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Photo-Anthropometric Study of Inferior wall and Inferior orbital fissure of Fully Ossified Dry Human Orbital Cavities

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Abstract

Background: *Orbital morphometry is important to provide useful baseline data for ophthalmologist, anthropologist, otolaryngologist, radiologist, maxillo-facial surgeon, reconstructive cosmetic surgeon and forensic medicine expert. The existing data suggest that the location of various foramina in the orbit vary in different ancestral population. An understanding of orbital disease demands a clear concept of normal orbital anatomy. Safe and effective orbital surgery requires an extensive knowledge of the anatomy of the bony orbit and the morphometric relationship that exist within it.*

Materials and Methods: *This cross sectional analytical study was performed on 200 (Two hundred) fully ossified dry orbital cavities of 100 human skulls collected from Department of Anatomy of different Medical Colleges of Dhaka city. Variation between different foramina in the walls of both orbital cavity at different landmarks were recorded in millimeter by photographic methods (Adobe photoshop version 10). Paired students 't' test was done for statistical analysis of the result.*

Results: *In the present study, no significant difference in the mean from infraorbital foramen to the closest margin of the inferior orbital fissure was observed between right and left orbital cavity (P>0.05). No significant difference in the mean from infraorbital foramen to the inferior border of the optic canal was observed between right and left orbital cavity (P>0.05). No significant difference (P>0.05) was observed in the mean length of posteromedial segment and middle segment between right and left inferior orbital fissure .Significant difference (P< 0.05) was found between the right and left inferior orbital fissure when compared the mean length of anteriolateral segment of inferior orbital fissure.*

Conclusions: *There was significant difference in the measurement of distances from the length of anterolateral segment of right and left inferior orbital fissure. Other parameters showed no significant difference between right and left orbital cavities.*

Key words: Photo anthropometric parameters, Inferior orbital fissure, Inferior wall of orbital cavity, Fully ossified.

Introduction

The two orbital cavities are situated on either side of the sagittal plane of the skull between the cranium and the skeleton of the face. Each orbital cavity essentially is intended as a socket for the eyeball but it also contains associated muscles, vessels, nerves, lacrimal apparatus, fascial strata, and soft pad of fat. In a nutshell it lodges the visual apparatus.

It is made up of seven bones namely maxilla, palatine, frontal, zygomatic, sphenoid, ethmoid & lacrimal. Bones are arranged to enclose a roughly quadrilateral pyramidal cavity with the apex located

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posteriorly forming the optic canal and the base located anteriorly forming the orbital margin.[1]Each orbit presents a roof, floor or inferior wall, medial and lateral walls, a base or orbital opening and an apex. Orbital morphometry is important to provide useful baseline data for ophthalmology, anthropology, otolaryngology, radiology, maxillo-facial surgery, reconstructive cosmetic surgery and forensic medicine.[2]

Several diseases such as trauma, inflammation, infections, and tumors can involve the orbital cavity. During performing surgeries in the orbit like orbital decompression, enucleation, exenteration, optic nerve decompression and vascular ligation to avoid injuries to the important structures in the orbit, mainly neurovascular bundles passing through various foramina and fissures, precise knowledge of the anatomy of these openings is important. The existing data suggest that the location of various foramina in the orbit vary in different ancestral population.[3] The inferior wall is formed by the orbital plate of maxilla, orbital surface of zygomatic bone and orbital process of palatine bone. In the inferior orbital wall, the inferior orbital approach is involved in several procedures, including exploration for fracture, decompression and maxillectomy.[4,5] The inferior orbital fissure is defined as a space between the lateral wall and floor of the orbit. This fissure runs in an anterolateral direction from the maxillary strut posteriorly to the zygomatic bone anteriorly. The inferior orbital fissure joins the orbit with the pterygopalatine fossa, infratemporal and temporal fossa. The morphometric anatomy of the inferior orbital fissure is classified into three segments relative to the infraorbital nerve and fossae. In the posteromedial segment, the foramen rotundum, superior orbital fissure and pterygopalatine fossa communicate with the orbit and cavernous sinus. The middle segment of the inferior orbital fissure communicates with the infratemporal fossa and anterolateral segment to the temporal fossa. The inferior orbital fissure is an important landmark for endonasal endoscopic surgery of the skull base. Knowledge of its anatomy can help both neurosurgeons and otolarygologist who navigate in this region.[6] Photo-anthropometry is the process of obtaining measurements by means of photographs. The term Photo-anthropometry, when used by anthropometrists, has generally referred to measurement from photographs. Digital photographic techniques potentially offer a highly practical, convenient and cost effective method. The reliability of the photographic technique is satisfactory. 2D digitization method is accurate, and it can be applied to both clinical practice and research. Photographic method has several advantages over conventional measurement methods. The same landmarks used in several different measurements have to be located repeatedly when direct measurements are made. In digital photography, there is no need to locate landmarks prior the image taking. Another advantage of digital photography is the opportunity to preserve the material, which allows to repeat the measurements anytime and to add new parameters in latter measurements.

