Research Article

Study of frontal sinus in north Karnataka region

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Abstract

In forensic science finger prints, foot prints, dental patterns, bones, skulls, sutures are the commonly used tools for identification of an individual. Recently paranasal sinuses have attracted attention of anatomist anthropologist, forensic experts[1]. Availability of even a small piece of frontal bone containing an intact frontal air sinus is sufficient for purpose of identification as well as knowing sex. Present study is conducted on 80 individuals in department of Radiology in Bidar Institute of Medical Sciences, Bidar. Frontal sinus study is carried out by taking radiographs. These radiographs are minutely studied under the heading of height, breadth, surface area .Height, Breadth% Surface area is studied with the help of Graphic method. The statistical test is used for sexual identification of frontal sinus. The demarcating point was calculated for all males and females, right, left and combined values were studied by application of 't' test. It is found that 't 'test shows significance for all parameters.

Keywords: Frontal sinus, sex determination, radiograph.

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INTRODUCTION

There are two frontal sinuses posterior to the supercilliary arches. It lies in between outer and inner table of frontal bone. In living to palpate the sinuses, it lies a triangular area 3 cm above the nasion and a junction between medial 1/3 and lateral 2/3 of supra-orbital margin. Two sinuses are rarely symmetrical. The septum between them usually deviates from the median plane.

The average measurements: Height-3.2 cm, Breadth-2.6 cm, Depth-1.8 cm.

Each frontal sinus opens into anterior part of corresponding nasal meatus by ethmoidal infundubelum. Frontal sinuses are rudimentary or absent at birth and reach its full size after puberty. Main function of sinus is to resonance to voice and to lighten the weight of skull. But saving in weight is trivial as absence of sinus does not add any weight to skull also there is no any change of volume of skull. Extensive studies have been undertaken on frontal sinuses by Forensic experts, Anatomist, ENT specialist and Surgeons. It has been found that no two frontal sinuses are alike[4]. This is important in differentiating the individuals and can be one of the important measures in establishing sex difference in frontal sinus of an individual.

MATERIAL METHODS

Present study of frontal sinus was carried out in 80 randomly selected individuals at Radiology department. Roentrograms of their sinuses were taken and studied as follow. The normal radiographs of known age and sex available in department of radiology were studied. All the individuals were free from infection and fully developed frontal sinus. There ages were ranging from 18 to 40 years. The X-Rays taken by Water's view selected. In this X-Rays 100 cm distance was kept constant between X-Ray tube and object. The X-Ray were marked 'L' for males and F for females. Out of 80 X-Rays 51 were males numbered as L1 to L51 and 29 were female numbered as F1 to F29.1111111111

Tracing of x-rays

To study the details of frontal sinuses, the trace paper is kept on X-Rays. X-Rays are traced on trace paper and trace paper is copied on graph paper with minute details. It facilitates the study of aircells, configuration, septa, shape, height, breadth and area of measurement of sinus.

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Method of Measurement

To study the frontal sinus in height, breadth and surface area following method is used.

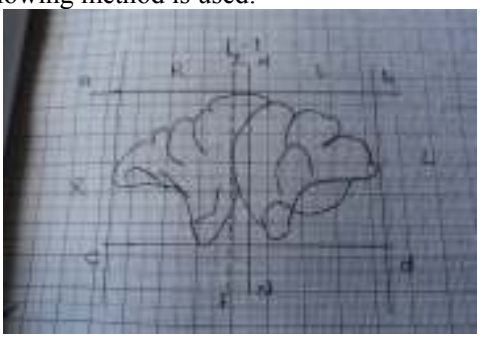

Figure 1: Measurement of Frontal sinus by Graphic Method[6]

In this method X-Rays are traced on trace paper and trace paper is copied on graph paper. Once the actual diagram of sinus is drawn on graph paper number of squares occupied are counted. Number of large cubes is expressed in terms of cm^2 which directly gives the surface area of sinus. If line is passing through less than half of square it is not taken in account while if it is going from more than half of square it is taken as one. The smallest square of each cube is 0.01 cm^2. No. of arches, No. of septas and No. of supra orbital cells are counted in each individual X-Rays, In the above fig. Height of right frontal sinus is 5 cm and that of left is 5.2 cm. Breadth of right frontal sinus is 3.5 cm and that of left is 4.5 cm. Surface area of right frontal sinus is 11.1 sq. cm and left is 13.5 sq.cm. No. of arches in the right are 5 and left are 4.No.of septas in right is 2 and left is 2.Supra orbital cells in right is 2 and left is 2.

