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# Use of Simple Skull Radiographs in Orbital Correlations in Nigeria

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

**Introduction:** Anthropometric measurements have been carried out in many studies to segregate people into races, ethnicity and various biological traits in the past. Such studies include cephalometry being deployed because of its significance in forensic and clinical evaluations of individuals. The objective of this study is to determine the correlation between the shape types of the orbit with different age groups and their prevalence using simple skull X-rays.

**Materials and Methods:** Plain X-rays of the skull with posteroanterior exposures were obtained for a retrospective period of 5-year period from 2004 to 2009. The selected radiographs were those based on clear recognition of their orbital margins assessed by 2 experienced Radiologist who determined the shapes of the orbits as being oval, circular or quadrangular. Out of total of five hundred (500) plain X-rays of the skull obtained, only 255 satisfied the inclusion criteria.

The data was analyzed statistically using INSTAT software to compare the mean values in relation to age distribution of the subjects with the Student's T-Test. Chi-Square (with Yates correction) was used for the comparison of proportions.

**Results:** In the first 30 years of postnatal life, the oval shape orbit had been found to be more predominant with values of 22(64.7%), 17(30.9%), and 27(38.0%) respectively. As from the age of

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30 to 70 years, the circular type had values of 16(34.0%), 8(33.3%), and 8(61.5%) respectively in each of the decades. Between the age of 60 to 70 years, the oval and circular types had equal prevalences.

**Conclusions:** In addition to the known oval and quadrangular (triangular) types of orbital shape, this study revealed a 3rd type of orbit which we described as circular in shaped. The oval type of orbit is found to be more common from birth to age of 30 years but from but from 40 to 70 years the circular type predominates.

*Keywords: Orbit; shapes; plain X-rays; skull.*

## 1. INTRODUCTION

Anthropometric measurements are taken on a variety of people for a variety of reasons such as monitoring athletes, tracking growth, development, and motor performance in children, which links physical activity and nutrition interventions to changes in body size, shape and composition [1]. Many studies were done to reliably differentiate between races, criminal temperament and intelligence amongst other traits especially for Caucasians and Negroes [2]. Many anthropologists believed by doing some morphometric analyses, they can accurately classify people to their race and continents of origin [3]. The orbit forms a craniofacial cavity which contains the visual apparatus and other soft tissues [4]. Its margin has been often been described as quadrilateral with rounded corners [5]. The relationship between the orbital height and width is given by the *orbital index*, which varies in the different races [6]. Taking the orbital index into context, the Megaseme (large-sized) orbit typical of Mongolians usually has circular orbital openings, while the Mesoseme (medium-sized) is seen mostly in the Caucasians, and the Microseme (small-sized) found mostly in the Negroes usually has quadrangular/rectangular-shaped type of orbital openings [7]. The orbital margin is basically made up of three bones: the frontal, zygomatic, and maxilla [8] (see Fig. 1 below).

