Effects of septoplasty on olfactory function evaluated by the Brief Smell Identification Test: A study of 116 patients

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Abstract

We conducted a prospective study of 116 patients—61 men and 55 women, aged 17 to 64 years (mean: 26.4)—to investigate the effects of septoplasty on olfactory function in patients with septal deviation (SD). The Mladina classification system was used to define SD types, and olfactory function was assessed with the Brief Smell Identification test (BSIT). The BSIT, which includes 12 odorants, was administered preoperatively and at postoperative months 1 and 3. The most common SD types were types 2 (20.7% of patients) and 1 (19.0%), followed by types 3 and 5 (both 16.4%). At postoperative month 1, the mean BSIT score was significantly higher in men than in the women. For patients with types 1 and 2 SD, BSIT scores at 1 month were significantly lower than the scores preoperatively and 3 months postoperatively. For types 3 and 4, BSIT values were significantly higher at 3 months than preoperatively or at 1 month. For type 3 SD, the preoperative mean score was significantly lower than those for types 1, 4, 5, 6, and 7; for type 2 SD, the BSIT score was significantly lower than those of types 5 and 6 only. At 1 month, the scores for types 2 and 3 were significantly lower than those for types 4, 5, 6, and 7. At 3 months, the BSIT score for type 2 was significantly lower than those of types 1, 3, 4, 5, and 6; the type 3 SD score at 3 months was significantly higher than those for types 1, 2, 5, 6, and 7. We conclude that septoplasty surgery for patients with a type 3 SD may improve olfactory function. In contrast, we found that olfactory function in patients with a type 2 SD did not improve to a satisfactory degree, even when good nasal patency was achieved with a corrected septum and an enlarged intranasal volume. Our findings should be investigated further in future studies.

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Introduction

Numerous epidemiologic studies have addressed the prevalence of deformities of the nasal septum. Mladina reported that patients with asymmetry between the right and left sides of the nasal floor exhibited more marked septal damage than did patients with other types of nasal septum deformities.[1] A regularly shaped maxilla and a symmetric nasal floor protect against more severe deformities after nasal trauma. Subarić and Mladina found deformities in the anterior septal areas (types 1 and 2 deviations according to the Mladina classification system,[1] described in the "Patients and methods" section) in 20 to 27% of their pediatric sample.[2]

The prevalence of nasal septum deformities in newborns was reported as 0.93% in India[3] and 17% in Greece.[4] In a Belgian study, the prevalence among children between 2.5 and 6 years of age was 12.4%.[5] In a Finnish study, the prevalence was 49.6% among first-grade children and 37.2% among eighth-graders.[6] A Korean study of 1,646 children found that the prevalence was 13.6%.[7] A particularly high prevalence of 55% was reported by Strambis in Greek adults aged 19, 20, and 23 to 26 years of age.[8]

Mladina et al reported nasal septum deformities in 89.2% of 2,589 adult ENT patients (1,500 men and 1,089 women).[9] Left-sided deviations were slightly more prevalent than right-sided deviations (51.6 vs. 48.4%). The most common type of deviation was type 3 (20.4%

of patients). A straight septum was observed in 15.4% of the women and 7.5% of the men. No association between the type of deviation and geographic region was observed.

The Brief Smell Identification Test (BSIT) is a commonly used measure of olfactory function in elderly populations. However, few studies have provided normative data for this measure, and minimal data are available regarding the impact of sociodemographic factors on test scores.[10-12] Reports on differences in olfactory function between the two sides of a deviated nasal septum are also scarce.[13] Septal surgery may increase olfactory thresholds by improving the transport of volatile molecules to the olfactory slit.[14,15]

In this article, we describe our study on the effects of septoplasty on olfactory function in patients with a septal deviation (SD). To the best of our knowledge, ours is the first study to evaluate olfactory function in different types of septal deviation in patients who have undergone a septoplasty.

Patients and methods

We conducted a prospective study to measure olfactory function in patients who underwent septoplasty for the treatment of a deviated septum.

Patients. We enrolled 129 patients who complained of nasal obstruction upon admission to the ENT Clinic at Adana Numune Training and Research Hospital in Adana, Turkey, during 18 months. We recorded their demographic information as well as information on their olfactory function at presentation and smoking status (there were 75 nonsmokers and 41 smokers). We also performed complete ENT and endoscopic nasal examinations. Patients who had a nasal septum deformity revealed by anterior rhinoscopy or endoscopic nasal examination were eligible for the study.

