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Original article

The Correlation Between the Foramen Magnum Dimensions and the Main Craniometric Data of the Skull

Anar Sardar oglu Abdullayev

Head of Department of Human Anatomy and Medical terminology, Azerbaijan Medical University, Baku, Azerbaijan.
E-mail: anarabdullaev72@mail.ru

Abstract

The purpose of the study *was to study the correlation between the length and width of the foramen magnum and the craniometric data of the skull.*

Methods*. The research material consisted of 200 skulls. There were 20 skulls of adolescence age, I adulthood age 68, II adulthood age 72, and elderly age 40. In total, there were 86 male skulls and 114 female skulls. Foramen magnum length is measured as the mid-sagittal distance from the most anterior point on the foramen magnum to opisthion. Foramen magnum breadth is gauged between the lateral margins of the foramen magnum at the point of greatest lateral curvature. A non-parametric ρ-Spearman's rank correlation was used in the study.*

Results. *A correlation between the foramen magnum length and foramen magnum breadth is identified (r=0.479, P<0.001).The foramen magnum length positively correlates with maximum cranial length, nasio-occipital length, bizygomatic breadth, basion-bregma height, cranial base length, basion-prosthion length, biauricular breadth, upper facial breadth, left and right orbital breadths, left and right orbital height, biorbital breadth, interorbital breadth, frontal chord, biasterionic breadth, bimaxillary breadth, and zygoorbitale breadth. The foramen magnum breadth positively correlates with maximum cranial length, nasio-occipital length, bizygomatic breadth, basion-bregma height, cranial base length, basion-prosthion length, maxilla-alveolar breadth, maxilla-alveolar length, biauricular breadth, upper facial breadth, nasal height, left and right orbital breadths, left and right orbital heights, biorbital breadth, frontal chord, parietal chord, bimaxillary breadth, and zygoorbitale breadth.*

Conclusion*. The fact that the length and breadth of the foramen magnum positively correlate with many basic craniometric indicators allows us to regard the foramen itself, or rather, the structures limiting it, as quite stable.*

Key words*: foramen magnum length, foramen magnum breadth, a non-parametric ρ-Spearman's rank correlation, male skulls, female skulls.*

Corresponding author: Abdullayev Anar Sardar oglu, Associate professor, PhD, Head of Department of Human Anatomy and Medical terminology, Azerbaijan Medical University, Baku, Azerbaijan.
Post code: AZ 1010
Address: Azerbaijan, Baku, Academician Mirali Kashkay str.24/83
Phone: +994516820871
E-mail: anarabdullaev72@mail.ru

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Introduction

Just behind the basilar portion of the occipital bone is a large median opening called the foramen magnum. Through this foramen, the cranial cavity communicates with the spinal canal. Posterior to the foramen magnum, the occipital bone makes up most of the base of the skull. The foramen magnum is an important landmark due to its close relationship with key structures such as the brain stem and spinal cord, an extension of the medulla oblongata. It is also the basis for the complex interaction of bony, ligamentous, and muscular structures that compose the craniovertebral junction [1-3]. According to Singh V. [4], the foramen magnum is divided into small anterior and large posterior compartments by the alar ligaments of the axis vertebra. The anterior compartment includes: (a) the apical ligament of the dens; (b) the upper longitudinal band of the cruciform ligament of the atlas; (c) the membrana tectoria, a continuation of the posterior longitudinal ligament of the vertebral bodies. To the posterior compartment belong: (a) Medulla oblongata: along with its meninges, i.e., dura mater, arachnoid mater, and pia mater; (b) Two posterior spinal arteries (right and left); (c) Anterior spinal artery; (d) Communicating veins between the internal vertebral venous plexus and the basilar venous plexus; (e) Two vertebral arteries (right and left); (f) Sympathetic plexus around the vertebral arteries: this plexus consists of postganglionic sympathetic fibers derived from the inferior cervical sympathetic ganglion; (g) Spinal roots of two accessory nerves (right and left). The cerebellar tonsils project from each side of the medulla oblongata into the large posterior part of the foramen magnum.

