RESEARCH ARTICLE

Comparative Study of Orbital Indices in Human Dry Skulls Obtained from People in Eastern Region of Nepal

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ABSTRACT

Aim: The aim of this study is to measure the known variables of orbital indices with utilization of human dry skulls among people in eastern region of Nepal. **Materials and Methods:** The parameters (such as orbital height [OH], orbital breadth [OB], and orbital index [OI]) were used for comparative analysis of orbital indices in collected skull samples. Based on these morphological features, each human dry skull was categorized into megaseme, mesoseme, and microseme groups. The determination of orbital indices with known parameters (such as OH, OB, and OI) was carried out in next. **Results and Discussion:** Here, we observed that abundantly 54% of people had OI >89 that had laid us to report that majority of population in this area belongs to the megaseme group. Mesoseme was next to grasp population as 32% of collected skulls were having OI values between 83 and 89. The remaining 14% were set into microseme with OI values <83. We further investigated the pattern of variation in both right- and left-sided OH, OB, and OI, and their findings were peculiar to interestingly report in our study among people residing in this part of the world.

Keywords: Eastern Nepalese people, human dry skull, orbital breadth, orbital height, orbital index

INTRODUCTION

A word termed "anthropometry," which literally means for measurement of humans, refers to the point of reference for an individual physical variation. Toward the successful treatment of congenital or post-traumatic facial disfigurements, a surgeon needs access to craniofacial database. Such information depends on accurate anthropological measurements.[1]

In contrast, the craniofacial structures such as orbits are located on either side of the nose in the face of bony socket under skull between the cranium and facial skeleton. In this orientation, they encroach nearby equally into these two regions.[2] Each orbit is conical or pyramidal cavities and consists of a base, an apex, and four walls. Apex is directed behind at an optical canal, and the orbital margin represents its base. Further certain bones such as maxilla, zygomatic, frontal, ethmoidal, lacrimal, sphenoid, and palatine one contribute to the framework of each orbit. Each orbit, moreover, contains eyeball and related muscles, the vessels, nerves, lacrimal apparatus, and structural characteristics to the lodging of visual apparatus has been its essence.[3] The previous study, carried out earlier by Patnaik *et al.*, has been important in biological field, not only for anatomical point of view but also for ophthalmologist, oral, and maxillofacial surgery purposes as well as for reconstructive cosmetic operational procedures of face[4] with an additional hormonal assessment for certain disorders including Down's syndrome [1,4,5] So far, orbits allow to accurate the positioning of visual axis which is essential for the binocular vision.[5] By contrast, the orbit exhibits an importance in certain clinical implications with its involvement in a number of congenital, traumatic,

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vascular, and endocrine disorders.[6] The strategy to the understanding of the structural proportion and mechanical function of human body with respect to racial variation in ocular anatomy is vital to clinical assessment and treatment of patients.[7] To carry out a comparative study of orbital index (OI), collection of skull specimens has literally been essential and several scientists have done it since previous days. As skull is least perishable and can resist fire, explosions, and mutilations, the scientists consider it as the most preferred bone for the identification of sexual dimorphism.[8] We can identify the sex of an individual accurately in 90% of cases with the use of the skull alone and in 98% if cases using pelvis with skull together.[9] By concern, OI is important as it varies in different races of humankind and determines the shape of the face in various groups of population.[10] Our anthropometric study employs the use of direct measurements of certain orbital parameters such as orbital height (OH), orbital breadth (OB), and OI in dry skulls as it is plausible to present a distinct and more natural perspective in assessing the orbital cavities. Hence, we collected 50 number of human dry skulls and comparatively investigated our result with respect to the parameters of OI. Here, we found that majority (around 54%) of orbits in these collected skulls from local people falls into the category of megaseme, followed by distribution in mesoseme (32%) and microseme (14%). In addition, we sighted for differential investigation relatively that carries the essence in several aspects of human biology.

MATERIALS AND METHODS

To carry out this comparative analysis, we collected a number of 50 dry skulls from the Department of Human Anatomy located at Birat Medical College and Teaching Hospital as well as Nobel Medical College and Teaching Hospital in Biratnagar, Nepal. We omitted to collect the sample from children, and the registered skulls were obtained from humans of unknown sex.

