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Assessment the Anatomical Variation of Maxillary Sinus Width and Length as Identified by Cone Beam Computed Tomography

Ryaheen Ghazi Rashid
B.D.S., M.Sc. (oral and maxillofacial radiology), College of Dentistry, University of Bilad Alrafidain, Diyala, 32001, Iraq

Sumaya Mohammed Mansor
B.D.S., M.Sc. (oral pathology), College of Dentistry, University of Diyala, Iraq

Abstract: Background: The maxillary sinus is the largest of the paranasal sinuses.it is a paired pyramid-shaped within the maxillary bone. The aim of this study is to assess the relation between width and length of maxillary sinus according to gender, age and side.

Materials and methods: 55 CBCT scans from the radiology archive at the Specialty Dental Center in Baquba, Diyala, were used in this investigation. The width and length of maxillary sinus were measured on the axial section of CBCT image. Age, gender, and side were used to categorize these measurements.

Result: gender had no statically significant difference on the width and length of maxillary sinus for both left and right side with p value (0.129), (0.474) for the width and p value was (0.600), (0.390) for the length. Age had significant effect on the length of maxillary sinus with p value (0.0492), (0.0488) for both right and left side while age had no significant effect on the width of maxillary sinus with p value (0.535), (0.672). There was no significant difference in the width and length of maxillary sinus when side was compared with p value (0.692) for the width and p value (0.588) for the length.

Conclusion: There was no different in the width and length of maxillary sinus according to gender and side. Age had effect on the length of maxillary sinus while it had no effect on the width of maxillary sinus.

Keywords: maxillary sinus, gender, age, cone beam computed tomography.

Introduction

The largest paranasal sinus, known as the maxillary sinus (MS), has a pyramidal form. Its three sides are the posterior wall, which protrudes above the maxillary tuberosity and molar teeth, the anterior wall, which extends above the premolars, and the superior wall, which forms the floor of the orbit. The inferior nasal conchae is carried by the medial wall of the MS on the nasal side, and it divides the sinus from the nasal cavity. When the lateral apex of the MS extends into the zygomatic process of the maxilla and reaches the zygomatic bone, the zygomatic recess is created. The alveolar and palatine processes of the maxilla form the floor of the sinus, which is situated underneath the nasal cavity and is often found between the mesial and distal regions of the first and second premolars. A small layer of dense bone separates the sinus floor from the molar dentition. [1, 2, 3]

A crucial component of forensic identification procedures is gender identification.[4] Because they are tougher and more resilient than any other tissue in the human body, skeletal structures are crucial for forensic identification.[5] Maxillofacial morphometric analysis has garnered increasing attention recently as a means of identifying gender.[6] The maxillary sinus in the maxillofacial region is comparatively protected and dimensionally stable, even if the surrounding body parts are nearly completely destroyed.[7,8]

A topic of interest for forensic research should be the assessment of sex based on craniofacial structures, such as the paranasal sinuses. Given the huge interindividual variability in the paranasal sinuses, imaging studies could yield valuable scientific data about paranasal sinus sex estimate. [9]

In contrast to alternative techniques like the histology and biochemical methods the radiographic method is the most straightforward and affordable way to determine age and gender. Radiographs are an essential instrument in the field of forensic anthropology. One of the most important instruments in forensic anthropology is the radiograph. [10] Cone-beam computed tomography (CBCT) is widely used to assess sinus architecture, particularly before receiving dental implants. [11,12] With its isotropic voxel values, low scanning periods, and high geometric accuracy data, it makes evaluating the maxillofacial region easier. [11,13] Moreover, it is less expensive, more precise, and requires less radiation exposure than computed tomography (CT). [13,14] Furthermore, because the radiation dose and picture quality of CBCT are similar to those of standard multidetector computed tomography (MDCT), it is an effective substitute for MDCT in the diagnosis of sinusitis. [15]

Despite having a significant anatomical feature, there is a dearth of information on maxillary sinus and there are significant demographic differences. [16] And this justifies the need to assess metrics in connection to the maxillary sinus, particularly for the local populace. In order to determine the linear measurements of the maxillary sinus in connection to gender, age, and side on CBCTs in the Iraqi population, the current study was conducted.