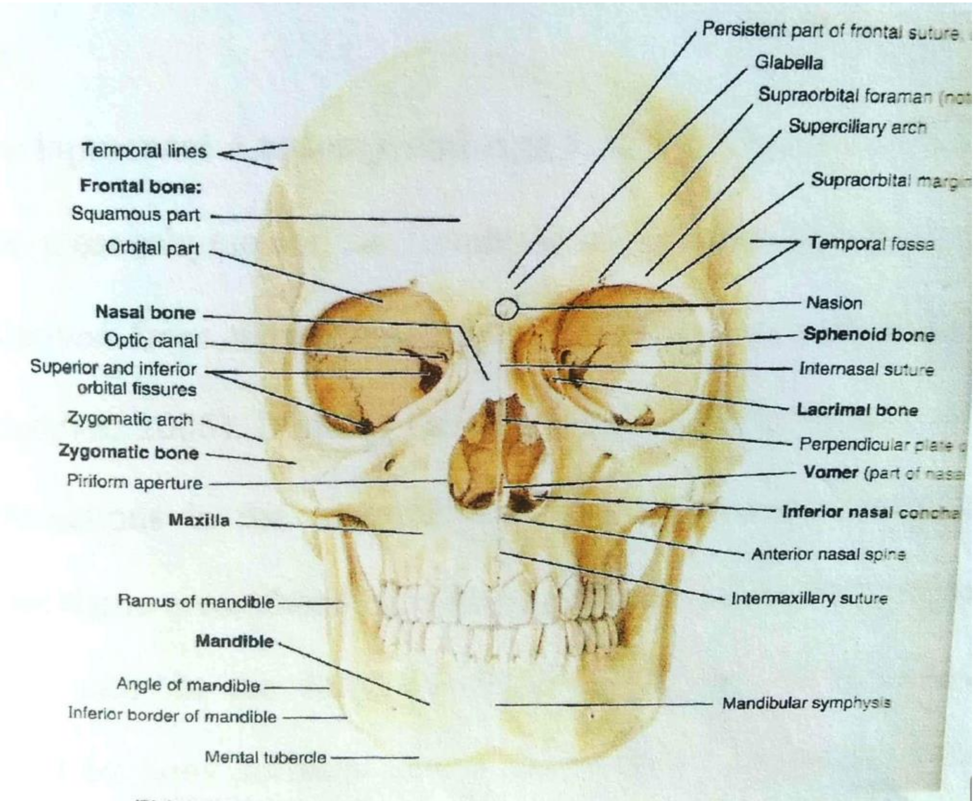


**Fig. 1. Anterior View of the Skull (*Norma frontalis)* showing the orbit and its parts**
*(Adopted from Keith L. Moore Text Book of Clinically Oriented Anatomy) [8]*

The mesenchyme for the formation of the orbit is derived from neural crest [9]. The condensation of this mesenchymal connective tissue area is surrounded by periosteum and muscular fragments [10].

In the prenatal stage, the orbit undergoes the mutual rotation around its both axes which results in the frontalization of the eyes from approximately 180 degrees in the early prenatal stages to approximately 50 degrees in adulthood [11].

The changes in the orbit during the period of growth depend partly on the development of the cranium and skeleton of the face between which the orbit is placed and also on the growth of the neighboring air sinuses. At birth, the orbital margin is sharp and well ossified. This serves as protection to eyeball from injury during child birth. At this stage, the infantile orbit looks more laterally than the adult [10].

The orbital fissures are relatively large in the child due to the narrowness of the orbital surface of the greater wing of the sphenoid and the wide and narrow portions are not well differentiated [10]. The interorbital distance is small which is why children are often brought to ophthalmic surgeon because they are thought to have squint because narrowness makes the eyes to look much closer but with further development the interorbital distances increase and so causes the squint to disappear. In old age, the changes being noticed are mostly due to absorption of the bony walls [12].

The study will be useful for clinicians in knowing the expected orbital shape in concordance with the age group while assessing the orbit and also to forensic experts in classifying cases. how to diagnose and tackle subtle orbital bony injuries, subtle lesions of retro-orbital space and the orbital muscles, and reconstructive surgeries [13]. Deviation from the normal orbit shape in the developing human will enhance the diagnosis of orbital tumors or injuries to the area [14]. Hence, the value of orbital morphometry in determining orbital lesions severity or postoperative complications of orbital surgeries cannot be over emphasized [15].

The bulk of past studies were on Caucasian [4], Asian subjects [8,13], and a few Africans [1]. Most of the studies were by either invasive procedures of mensuration or cadaveric and bony specimens [1,6]. Our present study, determined the different shapes of the orbits using plain X-rays done on Nigerian subjects to establish a baseline data on the different shape of the orbit, and their prevalence for the population under the study.

