

Anatomical Variations of the Frontal Sinuses in Sudanese Children

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ABSTRACT

The present study is designed to identify and compare the paranasal sinuses in Sudanese children subjects, respective of gender and age. The x-ray images of the child of the Sudanese population were viewed on x-ray images of 78 individuals. Their age was categorized for A (1-5 years), B (6-10 years) and C (11-16 years) groups. The percentage of male constituted 56% of study population. This study has designed to assess the morphology of frontal sinus in Sudanese children males and females, using mento-vertical radiographs of the skull. The samples are collected randomly from the central hospitals in Khartoum state. Variations from radiographs were compared according to age and sex of study population. The common feature of frontal sinus is bilocular chambers divided by bony septum. One of important results in this study that the left side of the sinus is larger than the right side in both sexes equally. Important notice in this study that the frontal sinuses are greater in male than female so further studies in this area are recommended. More studies with larger samples by advanced radiological machines are highly recommended.

Keywords: Paranasal – Sinuses - Morphological – Frontal - ENT

INTRODUCTION

Scientists were sincerely concerned about the mystery of paranasal sinuses due to their clinical importance. Endoscopic surgical intervention in new borns for pediatric sinusitis had further enhanced its importance⁽¹⁾.

The role of the paranasal sinuses in human race and many mammals in general, remained as much an enigma as it did nearly two millennia ago, data for Sudanese is lacking. Sinuses are cavities or small tunnels. They are called paranasal because they are "around or near the nose.

The paranasal sinuses are spaces within the bones of the skull and face, which are filled with air. These open spaces serve the purpose of warming and humidifying the air we breathe, as well as giving resonance to the voice. They also decrease the weight of the skull, which would be significantly heavier without these open spaces. The cells that line the sinuses also produce mucus that traps inhaled pathogens and keeps the inside of the nose from drying out. Humans have several paranasal sinuses, located in various places around the eyes and nose⁽²⁾.

Knowledge of morphological variations of paranasal sinuses in the Sudan would therefore be useful to the pediatric and ENT surgeons during Endoscopic surgical intervention for pediatric sinusitis. Each sinus communicates with the nasal cavity by the ostium which opens into the nasal meatus. Sinusitis is common and frequently accompanied by headache and toothache due to neighborhood between them. Infection may spread among the various sinuses, the nasal cavity, and the teeth.

In 1895, the discovery of X-ray by W.C. Roentgen brought much progress to medical science. The following year, in 1896, X-ray was used in diagnosis of paranasal sinusitis; this the first time that X-ray was used in ENT field. Thereafter, many studies were made such as the per oral radiography in 1923(3).

Previous studies were conducted about the measurement of the size, and anatomical variations of the paranasal sinuses with different results. This study was designed to assess the morphology of frontal sinus in Sudanese children males and females, using mento-vertical radiographs of the skull. The samples are collected randomly from radiological centers in the central hospitals in Khartoum state.

MATERIALS AND METHODS

Study Design

This study is designed as descriptive cross-sectional study.

Study Population

Total of 78 patients (34 females and 44 males) with age ranged from 1 year to 16 years. All the patients had referred for Skull X-Ray. Filled out a questionnaire on the name, age, and sex, of each subject together with the frontal sinuses measurements of right and left chambers were recorded.

Inclusion Criteria:

- Sudanese children patients' age between 1 year and 16 years only.

Exclusion Criteria

The subjects were excluded if she/he had

- Age less than 1 year or above 16 years.
- History of sinusitis
- Bone pathology or major illnesses.
- History of sinuses trauma or surgery.

Study Area

This study was conducted in radiological centers in Khartoum, Omdurman, and Gafaar Ibn Auf hospitals.

Study Time

This study has been conducted in period from November 2010 to July 2011.

Sample Size

Seventy eight mento-vertical radiographs skull images were evaluated. We examined all chambers of the frontal sinuses and comparison between two sexes was done in addition to correlation of chambers to each others.

Instrument and Tools

The X-ray films had been taken during the investigation of some problems in the skull, and we selected those that proved to be normal by excluding individuals with past history of bone diseases or sinuses problems. Ruler and thread were used to measure dimensions of sinuses chambers on radiographs.

