The effect of nasal septal deviation on nasal bone morphology: computed tomography evaluation

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Aims and objectives

Morphological characteristics of the nose such as bone length and thickness vary according to factors connected with age, gender, climate and race. The anatomical and morphological characteristics of the bony and cartilaginous parts of the nasal septum are important for physiological nasal respiration. Nasal bone morphology also plays an important role in the planning of successful septoplasty and rhinoplasty operation.

In the evaluation of the nasal bone and nasal septum, physical examination gives subjective findings, and so is insufficient for preoperative assessment. So imaging methods have the important role for evaluation of the maxillofacial region. Computed Tomography (CT) gives more reliable data for the maxillofacial region than other imaging methods. Excellent resolution of bone tissue and three-dimensional reformatted images are the major advantages of CT imaging. It has become the principally preferred imaging method in preoperative assessment of the nasal bone and septum (1).

Many studies have been made for assessing the characteristics of nasal bone morphology, and its relationships with sex, race, climate and age (1-4). According to the literature, the nasal bone of women is shorter and narrower (2). Additionally, the noses of those living in areas with cold and dry climates are seen to be longer and wider (3). It was found in a study conducted on a Korean population that nasal bones were shorter and narrower than those of the Western population (1). In our knowledge the relation of nasal bone morphology with a nasal septum deviation has not been researched. The aim of this study was to show the relationship between nasal bone morphology and nasal septal deviation, along with factors such as age and gender.
Methods and materials

The maxillofacial CTs of 250 patients with a nasal septal deviation taken between February 2012 and December 2014 were included retrospectively in this study. The medical records of patients were investigated, and patients with a history of rhinoplasty operation, cranial and facial trauma or bone deformity (e.g. S-shaped septal deviation), and patients with a mass in the nasal cavity, were excluded from the study. As a result, 203 patients (111 male and 92 female, mean age 36.23 years, range 18-79 years) were included. The study protocol conformed to the ethical guidelines of the 2013 Helsinki Declaration as reflected by prior approval by our institution's human research committee.

CT examinations were performed using an Activion 16 CT Scanner (Toshiba Medical Systems, 2008 Japan). The CT parameters were 120 kVp, 100-150 mA, 1.0 mm or less contiguous axial slice thickness, 512 x 512 matrix size, and field of view (FOV) of 240. All measurements were performed on axial images or sagittal and coronal multiplanar reformatted (MPR) images on a personal computer using OsiriX software (http://www.osirix-viewer.com). For each patient, CT parameters were measured in consensus by two radiologists with 8 and 6 years of experience in maxillofacial imaging.

The nasal deviation angle was measured on coronal CT images as the angle between the most deviated point of the septum and the midline (Fig 1). Patients were divided into three groups according to the deviation angle: mild (<9°), moderate (9-15°), and severe (15° and more) (5,6).

Nasal bone morphology was assessed by measuring lateral and intermediate nasal bone thickness, nasal bone length and internasal angle.

The nasal bone thickness was measured in axial images at the site of the lateral and intermediate osteotomy. The lateral osteotomy nasal bone thickness was measured at the nasomaxillary suture. Intermediate osteotomy nasal bone thickness was measured at the midpoint between the nasomaxillary suture and the rhinion (Fig 2).

The nasal bone length was measured in accordance with coronal images in the sagittal plane on both sides (Fig 3). The internasal angle was measured on coronal images at the site of the nasion point (Fig 4).

Statistical analysis was performed using SPSS for Windows, version 19.0 (IBM Corp., Chicago, IL, USA). Categorical variables are given as frequencies and percentages, and continuous variables are given as mean, standard deviation, median, minimum and maximum values. The Shapiro Wilk test was used as a test of normality. The Independent Samples t Test and ANOVA were used for two and three parametric group comparisons, and the Mann Whitney U and Kruskal Wallis tests were used for two and three non-
parametric group comparisons. The Student t test was used in intergroup comparison of parameters of normal distribution. For all statistical comparisons with a p value below 0.05, statistical significance was assumed.
Fig. 1: In accordance with axial and sagittal MIP images (A, B), the nasal deviation angle was measured on coronal CT images as the angle between the most deviated point of the septum and the midline (C).

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Fig. 2: Nasal bone thickness measurement. A) Lateral osteotomy thickness. B) Intermediate osteotomy nasal bone thickness measurement.

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Fig. 3: Measurement of the nasal bone length in accordance with coronal images on the sagittal plane for the right (A) and the left side (B).

