

Original Research Article

# Radiological Observations of Orbital Perimeter among South Indian population - A CT study


C.R. Parvathavarthine<sup>1</sup>, Soorya Sridhar<sup>1\*</sup>, Neelee Jayasree<sup>2</sup>

<sup>1</sup>Assistant Professor, Sri Muthukumaran Medical College, Chennai, Tamil Nadu, India

<sup>1\*</sup>Assistant Professor, Government Medical College, Chennai, Tamil Nadu, India

<sup>2</sup>Dean and Professor of Anatomy, Sakshi Medical College and Research Center, Myana, Madhya Pradesh, India

\*Corresponding author email: [dr.sooryasridhar@gmail.com](mailto:dr.sooryasridhar@gmail.com)

	International Archives of Integrated Medicine, Vol. 5, Issue 12, December, 2018. Copy right © 2018, IAIM, All Rights Reserved. Available online at <a href="http://iaimjournal.com/">http://iaimjournal.com/</a>	
	ISSN: 2394-0026 (P)	ISSN: 2394-0034 (O)
	Received on: 09-11-2018	Accepted on: 02-12-2018
Source of support: Nil		Conflict of interest: None declared.
<b>How to cite this article:</b> C.R. Parvathavarthine, Soorya Sridhar, Neelee Jayasree. Radiological Observations of Orbital Perimeter among South Indian population - A CT study. IAIM, 2018; 5(12): 61-65.		

## Abstract

**Introduction:** The Human Orbit is a complex structure containing muscles vessels, nerves, fat and the lacrymal apparatus. The perimeter of the orbit is found to be a significant factor while planning and in placing facial implants or any in mode of facial reconstruction procedures. It plays an important role in numerous specialities such as OMFS, Ophthalmology, plastic and trauma reconstructive surgeries. While among the daily practitioners of Ophthalmology the orbital perimeters are important in more common procedures such as orbital anesthesia to avoid damage to inbuilt structures and also in procedures such as enucleation, exentration, optic nerve decompression.

**Aims and objectives:** The present study aimed to provide morphometry of orbital perimeter using 200 CT images from the Department of Radiology, of various Radiology centers across Chennai collected retrospectively, to approximate the perimeter including the soft tissue contained thereby standing to be of greater clinical importance.

**Materials and methods:** The parameters recorded were analysed using inbuilt CT system generated digital measures.

**Results:** The study noted a significant difference in the morphometry between two sexes, while no significant difference was observed between the two sides.

**Conclusion:** Accurate measurements of orbital parameters are important in facial reconstructive procedures and maxillofacial surgeries. They are also important in designing protective eye wear.

Therefore, during structuring of implants of the zygoma and structures around the orbit the race and sex needs to be kept in mind as it is a factor for Morphometric variations thus seen.

## Key words

Orbital Perimeter, Computerised tomography, Radiology, South India.

## Introduction

The Human Orbit is a complex region. Each of its bony walls has its own unique features and is perforated by a number of fissures and foramina that carry important nerves and vessels [1].

The orbital structure is an important factor that decides facial features of an individual. The orbit lodges the Optic Complex. The orbit and its contents are important bony structures of the cranio facial complex [2]. It is an area of importance in facial reconstructive procedures and also in both basic and advanced maxilla-facial intervention. Periorbital, facial injuries caused by assault, fall, essentially trauma of any sort. These injuries that involve the forehead may require orbital reconstructions to correct aesthetic, functional deficits that may have occurred during the injury process.

The two orbital cavities are located on either side of the sagittal plane of the skull between the cranium and the skeleton of the face. Thus, each orbital cavity is intended as a socket for the structures contained [3]. Safe orbital anesthesia is largely dependent on the grasp of the morphometry of the orbit to prevent injury to orbital structures, most importantly the Optic Nerve [4].

Understanding the anthropometry of the structures has been greatly aided by imaging techniques such as CT and MRI scans. Computerized Tomography has changed the diagnosis and the treatment protocols for orbital trauma and orbital diseases [5].

The morphometry of orbital perimeter will help in implant sizing post trauma to suit the needs of specific population in this case the population of South India, Tamil Nadu in specific.

The values of the orbital perimeter is said to vary based on age, sex and race of the population involved. Not many studies have been undertaken based on Computerized Tomography imaging techniques with regard to the orbital perimeter. Majority of the studies have been undertaken among dry human skulls which after processing due to removal of the soft tissue and other supportive structures may not give an accurate value and thereby may be more approximate than accurate with respect to clinical application.

## Materials and methods

CT images of 200 adult patients between the age of 25-55 years were obtained retrospectively from the archives of various Radiology centers in Chennai. Images indicative of fractures, clefts and other abnormalities bony or of soft tissue were excluded from the study group. The measurements were taken using the digital meter scale inbuilt in the CT software. The values were computerized and the significance calculated using Mann-Whitney Test.

## Results

### Shape: Round Vs Square (Common Shapes)

The shape of the orbit among 200 skull CT images showed a significant pattern. Among the adult males the shape of the orbit was found to frequently resemble a square, while among the images from the female patients the shape tended to be more rounded. The two sides showed no specific differences as shown in **Table - 1**.

