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Original Article

ORBITAL DIMENSIONS AND ORBITAL INDEX: A MEASUREMENT STUDY ON SOUTH INDIAN DRY SKULLS

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ABSTRACT

Background: The human orbit is a complex anatomic region, which plays predominant role in the evaluation of craniofacial complex. The bony orbit which lodges the visual apparatus is important not only for anatomists but also for ophthalmologists, oral and maxillofacial surgeons and forensic experts. The objectives of the present study are to provide the normal reference orbital parameters for the South Indian population.

Materials and Methods: The study was done on 200 skulls (105 males and 95 females). The orbital height (Ht) and breadth (Br) were measured by using manual vernier caliper. Orbital index was calculated by using the formula Ht /Br x 100. All the data obtained were tabulated and analysed statistically by computing descriptive statistics like mean, standard deviation and range. Mann-Whitney test was done to find out the statistical significance of all parameters of orbits, with respect to gender and side (right and left side).

Results: The results showed that the height and breadth were significantly larger in males than in females. There were no significant differences in height and breadth between the right and left side orbits. There was no significant difference in OI between the genders and also sides. According to the OI, the studied group of Indian population comes under Mesoseme category.

Conclusion: This study provides useful baseline orbital morphometric data of south Indian population, which are very important during plastic surgery, maxillofacial and neurosurgeries and also in the forensic research.

KEY WORDS: Dry skull, Orbital dimensions, Orbital index.

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INTRODUCTION

The human orbit is a complex anatomic region. Each of its four bony walls has its own unique features and is perforated by a number of fissures and foramina that carry important nerves and blood vessels [1]. The bony orbit which forms the subject of this work, lodges the visual apparatus is important not only for anatomists but also for ophthalmologists, oral and maxillofacial surgeons and forensic experts[2].

The stereo-structure of the orbit is affected by several orbital diseases. The main goals of plastic surgery for orbital hypoplasia and orbital fracture are to repair the stereo-structure of the orbit and to re-establish the symmetric relation-

-ship between the two orbits. Orbital morphometric study will also provide parameters for preoperative planning and prediction of postoperative outcome [3]. Among modern human groups there is considerable variability in the characteristics of the orbit [4].The orbital index (OI), the proportion of the orbit height to its breadth multiplied by 100 is determined by the shape of the face and varies with race, regions within the same race and periods in evolution [5].

Table 1: Taking the orbital index as the standard, three classes of orbit are recognised [2].

Category	OI	Race
1. Megaseme (Large)	89 or over	Yellow races, except the Esquimaux.
2. Mesoseme (Intermediate)	83-89	European (87), English (88.4)
3. Microseme (Small)	83 or less	Black

Understanding the structural disposition of the human body is aided by the advances in medical imaging techniques such as radiography, MRI, CT scan etc. But direct measurement on dry skulls is a more natural perspective in assessing the orbital cavities [6]

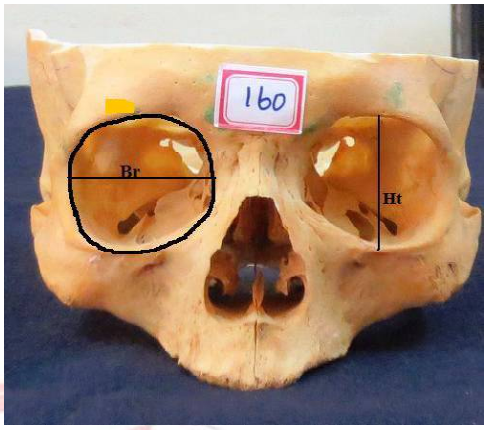
Thus a prior knowledge of the orbital morphometry is very essential for better surgical approach and outcome. Not many studies have been done pertaining to morphometry of orbit in Indian population especially in south Indian population skulls. Hence, this study of morphometry of orbit in skulls becomes essential to develop a database to determine normal range of orbital values and orbital index in south Indian population.

MATERIALS AND METHODS

200 skulls were collected from the Anatomy Department of Kempegowda Institute of Medical Sciences and Bangalore Medical College, Bangalore, Karnataka, India and also from the 1st year medical students of Kempegowda Institute of Medical Sciences. Based on the morphology, they were differentiated into 105 male and 95 female skulls.

