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PARAMETERS RELATIONSHIP OF THE FACIAL AND CEREBRAL PARTS OF THE SKULL AND THE POSTERIOR FOSSA

ВЗАЄМОВІДНОСИНИ ПАРАМЕТРІВ КІСТОК ЛИЦЕВОГО ТА МОЗКОВОГО ВІДДІЛІВ ЧЕРЕПА ТА СТРУКТУР ЗАДНЬОЇ ЧЕРЕПНОЇ ЯМКИ

Резюме. Метою дослідження було визначити взаємовідносини параметрів кісток лицьового та мозкового відділів черепа та структур задньої черепної ямки. Найважливішим напрямом медичної краніології залишається комплексне вивчення типової мінливості структур та утворень черепа та закономірності їх взаємозв'язків загалом. До таких утворень відноситься задня черепна ямка з відділами головного мозку, що містяться в ній, і судинно-нервовими комунікаціями. Морфологію задньої черепної ямки вивчали на 13 паспортизованих черепах дорослих людей із колекції фундаментального музею кафедри клінічної анатомії, анатомії та оперативної хірургії Дніпровського медичного університету. Для вирішення поставлених завдань було використано комплекс краніометричних методик. Краніометричні дослідження задньої черепної ямки, основи черепа проводили товстотним циркулем з міліметровою шкалою та технічним штангенциркулем з ціною розподілу 0,01 мм, згідно з загальноприйнятою в краніології методикою. Для статистичної обробки даних, отриманих в результаті краніометрії, застосовано метод комплексного статистичного аналізу, який включає сучасні методи математичного аналізу: варіаційний, кореляційний, факторний та регресійний. Статистична обробка властивостей задньої черепної ямки не виявила значних статевих та вікових відмінностей. Отримані дані можуть бути використані як в теоретичній медицині, так і в практичній, зокрема, в нейрохірургії, для визначення об'єму задньої черепної ямки за зовнішніми розмірами лицевого та мозкового відділів черепа. у нашій роботі були проведені вимірювання кісткових структур задньої черепної ямки в площині франкфуртської горизонталі за зовнішніми розмірами лицевого та мозкового відділів черепа. Виділено морфометричні ознаки «тісної» задньої черепної ямки (ЗЧЯ) як збільшення відношення обсягу мозкової речовини задньої черепної ямки до її кісткового об'єму. Краніометрично, що об'єм ЗЧЯ становить від 110 до 218 см3, в середньому, 158 см3 при статистичному відхиленні 19,14. Обсяг ЗЧЯ у дорослих варіює від 140 до 230 см3, у середньому 178 см3. Показник обсягу ЗЧЯ менший за 178 см3 є показником «тісної» ЗЧЯ. Вивчення кореляційних взаємин лицьового відділу черепа та задньої черепної ямки показало, що параметри задньої черепної ямки по-різному корелюють з окремими розмірами лицьового відділу черепа. В результаті досліджень, були визначені, V усіченого конуса, V еліпсоїда та V зрізу кулі. Так, V еліпсоїда варіював від мінімального 138,662 до максимального – 225,688 см3, V усіченого конуса від 111,562 до 169,455 см3; V зрізу кулі – від 83,694 до 192,06 см3.

Ключові слова: краніометрія, кістки лицевого та мозкового черепа, структури задньої черепної ямки, черепно-мозкова травма.

The most important area of medical craniology remains a comprehensive study of the typical variability of the structures and formations of the skull and the patterns of their relationships in general [1-6]. These formations include the posterior cranial fossa with the parts of the brain contained in it and the neurovascular communications. Injuries to the bones and fossae of the skull, intracranial structures are a severe type of traumatic brain injury (TBI), which cause a serious condition of patients, and therefore, their clinical diagnosis is difficult [7]. The main additional methods for determining the severity

of mechanical injuries and structural injuries to the cranium are X-rays, primarily craniography and CT brain [8, 9].

