Original Article

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EVALUATION OF ZYGOMATIC ARCH IN DETERMINATION OF SEXUAL DIMORPHISM: AN INSTITUTE BASED STUDY

Shruti Chandra[1], Sunira Chandra[2], Shweta Dwivedy[3], Akanksha Srivastava[4], Pratikchhya Shrestha[5], Richa Thakur[6]

1.MDS,Private Practitioner
2.Reader,Department of Oral Medicine,Dental College.
3.MDS,Private Practitioner
4.MDS,Private Practitioner
5.Post Graduate Student, Department of Oral Medicine,Dental College
6.Post Graduate Student, Department of Oral Medicine,Dental College

ABSTRACT:

Background: Determination of gender is one of the essential pre requisites in forensic odontology. Skull being the best after pelvis for sex determination.Various morphological features of skull have been studied for the gender determination i.e. muscle ridge, supraorbital ridge, mastoid process, frontal eminence etc. Very sparse study has been done on zygomatic bone and have shown sexual dimorphism. Hence, the present study was undertaken to study sexual dimorphism in zygomatic arch and to determine its reliability in determination of sexual dimorphism.

Method: Jug handle radiograph of 60 subjects (30 male and 30 female) were taken in a standardized manner and a lower exposure parameters (60 Kvp, 10 mA, 13.9 sec.) were used for the visualization of zygomatic arches. Linear measurements of the zygomatic arch were taken with the Universal desktop ruler software. The results were analysed by using Students t test and Discriminant analysis.

Result: All the linear measurements were observed higher in males and were also statistically significant with a reliability of 71.1%.

Conclusion: We can conclude from the present study that zygomatic bone is useful in gender determination, and should be used in conjunction with other sex determination methods to increase its reliability.

Keywords: Zygoma, Forensic, Identification, Jug handle view

INTRODUCTION:

Bones are the most durable part of the human body and sometimes the only recognizable remains in case of mass disasters, fire scenes, crime etc. They may be the only resource which forensic anthropologists can utilize to determine the person's identity by knowing the gender, age and ethnic origin. After pelvis, skull shows 80-100% of accuracy in sexual dimorphism. [1, 2] There are certain conditions where even advanced identification criteria i.e DNA, fingerprint are not helpful in gender determination due to advanced decomposition or damage. In such situation general identification criterias are employed which involves personal effects and physical profile. [3]

Zygomatic arch, also known as cheek bone, is formed by the temporal process of zygomatic bone and zygomatic process of temporal bone united by oblique suture. Malar bone, rectangular plate is the main structure composing it. It is attached through projections, anteriorly from maxilla, posteriorly from

*Corresponding Author Address: Dr. Shruti Chandra. E-mail: shruti.chandra42@gmail.com

temporal bone, superiorly to frontal and sphenoid bones and the free borders of malar bone forms the lateral border. [4, 5]

Various studies have been undertaken by various authors on human dried skull (immortals) to evaluate the usefulness of zygomatic arch in gender determination.

The present study was undertaken to establish, if there is any sexual dimorphism in zygomatic arch on jug handle radiograph. To best of our knowledge, this is the first study of its kind where linear measurements have been done on zygomatic arch in mortals through utilization of Jug handle technique.

MATERIALS AND METHODS:

This prospective study was conducted on 60 randomly selected healthy subjects in age group of 20-30 years, visiting the Department of Oral Medicine and Radiology of which 30 were males and 30 were females. The study was approved by the IRDC and IHEC. Before starting the study written informed consent was obtained from each subject after explaining the purpose and method of the study.

Individuals with history of skull surgery, trauma, or developmental anomaly related to skull, history or clinical characteristics of endocrine disturbances, nutritional diseases or hereditary facial asymmetries were excluded.

Jug handle radiographs were taken of all the subjects using Kodak 8000C Digital Panoramic and Cephalometric system with Kodak Dental Imaging Software and Cephalometric Acquisition Interface Module. The head of the subject was centered on the receptor and tipped back as far as possible so that the vertex of the skull touches the cassette. The midsagittal plane was kept perpendicular to the plane of the film and the radiographic base line parallel to the film (Fig I). Exposure parameters were reduced for the better visualization of zygomatic arch (60 kVp, 10 mA, and 13.9 s), and an adequate radiation protection measures were taken in to the consideration. Radiographs with evident bilateral zygomatic arch without any radiographic error were included in the study. Linear measurements of the zygomatic arch (Both sides) were recorded by Universal desktop ruler software. The measurements of zygomatic arch which were taken are (Fig II):

1. Length at superior point of attachment (Left- L1, Right- R1)
2. Length at inferior point of attachment (Left –L2, Right- R2)
3. Width at centre (Left- L3, Right- R3)
4. Length from superior to inferior point of attachment (Left- L4, Right- R4)

The data was statistically analysed by student's t test and discriminant analysis.

