeons hesitate to advise patients regarding surgery despite the expected functional benefits. When harmful effects of smoking on the nasal portion of the upper respiratory tract are considered, similar hesitation regarding septoplasty in smoking patients may occur. In the present study, smokers who underwent septoplasty for septum deviation had similar improvements in NOSE scores and complication rates to non-smokers. Smoking status did not significantly affect the complication rates in our study. The most common complications were synechiae and septal perforation (Table 5). Previous reports indicate that synechiae formation is a common complication, detected in 7% of subjects. Septal perforation rates have been reported to be between 1% and 6.7%¹⁸.

We were unable to find any study in the English-language literature that evaluated the effects of septoplasty outcomes with a prospective design. The effects of smoking in our study were evaluated as smoking under or over 20 cigarettes per day. However, smoke exposure will be highly variable because of the differences in nicotine contents of cigarettes, the smoking environment, and mainstream versus sidestream smoke. We also advised our patients to quit smoking for its known harmful effects.

Conclusion

According to the current results, active smoking status does not affect septoplasty outcomes and does not increase postoperative complication rates. Thus, it may not be a patient selection criterion for septoplasty.

Conflict of interest

Authors report no conflicts of interest.

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References

1. Samet JM. Adverse effects of smoke exposure on the upper airway. *Tob Control*. 2004; 13 Suppl 1: i57-i60.
2. Kjaergaard T, Cvancarova M, Steinsvaag SK. Smoker's nose: structural and functional characteristics. *Laryngoscope*. 2010; 120: 1475-1480.
3. Fettman N, Sanford T, Sindwani R. Surgical management of the deviated septum: techniques in septoplasty. *Otolaryngol Clin North Am*. 2009; 42: 241-252.

4. Gandomi B, Bayat A, Kazemei T. Outcomes of septoplasty in young adults: the Nasal Obstruction Septoplasty Effectiveness study. *Am J Otolaryngol*. 2010; 31: 189-192.
5. Sedaghat AR, Busaba NY, Cunningham MJ, Kieff DA. Clinical assessment is an accurate predictor of which patients will need septoplasty. *Laryngoscope*. 2013; 123: 48-52.
6. Rudmik L, Mace JC, Smith TL. Smoking and endoscopic sinus surgery: does smoking volume contribute to clinical outcome. *Int. Forum Allergy Rhinol*. 2011; 1: 145-152.
7. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT. Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale. *Otolaryngol Head Neck Surg*. 2004; 130: 157-163.
8. The ministry of health of Turkey. Global Adult Tobacco Survey. Turkey Report. Ministry of Health Publication, 2010, 11-12. Available at: http://www.who.int/tobacco/surveillance/en_tfi_gats_turkey_2009.pdf, last accessed: 11/12/14.
9. Stewart MG, Smith TL, Weaver EM, Witsell DL, Yueh B, Hannley MT, et al. Outcomes after nasal septoplasty: results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) study. *Otolaryngol Head Neck Surg*. 2004; 130: 283-290.
10. Kahveci OK, Miman MC, Yuçel A, Yuçedag F, Okur E, Altıntaş A. The efficiency of Nose Obstruction Symptom Evaluation (NOSE) scale on patients with nasal septal deviation. *Auris Nasus Larynx*. 2012; 39: 275-279.
11. Pagliuca G, Rosato C, Martellucci S, de Vincentiis M, Greco A, Fusconi M, et al. Cytologic and functional alterations of nasal mucosa in smokers: temporary or permanent damage? *Otolaryngol Head Neck Surg*. 2015; 152: 740-745.
12. Karaman M, Tek A. Deleterious effect of smoking and nasal septal deviation on mucociliary clearance and improvement after septoplasty. *Am J Rhinol Allergy*. 2009; 23: 2-7.
13. Hong SD, Lee NJ, Cho HJ, Jang MS, Jung TY, Kim HY, et al. Predictive factors of subjective outcomes after septoplasty with and without turbinoplasty: can individual perceptual differences of the air passage be a main factor? *Int Forum Allergy Rhinol*. 2015; 5: 616-621.
14. Kreski A, Galewicz A, Chmielewski R, Kisiel M. Influence of cigarette smoking on endoscopic sinus surgery. *Rhinology*. 2011; 49: 577-582.
15. Virkkula P, Hytönen M, Bachour A, Malmberg H, Hurmerinta K, Salmi T, et al. Smoking and improvement after nasal surgery in snoring men. *Am J Rhinol*. 2007; 21: 169-173.
16. Reh DD, Higgins TS, Smith TL. Impact of tobacco on chronic rhinosinusitis- a review of the literature. *Int Forum Allergy Rhinol*. 2012; 2: 362-369.
17. Kjærgaard T, Cvancarova M, Steinsvåg SK. Cigarette smoking and self-assessed upper airway health. *Eur Arch Otorhinolaryngol*. 2011; 268: 219-226.
18. Bloom JD, Kaplan SE, Bleier BS, Goldstein SA. Septoplasty complications: avoidance and management. *Otolaryngol Clin North Am*. 2009; 42: 463-481.