Procedure

The x-ray machine was placed 80 centimeters distance from the x-ray film plate, because

significant difference in distance results in affection of size of sinuses chambers^(4,5,6). Each radiograph was placed on an x-ray viewer for measurement of normal frontal sinuses. Measurement was done at the vertical mid sinus diameter and transverse diameter of each chamber of both frontal sinuses on radiographs to compare between chambers of the same sinus, diameters were taken in cm. Measurements were performed by two experienced radiological assistants in each centre on skull x-ray films, who were blinded to the anatomical measurement results. The radiographs were assessed using a ruler and, each dimension being measured three times to ensure accuracy. The precise definition of land marks to be used involved drawing line following the circumference of each chamber and then measured the length of this line by a thread and compared between measurements of male and female and between different age groups.

Data Analysis

Statistical analysis of measurements was performed by using SPSS. The results analyzed and compared with previous results in same studies. Descriptive statistics was used to evaluate correlation between measurements, and differences between males and females.

RESULTS

Total of 78 x-ray images respectively used in this study.

Age

The age ranged from 1-16 years was put in three groups, the first group range is 1-5 years and denoted by (A) the second group range is 6-10 years and marked by (B) and the last one is 11-16 years and marked by (C). The children whose radiographs were studied here are 78 the minimal age is Three years and maximal age is 16 years and the mean age is 9 years.

The 51% of children lies in group C, 40% in group B and only 9% found in group A as shown in Table 1&Figure 1.

Table1. Distribution of children according to Age

Age group	Frequency	Percentage
1 – 5 yrs (A)	7	9%
6 – 10 yrs (B)	31	40%
11 – 16 yrs (C)	40	51%
Total	78	100.0

Age distribution

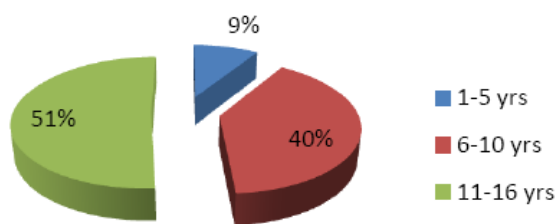


Figure1. Age subdivisions

Gender

The population was divided into males and females (56% and 44% per group respectively) Figure (2). These were subdivided into age categories to three subpopulations Table (2)

Sex distribution

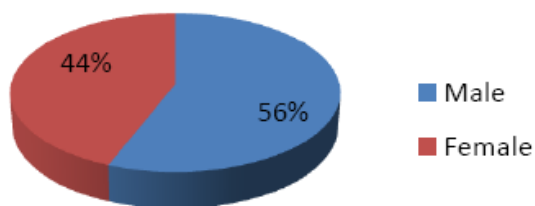


Figure2. Distribution of children according to sex:

Table2. Sex Subdivisions

Sex	Frequency	Percent
Male	44	56%
Female	34	44%
Total	78	100%

Bony Septum Appearance Variations

The bony septum presenting in 74% and absent in 26% of study population as shown in Figure (3)

Presence of Bony Septum

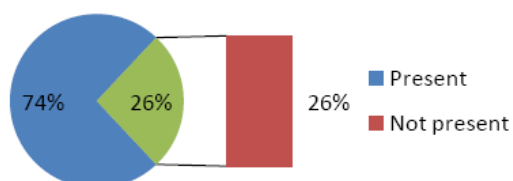


Figure3. Shows distribution of children according to presence of septum

Sex

The percentage of presence of one septum is 52% mainly in female , and more than one septum is 22% more in male, But the absence of septum constitutes 26%.as in Table 3.

Table3. Septum number in relation to the sex:

No. of septum	Female	Male	Total	%
One septum	28	13	41	52%
Two septum	4	11	15	19%
More than two	0	2	2	3%
Absence	2	18	20	26%
Total	34	44	78	100%

Age

The percentage of presence of one septum is 52% mainly in group C and two septum is 22% is equally distributed between groups B and C , but the absence of septum mainly in groups A and B as in Table 4.

Table4. Septum number in relation to the age:

No. of septum	Group A	Group B	Group C	Total	%
One septum	Absent	11	30	41	52%
Two septum	Absent	9	6	15	19%
More than two septum	Absent	Absent	2	2	3%
Absence	7	11	2	20	26%
Total	7	31	40	78	100%

Septum Positions

The position of septum, 48septum are straight and median, and 20 are deviated to right and only 9 deviated to left as in figure 4.