RESULTS:

The mean of all value of R1, R2, R3, R4, L1, L2, L3 and L4 are observed more in males as compared to females. Student t test was also significant except in L1 and R2. L4 and R4 are highly significant with a reliability of 71.1% in determination of sexual dimorphism (Table I, Graph I).

Discriminant Analysis

- FEMALE=-12.136+2.951(L1)-1.589(L2)+29.970(L3)+3.352(L4)-6.381(R1)-8.512(R2)+20.807(R3)+2.338(R4)
- MALE=-19.485+4.068(L1)+.674(L2)+35.538(L3)+3.420(L4)-7.818(R1)-14.084(R2)+32.370(R3)+3.605(R4)
- If value is less than 0 then female else male

DISCUSSION:

Forensic anthropometry is a discipline of anthropology dealing with the identification of human remains with the help of metric technique. It's use in gender determination is well established.

In the present study a total no. of 60 (30 males and 30 females) were subjected to jug handle radiographs for determination of sexual dimorphism through zygomatic arch. Linear measurements of both the right and left zygomatic arch were taken at four different points for both the right and left zygomatic arch.

Rattanasalee P, Mekjaidee K, Prasitwattanaseree S, Sinthubua A, 2014 conducted a study- Could zygomatic angles be used for determining the sex of Thai skeletal remains? From 100 skulls, 50 were male and 50 female. The mean left zygomatic angle was shown to have a statistically significant difference between males and females (p =0.027).Results showed distinguishable potential with 57% accuracy between males and females by using the cut off.[3] Ikeda T, Nakamura M, Itoh M, 1999 conducted a study- Sex differences in the zygomatic angle in japanese patients analyzed by MRI with reference to moiré fringe patterns. Degree of zygomatic protrusion, a new item, "zygomatic angle," was measured on MRI. Results were highly significant on both sides, being larger in males than in females. Zygomatic protrusion was classified into angulate, intermediate, and massive types.[6] In the above mentioned studies only zygomatic angle was measured while we took four measurements of the zygomatic arch bilaterally to assess sexual dimorphism.

Sahin G, Akın D, Aydin Kabakci, A. D, Sindel, M, Ay, D, Buyukmumcu, M. B,2014 conducted a study- Morphometric evaluation of zygomatic arch in human skull. The study was done on dried skulls where measurements of zygomatic arch were taken using digital caliper. (Thickness of the anterior, middle and posterior portions of zygomatic arch, distance between anterior and posterior end of the arch, etc.) Results showed no significant differences in measurements in males and females.[7] While in our study measurements showed significant sexual

dimorphism, the highest one being length of zygomatic arch.

Swami S, Patnaik VVG, Kaushal S, Sharma D,2010 conducted a study on skulls of 30 males and 30 females of Indian Punjab region. The study involved the zygomatic bone in assessing sexual dimorphism by series of metric and nonmetric variants. Results showed 75% reliability for six metric traits of zygomatic bone and 71.7% for two non metric traits in sexual dimorphism.[8]

In a study done by Jehan M, Bhadkaria V, Trivedi A, Sharma S.K,2014 on Sexual Dimorphism of Bizygomatic distance & Maxillary sinus using CT Scan and by Vidya C.S, Prashantha B, Gangadhar M.R. on Anthropometric predictors for sexual dimorphism of skulls of south indian origin it has been proved that sexual dimorphism exists in bizygomatic distance.[9,10]

CONCLUSION:

From the present study, we can conclude that zygomatic arch can be used to determine gender alone or in conjunction with other gender determination methods. The similar study, if done on larger sample would give more reliability, though our study has effectively established a positive relation between measurements on zygomatic arch and sexual dimorphism.

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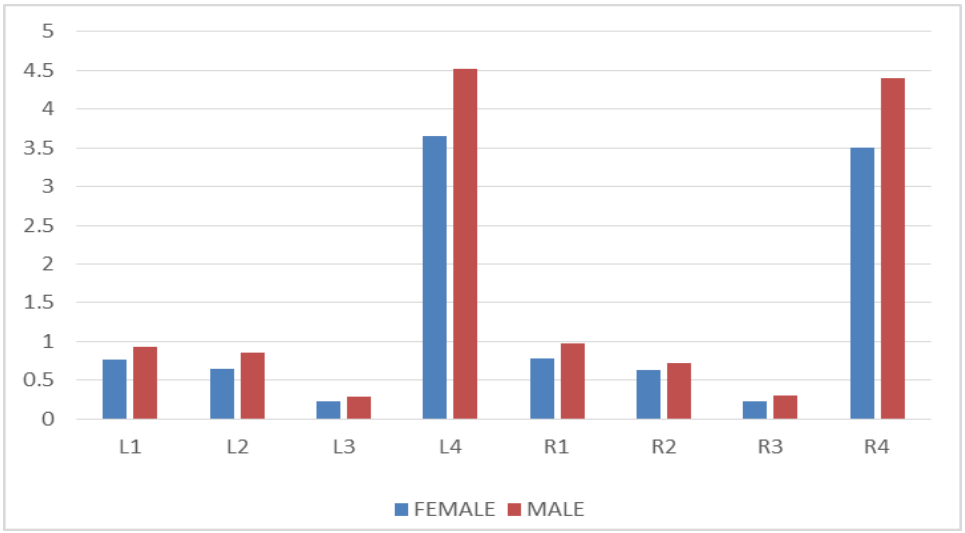
TABLES AND FIGURES:

	Gender	N	Mean	Std.Deviation	t	df	P Value
L1	FEMALE	30	0.7643	0.31251	-1.938	58	0.058
	MALE	30	0.9297	0.34744			
L2	FEMALE	30	0.642	0.27836	-2.963	58	**0.004**
	MALE	30	0.8477	0.25891			
L3	FEMALE	30	0.2263	0.06578	-3.246	58	**0.002**
	MALE	30	0.285	0.07399			
L4	FEMALE	30	3.6597	0.97865	-3.576	58	**0.001**
	MALE	30	4.517	0.8757			
R1	FEMALE	30	0.7833	0.32465	-2.018	58	**0.048**
	MALE	30	0.9777	0.41569			
R2	FEMALE	30	0.628	0.34212	-1.181	58	0.243
	MALE	30	0.7227	0.27543			
R3	FEMALE	30	0.2277	0.07758	-3.933	58	**≤0.001**
	MALE	30	0.2967	0.05671			
R4	FEMALE	30	3.51	1.02031	-3.36	58	**0.001**
	MALE	30	4.403	1.0384			

Table I

1. Length at superior point of attachment (Left- L1, Right- R1)
2. Length at inferior point of attachment (Left –L2, Right- R2)
3. Width at centre (Left- L3, Right- R3)
4. Length from superior to inferior point of attachment (Left- L4, Right- R4)



Graph I

Fig. I

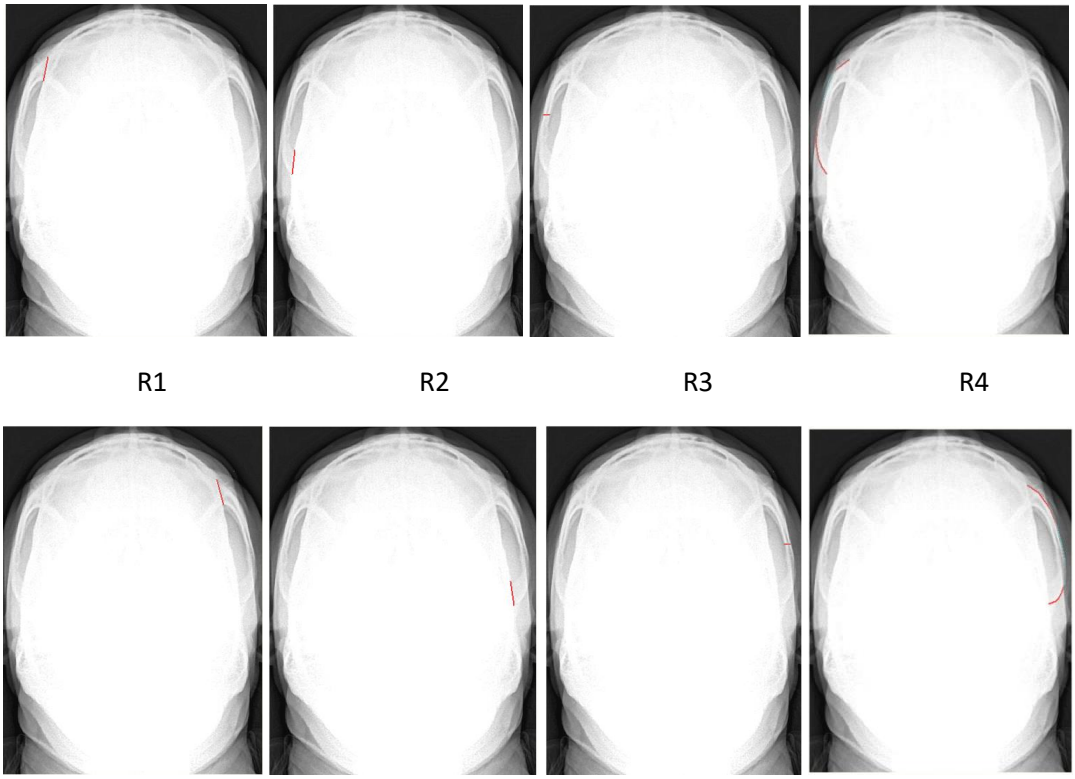


Fig. II