Materials and Methods

This cross-sectional analytical study was carried out at Department of Anatomy, Dhaka Medical College, Dhaka from July 2014 to June 2015. The study was performed on both orbital cavities of one hundred fully ossified dry human skull. Damaged or broken orbital cavities in fully ossified dry human skull were excluded from the study**.** Different measurements of orbital cavities of one hundred fully ossified dry human skull was recorded by photographic methods and 10 dry human skull was measured by physical methods to calculate the conversion factor. Before going to photographic measurement the human dry skull was placed on a wooden flat table at the same level of digital camera. The camera was fixed to a stand and the distance of the camera from the skull was fixed at 120 cm, with a fixed focus, zoom and illumination. The photograph of the orbital cavities were taken by the digital camera (Sony cyber shot 16.1 mega pixels).The photograph was uploaded in to the computer. The photographic measurements of the orbits was done by using a computer program Adobe Photoshop version 10. And measurements by physical methods was carried out on 10 dry human skull out of 100 to ascertain the conversion factor. Inferior wall and inferior orbital fissure were measured by digital slides caliper and the readings

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was noted in millimeter. These individual values of each photograph was converted into actual size by multiplying with the conversion factor. Calculation of conversion factor (CF) –

The conversion factor is a ratio, calculated by dividing a physically measured value of a variable, with a photographically measured value of the same variable of each orbital cavities to convert photographically measured values to actual measurements.

Formula for calculating conversion factor –

$$CF = \frac{\text{Orbital height or width measured by physical method}}{\text{Orbital height or width measured by photographic method}}$$

All data were checked and edited after collection. Later the data were put into computer and were analyzed with the help of SPSS version 19.0 for windows. Statistical analyses were done by paired student's 't' test.

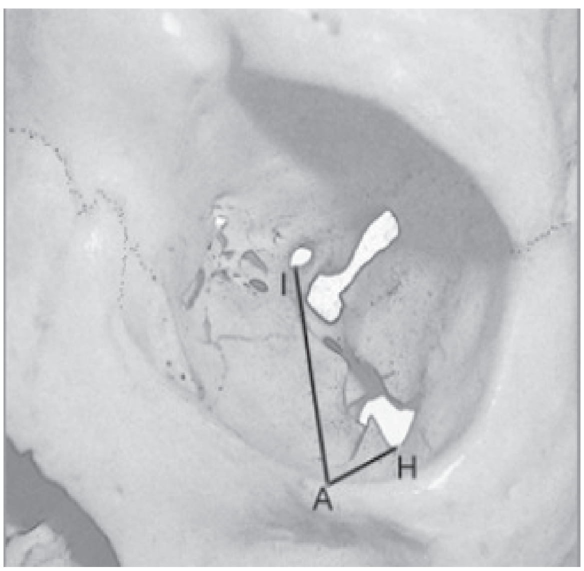

Fig-1: *Photograph showing distance of different foramen in the inferior wall of the left orbital cavity. A – Point in the inferior orbital rim just above the infraorbital foramen (IF). H – Point in the margin of the inferior orbital fissure (IOF) which is closest to the infraorbital foramen. I – Point in the inferior border of the optic canal (OC). A – H - Distance from orbital rim above the infraorbital foramen to the closest margin of the inferior orbital fissure. A – I – Distance from orbital rim above the infraorbital foramen to the inferior border of optic canal.*