The so-collected 50 dry skulls were measured using manual Vernier caliper with the use of 0.02 mm accuracy as calibrated in the instrument. Further, we measured these samples after putting them in anatomical position as already mentioned and oriented by Frankfurt's horizontal plane. The dimensions of right- and left-side orbits were recorded separately in skulls with additional uses of scale and marker.

The orbital parameters such as OH, OB, and OI were determined in all skull specimens in their both left and right sides. All the sizes were logged in a tabulated form under the standard unit of millimeters followed by further calculation of descriptive statistics to obtain mean, standard deviation (SD), and their range.

Determination of OH

The distance between the midpoint of upper and lower margins of the orbital cavity was measured for the determination of OH.

Determination of OB

The distance between the midpoint of medial and lateral margin of orbit was measured using manual Vernier caliper to determine the OB.

Determination of OI

We calculated the OI using the formula as OI = orbital height/orbital breadth × 100

Statistical analysis

Data obtained from all parameters were presented as mean and SD. The student *t*-test was applied to find the statistical differences among various OH and OB as well as OI. The data were analyzed under the Software Package for the Social Sciences version 16. Further, the findings were considered for the level of significance if $P < 0.05$.

RESULTS

Analysis of orbital indices in collected dry skulls

In the present study, based on parameters such as OH, OB, and OI as described earlier, we carried out the retrospective study to compare orbital indices in human dry skulls ($n = 50$). In each of these specimens, we at first took the measurements of OH, OB, and OI in their right and left sides. We found the ranges of OH, OB, and OI as 33.2 ± 2.4, 37.4 ± 1.4, and 88.8 ± 6.6 mm [Figure 1; Bars 1st-3rd], respectively, in the right side. By contrast,

in the left side, the numerals of similar indices were in order as 33.4 ± 2.5, 37.3 ± 1.3, and 89.6 ±6.9 mm.

Observational analysis and investigation on OI

According to the study carried out previously by Cassidy, human population is categorized into three groups as megaseme, mesoseme, and microseme having OI values >89, 83–89, and <83, respectively.[11] Relatively, in our study, we obtained such ranges as 88.8 ± 6.6 and 89.6 ± 6.9 mm in the right and left sides [Figure 1; Bars 3rd and 6th], respectively, that cover overall dimensions of megaseme, mesoseme, and microseme. Hence, we grouped the data in these three classes for further investigation toward comparative analysis. Of the total 50 number of samples, the measurements of OI at their right and left sides were 95.09 ± 3.37 and 95.96 ± 3.49, respectively [Figure 2; Bars 1st and 2nd], in 27 skulls, suggesting that majority, i.e., 54% were under a class of megaseme [Figure 3]. In next, 16 specimens showed the dimensions of similar variable in their right and left sides as 84.63 ± 1.8 and 86.09 ± 1.56, respectively [Figure 2; bars 3rd and 4th], indicative to the remarkable existence of 32% in a mesoseme group [Figure 3]. Moreover, the residual skulls (n = 7) showed OI values as 80.09 ± 3.04 and 80.07 ± 3.01 in their right and left sides [Figure 2; Bars 5th and 6th], respectively, indicating as 14% of the remaining specimens had orbital indices under category of microseme [Figure 3].

