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Original Research Article

Morphometric Analysis of Orbital Parameters for Sex Determination.

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Abstract

Introduction: Identification of a person from bone is most common and critical problem faced by Forensic experts and Anthropologist. Different craniometric parameters have been employed to accurately and reliably determine the sex of a person in forensic medicine. Orbital measurements are one of the craniofacial parameters that could be used in sexual estimation in terms of anthropological studies. The aim of this study was to evaluate orbital parameters as reliable tool in sex determination. **Material and Methods:** It is a cross sectional study which was conducted in the Department, 46 skulls were used and Orbital parameters dimensions (OH and OB) was measured using vernier callipers. Orbital Index was calculated by the formula. **Results:** Orbital Breadth was significantly higher in male skulls compared to female skulls. Orbital index was higher in female skulls compared to male skulls. {(OH 31.83 vs 31.28) (OB 37.36 vs 35.63) (OI 85.27 vs 87.92)}. **Conclusion:** Orbital height, Orbital breadth and Orbital index showed significant differences in male skulls compared to female skulls. Hence metric analysis of the orbital parameters are useful for sex determination.

1. Introduction

Identification of a person from bone is most common and critical problem faced by Forensic experts and Anthropologist. The morphometry of skull was most often used for the estimation of age, stature and ethnicity. It plays an important role in the forensic investigation and anthropological examinations of unidentified persons.^{1,2} Sex of an individual can be identified accurately in 90% of the cases using pelvis alone, 80% of cases using skull alone and in 98% cases using pelvis and skull together.³ Mostly the

craniofacial skeletal structures are injured or damaged after air accidents, mass disasters, fire, explosion, or injuries resulting from violence making it difficult to determine the gender and the identification of the individual.⁴

The orbit is a part of the body structure that is convenient to measure. There is noteworthy sexual dimorphism from the Orbits within the skull, with male having characteristically squarer and relatively smaller orbits, while female orbits are rounder and comparatively larger.⁵⁻⁷

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Diverse craniometric parameters have been utilized to precisely ascertain the sex of a person in forensic medicine. Orbital measurements are one of the craniofacial parameters that could be used in sexual estimation in terms of anthropological studies (Weaver et al., 2010; Rossi et al., 2012).^{8,9}

The present study was carried out for sex determination from dimensions of orbit in South Indian region by morphometric analysis which would be of great value to the forensic and anthropological investigators.

2. Materials and methods

The study includes 46 intact adult skulls (27 male and 19 female) present in the Department of Forensic Medicine. The skull was differentiated into male and female on the basis of certain classic anatomic characteristics. Morphometry of Orbital length (OH) & Orbital breadth (OB) was measured using vernier caliper (Forbes) to an accuracy of 0.5mm. The technique involved repetition of the measurements twice and average results were considered.

Measurement of orbital parameters

Orbit breadth (OB) - the distance in millimetres between the dacryon and ectochion was measured as the orbital breadth. Orbit height (OH) - the direct distance in millimetres between the superior and inferior orbital margins perpendicular to the orbital breadth (Ectochion - the intersection of the most anterior surface of the lateral border of the orbit and a line bisecting the orbit along its long axis. Dacryon - the point on the medial border of the orbit at which the frontal, lachrymal and maxilla bones intersect) (Fig. 1).

Fig 1: Measurement of dimensions of Orbital parameters.



Orbital index is calculated as Orbital height / Orbital breadth x 100.

The skull samples between 18 to 60 years were included in the study. The skull samples which were damaged or deformed was not included in the study. Statistical analysis was done in SPSS software version 21 using t-test, and a value of $p < 0.05$ was considered significant.

3. Results

Out of 46 intact adult skulls, there were 27 male and 19 female skulls. Left orbital height (LOH), left orbital breadth (LOB), right orbital height (ROH) and right orbital breadth (ROB), are higher in males compared to females {(LOH 31.82 vs 31.44) (LOB 37.33 vs 35.53) (ROH 31.84 vs 31.11) (ROB 37.38 vs 35.74)} (Table 1).

