B-ENT, 2013, **9**, 269-275

Olfactory function after nasal plastic surgery

E. Razmpa, B. Saedi, A. Safavi and S. Mohammadi

Otolaryngology Department, Tehran University of Medical Sciences, Tehran, Iran

Key-words. Anosmia; hyposmia; olfactory function; plastic surgery; rhinoplasty; smell test

Abstract. Olfactory function after nasal plastic surgery. *Objective*: Nasal plastic surgery is a common procedure, which may cause complications. Many patients are concerned about possible changes in the ability to smell. This study aimed to investigate the impact of nasal surgery, by itself, on the sense of smell in a group of patients with minimal endonasal pathologies and no pre-operative olfactory alterations.
Methodology: In this prospective study from January 2009 until January 2011, we evaluated post-rhinoplasty olfactory changes in a series of 100 rhinoplasty candidates. Olfactory evaluation was performed both subjectively and objectively. The subjective evaluation contained a 0-to-100 Visual Analogue Scale and a five-choice qualitative questionnaire; while, the objective evaluation was performed using the same odor variant of the University of Pennsylvania Smell Identification Test (UPSIT40). Then, the results were analyzed by age, sex, operation method, symptoms, and time-interval groups.
Results: Subjective and objective scoring revealed no significant change in terms of postsurgical olfactory outcome. According to subjective grading, 26 patients had improvement, 61 had no change, and 13 had deterioration of the smell sense. Closed rhinoplasty resulted in a better smell outcome after surgery according to the Visual Analogue Quantitative Score ($P = 0.034$).
Conclusion: Rhinoplasty does not appear to significantly change the preexisting olfactory status.

Introduction

Olfaction, one of the five human primitive senses, plays a major role in the quality of life; on the other hand, people also undergo esthetic rhinoplasty to promote their quality of life. Thus, the question is: "do people have to sacrifice one for the other?" Physiologically, a perfect perception of smell is attained when dispersed odor molecules in the air easily reach the nasal olfactory neuroepithelium, stimulate neural endings, and generate an electrical impulse that, finally, travels to the piriform cortex through the olfactory tract. There are two pathways that deliver air to the olfactory area: *orthonasal* (air passes from the nostrils to the olfactory epithelium) and *retronasal* (which connects oral and nasal cavities); the latter is the way flavor is perceived.[1] If a patient fails to smell, either pre- or post-operative, an alteration of these routes might be responsible. Anomalies or diseases that physically block nasal airflow may be categorized as *air-conduction factors* and include: nasal deviation or tip ptosis, nasal valve malfunction, turbinate hypertrophy,[2] anatomical distortion of intranasal structures,[3] sinonasal diseases, hypertrophied adenoids,[1] agents occupying the nasal cavity like clots, crusts, mucosal swelling,[4] polyps, masses, intranasal packing,[5] rhinitis (viral, allergic, or vasomotor),[6] or even foreign bodies. Furthermore, *neurological factors* may alter neural components of the olfactory mucosa and brain, for example: injuries to the olfactory neuroepithelium[3] or its swelling, frontobasal skull fractures,[7] cribriform plate fractures, head traumas, aging,[5] intranasal substance use, and CNS disorders with sensory involvement.

Rhinoplasty, like other nasal surgeries, may alter patients' olfaction by manipulating both internal and external nasal structures. Permanent anosmia after nasal surgery is a controversial issue, with an occurrence of 1 to 2%;[3,8] while, the majority of nasal surgeries with preexisting olfactory impairment result in better or unchanged olfactory function.[3,4,8-13] Olfactory function may improve by relieving the underlying pathology and reopening the airflow to the olfactory area. However, olfactory impairments have been observed in patients without pre- or post-operative nasal obstructions, creating some uncertainty on the impact of surgery on olfaction.[14,15]

Moreover, there is a lack of medical data, especially large series, on the effect of modern rhinoplasty on smell function. Thus, this study aimed to investigate olfactory outcomes after esthetic rhinoplasty in a group of patients with minimal endonasal pathologies and no significant olfactory alteration

prior to the surgery. In these cases, less surgical effort was spent on manipulation of the intranasal structures and the outcome was more related to the operation itself.

