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Cranial Index of Dry Foetal Skulls In South Indian Population

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Abstract:

Aim: To determine and analyse the geographic variation in the South Indian dry foetal skulls using Cranial Index

Objective: To analyse and categorise human foetal skull in relation to their geographic variation by using cranial index

Background: Morphometrical studies are used to compare the shapes and sizes of skulls by craniometry. Cranial index (CI) is the ratio of maximum width of the head to the maximum length multiplied by 100. It is often used to classify skull types of its high degree of variability both within and between populations.

Materials and Methods: A total of 20 dry human foetal skulls of unknown sex and without any gross abnormality were collected and evaluated from the Department of Anatomy, Saveetha Dental College and from Madras Medical College, Chennai. All skulls were serially numbered from 1 to 20. With the help of Vernier Calliper and Scale measurements such as Maximum Cranial Length (A), Maximum Cranial Breadth (B) and Cranial Index (CI) = B/A x100 were taken and calculated.

Results: The foetal skulls with CI up to 74.9 or below 75.0 were classified as Dolichocranic (Long headed). Skulls with CI from 75.0 to 79.9 were regarded as Mesocranic (Medium headed) and those with CI greater than 80.0 or between 80.0 to 84.9 were classified as Brachycranic (Round headed).

Conclusion: Variations in the CI provides a better means to determine racial ancestry by anthropologists to categorise human populations.

Keywords: Craniometry, Cranial Index, dolicocephalic, brachycephalic, mesocephalic, glabella, occipital point, parietal tuberosity.

INTRODUCTION:

Quantitative analysis of growth, shape and size of the human skull especially the foetal skull is of great importance and efforts have been made to associate these craniometrical variations to characterise different races geographically. Several metrical parameters are used to compare shapes and sizes of skulls. One such craniometrical parameter is the “Cranial Index (CI)” which is, the ratio of maximum width (Biparietal diameter) of the head to the maximum length (Occipitofrontal diameter) multiplied by 100. Cranial Index or Cephalic index (in living) was introduced by van Lindert *et al.*, as percentage of width to length in the skull [1]. The width is the distance between the most prominent point at the side of the cranium. The length is the distance from the glabella and the most prominent point at the back of the cranium, mainly the occipital protuberance.

Cephalic index is a useful tool for identification and classification of ancient human remains and was first used in physical anthropology by Swedish Professor of Anatomy Anders Retzius (1796-1860) [2]. The human body dimensions are affected by ecological, biological, geological, racial, sex, and age factors [3]. Cephalic index is very useful anthropologically to find out racial differences [4]. Craniofacial measurements are important for studying the head and face shapes. The measures used by Retzius, when applied to living individuals are known as cephalic index and when referring to dry skulls, cranial index [5]. Most commonly used anthropometric method in racial differentiation is cephalometry which helps us with head (cranium) dimensions. The most important of cephalometric dimension are length and width of head (cranium) that they used in Cephalic Index determination [6].

On the basis of cephalic/cranial index head shapes were grouped into four international categories, which includes, Dolicocephalic (Greek Kephale - head and dolikhos - long and thin), Brachicephalic (short and broad), Mesocephalic (intermediate length and width) and Hyperbrachicephalic (very short and broad) [7]. Australian aborigines and native southern Africans are Dolicocephalic, Europeans and the Chinese skulls are Mesocephalic and Mongolians and the Andaman Islanders have Brachicephalic skulls. Comparison between cephalic indices and the head shapes with race, age and sex is important, which are valuable for treatment monitoring and prediction of orthodontic treatment and the knowledge is valuable in plastic and reconstructive surgeries concerned with craniofacial deformities [8]. The present study is mainly concerned to categorise human foetal skull in relation to their geographic variation. CI is also used to describe individual’s appearances and to estimate age of foetuses for legal and obstetrical reasons.

MATERIALS AND METHODS:

In the present study a total of 20 dry human foetal skulls of unknown sex . Skulls with bony abnormalities were excluded from the study to get a correct measurement[9]. And those without any gross abnormality were collected from the Department of Anatomy, Saveetha Dental College and from Madras Medical College, Chennai and evaluated. All skulls were serially numbered from 1 to 20.

With the help of Vernier Calliper and Scale the following measurements were taken (Figure 1 & Figure 2).

- Maximum Cranial Length (A) = Summit of glabella to the furthest occipital point
- Maximum Cranial Breadth (B) = Greater breadth at right angle to median plane
- CRANIAL INDEX (CI) = B / A x 100

The results obtained were analysed, tabulated and classified.