The above is clearly summarized in the study [5], which states that the anatomy of the foramen magnum is of interest to many areas of medicine. The shape of the foramen magnum varies, most often oval. The importance of shape changes is due to their effect on the vital structures passing through them, and they also play an important role in various surgical approaches. The configuration and size of the foramen magnum play an important role in the pathophysiology of various disorders of the craniovertebral junction. Assessing the different shapes of skull base foramina using CT scans of patients has become important in clinical medicine [6,7]. Kumar P. et al. [7] indicated that it is easy to operate at the base of the skull in cases of foramen magnums of round, oval, and hexagonal shapes due to the fact that there is more working space. In this investigation, the oval shape of the foramen magnum was noted in 39.09% of the CT scans studied. The round shape of the foramen magnum was noted by the authors in 22.61% of the CT scans studied; 10.51% came from the hexagonal shape. The lowest occurrence was for the egg-shaped foramen magnum (1.59%). These arithmetic data contradict the data in [5]. According to Chetan P. et al. [5], the transcondylar approach is a commonly used way to treat lesions of the ventral brainstem and cervicomedullary junction in neurosurgery. The authors observed the following shapes of the foramen magnum and their frequencies: round (22.6%), egg-shaped (18.9%), tetragonal (18.9%), oval (15.1%), irregular (15.1%), hexagonal (5.6%), and pentagonal (3.8%). The mean antero-posterior and transverse diameters of the foramen magnum were recorded as 31±2.4 mm and 25.2±2.4 mm, respectively. The average foramen magnum index was calculated as 1.2±0.1.

Morphometry of the foramen magnum is important in several aspects. First of all, as stated above, morphometric indicators are of interest in connection with the numerous vital structures passing through the foramen. Especially, the morphometry of the foramen magnum region is essential for using the transcondylar approaches or their variants [8]. The studies concern such indicators as anteroposterior and transverse diameters and the area of the foramen [2,3,5,8–11]. Ulcay T. et al. [2] have suggested that the width of the foramen magnum (28.14±1.77 mm) and its length (35.81±7.56 mm) can be estimated by using the cranial length (162.45±6.20 mm) and cranial width (129.45±4.99 mm) measurements in the skull by accepting the mean of these coefficients (4.62) as the golden ratio. Tubbs RS. et al. [3] classified the foramen magnum into 3 types based on their surface areas. Type I foramina were identified by the authors in 20.8% of the dry skulls (15 skulls). These skulls had a surface area of less than 500 mm^2. Type II (66.6%, 48 skulls) was applied to foramina of intermediate size, according to the data of the investigation. The surface areas of an intermediate size ranged between 500 and 600 mm^2. Type III (12.5%, 9 skulls) was applied to large foramina with surface areas of more than 600 mm^2. The morphometric analysis of the foramen magnum revealed that the mean surface area of the foramen magnum was 558 mm^2 (range, 385–779 mm^2). The mean anteroposterior diameter of the foramen magnum was 3.1 cm (range, 2.5–3.7 cm). The mean horizontal diameter was 2.7 cm (range, 2.4–3.5 cm). As mentioned by the authors, there was no significant difference between the sexes with regard to surface area and vertical and horizontal diameters ($P>0.05$).

The foramen magnum index was calculated by dividing the anteroposterior (AP) and transverse diameters [8]. When the index was equal to or more than 1.2, the foramen magnum was identified as oval. 46% of the skulls had a foramen magnum index equal to or more than 1.2. The authors have also determined the shape of the foramen magnum by providing a simple foramen magnum index. According to their data, a similar-sized lesion located anterior to the brainstem will require more extensive bone removal in a person with an ovoid foramen magnum than in a person with a circular foramen. According to Degno S. et al. [9], the mean anteroposterior diameter (APD) of the foramen magnum was equal to 35.19 mm and ranged from 26 to 42 mm with a standard deviation of 2.699. The mean transverse diameter (TD) of the foramen magnum was found to be 30.17 mm, and this data ranged from 25 to 36 mm with a standard deviation of 2.44. The area of the foramen magnum, as mentioned in the investigation, was 853.36 mm^2 (ranging from 531 to 1099 mm^2). The most common shape of the foramen magnum was identified as round (22.2%), whereas the most unusual was triangular and rectangular; each one accounted for 3.7%.

Cirpan S. et al. [10] also identified the foramen magnum as oval when its index was greater than or equal to 1.2. In cases of index less than 1.2, authors accepted the foramen as round in shape. The mean AP and TD, according to the data, were found to be 34.38 ± 2.38 and 28.95±2.19, respectively. Of 150 dry skulls studied, 87 (58%) skulls were round and 63 (42%) skulls were oval.