The orbital height (Ht) was measured as the distance between the midpoint of the upper and lower margins of the orbital cavity and orbital - breadth (Br) was measured as the distance between the midpoint of the medial and lateral margin of the orbit by using manual vernier caliper [figure1].

Fig. 1: Measurement of Height and Breadth.



Orbital index (OI) was calculated by using the following formula,

OI = orbital height / orbital breadth x 100

The data obtained were tabulated and analysed statistically by computing descriptive statistics like mean, standard deviation and range.

Mann-Whitney test was done to find out the statistical significance of all parameters of orbits, with respect to gender and side (right and left side).

The results were considered significant when p value < 0.05 and was considered highly significant when p value < 0.001.

The statistical analysis was done using Statistical Package for Social Sciences (SPSS) software and Microsoft word excel were used to generate graphs and tables.

RESULTS

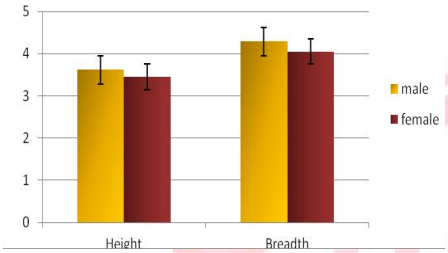
In male orbits, the range of height was observed as 3.3 – 4.2cm, whereas in case of female orbits it was 3.0 – 3.9cm. The range of breadth was observed as 3.7 – 4.9cm in male orbits, whereas in female orbits it was 3.5 – 5cm. By using orbital Height and Breadth, OI was calculated. In male skulls, the range of OI was 70.2 – 97.7, whereas in case of female skulls, it was 66.6 – 97.7. When the mean values were compared [shown in table 2], the orbital height and breadth were found to be higher in males than females. When the mean OI was compared between male and female orbits, statistically there was no significant difference observed.

Table 2: Comparison of Height and Breadth between male and female orbits.

Parameter	Gender	Mean	SD*	SE of Mean	Mean Difference	Z	P-Value
Height (ht)	Male	3.62	0.23	0.02	0.164	-7.398	<0.001*
	Female	3.45	0.2	0.01			
Breadth (br)	Male	4.29	0.27	0.02	0.245	-8.657	<0.001*
	Female	4.05	0.24	0.02			
OI	Male	84.62	8.21	0.57	-0.844	-1.625	0.104
	Female	85.46	5.93	0.43			

SD* Standard Deviation

Fig. 2: Bar diagram showing the comparison of Height and Breadth between male and female orbits. The values are expressed as mean± sd.

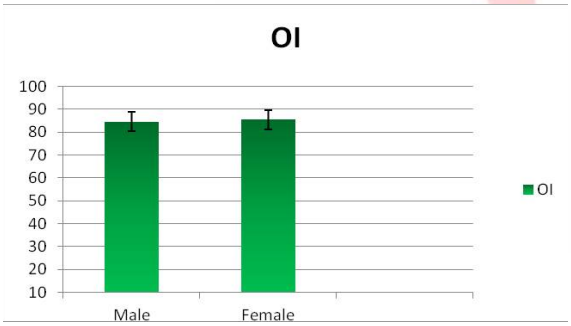


When the mean values of Height, Breadth and OI were compared [shown in table 3] between the two sides in overall skulls irrespective of genders, there were no statistically significant differences.

Table 3: Comparison of Height, Breadth and Orbital Index (OI) between right and left side orbits in overall skulls.

Parameter	Side	Mean	SD*	SE of Mean	Mean Difference	Z	P-Value
Height (ht)	Left	3.53	0.24	0.02	-0.014	-0.695	0.487
	Right	3.55	0.23	0.02			
Breadth (br)	Left	4.18	0.28	0.02	0.005	-0.223	0.823
	right	4.17	0.28	0.02			
OI	Left	84.82	7.24	0.51	-0.402	-0.363	0.716
	right	85.22	7.21	0.51			

Fig. 3: Bar diagram showing the comparison of OI between male and female orbits.