**Sex:** In the male orbits, the perimeter ranged between 11.4-14.3cm whereas in the case of female orbits it was 11.6- 13.7 cm. When the mean values were compared between the genders, the Z value was found to be -12.523,

(Table - 2) which was highly significant Side: No Specific/Significant Difference was noted between left and right sides (Table – 3, 4). (p<0.001).

**Table - 1:** Distribution of round and square orbits among males and females in cranial CT scan.

Shape	Male		Female		X <sup>2</sup>	P value
	N	%	N	%		
Round	27	27	58	58	19.648	<0.001
Square	73	73	42	42		
Total	100	100	100	100		

**Table - 2:** Comparison of perimeter in male and female orbits in cranial CT.

Parameter	Gender	Mean	Std Dev	SE of Mean	Mean Diff	Z	P value
Perimeter	Male	13.28	0.42	0.03	0.706	-12.753	<0.001
	Female	12.57	0.48	0.03			

**Table - 3:** Comparison of orbital perimeter between the right and left side male orbits in CT scans.

Parameter	Side	Mean	Std Dev	SE of Mean	Mean Diff	Z	P- value
Perimeter	Left	12.41	0.60	0.04	0.017	-0.306	0.759
	Right	12.39	0.59	0.04			

**Table - 4:** Comparison of orbital perimeter between Right and Left side Female orbits in CT scans.

Parameter	Side	Mean	Std Dev	SE of Mean	Mean Diff	Z	P- value
Perimeter	Left	12.91	0.56	0.04	-0.027	-0.621	0.534
	Right	12.93	0.58	0.04			

## Discussion

The orbit is the socket in which the eye and its appendages are situated [6]. Orbital Fractures are observed in more than 40% of maxilla facial injuries and thus represent the most common fractures of the midface [7]. Study of the Anatomy of the Orbit helps and allows the Anaesthetist to understand how to insert the needle into the orbit [8].

E. Pretorius, et al. [9] conducted a study in which female orbits were considered as round and male orbits were considered square. The present study concludes with E. Prestorius, et al. [9], as 73% of males were found to have square shaped orbit while 58 % of females were seen to have round shaped orbits. No relevant literature is available with regard to the shape of the orbit among CT studies. Though, CT studies are said to be more accurate due to the fact that, the required angulations are possible. The literature on the morphometry of the orbital perimeter is limited

to say the least. Among the CT studies Yongrong JI, et al. [11] recorded the perimeter to be 12.65 in males and 12.20 in females, while a study by Ashley A, Weaver, et al. [10], measured the orbital perimeter in men and women noting the average to be 11.47 in males and 11.21 in women. The present study has found the average perimeter to be 13.28 among men and 12.5 among women following the pattern set by Yongrong JI, et al. [11], with respect to the difference of the orbital perimeter among the two sexes. The difference in the values may be attributed to the racial variation of the orbital perimeter morphometry while the variation among the two sexes followed similar pattern. The values obtained in the present study when compared to previous studies showed a larger perimeter among the study population. Similar to Yongrong JI, et al. [11], a marked difference in the orbital perimeter recorded in the two sexes studied was observed. The difference in the values of the orbital perimeter between the

Yongrong JI, et al. [11], study and the present study could be due to the racial difference of the population studied. It could be also attributed to the smaller study group taken by the Yongrong JI, et al. [11], study of 64 CT scans (**Table – 5, 6**).

A study by Ashley A Weaver, et al. [10], involved Caucasian population. It did not record any significant difference between the two sexes

studied. The variation in the morphometry of the Orbital perimeter can also be attributed to epigenetic factors other than the small sample size. The Ashley A Weaver, et al. [10], study consisted of a study group of 39 CT scans.

The present study shows similarity to the Yongrong JI, et al. [11] study showing no laterality between the two sides.

**Table - 5:** Comparison of Orbital Perimeter among Males and Females in present study and among other authors.

Authors	Male	Female	P
Yongrong JI, et al. [11]	12.65	12.20	<0.001
Ashley A Weaver, et al. [10]	11.47	11.21	0.20
Present study	13.28	12.57	<0.001

**Table - 6:** Comparison of Orbital Perimeter of Both Sides.

Authors	Right	Left	P
Yongrong JI, et al. [11]	12.39	12.41	0.232
Present Study	12.93	12.91	0.534

## Conclusion

The present study establishes:

- A Statistically significant association between gender and the shape of the orbit. The margin being round in female and noticeably square among males.
- The Orbital Perimeter is greater among men than in women, establishing sexual dimorphism.
- No difference among the two sides of the same individual among those studied, therefore establishing no laterality in the normal study group population.

Accurate measurements of orbital parameters are important in facial reconstructive procedures and maxillofacial surgeries. They are also important in designing protective eye wear. Therefore, during structuring of implants of the zygoma and structures around the orbit the race and sex needs to be kept in mind as it is a factor for Morphometric variations thus seen. This study may also aid in the Forensic use of orbital morphometry for racial and sexual dimorphism

and for distinct identifications during suspect and victim identity verification or sketching.

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