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Radiomorphometric Evaluation of Orbit and Inter-Orbital Distance for Gender Determination

[1]Altaf Hussain Chalkoo, Professor and Head, Department of Oral Medicine and Radiology, Government Dental College, Srinagar, Jammu and Kashmir, India

[2]Diksha Koushal, PG Scholar Department of Oral Medicine and Radiology, Government Dental College, Srinagar, Jammu and Kashmir, India

Corresponding Author: Diksha Koushal, PG Scholar Department of Oral Medicine and Radiology, Government Dental College, Srinagar, Jammu and Kashmir, India

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Abstract

Introduction: Anatomy of the human orbit is complex, which plays an important role in the assessment of craniofacial complex. The bony orbit which lodges the eyeball is significant not only for the anatomists but also for oral and maxillofacial surgeons, forensic experts, ophthalmic surgeons and neurosurgeons. Study aimed to measure the width of the orbital apertures on Postero-anterior skull radiographic view, to measure the height of the orbital apertures on Postero-anterior skull radiographic view, to measure the interorbital distance on Postero-anterior skull radiographic view and to determine gender from radiomorphometric evaluation of orbit and inter-orbital distance

Materials and Methods: A retrospective study was conducted using posterior-anterior skull radiogrphs of 50 males and 50 females between the age group of 18 – 50years.Orbital measurements were done on PA skull views taken by New-Tom VGi Scanner (QR srl; Verona, Italy) in standard resolution mode (tube potential:50-85KV, tube current:12mA, and time:14sec The maximum width and height of orbit and inter-orbital distance of the orbits were measured .The data obtained was analyzed by using student "t" test

Results: The mean orbital width in males was 35.18 and females were 29.17. The observed mean difference was statistically significant ($P<0.05$). The mean orbital height in males was 34.36 and females was 29.59 the observed mean difference was statistically significant ($P<0.05$) The mean inter-orbital distance in males was 26.50 and females was 23.09. The observed mean difference was statistically significant ($P<0.05$)

Keywords: Gender Determination, Radiomorphometric, Determination of Orbit and Interorbital, Postero-Anterior Skull Radiographs

Introduction

Determination of age, sex, stature and ethnicity which form the feature of tentative identification are the big four pillars of personal identification in an anthropological protocol. During an emergency mishap, Sex determination can be done by various bones and among individual bones skull is known to provide 92% accuracy [1]

Anthropometry includes obtaining measurements of anatomical structures so that age and the stature of the individual can be identified[2] large number of individuals need to be identified during Natural disasters, mass transportation accidents, and terrorism. The process becomes easy to specialists if complete body is well preserved and not divided into fragments but if the body parts are severly destroyed or destructed to the extreme extent it becomes difficult or impossible to identify [3]

After human death, skull is the best preserved part of the skeleton owing to the fact that it is composed of hard tissue and in some instances it remains the only available part for forensic examination. Apart from this skull also provides elements for gender identification.[4]Dentofacial radiographs play an important role in participating in primary investigations in various dental and medical hospitals and therefore helps in performing routine procedures there. Identification of human remains can occur by the available antemotem data because large segment of the population have these radiographs already taken at different intervals of life[5] The orbit is the bony structure present in the skull where the eyes and its appendages are present[6] In the adult human, the volume of the orbit is 30–32 ml, of which the eye occupies only 1/5th of the space.[7] the bony walls of the orbit has their own peculiar features as they are perforated by a number of fissures and foramina which become passages of important nerves and blood vessels. [8]For planning orbital surgeries, the differences in the morphology and size measurements should be known to the clinician such as ophthalmologists, oral maxillofacial surgeons and neurosurgeons(9,10)Gender determination can be done by measuring orbital measurements and inter orbital distance[2]

Thus the **Aim** of the present study was

To determine the gender from radiomorphometric evaluation of orbit and inter-orbital distance.

The **Objectives** of the present study were

To measure the width of the orbital apertures on Postero-anterior skull radiographic view,

To measure the height of the orbital apertures on Postero-anterior skull radiographic view,

To measure the interorbital distance on Postero-anterior skull radiographic view.

Material And Methods

A retrospective study was conducted of fifty males and fifty females, using postero-anterior skull radiographs which were taken using New- Tom VGi Scanner (QR srl; Verona, Italy) in standard resolution mode(tube potential :50- 85KV), tube current :12Ma, and time :14 sec.

