Uniqueness of Frontal Sinus as a Tool for Personal Identification in Forensic Odontology.

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ABSTRACT

Background: Individual identification is a subtle concept and often one of the important priorities in mass disasters, road accidents, air crashes, fires, and even in the investigation of criminal cases. To assess the individual differences in radiographic patterns of frontal sinus and to propose it as a tool for personal identification. **Methods:** Sample consisted of fifty healthy individuals aged 20-40 years with no history of orthodontic treatment, ortho-gnathic surgery, trauma, endocrine disturbances, nutritional disorders or hereditary facial asymmetry. Water's radiographs were made according to Caldwell technique. Markings of frontal sinus were based on Riberro Fde's measurement criteria. The data were analysed for comparison of the means of the dimensions measured for the two genders. **Results:** The results of the study concluded that frontal sinus is bigger and wider in males as compared to females. Facial symmetry was noted in 31 individuals while asymmetry in 15 individuals. Bilateral aplasia was seen in one case and unilateral aplasia was seen in 6%.cases. **Conclusion:** The frontal presents with unique variations in each individual and thus can serve as identification tool in forensic sciences.

Keywords: Frontal sinus, Forensic, Personal Identification

INTRODUCTION

Individual identification is a subtle concept and often one of the important priorities in mass disasters, road accidents, air crashes, fires, and even in the investigation of criminal cases. When entire skeleton is available, identification can be done with 10% accuracy but in cases of mass disaster where usually fragmented bones are left, identification is based on whatsoever information that can be collected from the site.[1] The most reliable measures of identification include fingerprints, dental comparison and biological methods like DNA profiling.

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However, when soft tissues of human remain become putrid or is burnt or DNA is severely damaged, fingerprint identification and DNA analysis cannot be carried out. Thus identity of remain can only be determined by anthropological methods. As evident from earlier studies[1,2] skull is the most dimorphic and easily sexed portion of skull providing accuracy up to 92%. With this background, this study was undertaken to examine the individual anatomical variations in frontal sinus and to propose possible use of the same in personal identification.

MATERIALS & METHODS

Water's radiograph of fifty healthy individuals who were willing to be a part of this study was recorded. Prior written and informed consent was taken by all the participants. Sample consisted of fifty individuals (twenty five female and twenty five males) aged 20-40 years. Patients with history of orthodontic treatment, orthognathic surgery, trauma or any surgery, history of endocrine disturbances, nutritional disorders or hereditary facial asymmetry were excluded. The radiographs were made according to Caldwell technique by the same radiologist utilising Care stream radiographic films (size 8" X10") at an exposure of 80KVP, 2.5 seconds and 10mA.All measures for radiation protection were taken. All the radiographs were evaluated for frontal sinus patterns with the help of radiographic viewer and tracings [Figure.1a]. Markings of frontal sinus were based on Riberro Fde's measurement criteria which includes:
A: reference base line. It is a 10cm line standardised at superior border of orbit

B, C: Greatest height on each side. (Maximum distance between base and upper lines of frontal sinus)

F, G: Greatest width on each side (Maximum distance between medial and lateral lines of right and left sides of frontal sinus) [Figure 1b].

The linear measurements obtained from each radiograph were expressed in lineal millimetres up to the accuracy of 0.5mm. The data were analysed for comparison of the means of the dimensions measured for the two genders.

RESULTS

The results of the study concluded that frontal sinus is bigger and wider in males as compared to females. Facial symmetry was noted in 31 individuals(16 males and 15 females) while asymmetry in 15 individuals (7 males and 8 females). Out of which, right sided asymmetry was seen in 4 cases and left sided asymmetry in 11 cases. Bilateral aplasia was seen in one case and unilateral aplasia was seen in 6%.cases. It was noted on left side in two cases and one case reported with right sided frontal sinus aplasia. [Table 1] shows the mean, standard deviation for the right and left sided frontal sinus samples studied. [Figure.2] shows anatomical variations in frontal sinus.

Table 1: shows the mean, standard deviation for the right and left sided frontal sinus samples studied.