Differential observation of dry skulls fallen under a group of megaseme

As our early observation on 54% existence of dry skulls under a group of megaseme [Figure 3], we then analyzed the result based on orbital parameters such as OH, OB, and OI. In relation to OH, the findings were 35.35 ± 1.65 and 35.57 ± 1.61 mm in their right and left sides, respectively [Figure 4], indicating that although not remarkable, right-sided OH of collected dry skull was slightly smaller compared to left one of the similar counterpart. In next, we found the dimensions of OB variable as 37.19 ± 1.51 and 37.08 ± 1.25 mm, respectively [Figure 4], indicative to variance which was opposite to that of the OH parameter. The variation of OI was alike to that of OH [Figure 4].
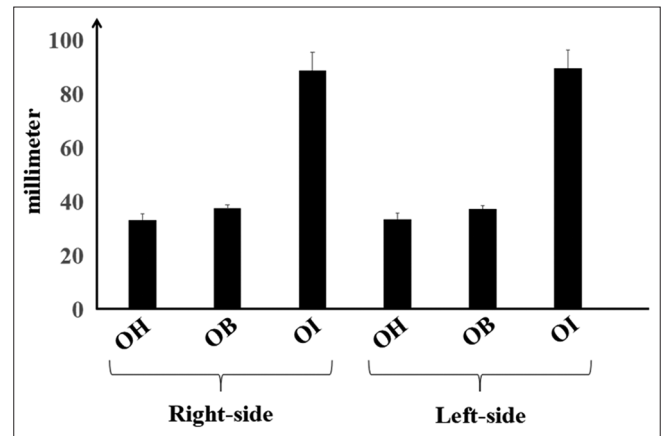

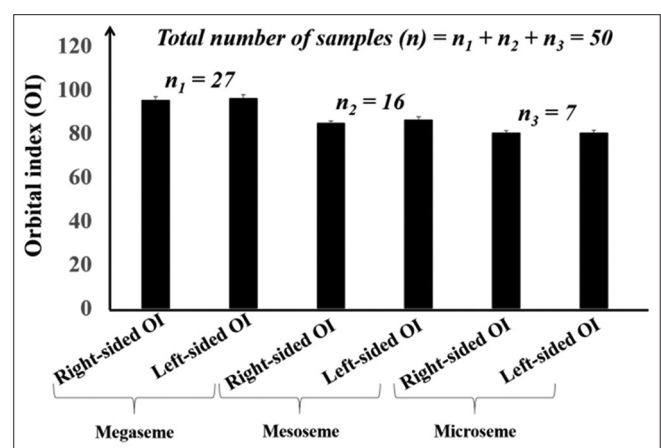**Figure 1:** Measurements of orbital indices of skulls in the right and left sides

Figure 2: Observational analysis on orbital index parameter based on megaseme, mesoseme, and microseme
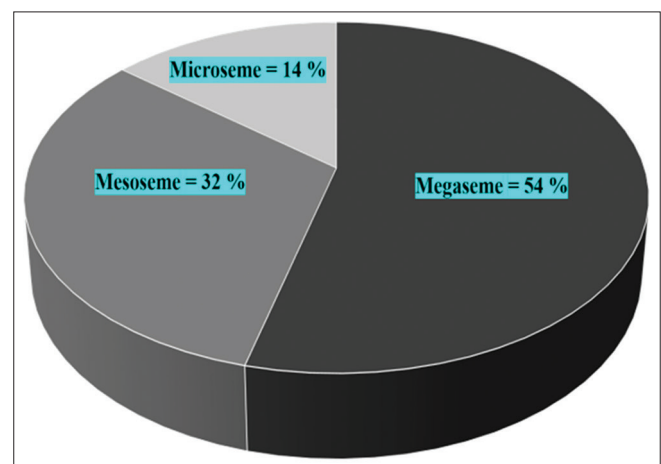

Figure 3: Percentage existence of orbital index of megaseme, mesoseme, and microseme

Differential observation of dry skulls fallen under a group mesoseme

As depicted in Figure 3, mesoseme had been another category to comprise 32% beingness of the collected dry skulls [Figure 3]. With respect to this group called mesoseme, we found the
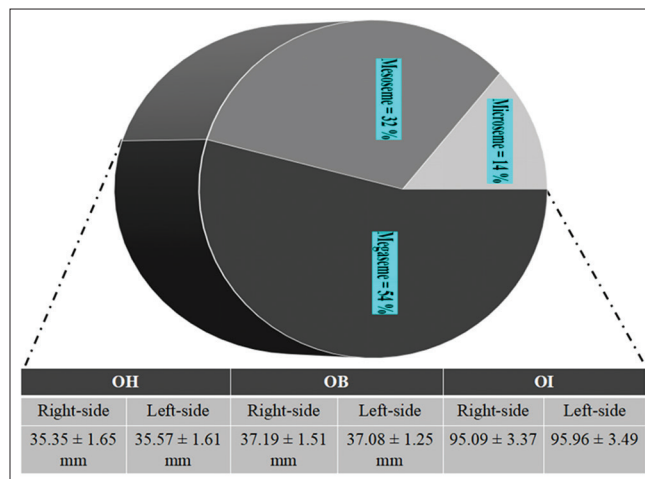
measurements as of OH as 31.38 ± 1.06 and 32.13 ± 1.43 mm in their right and left sides, respectively [Figure 5], suggesting that, however, the change was insignificant, but right-sided OH of collected dry skull was a little smaller compared to left one. In next, the data of OB were 37.63 ± 1.32 and 37.32 ± 1.43 in their right and left sides, respectively [Figure 5], indicative to alteration that was opposite to OH. The variation of OI, as observed previously, was again alike to that of OH [Figure 5].