Material and methods

Study Subjects

One hundred and two patients were selected among consecutive rhinoplasty candidates referred to ENT clinics of a tertiary otorhinolaryngology center (Imam Khomeini Hospital affiliated with the Tehran University of Medical Sciences) from January 2009 to January 2011. Patients with diseases or conditions altering olfactory function were excluded from the study; these conditions were: preexisting anosmia or significant hyposmia, CNS and hypothalamus diseases, Kallmann syndrome, midline anomalies and cleft palate and nose,[16] previous head trauma, psychiatric disorders, previous nasal surgery,[17] systemic diseases and sarcoidosis, allergies to any component of evaluation materials used in the study, and patients taking medications with a known effect on olfaction. Smokers,[18] intranasal drug users,[3] and those refusing to attend follow-up visits were also excluded. Two patients refused to participate in the follow-up smell tests and were consequently removed from the list.

Ethical approval

The protocol of this study was approved by the Institutional Review Board of the Tehran University of Medical Science. Detailed information about the study was provided to the participants and written informed consent was obtained from each one. All aspects of the study were conducted according to the Declaration of Helsinki.

Tests and objective and subjective variables

Patients provided their age, gender, and main reason for rhinoplasty.

Pre- and post-operative symptoms

Coexisting pre- and post-operative symptoms were taken into account. Based on the pre-operative symptoms, patients were categorized into symptom-groups for post-operative symptom-olfactory interrelation analysis.

Pre and post-operative clinical findings

A thorough ENT examination (nasal endoscopy was performed if needed) by one of the authors, ruled out any confounding factors. The existence of polyps, masses, and also nasal valve problems, septal deviation, mucosal changes, infections, and discharge were documented.

Evaluation of smell function

Three evaluations, described in detail below, were performed prior to the surgery, and one and six months post-operatively (two post-operative follow-up sessions). The time interval after which the post-operative evaluation was carried out for each individual patient was also documented in the questionnaires for over-time olfactory-change analysis. The detailed objective test was performed only one month after surgery. Therefore, all test results were reported after the first follow-up session; while, six-month subjective smell outcomes were included in the end results for comparison.

1. Visual Analogue Quantitative Olfactory Scores:

A 0-to-100 numeric scale was presented to patients for scoring their ability to smell in their own point of view. The score of 100 represented normal olfaction, while 0 represented an inability to smell.

2. Subjective Qualitative Olfactory Grading:

Patients graded their quality of olfactory function using a four-choice questionnaire (excellent, good, fair, and poor).

3. Odor Identification Test Scores (objective variable):

A variant of the University of Pennsylvania Smell Identification Test Scores, which was confirmed as a reliable tool, was employed for this section.[19] In this variant, like the original test, the same odorants were provided in unlabeled identical dark bottles, in which the odor was exposed to either of the patient's nostril with the contra lateral nostril occluded and the mouth shut. Patients actively sniffed each odor only once in a randomized sequence with an inter-exposure interval of at least 30 seconds. The scoring system used for our 40-item odor identification test was based on a three-point scale (0 to 2) for each odor; therefore, the

