International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Estimation of Gender Accuracy of an Individual by Zygomatic Bone Measurement Using Multi-Detector Computed Tomography Scan in Kannada Population - A Forensic Study

Manna Debnath[1], Dolly Sharma[1], Rahul P. Kotian[2], Bryal Dsouza[3]

[1]Assistant Professor, Department of Medical Imaging Technology, Charotar Institute of Paramedical Sciences, Charusat University, Changa, Gujarat, India.
[2]Assistant Professor, Department of Medical Imaging Technology, Manipal School of Allied Health Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India.
[3]Assistant Professor, MHA Program, Department of Public Health, Manipal Academy of Higher Education, Manipal, Karnataka, India.

Corresponding Author: Manna Debnath

ABSTRACT

Objectives: To determine the significant difference in the Bi-Zygomatic measurements between males and females. To evaluate the accuracy of gender determination using Bi-Zygomatic measurements in Multi-Detector Computed Tomography Scan
Materials and Methods: The present retrospective study was performed on 70 patients (35 males and 35 females) within the age range 20 – 60 years, who all came to CT brain due to clinical reasons at the Department of Radio-diagnosis and Imaging, Kasturba Medical College, Manipal, Karnataka, India. MDCT scan was performed and brain images were reconstructed using Volume Rendering (VR) technique, then Bi-zygomatic width was measured on 3D face CT. Descriptive statistics (i.e. mean and standard deviation) of Bi-zygomatic measurements were compared and calculated.The data which have been collected was analysed using Independent sample t-test and discriminant analysis.
Results: Bi-zygomatic measurements showed statistically significant difference between both the groups i.e male and female group ($p<0.001$). Wilks' lambda test showed the accuracy of the study. In present study, the value of Wilks' lambda is 0.400.The ultimate result of discriminant analysis showed the ability of the Bi-zygomatic measurement to identify the gender with an overall cross- validated accuracy of 91.4%.
Conclusion: In current study estimation of gender using Bi-zygomatic measurement was well established. Zygomatic measurement/Facial width can be useful to determine gender with high accuracy in Kanara population.

Keywords: Bi-zygomatic length, Gender estimation, Kanara population, Volume Rendering

INTRODUCTION

Nowadays, the most essential challenges are to recognize the gender or sexual orientation of the victim found in criminal mass grave including rape and murder. Bone can also be used for stature determination. [1,2] Gender is very essential for the juxtaposition of an individual population group.

Here in present study, we are going to measure the zygomatic bone for evaluation of gender. Zygomatic bone is also known as malar bone which is situated below the orbital cavity. We are measuring

Bi-zygomatic width for the gender determination. [3] The decision to focus on the Zygomatic bone is the minimal anthropological changes throughout the life even after the growth is complete. In case of criminal offense like murder, war crime and also natural disasters where other facial bones like nasal bone, nasal concha are usually broken and dispersed. Other bone components can also be used nowadays to estimate gender or sex, for example, hyoid, scapula, skull bone. [4-7] Many Indian studies also have been reported. [8,9] The CT we are used in the current study is Philips Brilliance 64 slice. Mostly in previous studies measurement of data by using calipers which is a very conventional technique to measure the data but in present study data is measured from Multi-detector Computed tomography scan using advanced tools, so the measurement we took may be more accurate compared to other methods.

AIM:

Estimation of Gender accuracy of an individual by Zygomatic bone measurement using multi-detector computed tomography scan in Kanara Population.

OBJECTIVE:

To determine the significant difference in the Bi-Zygomatic measurement between males and females.

To evaluate the accuracy of gender determination using Bi-Zygomatic measurement in Multi-Detector Computed Tomography Scan.

MATERIALS AND METHODS

The study included 70 samples in the age range between 20 - 60 years from the Department of Radio-diagnosis and Imaging, Kasturba Medical College, Manipal, Karnataka, India. Study procedure was clearly explained to the particular patients. The study was conducted between September 2016 to February 2017.

The Inclusion criteria were patient came for Computed Tomography Brain scan in this study period are included in the study. The exclusion criteria were Facial injury, Zygomatic Implant, Facial trauma are excluded from the study.