The mean areas of the foramen magnums were estimated according to the Teixeria formula, Radinsky formula, and Cavalieri stereological method in descending order, respectively, as follows: 790.47±99.86 mm^2, 783.66±99.34 mm^2, and 748.06±100.19 mm^2 [11]. The authors observed significant differences ($P<0.05$) in the mean surface areas obtained from each of the three methods used.

Another aspect of the study of the morphometry of the foramen magnum is the use of the obtained data for gender identification. Identification of skeletal and decomposed human remains is one of the most challenging tasks in forensic science. Gender determination is also an important identification issue. It is indicated that the basal region of the occipital bone is covered with a large volume of soft tissue. Due to its thickness and relatively well-protected anatomical position, the basal region of the occipital bone is more likely to withstand physical damage than other parts of the skull [12,13]. A number of studies are devoted to the study of the morphometric features of the foramen magnum in order to identify their sex determination [14–19]. According to Gapert R. et al. [14], the results of the descriptive statistics for the 158 crania show that the differences between all male and female variables investigated display statistically significant differences (p<0.001). The most reliable variable for sex determination was the WFM (maximum width of the foramen magnum – 65.8% overall accuracy), followed by Teixeira's area (65.2%) and the FMC (circumference of the foramen magnum – 64.6%). The best combined variables proved to be WFM + FMC (70.3%), followed by WFM + AreaCirc. (area circumference – 69.6%), and then WFM + FMC + AreaCirc (69%). Using the formula sex = 0.317(WFM) + 0.083(FMC) – 17.562 will result in the highest possible prediction percentage for the studied population.

As mentioned by Tambawala S.S. et al. [15], compared to many other skeletal elements, the foramen magnum reaches its adult size rather early in childhood. There is statistically significant expression of sexual differences in the foramen magnum region, which may prove useful and reliable in predicting sex in partial skull remains by discriminant function analysis when other methods tend to be inconclusive. The foramen magnum area, calculated using Teixeira's formula, is a reliable discriminant parameter that could be used for sex determination.

According to Aljarra K. et al. [16], among the eight studied forms of the foramen magnum, hexagonal (male - 30.93%, female - 30.51%) and irregular A (male - 22.46%, female - 18.22%) forms predominated. The edge of irregular B was more wavy than that of irregular A. The least common shape was the tetragonal shape (male - 2.97%, female - 3.39%). The χ^2 value was 4.100, but there was no statistically significant association (P=0.768) between foramen magnum's shape and gender. The mean of all foramen magnum measurements, namely foramen magnum length (P<0.0001), foramen magnum width (P<0.0001), foramen magnum area (P<0.0001), and foramen magnum index (P=0.02), were significantly higher in males than females.

Akay G. et al. [17] noted that all measurements of the foramen magnum, including the mean values of sagittal and transverse diameters, as well as foramen magnum circumference, were larger in males than in females (P<0.05). Regarding the shape types of the foramen magnum, the most common type was round (n=41, 21.6%), while egg-shaped (n=13, 6.8%) and tetragonal (n=15, 7.9%) were identified as the least common. There was no statistically significant difference between males and females for the types of foramen magnum (chi-square = 9.648, P=0.209).

It was observed that on average, the sagittal diameter (s) was greater than the transverse diameter (t) (p<0.001), and by conventional criteria, this difference is considered extremely statistically significant and also consistent with the shape of the foramen. The mean sagittal diameter in the study was 32.26 mm, and the transverse diameter was 26.29 mm [18].

Among the 8 types of foramen magnum, the round type was the most common; in the study, it was found in 19 (18.8%) persons. The anteroposterior (AP) and transverse (T) diameters were 34.7±3.6 (range 24.53–40.23) mm and 29.5±2.5 (range 23.80–35.51) mm, respectively. The diameter was larger in men than in women to a statistically significant extent (P=0.006 and P≤0.001, respectively). In addition, a statistically significant correlation was observed between AP and T diameters (P≤0.05) [19].

