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Variation in Maxillary Sinus Height and Length Among Skeletal Types I-III

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Abstract

Objective: The purpose of this study was to evaluate the effect of malocclusion in skeletal class I, II, III on maxillary sinus dimensions. **Materials and Methods**: 30 cone-beam computed tomography (CBCT) images of 30 patients were analyzed. MSH (maxillary sinus height) and MSL (maxillary sinus length) were measured using the MIMICS 19.0 software (Materialise HQ Technologielaan, Leuven, Belgium). Skeletal patterns (Angle class I-II-III) were defined. **Results**: The mean value of the MSH in class I was 23.27±4.01 mm for the right side and 23.03± 4.07 mm for the left side. For MSL, the values for class I were 29.20±3.26 for the right and 30.04± 3.13mm for the left. The mean value of the MSH in class II was 21.73±3.44 mm for the right and 19.61± 2.22 mm for the left. MSL in class II was 26.57±2.31 for the right and 26.96±3.41mm for the left. The average right MSH for class III was 22.90±0.62 mm, whereas the left side had a mean of 19.61±2.22 mm. **Conclusion**: Class I individuals exhibited the greatest MSH and MSL values bilaterally compared to Class II and III. Overall, maxillary sinus dimensions showed variation across skeletal classes, with Class II presenting the lowest averages.

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Introduction

Maxillary sinus is an air-filled, pyramidal-shaped structure present in the body of the maxilla [1]. it is the largest of the four pranasal sinuses [2] it is a cavity or space filled with air in the body of maxilla [3].

Consisting of the maxillary, frontal, sphenoid, and ethmoidal sinuses, which perform critical functions such as air filtration and providing immune barrier. For the sinuses, the inner surfaces are covered with a thin mucus layer, which ensures maintenance of moisture and health [4-5].

The maxillary sinus is a multifunctional bony cavity that begins at the ethmoidal infundibulum in the third month of fetal development [6,7]. After birth maxillary sinus continues to extend both laterally and inferiorly during the rapid growth period from birth to 3 years of age [8]. It measures approximately 144 mm3 at birth and grows pyramidally into adulthood. Anatomically, the maxillary sinus described as a quadrangular pyramid form with an internal base that formed by the lateral wall of the nasal cavity [9]. The size of the maxillary sinus is important in the field of dentistry during placement of implants, mini-screws, augmentation procedures, mesialisation of second molars in place of first molars, and intrusion of maxillary molars [10].

Craniofacial growth and development have a complex, multifactorial structure. According to the functional matrix theory, soft tissues affect the development of hard tissues [11]. The maxillary sinus can be affected by factors such as head posture, functional anterior displacement, the vertical–sagittal skeletal relationship, and surgical mandibular advancement [12].

Orthodontic treatment plan is affected by the size and position of the maxillary sinus. Likewise, the maxillary sinus may be affected by different malocclusions either dental or skeletal, anteroposterior or vertical in terms of size and position [13]. With the emergence of cone beam computed tomography (CBCT) and its advantages in the world of radiography appreciated, orthodontists are using it increasingly frequently. Studying the maxillary sinus becomes more accurate and with a 3D approach and the volume of the sinus could be evaluated [14].

Materials and Methods

The sample of the study was collected from the patients treated at the Orthodontic Clinic of the Department of Orthodontic in College of Dentistry, Tikrit University, from December 2023 to February 2024. Out of 50

subjects, 30 patients were selected that fulfilled the following selection criteria:

1. The subjects were 18 to 25 years.
2. No history of abnormal habits (mouth breathing) and no apparent facial disharmony or cleft lip and palate.
3. No history of orthodontic, orthopedic or facial surgical treatment.
4. Fully erupted permanent dentition (including upper third molar).
5. Symmetrical faces.
6. No maxillary sinus pathology.
7.No pathologies like cysts or tumors.
8. No nasal or sinus polyposis.

Ten patients for each Angle's class were included [15].

In the Class II malocclusion group, individuals were characterized by Class II molar-canine relationship and convex profile, In the creation of the Class III malocclusion group, attention was paid to the fact that the individuals were characterized by Class III molar-canine relationship, concave or flat profile [16].

Our study included CBCT images in which the boundaries of the maxillary sinus region were clearly observed in 3D within the field of view (FOV) area [17]. CBCT images were obtained in the standard sitting position using the device (3D Accuitomo CBCT instrument (J Morita Manufacturing Corp, Kyoto, Japan 17.5-second exposure, 90 kV voltage, 5 mA current, and 140 x 100 mm FOV). Patients were asked to bite with maximum intercuspation and not move their heads or tongues during scanning. All images had a full field of view so that the maxillary sinus was fully observed. To compute MSV, images were changed into DICOM format obtained from 0.25 mm thick axial slices [18].

Variables were defined as follows (Figure 1):

- Maxillary sinus length (MSL): this line extends from An to Po. The maximum distance between the most lateral and medial points of each sinus was identified as the width [19].
- Maxillary sinus height (MSH): this line extends from Su to In. The height was defined as the maximum distance between the bottom and the highest points of the sinus on each side [20].

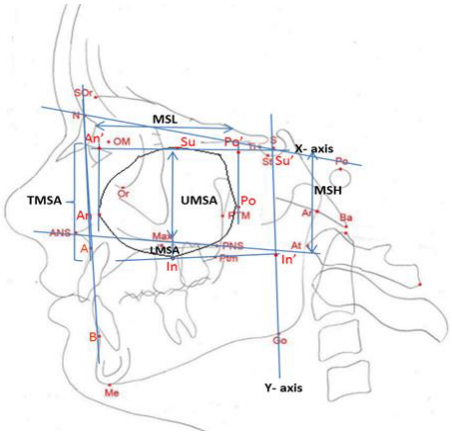

Figure 1. Cephalometric landmarks, planes and variables used in the study.

Statistics consisted of descriptive statistics including mean values for merged sample were calculated. All the groups were subjected to one way ANOVA test to assess the significance of association between maxillary size measurements and three malocclusion groups in male sample, female sample and merged sample (alpha of 0.05).

Results/Discussion

The mean value of right MSL for class I was 29.20±3.26 mm and was 30.04± 3.13 mm for the left side (Table 1). On the other hand, the mean value of right MSH for class I was 23.27±4.01 mm and for the left side the mean value was 23.03± 4.07 mm.

Also, according to the present study the mean value of right MSL for class II was 26.57±2.31 mm and was 26.96±3.41mm for the left side. On the other hand, the mean value of right MSH for class I was 21.73±3.44 mm and for the left side the mean value was 19.61± 2.22 mm. On the other hand, the mean value of right MSL for class III was 23.96± 2.38mm and was 29.26±2.57 mm for the left side. While the mean value of right MSH for class III was 22.90±0.62 mm and for the left side the mean value was 19.61± 2.22 mm.

Maxillary sinus dimensions vary significantly across skeletal Classes I to III, with Class I showing the highest values.

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Table 1. Descriptive statistics and ANOVA for overall sample.

Groups	R H	R L	L H	L L
Class I	23.27±4.01 ab	29.20±3.26 a	23.03± 4.07 a	30.04± 3.13 a
Class II	21.73±3.44 b	26.57±2.31 b	19.61± 2.22 b	26.96±3.41 b
Class III	24.64±3.50 a	23.96± 2.38	22.90±0.62 a	29.26±2.57 a
P-value	0.05	0.01	0.01	0.05