Original Article

Evaluating The Accuracy Of Maxillary Sinus For Gender Determination Using Computed Tomography: A Study Protocol

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Abstract

Background: In medico-legal cases for individual identification, the bone might play an important role in forensic sciences because bones can resist decomposition for a long time. It has been accounted for that maxillary sinus stay flawless even though the cranium & different bones might be seriously deformed in casualties who are burned & consequently, maxillary sinuses can be utilized for distinguishing proof for forensic purposes. From the skull, the maxillary sinus is located in the facial bones. It is possible to calculate the dimension of the Maxillary sinus using computed tomography scans of the skull and paranasal scans, which can be used to determine the correctness of maxillary sinuses for male and female sex determinations and may play an important role in forensic sciences.

Methodology: The total participants (n = 70) will be included (35+35) in two groups consisting of males and females using SIEMENS SOMATOM 16 SLICE machine in patients referred to Acharya Vinoba Bhave Rural Hospital for CT head and paranasal sinuses scan. The patient will be positioned for the head and paranasal sinuses scan. The scan will include the vertex to mandible for the head and paranasal sinuses bottom of the Maxillary sinus to the top of the frontal sinuses. Reconstructed bone window images are used. The reconstructed bone window images of the maxillary sinus will be measured; depth, width, and height of the RT and LT sinuses in two patient groups, including male and female.

Expected Results:The previous studies on maxillary sinus and their results say that the male subject values may be greater than the feminine subject. The maxillary sinus might be playing a vital role in individual identification in forensic sciences.

Conclusion: In forensic medicine, gender determination is a crucial stage in the identification process. CT scan measures of the maxillary sinus may be helpful in forensic sciences to facilitate sex determination. However, with a relatively low-accuracy rate. When the entire skeleton is unavailable, the height, width, and length of the maxillary sinuses, along with other bones, can be utilized to determine gender. Previous studies on a similar topic suggest that the maxillary sinus might play an important role in individual identification in forensic and medico-legal cases. We aim to strengthen these studies and after reviewing the literature about the study, the conclusion will be discussed in the final research project.

Keywords: Computerized tomography, gender determination, Maxillary Sinus, skull.

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Introduction

Sex assurance is one of the significant boundaries for identification in forensic science. Sexual orientation assurance in harmed and mangled buried bodies or from remaining skeletal parts comprises the premier advance for distinguishing in medico-legal assessment, hard to perform Post-mortem in such scenario, but required regarding the law and normal practices. Comparing instances before and after death, as well as maintaining records for the identification of significant corpses, are all important functions. [1] It has been accounted for that the maxillary sinus stays flawless even though the cranium & different bones might be seriously deformed in burned casualties. Consequently, that maxillary sinus may be utilized for distinguishing proof for forensic purposes. The bilateral maxillary sinuses are air-filled cavities in the maxillary bone that can be found in various dimensions and shapes. They are located on either side of the nose. Their maxillary walls will be brittle and brittle. The sinus tip might enlarge and reside in the zygomatic bone during the zygomatic process. [1]. Investigating anthropometric qualities is crucial to taking care of issues identified with recognizable proof. Since they can be utilized to help recognize an individual from a cranium bone that is separated from its skeleton. The remaining parts of the structure have been used for sexing the separate as bone; the last part of the body to decompose after death is the teeth. Sexual orientation assurance is a significant advance in distinguishing proof in medico-legal. CT estimations of the dimension of the maxillary sinus might be helpful in the determination of sex. [2]

Even though improvement and progress in different diagnostic strategies, at the same time, distinguishing proof of remains of skeletons & disintegrating portions of humans are perhaps the most difficult in forensic science. Sex & age assessment is likewise all things considered a significant issue in recognition of obscure skull that is the reason of utmost bones that are customarily utilized for sex assurance (long bone, pelvis, and head) is frequently recuperated either in a divided or demolished state; it has gotten crucial to use solid bone that is regularly recovered flawless, e.g., the maxillary sinus. Like this, it's significant for substitute regions of the whole skeletal to be investigated for sexual orientation assessment. [3].