Table 1
Pre- and six month post-operative subjective qualitative scores

Olfactory status		*After surgery*				
		Excellent	**Good**	**Fair**	**Poor**	**Total**
Before surgery	**Excellent**	14 (63.6%)	0	6 (27.3%)	2 (9.1%)	22 (100%)
	Good	7 (13.2%)	42 (79.2%)	3 (5.7%)	1 (1.9%)	53 (100%)
	Fair	6 (31.6%)	6 (31.6%)	6 (31.6%)	1 (5.2%)	19 (100%)
	Poor	2 (33.3%)	3 (50%)	1 (16.7%)	0	6 (100%)
	Total	29 (29%)	51 (51%)	16 (16%)	4 (4%)	100 (100%)

maximum side-score for each nostril was 80.[20] The score of 2 was recorded if the patient could both recognize the presence of an odor and correctly identify it, 1 if the patient could recognize the presence but not discriminate the odor, 0 if the patient could neither recognize the presence nor identify the odor. To assure the reliability of the test and participant's answers, a 30-second inter-item interval was also included to prevent olfactory exhaustion and adaptation and also to avoid bottle content degeneration. The odors bottles were renewed each month.

Method of surgery

Based on the severity of the nasal deformity, either an external or internal method of rhinoplasty was selected for each patient. In severely deviated noses, over projected noses, or severe problems of the tip, an external approach was used with sole techniques. All procedures were performed under general anesthesia by one of the senior authors. An internal lateral osteotomy was performed in all procedures and no packing was used. Moreover, antibiotic prophylaxis (Cephalexin 500 mg/QID for five days) was given to all patients and the only prescribed analgesic was acetaminophen. Subsequently, their nasal splints were removed after 7 days but tapings were continued for 4 weeks thereafter. Dexamethasone (8 mg) was used during the surgery, but there was no corticosteroid usage in the post-operative period.

Statistical Methods

Statistical comparisons were made using "Pearson's *r* correlation coefficient" analysis, and "Mann-Whitney U" to assess independent variables. *P* values of 0.05 or less were considered significant. Data was analyzed using the Statistical Package for the Social Sciences (11.5).

Results

Of the 100 individuals who finished follow-up sessions, 40 (40%) were male and 60 (60%) were female with a mean age of 25.6 ± 4.9 (Min = 18, Max = 34). All patients stated esthetics as one of the main reasons for rhinoplasty; in 58 (58%) patients, beauty was the only reason while 10 (10%) stated chronic sinusitis, 31 (31%) stated nasal deviation, and 1 (1%) stated chronic sinusitis and septal deviation in addition to esthetic purposes. Symptoms related to nasal obstruction, sinusitis, and rhinitis were present in 46, 20, and 28 patients, respectively, pre-operatively and 4, 6, and 29 patients, respectively, post-operatively. The pre-operative ENT examination revealed minimal anomalies in 3 of our patients, which were all corrected to normal limits post-operatively.

Olfactory evaluations

1. Visual Analogue Quantitative Olfactory Scores:

Via the 0-100 numeric scale, pre-operative and six-month post-operative mean quantitative scores were 76 ± 23 and 80 ± 19, respectively. These two values did not signify a statistical correlation (Mann-Whitney U, $P = 0.168$). Accordingly, quantitative scores after surgery had a mean change of -3 ± 26.4 units.

2. Subjective Qualitative Olfactory Grading:

Table 2 outlines the patients' pre- and post-operative qualitative olfactory function grading. Seventy-five percent of the patients graded their pre-operative olfactory status as excellent and good and this value improved to 80% post-operatively. Analysis of the changes of qualitative grading revealed improvement of the olfactory function in 26, no

Table 2
Symptom groups and olfactory outcomes

Type of olfactory evaluation	Symptom groups		Post-operative	
			Mean ± SD	*P* values
Δ Visual Analogue Olfactory Quantitative Score	With	Nasal obstructive symptoms	50 ± 25	<0.001
	Without		-5 ± 24	
Δ Odor Identification Score	With		16 ± 9.1	0.038
	Without		-2 ± 16	
Δ Visual Analogue Olfactory Quantitative Scores	With	Sinusitis	-17 ± 32	0.018
	Without		-2 ± 25	
Δ Odor Identification Score	With		-20 ± 25	<0.001
	Without		1.1 ± 16	

Δ in the table refers to the post-operative value minus the pre-operative value.

changes in 61, and deterioration in 13 patients. No patient was anosmic before or after the surgery.