A study of the literature data showed that despite the fairly extensive material concerning the morphometry of the foramen magnum and the predominance of one or another form of foramen in studies, the authors very rarely touched upon the correlations of the obtained data with other morphometric data. In fact, there are very few studies of correlations between the foramen magnum data and other arithmetic data of the studied material. The relationship between the foramen magnum and skull size has not yet been fully analyzed [2]. According to Uthman AT. et al. [12], the strongest correlation was between foramen magnum circumference and foramen magnum area for males and females (r=0.972 and 0.951, respectively) and between foramen magnum sagittal diameter and foramen magnum circumference (r=0.816 and 0.911 for males and females, respectively). The weakest correlations were between foramen magnum transverse diameter and foramen magnum sagittal diameter (r=0.449 and 0.776 for males and females, respectively). A positive correlation (r=0.271) was found by Acer N. et al [20] between the intracranial volume and foramen magnum cross-sectional surface area. The correlation between intracranial volume and the cross-sectional surface area of the foramen magnum was P<0.005.

Considering that the foramen magnum reaches its adult size in early childhood [15], in our opinion, the correlation of these sizes with the main craniometric dimensions is of both theoretical and clinical interest. Studies covering this aspect of the morphometric data of the foramen magnum, namely, the correlation of the main parameters of the foramen - its length and breadth - with the arithmetic data of the skull, according to our analysis of the literature, have not been conducted.

The purpose of the study was to study the correlation between the length and width of the foramen magnum and the craniometric data of the skull.

Material and methods

The research material was 200 skulls from the craniological collection of the museum of the Department of Human Anatomy and Medical Terminology of the Azerbaijan Medical University. The age periodization scheme adopted in 1965 at the 7th All-Union Conference on Problems of Age-Related Morphology, Physiology, and Biochemistry was used [21]. Thus, there were 20 skulls of adolescence age, I adulthood age 68, II adulthood age 72, and elderly age 40. In total, there were 86 male skulls and 114 female skulls. The exclusion criteria for investigation were the skulls with a destroyed occipital portion of their bases. All cranial measurements, including the foramen magnum length and foramen magnum breadth were made according to Langley NR. et al. [22].

Foramen magnum length is measured as the mid-sagittal distance from the most anterior point on the foramen magnum to opisthion. Foramen magnum breadth is gauged between the lateral margins of the foramen magnum at the point of greatest lateral curvature. These sizes were also determined using an electronic digital caliper (resolution: 0.01 mm, accuracy: ±0.02 mm). Statistical analysis was carried out using the program "IBM Statistics SPSS-26". A non-parametric ρ-Spearman's rank correlation was used in the study [23].

The protocol of this study to investigate the correlation between the length and width of the foramen magnum and craniometric data of the skull was approved by the Bioethics Committee of the Azerbaijan Medical Academy in 2020.

Results

The results obtained are presented in the form of tables 1–5.

Table 1 - Correlation relationships between foramen magnum length and foramen magnum breadth with age, gender, maximum cranial length, nasio-occipital length, and maximum cranial breadth

Data	FML	FMB	Age	Gender	MCL	NOL	MCB
FML ρ p	1.000	0.479** 0.000	0.044 0.535	-0.194** 0.006	0.305** 0.000	0.275** 0.000	0.113 0.112
FMB ρ p	0.479** 0.000	1.000	0.028 0.693	-0.048 0.502	0.225** 0.001	0.243** 0.001	-0.043 0.547

** - the null hypothesis is rejected*
FML: foramen magnum length; FMB: foramen magnum breadth; MCL: maximum cranial length; NOL: nasio-occipital length; MCB: maximum cranial breadth

Table 2 - Correlation relationships between foramen magnum length and foramen magnum breadth with bizygomatic breadth, basion-bregma height, cranial base length, basion-prosthion length, maxilla-alveolar breadth, maxilla-alveolar length, and biauricular breadth

Data	BZB	BBH	CBL	BPL	MAB	MAL	BAB
FML ρ p	0.225** 0.001	0.242** 0.001	0.217** 0.002	0.186** 0.008	0.109 0.124	0.053 0.459	0.314** 0.000
FMB ρ p	0.177* 0.012	0.194** 0.006	0.279** 0.000	0.315** 0.000	0.228** 0.001	0.164* 0.021	0.398** 0.000

** - the null hypothesis is rejected*
BZB: bizygomatic breadth; BBH: basion-bregma height; CBL: cranial base length; BPL: basion-prosthion length; MAB: maxilla-alveolar breadth; MAL: maxilla-alveolar length; BAB: biauricular breadth

Table 3 - Correlation relationships between foramen magnum length and foramen magnum breadth with nasion-prosthion height, minimum frontal breadth, upper facial breadth, nasal height, nasal breadth, left orbital breadth, and right orbital breadth