Table 1: Orbital height & Orbital breadth (left and right) of males & female skulls.

Sex	Parameter	Mean	SD
Male	LOH	31.82	1.91
	LOB	37.33	1.37
	ROH	31.84	1.90
	ROB	37.38	1.36
Female	LOH	31.44	1.60
	LOB	35.53	1.56
	ROH	31.11	1.62
	ROB	35.74	1.65

Table 2: Comparison of orbital height, orbital breadth and orbital index between male and female skulls.

Parameter	Gender	Mean	SD	P value
Orbital Height	Male	31.83	1.89	0.214
	Female	31.28	1.60	
Orbital Breadth	Male	37.36	1.35	0.097
	Female	35.63	1.59	
OI	Male	85.27	5.18	0.244
	Female	87.92	5.52	

Orbital height of male skulls was higher compared to orbital height of female skulls. Orbital Breadth was significantly higher in male skulls compared to female skulls. Orbital index was higher in female skulls compared to male skulls. {(OH 31.83 vs 31.28) (OB 37.36 vs 35.63) (OI 85.27 vs 87.92)}, but p value was not significant (Table 2).

4. Discussion

Orbital parameters can play an important role in case of sex determination. The results of the present study were compared with other studies.

Ghosh et al¹⁰, study conducted in Calcutta and Jain D et al¹¹, study conducted in Delhi, observed that right orbital breadth, left orbital breadth, right orbital height and left orbital height was more in males compared to female skulls (42.87 vs 42.00, 42.87 vs 40.66, 36.77 vs 36.00, 37.12 vs 36.33) (42.2

vs 40.4, 41.8 vs 39.8, 33.1 vs 32.7, 33.1 vs 32.7) respectively.

In the current study we also observed similar results but the mean values were on the lower side (37.38 vs 35.74, 37.33 vs 35.53, 31.84 vs 31.11, 31.82 vs 31.44). But study by Sarkar N and Mukhopadhyay PP¹², conducted in west Bengal observed right orbital breadth and left orbital breadth was more in males compared to female skulls but right orbital height and left orbital height was more in females compared to male skulls (39.86 vs 39.00, 39.93 vs 39.17, 34.96 vs 35.63, 35.22 vs 35.86) (Table 3).

Table 3: Comparison of orbital height & orbital breadth with other studies.

Author/Ethnicity	Gender	Orbital height	Orbital breadth
Jain K et al., Nagpur ¹³	Male	32.1 ± 0.28	38.7 ± 0.25
	Female	32.0 ± 0.31	35.5 ± 0.33
Mekala D., Tamil nadu ¹⁴	Male	36.2 ± 0.23	42.9 ± 0.27
	Female	34.5 ± 0.2	40.5 ± 0.24
Present Study	Male	31.83 ± 1.89	37.36 ± 1.35
	Female	31.28 ± 1.60	35.63 ± 1.59

The comparison of the morphometric analysis obtained in this study with the results of other studies had the following results: the orbital height of the male skulls in the present study (31.83±1.89) was lower than Jain K et al¹³ (32.1 ± 0.28) and Mekala D¹⁴ (36.2 ± 0.23).

Similarly in female skulls orbital height (31.28±1.60) was lower than Jain K et al¹³ (32.0 ± 0.31) and Mekala D¹⁴ (34.5 ± 0.2). Regarding the orbital breadth in the current study of male skulls (37.36± 1.35) was lower than Jain K et al¹³ (38.7 ± 0.25) and Mekala D¹⁴ (42.9 ± 0.27). Similarly in female skulls orbital breadth (35.63 ± 1.59) was similar in Jain K et al¹³ (35.5 ± 0.33) and but lower than Mekala D¹⁴ (40.5 ± 0.24). Orbital index calculated from the present study showed (85.27 ± 5.18) in males and (87.92 ± 5.52) in females. Similar results were also found in study by Mekala D et al¹⁴ (84.62 ± 8.21, 85.46 ± 5.93) and Jain D et al¹¹ {(right side 78.60 ± 4.53, 80.99 ± 4.85) (left side 79.44 ± 4.62, 82.40 ± 4.67)}.