The computed tomography (CT) estimates of the maxillary sinus can be used to ensure sexual orientation and aging when different tactics are ambiguous. CT and MR cross-sectional pictures, such as the sagittal and the axial scans, allow for a more thorough examination of this structure. [3] Sex is most efficient when delivered through a woman's cranium; nevertheless, she can't be certain of sex until she's in her teens. In medically justifiable circumstances, sexing the cranium is a must-do. All indications point to it being the major solid bone with specifically dimorphic properties due to the skull's long-term high protection from antagonistic natural conditions, resulting in the more conspicuous steadiness of dimorphic components compared with other skeletal bony elements. [4] Information about the skeletal system and how it rests will be useful to provide an accurate diagnosis. Because of the absence of other skeleton rest, the study of craniofacial morphometry gains significance. This is why the maxillary sinus, in particular, maintains its uprightness regardless of the extent of damage to other bone parts. Computed tomography (CT) is a fruitful technique to investigate the past examination of morphometric studies in maxillary sinuses. As an added benefit, it will be made available as a quick and practical recognition method.[5]

Rationale:

C.T. may be used to measure the depth, width, and height of the maxillary sinus & scans of the head and paranasal sinuses can be used to evaluate the accuracy of the maxillary sinus for the sex identification of men and females, which might play an important role in forensic sciences.

Aim:

To evaluate the accuracy of maxillary sinuses for gender determination using computed tomography.

Objectives:

The three-dimension measurement (depth, height, and width) of the right and left maxillary sinus in males and females.

Hypothesis:

We hypothesized that there is a difference in the accuracy of male & female, maxillary sinus & CT scan reconstructed images will help to find it. The proposed study will also strengthen the previous studies.

Methodology:

The head CT scan will be performed in the CT scan facility of the radiology department of Acharya Vinoba Bhave Rural Hospital for CT head and paranasal sinus scan. The patient will be positioned for the head and paranasal sinus scan. The scan will include the vertex to mandible for the head and paranasal sinus bottom of the maxillary sinuses to the top of the frontal sinuses. Reconstructed bone window images are used. The reconstructed bone window images of the maxillary sinus will be measured; the depth, width, and height of the RT & LT sinuses in two patient groups, including males and females.

Study design and sample size:

Patients with head and paranasal sinus scans will be included in the study. The number of participants in the survey will be 70 (n=70) and the participant will be divided into two groups of males and females. Each group will have 35 participants, Computed tomography reconstructed images of the head, and paranasal sinus of these participants will be evaluated for the measurement of the maxillary sinuses. After the size, proper statistical analysis will be applied to find any differences in the accuracy of the maxillary sinuses.

MAXILLARY SINUS	
MEASUREMENTS	**RESULTS**
DEPTH	
WIDTH	
HEIGHT	

Fig: Proforma for enrolment and evaluation

Statistical Analysis Plan:

Statistical analysis to measure the area of the maxillary sinus. And Software used: SPSS27.0V and graph pad prism 7.0V. Independent sample T-test to determine any notable difference between the male and female maxillary sinus and Discriminant analysis, Z=1.96 with 95% confidence interval.

Sample size:

The sample size of 70 (n = 70) is calculated for this study using the following formula;

$$n = \frac{(z_{\propto} + z_{\beta})^2 \ (\delta 1^2 + \frac{\delta 2^2}{k})}{\Delta^2}$$

Scope:

Using imaging modalities such as computer tomography scans of living individuals based on the dimensions of maxillary sinuses helps to find the morphological differences of maxillary sinuses in males & females, which helps in forensic science.

Implication:

This type of research plays an important role in Medico-legal cases where gender estimation from skull (maxillary sinus) morphology is essential, especially in forensic studies.

Expected Outcomes:

According to the findings of this recent study, female maxillary sinuses may be smaller than among males. The study will examine the value of length, height, & width of the maxillary sinus and their standard aberration by sex. The maxillary sinus measurements may be utilized for the determination of gender. There may be significant variability in the size of the sinuses between men & women. Males' maxillary sinuses are known to be significantly bigger than females. However, in both genders, the left maxillary sinuses may be bigger than the right sinus.

The optimal cut-off value will associate with the greatest accuracy rate in identifying patients based on gender and offers the best differentiation between men and women.