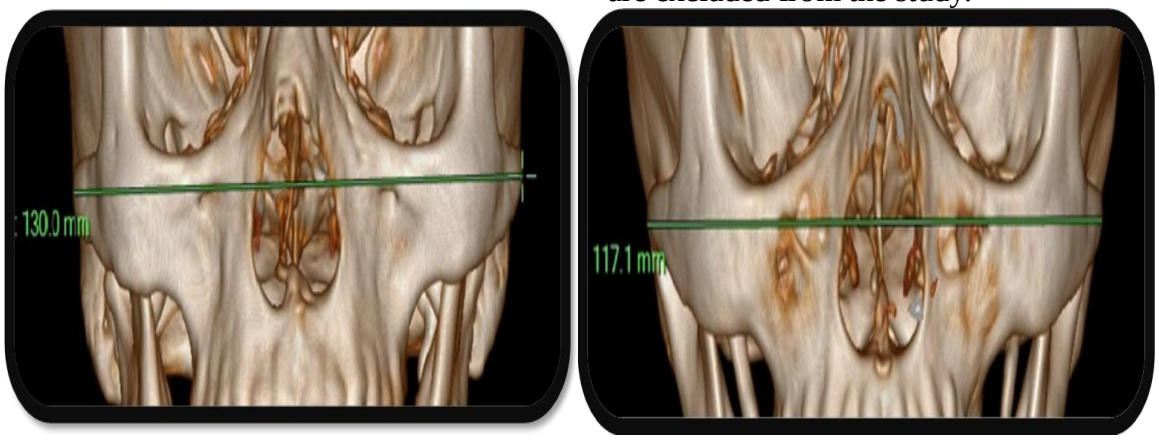


Fig – 1]: Figure showing Bi-Zygomatic measurement of facial width. Bi-Zygomatic Length (BZL)–The distance of entire facial width from the right end of the zygomatic bone to the left end side of the zygomatic bone.

Computed tomography of the brain was accomplished on Multi detector computed tomography 64 slice Philips with regular brain protocol. The patient was placed on the CT couch in the supine position with region coverage from Base of the skull to Vertex. Below the scanning protocol was applied during the scan – Scan Direction caudocranial with no angulation of gantry, FOV 250 mm, tube kilo voltage of 120 kVp (Peak kilovoltage), tube current of 350 mAs, rotation time 0.75 seconds, pitch 1.078 and scan duration or time 3.5 seconds, filter standard B, resolution standard. A scanning topogram was taken and the area of the interest is covered (Base of the skull to Vertex). Throughout the scan, the slice thickness of 5 mm and the slice

incrementation of 5 mm was taken. During the scan, the patient was instructed not to move on either side to abolish motion unsharpness or artifacts. The raw data was then reconstructed to slice thickness of 1.0 mm with slice increment of 0.5 mm. After accumulating all the raw data of each individual the two-dimensional images is converted into three-dimensional images via post processing Volume Rendering(VR) technique and Bi-zygomatic length (BZL) was measured [Fig 1].

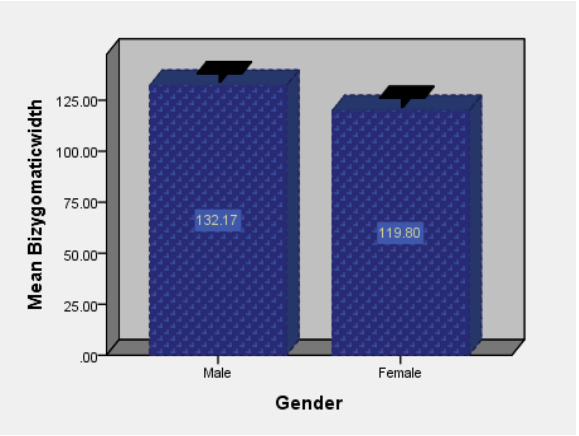
STATISTICAL ANALYSIS:

Social Package of Statistical Science (SPSS, Version 20.0) was used for the analysis of the data. The mean and standard deviation was calculated for analyzing the zygomatic bone measurement. Further analysis was done using independent t-test and discriminant analysis.

RESULT

In current study, a total number of 70 samples (35 males and 35 females) were included. The descriptive analysis was utilized to show the mean and standard deviation of the sample. Mean value of facial width for the male was 132.17 and mean value of facial value for the female was 119.80, however the overall mean value was 125.98 [Fig-2]. Standard deviation value for the male was 4.98 and standard deviation value for the female was 5.26 and the overall standard deviation was 8.04.

