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Original Article

Orbital dimensions of adult male nigerians: a direct measurement study using dry skulls

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ABSTRACT

Assessment of orbital dimensions is important for a good knowledge of the anatomical disposition of orbital structures and surgical management of orbital pathologies. Orbital dimensions of Seventy (70) dry skulls of adult males were measured by direct measurement technique. The mean orbital height for the right and left sides were 31.90±0.70 and 31.45±0.71mm respectively while their orbital breadth were 36.03±0.37 and 34.98±0.38mm respectively. The mean orbital index was 89.21. The study population belongs to the Megaseme category and this study will serve as a guide to surgical management of orbital pathologies as it relates to our environment.

1. Introduction

Understanding anatomical structure, proportion, and mechanical function of the human body and racial variations in ocular anatomy is vital to clinical assessment and treatment of patients[1]. Understanding this structural disposition of the human body has been aided by the advances in medical imaging techniques such as radiography, ultrasonography, MRI, CT Scan etc.

Also anthropometry, which equally aids the understanding of anatomical structures, constitutes the technique of expressing quantitatively the form of the human body and skeleton. It is a basic tool of biological anthropology and has been of immense help in the development of forensic sciences in general and forensic medicine in particular. Anthropometric studies are an integral part of craniofacial surgery and syndromology[2]. 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 [3]. As a result, racial and ethnic perspectives : have been totally incorporated into the study of anthropometry because Tanner[4] stated that body physique is determined by numerous genes and environmental factors even though the relative contributions of these factors are not precisely known. The genetic composition of individuals varies no matter the degree of intraspecificity of the individuals and environmental factors are diverse as ethno-racial aspects of the society differ.

These differences in intraspecificity have led to individualization as a very important aspect of forensic anthropometry. That is using individual's discrete anthropometric features like parts of the body or skeleton to identify the individual. The human skull and cranium are essential segments of the skeleton that have received significant attention in terms of forensic research having been described as a major anthropometric tool in the analysis of ethno-racial relationships. Therefore, the features within it may give further insight into the understanding of intraspecificity of craniofacial anthropometry.

Some of these features that have been studied include dimensions of the nasal cavity and Paranasal air sinuses [5,6], dimensions of the orbital cavity including measurement of orbital volume[7,8,9,10,11]. The orbital cavities, which form the subject of this work, are situated on either side of the sagittal plane of the skull between the cranium and the skeleton of the face [12]. Each orbital cavity is essentially intended as a socket for the eyeball and also contains associated muscles, nerves, vessels and in essence lodges the visual apparatus [13].

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Patnaik et al [13] 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 orbits have been described

-Megaseme (large) - The orbital index is 89 or over. This type is seen in the yellow races, except the Esquimaux (Eskimos) where the orbital opening is round.[14]

-Mesoseme (intermediate) - The orbital index range between 89 and 83. This type is found in the white races (European 87, English 88.4) [15].

-Microseme (small) - Orbital index 83 or less. This type is characteristics of the black races where the orbital opening is rectangular [16].

Studies on orbital cavity dimensions have involved the use of anterior and lateral skull radiographs [1,10,11]. In developed environments, CT has been used to ascertain orbital dimensions [7,8]. Weiss et al [17] described the CT as the best way of assessing the orbital cavity because of the complexity in the anatomy of ocular and ethmoidal regions. But considering the expensiveness of CT and its inaccessibility, it is far beyond the reach of most people in the developing world who have resorted to the use of plain radiographs. However, some critical issues in the use of X-rays have been reported by numerous authors. Thus, this anthropometric study employs the use of direct measurement on dry skulls as it will present a different and a more natural perspective in assessing the orbital cavities.

Also, this study will provide a deeper insight in the morphological disposition of anatomic relationships of the orbit and also a guiding principle for surgeons who are involved in the reconstructive management of fractures due to traumas and different orbital pathologies.

2. Materials and Methods

Seventy (70) intact Skulls were obtained from the dissecting laboratory and museum of Anatomy department of Nnamdi Azikiwe University, Nnewi campus and were those of male Nigerians who lived and were from the Southeast geopolitical zone. On collection, the bones were washed and brushed in water using a detergent and then soaked in water at about 700C for six (6) hours. The bones were washed again with water and detergent to remove any left over tissue. Later the bones were sundried for four (4) days and then soaked in a mixture of five (5) litres of water, one (1) litre of bleach and 10% hydrogen peroxide (H2O2). Finally, the bones were sundried for another (eight) 8 days and measurement were taken.

