ORIGINAL RESEARCH

Assessment of Gender by Frontal Sinus in North Gujarat Population- A Reliable Anthropologic Method

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ABSTRACT

Background: Radiographic means have been commonly used from decades for identification of decomposed, burnt or otherwise disfigured human remains. Among several osteological structures used, frontal sinus has been used for sex determination reliably due to its irregular shape and unique nature with respect to every individual just like finger prints. Despite the uniqueness in both the sexes, its use for determination of sex is limited. In the present study try is made to check the reliability of the radiographic method for sex determination using frontal air sinus. Present study was aimed to determine the sex using frontal sinus measurements among the adults in selected north Gujarat population using PA view skull radiographs.

Material and method: Total number of 40 PA view skull radiographs including 20 male and 20 females, age ranged between 20-35, collected from the archives of the x-ray imaging center. High resolution images were assessed for right and left height, width and areas in adobe Photoshop CS2 software. Comparison of the values will be done using student-t test and logistic regression analysis will be carried out for assessment of accuracy of the method in sex determination.

Results: frontal sinus is a reliable anthropological mean for gender determination

Conclusion: The present study determines frontal sinus as reliable anthropological measure to determine the sex.

Keywords: Frontal Sinus, Sex determination, student-t test.

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INTROUCTION

Forensic radiological analysis is a common procedure in human identification. Forensic anthropology is application of the science of anthropology in legal setting-most often physical anthropology and human biology are used in criminal cases where the victim's remains are in the advanced stages of decomposition.[1] Osteological structures are of great importance for identification of the human remains that are highly decomposed, burnt or otherwise disfigured. In such situation dental and medical ante and post mortem radiographs are proven highly relevant for comparison with post mortem radiographs.[2]

Anatomical structures in the skull radiographs are reliable for human identification such as cranium, paranasal sinuses, zygomatic process, nasal cavity, teeth etc. Among them frontal sinus is one of the most interesting and significant in forensic identification. Schuller was the first to study the frontal sinus in 1921 and revealed information about its uniqueness in human identification. Several authors have studied the reliability of the frontal sinus in forensic identification.[3-4]

Frontal sinus is paired lobulated paranasal sinus present in the frontal bone possessing uniqueness in every individual like fingerprints. Frontal sinus differs in shape, size, and symmetry from person to person. It starts developing after birth, for this reason radiographically it is not identified till the age of 5 years. By the age of about 20 years it develops completely. Due to the bone resorption enlargement results with the advanced age.[3] Frontal sinus almost invariably deviates from midline, which is the reason for difference between left and right frontal sinus. The definite difference exists between both right and left frontal sinus in each individual which can be helpful for forensic identification. An attempt is made here to measure the height, width, and area of both frontal sinus to establish the most reliable parameter for gender determination.

Thus, present study is aimed to determine the sex of adults in North Gujarat population using frontal sinus.

MATERIALS AND METHODS

The retrospective double blind study was conducted on North Gujarat population using 40 PA view skull radiographs taken from Hospital x-ray imaging center.

The age ranged from 18-35years. Determination of the sample size was done based on the studies conducted earlier. The group consisted of radiograph of 20 Males and 20 Females. The radiographs with minimal artifacts were selected. The digital radiographs were taken by the X fugi apparatus with the distance 1.8m from source to film, using an exposure of 70 kvp for 30 seconds at 20 mA. All the images were saved in high resolution jpeg format and transferred to adobe photoshop CS2 software. The measurements were taken in centimeters scale with the help of ruler tool.

A line joining two supercilliary arches was drawn which was considered as baseline from which the other measurements were taken. All the measurements were taken considering the line as base line.

The sinuses were measured for height and width. The area was calculated using these values.

- Right height (RH).
- Left height (LH)
- Right width (RW)
- Left width (LW)

Right area (RA) and left area (LA) were calculated by the formulae:

Area = Height X Width

STATISTICS

The statistical analysis was done using SPSS software version 10.0. The analysis of the frontal sinus measurement data was done by student-t test to compare the means of the measured dimensions for two genders.