Inclusion criteria

1. Postero-anterior radiographs of both dentulous and edentulous patients of age groups 18-50 years
2. Postero-anterior radiographs where orbital landmarks were clearly visible
3. Only high quality radiographs with no visible errors

Exclusion criteria

Patients with a history of extraction, trauma and any other severe developmental disturbances leading to variation in the size of mandible were excluded from the study. The following variables were measured using Newtom digital software (figure1,2 and 3)

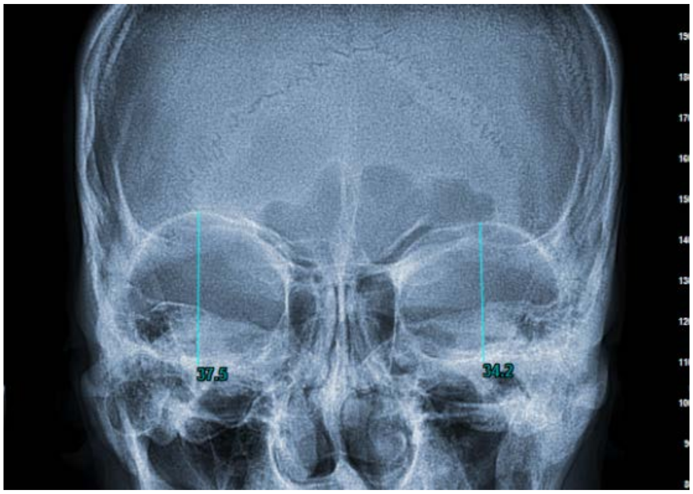

Figure 1: orbital height measurements of a male patient on postero-anterior radiographs using Newtom digital software

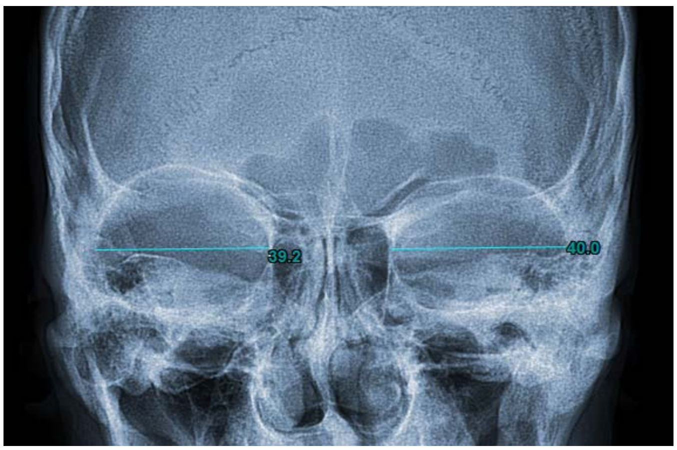

Figure 2: orbital width measurements of same patient on postero-anterior radiographs using Newtom digital software

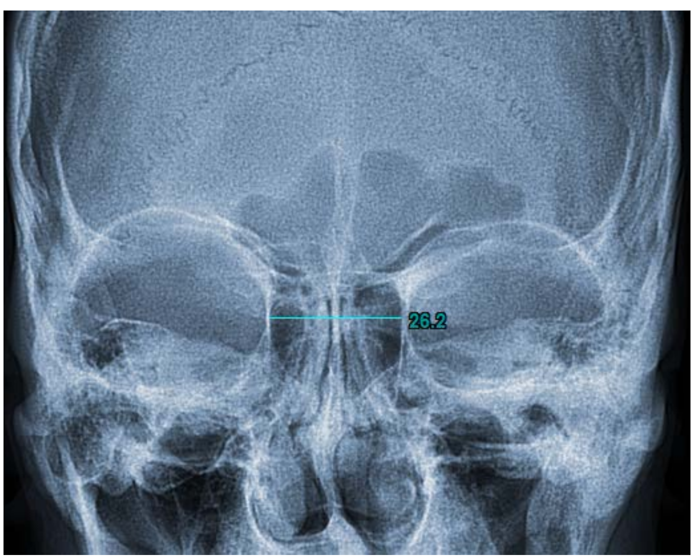

Figure 3:interorbital distance measuremdents of same patient on postero-anterior radiographs using Newtom digital software Orbit height was determined by measuring the maximum distance between the superior and inferior orbital margins on each side. Orbit width was determined by measuring the maximum horizontal distance between the medial and lateral orbital rims on each side. Inter-orbital distance was determined by measuring the distance between the medial walls of the orbits

The linear measurements obtained from each radiograph were expressed in millimeters. The data obtained was statistically analyzed and student “t” test was used.

Results

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor to SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Data was expressed as Mean +_ SD. Graphically the data was presented by bar diagrams. Student’s independent t- test was employed for comparison of age, orbital width, orbital height and interorbital distance between males and females .A P-value of less than 0.05 was considered statistically significant.

The mean age of males was 29.9 and females were 30.8 years respectively (Table-1). Higher mean orbital width was observed in males compared to the females. The difference in mean orbital width was found to be statistically significant ($P<0.001$) (Table-2).

