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Anthropometrical Profiles Of The Frontal Sinus In Population Of Southeast Nigerians

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ABSTRACT

The anthropometrical profiles, function and variation of frontal sinus have been poorly understood. Understanding these are important in sinus operation and in paleontology, to understand the puzzle of the meaning of the supra orbital development. In the present study radiographs of 74 males and 46 females of south east Nigerians were measured from 18th August 2003 to 12th July 2004. The subject age range from 9 75 years. The mean length, width and height of frontal sinuses were 35.36mm, 63.87mm and 12.93mm for males and 28.70mm, 60.73mm and 10.35mm for females respectively. Thus values for the dimensions of the frontal sinus were higher for males than females. The study revealed that most of the female frontal sinus width values fall above the mean in the distribution while most values for anthropometrical profiles of both sexes fall below the mean. This study is important to otorhinolaryngologist in the evaluation of the sinuses

Key word: Anthropometrical profile, frontal sinus, paleontology

The frontal sinus lies between the lamina of the frontal bone, above the supraorbital rims and root of the nose at the anterior skull. The frontal sinus extends superiorly into the superciliary region and then posteriorly above the roof of the orbit (Shankar, et al., 1994). In addition, the frontal sinus may extend into the crista galli (Shapiro and Janzen 1960). The frontal sinuses are normally asymmetrically separated by a bony septum. The spaces communicate with the nasal airway through natural ostia. The question of why paranasal, and specifically the frontal sinuses exist dates back to the time of Galen in 130 201 AD, who referred to the frontal sinuses as "...(the) porosity of the bones of the head" (Blanton and Biggs, 1969). Sinuses may have originally developed to increase the available surface area for the sense of smell. Therefore in humans, with olfaction limited to a much smaller area, sinuses may be vestigial anachronisms. Although paranasal pneumatization was described in the scientific literature as early as 1651 (Rae T.C et al 2002), the biological role of the paranasal sinuses remains unclear (Blanton and Biggs 1969) Their function is unknown but has been subject to a great deal of speculation. Several functional theories that try to explain the existence of frontal sinuses have met with varying levels of acceptance among researchers. These include; Impart resonance to the voice, humidify and warn inspired air, Increase the area of the olfactory membrane, absorb shock applied to the head for protection of the sensory organs, secrete mucus for keeping the nasal chambers moist, thermally insulate the nervous centers, lighten the bones of the skull for maintenance of proper balance and aid facial growth and architecture. Though their function is obscure their medical significance is not. Sinuses frequently, become infected due to obstruction of normal drainage.

Romanes (1981) states that the shape of the supraorbital ridges and the forehead are no indication of the frontal sinus size. The size and shape of frontal sinuses vary among individuals and between the two sides. In addition, variability due to the effect of age and pathology is recognized. Also variation has been suggested to be attributable to both sex (Buckland wright, 1970) and biological affinity (Brothwell, et al 1968). However, no one theory or explanation for variation has emerged as dominant (Koertvelyessy, 1972). Within the realm of human variation, it is possible to recognize and differentiate the three main races of man (Europids, Mongolid and Negrid), by utilizing metric and morphologic characteristics of the paranasal sinuses (Szilvassy et al., 1987). Reichs (1993) showed that frontal sinus provides for excellent forensic identification if perimortem CT or radiographs are available on the subject in question. Romanes (1981) states that an average size of frontal sinus would be about 25mm by 25mm as seen from the front. Williams (1995) gave the average measurements of frontal sinuses as: height 3.2cm;

breadth 2.6cm; depth 1.8cm.

The importance of understanding frontal sinuses lies on two aspects, firstly their drawback specifically chronic sinusitis may be partially understood (Shanker et al., 1994). Secondly researchers in paleontology have offered a variety of hypotheses concerning the development of the supra orbital region. However no one hypothesis has fully explained the basis of variation in the supra orbital region of earlier humans. If the metric and morphologic characteristics of the frontal sinuses can be understood, it adds an additional factor to the puzzle of the meaning of supra orbital development.

There is paucity in the literature on the anthropometrical profiles of the sinuses in Nigeria or Africa in general. Anthropologists that were linking sinus morphology and development to races (Szilvassy, et al., 1987) and evolution (Frayer, 1992) did few works on the sinuses. The purpose of this study is to document the anthropometrical profiles of frontal sinuses of the south-East Nigerians using plane radiographs. Since in Nigeria most of the diagnosis of inflammatory and neoplastic diseases of the sinuses and adjacent structures are being performed with the aid of radiographs.