RESULTS:

The skulls with CI up to 74.9 or below 75.0 were classified as Dolichocranic (Long headed). Skulls with CI between 75.0 to 79.9 were regarded as Mesocranic (Medium headed) and those with CI greater than 80.0 or between 80.0 to 84.9 were classified as Brachycranic (Round headed). Table-1 shows different types of head shapes. The maximum cranial length ranged from 8.15 to 10.86 with Mean value of 9.84. The maximum cranial breadth ranged from 6.43 to 8.15 with Mean value of 7.61. Cranial Index (CI) ranged between 73.02 and 79.78 with average value of 77.33. When all the calculated CI were listed Mesocranic skulls accounted to the maximum of 60% (CI=78.61), Dolichocranic skull accounted for 30% (CI=73.95) and Brachycranic to 10% (CI=84.83). The values of various Cranial Indices are given in Table-2 & Table-3.

Table 1: Types of Head Shape

Head Shape	CI Range
Dolichocranic	70.0-74.9
Mesocranic	75.0-79.9
Brachycranic	80.0-84.9

Table 2: Showing various parameters of CI

Parameter (cm)	Range	Mean
Maximum Cranial Length (A)	8.15-10.86	9.84
Maximum Cranial Breadth (B)	6.43-8.15	7.61
Cranial Index (CI)	73.02-79.78	77.33

Table 3: Categorisation of foetal skulls based on CI

Head Shape	Mean	n=20	%
Dolichocranic	73.95	06	30%
Mesocranic	78.61	12	60%
Brachycranic	84.83	02	10%

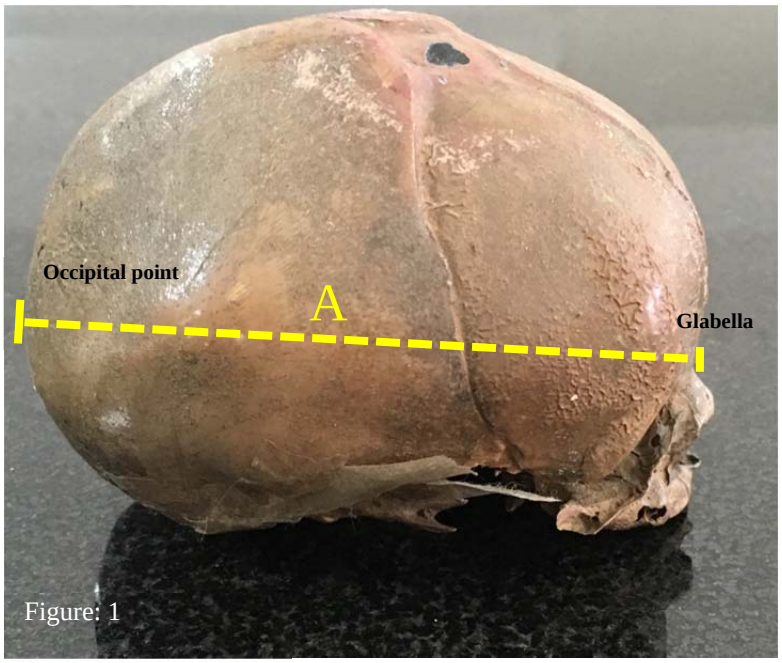

Figure: 1 & 2 shows the Maximum Cranial Length (A) and Maximum Cranial Breadth (B) of Cranial Index (CI) in foetal skull.

DISCUSSION:

In the present study the majority of the foetal skulls fall under Mesocranic (medium headed) with mean CI of 78.61 and minimally under the Brachycranic (short headed) category with mean CI of 84.83.

The study suggests the tendency of skulls towards "Mesocephalisation" which shows evidence of continuous growth of brain more in the lateral direction. Head shapes can also change from one generation to the other. For example, the first generation of Japanese immigrants in Hawaii it was noticed that they had an increased head breadth, a decreased head length and a higher Cephalic Index than their parents. Also, in tropical zones head form is longer (Dolichocephalic), but in temperate zones the head form is more round (mesocephalic or brachycephalic) [10]. Since India is partly in temperate and tropical zone, the study shows tendency to Mesocephalization.

Today it is mainly used to describe individual's appearances and estimating age of foetuses for legal, obstetrical reasons [11]. Development of a child's head depends upon the development of the brain [12]. The brain reaches 90% of its size until the first year of age, while its complete development ends when the child turns 7 [13]. Among the deformations that develop in prenatal period or within the first months after birth, there are craniosynostosis [14]. Therefore, the Cranial Index will also suggest if any deformities are present.

The reasons for asymmetry of skull may range from uterine walls compressing foetus head to external reasons that occur after the birth, to which the newborn and infant are particularly exposed. Numerous authors point out that cranial deformations may result from the fact that infants, especially newborns, are invariably arranged in the same position when they are about to sleep [15]. The growth of the human skeleton is under the influence of several factors; among them are hormones, nutritional status, cultural differences, environmental factors, genetic factors and evolutionary adaptations and modifications.

CONCLUSION:

Variation in the CI predicts some utility in distinguishing skulls from different geographic regions. The data can be useful for forensic medicine experts, anatomist, anthropologist and for clinical and research purposes. The observations and results of this study may provide platform for similar craniometric studies based on various communities, castes, races of particular geographical regions.

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