Original Article

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Morphometric Study of Human Adult Orbit Using Computed Tomography Images

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Abstract

Background and objective: Computed Tomography, provides a direct visual window into the morphological anatomy of the orbit. The morphometric information of the human orbit is of great importance to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons. Purpose of the present study is to do morphological study of human adult orbit using randomly selected computed tomography images. *Materials and Methods*: Ours is a cross-sectional study where in 100 randomly selected computed tomography films of skull were studied in the department of ENT at Navodaya Medical College, Raichur during the month of January 2017. The morphological parameters of the orbit which were studied include shape, height, breadth, perimeter and orbital index. *Results:* Of the total 200 orbital readings in the total of 100 CT films, 94 (47%) orbits were round in shape and 106 (53%) orbits were in square shape. The mean height of the orbit was 3.58 cm (SD ±0.41). The mean breadth of the orbit was 4.18 cm (SD±0.47). The mean perimeter of the orbit was 12.58 cm (SD±0.94). The mean orbital index was 75.28 (SD±9.05). *Conclusion*: Computed Tomography, provides a direct visual window into the morphological anatomy of the orbit. The morphometric information of the human orbit is of great importance to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons.

Keywords: Human; Anatomy; Morphology; Computed Tomography; Orbit.

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]. Each orbital cavity contains associated muscles, vessels, nerves, lacrimal apparatus, fascial strata and soft pad. This anatomical region is of clinical & surgical interest to many disciplines like ophthalmology, oto-rhinolaryngology, forensic science, oral and maxillofacial surgery and neurosurgery [2]. The orbit may be involved in conditions like trauma, inflammation, infections, and tumors, thereby compromising the visual apparatus. Also, a precise anatomy of the orbit is essential to avoid complications during orbital surgeries. Accurate measurements of orbital dimensions are also very important in designing various eye protective equipments. Hence is the requirement of a morphological study of the human orbit. The advent of the computed tomography has immensely helped in gaining insight into this morphological anatomy of the orbit. Purpose of the present study was to do morphological study of human adult orbit using randomly selected computed tomography images.

Materials and Methods

Ours is a cross-sectional study where in 100 randomly selected computed tomography films of skull were studied in the department of ENT at Navodaya Medical College, Raichur during the month of January 2017. The CT scans were taken previously in the ENT department for evaluation of patients coming with head injuries. However,

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pathological or fractured orbital bone CT films were excluded from the study. The morphological parameters of the orbit which were studied include shape of the orbital rim, height of the orbit, breadth of the orbit, perimeter of the orbital rim and orbital index (calculated as height divided by breadth multiplied by 100). 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 (Fig 1). All the data collected was statistically analysed using Microsoft office Excel 2007 software.

Results and Observations

Of the total 200 orbital readings in the total of 100 CT films, 94 (47%) orbits were round in shape and 106 (53%) orbits were in square shape. The mean height of the orbit was 3.58 cm (SD ±0.41). The mean breadth of the orbit was 4.18 cm (SD±0.47). The mean perimeter of the orbit was 12.58 cm (SD±0.94). The mean orbital index was 75.28 (SD±9.05).

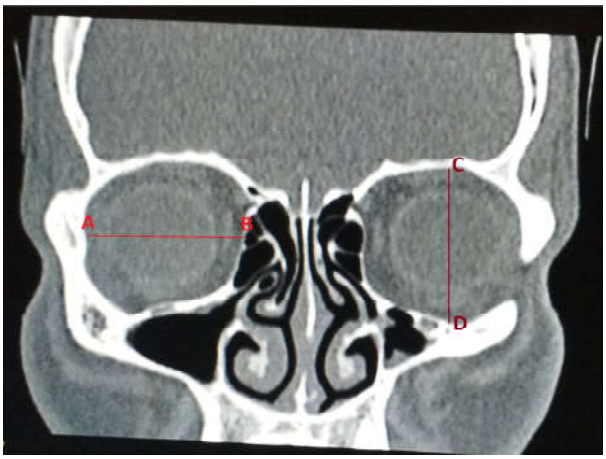

Fig. 1: CT scan with graphical depiction of measurement of height (a -b) and breadth (c-d) of the orbit

Discussion

As discussed above, the morphological anatomy of the orbit is of immense importance in the fields like ophthalmology, oto-rhinolaryngology, forensic science, oral and maxillofacial surgery and neurosurgery [2]. Computed tomography has made significant contribution in understanding the morphometry as well as pathology of the orbit. CT scan helps us in getting accurate measurements for soft tissue structures such as the eye, as well as the underlying bony structures that surround and protect the eye [3].

A similar radiological study was done on 64 Chinese adults in whom the researchers observed that there were no differences in the anatomic parameters between the two sides in the same individual. No laterality of the orbital features was detected in normal Chinese adult population [4]. A similar CT assisted morphological study has been done on 70 European adults (140 orbits) with unaffected orbits and the authors have presented an easily measurable 2D reference data set of the bony orbit for study of individual orbital morphology prior to decompression surgery in Graves' orbitopathy [5]. In a study conducted in Malaysia, the authors have concluded that the orbital breadth, bi-orbital breadth and inter-orbital breadth are not useful for identifying anthropological race [6].

In our study, both the orbital shapes, round and square were found, even though, the number of square shaped orbits was marginally higher. E.Pretorius et al conducted a study in which the female orbits were considered as round shaped and male orbits as square. However, we did not do gender based study [7]. The mean perimeter of the orbit in our study was 12.58 cm (SD±0.94). This is comparable to the findings of the studies by Yongrong ji et al [4] (12.20 to 12.65) and Ashley A. Weaver et al [8] (11.21 to 11.47) even though their study populations were racially different.

In our study, the mean height of the orbit was 3.58 cm (SD ±0.41). This finding is in line with similar findings by Sanjai Sangvicichien et al [9](3.289 to 3.314). Even in this study, the sample population was racially different from our sample population. The Jaswinder Kaur et al study done on Indian population has mentioned the height of the orbit as 3.19 to 3.22 cm [10]. The minimal difference noticed between our study and this study could be due to environmental and genetic factors. In a similar CT guided study Yongrong ji et al [4] has mentioned the height of adult orbit to be 3.332 to 3.335, again comparable with our finding.

In our study, the mean breadth of the orbit was 4.18 cm (SD±0.47). A similar observation was done by Sanjai Sangvicichien et al in their study. In their study, the breadth of the orbit was between 3.80 and 4.01 cm [9]. In their study, Yongrong ji et al has mentioned the breadth of the orbit as between 3.80 and 4.00 cm [4]. The slight differences in values could be due to environmental factors and differences in the methodology of recording.

In our study, the mean orbital index was 75.28 (SD±9.05). The mean orbital index of Nigerian study population as per the study by Ukoha U et al8 was

89.21 [11]. The mean orbital index of Indian study population as per the study by Jaswinder Kaur et al was 81.65 [10]. Variation of orbital index 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. 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 [12].

Conclusion

The computed tomography gives valuable information about the various anatomic parameters of the orbit which is helpful to ophthalmologists, rhinologists, facial plastic surgeons, forensic experts as well as maxillo-facial surgeons. Accurate measurements of orbital dimensions are also very important in designing various eye protective equipments.

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