## 2. MATERIALS AND METHODS

Plain X-rays of the skull with posteroanterior exposures were obtained for a retrospective period of 5 years from the Radiology Unit of the Usmanu Danfodiyo University Sokoto which is a metropolitan city in the Northwestern part of Nigeria. The X-rays collected were from 2004 to

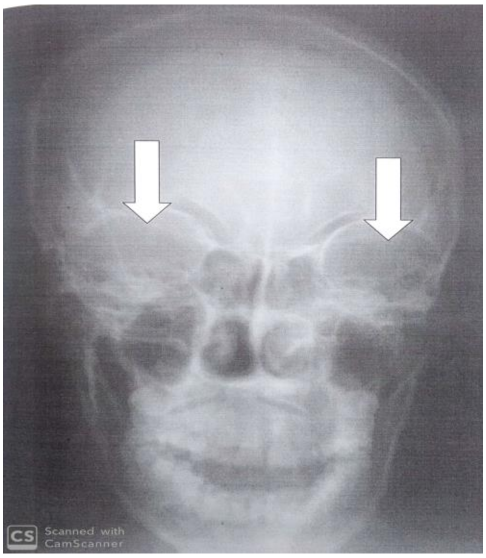


**Fig. 2. A postero-anterior view of a 31-year-old male skull radiographs with the white bold arrows pointing at the orbits**

2009. The inclusion criteria of the radiographs were based on clearness of the images with distinct recognition of the orbital margins also only those that were interpreted by 2 experienced Radiologist who determined the shapes as oval, circular, or quadrangular (see Fig. 2 above). Out of total of five hundred (500) plain X-rays of the skull obtained, only 255 satisfied the inclusion criteria.

## 2.1 Statistical Methods

The data was recorded in Microsoft word and excel format before being imported into INSTAT Statistical for the data analysis. Comparisons of mean values in relation to age distribution of the subjects were done using the Student's T-Test. Chi-Square (with Yates correction) was used for the comparison of proportions. Proportional percentages of the different orbital shapes obtained were observed.

## 3. RESULTS

The results of two hundred and fifty-five samples were analyzed that met the inclusion criteria and the following results were obtained as depicted in the Table 1.

The below table shows the disposition of different orbital shape types in relation to the different age groups stratified into decades according to the age of the subjects and age limit of 70 years was established. Within the first thirty years of postnatal life, the oval orbital shape type was found to be more predominant with values of 22(64.7%) in the first decade, and 27(38.0%) in the third decade of life. By the age of 40 to 70 years of post-natal life, the circular type was found to be more common than the other shape types with values of 16(34.0%) in the fourth decade, 8(33.3%) in the fifth decade, 8(61.5%) in the sixth decade, and 2(40.0%) in the 7$^{th}$ decade of life. At the 4$^{th}$ and the 7$^{th}$ decades, the oval and circular shaped-type of orbits were found to have equal prevalence as indicated in the table below. However, in all the differences found, they were of no statistical significance.

## 4. DISCUSSION

The types of orbital shapes have been previously described in many studies based on the X-rays of the skull which were mostly oval and quadrangular (rectangular). This study revealed another third type and it fits the description of a circular-type of orbit. In relation to age groups, the oval type predominates in the first 30 years of life but from the but from 40 to 70 years, the circular type was found to predominate while in the 4$^{th}$ and 7$^{th}$ decades of the study the oval and circular types had equal proportions. The quadrangular type as seen in the study has the least representation/frequency of all the types in all age groups under study. These findings are like what was obtained by other scholars when they performed similar studies on dry human skulls [14]. However, the differences observed were not proven to be significant statistically.

**Table 1. Various anatomical shapes of the orbit in relation to age groups**

| Group (Years) | Oval | Quadrangular | Circular | Total |
|---|---|---|---|---|
| 1-10 | 22 (64.7%) | 5 (14.7%) | 7 (20.6%) | 34 |
| 11-20 | 17 (30.9%) | 16 (29.1%) | 22 (40.0%) | 55 |
| 21-30 | 27 (38.0%) | 21 (29.6%) | 23 (32.4%) | 71 |
| 31-40 | 16 (34.0%) | 15 (31.9%) | 16 (34.0%) | 47 |
| 41-50 | 10 (41.7%) | 6 (25.0%) | 8 (33.3%) | 24 |
| 51-60 | 2 (15.4%) | 3 (23.1%) | 8 (61.5%) | 13 |
| 61-70 | 2 (40.0%) | 1 (20.0%) | 2 (40.0%) | 5 |
| **Total** | **96 (38.5%)** | **67 (27%)** | **86 (34.5%)** | **249** |