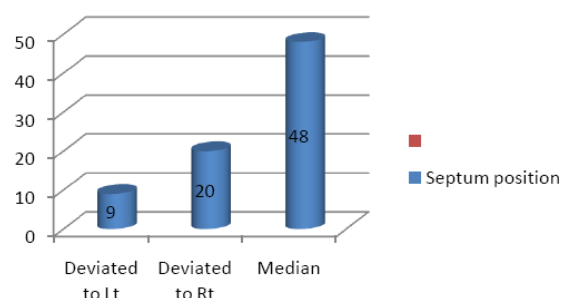


Figure4. Comparison between positions of septum:

Feature of Frontal Sinus Chambers

The chambers present in 91% and absent in only 11%. Bilocular feature constitutes 53%, monolocular is 14% and polylocular 22% as in Figure 5

Anatomical Variations of the Frontal Sinuses in Sudanese Children

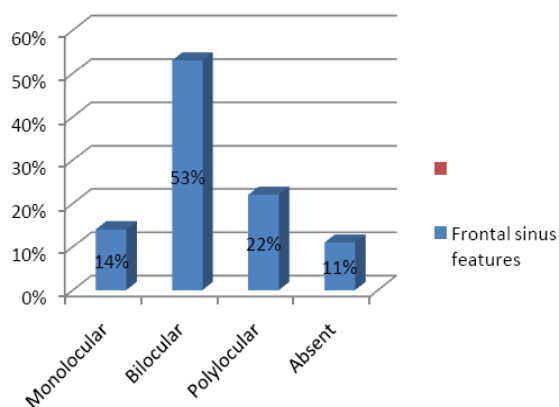


Figure5. Shows distribution of the feature of frontal sinus chambers

Chambers Feature Vs Age

The distribution of sinus feature according to age and noticed that bilocular dominant in group C and monolocular dominant in groups B and polylocular is equally distributed between group B and C as in Table 5.

Table5. Relation between chambers feature and age categories:

Chambers feature	AGE			Total
	Group A	Group B	Group C	
Monolocular	2	9	absent	11
Bilocular	absent	11	30	41
Polylocular	absent	9	8	17
Absent	5	2	2	9
Total	7	31	40	78

Chambers Feature Vs Sex

The distribution of sinus feature according to sex and noticed that bilocular dominant in female and monolocular dominant in male and polylocular is also distributed more in male as in Table 6.

Table6. Distribution of children sex according to chambers feature:

Sex Chambers feature	Male	Female	Total
Monolocular	10	1	11
Bilocular	13	28	41
Polylocular	14	3	17
absent	7	2	9
Total	44	34	78

Chamber Size Variations

It appears that the left side is larger in 74% of study population. Also shows that right side is greater in only 14% and symmetrical in 12% as Figure 6.

Dominant Chamber

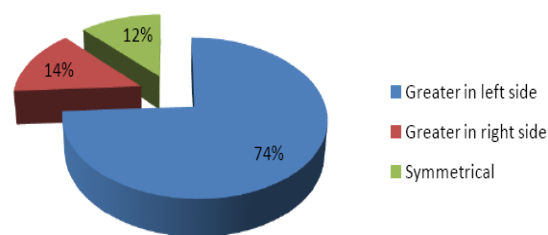


Figure6. Distribution of children having sinuses according to size of chambers

Chamber Size and Age

It appears that the left side is larger in group B and C of study population. Also shows that right side is also greater in group B and C and symmetrical in age group C as in Table 7.

Table7. Relation between chamber size and age categories:

Chambers size	AGE			Total
	Group A	Group B	Group C	
Greater in Rt side	0	5	4	9
Greater in Lt side	2	24	25	51
Symmetrical	1	0	7	8
Total	3	29	36	68

Chambers Size Vs Sex

It appears that the left side is larger in both sexes of study population. Also shows that right side is greater in only male and symmetrical in equally in both sexes as Table 8.

Table8. Distribution of children sex according to chambers size:

Sex Chambers size	Male	Female	Total
Greater in Rt side	9	0	9
Greater in Lt side	25	26	51
Symmetrical	4	4	8
Total	38	30	68

DISCUSSION

This research study revealed the normal variations of the frontal sinuses by X-ray radiographs of seventy eight Sudanese children in three radiological centers; the study was only concerned with the X-ray form of the frontal sinuses. No previous studies focused on studying the normal variations of the frontal sinuses, but this research only interested in studying the overall measurement of the variations of the frontal sinuses in Sudanese children in three hospital in Khartoum state.