DISCUSSION

Morphometric parameters of orbit are important in ophthalmology, oral maxillofacial surgery and neurosurgery. Orbital index has been employed to determine the sex of a person in forensic medicine. The prior knowledge of these parameters is vital to their successful application since they are different from one population to another.

Results of the present study are compared to the previous studies. When the mean values of the height and breadth were compared between the genders [shown in tables 4 & 5] Contrary to the present study, in the previous studies by Sayee Rajangam et al [7], there was no significant difference in the Height and Breadth of the orbit between the two genders. Though the study was on Indian population, the values are lower than the present study. These differences could be due to smaller sample size in their study and also they have not compared the values between the genders irrespective of side. Sanjai Sangvicichien et al [8] have also reported that there was no significant difference in the Height of the orbit between the two genders, and the values are also lower than our values. Similar to present study, Sanjai Sangvicichien et al [8] also found a significant difference in the breadth between the two genders. The reason for the lower values may be due to racial differences as seen from the population studied or variations in the sample size.

Table 4: Comparison of Height of the orbit between the two genders in the present study with that of previous skull studies.

Authors	Male	Female	P
Sayee Rajangam et al 2012 [7]	Right – 3.5 Left – 3.37	Right – 3.2 Left – 3.08	0.397 0.174
Sanjai Sangvicichien et al 2007 [8]	3.314	3.289	0.255
Present study	3.62	3.45	<0.001

Table 5: Comparison of breadth of the orbit between the two genders in the present study with that of previous skull studies.

Authors	Male	Female	P
Sayee Rajangam et al [7]	Right – 4.17	Right –3.72	0.07
	Left – 4.08	Left – 3.69	0.145
Sanjai Sangvicichien et al [8]	4.01	3.809	<0.001
Present study	4.29	4.05	<0.001

Similar to previous studies, in the present study there was no significant difference in the height and breadth of the orbit between the two sides [Tables 6 & 7].

The values of the present study are slightly larger compared to Ukoha U et al study [6]. The reason may be because of the racial differences as they studied male skulls of Nigerian population and also due to variations in the sample size (n=70).

Though Jaswinder Kaur et al [9] study was on Indian population, the minimal difference noticed could be due to environmental and genetic factors or due to a smaller sample size in their study (n=30).

Table 6: Comparison of Height of the orbit between the two sides in the present study with that of previous studies.

Authors	Right	Left	P
Ukoha U et al 2011 [6]	3.19	3.145	>0.05
Jaswinder Kaur et al 2012 [9]	3.19	3.22	-
Present study	3.55	3.53	0.487

Table 7: Comparison of breadth of the orbit between the two sides in the present study with that of previous studies.

Authors	Right	Left	P
Ukoha U et al 2011 [6]	3.603	3.498	>0.05
Jaswinder Kaur et al 2012 [9]	3.97	3.88	-
Present study	4.17	4.18	0.823

OI has been studied by several authors. It has been reported that the racial and ethnic differences occur in OI amongst different population.

The present study aimed to compare the OI of the Indian population with available data from other populations of the world.

In the present study there were no statistically significant differences observed in the OI, between the genders and also sides [Tables 2 & 3].

According to standard classification [Table 1], the mean OI of both the genders in the present study belongs to Mesoseme category.

In the following section, the OI in the present study is compared with that of other studies.

Table 8: Comparison of OI between the two genders in the present study with that of previous studies.

Authors	Population	Male	Female	P	Category
Sayee Rajangam et al 2012 [7]	Indians	Right – 73.55 Left – 75.27	66.79 65.03	0.003 0.028	Microseme
Sanjai Sangvicichien et al 2007 [8]	Thais	83.5	86.61	0.027	Mesoseme
Munguti Jeremiah 2013 [5]	Kenyans	82.57	83.48	-	Male – Microseme Female – Mesoseme
Present study	Indians	84.62	85.46	0.104	Mesoseme

It can be seen from the table 8, that the values reported by Sayee Rajangam et al [7] are lower compared to our values. According to their study OI in males is significantly larger when compared to females. Though the study was done on Indian population, this group of population belongs to Microseme category, which is contrary to our results. This variation could be due to a smaller sample size in the previous study.

Sanjai Sangvicichien et al [8] and Munguti Jeremiah et al [5] have reported that male OI was lower compared to females.