In order to detect bone pathology, visual craniography is carried out in direct and lateral projections. Craniography allows to diagnose fractures of the base of the skull only in 8.45% of victims, fractures of the bones of the arch – in 63.69% [10]. It should be noted that in 30 per cent of cases, skull fractures are not detected during X-rays and are subsequently detected during CT or surgery. X-rays – shadow images of bone formations – have their specifics and features. Linear fractures of the skull are only then clearly visualized on the head imaging (CT) when accompanied by a displacement of the edges to each other [11]. CT scans can verify the fracture itself, its nature, length and spread. In the existing literature, with an abundance of work on the morphology and relationship of parameters of the posterior fossa with adjacent structures of the brain skull, there is insufficient data on the variability of its parameters depending on the relationship of parameters of the bones of its facial section [12, 13]. Thus, the complex morphometric study of the structures of the posterior cranial fossa and the relationship between the parameters of the facial and cerebral regions of the skull, as well as their correlation relationships, remain relevant.

Purpose of the study: to determine the relationship of parameters of the facial and cerebral parts of the skull and structures of the posterior cranial fossa.

Material and methods. Morphology of the posterior cranial fossa was studied on 13 certified adult turtles from the collection of the fundamental museum of the Department of Clinical Anatomy, Anatomy and Operative Surgery of the Dnipro State Medical University. To solve the problems, a complex of craniometric methods was used. Craniometric studies of the posterior cranial fossa, the base of the skull, were performed with a thick compass with a millimetre scale and a technical calliper with a fission price of 0.01 mm, according to the standard craniology procedure. For statistical processing of data obtained as a result of craniometry the method of complex statistical analysis is applied, which includes modern methods of mathematical analysis: variation, correlation, factor and regression. Statistical analysis of the posterior fossa showed no significant gender and age differences. The obtained data can be used both in theoretical medicine and in practical medicine, in particular in neurosurgery, to determine the volume of the posterior cranial fossa by the external size of the facial and cerebral regions of the skull.

Results of the research. The posterior fossa is a receptacle of two parts of the brain, derived from the rhombus and middle brain bladders. At the stage of five brain bubbles in the 5th week of the embryonic period of prenatal ontogenesis, the diamond brain derivatives are the oblong brain and the posterior brain, which makes up the cerebellum and the bridge (Varolian bridge). The bridge contains the main or basilar groove (sulcus basilaris) in which the arteria basilaris are located (fig. 1-A, B).

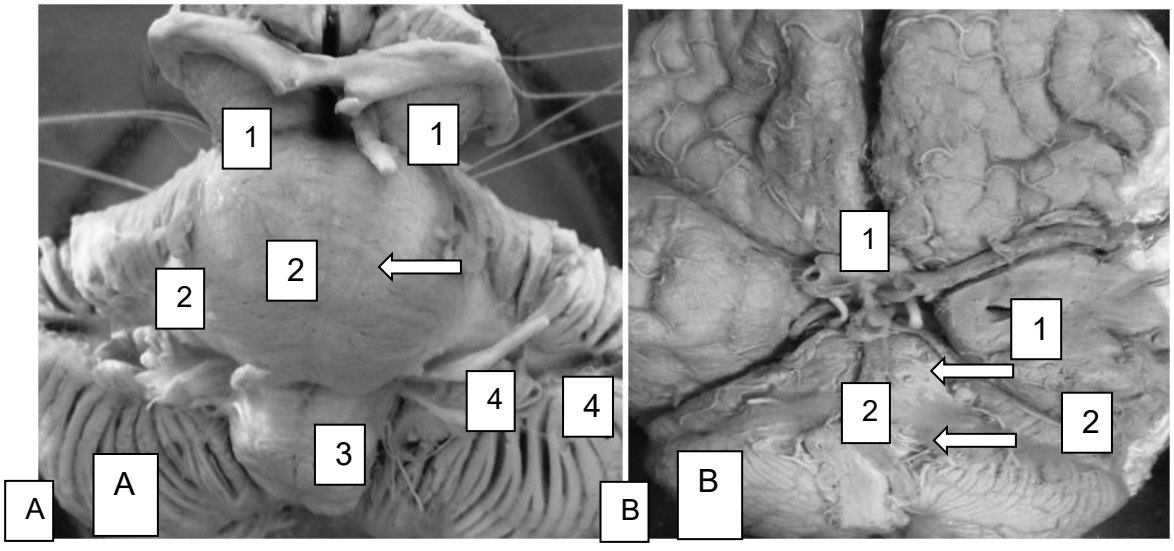

Fig. 1. Macrodrug of the middle and diamond brain. Ventral surface: A – 1 – brain legs (middle brain); 2 – bridge; 3 – oblong brain; 4 – cerebellum. The arrow indicates the primary (basilar) groove. B – 1 – the left vertebral artery; 2 – the basilar artery and its bridge branches

