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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

MORPHOLOGY OF THE PTERYGOMAXILLARY FISSURE IN DIFFERENT PERIODS OF POSTNATAL ONTOGENESIS

Speciality: 3241.01 «Human Anatomy»

Field of science: «Medical sciences»

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GENERAL REVIEW OF THE RESEARCH

Actuality of the topic. According to morphologists, the structural variants of organs and morphometric indicators of age characteristics at different stages of ontogenesis have not yet been sufficiently studied and it is necessary to reconsider this problem. Therefore, the study of the characteristics of the individual, age, and sex variability of the human body can be considered one of the most promising areas of modern anatomy. Because the results obtained using classical examination methods tested over the years can be used in a broad interpretation of the results obtained by X-ray, computed tomography and magnetic resonance imaging, based on the achievements of modern medical technology.

In pathologies of difficult-to-obtain structures of the skull, it is very difficult to use the possibilities of modern medical diagnostics and neurosurgical interventions without accurate information about the structural variants, age and sex characteristics of these derivatives.[1,2] The research work is descriptive or briefly experimental and does not provide theoretical and generalized information about structures located deep in the skull.

The aforementioned arguments can also be attributed to the blood vessels and nerves of the pterygopalatine fossa (PPF), as well as the pterygomaxillary fissure (PMF), which acts as an "entry gate" for the mentioned derivative to be associated with the adjacent anatomical structures.

Although it is possible to find informative studies in the literature on the relationship between shape and types of PMF and

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[1] Шадлинский, В.Б., Мустафаева, Н.А., Караева, С.Д. (Shadlinskiy, V.B., Mustafaeva,N.A., Karaeva,S.D.) Особенности формы, краниометрических показателей входа в глазницу и глазничных щелей при различных краниотипах // Журнал анатомии и гистопатологии,– Воронеж: – 2015. т.4, №2, – с.60-64.

[2] Abuzayed, B. Extended endoscopic endonasal approach to the pterygopalatine fossa: anatomic study / B.Abuzayed, N.Tanriover, N.Gazioglu[et al.] // Journal of Neurosurgical sciences, –Turin: – 2009. vol.53, No2, – p. 37-44.

craniotypes of the skull which can be encountered in adults, but there is not any facts about age and sex, as well as individual characteristics of that derivative at different stages of the ontogenesis.

In the formation of the skull and its individual structures, it is undeniable the role of global climate change, anthropogenic and technogenic factors, as well as congenital pathologies of the skull. Fractures of the pterygoid process of the sphenoid bone and the base of the skull are found during surgery on difficult-to-obtain structures of the skull, located between the cerebral and facial parts of the skull, especially on the bone derivatives involved in the formation of the infratemporal fossa and the PPF, as well as PMF, which communicates these two fossae. [3] This again shows the great need for a comparative study of the anatomical and topographical features of the deep and difficult-to-obtain structures of the skull at different age periods.

There are some difficulties for clinicians in case of the absence of extensive information of the individual variability of these structures during the endoscopic examination and surgical interventions on the cranial nerves and the large blood vessels passing through the canals and holes adjacent to the PMF and branching in the PPF. Thus, the lack of scientific data on the anatomical and topographic variants of the sphenopalatine foramen makes it difficult to perform coagulation of the maxillary artery, one of the end branches of the external carotid artery, during transnasal endoscopic posterior nasal bleeding and neurotomy of the pterygoid canal nerve in chronic rhinitis. Thus, it is still actual to study anatomical and topographical variants of the PMF and its adjacent structures at different stages of ontogenesis for high-level video endoscopy in cases of damage to the maxillary artery, maxillary

[3] Петров, Б.А. (Petrov, B.A.) Возрастные и индивидуальны особенности костно-мышечных структур глубокой области лица и их использование в стоматологии: / Автореферат диссертации кандидата медицинских наук / – Москва, 2009. – 25 с.

nerve, the nerve of pterygoid canal, the sphenopalatine artery, and benign tumors of the pterygopalatine ganglion. [4, 5]

Purpose of the study. To study the individual, age and sex characteristics of the pterygomaxillary fissure at different stages of postnatal ontogenesis, depending on the craniotypes of the human skull, as well as the interaction of that derivative with the anatomical structures surrounding it.

Objectives of the study:

1. To study the individual, age and sex characteristics of linear dimensions of the pterygomaxillary fissure and bone structures adjacent to it.

2. To determine the individual and sex characteristics of the shape and typological variations of the pterygomaxillary fissure.

3. Identification of craniotypes of the cerebral and facial parts of human skulls at different age groups.

4. To detect the relationship between the individual-typological variations of the pterygomaxillary fissure with the craniotypes of the skull.