2.1.Measurements

The measurements for the dimensions of the orbital cavities were taken directly using a manual vernier caliper caliberated in millimeters.

2.2.Measurements taken were

-Orbital length: This was measured as the maximum distance between the upper and lower margins of the orbital cavity.

-Orbital breadth: Distance between the midpoint of the medial margin of the orbit to the midpoint on the lateral margin of the orbit.

-Orbital Index: Calculated as Orbital height/Orbital breadth X 100. All measurements were recorded and expressed as means ± SD and range (minimum value – maximum value of each measurement).

3. Results and Analysis

Table 1. showing the descriptive statistics of the Orbital dimensions

Orbital Dimensions	Mean ± SEM (mm)	Range (mm)
Right Orbital length	31.90 ± 0.70	24.00-39.00
Left Orbital length	31.45 ± 0.71	23.50-39.10
Right Orbital Breadth	36.03 ± 0.37	31.50-39.50
Left Orbital Breadth	34.98 ± 0.38	30.50-39.00

The results indicate that the right orbital breadth showed the largest value (36.03±0.37mm) while the left orbital length showed the lowest value (31.45±0.71). From the results, orbital index was calculated as orbital length/orbital breadth X 100. A mean orbital index of 89.21 was deduced. Independent samples t-test indicate that there was no significant difference between the right and left sides in both parameters. (P>0.05; P=0.158).

4.Discussion

Results from this study show that the orbital index of these male Nigerians is 89.21. This places this group of adult male Nigerians in the Megaseme category just above the mesoseme (Intermediate) category. The other known category is the Microseme (small). This is contrary to previous studies that placed the black race on the Microseme category [14]. This result did not have much deviation from studies by Igbigbi and Ebite[11] in Malawians who stated that the orbital index of Malawians as 96.03 in females and 94.35 in males; also in the megaseme category.

In Port Hacourt, Southsouth Nigeria, Fawehinmi et al[1] reported an orbital height of 40.6mm and a breadth of 44.5mm. Though they didn't calculate the orbital index of the population, the figures show a very small difference between the orbital breadth and height, which implies a megaseme category of orbital index (>89). This also corroborates with our findings even though the values were slightly higher.

The relatively significant difference seen in these black populations may be attributed to the wide age spread of the Malawians as reported by Igbigbi and Ebite[11]. Also, Lusted and Keats [18] reported that orbital parameters obtained from roentgenographs has been shown to be slightly different from those obtained from direct measurement of human skulls and this difference could be attributed to magnification factor of X-ray machines. In this study, no magnification factor contributed to our results since direct measurement technique was used and therefore, these results truly present a near perfect description of the orbital morphology.

The microseme category described in the past for the black race by Casidy[14] 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 patterns and masticatory functions [19]

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 [20]. There are certain universal traits of the skull that influence appearance, regardless of geographic or racial differences [21]. As a result, our current findings in this study suggest an immediate re-evaluation of bony orbital parameters within our environments to establish a relative degree of natural consistency since recent findings for blacks are of megaseme category. This evaluation will create an adjustment that will lead to a more likely disposition towards the correction of orbital fractures, orbitoethmoid disjunctions and bony pathologies of the orbit. It will also aid a near perfect design of craniofacial prosthesis that fit the individuals within the environment.

The slight difference observed between the right and left side, though not significant, could be attributed to the differential growth of the two sides of the brain and in this case, the right side has shown dominance; A factor that must be considered in the surgical correction of the bony orbit to ensure an efficient structural disposition of the visual apparatus.

5. Conclusion

It is important to state that direct measurement technique has not been employed in the assessment of the bony orbit within our environment. This technique, though affords a more natural description of the skull, requires the use of many dry skulls, which are always not accessible. However, this study serves as a guide post to the expansion of normographic data as regards the bony orbit in our immediate environment. It will also present a more in-depth guide to the surgical correction of orbital pathologies and fractures.

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