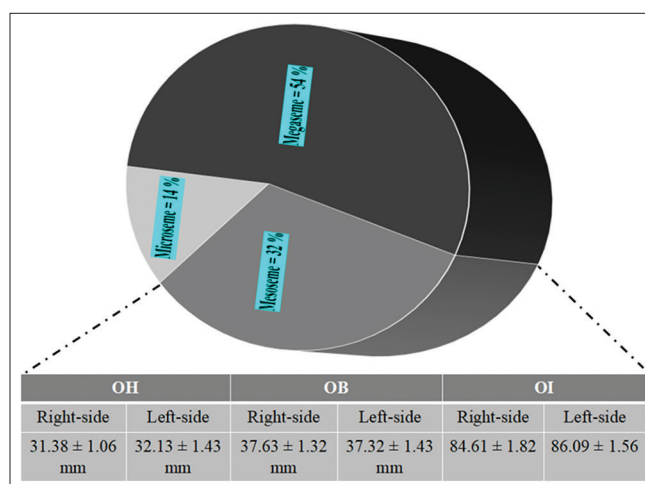### Differential observation of dry skulls fallen under a group microseme

We found 14% existence of dry skulls under a group of microseme [Figure 3]. We then analyzed the result based on orbital parameters such as OH, OB, and OI. In relation to OH, the data obtained were 31.04 ± 1.05 and 30.90 ± 1.21 mm in their right and left sides, respectively [Figure 6], indicating that although insignificant, the right-sided OH of collected dry skull was slightly larger compared to left one. In next, we found the dimensions of OB variable as 37.84 ± 1.16 and 37.65 ± 1.51 mm, respectively [Figure 6], indicative to variance which was, in contrast, similar to that of the OH parameter. The variation of OI was dissimilar to that of OH [Figure 6].
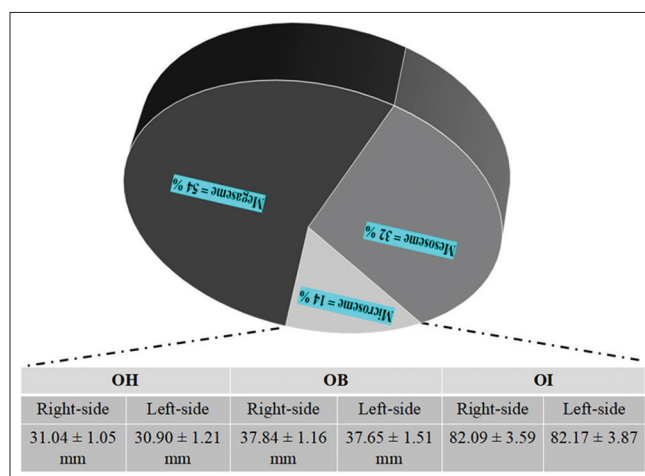
DISCUSSION

Human face carries information and allows identification of a single person. The measurement of orbit and OI varies with age, sex, race, and regions in the same group.[12-15] In the present study, we carried out a comparative survey to investigate OI of dry human skulls. The OH, OB, and OI were selected as orbital parameters. According to the previous study carried out by Cassidy, the data have categorized human population into three groups termed megaseme, mesoseme and microseme depending on OI values as aforementioned.[11] Here we observed that majority of people had fallen into a group of megaseme as around 54% of them had OI >89 [Figure 2]. Mesoseme was next to grasp population as 32% of collected skulls were having OI values between 83 and 89 [Figure 2]. The remaining 14% were set into microseme with OI values <83 [Figure 2]. In the recent study carried out by Lal