Data	NPH	MFB	UFB	NH	NB	OBL	OBR
FML ρ p	0.016 0.827	0.119 0.094	0.178* 0.012	-0.083 0.244	0.044 0.535	0.174* 0.014	0.215** 0.002
FMB ρ p	0.105 0.140	0.045 0.531	0.297** 0.000	0.251** 0.000	0.121 0.088	0.234** 0.001	0.236** 0.001

** - the null hypothesis is rejected*
NPH: nasion-prosthion height; MFB: minimum frontal breadth; UFB: upper facial breadth; NH: nasal height; NB: nasal breadth; OBL: orbital breadth left; OBR: orbital breadth right

Table 4 - Correlation relationships between foramen magnum length and foramen magnum breadth with left orbital height, right orbital height, biorbital breadth, interorbital breadth, frontal chord, parietal chord, and occipital chord

Data	OHL	OHR	BOB	IOB	FC	PC	OC
FML ρ p	0.144* 0.042	0.149* 0.035	0.174* 0.013	0.158* 0.025	0.301** 0.000	0.038 0.592	0.121 0.088
FMB ρ p	0.159* 0.025	0.150* 0.034	0.217** 0.002	0.017 0.807	0.172* 0.015	0.224** 0.001	0.019 0.791

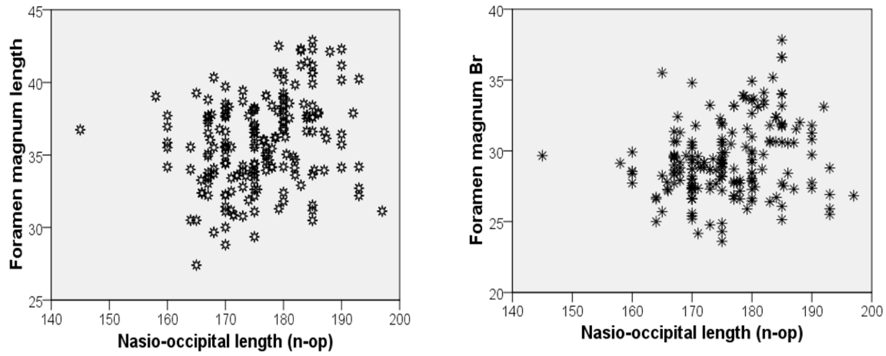
** - the null hypothesis is rejected*
OHL: orbital height left; OHR: orbital height right; BOB: biorbital breadth; IOB: interorbital breadth; FC: frontal chord; PC: parietal chord; OC: occipital chord

The correlation relationships between FML and NOL, and between FMB and NOL are presented in diagrams 1a and 1b.

Table 5 - Correlation relationships between foramen magnum length and foramen magnum breadth with mastoid height, biasterionic breadth, bimaxillary breadth, and zygoorbitale breadth

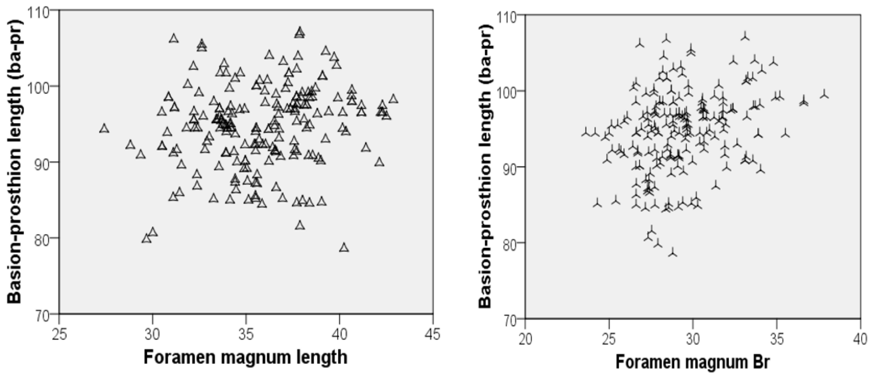
Data	MH	BiAB	BMB	ZOB
FML ρ p	0.013 0.860	0.207** 0.003	0.163* 0.021	0.300** 0.000
FMB ρ p	0.087 0.221	0.062 0.381	0.200** 0.005	0.172* 0.015