Patients with acute or chronic sinusitis or another chronic disease were not eligible. In addition, 13 patients were excluded from the final study data analysis at one time or another—5 who experienced postoperative synechiae, 5 who required revision surgery, 2 who had a septal perforation, and 1 who experienced head trauma at postoperative month 3. This left us with a final study group of 116 patients—61 men and 55 women, aged 17 to 64 years (mean: 26.4 ± 9.4).

Surgery was performed on all patients with general anesthesia by ENT Clinic physicians using the Cottle septoplasty procedure. No turbinate reduction was performed.

The Mladina classification system. After anterior rhinoscopy and endoscopic examination, patients were assessed with the use of the Mladina classification system,[1] which categorizes septal deformities into seven types:

- Type 1: presence of a unilateral crest within the valve area that does not impair nasal valve function.
- Type 2: presence of a unilateral crest that does impair valve function and a reduction in symptoms elicited by the Cottle maneuver after nostril raising, conferring subjective and objective improvements in nasal patency.
- Type 3: presence of a unilateral crest at the level of the head of the middle nasal concha.
- Type 4: presence of two crests, one at the level of the head of the middle nasal concha and the other on the opposite side (in the valve area) with impaired valve function.
- Type 5: presence of a unilateral ridge on the base of the septum, the opposite side of which is straight.
- Type 6: presence of a unilateral sulcus running through the caudal-ventral part of the septum with a ridge on the opposite side and accompanying asymmetry of the nasal cavity.
- Type 7: presence of a combination of two or more of the other six types.

Smell identification test. The BSIT includes 12 odorants embedded on scent strips; the scents are released when scratched with a pencil tip. Participants complete a four-category multiple-choice questionnaire in which they identify each smell. The BSIT is a forced-choice test; participants identify each odorant or indicate the closest of the options if they perceive no particular smell. The total BSIT olfaction score indicates how many of the 12 odorants a patient correctly identifies. An abnormal olfactory function is defined as a score of 8 or less.[12] The BSIT is associated with good internal reliability and validity.

We used the Turkish version of the BSIT, which is a rapid, 12-item screening instrument derived from the 40-item University of Pennsylvania Smell Identification Test.[16] Our BSIT was applied preoperatively and 1 and 3 months postoperatively.

Statistical analysis. Statistical analysis was performed with the Statistical Package for the Social Sciences for Windows (v. 20.0). Analyses were performed by a third party (İstatistik Dünyası [Statistical World]; Ankara, Turkey). The Mann-Whitney *U* test, Friedman test, and Kruskal-Wallis test were used for group comparisons. A value of $p < 0.05$ indicated statistical significance.

The Mann-Whitney *U* test with Bonferroni adjustment was used for pairwise comparisons. For pairwise comparisons of the BSIT scores of the seven different SD types, a $p_{adjusted}$ value of <0.00714 was taken to indicate statistical significance. For pairwise comparisons of BSIT values preoperatively and at 1 and 3 months postoperatively, a $p_{adjusted}$ value of <0.0175 was taken to indicate statistical significance.

Ethical considerations. The study protocol was approved by the Ethics Committee of Adana Numune Training and Research Hospital. All patients were apprised of the study details before providing written informed consent.

Results

Sex. At the preoperative and 3-month assessments, we found no statistically significant differences in BSIT scores between the men and women. However, the men had a significantly higher score at 1 month (p = 0.043) (table 1).

Smoking. No significant differences in BSIT scores between smokers and nonsmokers were seen at any of the three assessments (table 1).

SD type. SD types 2 (20.7%) and 1 (19.0%) were the most prevalent, followed by types 3 and 5 (both 16.4%) (table 2).

Within SD types 1 through 6, we observed statistically significant differences among the BSIT values at the three assessments ($p < 0.05$); no significant differences were seen within type 7 (table 2).

Next, findings were analyzed with pairwise comparisons performed with the Mann-Whitney *U* test with Bonferroni adjustment:

- For SD types 1 and 2, BSIT scores at 1 month were significantly lower than the preoperative and 3-month scores ($p_{adjusted} < 0.0175$). The scores decreased from baseline at 1 month and then increased at 3 months.
- For SD types 3 and 4, the 3-month BSIT scores were significantly higher than the preoperative and 1-month scores ($p_{adjusted} < 0.0175$) (table 2).