Higher mean orbital height was observed in males compared to the females. The difference in mean orbital height was found to be statistically significant ($P<0.001$*) (Table-3).

Higher mean inter-orbital distance was observed in males compared to the females. The difference in mean inter-orbital distance was found to be statistically significant ($P< 0.001$*) (Table-4).

Table1 : Mean age (Years) of subjects as per gender					
Gender	N	Mean	SD	Range	P-value
Male	50	29.9	8.49	16-48	0.615
Female	50	30.8	7.32	19-45	

Table 2: Measurement of orbital width (mm) among males and females

Gender	Mean	Standard deviation	Standard error of mean	Mean difference	t-value	P-value
Male	35.18	2.041	0.289	6.01	14.012	<0.001*
Female	29.17	2.2243	0.317			

*Statistically Significant Difference (P – value <0.05)

Table 3: Measurement of orbital height (mm) among males and females

Gender	Mean	Standard deviation	Standard error of mean	Mean difference	t-value	P-value
Male	34.36	3.824	0.541	4.77	7.629	< 0.001*
Female	29.59	2.206	0.312			

*Statistically Significant Difference (P – value <0.05)

Table 4: Measurement of inter orbital distance (mm) among males and females

Gender	Mean	Standard deviation	Standard error of mean	Mean difference	t-value	P-value
Male	26.50	2.237	0.316	3.41	8.142	<0.001*
Female	23.09	1.933	0.273			

*Statistically Significant Difference (P – value <0.05)

Discussion

Orbit is one of the highest multiplex structures of the craniofacial complex whose volume and diameters differ from one individual to another. Due to this variability, interest has been evolved to study the morphometric analysis of the orbit in the last century. Inspite of this , there is still no standardised criteria at the comprehensive level. Orbital measurements has a crucial role in the medical and the dental practices as numerous pathologies occur at this level(11). The work of forensic anthropologists and osteologists in a massive disaster is to identify gender , race , age of the affected individual. Determination of gender can be done with sureness. Age determination can be approximated with a 5 year error, and the height with an error of about 3.5cm , if the skelton is fully preserved and not damaged (12) Dimorphism in gender also depend upon on the development of bone ,bone development occurs earlier in males whereas ossification centers appear sooner in females. Variation in the hormonal secretions too have a role in the sexual differences.(13)

In this study, the mean age of males was 29.9years and that of females was 30.8 years respectively [Table 1]. In males the mean orbital width observed was found to be high and statistically significant (P< 0.005*). [Table 2]. This finding was in accordance with the study conducted by Fetouh and Mantour(2014)(14). Elzaki et al also found that orbital width in males is slightly higher than females(15). Sayee Rajangam et al., (2012) in their study also achieved slightly higher orbital width in males(16) In a study done by Mekhala D(2014)20

In males the values were 4.29 and 4.05 in females and the p-valueis<0.001(17) Whereas Igbigbi, P.S et al (2009) and Mahalakshmi et al observed increased orbital width in females, than in males(18)

In males mean orbital height observed was found to be high and statistically significant (P<0.001*) [Table 3]. This finding was in accordance with the study conducted by Leko Bankole et al (2012)(19) and Igbigbi, P.S et al

(2009) normally, male skulls are more robust, and larger. Hence morphologically, the anatomical structures appear to be larger thus contributing for larger height in males. Also In the work done by Sayee Rajangam et al.(16),orbital height in males was found higher than females. In a study done by Sanjai S et al., (2007) the mean height value was 3.314 in males And 3.289 in females and the p-value being 0.255.(20)

The mean inter-orbital distance observed was found to be statistically significant (P. < 0.001*) in males [Table 4]. Our findings are consistent with studies conducted by Sayee Rajangam et al., In the study of Sanjai Sangavicichien et al.,(2012) in Thais the OI

Mean value in males is 83.50 and females is 86.61. In the study of Mekhala D

(2012) in Indians in males the OI was 84.62 and 85.46 in females Rossi et al, who also found increase in the inter-orbital distance in males. Normal values of orbital indices are vital measurements in the evaluation, and diagnosis of craniofacial syndromes and posttraumatic deformities, and knowledge of the normal values for a particular region or population can be used to treat abnormalities to produce the best esthetic and functional results Ebeye O et al(21)

In males the growth continues to increase till the age of 21 years, in females growth begins to level off at about 13 years of age. hence the measurements in females fall more markedly behind the males(22) The gender difference was highly significant and that orbital width,height and inter-orbital distance was statistically significant in males.

Conclusion

This study gives useful baseline anthropometric data where we can use anatomical structures and radiographs that are helpful in forensic identification. The radiomorphometry of the orbital aperture and inter-orbital distance parameter can be used for determining the gender.

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