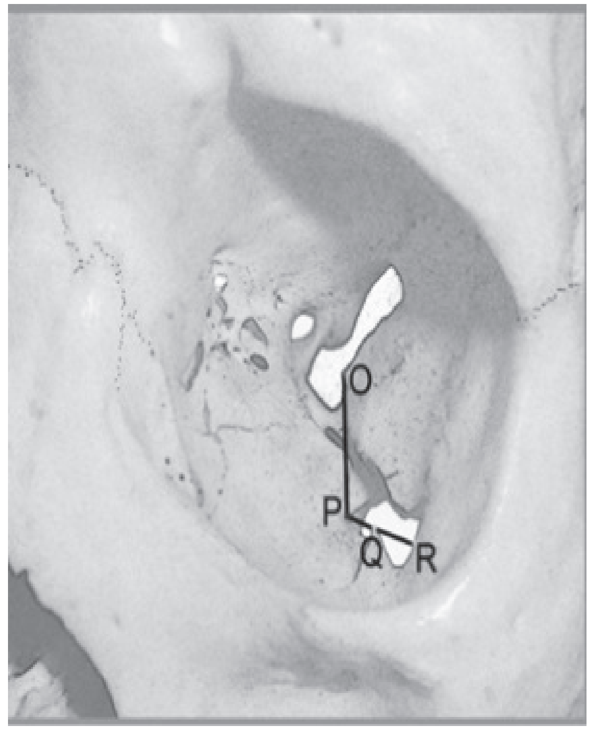

Fig-2: *Photograph showing the length of three segment of the inferior orbital fissure of the left orbital cavity. O – Point in the maxillary strut (MS). P— Point in the posterior border of the infraorbital groove (PBIG). Q – Point in the anterior border of the infraorbital groove (ABIG). R – Point in the most anterolateral aspect of the infraorbital fissure (ALAIF). O – P - Length of the posteromedial segment of the inferior orbital fissure. P – Q – Length of the middle segment of the inferior orbital fissure. Q – R – Length of the anterolateral segment of the inferior orbital fissure.*

Ethical Clearance:

The study was approved by Ethical Review committee of Dhaka Medical College.

Results :

Comparison between the distance on the inferior wall of the right and left orbital cavities from the infraorbital rim above the infraorbital foramen (IF) to the closest margin of the inferior orbital fissure (IOF) and inferior border of the optic canal (OC) (Table 1, Fig 3).

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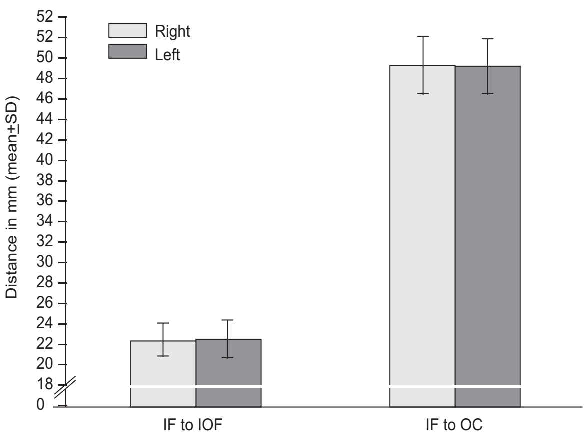
Table-I

Comparison between the distance on the inferior wall of the right and left orbital cavity from the infraorbital rim above the infraorbital foramen (IF) to the closest margin of the inferior orbital fissure (IOF) and inferior border of the optic canal (OC)

Side	IF to IOF in mm Mean±SD	IF to OC In mm Mean±SD
Right	22.25±1.53	47.52±2.62
(n=100)	(19.32-26.61)	(42.33-53.12)
Left	22.40±1.74	47.41±2.48
(n=100)	(18.59-26.90)	(41.11-52.44)
P value	0.117^{ns}	0.257^{ns}

Figures in parentheses indicate range. Comparison between right and left side done by paired Student's't' test, ns = not significant.