The structure of the rhombus brain includes the isthmus of the rhombus brain, the oblong brain and the posterior brain. The isthmus of the rhombus brain consists of the upper legs of the cerebellum, the upper cerebral sail (vellum medullare superior) and the triangle of the lateral loop. Lateral wall – the legs of the brain, upper – the upper legs of the cerebellum; lower – the handles of the lower hills. The functional significance of the cerebral structures of the posterior cranial fossa determines their special importance in the development of clinical symptoms at traumatic impact, the possibility of rapid development of irreversible disorders under the direct influence of intracranial hematoma, as well as a result of compression-dislocation and the resultant secondary hemodynamic disorders.

The posterior fossa is formed by the occipital and two temporal bones, forming part of the base of the skull. The boundaries of the posterior cranial fossa are: at the front – the base of the back of the Turkish saddle, at the edges on both sides – the upper edges of the pyramids, at the rear – the furrow of the transverse sinus of the occipital bone, above – the cerebellum maximus (fig. 2).

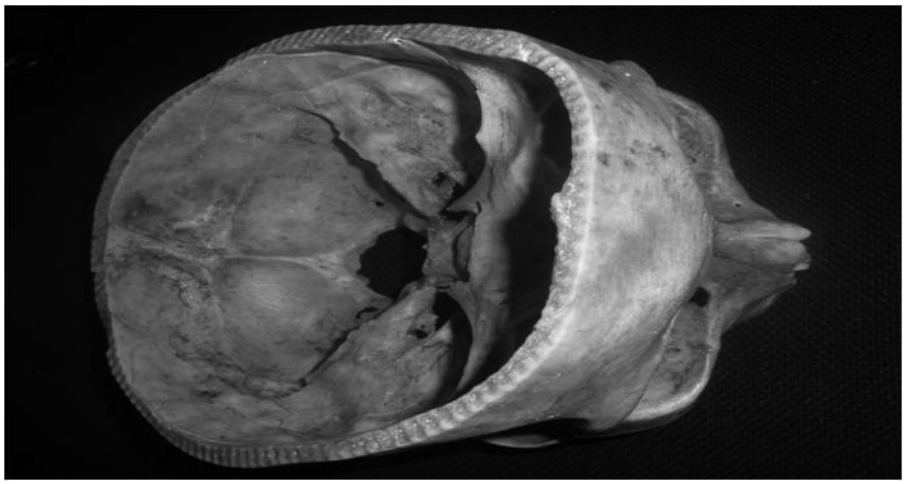

Fig. 2. Skull macro-eparament

The bone structures of the posterior cranial fossa were measured in the plane of the Frankfurt horizontal, which passes through the upper edges of the external auditory passages and the lower edge of the left eye socket. The length of the posterior cranial fossa corresponds to the distance between the base of the back of the Turkish saddle and the most prominent part of the inner occipital elevation, the width corresponds to the distance between the lateral points of the upper left and right pyramids (Fig. 3-A, B).