5. To determine the individual, age and sex characteristics of the distance between the pterygomaxillary fissure and the anatomical structures surrounding it.

Research methods. During the study, cranioscopic, craniometric, X-ray, computed tomography examination of 188 human skulls of different age groups was performed. Variation-statistical methods were used to determine the accuracy of the obtained results.

Scientific novelty of the study. Using cranioscopic, craniometric, morphometric, X-ray and computed tomography

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[4] Полев, Г.А. (Polev, G.A.) Хирургические аспекты вариабельности топографической анатомии вариабельности ветвей клиновидно-небной артерии и клиновидно-небной ямки: / Автореферат диссертации кандидата медицинских наук / – Москва, – 2014. – 26 стр.

[5] Cho, D. The Effectiveness of Preemptive Sphenopalatine Ganglion Block on Postoperative Pain and Functional Outcomes after Functional Endoscopic 167 Sinus Surgery // D.Cho, D.Drover, V.Nekhendzy [et al.] // Allergy and Rhinology, – 2011. 1 (3), – p. 212-218.

methods, the individual, age and sex variability of morphometric measurements of PMF in different age groups were studied in a complex way.

At different stages of postnatal ontogenesis, depending on the value of the pterygomaxillary index, the types of the PMF (low-wide, medium, and narrow-high) were identified and the interaction of these types with the shapes of the skull was determined.

The variants of the shapes of the PMF (triangular, crescent, incomplete rectangular, oval, and wedge-shaped) were found, and the individual and sex characteristics of these shapes were identified. The study revealed bone elevations that could interfere with the trajectory of the probe during video-endoscopic surgery, not only on the superior wall of the PMF but also on the posterior wall, as well as on both walls.

With the vertical and oblique position of the greater palatine canal about the hard palate, its obliterated form, the shapes of the greater palatine foramen, and dependence on shapes of hard palate were also found.

One of the advantages of the study can be considered the determination of the morphometric parameters of the PMF and the regularity of dependence of the distance between this fissure and the adjacent anatomical structures on the shapes of the skull.

The main provisions of the dissertation submitted for defense:

– The morphometric parameters of the height and width of the pterygomaxillary fissure, the distance between this fissure and adjacent anatomical structures vary differently at different stages of ontogenesis; at this time, the period of active growth and relative stability is different for each age group.

– The variants of the pterygomaxillary fissure are wide-ranging (triangular, crescent, incomplete rectangular, wedge-shaped and oval), in addition to individual characteristics, also have sex dimorphism; triangular and crescent shapes prevail in males, and crescent and incomplete rectangular shapes are prevalent in females.

– Depending on the value of the pterygomaxillary index, there are low-wide, medium, and narrow-high types, which have sex

dimorphism and some interaction with the craniotypes of the skull, it was found that medium and low-wide type prevails in males and medium and narrow-high type in females. All types of PMF are more common in the meso- and brachycephalic shape of the cranial vault, and the mesen types of the facial skull.

Theoretical and practical significance of the study. The results obtained on the sex dimorphism, individual-typological and age characteristics of the PMF will enrich medical craniology, one of the important fields of anthropology, with new information by expanding knowledge about the anatomical and topographical features of different parts of the skull.

The obtained results can also be used during forensic medical examination of the fragmented skull and pathological anatomical examination of the skull bones, including the parameters of the skull.

Information about linear sizes, shapes and types of the PMF can be used to interpret the parameters obtained during X-ray and computed tomographic examinations. Determining the age and sex characteristics of the PMF and anatomical structures which are located close to the PMF (including the craniotypes of the skull), may assist neurosurgeons, maxillofacial surgeons, and otorhino-laryngologists in discovering the new operational methods to operate on the cranial nerves and vessels located in the PPF.

Approbation of dissertation materials. The main results of the dissertation work were discussed at the International Conference dedicated to the 100th anniversary of the Department of Human Anatomy and Medical Terminology of the Azerbaijan Medical University (Baku, 2019), at XXIII Republican Scientific Conference of Doctoral Students and Young Researchers (2019), at International Scientific-Practical Conference dedicated to the 90th anniversary of the Azerbaijan Medical University (Baku, 2020), at the interactive meeting of the staff of the departments of Human Anatomy and Medical Terminology, Cell Biology, Cytology and Histology and the Scientific Research Center (Baku, 19.04.2021, protocol №2), as well as at the scientific seminar of the FD 2.08 Dissertation Council of the High Attestation Commission under the President of the Republic of

Azerbaijan operating at the Azerbaijan Medical University (Baku, 24.06.2021, protocol №1).

Application of results. The results of the study were applied in the Departments of "Human Anatomy and Medical Terminology" and "Forensic Medicine" of Azerbaijan Medical University.