Logistic regression model was applied, whereby parameters of the model were determined that allowed the prediction of probability of relevance of the males and females. In the logistic regression analysis multiplication of the value of each dimension with its corresponding coefficient (b) and adding the products together along with the appropriate constant (a) can determine the sex. For example, for the regression equation incorporating right height dimensions the logistic regression score (y) was calculated using the formula $y = a + bx$ where 'b' stands for regression co-efficient, 'x' stands for the variable measured and 'a' is a constant. Individuals with scores greater than the 0.5 sectioning point are classified as males, while individuals with scores less than 0.5 were classified as females. The closer the value is to 1, the greater the probability that the individual is male, while a value closer to 0 indicates a greater probability of the individual being female.

RESULTS

Among total 40 samples, 2 radiographs (5%) showed bilateral absence of the frontal sinus.

The descriptive variables means, standard deviation, standard error mean, and the p value is depicted in table.1

Variables	GENDER	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P Value
Left Heigth	Male	18	2.12	0.468	0.110	0.63	<0.0001
	Female	20	1.49	0.394	0.088		
Rigth Heigth	Male	18	2.13	0.741	0.175	0.54	0.015
	Female	20	1.59	0.556	0.124		
Left Width	Male	18	3.59	0.582	0.137	0.84	0.001
	Female	20	2.76	0.860	0.192		
Rigth Width	Male	18	3.38	0.805	0.190	0.37	0.144
	Female	20	3.01	0.721	0.161		
Left Area	Male	18	7.64	2.097	0.494	3.29	<0.0001
	Female	20	4.35	2.182	0.488		
Rigth Area	Male	18	7.52	3.768	0.888	2.46	0.030
	Female	20	5.06	2.947	0.659		

Table-1 The descriptive variables means, standard deviation, standard error mean, and the p value is depicted in table.

The student-t test results shows the comparison of the means of two groups (males and females) for all variables studied. The strong indication of the differences can be seen between means of the male and female for all the variables except the right width ($P < 0.05$).

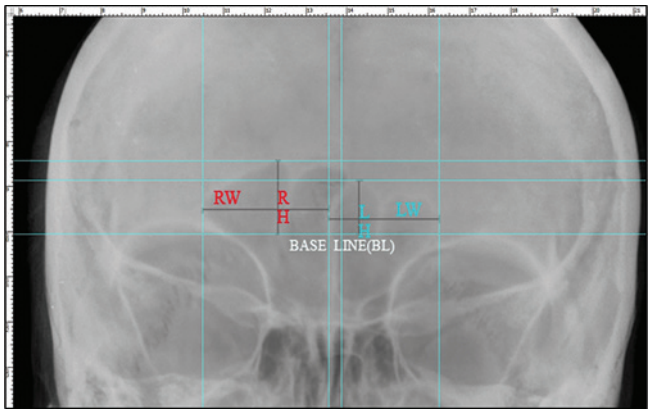
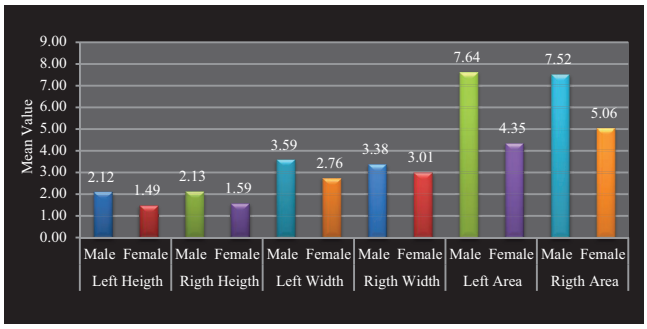
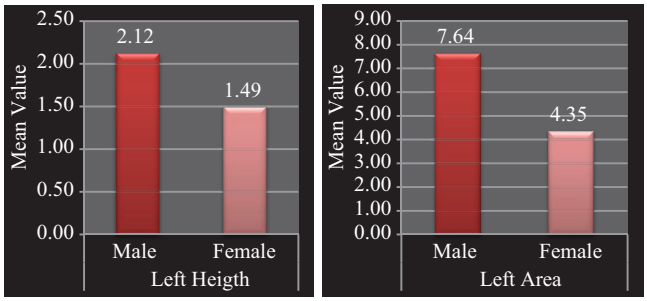


Figure-1: Line joining two supercilliary arches was drawn which was considered as baseline from which the other measurements were taken. All the measurements were taken considering the line as base line



Graph-1: Showed the differences in the mean of the variables of male and female, which indicates means for the measurements of the male were constantly greater than the female.