** - the null hypothesis is rejected*
MH: mastoid height; BiAB: biasterionic breadth; BMB; bimaxillary breadth; ZOB: zygoorbitale breadth



a *b*

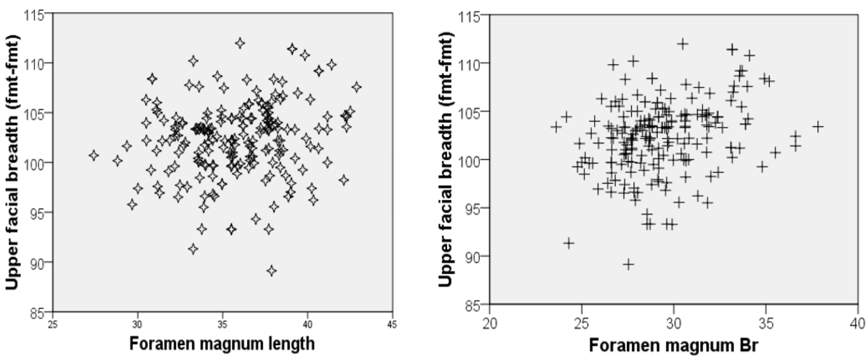
Diagrams 1 a,b - The correlation relationships between FML and BPL, and between FMB and NOL



a *b*

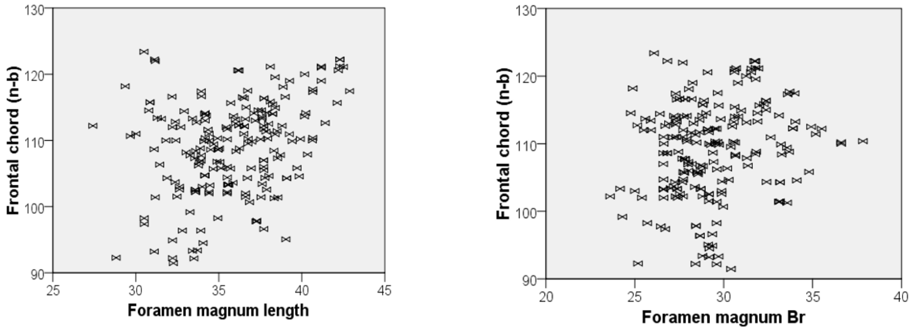
Diagrams 2 a,b - ρ-Spearman's rank correlation showed that there is correlation between FML and UFB (ρ=0.178, P=0.012). Also FMB and UFB are in correlative relationships (ρ=0.297, P<0.001)

Results of these correlations are presented in the diagrams below (Diagrams 3 a–b). Also FMB and FC are in correlative relationships (ρ = 0.172, P = 0.015). Results of these correlations are presented in the diagrams 4 a–b.



a *b*

Diagrams 3 a,b - ρ-Spearman's rank correlation showed that there is correlation between FML and FC (ρ = 0.301, P < 0.001)



a *b*

Diagrams 4 a,b - ρ-Spearman's rank correlation showed that there is correlation between FMB and FC (ρ = 0.172, P = 0.015)

Discussion

According to Tambawala S.S. et al. [15], all measurements were significantly correlated with each other (p<0.01) by applying Pearson's correlation equation. The strongest correlation was between Area 2 and Area 1 for males and females (r=0.999 and 0.999, respectively). The weakest correlations were between the length and the width (r=0.433 and 0.524 for males and females, respectively).

There was a statistically significant mean difference between the anteroposterior and transverse diameters (P<0.001) in the study of [24]. Additionally, a strong positive linear correlation was found between the two variables using Spearman's rank correlation (r=0.52, P<0.001). There was no statistically significant difference in age between males and females (P=0.2). A weak negative linear correlation was found between participant age and anteroposterior diameter (rs=-0.15, P=0.02) and participant age and transverse diameter (rs=-0.14, P=0.03). After controlling for participant age, there was a statistically significant difference in anteroposterior diameter (P<0.001), transverse diameter (P<0.001), and foramen magnum index (P=0.02) between males and females. This reflected the proportionality of the growth rate of the foramen magnum. These data are consistent with those obtained in our investigation: we found a correlation between FML and FMB (r=0.479, P<0.001). Also, according to our data, changes in FML (r=0.044, P=0.535) and FMB (r=0.028, P=0.693) do not correlate with age. This coincides with the data in the investigation of Tambawala SS. et al. [15], indicating that the size of the foramen magnum reaches the level corresponding to adults in childhood.