IF : Infraorbital formen IOF : Inferior orbital fissure
OC : Optic canal

Fig-3: *Distance on the inferior wall of the right and left orbital cavity from IF to IOF and IF to OC*

The mean (±SD) distances between infraorbital rim above the infraorbital foramen (IF) to the closest margin of the inferior orbital fissure were 22.25 ±1.53 mm and 22.40±1.74 mm on the right and left orbital cavity respectively. The range of the distance from infraorbital foramen (IF) to the closest margin of the inferior orbital fissure were 19.32-26.61 mm and 18.59-26.90 mm on the inferior wall of the right and left orbital cavity respectively. Statistically no significant difference in the mean from infraorbital foramen (IF) to the closest margin of the inferior orbital fissure was observed between right and left orbital cavities (P= 0.117). The mean (±SD) distances between infraorbital rim above the infraorbital foramen (IF) to the inferior border of the optic canal (OC) were 47.52 ±2.62 mm and 47.41±2.48 mm on the right and left orbital cavity respectively. The range of the distance from infraorbital foramen (IF) to the inferior border of the optic canal (OC) were 41.33-53.12 mm and 41.11-52.44 mm on the inferior wall of the right and left orbital cavity respectively. Statistically no significant difference in the mean from infraorbital foramen (IF) to the inferior border of the optic canal (OC) was observed between right and left orbital cavities (P= 0.257).

Comparison among the length of posteromedial, middle and anterolateral segment of inferior orbital fissure of right and left orbital cavities. (Table II, Fig 4).

The mean (± SD) length of posteromedial segment from maxillary sturt (MS) to the posterior border of infraorbital groove (PBIG) were 21.45 ± 1.66 mm

Table-II

Comparison among the length of the posteromedial, middle and anterolateral segment of the inferior orbital fissure of the right and left orbital cavity

Side	Posteromedial segment of Inferior orbital fissure in mm Mean±SD	Middle segment of Inferior orbital fissure in mm Mean±SD	Antero lateral segment of Inferior orbital fissure in mm Mean±SD
Right	21.45±1.66	7.52±1.27	9.84±0.47
(n=100)	(15.12-26.11)	(4.60-9.50)	(8.50-10.89)
Left	21.44±1.59	7.58±0.92	9.69±0.29
(n=100)	(14.70-25.42)	(5.40-9.50)	(9.00-10.50)
P value	0.947^{ns}	0.490^{ns}	0.010*

Figures in parentheses indicate range. Comparison between right and left side done by paired Student's 't' test, ns = not significant, * = significant at P<0.05.

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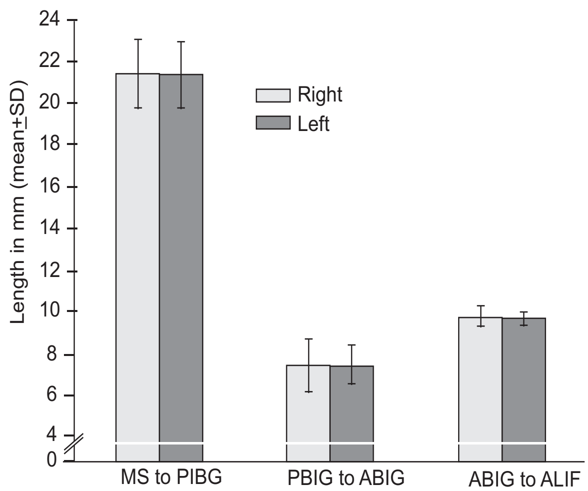

Fig-4 : *Length of the posteromedial, middle and anterolateral segment of the inferior orbital fissure of the right and left orbital cavity.*

on the right side and 21.44 ±1.59 mm on the left side respectively. No significant difference (P>0.05) of mean length from maxillary sturt (MS) to the posterior border of infraorbital groove (PBIG) was observed between right and left inferior orbital fissure.