Graph-2: Showed the mean difference for the left area and left height of the sinus were more than other variables which indicates these variables to be more predictive for the identification.

The subsequent logistic regression analysis is shown in table 2.

Table 3. showed regression co-efficient of all variables. Regression model shows the left area, left height and left width to be more predictive regresser for sex determination.the overall corrected classification indicates the accuracy rate of the left area 78.9% and left height 73.7% for the north Gujarat population.

DISCUSSION

The anthropology mainly deals with the study of skeleton of the human remains. In forensic anthropology the easily applicable and low cost means of personal identification are necessary to establish.[2]

Determination of the sex is critical for the identification of an individual with advanced decomposition, mutilation, incineration of the body. It necessitates the use of skeletal remains among which the skull is the second best area of the body for sex identification. Morphomertic analysis of the mastoid process, gonial angle and paranasal sinuses have been used in the literature for sex determination. The frontal sinus is a paranasal sinus situated in the frontal bone has an important role in forensic anthropology due to its uniqueness in each individual like that of fingerprints.[8]

The present study showed that the morphology of the frontal sinus in both males and females were asymmetrical in each radiograph. Porbonika (1974) evaluated the frontal sinus growth in children of the age 1 to 13years. She observed beginning of the sinus growth at thirteenth month of age, being the same for both sexes. The growth goes up to the age of 20 years when the parameters starts diverging in girls which shows horizontal enlargement while boys shows vertical enlargement of the sinus. This fact may contribute to the difference between the sinus morphology between two genders observed.[14] This was observed in present study also.

The size of the frontal sinus may be related to environmental factors. Environmental and genetic factors control the frontal sinus configuration within each population. Koertvelyessy (1986) studied frontal sinus in Eskimos and stated that degree of pneumatization correlates positively with the degree of environmental coldness in which the population lives. The other systemic factors affecting the frontal sinus morphology are craniofacial configuration, the thickness of the frontal bone and the growth hormone levels.[6]

2 cases (5%) showed absence of the frontal sinus (1 unilateral and 1 bilateral) in the present study. Atif aydiuhoglu and co-worker studied absence of the frontal sinus in Turkish individuals and has reported that the frequency of the absence of the frontal sinus differs in different ethnic populations.[6] A similar study done

Parameters	Logistic regression y=a+bx	P for b	–2log LL	x2 for model fit	P value	% of overall corrected classification
Left Heigth	yLH=-3.46+6.27x	0.002	36.09	16.49	<0.0001	73.7
Rigth Heigth	yRH=-1.51+2.85x	0.030	45.93	11.96	<0.0001	71.1
Left Width	yLW=-1.70+5.60x	0.007	41.29	11.28	<0.0001	73.7
Rigth Width	yRW=-0.660+2.22x	0.145	50.31	5.99	<0.0001	63.2
Left Area	yLA=-0.679+4.14x	0.002	35.35	17.23	<0.0001	78.9
Rigth Area	yRA=-0.232+1.56x	0.044	47.57	5.01	<0.0001	71.1

Table-2 Measurement of association between estimated probability and observed responses

Variables (x)	Regression co-efficient (b	P value for b	–2log LL	x2 for model fit	P value	% of overall corrected classification
Left Heigth	-10.67	<0.0001	30.129	8.23	<0.0001	81.6
Rigth Heigth	-7.11	0.016				
Left Width	-5.71	0.002				
Rigth Width	-3.53	0.136				
Left Area	2.40	<0.0001				
Rigth Area	1.90	0.030				
Constant	36.15	0.011				

Table-3: Regression co-efficient of all variables

by Anuj Jain (2013) assessing frontal sinus aplasisa showed 2.5% and 0.84% absence in male and female respectively.[10] He concluded that frequency of the frontal sinus aplasia is low and the might be related to the environmental factor i.e. warm climate. He suggested that the anatomical variation of the paranasal sinuses may be related to sinus disease and frequency of an absence of the sinus shows racial difference.[10]

40 PA view skull radiographs of the adult males and females of age 18-35 years were studied for the assessment of frontal sinus dimensions.

In the present study the mean values for height of the right side sinus for males and females were 2.13 cm and 1.59 cm, which was less significant.[1]

Camargo et al. used logistic regression analysis in Brazilian population for gender determination using frontal sinus and found 79.7% precision. In the present study it was 81.6 %.[2] The results of the present study showed the mean difference of all parameters measured had higher values in males then the females.