Materials and methods

The samples composed of 55 dentate patients (22 males and 33 females), age ranged between (20-60) years old, the total sample including patients attended specialties dental center in baquba- diyala for CBCT investigation for different diagnostic purposes.

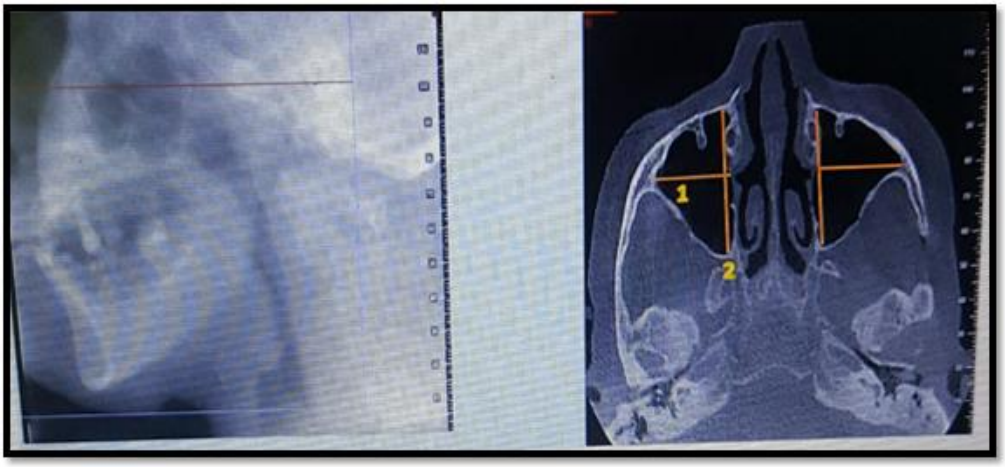
The image of patients used in this study included dentate patient (maxillary posterior teeth) without any infection on maxillary sinus on both sides. Patients with previous maxillofacial surgery, maxillofacial trauma, mucosal thickening and edentulous maxillary posterior arch were excluded from the study.

The measurements on the axial part of the New Tom Giano CBCT (Field of view: 16 cm by 14 cm; voltage: 110 kv; exposure time: 24 seconds; electrical current: 5-7 mA; voxel size: 0.5 mm) were conducted for this investigation.

Linear measurements

1. From the most outer point of the lateral wall to the medial wall of the maxillary sinus, the width of the sinus was measured on both sides of the axial section. **(Figure 1) line 1**

2. From the highest point on the superior wall to the inferior wall of the maxillary sinus, the length of the sinus was measured on both sides using an axial section.



(Figure 1) line 2 measurements the width and height of maxillary sinus on axial section

Statistical Analysis:

The SAS (2018) software was utilized to ascertain the impact of variance variables on the study parameters. In this investigation, the T-test and the Least Significant Difference (LSD) test (Analysis of Variation, or ANOVA) were utilized to evaluate means statistically.

Result

According to gender, MS width show non-significant different with *p* value (0.129) for right side and *p* value was (0.474) for the left side. **(Table 1)**

Table 1: Effect of gender on maxillary sinus width for right and left side

Measurement	Gender	Mean ± SE	
		Right side	Left side
MS Width	Male	22.09 ±1.47	23.45 ±1.17
	Female	24.54 ±0.88	24.63 ±1.06
	T-test (*P*-value)	3.271 NS (0.129)	3.286 NS (0.474)

Comparison the length of MS between male and female, the results show that there was no significant different in MS length on both side right and left with *p* value (0.600) for right side and *p* value was (0.390) for left side. **(Table 2)**

Table 2: Effect of gender on maxillary sinus length for right and left side

Measurement	Gender	Mean ± SE	
		Right side	Left side
MS Length	Male	33.06 ±1.20	34.92 ±0.83
	Female	33.87 ±1.01	33.75 ±0.97
	T-test (*P*-value)	3.092 NS (0.600)	2.713 NS (0.390)

For the effect of age on the width of MS, *p* value for the right was (0.535) and for the left side it was (0.672), Therefore, these values indicate that there was no discernible difference in MS width between patient age groups. **(Table 3)**

Table 3: Effect of age on maxillary sinus width for right and left side

Measurement	Age groups (year)	Mean ± SE	
		Right side	Left side
MS Width	20-30	23.46 ±1.56	32.54 ±1.64
	31-40	22.27 ±1.44	32.65 ±1.22
	41-50	24.84 ±1.67	33.51 ±1.39
	51-60	25.20 ±1.68	37.86 ±1.56
	LSD value (*P*-value)	4.818 NS (0.535)	4.88 NS (0.672)