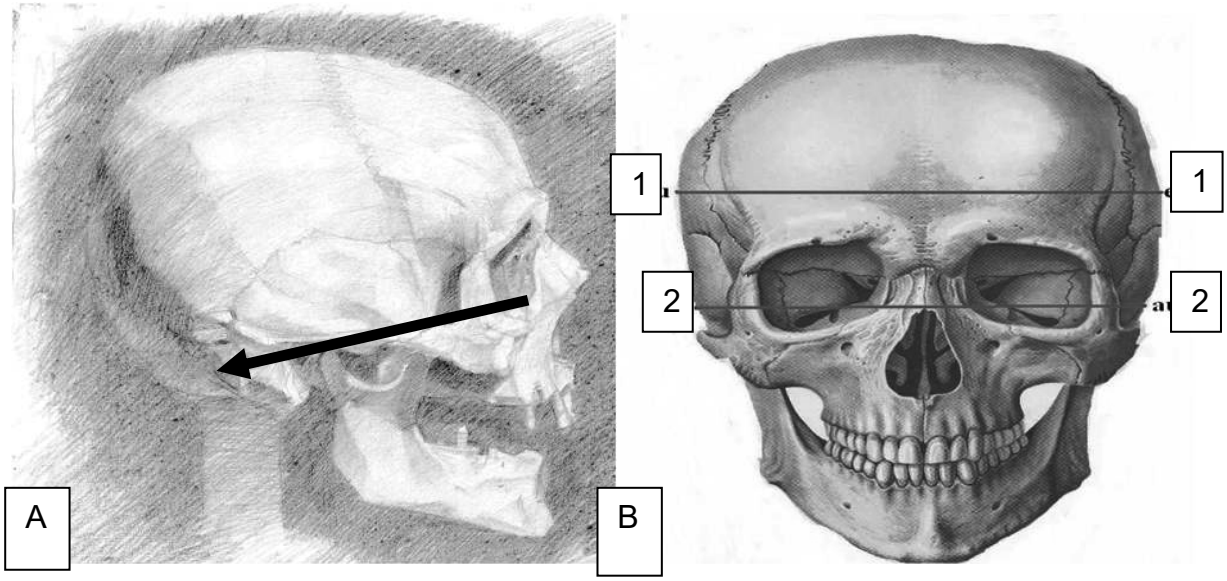

Fig. 3. Frankfurt contour. B – facial skull structure (1 – width of vault; 2 – width of base)

The latching angle (convergence) of the pyramids creates a stabilisation of the base of the skull. The basilar angle, or the angle of the base of the skull, is formed by a line connecting the nasion to the saddle bump (the cellar point) and a line connecting the saddle bump to the basion. The volume of the posterior cranial fossa is limited by the line connecting the following landmarks at the median sagittal slice: the line connecting the lower edge of the occipital rim – the base (B) and the lower edge of the occipital bone – the opistion (O) – the internal occipital protuberance (C) – the top of the cerebellum (G) – the top of the back of the Turkish saddle (A) – basion (B). Currently, to determine the volume of the posterior cranial fossa used the developed formula: V=1/3 S (b+c(a2+ae+e2)/a2), where S = πad / 4; a – length, b – height of indicated cerebellum, e – longitudinal size of occipital opening, c – height, b – width.

The volume of the posterior cranial fossa was calculated as the sum of the volumes of the two truncated cones. The volume was estimated on MRI images of the posterior cranial fossa, cervical and thoracic spine regions by their analysis using the developed mathematical program, to determine the «close» posterior cranial fossa, used the formula 4/3×π×(x/2×y/2×z/2), where x – width, y – length, z – height.

The morphometric traits of the «close» posterior fossa are an increase in the ratio of the volume of brain matter of the posterior fossa to its bone volume and a narrowing of the lycoconductive pathways of the posterior fossa. We measured and correlated the facial section of the skull with the posterior fossa, and a correlation well was built, showing that the posterior fossa is correlated to varying degrees with the individual facial size of the skull (fig. 4).

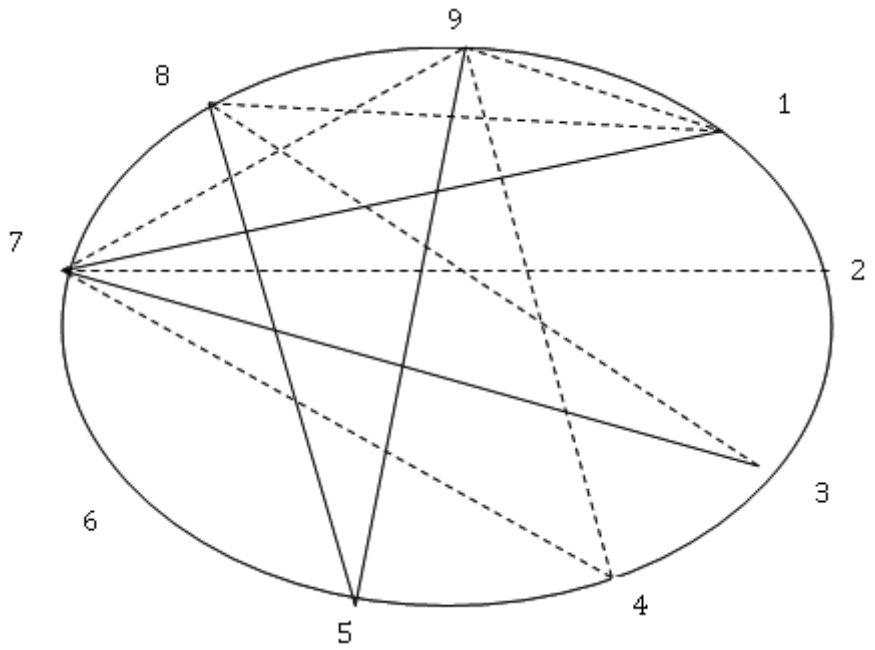

Fig. 4. Correlation between individual parameters of the facial and posterior fossa. Correlation relationships:
Strong positive _____ Moderately – - - - - - - —
1 – the width of the right eye socket, 2 – the height of the right eye socket, 3 – the width of the left eye socket, 4 – the height of the left eye socket, 5 – the width of the forehead, 6 – the length of the posterior cranial fossa, 7 – the width of the posterior

