



3D RECONSTRUCTION COMPUTER TOMOGRAPHY OF FORAMEN MAGNUM AND FRONTO NASAL JUNCTION FOR SEX DETERMINATION IN SOUTH INDIAN POPULATION

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ABSTRACT

Aim: The Present study was to determine whether the Foramen Magnum and Angular Fronto Nasal Junction were useful in sex determination in South Indian population using 3D Reconstruction of "Philips Brilliance 64-slice computer Tomography scan". **Materials and methods:** 54 patients with mean age of Male 45.66±18.84 and Female 46.66±14.56 were selected for this study. Foramen Magnum Anterior Posterior diameter and Transverse diameter were calculated from 3D volume Rendering Technique of Computer Tomography of head in millimetre. The Angular Fronto Nasal Junction was calculated by drawing a line parallel to the nasal bone and the frontal bone. **Result:** Mean Antero-posterior diameter of male is significantly higher than in female, 35.18±2.84 > 31.77±2.05 and transverse diameter is significantly higher in male than in female 29.53±2.76 > 26.31±1.15. The value of p < 0.01 is considered significant and the t value of Antero-posterior diameter is 4.82 and for transverse diameter is 5.13. The mean Angular Fronto Nasal Junction is significantly higher in male (116.59°±11.74) than in female (109.39°±13.48) with p value of < 0.042 and t value of 2.08

KEY WORDS: computer tomography, foramen magnum, sex, determination, Angular Frontal Nasal Junction



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INTRODUCTION

In Medico-Legal cases, Sex determination from skull morphology is important. In Forensic studies, in most of the cases skeleton is incomplete and the sex identification is very difficult. During growth and development, the Foramen Magnum is one of the primary centres of ossification on the cranial base and is located inferior to the sagittal on the cranial base¹. Based on their research the authors proved that Foramen Magnum plays an important role in Sex determination. Uysal¹⁵ using computer Tomography scans of living individuals based on the dimensions of Foramen Magnum, they proved that it is larger in males compare to the females. Based on their research, many authors claim that usefulness of the Foramen Magnum in gender determination⁽⁴⁻⁹⁾. Hence this research has been carried out to find the morphological differences of foramen magnum and Angular frontal nasal junction for sex determination in human skulls of South Indian population using 3D reconstruction of Philips Brilliance CT 64-slice living individuals.

MATERIALS AND METHODS

54 patients (32 males and 22 females; mean age of male 45.66 ± 18.84 and Female 46.66 ± 14.56) were selected for this study. Foramen Magnum Anterior Posterior diameter and Transverse diameter were calculated from 3D volume rendering technique of computer tomography living

individuals of head in millimetre units. The Angular Frontal Nasal junction was calculated by drawing a line parallel to the nasal bone and the frontal bone.

Statistical Analysis

The 'Independent Samples t Test' was used to evaluate the mean differences of the measured parameters. A comparison was performed between male and female and $p < 0.05$ was considered as statistically significant. Mean values and standard deviation were taken into consideration in the statistical analysis using the software SPSS 16.0, with 95% confidence interval.

RESULTS

Mean Antero-posterior (AP) diameter of male is significantly higher than in female, $35.18 \pm 2.84 > 31.77 \pm 2.05$ and transverse diameter of male is significantly higher than in female $29.53 \pm 2.76 > 26.31 \pm 1.15$. The value of $p < 0.01$ is considered significant and the t value of Antero-posterior Diameter is 4.82 and for transverse diameter is 5.13 from Table 1. The mean Angular front nasal junction is significantly higher in male ($116.59^\circ \pm 11.74$) than that of in female ($109.39^\circ \pm 13.48$) with p vale of < 0.042 and t value of 2.08. Statistical Analysis of the date (Antero-posterior and Transverse Diameter of Foramen Magnum and frontal nasal angel with 95% confidence interval)

Table 1
Statistical Analysis of the date (Antero-posterior and Transverse Diameter of Foramen Magnum and Frontal nasal angel with 95% confidence interval)

Sl.no	Gender	N	Mean	S.D	t value	p value
Antero-posterior Diameter of Foramen Magnum	Female	22	31.77	2.05	4.82	<0.001
	Male	32	35.18	2.84		
Transverse Diameter of Foramen Magnum	Female	22	26.31	1.15	5.13	<0.001
	Male	32	29.53	2.76		
Frontal nasal angel	Female	22	109.39	13.48	2.08	<0.042
	Male	32	116.59	11.74		
Age	Female	22	46.54	14.56	0.184	0.852
	Male	32	45.66	18.84		