Published materials. 21 scientific works on the topic of the dissertation have been published. 8 of them are journal articles, 3 theses, 10 are conference materials, 2 articles («Журнал Анатомии и Гистопатологии» - Воронеж, «Морфологические ведомости» - Самара), 2 conference materials and 1 abstract were published in foreign press.

Volume and structure of the dissertation. The dissertation consist of 174 computer pages (201477 characters)) including the chapters of "Contents", "Introduction" (volume: 12886 characters), "The main content of the dissertation" (volume: 152033 characters), "Conclusion" (volume: 33115 characters), "Results" (volume: 2380 characters), "Practical recommendations" (volume: 1033 characters) and "List of used literature".

"Main content of the dissertation" is divided into 6 chapters: Chapter I. "Literature review" (volume: 44129 characters), Chapter II. «Materials and methods» (volume: 11554 characters), Chapter III. "Anatomical and topographic characteristics of pterygomaxillary fissure and adjacent bone structures at different stages of postnatal ontogenesis" (volume: 42491 characters), Chapter IV. "Characteristics of the shape and individual-typological variability of pterygomaxillary fissure " (volume: 10800 characters), Chapter V. "Individual, age and sex characteristics of the distance between the middle of the posterior wall of pterygomaxillary fissure and the anatomical structures surrounding it" (volume: 43059 characters).

The bibliography includes 187 sources, of which 19 in Azerbaijan, 86 in Russian and 82 in other foreign languages. The text of the dissertation contains 37 figures and 26 tables.

MATERIALS AND METHODS OF RESEARCH

As a research object, 188 certified human skulls were examined in the fundamental museum of the Department of Human

Anatomy and Medical terminology at AMU, covering different ages and both sexes. At that time, the ages adopted at the VII All-Union Conference of the Pedagogical Sciences Academy of the USSR in 1965 devoted to the problems of age morphology, physiology and biochemistry were used (table).

Cranioscopic, craniometric, morphometric, X-ray, computed tomographic examinations and variation-statistical methods have been used to perform the tasks.

Cranioscopic examination was used to determine the shapes of PMF, the anterior foramen of the pterygoid canal (AFPC), foramen rotundum (FR), greater palatine foramen (GPF) and sphenopalatine foramen (SPF).

Table

Distribution of skulls by age and sex

Age periods, by years	Gender		Total
	Male	Female	
Puberty period 13-16 years (boys) 12-15 years (girls)	10	10	20
Adolescence period 17-21 years (boys) 16-20 years (girls)	10	10	20
I adulthood period 22-35 years (males) 21-35 years (females)	20	16	36
II adulthood period 36-60 years (males) 36-55 years (females)	30	25	55
Elderly age period 61-74 years (males) 56-74 years (females)	15	12	27
Senile age period 75-90 years (males) 75-90 years (females)	15	15	30
Total	100	88	188

The proposed research method is to study the shape and appearance of the skull in the norm by examining the skull and its individual bone structures from above (*norma verticalis*), from the side (*norma lateralis*), in front (*norma facialis*), and below (*norma basilaris*) and is still widely used today.

To determine the shape of PMF, we paid more attention to the degree of development of the fissure-forming parts of the bones involved in its formation.

Taking into account the above, it should be noted that the variety of shapes of PMF is associated with the degree of development of the masticatory apparatus, which is considered one of the morphogenetic and shaping factors, the size and configuration of the pterygoid processes of the sphenoid bone, the degree of development of maxillary tuberosity and the number of its angles (antero-superior, postero-superior and inferior).

During the study, using morphometric and craniometric methods, the width and height of the PMF, the distance between the anatomical structures close to that area (AFPC, FR, GPF, SPF), the length and width of the cranial vault, and the height and width of the facial skull were studied. In addition to those mentioned, the diameters of the GPF, AFPC, SPF and FR at different age periods were also calculated.

While measuring (Alekseev VP, Debetz PF, 1964) vernier caliper with 0.01mm divisions, caliper with both ends straight and with one end straight and the other one curved, as well as a sliding caliper was used as a reliable tool during measurement.

We considered it expedient to use the *norma lateralis* (lateral view) and *norma facialis* (facial view) for craniometric measurements of the PMF and skull.