The mean (±SD) length of middle segment from posterior border of infraorbital groove to the anterior border of infraorbital groove (ABIG) were 7.52 ± 1.27 mm on the right side and 7.58 ±0.92 mm on the left side respectively. No significant difference (P >0.05) of mean length from posterior border of infraorbital groove to the anterior border of infraorbital groove (ABIG) was observed between right and left inferior orbital fissure.

The mean (± SD) length of anterolateral segment of inferior orbital fissure of right and left orbital cavity from anterior border of infraorbital groove to the most antero-lateral aspect of the infraorbital fissure (ALAIF)were 9.84 ± 0.47 mm and 9.69 ±0.29 mm respectively. The mean length of anterolateral segment of inferior orbital fissure was significant ((P<0.05) between the right and left inferior orbital fissure . Mean length from the anterior border of infraorbital groove to the most antero-lateral aspect of the infraorbital fissure(ALAIF) was greater on the right side in comparison to left side.

Discussion:

The study revealed some statistically important findings about morphometric variations of right and left orbital cavity. But there is no published work on anthropometric measurements of orbital cavity from photographic image in our country. So, present study could not be compared with any previous similar study of Bangladesh. Hence a comparative discussion on the results of different variables of the measurement of orbital cavity of both sides were done with that of different authors and researchers of the other countries.

Present study also shows some dissimilarity with the studies reported by Fathy, Fetouh and Mandour,[8] Ukoha et al[9] and Jeremiah et al[10] Because they collected skull bones from Egyptian, Nigerian and Kenyan population. Egyptian population are mixture of Causasoid and Negroid whereas Nigerian and Kenyan population are solely Negroid. The reason of dissimilarities might be due to racial variation and use of different measurement techniques.

In the present study, no significant differences (P>0.05) were observed in the mean (±SD) distance from the infraorbital rim above the infraorbital foramen to the inferior border of the optic canal (OC) and closest margin of the inferior orbital fissure (IOF) on the inferior wall of the right and left orbital cavities. On comparison with Huanmanop et al[3] significant differences (P<0.05) were observed on the inferior wall of the both orbital cavities from the infraorbital rim above the infraorbital foramen to the inferior border of the optic canal (OC).The mean (±SD) distance from the infraorbital rim above the infraorbital foramen to the closest margin of the inferior orbital fissure (IOF) was significant (P<0.05) on the inferior wall of the right orbital cavity while left orbital cavity was not significant (P>0.05). No statistically significant difference were found between the distance on the inferior wall of the right and left orbital cavities from the infraorbital rim above the infraorbital foramen to the inferior border of the optic canal (OC) and closest margin of the inferior orbital fissure (IOF). Shilpa et al[11] found statistically non-significant difference in the mean (±SD) distance from the infraorbital rim above the infraorbital foramen to the inferior border of the optic canal (OC) and closest margin of the inferior orbital fissure (IOF) on the inferior wall of the right and left orbital cavities. Their results were similar with the present study. On comparison with the present study the mean (±SD) distance from the infraorbital rim above the infraorbital foramen to the inferior border of the optic canal (OC) of right orbital cavity showed non-significant difference ($P>0.05$) but left orbital cavity showed significant difference ($P<0.05$). on the other hand, no significant difference ($P>0.05$) was found from the mean (±SD) distance of the infraorbital rim above the infraorbital foramen to the closest margin of the inferior orbital fissure (IOF) on the inferior wall of the right and left orbital cavities.

No significant differences ($P>0.05$) were found in the length of the posteromedial and middle segment of the inferior orbital fissure between the right and left orbital cavities but significant difference ($P<0.05$) was observed in the anterolateral segment of the inferior orbital fissure of both orbital cavities. Battista et al[6] conducted a study on 50 dry cadaveric skulls. The average length of the posteromedial, middle and anterolateral segment of the inferior orbital fissures were 17.0mm, 5.0mm and 6.5mm respectively which is lower than the mean of present study. Findings of their study were not similar with the findings of present study. This difference may be due to racial & geographical factors. Their results were not statistically compared with the results of the present study as the authors did not mention the SD of length of three segment of the inferior orbital fissure.

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