Table 9: Comparison of OI in the present study with that of previous studies (irrespective of sides and genders).

Authors	Population	OI	Category
Ukoha U et al 2011 [6]	Nigerians	89.21	Megaseme
Jaswinder Kaur et al 2012 [9]	Indians	81.65	Microseme
Present study	Indians	85.8	Mesoseme

Though Jaswinder Kaur et al [9] study was also on Indian population, the OI values are lower compared to our results.

Deepak S Howale et al [10] have also studied Indian population and have reported a slightly higher mean OI (86.4) compared to our results. They followed different classification to categorize the skulls according to OI. According to the classification which was followed in the present study [Table 1], this group of Indian population can be placed under Mesoseme category which is similar to our results.

The importance of orbital index lies in its use for the interpretation of fossil records, skull classification in forensic medicine and the explanation of trends in evolutionary and ethnic differences [11].

Normal values of orbital indices are vital measurements in the evaluation, and diagnosis of craniofacial syndromes and post traumatic deformities, and knowledge of the normal values for a particular region or population can be used to treat abnormalities to produce the best aesthetics and functional result [12].

Variation of OI between and within the population could be due to genetic and environmental factors and also different patterns of craniofacial growth mainly resulting from racial and ethnic differences.

CONCLUSION

This study provides useful baseline orbital morphometric data of south Indian population, which are very important during plastic surgery, maxillofacial and neurosurgeries and also in the design of eye protective equipment. Also these parameters especially OI can be used during forensic and anthropological investigation of unknown individuals for determining gender, ethnicity, etc.

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Conflicts of Interests: None

REFERENCES

[1]. Andy C. O. Cheng, Peter W. Lucas, Hunter K. L. Yuen, et al. Surgical Anatomy of the Chinese orbit. Ophthalmic Plastic and Reconstructive Surgery 2007;24(2):136-141.

[2]. Patnaik V.V.G., Bala Sangu, Singla Rajan K. Anatomy of the Bony Orbit- Some Applied Aspects. J Anat. Soc. India. 2001;50(1):59-67.

[3]. Yongrong Ji, Zanqun Qian, Yang Dong, et al. Quantitative morphometry of the orbit in Chinese adults based on a three-dimensional reconstruction method. J. Anat 2010; 217:501-506.

[4]. Xing, Song, Victoria Gibbon, Ronald Clarke, and Wu Liu. Geometric morphometric analyses of orbit shape in Asian, African, and European human populations. Anthropological Science 2013; 121(1):1-11.

[5]. Munguti Jeremiah, Mandela Pamela, Butt Fawzia. Sex differences in the cranial and orbital indices for a black Kenyan population. Int. J. Med. Sci 2013;5(2):81-84.

[6]. Ukoha U., Egwu OA., Okafor IJ., et al. Orbital dimensions of adult male nigerians: a direct measurement study using dry skulls. Int J Biol Med Res.2011;2(3):688-690.

[7]. Sayee Rajangam, Kulkarni R.N, Lydia Quadrilos, et al. Orbital dimensions. Indian Journal of Anatomy 2012;1:5-10.

[8]. Sanjai Sangvichien, Komon Boonkaew, Aporn Chuncharunee, et al. Sex determination in Thai skulls by using craniometry: Multiple logistic regression analysis. Siriraj Med J 2007;59:216-221.

[9]. Jaswinder Kaur, Savita Yadav, Zora Singh. Orbital dimensions- A direct measurement study using dry skulls. J. Acad. Indus. Res 2012;1(6):293-295.

[10]. Deepak S. Howale, Jain L. K, Kanaklata Iyer, et al. Orbital and Nasal indices of Maharastra region: A direct measurement study using dry skulls. International Journal of Current Reasearch 2012;4(8):158-161.

[11]. Leko Bankole J, 1Douglas Promise, 2Ukoima H.S, et al. Radiological Assessment of Orbital Dimensions of the Kalabaris and Ikwerres of Rivers State, Nigeria. Afr. J. Biomed. Res 2012;15:197-200.

[12]. Ebeye O.A, Otikpo O. Orbital index in Urhobos of Nigeria. IOSR Journal of Dental and Medical Sciences 2013;8(2):51-53.

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