Line dimensions of the PMF and craniometric parameters of the skull were measured by the following method: [6] 1. Height of the PMF - the size of the line connecting the upper and lower sides of the fissure; 2. Width of the PMF – the size of the transverse line

[6] Алексеев, В.П. (Alekseev, V.P.) Краниометрия:Методика антропологических исследований / В.П. Алексеев, Г.Ф.Дебец, – Москва: Наука, – 1964. – 128 с.

connecting the anterior and posterior walls; 3. Longitudinal size of the cranial vault (length) - distance between *glabella* and *opisthocranion* (g-op); 4. The transverse size of the cranial vault (width) - the distance between both *euryon* (eu-eu); 5. Upper facial height - the distance between the *nasion* and the *prostion* (n-pr); 6. Face width or zygomatic diameter - the distance between the farthest points of the zygomatic bones - *zygion* (zy-zy). To determine the types of PMF in skulls of different craniotypes, we calculated the pterygomaxillary index by finding the percentage expression of its width to height. According to the pterygomaxillary index, 2 out (narrow-high and low-wide) and 1 medium type of the PMF were identified.

In addition to linear dimensions, we determined the cephalic index and the upper facial index to determine the shapes of the cranial vault and the facial part of the skull. Skulls with an index up to 74,9 are considered dolichocranes, those between 75,0-79,9 are mesocranes, and skulls 80,0 and more are brachycranes. If the upper facial index is 55,0 and above, such a skull is considered a narrow-faced (lepten) skull, if it is between 50,0-54,9 it is a medium-faced (mezen) skull, and a broad-faced (euryon) skull if it is less than 50,0.

To determine the distance between the PMF and the adjacent canals and holes, the closest distance between the middle of the posterior wall of the fissure and AFPC, FR, GPF, SPF, ILOA and ZA was measured. 15 skulls were X-rayed to study the shape of the PMF and the topography of the surrounding canals and holes (GPC, GPF, SPF and AFPC). Considering that the anatomical structures are located on different surfaces, sagittal and frontal radiographs we have used. In these images, it is possible to see more clearly the GPC and its relation with the hard palate, the LPC and their relation with the GPC (the SPF, as well as AFPC, FR). To more accurately determine the position and direction of the canal and holes, we used a shaft made of metal passed through the above structures. For this purpose, digital devices "Shimadzu" and "Philips" operating at the "Surgical Clinic" of AMU were used.

The Toshiba Asteion device was used for CT scanning. The duration of the examination was 15-20sec, step 4-8mm, cut off

the thickness of the cuts 5mm, exposure was 40mAc, the voltage was 140kV. The examination began with a direct X-ray and tomogram of the skull, and the level of the first incision and the thickness of the incisions were determined. CT images were mainly evaluated in the bone window.

Incisions on different planes (coronary, sagittal, axial) were used to obtain craniometric planes measurements of the length and width of the cranial vault, upper facial height and width, as well as the morphometric measurements of the height and width of PMF. Multivox Dicom Viewer was used to measure images. For the statistical analysis of the results obtained, the parametric Student's t-test was used, and for the verification and determination the obtained results, the non-parametric U-Wilcoxon (Manna-Whitney) criterion was used. [7]

Statistical calculations were performed on the computer according to the EXCEL spreadsheet.

THE RESEARCH RESULTS AND THEIR DISCUSSION

The results of cranioscopic examinations showed that bone elevations can be found not only on the superior wall of PMF, as noted by Zakiev I.I. (1989), but also on its posterior wall, and as well as on both walls.

The oval shape of the investigated AFPC is more and it is 73.7% (246 holes), but the round shape is 26.3% (88 holes). The bone crest, which can be used as an orientation in the neurotomy of the pterygoid canal nerve and is located between the AFPC and FR, is found in 86.2% of cases. We observed this case during the examination of both male and female skulls.

Of 334 GPC examined in relation to the hard palate, it was revealed that 59,9% (200 holes) were vertical, 37,1% (124 holes) were oblique position and 3,0 % (10) were obliterated 5-6 mm distal due to age.

[7] Лакин, Г.Ф. (Lakin, G.F.) Биометрия / Г.Ф. Лакин. – Москва: Высшая школа, – 1990, – 352 с.

The oval shape of GPF is found in 51.5% (182), the round in 32.9% (110), dropsy in 12.6% (42), and obliterated form in 3.0% (10). Observations also showed that 1, sometimes 2-3 LPF were located at the posterior of the GPF.

According to the results of the research, 64.7% (216 holes) of 334 SPF are located on the postero-superior side of the ethmoidal crest in the internal surface of the perpendicular plate of the palatine bone and connect the PPF to the superior nasal meatus. In 26.6% of cases (89 holes), the SPF is located on the posterior side of the ethmoid crest and is projected to the middle nasal meatus. In 8.7% of cases (29 holes), in addition to the sphenopalatine foramen connecting the PPF with the superior nasal meatus, there were also found accessory sphenopalatine foramen (*foramen sphenopalatinum accessorium*) connecting the PPF with the middle nasal meatus.