Participants:

The inclusion criteria:

- Patients at Acharya Vinoba Bhave Rural Hospital
- Patients referred to radio-diagnosis department for CT head and paranasal sinuses scan
- Patients above the age of 21

The exclusion criteria:

- Patients not agreeing to give informed consent
- Patients with a history of trauma that may be in the region of interest (ex- facial injury)
- Patients with any active inflammation in the area of interest (ex- sinusitis)
- Pediatric patients

Discussion:

Identifying the accuracy of maxillary sinuses for gender determination in males and females is not much easier because as the human skeleton degrades, it becomes more difficult to distinguish between males and females. [2] The study calculates the depth, width, and height of the maxillary sinuses to evaluate their accuracy of the maxillary sinus. The differences in individual identification are made by computed tomography reconstructed images.

The maxillary sinus will be evaluated on living individuals because few studies suggested significant differences in maxillary sinuses area in males & females, which may prove in sex determination in forensic medicine.

Additionally, the FM (Foramen Magnum), the Occipital Bone, and the Frontal Bone can be manipulated to induce sexual dimorphism, as can the maxillary sinus. Sexual dimorphism can be seen in the Foramen Magnum, according to a study on sex determination. Compared to female skulls, males possessed bigger anteroposterior and transverse dimensions (34.04 vs. 31.72 and 28.63 vs. 26.59). [6]

According to Teke HY et al, study results, they find that the female maxillary sinuses may be found to be shorter than those of males. Depicts the gender-specific circulation of the values, such as the mean dimension of maxillary sinuses and their standard deviations. [1] Females had a measurement accuracy rate of 59.7% and males had a measurement accuracy rate of 67.7%, with a mean of 63.8%. [1]

Based on the Uthman et al, study results, with an overall accuracy rate of 71.6 percent, maxillary sinus height was the best determinant of maxillary sinus disease (LT Maxillary sinuses height). [2]

A similar study was done by Jehan M et al, Male and female bizygomatic distances were 9.55 and 9.26 cm, respectively. Males in this study had larger average dimensions for each parameter than females. [3]

In India, Sharma SK et al. and M, Kumar A. M. conducted similar investigations. Computed tomography was used to determine the gender of the maxillary sinus by measuring its

volume and dimensions. [4] Males' maxillary sinuses were discovered to be substantially larger than their female counterparts. [4]

Ekizoglu O et al. found that in all variables, male values were bigger than female values. [5] Using multidetector computed tomography, thin sections of the maxillary sinus were used to aid in the morphometric analyses. [5-10]

Kanthem RK et al, Sex determination using maxillary sinuses. The Sexual Dimorphism of maxillary sinuses dimensions and volume is comparatively more in males than females. [11-17]

According to Samhitha G, et al., the maxillary sinus's height, width, depth and volume are all averaged to come up with an average. Regarding volume, male maxillary sinuses are larger than female maxillary sinuses in all four dimensions: height, width and depth. [18-20]

Using the Belgian CA et al, the average male and female mean serum volume (MSV) was found to be 31.62% and 27.18%, respectively. It was found that in men, the MSV was much higher than in females. C.B.C.T. can be used to measure the volume of the maxillary sinus in people of all ages and genders. [20]

If the whole skeleton is accessible, the gender can be determined with 100% accuracy. However, there is a considerable variation in maxillary sinus size between males and females. Because that the males are bigger than females & also men reveal higher & broad maxillary sinus than women.[20]

The study will be performed on a living individual using a CT scan with reconstructed images of the maxillary sinus on the bone window.

Conclusion:

In forensic medicine, gender determination is a crucial stage in the identification process. CT scan measures of the maxillary sinus may be helpful in forensic sciences to facilitate sex determination. However, with a relatively low-accuracy rate. When the entire skeleton is unavailable, the height, width, and length of the maxillary sinuses, along with other bones can be utilized to determine gender. Maxillary Sinuses (MS) proportions are very useful in examining sexual dimorphism. They tend to stabilize during the second decades of life & reconstructed computed tomography scans may offer acceptable measures for maxillary sinus that can't be accessed by other means. The maxillary sinus might be playing a vital role in individual identification in forensic sciences.

After reviewing the literature, the study's conclusion will be discussed in the final dissertation.

Patient Consent:

Consent will be obtained from the patients or relatives on a printed form with a signature along with consent. Clinical history will also be taken to fulfill the criteria of the study. The study will be properly explained to the patient or patient relatives.

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