At each of the three assessments, BSIT scores among the seven different SD types were significantly different ($p < 0.05$). The pairwise comparisons were performed with the Mann-Whitney *U* test with Bonferroni adjustment:

- Preoperatively, the type 3 SD BSIT score was significantly lower than those for types 1, 4, 5, 6, and 7. The type 2 SD score was significantly lower than those for types 5 and 6 ($p_{adjusted} < 0.00714$).
- At 1 month, the types 2 and 3 SD BSIT scores were significantly lower than those for types 4, 5, 6, and 7 ($p_{adjusted} < 0.00714$).
- At 3 months, the type 2 SD BSIT score was significantly lower than those for types 1, 3, 4, 5 and 6. The type 3 SD score was significantly higher than those for types 1, 2, 5, 6 and 7 ($p_{adjusted} < 0.00714$) (table 2).

Discussion

All types of nasal surgery confer a risk of damage to olfactory function, even when surgery is performed in areas remote from the olfactory epithelium.[17] Although the precise reason for this risk remains unclear, it has been suggested that psychological factors[18,19] and changes in the intranasal volume[20,21] may be involved.

Fyrmpas et al reported that smell-disorder patients and, less often, healthy individuals are characterized by differences in olfactory function between the two sides of the nose, with higher olfactory thresholds being observed on the obstructed side of a nasal septum deformity.[22] For their study, they recruited 30 patients with nasal obstruction secondary to a deviated septum who were scheduled to undergo primary septoplasty with or without radiofrequency reduction of the inferior turbinates. Pre- and postoperatively, symptoms were assessed on a visual analogue scale, and bilateral nasal spirometry was used to determine the degree of the obstruction (nasal partitioning ratio). Olfactory function was tested separately for each nasal cavity with the 12-item Sniffin' Sticks test; a difference of 3 points between the two sides was considered significant.

No complications or anosmia were reported postoperatively in the Fyrmpas study, and subjective hyposmia, nasal obstruction, and the nasal partitioning ratio were all significantly reduced ($p < 0.001$). Fyrmpas et al con-

Table 1. Pre- and postoperative BSIT scores according to sex and smoking status (N = 116)

Score	Preop	1 mo	3 mo
Sex, n (%)			
Male, 61 (52.6)			
Mean ± SD	8.8 ± 1.2	8.5 ± 1.3	9.4 ± 1.2
Median (range)	9 (6 to 11)	8 (6 to 11)	9 (6 to 11)
Female, 55 (47.4)			
Mean ± SD	8.5 ± 1.2	8.1 ± 1.1	9.2 ± 1.3
Median (range)	8 (7 to 11)	8 (6 to 11)	9 (7 to 11)
p Value*	0.102	0.043	0.659
Smoking status, n (%)			
No, 75 (64.7)			
Mean ± SD	8.6 ± 1.2	8.3 ± 1.3	9.3 ± 1.3
Median (range)	9 (6 to 11)	8 (6 to 11)	9 (6 to 11)
Yes, 41(35.3)			
Mean ± SD	8.8 ± 1.2	8.3 ± 1.2	9.2 ± 1.1
Median (range)	9 (7 to 11)	8 (7 to 11)	9 (7 to 11)
p Value*	0.493	0.826	0.481

