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MORPHOLOGICAL CHANGES OF PARANASAL SINUSES AMONG AFGHANS: A RADIOGRAPHIC STUDY

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Abstract

Background
The sinuses are a network of interconnected hollow spaces in the face, filled with air and a thin mucus lining. The paranasal sinuses consist of four pairs of air-filled cavities surrounding the nasal cavity, all linked to the nose through small openings. This study aims to assess the different dimensions of the right and left frontal sinuses using CT scans in Afghan patients.

Methods & Materials: This is a descriptive cross-sectional study that used data from patients who needed CT-scan examinations for their skull-related problems at the radiology department of the French Medical Institute for Mother and Children hospital in Kabul City.

Results: Among the 60 patients referred, 30 were men and 30 were women. The patients' ages ranged from a minimum of 16 years to a maximum of 65 years, with an average age of 37.2 years. The overall average volume of the frontal sinuses for both sexes was found to be 4.42 cm^3. For men, the average frontal sinus volume was 4.13 cm^3, while for women, it was 4.71 cm^3, indicating that women have larger frontal sinuses than men. In women, the average volume of the left and right frontal sinuses was 4.85 cm^3 and 4.57 cm^3, respectively, showing that the left frontal sinus is larger. In men, the average volume of the left and right frontal sinuses was 4.11 cm^3 and 4.14 cm^3, respectively, suggesting that the right frontal sinus is slightly larger. Additionally, 6.6% of the cases showed the absence of frontal sinuses in the referred patients.

Conclusion: In this study, the average age of the patients was assessed to be in the late thirties. The estimated average volume of the frontal sinuses was approximately four point four cubic centimeters. The volume of the frontal sinuses was found to be greater in women compared to men. Additionally, in women, the left frontal sinus tended to be slightly larger than the right, while the opposite was true for men. Furthermore, a small percentage of the patients had no frontal sinus present at all.
Keywords: Paranasal sinus, Afghans, Radiography

Introduction:

The sinuses are a system of interconnected, air-filled spaces in the face, each containing a thin mucus lining. The paranasal sinuses are made up of four pairs of cavities that encircle the nasal cavity, all connected to the nose by small openings. These include the maxillary sinuses beneath the eyes, the frontal sinuses above the eyes, the ethmoidal sinuses between the eyes, and the sphenoidal sinuses located behind the eyes (1).

Frontal sinuses are usually asymmetrical, with the septum between them often deviating to one side. On average, they measure approximately 28 mm in height, 24 mm in width, and 20 mm in depth, creating a volume of 6-7 ml. These sinuses are absent at birth but begin to develop and become functional between the ages of six and eight, continuing to grow at a slower pace until they reach their full size after puberty. The frontal sinuses play a crucial role in immune defense

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and air filtration by producing significant amounts of mucus. Around 5% of individuals may lack frontal sinuses entirely (2).

History of the study: Doppler ultrasound is utilized as a non-invasive method for diagnosing sinus infections. It serves as a diagnostic tool in rhino sinusitis, where the role of Doppler ultrasonography has been examined in identifying sinus infections. (4).

In this procedure, the flow of non-suppurated secretions generates a sound, which aids in distinguishing them from suppurated secretions. To further advance and refine this examination, it is essential to measure the dimensions of the paranasal sinuses, particularly the thickness of the anterior wall and the anterior-posterior dimensions of the frontal sinus (5).

These sinuses have anatomically complex structures with significant variations. The use of CT scans, in contrast to standard radiography, is more effective in detecting and observing pathological changes in the paranasal sinuses. (2). A CT scan is essential at the start of the examination to detect and monitor changes in the sinuses prior to sinus surgery. CT scans are also used before endoscopic sinus surgery. As a result, CT imaging allows us to obtain detailed measurements of the paranasal sinuses (5).

In addition, some other studies described this issue and caused this method to continuously develop and evolve also worked on finding the volume of the sinus in normal subjects by CT (6-7).

Furthermore, another study finding indicated that CT analysis was found to be effective in the endoscopic surgery of the sinuses (8).

In addition, a study found that age affects the volume of the sinuses, highlighting a correlation between aging and a decrease in sinus volume. (9). Numerous studies have been conducted on the anatomy of the paranasal sinuses, but further research is required to explore the dimensions and changes in these sinuses and surrounding structures. No studies have been published on the volume of the paranasal sinuses among Afghan populations, making it impossible to compare their volumes with those of other countries or between genders. This study aims to determine the dimensions of the right and left frontal sinuses using CT scans in Afghan patients, as well as to examine the volume differences based on side and gender.

Research questions:

1. Is there a difference in the average volume of the frontal sinus between men and women?
2. Are there variations in the frontal sinus volume between the right and left sides?

2. Methods & Materials

This descriptive cross-sectional study was conducted from July 24, 2019, to August 6, 2019, on patients who required CT scans for skull-related issues at the Radiology Department of the French Medical Institute for Mother and Children Hospital in Kabul. During this period, radiological images of 60 patients were examined, with the images captured at a thickness of 0.75 mm in both axial and coronal planes. The anatomical features of the frontal sinuses were assessed for both men (30) and women (30).

In collaboration with the radiologist, the anterior, posterior, horizontal, and vertical diameters of the sinuses on both the right and left sides were measured and analyzed. The volume was calculated using the formula provided by the radiologist based on the CT scan.

$$\frac{\text{anterior-posterior Diameters} * \text{transverse diameter} * \text{vertical diameter}}{2}$$

Inclusion Criteria:

This study included individuals who underwent CT scans for skull-related issues, such as head trauma, headaches, strokes, epilepsy, as well as other conditions like ear tinnitus and facial pain, all of which required CT imaging.