RESULT AND OBSERVATION

The study was done on left and right side separately and combined in either sex. Therefore in present study the age changes could not be studied. The results obtained were studied by applying the various statistical tests. Out of 80 X-Rays congenital absence of frontal sinus either unilateral or bilateral was not observed in single subjects.

Table 1: Average Height of Right, Left and Combined sinus in either sex in mm

Details of Measurements	Right Frontal Sinus		Left Frontal Sinus		Combined Frontal Sinus	
	Male	Female	Male	Female	Male	Female
Total	1771	626	1805	673	1789	649.5
Mean	35	24	35	25	35	25
Standard Deviation	11.6	23	8.2	8.2	10	15
Range	10-58	10-42	5-52	13-47	5-65	20-70
Mean ±3 S.D.	0.2-69.8	45-93	10.4-59.6	0.4-49.6	7.5-55	11.5-44.5
Demarcating Point	>93	<0.2	49.6	10.4	70	5
% Beyond D.P.	0%	0%	8.92	0	12.5	57.59
't' Test	2.8	-	6.19	-	3.49	-

The value of t' test for height of Right, Left and Combined frontal sinus in either sex is 2.8,6.19 and3.49 respectively which is more than probability 0.05 according to 't' table. So the values are highly significant. On the basis of Demarcating Point, the values of Average Height of Right, Left and Combined frontal sinus for males are >93,>49.6 and>70 respectively and for females are <0.2,<10.4 and<5 respectively. On the basis of % beyond DP, the values of Average Height of Right, Left and Combined frontal sinus for males are 0%,8.92% and12.5% respectively and for females are 0%,0% and57.59% respectively. From the above it is concluded that the Height of

1. Right frontal sinus neither male nor female can be sexed as male and female.
2. In Left frontal sinus 8.92% males and 0% females can be sexed with 100% accuracy.
3. In Combined frontal sinuses 12.5% males and 57.59 females can be sexed with 100% accuracy.

Table 2: Average Breadth of Right, Left and Combined sinus in either sex in mm

Details of Measurements	Right Frontal Sinus		Left Frontal Sinus		Combined Frontal Sinus	
	Male	Female	Male	Female	Male	Female
Total	1491	577	1578	588	1534.5	582.5
Mean	29	22	31	22	30	22
Standard Deviation	11	8	12	10	12	9
Range	6-49	12-42	6-71	5-47	6-60	9-44
Mean ±3 S.D.	4-62	2-46	5-67	8-52	4.5-64.5	10-49
Demarcating Point	46	4	52	5	49	4.5
% Beyond D.P.	8.92	0	3.57	0	6.25	0
't' Test	2.84	-	3.28	-	3	-

The value of 't' test for Breadth of Right, Left and Combined frontal sinus in either sex is 2.84,3.28 and3 respectively which is more than probability 0.05 according to 't' table. So the values are highly significant. On the basis of Demarcating Point , the values of Average Breadth of Right, Left and Combined frontal sinus for males are >46,>52 and>49 respectively and for females are <4,<5 and<4.5 respectively. On the basis of % beyond DP, the values of Average Breadth of Right, Left and Combined frontal sinus for males are 8.92%, 3.57% and6.25% respectively and for females are 0%, 0% and0% respectively. From the above it is concluded that the Breadth of

1. Right frontal sinus 8.92% males and not a single female can be sexed with 100% accuracy.
2. In Left frontal sinus3.57% males and 0% females can be sexed with 100% accuracy.