Though statistical significance was not obtained in our study, but the results demonstrated that significant differences in orbital parameters (OH, OB and OI) in male and female skulls. Hence in unknown skulls, metric analysis of the orbital parameters is useful for sex determination. The values obtained will be helpful for this part of South Karnataka region (South Indian).

5. Conclusion

In unknown skulls, orbital parameters can be used during forensic and anthropological investigation for determining sex.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

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References:

1. Iscan MY. Global forensic anthropology in the 21st century. *Forensic Sci Int.* 2001; 117 (1-2): 1-6.
2. Harvati K, Weaver TD. Human cranial anatomy and the differential preservation of population history and climate signatures. *The Anatomical Record Part A: Discoveries in Molecular, Cellular, and Evolutionary Biology: An Official Publication of the American Association of Anatomists.* 2006; 288(12):1225-33.
3. PC Dikshit. *Textbook of Forensic Medicine and Toxicology.* 1st edition. New Delhi: Peepee Publishers; 2007, P 66-7.
4. Graw M. Morphometrische und morphognostische Geschlechtsdiagnostik an der menschlichen Schädelbasis. In Oehmichen M. and Geserick G. (Eds.). *Osteologische Identifikation und Altersschätzung.* Lübeck: Schmidt-Römhild. 2001: 103-21.
5. Kanchan T, Krishan K, Gupta A, Acharya J. A study of cranial variations based on craniometric indices in a South Indian population. *J Craniofac Surg.* 2014; 25: 1645-9.
6. Kumar A, Nagar M. Morphometry of the orbital region: "Beauty is bought by judgement of the eyes". *Int J Anat Res.* 2014; 2: 566-70.
7. Biswas S, Chowdhuri S, Das A, Mukhopadhyay PP. Observations on symmetry and sexual dimorphism from morphometrics of foramen magnum and orbits in adult Bengali population. *J Indian Acad Forensic Med.* 2015; 37: 346-51.
8. Rossi AC, de Souza Azevedo FH, Freire AR, Groppo FC, Júnior ED, Caria PH et al. Orbital aperture morphometry in Brazilian population by postero-anterior Caldwell radiographs. *J Forensic Leg Med.* 2012; 19(8):470-3.
9. Weaver AA, Loftis KL, Tan JC, Duma SM, Stitzel JD. CT based three-dimensional measurement of orbit and eye anthropometry. *Invest Ophthalmol Vis Sci.* 2010; 51(10):4892-7.
10. Ghosh R, Chowdhuri S, Maity S. Sexual dimorphism in right and left orbital fossa measurements from adult human skulls from an Eastern Indian population. *J Forensic Sci med.* 2019; 5(4): 173-6.

11. Jain D, Jasuja OP, Nath S. Determination of sex using orbital measurements. *Ind J Phys Anthrop Hum Genet.* 2015; 34(1): 97-108.
12. Sarkar N, Mukhopadhyay PP. Determination of sex from the morphometry of orbits in adult skull of contemporary eastern Indian population. *Egyptian J Forensic Sci.* 2018; 8: 61.
13. Jain K, Nagrale N, Ambad R, Bankar N, Patond S. Osteometric evaluation of human skull for sex determination: A comparative study. *Ind J Forensic Med Toxicol.* 2020; 14(4): 7142-6.
14. Mekala D, Shubha R, Rohini Devi M. Orbital dimensions and orbital index: A measurement study on South Indian dry skulls. *Int J Anat Res* 2015; 3(3): 1387-91.