The mean value of the height of the frontal sinus on left side of male and female was 2.12cm and 1.49cm (Table 1). This suggested the left height to be a highly significant parameter ($p<0.0001$). Chetan Belaldavar(2014) studied frontal sinus in Indian population and found a significant difference between male and female in left height of the sinus. The means of the width of the frontal sinus on the left side in male and female was 3.59cm and 2.77cm (table 1), which was highly significant. While the right width shows the mean value of 3.38cm and 3.01cm, which was statistically not significant. Contradictor y to this camargo et al.[2] and chetan belaldavar[1] found the right width to be a significant parameter.

The means of the left area in male and female was 7.64cm^2 and 4.33 cm^2 (Table 1), which was highly significant. While the right area shows the mean value of 7.52 cm^2 and 5.06 cm^2. The left area specifically had the highly significant value that agrees the statement Chetan belaldavar, who found the left height and left area to be better regresser.[1]

According to the logistic regression analysis (table 2) the overall corrected classification indicates the accuracy rate of the left area 78.9% and left height 73.7% for the North Gujarat population. This shows that the left variables are more predictive than the right in the present study. Chetan Belaldavar (2014) studied logistic regression model that provided 64% accuracy in determining sex and stated that left height and area are more accurate in sex determination.[1]

The left area and left height are more reliable parameter for sex determination in our study.

CONCLUSION

The present study determines the usefulness of the

frontal sinus as a reliable mean for sex determination. Among the individual criteria the right width showed less reliability as a sex predictor. So, the present study concludes that left area of the frontal sinus was more significant for gender prediction in North Gujarat population.

REFERENCES

1. Belaldavar C, Vijayalakshmi S. Kotrashetti, S R. Hallikerimath, A D. Assessment of frontal sinus dimensions to determine sexual dimorphism among Indian adult; Journal of Forensic Dental Sciences 2014;6:25-30.
2. Camargo JR, Daruge E, Prado FB, Caria PH, Alves MC, Silva RF, et al. The frontal sinus morphology in radiographs of brazilian subjects; its forensic importance. Braz J Morphol Sci 2007; 24:239-243
3. Cameriere R. Frontal sinus accuracy in identification as measured by false osiitive in kin groups. Journal of forensic science 2008;53;1-3.
4. Silva RF et al; Radiographic alterations of the frontal sinus morphology according to variations of the vertical angle in posteroanterior radiographs of the skull; Acta Scientiarum. Health Sciences Maringá, 2014;36:113-117
5. Prossinger H; Mathematical Analysis Techniques of Frontal Sinus Morphology, with Emphasis on Homo; The Anatomical record 2008;291:1455-1478.
6. Ayenglu A, Kavak A , Ahdem S; absence of frontal sinus in Turkish individuals; Yansie Medical journal 2003;44:215-218
7. Pondé JM, Andrade RN, Via JM, Metzger P & Teles AC; Anatomical Variations of the Frontal Sinus; Int. J. Morphol. 2008;26:803-808.
8. Sumati, Patnaik V.V.G, Pathak A; determination of sex from mastoid process by discriminant functional analysis; Journal of Anat. Soc. Ind. 2010;59:222-225
9. Dawson C, Ross D, Dr. Mallett Z ;Sex Determination. fornasic anthropology 2012;4:61-85
10. Jain A; frontal sinus aplasia;Indian stream research journal. 2013;3:1-5
11. Raghavan P, Pathmanathan G, Talwar I; The evolution of the anatomically modern or advanced Homo sapiens: time, place, process, affinities and variations; Singapore Med Journal 2009; 50: 556- 565
12. Silva RF, Pinto RN, Ferreira GM, Júnior ED; Importance of frontal sinus radiographs for human identification: Rev Bras Otorrinolaringol 2008;74:798-800.
13. Patil N, Karjodkar FR, Sontakke S, Sansare K, Salvi R Uniqueness of radiographic patterns of the frontal sinus for personal identification: Imaging Science in Dentistry 2012; 42 : 213-217.
14. Porbonikova, S. An X-Ray investigation of the development of the frontal sinus in children. Folia Med 1974; 16:213-220.