



A MORPHOMETRIC STUDY OF FORAMEN MAGNUM IN ADULT HUMAN DRIED SKULL & ITS CLINICAL IMPLICATION.

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ABSTRACT

Morphometry of foramen magnum is important because vital structures pass through it. The dimensions of foramen magnum are clinically important because vital structures passing through it may endure compression such as in case of foramen magnum herniation, foramen magnum meningiomas and foramen magnum achondroplasia. The knowledge of foramen magnum diameters is needed to determine some malformations such as Arnold Chiari Syndrome, which shows expansion of transverse diameter. In present study fifty human dry skulls of unknown age and sex were used from Department of Anatomy, Government Medical College Surat, Gujarat. In our present study we found that the mean vertical and transverse diameter 33.6mm and 29.7mm respectively. Anterior intercondylar distance and posterior intercondylar distance is 19.10 mm and 40.10 mm respectively.

KEYWORDS : Foramen Magnum, Skull, Morphometry.

Introduction

The foramen magnum is a wide opening present in the occipital bone of the cranium. The boundary of foramen magnum is formed by all parts of occipital bone that is two condylar parts, squamous parts and occipital part. Vital structures passing through the foramen magnum are medulla oblongata with the meninges, fourth part of vertebral arteries, anterior & posterior spinal arteries and spinal roots of accessory nerves & occasionally cerebellar tonsil may project on each side of the brain stem. In a condition like achondroplasia, foramen magnum brain herniation, meningiomas and atlanto-occipital fusion the vital structure that pass through it may be compressed, so the dimensions of the foramen magnum are clinically important for neuro-surgeons to do cranio-vertebral surgeries. The morphometric study of the human skull is a common practice among Anatomists, Anthropologists and Forensic Experts as it is a structure of great interest.

Material and Method:

Fifty human dry skulls of unknown age and sex were used for the study from Department of Anatomy, Government Medical College Surat. The deformed skulls (4) were excluded from the study. All other adult skull bones (50) which were in good condition were included.

The anteroposterior and transverse diameters were measured using a vernier caliper graded upto 0.01mm. Measurements were done using following bony landmarks on the skull.

Basion: middle point of the anterior margin of foramen magnum and Opisthion Opisthion is middle point of posterior margin of foramen magnum:

1. Anteroposterior diameter of foramen magnum is the distance measured between Basion and opisthion.
2. Transverse diameter of foramen magnum is the distance measured at right angles to anteroposterior diameter of foramen magnum.

Other parameters recorded as follows:

3. Anterior intercondylar distance- distance between anterior tips of right and left occipital condyles.
4. Posterior intercondylar distance- distance between posterior tips of right and left occipital condyles.

The Statistical methods:

Results were expressed as mean ± standard deviation and range.

Observation and Results:

The statistical analysis was carried out and the results were represented in a tabulated form.

Table 1: The mean Antero posterior, Transverse Diameter of Foramen Magnum along with Standard Deviation.

Number of skull(50)	Anteroposterior Diameter of foramen magnum(mm)	Transverse Diameter of foramen magnum(mm)
Mean	33.6	29.7
Standard Deviation	2.7	2.8
Minimum	31	22
Maximum	41	34

The longitudinal diameter of the foramen magnum in the present study is between 31 mm - 41 mm with a mean of 33.6±2.7(mean±SD). The transverse diameter is between 22mm-34mm with mean of 29.7±2.8.

Table 2: Mean length of Anterior & Posterior Intercondylar Distance along with Standard Deviation.

	No. of skull	Mean (mm)	Minimum (mm)	Maximum (mm)	Standard Deviation
Ant. Intercondylar Distance	50	19.10	11	25	3.1
Post. Intercondylar Distance	50	40.10	36	48	3.6

The present study indicates that, the mean anterior intercondylar distance between two condyles in 50 skulls was found to be 19.10 mm with a range of 11 - 25 mm and a standard deviation of 3.1. Mean posterior intercondylar distance between the two condyles in 50 skulls was found to be 40.10 mm ranging from 36 - 48 mm having a standard deviation of 3.6.

Discussion:

Morphometrical study of foramen magnum and occipital condyle was done in the 50 human skulls. In the present study the mean longitudinal diameter of foramen magnum is 33mm which is similar to Muthukumar et al, Muralidhar et al and Ashwini et al study was done on Karnataka human skulls [5,6,20]. However the values are slightly lower than the observations made by Radhika et al and Sanjukta et al which were done on south Indian population. The mean value of anteroposterior diameter in their study is 35 mm but the transverse diameter is 29 mm which is similar to present study [3,6].