OH		OB		OI	
Right-side	Left-side	Right-side	Left-side	Right-side	Left-side
35.35 ± 1.65 mm	35.57 ± 1.61 mm	37.19 ± 1.51 mm	37.08 ± 1.25 mm	95.09 ± 3.37	95.96 ± 3.49

Figure 4: Observational analysis of data obtained under a set of megaseme

OH		OB		OI	
Right-side	Left-side	Right-side	Left-side	Right-side	Left-side
31.38 ± 1.06 mm	32.13 ± 1.43 mm	37.63 ± 1.32 mm	37.32 ± 1.43 mm	84.61 ± 1.82	86.09 ± 1.56

Figure 5: Observational analysis of data obtained under a set of mesoseme

OH		OB		OI	
Right-side	Left-side	Right-side	Left-side	Right-side	Left-side
31.04 ± 1.05 mm	30.90 ± 1.21 mm	37.84 ± 1.16 mm	37.65 ± 1.51 mm	82.09 ± 3.59	82.17 ± 3.87

Figure 6: Observational analysis of data obtained under a set of microseme

et al., they found the overall mean OI to be 81.29 ± 6.14.[16] However, our observation has laid us to notice that Nepalese population were having OI values in the range of 88.8 ± 6.6 [Figure 1]. It was therefore interestingly suggestive to the fact

that local people in this part of the world has OI comparatively greater than Sinhalese one form Sri Lanka.

Further, in relation to our observation on 54% existence of dry skulls under megaseme group [Figure 3], we specifically analyzed the result related to OH at their right and left sides, and our findings were 35.35 ± 1.65 and 35.57 ± 1.61 mm, respectively [Figure 4]. Our data, therefore, were indicative to the point that although not remarkable, the right-sided OH was slightly smaller compared to left one in megaseme group of population [Figure 7]. In a similar "megaseme" group of Nepalese population, we found the dimensions of OB variable as 37.19 ± 1.51 and 37.08 ± 1.25 mm, in right and left sides, respectively [Figure 7], indicative to variance which was opposite to that of the OH parameter. The variation of OI, in contrast, was alike to that of OH [Figure 7]. Interestingly, the pattern of variation of OH, OB, and OI under a group of "mesoseme" was in the same line that we found for "megaseme." "Microsome" was the category under which only around 14% people had resided. Unfortunately, when we investigated and had insight toward the data obtained for this small group "microseme," the OH variable was comparatively larger (although insignificantly) in each human dry skull. Such finding in this "microseme" group of individuals was in the opposite pattern of variation and was peculiar to observe in our study.

CONCLUSION

In the present study, we described the pattern of variation in orbital indices of human dry skull obtained among the people in the eastern region of Nepal. Here, we observed that abundantly 54% of people had OI >89 that had laid us to report that majority of population in this area belongs to the megaseme group. Further, in megaseme and mesoseme groups, the values of left-sided OH as well as OI were more compared to their right side, and the numerals of right-sided OB was greater compared to left one of the same counterpart. However, in contrast, the right-sided OH (and not the left one) was greater in each individual under the category of microseme which was in opposite line of variation compared to mega- and mesoseme groups of populations.

OH		OB		OI		
Right-side	Left-side	Right-side	Left-side	Right-side	Left-side	
35.35 ± 1.65 mm	35.57 ± 1.61 mm	37.19 ± 1.51 mm	37.08 ± 1.25 mm	95.09 ± 3.37	95.96 ± 3.49	Megaseme
31.38 ± 1.06 mm	32.13 ± 1.43 mm	37.63 ± 1.32 mm	37.32 ± 1.43 mm	84.61 ± 1.82	86.09 ± 1.56	Mesoseme
31.04 ± 1.05 mm	30.90 ± 1.21 mm	37.84 ± 1.16 mm	37.65 ± 1.51 mm	82.09 ± 3.59	82.17 ± 3.87	Microseme

Figure 7: Comparative analysis toward pattern of variation of orbital index in magaseme, mesoseme, and microseme categories of dry skull

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