Figure 1
3D reconstruction Image of Computer Tomography of skull -Antero-posterior and Transverse Diameter of Foramen Magnum measurement

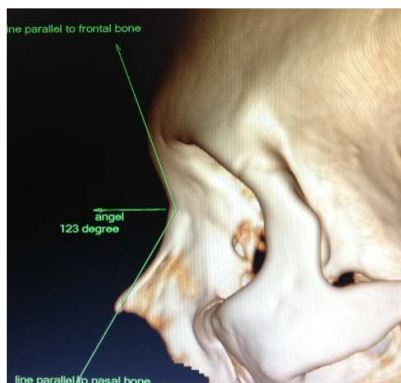


Figure 2
Fronto nasal angel measurement

DISCUSSION

The sex determination of incomplete or damaged skeletons is an important task in forensic medicine. Anthropometric measurements can aid in solving such problems of gender identification. The foramen magnum is used since it is a regular structure and less likely to major morphological changes. The comparison of the morphometric analysis obtained in this study with the results of other studies have the following results, the length AP diameter of the foramen magnum of South Indian male skulls (35.18 ± 2.05) is matching to the Brazilian male skulls (35.7 ± 0.29)¹⁰, the English (35.91 ± 2.41)¹¹, and the Indian population (35.5 ± 2.8)¹² but is lower than that of the Turkish (37.2 ± 3.43)¹³ and the Spanish (36.2 ± 0.3)¹⁴. Regarding the transverse diameter of the foramen magnum, the values of the South Indian male skulls (29.53)¹⁰ which are lower than that of the Brazilian Male skulls (30.3 ± 0.20), the Turkish (31.6 ± 2.99)¹³, the Spanish (31.1 ± 0.3)¹⁴ and the English Populations (30.51 ± 1.77)¹¹, are matching the Indians (29.6 ± 1.9).¹² Similarly AP diameter of the female skulls of the South Indian population is (31.77) lower than that of the Brazilian population (35.1 ± 0.33)¹⁰, than those of the Turkish (34.6 ± 3.16)¹³, the Spanish (34.30 ± 0)¹⁴, the Indian (32.0 ± 2.8)¹², and the English populations (34.71 ± 1.91).¹¹ Transverse diameter of the foramen magnum, the values of the South Indian female skulls (29.53) are lower than that of the Indian (27.1 ± 1.6) and are matching to the Brazilian population (29.4 ± 0.23)¹⁰ and the Turkish (29.3 ± 2.19)¹³, the Spanish (29.6 ± 0.3)¹⁴ and the English (29.36 ± 1.96)¹¹ populations. The mean nasal angle of female is $109.39^\circ \pm 13.14$ and for the male is $116.59^\circ \pm 11.74$ with $t = -2.08$ and $p < 0.045$. The results demonstrated that sexual dimorphism is present in the foramen magnum and also

from the Angular front nasal junction. In incomplete skeletons, metric analysis of the foramen magnum may provide a statistically useful indication as sex of the unknown skull. Radhakrishna et al concluded that, The AP diameter (34.04 vs. 31.72) and transverse diameter (28.63 vs. 26.59) are significantly higher in males than in females ($P < 0.05$)¹. Iván Claudio Suazo Galdames et al (2009) concluded that, the dimensions of the foramen magnum are significantly higher in males' skulls than that of in females' skull.² The discriminant function analysis showed that all linear dimensions tested had a low discriminating power (Wilks' $\lambda = 0.953$; Canonical correlation = 0.216) and the variables analysed were able to correctly classify only 66.5% of the cases examined.¹

CONCLUSION

Overall, the study concluded that, the 3D technique is the most reproducible technique for measuring the Antero-posterior and Transverse Diameter of Foramen Magnum and frontal nasal angle. In view of the software requirement for 3D volume measurement, a rapid and reliable diameter measurement technique tool is considered as useful for morphological differences of foramen magnum and Angular front nasal junction for sex determination in human skulls of South Indian population using 3D reconstruction of Philips Brilliance CT 64-slice. Further research is needed in this area using 3D reconstructed image in large sample to evaluate in Indian population.

Conflict of interest statement

We (the authors) confirm that there are no conflicts of interest associated with the submission of this article.

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