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Original Article

Measurement of Orbital Dimensions (Orbital Height, Breadth and Length of Superior Orbital Fissure) using Dry Skull's

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Abstract

Introduction *Anthropometry is the scientific study of the measurements and proportions of the human body. Anthropometric studies are an integral part of craniofacial surgery and syndromology. Each orbital cavity is essentially intended as a socket for the eyeball. Assessment of orbital dimensions is important for knowing the anatomy of orbital structures and surgical management of orbital pathologies.*

Aim *To estimate the orbital index and length of superior orbital fissure using dry skulls.*

Methods *The study was conducted in the Anatomy department after ethics clearance. Forty dried skulls were utilised for study. The measurements for the dimensions of the orbital cavities were taken directly using a digital Vernier Calliper calibrated in millimetres except inter distance between lateral walls which was estimated by spreading calliper. The parameters investigated in our study were Orbital height, Orbital breadth, Length of superior Orbital fissure, Inter-distance between medial wall and Inter - distance between lateral walls of Orbit. Orbital index was calculated using formula: OI = orbital height/orbital breadthX100.*

Result: *Mean orbital height of right orbit of the dry skulls was 31.94±2.91mm and Left orbit was 31.85±3.34mm. Mean Orbital breadth of right orbit was 39.6±1.88mm and Left orbit was 39.91±2.65mm. The mean inter-distance between medial walls of orbits was 21.62±1.08mm. The mean inter-distance between lateral walls of orbits was 94.28±4.45mm. Mean length of right superior orbital fissure of the dry skulls was 1.39±0.21cm and Left orbital fissure was 1.4 ±0.24cm. The mean Orbital index of Right orbit was 80.9 and Left Orbit was 80.2. Paired t test demonstrated no significant statistical difference between the right and left orbits (p>0.05).*

Conclusion: *Normative Data for Indian skulls was reported. No significant difference was reported in the right and left orbits.*

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Keywords *: Orbital Dimensions, orbital Height, orbital Breadth, superior orbital Fissure*

Introduction

Anthropometry is the scientific study of the measurements and proportions of the human body. Anthropometric studies are an integral part of craniofacial surgery and syndromology. Each orbital cavity is essentially intended as a socket for the eyeball. Assessment of orbital dimensions is important for knowing the anatomy of orbital structures and surgical management of orbital pathologies The two larger orbital cavities are situated on either side of the sagittal plane of skull between the cranium and the skeleton of the face. They encroach about equally on these two regions.[1] Understanding anatomical structure, proportion and mechanical function of the human body and racial variations in ocular anatomy is important for clinical assessment and treatment of patients.[2] Anthropometric studies are an integral part of craniofacial surgery and syndromology.[3] For these reasons, standards based on ethnic or racial data are desirable because these standards reflect the potentially different patterns of craniofacial growth resulting from racial, ethnic and sexual differences.[4] The human skeleton is essential for forensic research having been described as a major anthropometric tool in the analysis of ethno-racial relationships.[5] These features that have been studied previously including dimensions of the nasal cavity and Paranasal air sinuses[6,7] and dimensions of the orbital cavity including measurement of orbital volume.[8,9,10] Each orbital cavity is essentially intended as a socket for the eyeball and contains associated muscles, nerves, vessels and in essence lodges the visual apparatus.[11] Apex of orbit or the Orbital apex is the posterior end of the orbit. Here the four orbital walls converge. The apex has two orifices: the optic canal and the superior orbital fissure which are situated in the sphenoid bone (where the body, greater wing and lesser wing meet each other) Optic canal -It connects the orbit to the middle cranial fossa. It transmits the optic nerve (surrounded by meninges) and the ophthalmic artery. Its average length is 6-11 mm (lateral wall is shortest and medical wall is longest). Tumours such as optic nerve glioma and meningioma may lead to unilateral enlargement of the optic canal. Superior orbital fissure is a comma shaped aperture in the orbital cavity. It is bound by lesser and greater wing of the sphenoid and is situated lateral to the optic foramen at the orbital apex. The fissure is divided into upper, middle and lower parts by the common tendinous ring. Patnaik et al. (2001) stated that in each orbital cavity, the width is usually greater than the height, the relation between the two is given by the orbital index, which varies in different races (Orbital Index = Orbital Height/Orbital Breadth).