We also found that FML was significantly greater in men than in women (r=-0.194, P=0.006); FMB data, although higher in men, is not statistically significant (r=-0.048, P=0.502).

Vinutha SP. et al. [6] applied Pearson's correlation equation for all foramen magnum measurements in male CT scans. It was found to be a signifcant correlation among all the parameters studied (P<0.001). The strongest positive correlation was observed by the authors between circumference and area (r=0.930). The weakest positive correlation was observed between anteroposterior diameter and transverse diameter (r=0.472). Pearson's correlation equation was also applied for all foramen magnum measurements in female CT scans. There was a significant correlation among all the parameters studied (P<0.001). The strongest positive correlation was observed between circumference and area (r=0.930). The weakest positive correlation was observed between anteroposterior diameter and transverse diameter (r=0.582).

Pearson's correlation was applied for all the variables; among the female group, the strongest positive correlation was between foramen magnum length/foramen magnum area (r=0.836); foramen magnum width/foramen magnum area (r=0.863) and left occipital condyle/right occipital condyle (r=0.721). While in the male group, the strongest positive correlation was between foramen magnum width /foramen magnum area (r=0.861); foramen magnum length/foramen magnum area (r=0.759) and foramen magnum width/foramen magnum index (r=0.701). The strongest positive correlation was between foramen magnum width/left occipital condyle in males and foramen magnum index/right occipital condyle in females [16].

As can be seen from the above, the research mainly concerned the correlation of data from the foramen magnum itself; correlations with basic craniometric parameters have not been studied. We conducted a study of the correlations of the foramen magnum using non-parametric ρ-Spearman's rank correlation with the main craniometric indicators given in [22].

The foramen magnum length positively correlates with maximum cranial length, nasio-occipital length, bizygomatic breadth, basion-bregma height, cranial base length, basion-prosthion length, biauricular breadth, upper facial breadth, left and right orbital breadths, left and right orbital height, biorbital breadth, interorbital breadth, frontal chord, biasterionic breadth, bimaxillary breadth, and zygoorbitale breadth.

The foramen magnum breadth positively correlates with maximum cranial length, nasio-occipital length, bizygomatic breadth, basion-bregma height, cranial base length, basion-prosthion length, maxilla-alveolar breadth, maxilla-alveolar length, biauricular breadth, upper facial breadth, nasal height, left and right orbital breadths, left and right orbital heights, biorbital breadth, frontal chord, parietal chord, bimaxillary breadth, and zygoorbitale breadth.

Conclusion

The fact that the length and breadth of the foramen magnum positively correlate with many basic craniometric indicators allows us to regard the foramen itself, or rather, the structures limiting it, as quite stable. As can be seen from our study and review of the relevant literature, the size of the foramen magnum reaches definitive values in the early stages of postnatal ontogenesis. This also suggests a role for the foramen magnum in the formation and remodeling of the skull base, particularly the posterior cranial fossa.

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Бас сүйегінің үлкен тесігінің ұзындығы мен енінің және краниометриялық көрсеткіштер арасындағы корреляция

Абдуллаев А.С.

Адам анатомиясы және медициналық терминология кафедрасының меңгерушісі, Әзірбайжан медицина университеті, Баку, Әзірбайжан. E-mail: anarabdullaev72@mail.ru

Түйіндеме

Зерттеудің мақсаты - бас сүйегінің үлкен тесігінің ұзындығы мен ені мен бас сүйегінің краниометриялық деректері арасындағы корреляцияны зерттеу.

Әдістері. Зерттеу материалына 200 бас сүйек (20 кәмелетке толмаған бас сүйек, 68 бірінші, 72 екінші жетілген және 40 қарт бас сүйек) кірді. Барлығы 86 ер адамның бас сүйегі мен 114 әйелдің бас сүйегі зерттелді. Бас сүйегінің үлкен тесігінің ұзындығы ортаңғы сагитальді қашықтық ретінде, магнум тесіктің ең алдыңғы нүктесінен опистионға дейін өлшенді. Ең үлкен бүйірлік қисаю нүктесінде бас сүйегінің үлкен тесігінің бүйірлік жиектері арасында үлкен тесіктің ені өлшенді. Зерттеуде параметрлік емес ρ-Спирман дәрежелік корреляциясы қолданылды.