Independent sample t-test was done to compare the means of two independent groups (i.e. Male & Female) to determine whether there was any statistically significant difference or not. If the p-value is <0.05, that means there is a statistically significant difference. In present study p-value was <0.001, that meant bi-zygomatic measurement shown statistically significant difference between two groups i.e. male and female.



[Fig – 2]: 3D Bar diagram shows mean difference between male and female

Wilks' lambda test showed the accuracy of the study. In present study shows that the value of Wilks' lambda was 0.400. The standard value of Wilks' lambda ranges from 0 to 1, where 0 indicate complete discrimination and 1 indicate no segregation. The result accuracy is better if the value of Wilks' lambda is lower.

The discriminant analysis showed the overall cross-validated accuracy to determine the gender was 91.4 % (Accuracy of Male - 88.6% and Accuracy of Female - 94.3%)

DISCUSSION

Estimation of gender is very important for identification of victims found in terrorist attacks, disaster victims and medico-legal cases.

[Table – 1]: Comparison of result accuracy of previous study with present study.

Study	Number of samples	p-value	Result accuracy
Lawan H. Adamu et al, [3]	283(147 males & 136 females)	P<0.001	76.2%
Ankit Rawat et al, [10]	200(100 males & 100 females)	P<0.05	Comparison between bi-zygomatic width and mesiodistal dimension shows higher accuracy in case of male than female.
Twisha Shah et al, [8]	901(676 males & 225 females)	P<0.001	Highest accuracy 92% male using logistic regression and 80.9% female using discriminant function
Present study	70 (35 males & 35 females)	P<0.001	91.4%

In 2015 Twisha Shah et al, performed a study based on sex determination using cephalo-facial dimensions. Eight cephalo-facial dimensions were included (Maximum head length, maximum head breadth, Bi-zygomatic breadth, Bigonial breadth, Physiognomic facial height, Total head height, Morphological facial height, Biocular breadth) which shown means and standard deviation of both sexes. [8] Similarly Lawan H. Adamu et al, published one study based on sex identification using facial linear dimension, which shows the descriptive statistics of the both sexes i.e. mean and standard deviation. [3] In present study the descriptive analysis of variables were reported which shown mean and standard deviation for both groups (i.e. male and female groups).The total value of mean and standard deviation of female was smaller than the male which interoperated that there was a strong statistically significant difference between both the groups.

Lawan H. Adamu et al, reported in their project that independent sample t-test was done which shown greater statistical significant difference between male and female group i.e. $p<0.001$. [3] Similarly in the present study same test was used i.e. independent sample t-test which proved statistical significant difference between both the groups ($p<0.001$).

Twisha Shah et al, reported in their study that discriminant analysis was done in which Wilks' Lambda value ranges from 0.799 to 0.903. [8] Similarly, Manna Debnath et al conducted a study based on gender determination of scapula in Dakshina Kannada Population, has reported multivariate analysis were done for the variables in which the Wilks' lambda value was 0.290. [6] Another study by Ismail Ozer was to determine sex from scapula in medieval skeletons from East Anatolia in which the Wilks' lambda value was 0.265 for glenoid cavity height, which was the most segregated variables in the study. [11] In present study, the value of Wilks' lambda is 0.400. If the value of Wilks' lambda is small there is a good result accuracy and discrimination in the study.

Nine hundred one samples was studied by Twisha shah based on sex determination and found accuracy 92% by calculating logistic regression equations in males and 80.9% accuracy by using discriminant analysis in females. [8] Another study was conducted by Lawan H. Adamu based on estimation of sex and the result showed the highest accuracy of 76.2% by using upper facial height which was the single best predictor of sex. [3] Giurazza F performed a study with 200 samples, study based on sex determination of scapula in which the accuracy rate was 90% & 88% of the skeletons and calibration sample. [12] A study conducted by Manna Debnath based on sex estimation using six parameters of both the scapula of Dakshina Kannada population and found the cross-validated accuracy 93.5%. [6] In present study by using discriminant function analysis of Bi-zygomatic measurement with the cross-validated accuracy of 91.4%.

The differentiation between the previous studies and the present study has been enlisted [Table - 1]. There are still numerous factors which we can compute in facial measurement other than this variable (Bi-zygomatic width) which might have produced to better precision of the study. In present analysis, the sample measured was excessively small, if the sample size is more the outcome exactness may be good. The data estimated were randomly picked which might have generated bias. Further study can be done to overcome these impediments of the present research.