Analysis of the craniometry data found that the volume of the posterior cranial fossa ranged from 110.0 to 218.0 cm^3, averaging 158.0 cm^3 with a statistical deviation of 19.14. The volume of the posterior cranial fossa in adults ranges from 140.0 to 230.0 cm^3, with an average of 178.0 cm^3. The index of the volume of the posterior cranial fossa is less than 178.0 cm^3 and we propose to consider the indicator of «close» posterior cranial fossa in adults. Thirteen studies have identified the V truncated cone, the V ellipsoid, and the V cut of the ball, taking into account the craniological points listed on the macro-specs, which we considered the most informative indicators (fig. 5-A, B). Thus. Taking into account the results of 13 of our studies, the V ellipsoid ranged from a minimum of 138.662 to a maximum of 225.688 cm^3, V truncated cone from 111.562 to 169.455 cm^3; the V cut of the ball from 83.694 to 192.06 cm^3. In our opinion, the most approximate data are V-section of the ball, although each case should be considered separately. Thus, taking into account the results of 13 of our studies, the V ellipsoid ranged from a minimum of 138.662 to a maximum of 225.688 cm^3, V truncated cone from 111.562 to 169.455 cm^3; V dissected ball from 83.694 to 192.06 cm^3.

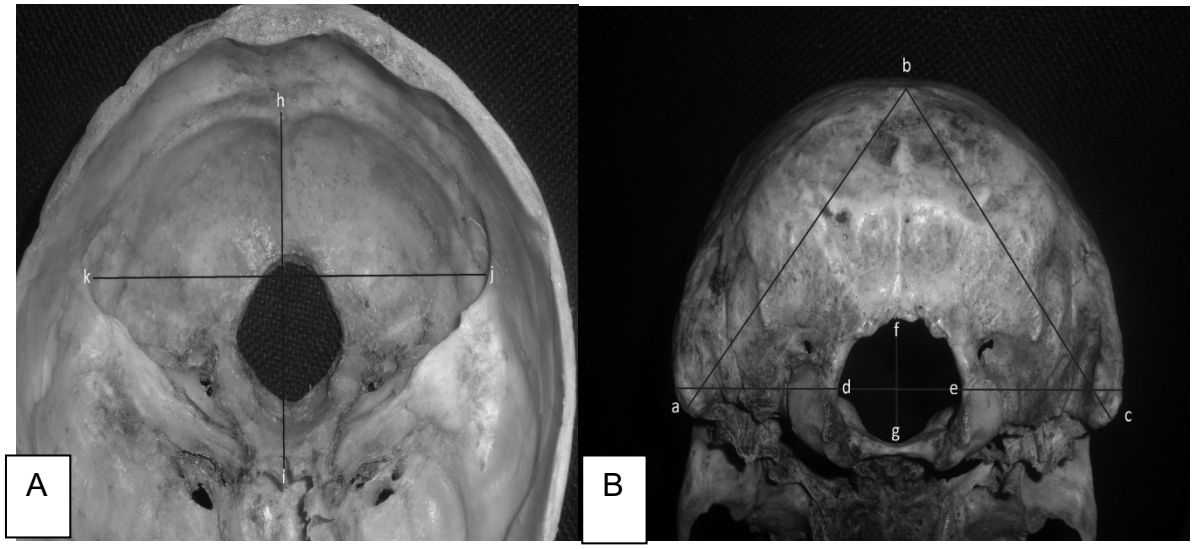

Fig. 5. Craniological points on the human skull in frontal projection (rear and snorkel view): hi – rear cranial fossa length, jk – rear cranial fossa width (A). Craniological points on the human skull in frontal projection (rear and exterior view): ac – processus mastoideus dexter – processus mastoideus sinister, cb – processus mastoideus dexter – protuberantia occipitalis externa, ab – processus mastoideus sinister – protuberantia occipitalis externa, ad – processus mastoideus dexter – foramen magnum, ec – processus mastoideus sinister – foramen magnum, bf – protuberantia occipitalis externa – foramen magnum, de – foramen magnum (frontalis) width, fg – foramen magnum (saggitalis) length (B)