MATERIALS AND METHOD

A total of 120 radiographs (74 males and 46 females) with age ranging from 9 75 years taken within 18th August, 2003 and 12th July, 2004 with lateral and Caldwell views were measured at Ebonyi State Teaching Hospital, Abakaliki, University of Nigeria Teaching Hospital Enugu and Hansa Clinic Enugu. Although the samples of radiographs used were collected from different places, the focus film distance used was the same (90cm as indicated from the centers where the samples were collected). Materials used for the study include a radiograph-viewing screen, mathematical set containing pair of dividers, metric rule calibrated in millimeters, sets of squares, protractor and pencil. Radiographs of sinus used include those reported normal by the radiologists and those not affected by any pathological conditions. Those excluded from the study were in the following categories.

* All cases of tumors and polyps from radiologist reports.
* All cases with previous sinus operation
* Patients without proper data from radiologist reports.
* Patient with incomplete views
* Poorly taken films example Radiographs with blurred images.

The three parameters measured were length (L) width (W) and height (H) of frontal sinuses. The length and height of the frontal sinuses were taken from the lateral view radiographs. Frontal sinus mostly appears as a shadow with its apex superiorly and base/floor inferiorly shown. The length was measured in vertical plane from the apex to the base. The height or antero posterior dimension was taken as the longest line perpendicular to the length and touching the anterior and posterior tables of the frontal sinus at its floor using the protractor and metric rule, because of its irregularly shaped floor.

The width of the frontal sinus was taken from the anteroposterior view radiographs. It appears as a crescent-shaped shadow in this view separated into two or three lobes by a thin septa. Because of difficulty delimiting the inferior borders of the frontal sinus, previous researchers have often drawn a base line tangential to the superior borders of the orbit Brothwell et al., 1968; Koertvelyessy, 1972; Hanson and Owsley 1980; Francis et al., 1990). The width was taken as the longest line parallel to the baseline touching the left and right lateral edges of the frontal sinus using the sets of squares and metric rule. In cases of smaller frontal sinuses, which may be partially or completely eliminated in this procedures, the parallel line was taken midway between the baseline and the nasion (the midpoint of the nasofrontal suture).

RESULT

Table 1A presents the mean length, width and height of frontal sinuses as 35.36mm, 63.87mm, 12.93mm for males and 28.70mm, 60.73mm, 10. 35mm for females respectively. Table 1B and 1C shows the descriptive statistics of male and female frontal sinuses respectively. The male frontal sinus length distribution showed in Table 2A that individuals (43) with their values within 25 40mm have the highest frequency representing 58.1% of the total male sample. The male frontal sinus width distribution shows in Table 2B that males (3) with their values above 96mm has the least frequency and those within 67 76mm has the highest frequency representing 32.4% of the male sample. The male frontal sinus height distribution showed in Table 2C that males with their values within 9 18mm has the highest frequency representing 66.2% of the male sample. The female frontal sinuses length distribution showed

in Table 3A that females (14) with their values within 25-32mm have the highest frequency representing 30.4% of female sample. The female frontal sinus width distribution showed in Table 3B that females (12) with their values within 57, 66mm and 77-86mm have the highest frequency representing 26.1% each. The female frontal sinuses height distribution showed in Table 3C that females (38) with their values within 4-13mm have the highest frequency representing 82.7% of the female sample.

Table 1A: The Mean Frontal Sinus Length, Width And Height For Male And Female

	Length (mm)	Width (mm)	Height (mm)
Male	35.36	63.8716	12.9257
Female	28.70	60.7283	10.3478

Table 1B Descriptive Statistics Of Male Frontal Sinus

	FRONTAL LENGTH	FRONTAL WIDTH	FRONTAL HEIGTH
N Valid	74	74	74
Missing	0	0	0
Mean	35.36	63.8716	12.9257
Std. Error of Mean	1.04	1.7355	.5138
Median	36.00	63.5000	13.0000
Mode	36	80.00	15.00
Std. Deviation	8.93	14.9295	4.4195
Variance	79.77	222.8908	19.5321
Skewness	.049	.135	.492
Std. Error of Skewness	.279	.279	.279
Range	43	81.00	23.00
Minimum	14	27.00	4.00
Maximum	57	108.00	27.00
Sum	2617	4726.50	956.50