The *p* value for the length of MS on the right side with respect to age was (0.0492) and for the left side it was (0.0488), Consequently, there was a statistically significant difference between the patients' ages and the length of their MS on both the left and right sides as shown in table 4

Table 4: Effect of age on maxillary sinus length for right and left side

Measurement	Age groups (year)	Mean ± SE	
		Right side	Left side
MS Length	20-30	24.03 ±1.43	34.90 ±1.07
	31-40	23.52 ±1.49	33.02 ±1.28

	41-50	23.49 ±1.37	33.39 ±1.40
	51-60	26.93 ±2.01	336.98 ±1.50
	LSD value (*P*-value)	4.552 * (0.0492)	3.099 * (0.0488)

For comparison the length and width of MS according to sides (right and left), the *p* value for the width of MS was (0.692) and the *p* value for the length of MS was (0.588). The findings indicate that there was no statistically significant variation in MS width or length between the right and left sides. **(Table 5)**

Table 5: Effect of side difference on maxillary sinus width and length

Measurements	Mean ± SE		T-test (*P*-value)
	Right side	Left side	
MS Width	23.56 ±0.80	24.16 ±0.78	1.274 NS (0.692)
MS Length	33.55 ±0.76	34.22 ±0.67	1.355 NS (0.588)

Discussion

Finding the remnants of a human skeleton is a significant difficulty and among the trickiest tasks in forensic medicine. [10] In this study, sexual dimorphism is examined by evaluating the maxillary sinus in the axial section of the CBCT image. According to this study, there was no significant difference in the maxillary sinus length or width between males and females. Moreover, age had no discernible effect on the maxillary sinus width, but it has a significant effect on the sinus length. Additionally, this study demonstrates that the maxillary sinus width and length on the right and left sides did not differ statistically significantly.

Our findings were in line with a study by **Najem et al** [10], which looked at the maxillary sinus's three dimensions (height, width, and length) and concluded that there was no significant difference between males and females in terms of the sinus's dimensions. **Najem et al** [10] also found that there was no significant effect of age on the diameter of maxillary sinus and this seem to be agreed with the result of our study except the length of maxillary sinus which according to the result of our study, the age had significant effect on this parameter.

Our research appears to be comparable to that conducted by **Hettiarachchi et al** [17] who examine the maxillary sinus's linear measurements (height, length, and width) on CBCT in relation to gender and side. The study's findings indicate that there was no statistically significant variation in the maxillary sinus's linear measurements when gender and side were examined.

Bangi et al [18] study the effect of gender on maxillary sinus using CT and the results of this study conclude that measuring the maxillary sinus can be used to determine gender. These result come disagreement with the result of our study.

The results of our study are not consistent with the results of study made by **Tambawala et al** [19] who conclude that the length of maxillary sinus had effect on sex discrimination.

Our result showed that the gender and side had no significant effect of width and length of maxillary sinus, these finding come accordance with the study made by **Saccucci et al** [20] who revealed that there was no significant variation in the maxillary sinus's height, length, or width according to gender or side.

Saccucci et al [20] **and Najem et al** [10] revealed that the height, length, and width of the maxillary sinus were unaffected by age. This result is consistent with our study in terms of the effect of age on width, but does not agree with the effect of age on length, as the result of our study showed that the age had significant effect on the length of maxillary sinus.

Al-Amodi et al [21] Examine how gender affects the maxillary sinus's width, length, and height. and this study conclude that the gender had significant effect on linear measurements of maxillary sinus and this come disagreement with the result of our study.

Numerous factors, including sample size, variation in the method of assessment, genetic variations among people, and dietary and behavioral variances between people, could account for the discrepancy between our study's results and those of several other research. The maxillary sinus's dimension may be impacted by these variables. Disparities in imaging equipment software taking into account that some earlier research used a CT imaging system.

Conclusion

This study included assessment the dimensions of the MS in terms of length and width then the extent to which it was affected by different genders, age and side was evaluated. The results show that there was no different in MS width and length according to gender and side. Age had effect on the length of MS but it had no effect on the width of it.

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