Thus, the results obtained from the research of the anatomical and topographical features of the PMF and surrounding bone structures in different stages of ontogenesis can be used at least as supportive material in the elimination of problems during posterior nosebleeds, rhinocerebral infections, anesthesia of the nerves and PPG located in the PPF.

Based on the results of the research, the average indicators of diameters of the AFPC, RF, PPF, GPF, and length of the GPF at different age periods do not have age or sex peculiarities.

Thus, the results of the research showed that the height of PMF in males increased by 5.9mm or 29.2% and 6.1mm or 29.9% respectively during I and II adulthood periods (M=20.2±0.8mm and 20.4±0,6 mm) on the left side (M=14,3±0,6mm) in comparison with adolescents. In females, the value of this indicator increases by 4.0mm or 21.4% on the right side during the II adulthood period (M=18.7±0.6mm), reaching the highest value in comparison with adolescents (M=14.7±0.7mm).

According to the results of the research, a comparison between the opposite sides showed that in males, the height of the PMF was 2,1mm, or 11,2% more on the left side (on the right side – 18,3±0,6mm; on the left side – 20,4±0,6mm, $p_t<0,05$) during II adulthood period. Our analysis to study by age characteristics helped

to reveal that this parameter increased 2.2 mm or 15,5% on the left side during the adolescence period (respectively on the right side – 14.3±0.6mm, on the left side – 16.5±0.8mm, $p_l<0,05$) in comparison with adolescents, 3.2mm or 17.7% on the right side and 3.7mm or 22.3% on the left side during I adulthood period (on the right side – 21.0±0.8mm; on the left side – 20.2±0.8mm) in comparison with adolescence period (on the right side – 17,8±0,9mm; on the left side – 16,5±0,8mm, $p_l<0,05$ və $p_l<0,01$), 2.7mm or 12.8% on the right side (M=18,3±0,6mm, $p_l<0.01$) in comparison with II adulthood period.

In females, a comparison of opposite sides of each age group showed that this indicator was 2.1 mm or 10.4% right-sided prevalent during the I adulthood period (right side – 20.2±0.6mm; left side – 18.1±0.7mm, $p_l<0,05$). The height of PMF (M=16.4±0.8 mm, $p_l<0.05$) is 3.0 mm or 21.2% more on the left side during the adolescence period (M=17.5±0.7mm, $p_l<0.05$) in comparison with the left side of the puberty period (M=14.5±0.6mm), 3.8mm or 23.2% more on the right side during I adulthood (M=20.2±0.6mm) in comparison with the same side of adolescence period.Comparative analysis of sex characteristics showed that in males during the I adulthood period this indicator was 2.1 mm or 10.3% more on the left side (20.2±0.8mm in males; 18.1±0.6mm, $p_k<0.05$ in females).

The average indicators of the height of PMF in males are "right-sided" rather than bilateral during the I adulthood period in comparison with the II adulthood period. Although in males during the I adulthood period this indicator is bilateral, in our material it is left-sided. In females, the results of our study are consistent with the data obtained by the authors and have a right-sided prevalence during the I adulthood period.[8,9]

[8] Apinhasmit, W. Anatomical study of the maxillary artery at the pterigomaxillary fissure in a Thai population: its relationship to maxillary osteotomy / W.Apinhasmit, D.Methathratip, S.Ploytubtim [et al.] // Journal of the medical association of Thailand, – 2004, 87(10), – p.1212-1217.

[9] Полкокова, И.А. (Polkokova, I.A.) Морфология крыловидно-верхнечелюстной щели при различной форме черепа у взрослых людей: / Диссертация кандидата медицинских наук / – Саратов, – 2009. – 133 стр.

In our opinion, the differences in geographical climatic conditions and physical employment may be one of the reasons for this diversity.

In males, a comparative analysis of the coefficient of variation in the height of the PMF (CV, %) for the opposite sides of the studied age groups showed that this indicator is prevailing on the left side during puberty and elderly age periods, and on the right side during II adulthood period. In females, the coefficient of variation of this parameter showed an increase on the right side during puberty, adolescence, the elderly, and senile age periods, and on the left side during the I adulthood period.

In males, the width of the PMF period increases 1.6mm or 30% on the left side (M=6.8 ±0.4mm, $p_0<0.05$) during I adulthood period (right side – 5.2±0.5mm; left side – 5.2±0.5mm), 1.8mm or 33.6% on the left side (7.0±0.5mm, $p_0<0.05$) during the elderly age period, 1.9mm or 34.3% on the right side (M=7.4±0.5mm, $p_0<0.05$) and 2.4mm or 45.4% on the left side (M=7.6±0.6mm, $p_0<0.01$) during senile age period in comparison with puberty period reaching its maximum value. In females, the indicator of the width of PMF decreases by 0.8mm or 19.0% on the right side during II adulthood period in comparison with adolescents (M = 5.8 ± 0.5mm, $p_0<0.05$), reaching an average of 5.0±0,3mm ($p_0<0.05$).