Berge and Bergmann reported an average sagittal diameter of 34 mm and an average transverse diameter of 29mm [7]. Philipp Gruber, in his study on skulls from Western Europe found the sagittal diameter ranges 30 mm to 43 mm with mean of 36.6 mm. The transverse diameter ranges from 25 mm to 39 mm with the mean of 31.1 mm [8].

In the Morphometric analysis of the foramen magnum in human skulls of Brazilian individual found that mean antero-posterior diameter of foramen magnum was 35.7 mm in male and 35.1 mm in female. The transverse diameter was 30.3 mm in male, 29.4 mm in female[9]. In the present study the mean longitudinal diameter of foramen magnum was 33mm which is similar to AshwiniC et al and Pratik Khorana et al study was done on south Indian population, but transverse diameter in the present study is higher than their study which is 29.7mm[20]

Table3: Comparison with other studies:

Authors	Anteroposterior Diameter(mm)	Transverse Diameter(mm)
Murlidhar et.al(2014)[14]	33.4	27.4
Muthukumar et.al(2005)[5]	33.3	27.9
Suazo,G.et.al(2009)[18]	36.05	30.05
Avci et.al(2010)[15]	34.5	29
Kizilkant et.al(2006)[11]	34.8	29.6
Murshed et.al(2003)[2]	35.9	30.45
Tubbs et.al(2010)[16]	31	27
Manoel et.al(2009)[19]	35.4	29.85
Osunwoke et.al(2012)[17]	36.1	29.5
Radhika et.al(2014)[6]	35.3	29.4
Sanjukta et.al(2015)[13]	35.3	29.45
Ashwini et.al(2018)[20]	33	27
Present study	33.6	29.7

In a study conducted at St.John Medical College, Bangalore on 350 skulls (175 males, 175 females) for foramen magnum dimensions showed. In male skulls antero-posterior diameter of foramen magnum was varied from 2.8 - 4.1 cm with a mean of 3.42 ± 0.24 cm, transverse diameter was varied from 2.3 - 3.6 cm with a mean of 2.85 ± 0.23 cm and the area of foramen magnum was varied from 5.6 - 11cm with a mean of 7.69 cm. In female skulls antero posterior diameter of foramen magnum was varied form 2.2 - 3.3 cm with a mean of 2.8 ± 0.22 cm and area of the foramen magnum was varied from 5.1 – 10 cm with a mean of 7.8 ± 0.98 cm[2].From the above data, it can be stated that there is significant difference between antero posterior and transverse diameters. The antero posterior diameter is generally larger than transverse diameter.

Occipital condyles converge ventrally. There is significant difference between anterior and posterior intercondylar distance. This leads occipital condyle to have different anterior and posterior angles. This difference in the anterior and posterior intercondylar distance reflects the asymmetry in the orientation of occipital condyles which may affect the lateral approach. According to recent studies, condylectomy provides the wider angle of exposure. Naderi in his metrical study of occipital condyles found that the mean anterior intercondylar distance and posterior intercondylar distance as 21.0 ± 2.8 mm and 41.6 ± 2.9 mm, respectively[10]. Kizilkant studied the occipital condyles, hypoglossal canal and foramen magnum in 59 Turkish-Caucasian skulls. In his study, the anterior and posterior intercondylar distances were 22.6 mm and 44.2 mm respectively[11]. Ozer MA demonstrated a study where morphological analysis of 704 sides of occipital bones of adult skulls was done. The mean anterior intercondylar distance and posterior intercondylar distance were found to be 20.9 ± 3.6 mm and 43 ± 4 mm respectively[12]. Sanjukta et al found that in their study the mean anterior intercondylar distance between two condyles was 20.31 mm with a range from 11 - 34 mm. and a standard deviation of 3.431.[13] The Mean posterior intercondylar distance between two condyles was found to be 41.17 mm with the range being 32 – 49 mm and a standard deviation of 3.759[13].The results of present study is not similar to other studies done previously as depicted in table2.

CONCLUSION:

Craniovertebral junction is formed by foramen magnum, occipital bone with its condyles. Many vital structures pass through it. It is clinically important for physicians to have a thorough knowledge of

craniovertebral junction.

In our present study we found that the mean vertical and transverse diameter 33.6mm and 29.7mm respectively. Anterior intercondylar distance and posterior intercondylar distance is 19.10 mm and 40.10 mm respectively.

Morphometrics of occipital condyle and foramen magnum is especially important for newly described transcondylar approach. The above said parameters will be useful for neurosurgeons, orthopaedicians and radiologists in planning surgical procedures involving the skull base.



Photo1:Sliding Vernier Caliper



Photo2:A.P Diameter of Foramen Magnum



Photo3:Transverse Diameter of Foramen Magnum



Photo4:Anterior intercondylar Distance



Photo5:Posterior intercondylar Distance

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