3. Odor Identification Test Scores (objective variable):

Out of a total of 80, patients earned a mean score of 73.3 ± 10 in the pre-operative evaluation and a mean score of 73.3 ± 8.3 after surgery. The changes in odor identification after six months were insignificant (Mann-Whitney U, $P = 0.482$).

4. Smell status and outcome in the sinusitis group:

Ten (10%) patients suffered from sinusitis. Accordingly, their mean preoperative Visual Analogue Quantitative Olfactory Score was 67 ± 12 and the mean Odor Identification Test score was 71.9 ± 9.1. Their post-operative results were 79 ± 16.2 and 72.9 ± 9.3, respectively.

Inter-variable analysis

Age and olfactory outcomes

Visual Analogue Olfactory Quantitative Scores, displaying a mean linear regression, were inversely related to patients' ages in a significant correlation (Spearman's ϱ, r = -0.289, $P = 0.004$) (Figure 1). Odor identification scores were also inversely related to patients' ages, but the relationship was insignificant (Spearman's ϱ, r = -0.186, $P = 0.300$).

Gender and olfactory outcomes

The mean changes in the Visual Analogue Quantitative Score in sex groups were -1 for females and -6.5 for males (Mann-Whitney U, $P = 0.441$); the mean changes for the odor identification test were -1 for females and 3 for males (Mann-Whitney U, $P = 0.549$), demonstrating no significant gender-related change.

Method of surgery and olfactory outcomes

Patients undergoing open rhinoplasty had a mean change of -11.4 in the Visual Analogue Olfactory Quantitative Score compared with patients undergoing the closed method, with a mean change of 0.7 (Mann-Whitney U, $P = 0.034$). This ascertained

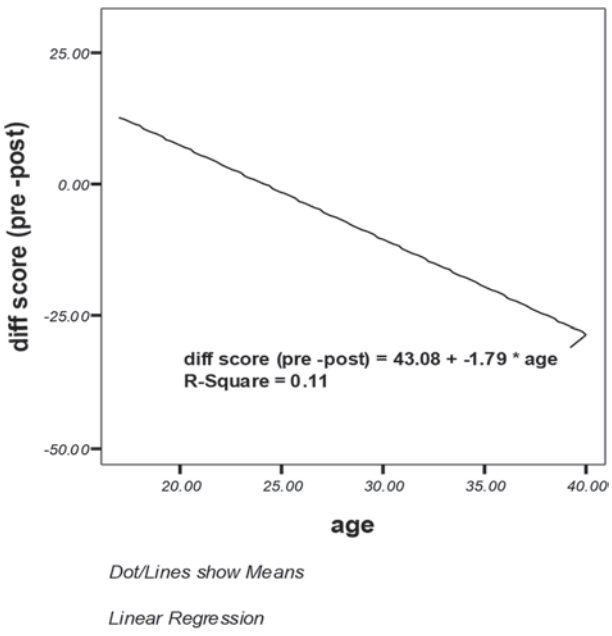

Figure 1
Correlation between Visual analogue olfactory quantitative scores and age.

Table 3
Olfactory changes in the time-interval groups

Type of Evaluation	Time-Interval Groups	Mean Change	*P*-Values#
Visual Analogue Olfactory Quantitative Scores	1 month	-14.8 ± 12.1	<0.001*
	6 months	8.7 ± 6.6	
	>6 months	24.6 ± 13.9	
Odor Identification Test Scores	1 month	-3.7 ± 1.1	0.236
	6 months	2.1 ± 1.5	
	>6 months	2.8 ± 1.9	

#: Mann-Whitney U Test, *: significant.

that closed surgery was significantly more effective in preserving preexisting olfactory status than the open method. There was a mean change of 4 units after open surgery and -0.3 after closed surgery in odor identification scores, which did not signify a significant correlation (Mann-Whitney U, $P = 0.755$). The effect of patients' symptoms on post-operative smell tests are summarized in

The time course and olfactory outcomes

Three time-interval groups were categorized according to when the patients received their post-operative olfactory evaluation; the groups were: the 1-month group, the 6-month group, and the >6 month group.