*X = 19.6; df = 18; p<0.05. No statistical significance*

## 5. CONCLUSION

The study found out that the most common type of shape of the orbit amongst the samples under study within the first 30 years of life is the oval type of orbit. However, from the age of 40 to 70 years, the study revealed the circular-shaped type of the orbit to be the most common. As part of our study limitations, using the plain X-rays could not determine the volume of the orbit as the view is in 2D format. Incomplete biodata from the hospital records did not permit other comparisons to be made as the records were obtained retrospectively. Therefore, other confounders like the BMI, vital signs records and also ethnicity, nutritional status and full demographic domain of the study subjects could not be ascertained. It is recommended that future studies need to be done in a large prospective cohort manner with newer innovations that allows for volumetric assessment on 3D format such is 3D/4D doppler ultrasounds, CT scans or MRI to give better views for a more accurate analysis.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

Ethical clearance for the study was obtained from the Ethical Committee of the Radiology Department of Usmanu Danfodiyo University Teaching Hospital Sokoto, Nigeria, with the ethical clearance number UDUTH/HREC/2010/ NO.827.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Umar MBT, Singh SP, Shugaba AI. Orbital measurements among the ethnic groups of Plateau State, Nigeria, Highland Medical Research Ltd. July-December; Bol. 2005;3(2):26-28.
2. Westcott DK, Jantz RL. Anthropometric variation between the sixious and assiniboine. Human Biology (United States). 1999;71(5):877-888.
3. Wade N. A new look at old data may discredit a theory on race. New York Times; 2002.
4. Khan Z, Nadeem G, Khan H, Billah AK. An anatomical study of orbital dimensions and Its Utility in Orbital Reconstructive Surgery. Journal of Oncology and Radiotherapy. 2021;15(3):001-9.
5. Susan S, Harold E, et al. Gray's anatomy. the anatomical basis of clinical practice. Elsevier Churchill Livingstone. 39th Edition. 2005;27:487-489; 28:493-495; 48:688-690.
6. Zurifa A, Uzeir A, Lejla D, Haris H, Alma V. A Geometric morphometrics approach for sex estimation based on the orbital region of human skulls from bosnian population. Hindawi Scanning. 2023;Article ID 2223138:9. Available:https://doi.org/10.1155/2023/2223138
7. Karakas P, Bozkir M, Oguz O. Morphometric measurements from various reference points in the orbit of male caucasians. Surgical and Radiologic Anatomy. 2002;24(6):358-362.
8. Moore Keith L, Arthur F Dalley, Anne Agur. Clinically oriented anatomy. 7th ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2014.
9. Saddler TW. Langman's medical embryology, 14th ed. Philadelphia: Wolters Kluwer; 2019.
10. Moore Keith L, Persaud TVN. The developing human: Clinically oriented embryology [10th Ed.]. 10th ed. Elsevier; 2016.
11. Taylor WOG. The effect of enucleation of one eye in childhood upon the subsequent development of the face. Transaction of the Ophthalmological Societies of UK. 1939;59(Part 1):361.
12. Kier EL. Embryology of the normal optic canal and its anomalies investigative radiology. 1966;1:346-362.
13. Williams PL, Bannister LH, Berry MM, Collins P, Dyson P, Dussek JE, Ferguson MWJ. Gray's Anatomy in: Skeletal System Edited by Soames, R.W. Churchill Livingstone, Edinburgh, London. 1999;555-560.
14. Lloyd MA, Glynn AS. Radiology of the Orbit, W.B. Saunders, and Company Ltd London. 1st Edition. 1973;1-29.
15. Khwaja MJ, Shaikh SH, Hiware SD, et al. Morphometric assessment of orbit in the human skull. J Evolution Med Dent Sci. 2020;9(48):3623-3627. DOI: 10.14260/jemds/2020/796




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