Taking the orbital index as the standard, three classes of orbit have been described as follows:

- This type is seen in yellow races (Cassidy, 1913).[12]

- Mesoseme (Intermediate): The orbital index range between 89 and 83. This type is seen in the white races.[13]
- Microseme (Small): Orbital index 83 or less. This type is characteristics of the black races where the orbital opening is rectangular.

It is necessary to determine their reference value in order to help anthropologists, forensic experts and anatomists identify morphological variants of this structure and surgeons and physicians for surgical and cosmetic procedures. The present study attempts to provides normative data from dry skulls in an attempt to help ophthalmologists and orbital surgeons to better understand orbital structure and relationships. It is also one of the first studies to measure the length of the superior orbital fissure.

Objectives

I. The objective of the study is to estimate the orbital index and length of superior orbital fissure in dry skulls.
II. To compare the anthropometric measurements of right & left Orbits.

Methodology

Setting: The study was conducted in the Anatomy department of Mahatma Gandhi Institute of Medical Sciences, Sevagram. Prior permission from ethics committee was obtained. Total of forty dried skulls were employed in our study.

Measurements: The measurements for the dimensions of the orbital cavities were taken directly using a digital Vernier Caliper calibrated in millimetres except inter distance between lateral walls which was estimated by spreading calliper. Each reading was repeated thrice and the mean of the three was recorded.

The parameters investigated in our study were:

1. Orbital height,
2. Orbital breadth,
3. Length of superior Orbital fissure,
4. Inter - distance between medial wall and
5. Inter - distance between lateral walls of Orbit.

Orbital height, breadth and length of Superior Orbital fissure was measured bilaterally.

Orbital height: It is the height between superior orbital notch/foramen to the inferior orbital foramen.

Orbital Breadth: It is the distance between medial point on fronto zygomatic suture to medial point on nasal maxillary suture.

Superior Orbital Fissure: The maximum length of the fissure was calculated using Vernier calliper.

Inter- distance between medial wall: the distance between nasomaxillary suture of two sides was measured.

Inter -distance between lateral walls: The distance between medial point of fronto zygomatic suture was measured.

All measurements were recorded and expressed as Means± Standard Deviation and range (Min. value – Max. value of each measurement). Orbital index was calculated using following formula

OI = orbital height / orbital breadth x 100

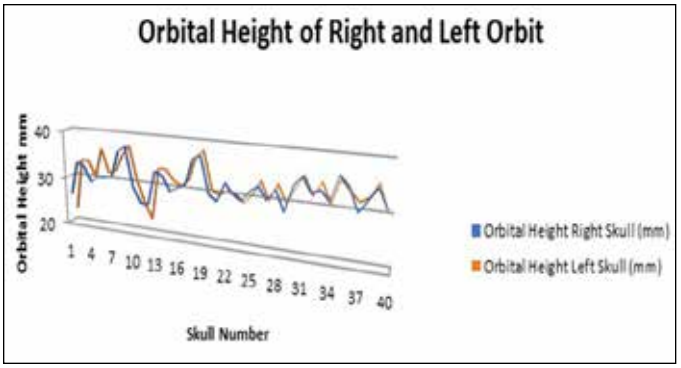

Figure 1: *Mean orbital height*

Table 1: Orbital *measurements of Right and Left Orbits*

	OH R (mm)	OH L (mm)	OB R (mm)	OB L (mm)	SOF R (cm)	SOF L (cm)	IDM (mm)	IDL (mm)
MEAN	31.94	31.85	39.6	39.91	1.39	1.4	21.62	94.28
SD	2.91	3.34	1.88	2.65	0.21	0.24	1.08	4.45
MAX	37.76	38.08	41.83	43.78	1.9	1.9	23.25	106.57
MIN	26.29	22.67	36.28	35.31	1	1	19.09	87.25