Conclusions. Thus, in our work we have measured the skeletal structures of the posterior cranial fossa in the plane of the Frankfurt horizontal along the outer dimensions of the facial and cerebral regions of the skull. The morphometric traits of «close» posterior cranial fossa (posterior cranial fossa) have been highlighted as increasing the ratio of the brain matter volume of the posterior cranial fossa to its bone volume. Craniometrically, the volume of the posterior cranial fossa has been determined to be between 110.0 and 218.0 cm^3, averaging 158.0 cm^3 with a statistical deviation of 19.14. The volume of the posterior cranial fossa in adults ranges from 140.0 to 230.0 cm^3, with an average of 178.0 cm^3. The posterior fossa volume of less than 178 cm^3 is an indication of a «close» posterior fossa. Studies of the correlation between the facial and posterior cranial lobes have shown that the posterior fossa correlates to varying degrees with individual facial size. As a result of research, V truncated cone, V ellipsoid and V cut of ball were determined. The V ellipsoid ranged from a minimum of 138.662 to a maximum of 225.688 cm^3, V truncated cone from 111.562 to 169.455 cm^3; the V cut of the ball from 83.694 to 192.06 cm^3.

Prospects for further research. In the future, the relationship of diagnostic features in patients with lesions of structures of the posterior cranial fossa and craniometry will be considered, taking into account the intracranial fossils of the skull.

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PARAMETERS RELATIONSHIP OF THE FACIAL AND CEREBRAL PARTS OF THE SKULL AND THE POSTERIOR FOSSA

Abstract. The purpose of the study was to determine the relationship between the parameters of the facial and brain bones of the skull and the structures of the posterior cranial fossa. The most important area of medical craniology remains the complex study of the typical variability of skull structures and formations and the regularity of their interrelationships in general. These include the posterior fossa with its brain regions and vascular communications. The morphology of the posterior fossa was studied on 13 passport turtles of adults from the collection of the fundamental museum of the Department of Clinical Anatomy, Anatomy and Operative Surgery of the Dnipro State Medical University. To solve the problems, a complex of craniometric methods was used. Craniometric studies of the posterior cranial fossa, the base of the skull, were performed with a thick compass with a millimetre scale and a technical calliper with a fission price of 0.01 mm, according to the standard craniology procedure. For statistical processing of data obtained as a result of craniometry the method of complex statistical analysis is applied, which includes modern methods of mathematical analysis: variation, correlation, factor and regression. Statistical analysis of the posterior fossa showed no significant gender and age differences. The obtained data can be used both in theoretical medicine and in practical medicine, in particular in neurosurgery, to determine the volume of the posterior cranial fossa by the external size of the facial and cerebral regions of the skull. In our work, measurements were made of the skeletal structures of the posterior cranial fossa in the plane of the Frankfurt horizontal along the external dimensions of the facial and cerebral areas of the skull. The morphometric traits of «close» posterior cranial fossa (posterior cranial fossa) have been highlighted as increasing the ratio of the brain matter volume of the posterior cranial fossa to its bone volume. Craniometrically, the volume of the posterior cranial fossa has been determined to be between 110 and 218 cm^3, averaging 158 cm^3 with a statistical deviation of 19.14. The volume of the posterior cranial fossa in adults ranges from 140 to 230 cm^3, with an average of 178 cm^3. The posterior fossa volume of 178 cm^3 is an indication of a «close» posterior cranial fossa. Studies of the correlation between the facial and posterior cranial lobes have shown that the posterior fossa correlates to varying degrees with individual facial size. As a result of research, V truncated cone, V ellipsoid and V cut of ball were determined. The V ellipsoid ranged from a minimum of 138,662 to a maximum of 225,688 cm^3, V truncated cone from 111,562 to 169,455 cm^3; the V cut of the ball from 83,694 to 192,06 cm^3.
Key words: craniometry, bones of facial and cerebral skull, structure of posterior cranial fossa, cranial-cerebral trauma.

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