Нәтижелері. Бас сүйегінің үлкен тесігінің ұзындығы мен саңылаудың ені арасында корреляция анықталды (r=0,479, P<0,001). Бас сүйегінің үлкен тесігінің ұзындығы мұрын-желке ұзындығымен, бизигоматикалық енімен, базион-брегма биіктігімен, бас сүйегінің ұзындығымен, базион-просция ұзындығымен, қос құлақтың енімен, жоғарғы сол және оң жақбет енімен, сол және оң орбитаның биіктігімен, биорбиталдың енімен, орбита аралық енімен, фронтальды хордамен, биастериондық енімен, бимаксилярлы ені және зигоматикалық-орбиталь енімен оң корреляцияланады. Бас сүйегінің үлкен тесігінің ені бас сүйегінің ең үлкен ұзындығымен, мұрын-желке ұзындығымен, бизигоматикалық енімен, базион-брегма биіктігімен, бас сүйегінің негізінің ұзындығымен, базион-просция ұзындығымен, жоғарғы жақ-альвеолярлы енімен, жоғарғы жақ-альвеолярлы ұзындығымен, биаурикулярлық жолмен, үстіңгі бет енімен, мұрын биіктігімен, сол және оң орбитаның енімен, сол және оң орбитаның биіктігімен, биоорбитаның енімен, фронтальды хордамен, қабырғалық хордамен, екі жақтық енімен және зигоматикалық орбитаның енімен оң корреляцияланады.

Қорытынды. Бас сүйегінің үлкен тесігінің ұзындығы мен енінің көптеген негізгі краниометриялық көрсеткіштермен оң корреляциялануы тесіктің өзі, дәлірек айтқанда, оны шектейтін құрылымдардың айтарлықтай тұрақты екенін көрсетеді.

Түйін сөздер: бас сүйегінің үлкен тесігінің ұзындығы, бас сүйегінің үлкен тесігінің ені, ρ-Спирменнің параметрлік емес рангтік корреляциясы, ерлердің бас сүйектері, әйелдердің бас сүйектері.

Корреляция между длиной и шириной большого отверстия и краниометрическими данными черепа

Абдуллаев А.С.

Заведующий кафедрой анатомии человека и медицинской терминологии, Азербайджанский медицинский университет, Баку, Азербайджан. E-mail: anarabdullaev72@mail.ru

Резюме

Цель исследования явилось изучение корреляции между длиной и шириной большого отверстия и краниометрическими данными черепа.

Методы. Материалом исследования послужили 200 черепов (20 черепов юношеского возраста, 68 первого, 72 второго зрелого возрастов и 40 черепов пожилого возраста). Всего было исследовано 86 мужских черепов и 114 женских черепов. Длина большого отверстия измерялась как среднесагиттальное расстояние, между самой передней точкой большого отверстия до опистиона. Ширина большого отверстия измерялась между боковыми краями большого отверстия в точке наибольшей латеральной кривизны. В исследовании использовалась непараметрическая ранговая корреляция ρ-Спирмена.

Результаты. Выявлена корреляционная связь между длиной большого затылочного отверстия и шириной большого затылочного отверстия (r=0,479, P<0,001). Длина большого отверстия положительно коррелирует с наибольшей длиной черепа, носо-затылочной длиной, бизигоматической шириной, высотой базион-брегма, длиной основания черепа, длиной базион-простион, биаурикулярной шириной, верхней шириной лица, шириной левой и правой орбиты, высотой левой и правой орбиты, биорбитальной шириной, межорбитальной шириной, лобной хордой, биастерионической шириной, бимаксилярной шириной и скулоглазничной шириной. Ширина большого отверстия положительно коррелирует с наибольшей длиной черепа, носо-затылочной длиной, бизигоматической шириной, высотой базион-брегма, длиной основания черепа, длиной базион-простион, максилло-альвеолярной шириной, максилло-альвеолярной длиной, биаурикулярной шириной, верхней шириной лица, высотой носа, шириной левой и правой орбиты, высотой левой и правой орбиты, биорбитальной шириной, лобной хордой, теменной хордой, бимаксилярной шириной и скулоглазничной шириной.

Выводы. Тот факт, что длина и ширина большого затылочного отверстия положительно коррелируют со многими основными краниометрическими показателями, позволяет считать, что само отверстие, точнее, ограничивающие его структуры, являются вполне стабильными.

Ключевые слова: длина большого отверстия, ширина большого отверстия, непараметрическая ранговая корреляция ρ-Спирмена, мужские черепа, женские черепа.