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Fig. 4: In accordance with axial and sagittal MIP images (A, B), the internasal angle was measured on coronal images at site of nasion point (C).
Results

There were 107 patients in our study (52.7%) with nasal septal deviation to the right, and 96 (47.3%) with deviation to the left. No significant difference was found between deviation direction groups with regard to age, gender or deviation angle (p>0.05) (Table 1).

When we compared nasal morphological parameters by sexes, we did not find any statistically significant differences (p>0.05) (Table 2).

Nasal bone deviation angles ranged between 4.9° and 34.1°. Mean deviation angles were 13.6 ± 5.29° for right deviation and 14.44 ± 6.08° for left deviation. The deviation angle showed 43 patients with mild deviation (Group 1), 77 patients with moderate deviation (Group 2) and 83 patients with severe nasal septal deviation (Group 3).

The median (min-max) value of nasal deviation angle, lateral and intermediate osteotomy bone thicknesses and length of nasal bone in the right and left sides are given in Table 3. There were statistically significant differences between right and left side nasal septal deviation in all parameters (p<0.05) except for the internasal angle.

There were no significant differences for internasal angle, nasal bone length and lateral and intermediate osteotomy bone thicknesses between nasal septal deviation angle groups (p>0.05) (Table 4).

In order to examine the relation between age and bone morphology, the patients were divided into seven groups by decade. No statistically significant difference was found between the groups for right and left nasal bone length and right and left lateral and intermediate nasal bone thickness (p> 0.05).
Conclusion

This study shows that in the patients with nasal septum deviation ipsilateral nasal bone length and osteotomy bone thicknesses were greater than contralateral side. The nasal bone is directly connected to the perpendicular plate of the ethmoid bone and cartilaginous septum. Upper lateral cartilage is situated below the inferior margin of the nasal bone. It has been shown that upper lateral cartilage and the cartilaginous septum have influence in the growth of the nasal bone (7,8). It is thought that nasal septum deviation affects the development of the nasal bones because of this close relationship.

This study indicates that there is no relationship between variations in the septal deviation angle and nasal bone length. The morphological effects of nasal septal deviation angles in neighboring anatomical structures and the effect on pathologies of the maxillofacial region such as sinusitis have been discussed in the literature. In a study by Hatipoğlu et al. on the relation between septal deviation and sinusitis, a significant correlation was found between an increase in septal deviation and the presence of sinusitis (9). In a study by Kapusuz et al. investigating the relationship between nasal septal deviation and maxillary sinus volume and the development of sinusitis, it was found that maxillary sinus volumes on the deviation side were significantly larger than on the contralateral side. It was reported in the same study that cases of sinusitis were more often seen on the deviation side. When patients were classified according to deviation angles as mild, moderate and severe, contralateral maxillary sinus volume was found to be significantly greater than on the ipsilateral side only in patients with a severe septal deviation (5). In a study by Saylisoy et al. evaluating the relationship between the width and depth of the cribiform plate (CP) and the nasal septal deviation, it was found that CP width was greater in deviations to the right than to the left, and in the ipsilateral direction than on the contralateral side (10).

We did not find a statistically significant difference between male and female patients for nasal bone length and osteotomy bone thicknesses on either side. In a study by Yüzbaşoğlu et al. using three-dimensional reconstructed images to assess the morphology of the nasal bone and the piriform aperture, it was found that nasal bone length on both sides and on the center line was significantly greater in males than in female patients (2). According to us this difference in the results may be related to the fact that nasal bone convexity was influenced results that measured from three-dimensional volume-rendered images. In order to avoid this, we took our measurements using sagittal and coronal MPR views. In a study by Karadağ et al. on the Anatolian population, no significant difference was found between the genders in nasal bone thickness, although nasal bone length was found to be greater in males (4). In a study of nasal bone morphology in Koreans, Hwang et al. found a statistically significant difference between the genders in terms of nasal bone height.
In these studies, nasal bone thicknesses were taken as an average of the two sides, and the difference between left and right was ignored. In this study, lateral and intermediate nasal bone thickness and nasal bone length were evaluated separately on each side.

When the nasal bone parameters of our patients were compared with age groups in adult patients, no statistically significant difference was found, as was the case in the literature. Hommerich et al. were unable to find out a significant difference between the width of the piriform aperture and age in adult patients (11).

In the present study, no correlation was found between internasal angle and gender or age. In addition, variations in the direction or degrees of nasal septal deviation did not affect the internasal angle. The internasal angle may be a factor influencing the facial morphology and that there is a need for interracial studies on such topics as the nasal aperture.
References