Comparison of the morphometric indicators of the width of PMF between opposite sides of each age group showed that in females the indicators of the right side of the adolescence period were 1.4mm or 22.6% more in comparison with the left side (right side –6.2±0.6mm və left side – 4.8±0.3mm, $p_t<0.05$), and comparison of identical sides of adjacent age groups of males on the right side of I adulthood period (M=6.7±0.5mm, $p_l<0.05$) it is 1.,9mm or 39.2% more in comparison with the identical side of adolescence period (M=4.8±0.3mm), and on the left side (M=6.4±0.4mm, $p_l<0.05$) in the females of elderly age period it is 1.1mm or 22.2% more in comparison with the identical side of II adulthood period.

In males, the morphometric indicators of the PMF width (M=6.7±0.5mm and 6.8±0.4mm) 1.7mm or 25.4% bilaterally more (M=5.0±0.3mm and 5.2±0.4mm; M=5.0±0.3mm and 5.3±0.3mm;

M=5.9±0.4mm and 5.6±0.3mm) on the right, 1.6mm or 23.7% on the left side during I adulthood period, 1.0mm or 16.1% on the right, 1.1mm or 17.6% on the left side during II adulthood period (M=6.0±0.3mm and 6.4±0.3mm), and 1.5mm or 20.1% on the right, 2.0mm or 27.0% on the left side during senile age period (M=7.4±0.5mm and 7.6±0.6mm), in comparison with females. However, in the adolescence period, the value of this parameter in females (M=6.2±0.6mm, p_k <0.05) is 1.4 mm or 29.5% more on the right side than in males (M=4.8±0.3mm).

It was revealed that in males, the CV of the width of the PMF is more on the right side during puberty, I adulthood and elderly age periods, and on the left side during adolescence and senile age periods.

But in females, the CV of this parameter is higher on the left side during I and II adulthood, and on the right side during adolescence, elderly and senile age periods.

Thus, the degree of variability of the height of the PMF varies between 10.8-17.8% in males and 12.8-16.5% in females, which is close to each other and varied moderately (CV=11.0–25.0%). The average value of this indicator for the width of the PMF is varied strongly (CV=25.0-50.0%) with hesitation between 25.3-3.5% in males, and moderately and strongly ranging between 20.9-32.5% having wider diapason in females.

A study of 140 fissures in males and 120 fissures in females showed that PMF has 5 shapes (triangular, crescent, incomplete rectangular, oval and wedge-shaped) and these shapes have sex characteristics. According to our results, a triangular shape observed in males is a little bit more than one-third of the studied material (on the right side – 42.9%, on the left side – 37.1%), but in females, in contrast, the crescent shape is close to one-third (30.0%) on the right side, a little more than one-third (35.0%) on the left side. If excluding the sides, males have a triangular shape in 40.0%, crescent shape in 20.7%, incomplete triangular shape in 16.4%, but females have a crescent shape in 32.5%, incomplete rectangular shape in 22.5%, triangular shape in 19.2%.

Comparison of the obtained results with the literature sources showed that in our material there is no indeterminate shape of the PMF, and in females, the crescent shape is more common (32.5%) than the incomplete rectangular shape (22.5%). However, the idea of the preference of triangular shape in males is consistent with our opinion.[14]

Using a pterygomaxillary index we discovered narrow-high, wide-low, and medium types of PMF. The aforementioned fissure has bilateral and sex characteristics and is significantly correlated with the craniotypes of the skull having; in males, the medium type of PMF is found a little more than one-third (on the right side – 41.0%; on the left side – 36.0%), narrow-high type on the right side close to one-third (28.0%), on the left side up to one-fourth (24.0%), wide-low type on the right side close to one-third (31.0%), on the left side a little more than one-third (40.0%) of the total number of the studied material.

In female skulls, the middle type is more common and up to half of the studied material (47.7% on the right side, 51.1% on the left side), while the narrow-high type is slightly more than the one third (35.3% and 38.6%, respectively), wide-low type is – 17.0% on the right and –10.3% on the left side.

If excluding sides in males medium type is – 38.5%, wide-low type – 35.5%, narrow-high type – 26%, in females medium type is – 49.4%, narrow-high type is – 37.0%,wide-low type is – 13.6%. Thus, the medium type is prevailing in both sexes, while the wide-low type is prevailing in males and the narrow-high type is in females.