3. In Combined frontal sinuses 6.25% males and 0% females can be sexed with 100% accuracy.

Table 3: Average Surface Area of Right, Left and Combined sinus in either sex in mm^2

Details of Measurements	Right Frontal Sinus		Left Frontal Sinus		Combined Frontal Sinus	
	Male	Female	Male	Female	Male	Female
Total	3703	1143	3965	1165	3834	1204
Mean	73	44	78	48	76	46
Standard Deviation	38	28	44	28	41	28
Range	5-161	4-151	7-201	4-145	6-186	4-148
Mean ±3 S.D.	41-187	40-128	54-210	35.8-132.7	47-199	38-130
Demarcating Point	128	41	132.7	54	130	47
% Beyond D.P.	7.14	38.46	17.85	76.92	12.49	57.69
't' Test	3.44	-	3	-	3.35	-

The value of 't' test for Surface area of Right, Left and Combined frontal sinus in either sex is 3.44,3.04 and3.35 respectively which is more than probability 0.05 according to 't' table. So the values are highly significant. On the basis of Demarcating Point , the values of Average Surface area of Right, Left and Combined frontal sinus for males are >128,>132.7 and>130 respectively and for females are <41,<54 and<47 respectively. On the basis of % beyond DP, the values of Average Surface area of Right, Left and Combined frontal sinus for males are 7.14%, 17.85% and12.49% respectively and for females are 38.46%, 76.92% and57.69% respectively. From the above it is concluded that the Surface area of

1. Right frontal sinus 7.14% males and 38.46% females can be sexed with 100% accuracy.
2. In Left frontal sinus 17.85% males and 76.92% females can be sexed with 100% accuracy.
3. In Combined frontal sinuses 12.49% males and 57.69% females can be sexed with 100% accuracy.

DISCUSSION

The radiograph can play a great role in identification of individuals. The earlier workers had reported that no 2 sinuses were alike; Grey also reports the same thing. In present study the congenital absence of any case was not reported in any X-Ray. Previously the same research was done by Dr.Uppe; there were 4 cases of congenital absence of frontal sinus. A study of frontal sinus can be performed at remote places where the finger print experts are not available. This study is easy and reliable. Radiographic study can also be performed in selected group of person's for example criminals for identification. Various workers like Culberd and Law in (1927), Thomas Poole in (1931), Mayer in (1935), Schuller in (1943), Uppe in (1984), Sahoo Gupta in (1993) were concluded the importance of frontal sinus. Dr.Uppe in his work stated that both the frontal sinuses were bigger in males than in females. The same conclusion is drawn by Schuller in (1943).He also stated that the size of left sinus is significantly bigger in both sexes as compared to right. The same observation is seen in present study. Likewise the maxillary sinus was also studied extensively for sexual dimorphism and personal identification. Percentage of agenesis is 6.2% in present study where as it is 5.28% in study done by Dr.Uppe and percentage of agenesis is only 1 % by schullers method. The present study is compared with the study done by Dr.Uppe in (1984).

		Surface Area(Male)	
By Dr.Uppe	Method	Right	Left
	Graphic	5.05	5.98
By Present Study	Graphic	7.30	7.80

The above study shows that the findings of Dr.Uppe's study correlate with present study. The slight variations in values are because of racial and geographic differences. The value of determining the sex by radiography is of medico legal importance and requires maximum accuracy.

CONCLUSIONS

1. Frontal sinuses are bigger in males than in females.
2. The left sinus is bigger in significant number of cases.
3. Presence of septas and their numbers are always variable thus they help in establishing the identity.
4. The no. of arches is variable and their number does not help in identification. The arching pattern in the sinus is different in every individual thus it helps in identification of individual.
5. Supra orbital cells are commonly present but their sight, size, shape and position is variable and helps in person identification.
6. Unilateral absence of sinus was seen 6.28% in present study where as the cases of agenesis were found to be 0% i.e. not a single case with bilateral agenesis is found.
7. Measurement of height, breadth and breadth of left sinus are important three criteria in identification of an individual. But if one sinus absents then it can affect utility of method. At this time surface area is measured and used as important criteria for measurement.

8. Graphic method is preferred method due to following reasons
    a. It is simple
    b. Because of sketches the sinus can be studied with minute details.
    c. It is an additional record on paper along with X-Ray.
    d. The graph paper and trace paper is easily available.
9. The measurement of surface area by graphic method is a new concept for recording height and breadth. It may open a new vista in cephalometeric studies in coming generation.

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