By measuring the statistical dependence between the time course and the decline in subjective quantitative scores, a significant negative correlation coefficient was revealed (Spearman's ϱ, $r = -0.396$, $P<0.001$); the same value for the odor identification test scores was also negative and significant (Spearman's ϱ, $r = -0.642$, $P<0.001$), indicating that the post-operative decline in olfactory function would improve over time. There was no major complication during the follow-up period; only two patients developed intranasal synechia, which could be safely managed with local anesthesia.

Discussion

Smell is an important human sense and plays a great role in the quality of human life. Nasal diseases and surgery may affect smell. The effect of rhinoplasty, especially for cosmetic purposes, on smell function is a major concern; although, there is a shortage of medical data on this. In our group of patients who underwent nasal plastic surgery, no one had preexisting anosmia or significant hyposmia; in addition, despite the presence of nasal symptoms in a remarkable number of subjects, 97% had normal or near normal nasal airflows. Thus, this group of subjects was suitable for evaluation of the impact of rhinoplasty on olfactory outcomes.

In our study, the mean post-operative quantitative score (0-100 scale) was 80 ± 19 after rhinoplasty compared with the mean pre-operative score of 76 ± 23; while, the smell identification score (0-80 scale) changed from 73.3 ± 8.3 pre-operatively to the post-operative value of 73.3 ± 10. Although these changes in olfactory function were not significantly correlated, the numbers show that our patients had good olfactory function prior to surgery that remained in a good condition after the surgery; therefore, it could be concluded that rhinoplasty imposed no significant changes in terms of olfactory function post-operatively. Yet, the very high scores in both tests possibly indicate a ceiling effect; therefore, we recommend other tests, such as threshold tests, for future studies. Many authors determined that auto evaluation of smell function in tests like the VAS should be assessed with caution. Therefore, both methods for testing smell in this study had their limitations. Despite these downsides, the overall results of this study suggest any effect on smell function after nasal plastic surgery will be unremarkable. In addition, Pfaar O *et al*.[12] reported the supra threshold is not an ideal test for olfactory changes after septoplasty.

The extent of surgical intervention does not seem to affect the olfactory outcome,[3, 12] since olfactory alteration has been reported even with closed reduction of nasal fractures due to manipulation of the cribriform area;[3] on the other hand, many studies have reported olfactory improvement after extensive nasal surgeries because of the facilitated passage of odor and elimination of inflamma-

tion.[3,4,8-11,13] Rhinoplasty manipulates both internal and external nasal structures; therefore, damage to both the air conducting system and the olfactory nervous system is quite inevitable, even in optimal circumstances. In our study, the closed method of rhinoplasty, with a mean change of 0.7 units in subjective quantitative scores, appeared to significantly preserve (if not improve) the preexisting olfactory status. However, the impact of rhinoplasty on odor identification scores cannot be confirmed.

The role of age and gender on postsurgical olfactory outcome are still controversial; generally, due to aging, cortical and neural fiber atrophy can lead to a decline in olfactory acuity.[5] There were not enough older patients in our series to evaluate the effect of surgery on different age groups. Both quantitative and odor identification scores showed a linear regression by age, meaning that older patients had a significant decline in their quantitative scores and an insignificant decline in their odor identification scores. There was also no significant gender-related olfactory change in our study, in the subjective scale or odor identification scores; while, Goldwyn *et al*. and Minovi *et al*.[5,21] reported better outcomes in females. Kimmelman *et al*.[3] claimed that age and sex had no impact on the olfactory outcome.