**Mann-Whitney U test.*

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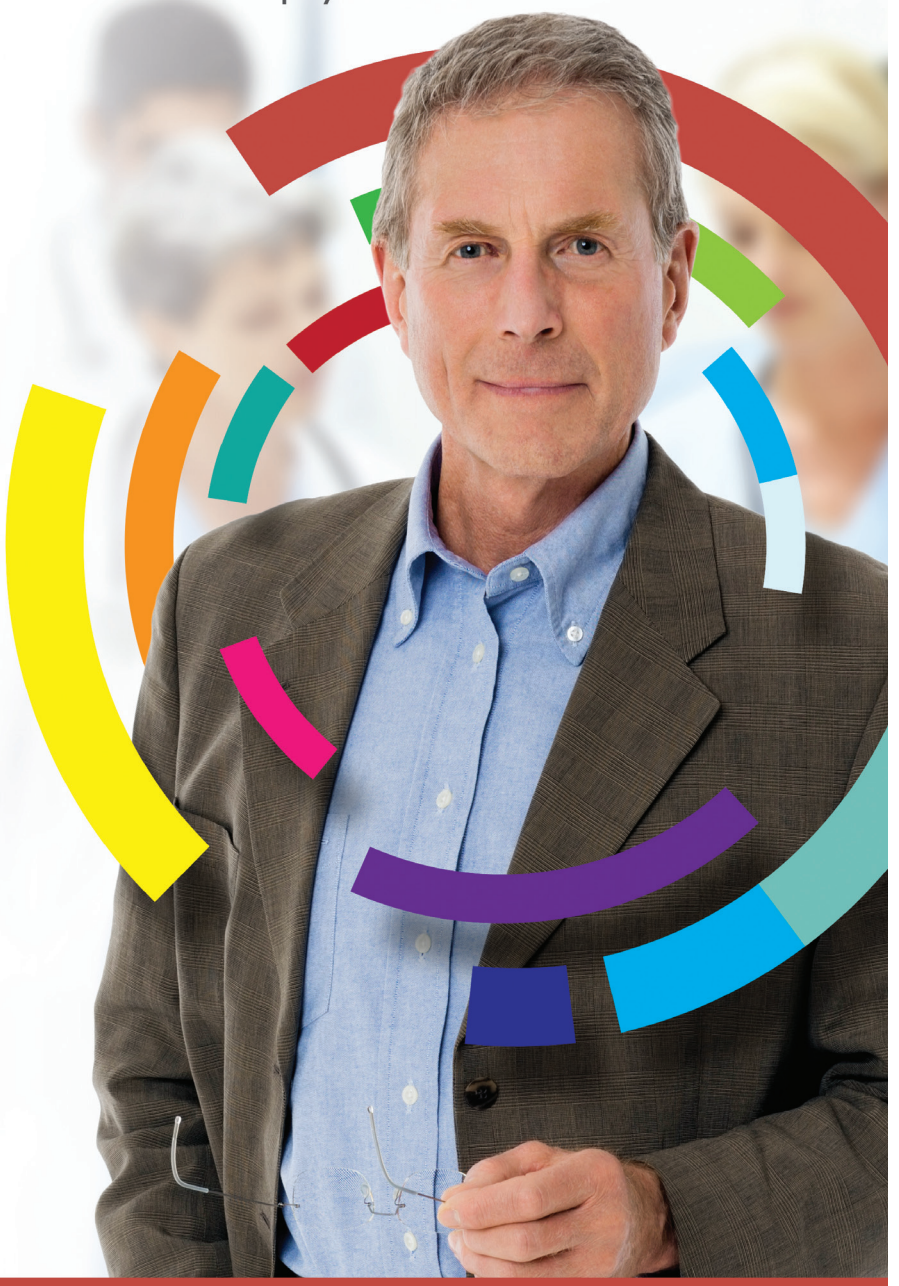

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Table 2. BSIT scores according to the type of septal deviation (Mladina classification[1])

Type, n (%)	Preop	1 mo	3 mo	*p* Value*
Type 1, 22 (19.0)				
Mean ± SD	8.9 ± 1.4	8.4 ± 1.3	9.2 ± 1.2	<0.001
Median (range)	9 (7 to 11)	8.5 (6 to 10)	9 (7 to 11)	
Type 2, 24 (20.7)				
Mean ± SD	8.2 ± 1.4	7.6 ± 1.1	8.3 ± 1.3	0.001
Median (range)	8 (6 to 11)	7 (6 to 11)	8 (6 to 11)	
Type 3, 19 (16.4)				
Mean ± SD	7.8 ± 0.6	7.5 ± 0.8	10.3 ± 0.7	<0.001
Median (range)	8 (7 to 9)	8 (6 to 9)	10 (9 to 11)	
Type 4, 10 (8.6)				
Mean ± SD	8.5 ± 0.5	8.6 ± 0.8	10.0 ± 1.1	0.001
Median (range)	8.5 (8 to 9)	9 (7 to 10)	10 (8 to 11)	
Type 5, 19 (16.4)				
Mean ± SD	9.3 ± 1.1	8.9 ± 1.0	9.3 ± 1.0	0.018
Median (range)	9 (7 to 11)	9 (7 to 11)	9 (7 to 11)	
Type 6, 15 (12.9)				
Mean ± SD	9.3 ± 1.0	8.7 ± 1.4	9.6 ± 0.8	0.001
Median (range)	9 (8 to 11)	9 (6 to 11)	10(8 to 11)	
Type 7, 7 (6.0)				
Mean ± SD	9.0 ± 0.8	9.3 ± 1.1	9.1 ± 1.1	0.223
Median (range)	9 (8 to 10)	9 (8 to 11)	9 (8 to 11)	
p Value†	<0.001	<0.001	<0.001	

** Kruskal-Wallis variance analysis.*
† Friedman test.

cluded that olfactory function may be impaired on the convex side of a large septal deviation. Postoperatively, patients with deviated septum exhibit differences in lateralized olfactory function with the same frequency as do healthy individuals.

