

Original Articles

Morphometry of Baudoin Occipital condylar index in Dry Ossified Human Occipital Bone

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Abstract

Context: The occipital condyles of the skull articulate with the superior articular facets of the atlas vertebra and form an important junction between the cranium and the vertebral column. The great vital important neuroanatomical structures such as spinal cord, vertebral arteries, nerves and meninges are passing through the foramen magnum. In case of fragmentary human remains where no other skeletal remains are preserved the intact occipital region may be useful for determining the sex of the individuals. So morphometric data of occipital condylar index is essential in anthropologist and neurosurgeons for various surgical diagnosis and treatment. Baudoin condylar index is a sex determination method based on measurements of length and width of the occipital condyle. This study was performed by the help of this Baudoin condylar index method.

Materials and Methods: A cross sectional analytical type of study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka from January 2011 to December 2011. The length, width of occipital condyle and condylar index were measured with the help of digital slide calipers.

Results: The mean \pm SD occipital condylar index was significantly higher ($p < 0.001$) in male than in female.

Key words: Baudoin condylar index, occipital condyles

Introduction

Identification based on skeletal elements is one of the most difficult skills in forensic medicine. Sex determination is also an important problem in identification. When the skeleton exists completely, sex can be determined with 100% accuracy. This estimation rate is 98% in existence of pelvis and cranium, 95% with only pelvis or pelvis and long bone and 80-90% with only long bones.¹ Distinguishing males from females using morphological characteristics of bone, is important in the field of physical and forensic anthropology. The cranium is an important source of information in forensic investigators. There was extensive

literature on sex determination of cranium using both morphological and metrical criteria.² In most of the forensic studies the skeleton is incomplete and this makes the sex determination difficult. So it is important to establish methods for determining sex from skeletal elements that are survived and recovered.³

The lateral parts of occipital bone present two occipital condyles. They are located antero-laterally on either side of foramen magnum. These condyles are important part of craniovertebral junction and is the only articulation between occiput and atlas. The weight of head is transmitted through the occipital condyles.⁴ The condyles are oval or reniform in shape. The articular surfaces face inferolaterally. These condyles are frequently used to calculate the condylar index and are cited in anatomy, forensic anthropology and forensic medical texts as a method for determination of sex.⁵

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Baudoin condylar index is a sex determination method based on measurements of length and width of the occipital condyle.⁶ It is a percentage relationship between length and width of the condyle. If the result is greater than 55, the skull is considered as female. If result is less than 50, is considered as male. The results between 50 and 55 are considered inconclusive.⁷ Morphologically male occipital condyles are larger than female, external occipital protuberance are prominent in male, in occipital area muscle lines are marked in male⁸, nuchal lines and occipital crest are marked in male.⁹

The occipital condyle is frequently being drilled to expose lesions ventral to brainstem. For this approach understanding bony anatomy of this region is important for neurosurgeons.¹⁰ Detailed morphometric analysis of occipital bone will help in the planning of surgical intervention involving the skull base safer and easier.¹¹

Materials and Methods

The study was carried out on 156 dry ossified human occipital bones of both sex (82 male, 74 female). These bones were collected from Anatomy Department of Dhaka Medical College and other government and non- government medical colleges in Dhaka city. Fractured, mutilated skulls with gross deformity were excluded from the study. Sex determination of the collected occipital bones were done by discriminant function analysis according to Gapert.⁴ All measurements were recorded using digital vernier slide caliper.

The following parameters were recorded

- length of the occipital condyle (right and left) = most anterior tip of condyle and most posterior tip of condyle.
- width of the occipital condyle (right and left) = midpoint of one condylar lateral margin and midpoint of that condylar medial margin
- Baudoin condylar index (right and left) = (maximum width of the condyle/ maximum length of the condyle) x 100

The data obtained was analyzed statistically by computing descriptive statistics, the mean, standard

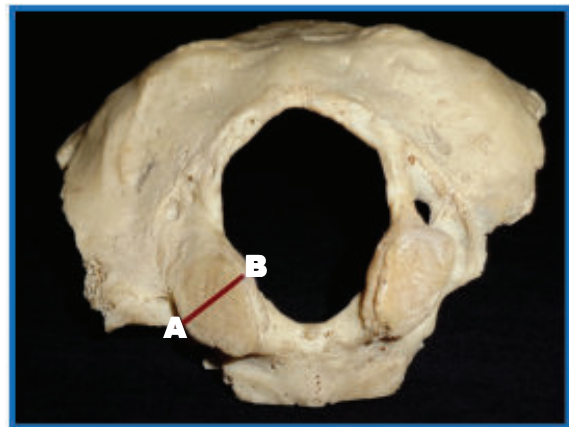
deviation and percentages of each variable. The inferential statistics was done using Student's t test. The results were considered statistically significant whenever $p < 0.05$.