All types of PMF are more often observed in the meso- and brachicran forms of the skull. The narrow-high and medium types are most commonly found in the mesen and lepten, and the wide-low type is in the mesen and euryon shapes of the facial skull.[10]

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[10] Полкокова, И.А. (Polkokova, I.A.) Типовая изменчивость крыловидно-верхнечелюстной щели в зависимости от формы лицевого черепа / И.А.Полкокова, О.Ю.Алешкина, В.Н.Николенко [и др.] // Морфологические ведомости, – Самара: – 2017. т.25, № 2, – с.57-59.

The plan of the research also included the analysis of the characteristics of the morphometric parameters of the distance between the PMF and the adjacent bone structures. Thus, in males, the distance between the middle of the posterior wall of the PMF and the

AFPC increases by 2.9mm or 31.5% on the right side (9.2±0.6mm) and 3.8mm or 38.0% on the left side (10.0±0.5mm) during the II adulthood in comparison with the puberty period (6.3±0.5mm and 6.2±0.5mm, respectively) and reaches to its highest value. In females the value of that distance in the elderly period is 2.1mm or 26.6 % more on the right side (7.9±0.5mm, $p_0<0.01$) in comparison with the same side of the puberty period (6.3±0.5mm). Comparison of this indicator between the opposite sides of each age group showed that there is no statistically significant difference in both sexes ($p_t>0.05$).

Although this distance was 1.5 mm or 15.0% more on the left side (10.0±0.5mm) during the II adulthood period in comparison with the same side of I adulthood period (8.5±0.4mm), 1.8mm or 20.9% more on the left side (8.6±0.6mm) during elderly age period in comparison with senile age period (6.8±0.5mm), no statistically significant difference was found in females ($p_l>0.05$).

Comparison of the sex characteristics of the studied parameter showed excess (bilaterally) in males (right side – 7.9±0.4mm and left side – 8.5±0.4mm) 1.4mm or 17.7% on the right, 1.5mm or 17.6% on the left side compared to females (6.5±0.4mm and 7.0±0.4mm, respectively) during I adulthood period, but during II adulthood period it is 2.4mm or 26.1% on the right side, 3.6mm or 36.0% on the left side in males (9.2±0.6mm və 10.0±0.5mm, respectively), compared to females (6.8±0.3mm və 6.4±0.3mm).

According to the results of the research, in males, the coefficient of variation (CV) for the opposite sides of the distance between the PMF and the AFPC is right-sided prevailing in adolescence, I and II adulthood periods, and left-sided prevailing in puberty, elderly and senile age periods. In females, it can vary moderately and strongly (CV=11.0-25.0% and 25.0-50.0%), with

right-sided prevalence in puberty, I and II adulthood periods, and left-sided prevalence in adolescence, elderly and senile age periods.

The distance between the middle of the posterior wall of the PMF and the FR increases significantly on both sides of II adulthood period (1.4 times – 44.9% on the right side, 1.6 times – 61.5% on the left side) in males, and on the right side (1.3 times – 32.3%) of the elderly period in females in comparison with adolescents (6.0±0.5mm and 5.8±0.4mm, respectively).

The bilateral comparison of that distance showed that in males, the indicators of the I adulthood period increased by 1,1 mm or 13.7% on the left side (right side – 7.8±0.4mm and left side – 8.9±0.3mm, $p_t<0.05$), while there was no significant difference in females. Comparison of adjacent age groups between the same sides showed that in males this indicator has 1.9mm or 26.6% prevalence on the left side during I adulthood period to compared to adolescence period (8.9±0.3mm and 7.0±0.7mm, respectively), 2.6mm or 27.9% during the elderly period to compared to the senile period (9.2±0.6mm or 6.6±0.4mm), but in females 1.2mm and 12.3% (8.0±0.5mm və 6.4±0.5mm) prevalence on the right side during the elderly period to compared to the senile period ($p_l<0.05$). It was revealed that the same distance has prevalence during I and II adulthood on both sides, on the left side during the elderly period and on the right side during the senile period in males compared to females ($p_k<0.05$).

Thus, in males, the CV of the average value of the distance between the middle of the posterior wall of the PMF and the FR is right-sided prevailing during puberty, I and II adulthood, and left-sided in adolescence and senile age periods. In females, CV of the distance between the middle of the posterior wall of the PMF and FR was right-sided prevalence during adolescence, I and II adulthood periods, and left-sided during elderly and senile age periods, and varied moderately and strongly.