Patients with pre-operative nasal obstructive symptoms experienced more changes in terms of subjective and objective scores, showing significantly more improvement in comparison with those without preexisting obstructions. This finding does not mean patients without pre-operative obstructions are prone to worse olfactory outcomes, but the improvement is clearly related to the poorer olfactory status pre-operatively. This operation corrects the underlying obstruction, letting air reach the olfactory area. On the other hand, patients with preexisting sinusitis symptoms prior to the surgery had quite worse olfactory outcomes compared to those without pre-operative sinusitis. This finding, which was statistically significant in terms of both subjective and objective scores, might be caused by chronic alteration of the olfactory mucosa from inflammatory secretions of the sinuses. Litvack *et al*.[22] also reported that poor olfactory outcomes were more frequent among patients with chronic rhinosinusitis.

The differences in outcomes in patients undergoing the closed and open approaches in this study can be explained by our selection criteria. The most difficult and traumatic cases underwent surgery using the open approach, which could possibly affect the smell results of this group. Furthermore, we could not randomize patients to open vs. closed rhinoplasty because of the specific selection criteria of each procedure. Olfactory changes after nasal surgery seem to act in a chronological way. Early after the operation, patients experience a remarkable transitory decline in their ability to smell. This condition is usually due to immediate mucosal swelling and obstruction from nasal packing.[4,5] Edema and packing are usually removed after a week or two. From this time on, the path is fully open for airflow to reach the olfactory area, and olfactory function can then be evaluated. There is no practical endpoint set after which the olfactory status stabilizes so that the olfactory outcome can be purely assessed with no bias from intranasal inflammation. Goldwyn *et al*.[15] reported that two months after nasal surgery, all their patients maintained the same olfactory acuity as pre-operatively, and there were no changes in olfactory function 6 to 12 months post-operatively; in addition, olfactory problems that developed one year after nasal surgery were not related to the operation. Briner *et al*.[14] evaluated their patients 6 to 12 weeks after surgery; while, Shemshadi *et al*.[13] reported that olfactory malfunction due to open rhinoplasty fully resolved by the end of the 6th post-operative month. In a study by Champion *et al*.,[23] olfactory impairments lasted up to 18 months post-operatively. This time range is consistent with postsurgical olfactory changes diminishing over time, leading to improvement. Similarly, our study showed a significant over-time olfactory improvement; mean subjective and objective scores were negative in the first post-operative month, clearly demonstrating hyposmia. The same values in the next time-interval groups (6 months and >6 months) showed improvements that were significant in terms of the time course. Our findings suggested a stable smell outcome after nasal plastic surgery with a better outcome in the closed approach; however, because of limitations of the smell tests,[24,25] more specific studies are required to confirm our findings, especially the effect of the method of surgery on the smell outcome.

Conclusion

Despite the temporary decline in the sense of smell in the first month after nasal plastic surgery, our

patients experienced an over-time olfactory improvement with no significant change in the final outcome compared with the preoperative olfactory status. Some significant differences were noted in patients' final olfactory statuses in closed versus open rhinoplasty.