Exclusion Criteria:

Patients who had CT scans for parts of the body other than the skull and those under 15 years of age were excluded from the study.

Variables:

The study considered variables such as age, gender, and side.

3. Results:

A total of 60 patients were referred, consisting of 30 men and 30 women. The patients' ages ranged from a minimum of 16 years to a maximum of 65 years, with an average age of 40.5 years.

The average volume of the frontal sinuses for both sexes was found to be 4.42 cm^3. For men, the average volume of the frontal sinuses was 4.13 cm^3, while for women, it was 4.71 cm^3, indicating that women's frontal sinuses are larger than those of men.

In women, the average volume of the left and right frontal sinuses was 4.85 cm^3 and 4.57 cm^3, respectively, showing that the left frontal sinus is larger. In men, the average volume of the left and right frontal sinuses was 4.11 cm^3 and 4.14 cm^3, respectively, indicating that the right frontal sinus is slightly larger. Overall, the average sinus volume for both genders was 4.42 cm^3. Additionally, 6.6% of the cases showed the absence of frontal sinuses in the referred patients.

Table (1): General findings:

MIN 16 AGE MAX 65 AGE		Average of age
40.5	years	
4.42	cm3	Average sinuses volume
6.6	%	Absent of sinuses
4.215	cm3	Standard deviation

Table 1**:** In general, the average age of the participants was 40.5 years, and the average volume of the sinuses was 4.42 cm^3. Approximately 6.6% of participants had absent paranasal sinuses, with a standard deviation of 4.215 cm^3.

Table (2): Comparison of paranasal sinuses volume according to the gender:

Average sinuses volume	Left sinus volume	Right sinus volume	Gender
4.13 cm3	4.11 cm3	4.14 cm3	Men
4.71 cm3	4.85 cm3	4.57 cm3	Women

Table 2 indicates that right and left sinus volumes are larger in women than in men.

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Table (3): Comparison of paranasal sinuses volume according to side in both sexes:

Sinus volume	Side
4.36 cm3	Right
4.48 cm3	Left

Table (3) indicates that the left sinus volume is greater than the right one.

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. Discussion

Among the 60 patients referred, 30 were men and 30 were women. The patients' ages ranged from a minimum of 16 years to a maximum of 65 years, with an average age of 37.2 years. The overall average volume of the frontal sinuses for both sexes was found to be 4.42 cm^3. For men, the average frontal sinus volume was 4.13 cm^3, while for women, it was 4.71 cm^3, indicating that women have larger frontal sinuses than men. In women, the average volume of the left and right frontal sinuses was 4.85 cm^3 and 4.57 cm^3, respectively, showing that the left frontal sinus is larger. In men, the average volume of the left and right frontal sinuses was 4.11 cm^3 and 4.14 cm^3, respectively, suggesting that the right frontal sinus is slightly larger. Additionally, 6.6% of the cases showed the absence of frontal sinuses in the referred patients.

A study on the anatomical changes of the frontal sinus found that the volume of the frontal sinus in men was larger than in women, which contradicts the findings of the present study (1).

Similarly, another research conducted in South Nigeria on the anatomical changes of the frontal sinus indicated that the frontal sinus volume in men was greater than in women, which is also at odds with the results of the current study (9).

Furthermore, a study on anatomical changes in the frontal sinus reported that men had a larger frontal sinus volume than women, which conflicts with the findings of this research (10).

In addition, research on the anatomical changes of the frontal sinus found that men's frontal sinus volume was larger than that of women, a result that contradicts the current study (11).

Moreover, a study in South Nigeria examining the sex differences in the frontal sinus found that the entire diameter of the frontal sinus in men was larger than in women, suggesting that the frontal sinus is larger in men, which is inconsistent with the findings of the present study (9).

Finally, another study noted that 4% to 6% of cases showed the absence of frontal sinuses on both sides, which aligns with the results of this study (12).

5. Conclusion:

In this study, the average age of the patients was assessed to be in the late thirties. The estimated average volume of the frontal sinuses was approximately four point four cubic centimeters. The volume of the frontal sinuses was found to be greater in women compared to men. Additionally, in women, the left frontal sinus tended to be slightly larger than the right, while the opposite was true for men. Furthermore, a small percentage of the patients had no frontal sinus present at all.

Ethical Considerations: The ethical aspects of this study were reviewed and approved by the ethical committee of Kabul University of Medical Sciences, "Abu Ali Ibn Sina." Verbal consent was obtained from patients who were referred for CT scans related to skull issues and met the inclusion criteria for the study, with the cooperation of the radiologists. For patients unable to provide verbal consent, consent was obtained from their parents or guardians. The identities of the patients will remain confidential in this study. There was no intentional or required exposure to radiation for the patients or individuals involved in this study.

Conflict of interest: The authors declare have no conflict of interest regarding the current study.

Authors' contributions: The conceptualization, explanation, and analysis were conducted by Saniullah Zalmai. The manuscript was written and the analysis was corrected by Abdulhafiz Rahmati. Data collection was carried out by Mohammad Aref Ibrahimi, and the editing and final correction of the manuscript were done by Ahmad Wali Ataye. All authors have reviewed and approved the manuscript.

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