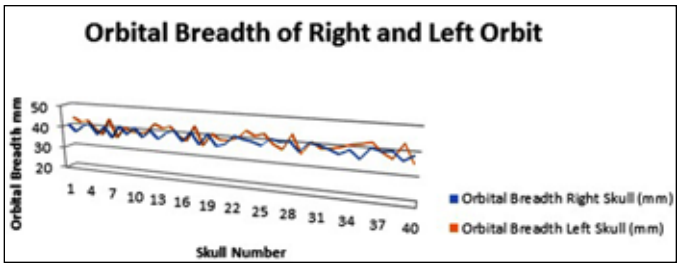

Figure 2: *Mean orbital breadth*

Results

As shown in Table 1, the Mean orbital height of right orbit (OH R) of the dry skulls was 31.94±2.91 mm and Left orbit (OH L) was 31.85±3.34 mm (Figure 1).

Mean Orbital breadth of right orbit (OB R) was 39.91±1.88 mm and Left orbit (OB L) was 39.91±2.65 mm (Figure 2).

The mean inter-distance between medial walls of orbits (IDM) was 21.62±1.08 mm.The mean inter-distance between lateral wall of orbits (IDL) was 94.28±4.45 mm. Mean length of right superior orbital fissure of the dry skulls was 1.39±.21 cm and Left orbital fissure was 1.4 ±.24 cm (Figure 3).

As shown in (Table 2), the mean Orbital index of Right orbit was 80.9 and Left Orbit was 80.2 (Figure 4).

This indicates that the dry skulls measured in the present study were having small orbital index (Microseme).

(Table 2) depicts the distribution of Type of Orbits (Right & Left). Paired test demonstrated no significant statistical difference between the right and left orbits ($p>0.05$) 14% of the skulls measured were Megaseme, 20% were mesoseme and majority (66%) were microseme (Figure 5).