In This study the age of study population was ranged between one and sixteen years old which mean that the study among children only in both sexes regardless residence or tribal origin .According to the exclusion and inclusion criteria mentioned above all cases selected were eligible. Seventy eight mento-vertical radiographs skull images were evaluated. We examined all chambers of the frontal sinuses and comparison between two sexes was done in addition to correlation of chambers to each others. The distribution of gender in this study was found that the male constituted about 56% of total study population and the female constituted 44%.The minimal age is three years old and the maximal age is sixteen years old and most of cases about 91% lie in range of age 5 to 16 years old and only 9% of cases below 5 years old. The study showed that the bony septum appearance variations found in number, presence and position .In the result about 74% of children, the septum is present with different numbers and positions. As found in the results there is different numbers of bony septum. Most of study population have one septum and most of them are female, and reversely males are majority in study population with poly septum. Also results showed those males are 90% of total children who have no bony septum. It is logic that most children below 5years old have no septum because its development not complete yet. The present study also revealed variations in position of septum, as mentioned in some references mainly the septum deviated to left or right side. But in this study most population study about 48 children have median straight septum and this one of points need further studies to be proven. In comparison between male and female in chamber feature regarding number and size according to age, the results showed that 89% study population have sinus chambers and only 11% with absent sinus most of them below 5 years old. And also cases were distributed according to number of chambers to 53% have two chambers (mainly in female) and 14% have one chamber and 22% have three or four chambers (mainly in male). So bilocular feature is common as mentioned in most references. As noticed the number of chambers increases with age of study population and this is normal development. Also the study revealed that the left side of the sinus is larger than the right side in both sexes equally. The symmetrical feature is only found mainly in age group C and this may be due to progress in development. Lastly there is a result just noticed but not measured. That the frontal sinuses is

greater in male than female so one of recommendations is to prove that with further CT scan study and even in adults. Blaney⁽⁷⁾ reports that the frontal sinuses are anatomical structures only found in the human being and in some large African apes. Such facts draw the attention to the anatomical similarities between both species. Schuller⁽⁸⁾ has verified in radiological studies that the frontal sinuses are quite bigger in males than in females, and emphasized that the presence of metopic suture is associated with absence of the frontal sinuses. Libersa & Faber⁽⁹⁾ have observed that the frontal sinus usually appear in the third year of life. Krogman⁽¹⁰⁾ reports that the frontal sinus become an extension of the nasal cavity after the second year of life and grows progressively until the age of 20 years. Porbonikova⁽¹¹⁾ carried out a study with 720 X-ray pictures in 1 to 13 years old children by evaluating the frontal sinus growth. She observed that growth begins on the thirteenth month of age, being the same in both sexes, and goes on up to the age of 20 years when the parameters start diverging in girls who display a horizontal sinus enlargement while boys show a vertical enlargement of the sinuses. Apart this, she observed a larger growth of the left sinus when compared to the right one. Szilvassy⁽¹¹⁾ studied the variability of the frontal sinus in children and young people aged between 3 and 7 years, in 215 children. He observed that between the age 8 to 12 years, the growth rate of male frontal sinus is a very low one. Between the age 14 to 15 years, male frontal sinuses exceed female ones, where size is concerned, so we can conclude that a complete formation of the sinuses takes place at the age of 18.

CONCLUSION

This research studied the normal variations of the frontal sinuses by X-ray radiographs of seventy eight Sudanese children in three radiological centers at Khartoum, Jaafar Ibauf and Omdurman Pediatric Hospitals. Detection of normal variations in the Frontal sinuses, in relation to gender and age, could have a useful impact both in teaching of clinical anatomy as well as clinical implications.

The frontal sinus rarely appears or develops in children. it may consist of different numbers of chambers but bilocular feature is common. The bony septum presents in most children and takes many position and directions but straight and median positions are dominant in both sexes. The number of sinus bony septum differs in

different children but presence of one septum is most common as a sequence to the common presence of bilocular feature. As noticed in this study the left side of the frontal sinus is greater than the right side in both sexes with different ages. Also generally it is noticed that the frontal sinus chambers slightly bigger in male than female.

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