References

1. Doty RL, Frye R. Influence of nasal obstruction on smell function. *Otolaryngol Clin North Am*. 1989;22(2):397-411.
2. Canady JW. Evaluation of nasal obstruction in rhinoplasty. *Plast Reconstr Surg*. 1994;94(3):555-559.
3. Kimmelman CP. The risk to olfaction from nasal surgery. *Laryngoscope*. 1994;104(8 Pt 1):981-988.
4. Fiser A. Changes of olfaction due to aesthetic and functional nose surgery. *Acta Otorhinolaryngol Belg*. 1990; 44(4):457-460.
5. Goldwyn RM, Shore S. The effects of submucous resection and rhinoplasty on the sense of smell. *Plast Reconstr Surg*. 1968;41(5):427-432.
6. Ghorbanian SN, Paradise JL, Doty RL. Odor perception in children in relation to nasal obstruction. *Pediatrics*. 1983; 72(4):510-516.
7. Piek J. Surgical treatment of complex traumatic frontobasal lesions: personal experience in 74 patients. *Neurosurg Focus*. 2000;9(1):e2.
8. Garzaro M, Pezzoli M, Pecorari G, Landolfo V, Defilippi S, Giordano C. Radiofrequency inferior turbinate reduction: an evaluation of olfactory and respiratory function. *Otolaryngol Head Neck Surg*. 2010;143(3):348-352.
9. Damm M, Eckel HE, Jungehulsing M, Hummel T. Olfactory changes at threshold and suprathreshold levels following septoplasty with partial inferior turbinectomy. *Ann Otol Rhinol Laryngol*. 2003;112(1):91-97.
10. Pade J, Hummel T. Olfactory function following nasal surgery. *Laryngoscope*. 2008;118(7):1260-1264.
11. Stevens CN, Stevens MH. Quantitative effects of nasal surgery on olfaction. *Am J Otolaryngol*. 1985;6(4):264-267.
12. Pfaar O, Hüttenbrink KB, Hummel T. Assessment of olfactory function after septoplasty: a longitudinal study. *Rhinology*. 2004;42(4):195-199.
13. Shemshadi H, Azimian M, Onsori MA, Farahani MA. Olfactory function following open rhinoplasty: A 6-month follow-up study. *BMC* 2008;8:doi:10.1186/472-6815-8-6.
14. Briner HR, Simmen D, Jones N. Impaired sense of smell in patients with nasal surgery. *Clin Otolaryngol Allied Sci*. 2003;28(5):417-419.
15. Daele JJ. The rhinoplasties: conclusions. *B-ENT*. 2010;6 Suppl 15:115-117.
16. Anastassov GE, Joos U, Zollner B. Evaluation of the results of delayed rhinoplasty in cleft lip and palate patients. Functional and aesthetic implications and factors that affect successful nasal repair. *Br J Oral Maxillofac Surg*. 1998;36(6):416-424.
17. Fokkens W, Lund V, Bachert C, Clement P, Helllings P, Holmstrom M, *et al*. EAACI position paper on rhinosinusitis and nasal polyps executive summary. *Allergy*. 2005;60(5):583-601.
18. Adams RG, Crabtree N. Anosmia in alkaline battery workers. *Br J Ind Med*. 1961;18:216-221.
19. Doty RL, Shaman P, Dann M. Development of the university of pennsylvania smell identification test: A standardized microencapsulated test of olfactory function. *Physiol & Behav*. 1984;32(3):489-502.
20. Frasnelli J, Charbonneau G, Collignon O, Lepore F. Odor localization and sniffing. *Chem Senses*. 2009;34(2):139-144.
21. Minovi A, Hummel T, Ural A, Draf W, Bockmuhl U. Predictors of the outcome of nasal surgery in terms of olfactory function. *Eur Arch Otorhinolaryngo*l. 2008; 265(1):57-61.
22. Litvack JR, Fong K, Mace J, James KE, Smith TL. Predictors of olfactory dysfunction in patients with chronic rhinosinusitis. *Laryngoscope*. 2008; 118(12):2225-2230.
23. Champion R. Anosmia associated with corrective rhinoplasty. *Br J Plast Surg*. 1966;19(2):182-185.
24. Landis BN, Hummel T, Hugentobler M, Giger R, Lacroix J.S. Ratings of Overall Olfactory Function. *Chem Senses*. 2003;28:691-694.
25. Rombaux P, Collet S, Martinage S, Eloy P, Bertrand B, Negoias S, *et al*. Olfactory testing in clinical practice. *B-ENT*. 2009;5(Suppl 13):39-51.

Babak Saedi, M.D.
Otolaryngology Research Center
Associate professor of Otolaryngology
Imam Khomeini Medical Center
Bagherkhan Street, Chamran Highway
141973141 Tehran, Iran
Fax: 00982166581628
E-mail: saedi@tums.ac.ir