Table 1c Descriptive Statistics Of Female Frontal Sinus

	FRONTAL LENGTH	FRONTAL WIDTH	FRONTAL HEIGTH
N Valid	46	46	46
Missing	0	0	0
Mean	28.70	60.7283	10.3478
Std. Error of Mean	1.46	2.3099	.4961
Median	28.25	63.2500	10,0000
Mode	20[a]	78.00	7.00
Std. Deviation	9.88	15.6662	3.3646
Variance	97.58	245.4301	11.3208
Skewness	.026	-.336	1.295
Std. Error of Skewness	.350	.350	.350
Range	38	55.00	14.00
Minimum	9	31.00	6.00
Maximum	47	86.00	20.00
Sum	1320	2793.50	476.00

[a] multiple modes exist. The smallest value is shown

Table 2a Male Frontal Sinus Length Distribution

Length(mm)	9-16	17-24	25-32	33-40	41-48	49-56	57-64	Total
Frequency	2	9	16	27	13	5	2	74
Percent	2.7	12.2	21.6	36.5	17.6	6.8	2.7	100.0

Table 2b Male Frontal Sinus Width Distribution

Width (mm)	27-36	37-46	57-66	67-76	77-86	87-96	97-106	107-117	Total
Frequency	4	3	14	24	13	13	1	2	74
Percent	5.4	4.1	18.9	32.4	17.6	17.6	1.4	2.7	100

Table 2c Male Frontal Sinus Height Distribution

Height (mm)	4-8	9-13	14-18	19-23	24-28	Total
Frequency	16	26	23	8	1	74
Percent	21.6	35.1	31.3	10.8	1.4	100

Table 3a Female Frontal Sinus Length Distribution

Length (mm)	9.16	17-24	25-32	33-40	41-48	Total
Frequency	5	11	14	10	6	46
Percent	10.9	23.9	30.4	21.7	13.0	100

Table 3b Female Frontal Sinus Width Distribution

Width (mm)	27-36	37-46	57-66	67-76	77-86	87-96	Total
Frequency	3	5	12	5	12	9	46
Percent	6.5	10.9	26.1	10.9	26.1	19.6	100

Table 3c Female Frontal Sinus Height Distribution

Height (mm)	4-8	9-13	14-18	19-23	Total
Frequency	17	21	6	2	46
Percent	37.0	45.7	13.0	4.3	100

DISCUSSION

The observed differences in values of Williams (1995) who gave the average measurements of frontal sinus as length 3.2cm, depth/height 1.8cm and the present study as shown in table 1A could not be explained since possible determinants for sizes of paranasal sinuses; temperature, geography and nasal parameters were not dealt with in this study. It has been reported that the sinuses of both humans (Shea. 1977) and macaques (Rae et al., 2002) are reduced in size at higher latitudes, probably due to a corresponding increase in size of the nasal cavity. Also Rae et al., (2003) demonstrated the significant positive correlations between sinus index and temperature, thus stated that large maxillary sinus volume is associated with high temperatures, with a tendency toward relatively smaller maxillary sinus volumes farther from the equator.

The differences between the mean values for male and female frontal sinus length, width and height are 6.66mm., 3.14mm., and 2.58mm., respectively. Variation in the frontal sinus has been suggested by Buckland-Wright (1970) to be attributable to sex.

The result also showed in the Table 1 (B and C) from the standard deviation that there is a wide spread dispersion of values from the mean in frontal sinus length, width and height distributions. From the skew ness distributions of frontal sinus length was almost normal with height distribution showing positive deviation (i.e. most of the values for height fall below the mean) Values for the male width below means are slightly more than values above means while values for female sinus width showed a negative deviation from normal distribution (i.e. values for females sinus width fall above the mean). Therefore, there was a higher chance of encountering an individual with frontal sinus length and height values less than the mean in the population (male length 35.36mm, height 12.93mm and female length 28.70mm, height 10.35mm). Also there was a higher chance of encountering female with her frontal sinus width value more than the mean (60.73mm).

Pathological conditions affecting frontal sinuses are very serious conditions requiring aggressive medical management with a low index of suspicion for development of complications requiring surgical intervention. Therefore any additional information on metric and morphologic characteristics of frontal sinus aid otorhinolaryngologists and neurosurgeons in evaluation of frontal sinuses.

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