In our study, the most prevalent types of septal deviation were types 2 (20.7%) and 1 (19.0%), followed by types 3 and 5 (16.4% each), type 6 (12.9%), type 4 (8.6%), and type 7 (6.0%). In their study of 2,589 adults, Mladina et al found that type 2 SD was more common in men than in women (18.7 vs. 13.3%).[9] Type 2 SD typically results from trauma, and it is widely accepted that males experience nasal trauma more often than females.

In another study, Mladina and Subarić found that type 6 SD was more common in men than in women (11.6 vs. 6.4%), and this finding is more difficult to explain because type 6 SD is inherited.[23] In that study, type 3 SD was more prevalent in women than in men (23.7 vs. 17.9%). In our study, BSIT scores at 1 month were significantly higher in men than in women, but there was no significant difference at 3 months.

In patients who have undergone septoplasty, olfactory function is rarely impaired by direct trauma, traction, or vascular damage to the olfactory epithelium; complete postoperative functional anosmia is particularly rare.[17] Zhao et al used computational fluid dynamics to demonstrate that a small decrease in the surface of the nasal valve area (1.45%) can result in a large decrease (18.7%) in airflow directed to the olfactory cleft.[24]

According to the Mladina classification system, type 2 SD is defined as a disturbance of valve function caused by a unilateral crest.[1] Also, a positive Cottle maneuver can be observed after raising the nostril, which results in subjective and objective improvement in the nasal patency. In type 2 SD, nasal valve function is impaired and nasal patency is blocked. An anteriorly localized deviated septum obstructs the nose and nasal airflow, which prevents the passage of odor molecules to the olfactory epithelium. This may attenuate neuronal transmission within central olfactory areas and could explain the low BSIT values observed in patients with type 2 SD at 3 months.

According to the Mladina classification, a type 3 SD involves a unilateral crest at the level of the head of the middle nasal concha.[1] In this case, the deviated part is localized in the upper part of the nose, and the nasal valve region and nasal patency are unaffected (unlike the case with a type 2 SD). In our study, olfactory function in type 3 SD was impaired preoperatively and at 1 month, but it had improved by 3 months. Therefore, we believe that septoplasty and nasal septum correction appear to be beneficial for olfaction in type 3 SD.

Pfaar et al reported that improved olfactory discrimination improved after septoplasty.[13] An improvement in nasal airflow could increase olfactory sensitivity above the level of the olfactory mucosa. Cognitive factors are also known to play a major role in olfactory perception.[25] Nasal dilators improve odorant transport, thresholds, and identification.[26]

Savvateeva et al investigated the olfactory function of patients with a curved nasal septum before and after surgery.[27] In 40 patients aged 18 to 59 years who under-

went olfactometry with the Sniffin' Sticks test, significant improvements in all olfactory function parameters were detected at 1 month. Differentiation, identification, and overall olfactory index scores indicated further recovery of olfactory function during the following 4 months. The authors concluded that normalization of nasal breathing improves olfactory function, although a complete recovery is unlikely.

Damm et al used magnetic resonance imaging to assess intranasal volume and its relationship to olfactory function in normosmic individuals.[15] They found significant correlations between odor thresholds and the volume of the segment in the upper meatus directly below the cribriform plate and the anterior segment of the inferior meatus. They found no such correlations with suprathreshold measures of olfactory function such as odor discrimination and odor identification.[15] In a study of septoplasty in conjunction with partial turbinectomy, Damm et al reported improvements of 80% in odor identification, 70% in discrimination, and 54% in thresholds.[21]

Wound healing and edema may decrease nasal patency and airflow, and nasal cavity volume may decrease during the early postoperative period. As wound healing progresses, nasal cavity volume continues to increase, and nasal patency and nasal airflow improve during the late postoperative period, as does olfactory function.

In conclusion, we found that olfactory function in type 3 SD patients improved after septoplasty. In patients with type 2 SD, olfactory function did not improve to a satisfactory degree, even when good nasal patency was achieved with a corrected septum and an enlarged intranasal volume. This finding should be investigated further in future studies.

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