CONCLUSION

Estimation of gender by using Bi-zygomatic measurement was well entrenched in this study. In present study, the mean and standard deviation value of males were higher compared to females. The gender of an individual subject of Kanara population can be determined by utilizing Bi-zygomatic measurement with

91.4% accuracy. The present study suggested that the facial width or Bi-zygomatic measurement can be useful with high accuracy to estimate gender in Kanara populations.

ACKNOWLEDGEMENT

We are thankful to the Department of Medical Imaging Technology, Manipal School of Allied Health Sciences, Manipal Academy of Higher Education, for their constant support and also thankful to the Department of Radio diagnosis, Kasturba Medical College, Manipal, for their approval in accumulating the data.

Authors' Contribution

Manna Debnath, Dolly Sharma, Rahul P. Kotian, Bryal Dsouza had contributed to the design of the study, analysis and interpretation of data. Manna Debnath also contributed to the collection of the data. Dolly Sharma and Rahul P. Kotian had scrutinized the article for the quality content. The manuscript is written by Manna Debnath.

Conflicts of interest:

There are no conflicts of interest

REFERENCES

1. Mounika S, Yuvarajbabu K. Estimation of Stature from the Facial Width. Journal of Pharmaceutical Sciences and Research. 2015 Jun 1;7(6):353.
2. Shah T, Patel MN, Nath S, Bhise RS, Menon SK. Estimation of stature from cephalo-facial dimensions by regression analysis in Gujarati population. Journal of Indian Academy of Forensic Medicine. 2015;37(3):253-7.
3. Adamu LH, Ojo SA, Danborno B, Adebisi SS, Taura MG. Sex determination using facial linear dimensions and angles among Hausa population of Kano State, Nigeria. Egyptian Journal of Forensic Sciences. 2016 Dec 1;6(4):459-67.
4. Logar CJ, Peckmann TR, Meek S, Walls SG. Determination of sex from the hyoid bone in a contemporary White population. Journal of forensic and legal medicine. 2016 Apr 1; 39:34-41.
5. D'Souza DH, Kiran J, Harish SS. Determination of sex by shape and size of hyoid bone. Journal of Indian Academy of Forensic Medicine. 2013;35(2):145-7.
6. Debnath M, Kotian RP, Sharma D. Gender Determination of an Individual by Scapula using Multi Detector Computed Tomography Scan in Dakshina Kannada Population-A Forensic Study. Journal of Clinical & Diagnostic Research. 2018 Mar 1;12(3).
7. Galdames IC, Matamala DA, Smith RL, Suazo G, Zavando M, Smith R. Sex determination using mastoid process measurements in Brazilian skulls. Int J Morphol. 2008 Dec 1;26(4):941-4.
8. Shah T, Patel MN, Nath S, Menon SK. Determination of sex using cephalo-facial dimensions by discriminant function and logistic regression equations. Egyptian Journal of Forensic Sciences. 2016 Jun 1;6(2):114-9.
9. Singh A, Sreedhar G, George J, Shukla A, Vashishta V, Negi MP. Anthropometric study using craniofacial features to determine gender in Lucknow population. Journal of forensic dental sciences. 2017 Sep;9(3):120.
10. Rawat A, Godbole SR, Sathe S, Patidar N, Ramteke S. Evaluation of Relation between Bizygomatic Width and Mesiodistal Dimension of Maxillary Central Incisor in Indian Population: An In Vivo Study. International Journal Of Scientific Study. 2015 Sep 1;3(6):38-42.
11. Özer I, Katayama K, Sahgir M, Güleç E. Sex determination using the scapula in medieval skeletons from East Anatolia. Collegium antropologicum. 2006 Apr 10;30(2):415-9.
12. Giurazza F, Schena E, Del Vescovo R, Cazzato RL, Mortato L, Saccomandi P, Paternostro F, Onofri L, Zobel BB. Sex determination from scapular length measurements by CT scans images in a Caucasian population. In2013 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) 2013 Jul 3 (pp. 1632-1635). IEEE.

How to cite this article: Debnath M, Sharma D, Kotian RP et.al. Estimation of gender accuracy of an individual by zygomatic bone measurement using multi-detector computed tomography scan in Kannada population - a forensic study. Int J Health Sci Res. 2019; 9(9):65-69.

******