Ethical clearance

This study was approved by the Ethical Review Committee of Dhaka Medical college, Dhaka.



Photograph showing AB line, is the length of occipital condyle (A is the anterior tip and B is the posterior tip of occipital condyle).



Photograph showing AB line, is the width of occipital condyle (A is most lateral point and B is the most medial point of condylar articular surface)

Results

The mean \pm SD occipital condylar index was $48.82 \pm 1.89\%$ and $48.67 \pm 2.32\%$ on right and left side respectively in male. In case of female the mean \pm SD occipital condylar index was $57.12 \pm 1.29\%$ and $56.99 \pm 1.07\%$ on right and left side respectively.

There was no statistical difference ($p>0.01$) between mean \pm SD occipital condylar index of right and left side both in male and female. The mean \pm SD occipital condylar index was greater in male than female ($p<0.001$). The results are shown in figure 1.

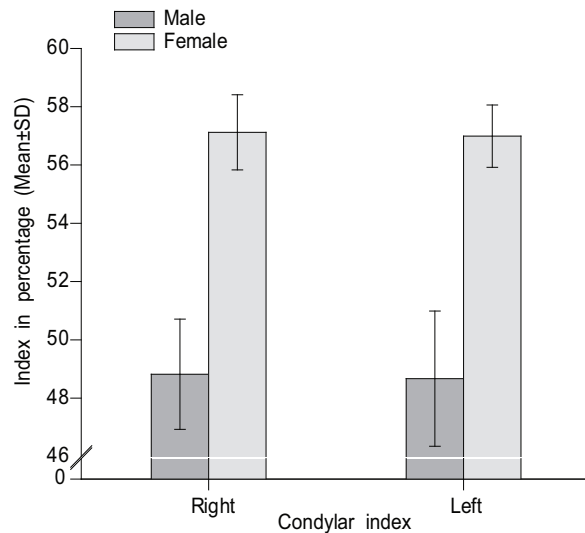


Fig.-1: Bar diagram showing condylar index of right and left side of occipital bone in male ($n=82$) and female ($n=74$).

Discussion

It has widely been recognized that skeletal characteristics vary among populations and due to this regional variability each population should have specific standards to optimize the accuracy of identification. Though use of the entire skeleton is optimal for estimating sex of an individual, complete skeletal remains are often not available. Some skeletal elements prove to be better for estimation of sex than others. The present work was undertaken to study various morphometric variables of 156 (one hundred and fifty-six) dry ossified human occipital bones of both sexes and describes a statistically based analysis that illustrates the usefulness of this bone as an indicator of sex. The occipital bones of present study were collected from the Anatomy Department of Dhaka Medical College, Dhaka and some other government and non-government medical colleges in Dhaka city. All the bones were completely dried and ossified and were grossly

normal. It cannot be claimed that occipital bones collected from different medical colleges of Dhaka city are the bones of Bangladeshi, as skeletons that are available in Bangladesh also come from neighboring countries such as India, Myanmar and Pakistan etc. Bangladeshis are mixed race of Negroid, Caucasoid and Mongoloid.¹² Indian population is racial admixture of Caucasoid, Negroid, Mongoloid and Australoid.¹² The Pakistanis are mixed race of Caucasoid and Mongoloid and people of Myanmar are Mongoloid.¹² In the present study, published works of some researchers are discussed who collected their sample from Brazil.

The findings of this study was statistically analyzed and revealed important information about morphometric variations in male and female. A comparative discussion of the results with that of different authors and researchers of abroad is done. Some variables have been compared with values of text books as sufficient publications were not available. Observed results of morphological parameters showed some similarities as well as dissimilarities with the available information present on different text books and publications. The findings of present study were dissimilar to that of Suazo⁵ and Crider¹³. They carried out the study on Brazilian population respectively. Brazilians are mainly of Caucasoid and Negroid origin.¹² The reason of dissimilarities might be due to racial and geographical variation. The mean \pm SD occipital condylar index of present study was similar ($p>0.01$) on right and left side both in male and female. The mean \pm SD occipital condylar index was greater ($p<0.001$) in male than female. Suazo⁵ carried out a study on Brazilian population. He reported the mean \pm SD occipital condylar index was similar ($p>0.01$) with the value of present study in female. But the male value of Suazo⁵ was greater ($p<0.001$) than that of present study.

Conclusion:

Radiographic and computed tomographic study and measurement of different parameters of living occipital bone and comparison between the radiographic findings with the morphometric study of human dry ossified occipital bone are recommended.

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With the data obtained from the present study we conclude that, metric analysis of occipital condyles may be a useful indicator of sex determination of unknown skulls, especially in fragmentary human remains, where no other skeletal remains are found. This study is also useful for anthropologists, morphologists, forensic experts for sex determination in medico legal cases and for the neurosurgeons in dealing with lesions of posterior cranial fossa during surgery.

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