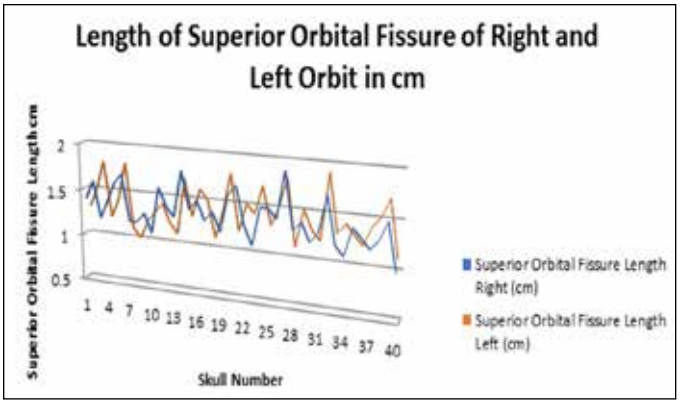

Figure 3: *Length of Superior Orbital Fissure*

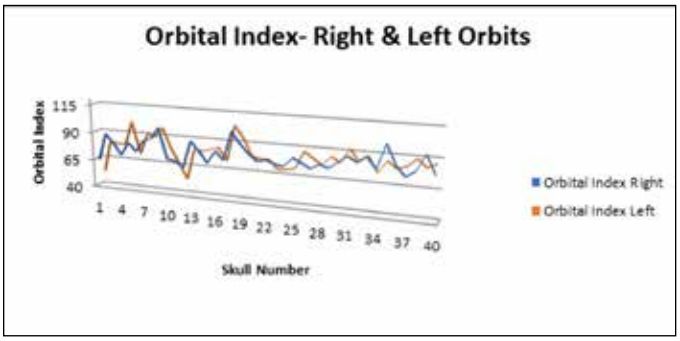

Figure 4: *Orbital Index*

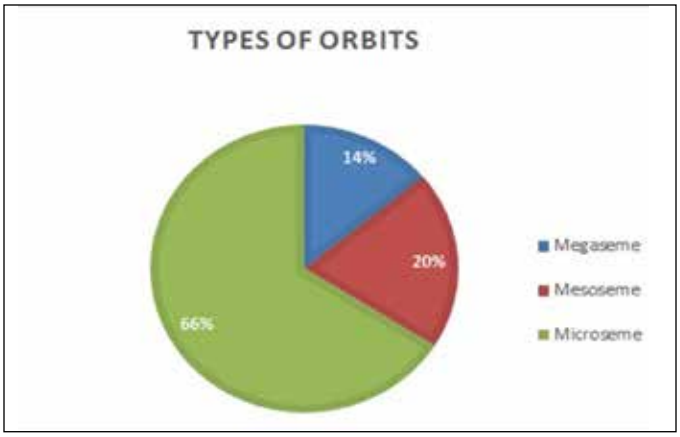

Figure 5: *Type of Orbits*

Discussion

The present study conducted on forty dry skulls measured orbital height, orbital breadth and length of superior orbital fissure revealed that mean orbital height of right orbit of the dry skulls was 31.94±2.91 mm and left orbit was 31.85±3.34 mm. Mean orbital breadth of right orbit was 39.91±1.88 mm and left orbit was 39.91±2.65 mm. The mean inter-distance between medial walls of orbits was 21.62±1.08 mm. The mean inter-distance between lateral wall of orbits was 94.28±4.45 mm. Mean length of right superior orbital fissure of the dry skulls was 1.39±0.21 cm and Left orbital fissure was 1.4 ±0.24 cm. The mean orbital index of Right orbit was 80.9 and left orbit was 80.2. Majority (66%) of the skulls were microseme.

Table 2: ***Type of Orbits***

Orbital Index Megaseme >89	**Right Orbit n(%) 5 (12.5%)**	**Left Orbit n (%) 6 (15%)**	**Both Orbits n (%) 11(14%)**
Mesoeme 83-89	8 (20%)	8 (20%)	16 (20%)
Microseme >83	27 (67.5%)	26 (65%)	53 (66%)
Total	40	40	80

The orbital index differs in different population groups. This means that the orbits with larger widths than height will have smaller orbital indices while those with larger orbital indices will have narrow faces. This index varies with race, regions within the same race and periods in evolution.[14] Anthropometric studies of various population groups have found different sizes and shapes of the orbits in different ethnic groups. Various studies from India, have also found similar orbital dimensions as our study with majority of the population being microseme (15-18). Contrasting to this, studies in the African population has revealed that Nigerian and Kenyan skulls are Megaseme (Orbital index greater than 89).[19,20] The microseme category described in the past for the black race by Cassidy.[13] may be a product of environmental trends, invented by the influence of time, on the people involved in the study. Many factors have been implicated in the transformation of the facial skeleton into the adult form. Although the basic structure is determined in accordance with genetically regulated blueprint while in-utero, that is modified pre- and postnatally through functional matrices responding to environmental and epigenetic influence such as climate, activity patter. Thus, this lower orbital index in India may be attributed to malnutrition or genetic traits.

In the skulls studied, hypertelorism and hypertelorism were not found. The average distance between the medial walls of left and right orbits was found to be 21.62 mm. The average distance between lateral walls of left and right orbits was found to be 94.28 mm. This study contributes to establish normative database for interdistance between the two orbits for Indian population which has surgical implications. It will be of immense use to ENT surgeons and ophthalmic surgeons for orbitotomies. Literature search for superior orbital fissure length revealed no article for Indian dry skulls. Our study found mean right superior orbital fissure length to be 1.39±0.21 cm and mean left superior orbital fissure length to be 1.4±0.24 cm. These values help in establishing diagnosis and treatment modalities of orbital diseases including superior orbital fissure syndrome. Metric traits are continuous morphological variables dealing with the size and dimension of the skull and postcranial skeleton. The inheritance of these traits depends on the combined influence of many genes.[21] There are certain universal traits of the skull that influence appearance, regardless of geographic or racial differences.[22] This study will create a database that will help clinicians in management of orbital fractures, and bony pathologies of the orbit.[23,24] It will help the in forensic investigations and in designing orbital prosthesis.

Conclusions

The present study serves as an effort to establish normative anthropometric data for orbital dimensions in our population. Orbital index of the study group demonstrated that the mean Orbital index of right orbit was 80.9 and Left Orbit was 80.2. 14% of the skulls measured were megaseme, 20% were mesoseme and majority (66%) were microseme. No significant difference was reported in the right and left orbits.

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