Variable	Gender	Mean	Standard deviation
Right height	Male	1.75	0.67
	Female	1.47	0.64
Left height	Male	1.85	0.67
	Female	1.54	0.74
Right width	Male	2.62	0.81
	Female	2.16	0.61
Left width	Male	2.97	0.83
	Female	2.58	1.19
Right area	Male	4.52	2.86
	Female	3.46	2.30
Left area	Male	5.85	3.60
	Female	4.29	2.84
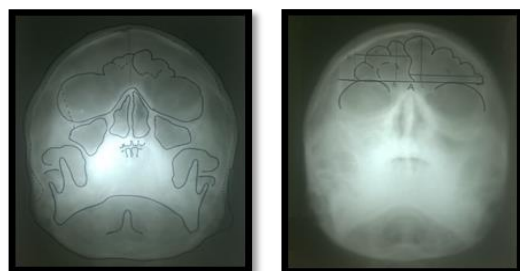
1a   **1b**

Figure 1a: Water's radiograph with radiographic tracings

Figure 1b: Markings of frontal sinusbased on Riberro Fde's measurement criteria

DISCUSSION

The determination of gender of unknown persons is of vital importance in forensic investigations, such as anthropologic, medical and dental forensic studies, mainly in cases where only fragments of the skull remain and there is no possibility of identification based on the dental arch. [1,2]Some typical features of frontal sinus morphology make it a very convenient part of the human skeleton for forensic identification. Firstly, it presents a highly variable nature and shows variation even among monozygotic twins.[3-6]This empirically accepted variability was proven mathematically using elliptical Fourier analysis by Christensen.[7]The second feature is its relatively stable structure during adult life.[3,5,6] Thirdly, the resiliency of the frontal sinus makes it useful for forensic purposes. It has very strong walls and is preserved intact in human remain as its internal bony structure and arched nature protect it from damage and decomposition. [8,9]Being placed posterior to the thick outer table of the frontal bone in the glabellar region, its stability is further enhanced. It has been noted that 800-1600 foot-pounds of force is required to fracture the walls of the frontal sinus, as with victims of high impact accidents and gunshot wounds.[10]Fourthly, paranasal sinus radiographs are commonly taken for diagnostic purposes and many people has one in his/her health records

In our study individuals were selected randomly between the ages 20-40 years because development of frontal sinus is usually completed by about of age of 18-20 years and thus to exclude the possibility of incomplete growth which may lead to false results.[3,4]Advancing age could lead to changes due to bone resorption, hence, individuals up to the age of 40 years were included in the study.[6]

The results of present study showed that width of frontal sinus was more in males as compared to females. It was similar to Ponde et al who also found a significantly higher antero-posterior diameter in males.[11] In our study, symmetry of the frontal sinus was found in 62% of the individuals, whereas, Tang et al. obtained 43.1% symmetry in the Japanese population. Frontal sinus asymmetry was observed in 30% in our sample, whereas, Tang

et al. observed 56.6% asymmetry.[5] Unilateral aplasia was seen in 6% of the individuals and bilateral aplasia in 2%. The results were consistent with those of Kullman[1], who observed frontal sinus absence in 5% of the adults, while some studies observed its absence in 4.8% of the cases. [3-6]
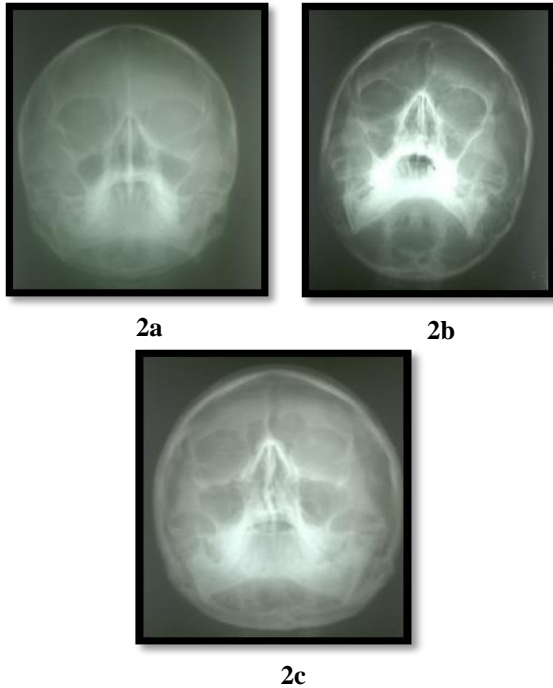

2a

2b

2c

Figure 2: Variations in morphology of frontal sinus:
2a: Unilateral aplasia of frontal sinus
2b: Left dominant frontal sinus
2c: Right dominant frontal sinus

CONCLUSION

From our study we could conclude that use of frontal sinus patterns could be used as one of the aids for personal identification. Moreover, the method used for identification was simple and not time consuming. It could be easily employed by a general dentist, as it did not require expertise.

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