Comparison of the distance between the middle of the posterior wall of the PMF and the GPC at different stages of ontogenesis showed that this parameter reached its highest value (1.7 times and 1.4 times, respectively) on the left side during the senile age period

in males and during I adulthood period in females to compared to adolescents (9.3±0.6mm and 9.0±0.6mm in males; 10.9±0.6 mm and 10.7±0.6 mm in females).

Comparison of the distance between the middle of the posterior wall of the PMF and the GPC in adolescents (9.3±0.6 mm and 9.0±0.6 mm in males; 10.9±0.6 mm and 10.7±0.6 mm in females) at different stages of ontogenesis showed that the above-mentioned parameter reached the highest value (1.7 times and 1.4 times, respectively) in males on the left side of the senile age period in males and the left side of the I adulthood period in females.

Bilateral analysis of morphometric parameters of the same distance showed that in males (right – 12.2±0.6mm and left – 14.9±0.7mm) it has 2.7mm or 21.8% prevailing on the left side during the senile age, the comparison of the same sides of adjacent age groups showed that it has bilateral (2.2mm or 23.5% in the right; 2.5mm or 27.7% on the left) prevailing during the adolescence (11.5±0.6mm and 11.5±0.6mm, respectively) in comparison with the adolescents (9.3±0.6mm and 9.0±0.6mm), 2.3 mm or 18.3% left-sided prevailing during senile age in comparison with elderly age (14.9±0.7mm and 12.6±0.6mm, respectively). In females, although there was no difference between the sides of each age group (bilateral), there was observed bilateral increase in the average values of the sides of adjacent age groups during adolescence (13.1±0.7mm and 14.4±0.7mm) in comparison with puberty (10.9±0.6mm and 10.6±0.6mm) and during I adulthood (14.4±0.6mm and 14.7±0.5mm) in comparison with II adulthood (12.1±0.6mm and 11.7±0.6mm). The average value of this indicator increases bilaterally (on the right side – 2.3mm or 18.9%; on the left side – 3.0mm or 24.9%; $p_k<0.05$, $p_k<0.01$) in I adulthood in females (14.4±0.6mm and 14.7±0.5mm) compared to males (12.1±0.6mm and 11.7±0.6mm).

The results of the study showed that in males, the value of the CV of the distance between PMF and GPC has left-sided prevailing in other age groups, excluding adolescence and I adulthood. The CV of the studied parameter is right-sided during the I adulthood in

females, and left-sided during II adulthood, elderly and senile in males, with moderate (CV=11.0-25.0%) variation.

The value of the distance between the middle of the posterior wall of the PMF and SPF reaches the highest index in both sexes during the II adulthood period (10.1±0.5mm and 10.6±0.4mm in males; 11.9±0.5mm and 10.7±0.5mm in females) in comparison with the puberty period (9.0±0.8mm and 7.2±0.7mm in males; 7.3±0.6mm and 7.0±0.6mm in females).

Although a comparison of the average value of the studied distance revealed 2.5mm or 21.9% right-sided prevalence during the I adulthood period between the opposite sides in males, it was not possible to see this difference in females. The average value of the parameters of the II adulthood period in males has left-sided (1.8mm or 17.3%) prevalence in comparison with the same parameters of I adulthood and elderly age periods, while in females it has bilateral prevalence. The indicators of the I adulthood have right-sided prevalence in males in comparison with females (2.2mm or 19.2%), and the indicators of the II adulthood period have right-sided prevalence in females in comparison with males (1,8mm or 17.1%).

In males, the morphometric values of the distance between the middle of the posterior wall of PMF and the ILOA are increasing (45.2±0.9mm and 45.7±0.8mm, respectively) 5.7mm or 15.7 % on the right side of the senile age (41.9±0.8mm) in comparison with the puberty (36.2±0.7 mm), and 5.7 mm or 14.4% on the right side of the I adulthood period (39.5±1.0 mm) and 6.5mm or 14.3% on the right side of the II adulthood period in females and reaches its highest value.

It was found that the CV of the distance between the middle of the posterior wall of the PMF and SPF is right-sided prevalence in I, II adulthood and elderly age periods, and left-sided in puberty, adolescence, and senile age periods. But in females, this distance was found to be left-sided in I, II adulthood and senile age periods.

In males, the morphometric indicators of the distance between the middle of the posterior wall of PMF and the ILOA increase 5.7mm or 15.7% on the right side of the senile age period (41.9±0.8 mm) in comparison with the puberty period (36.2±0.7mm), 5.7 mm

or 14.4% on the right side of the I adulthood period (39.5±1.0 mm) and 6.5mm or 14.3% on the right side of the II adulthood period (45.2±0.9 mm and 45.7±0.8 mm, respectively) in females and reach to its highest value.

A comparative analysis of the average value of the opposite sides of each age group showed that males have 2.9 mm or 6.8% right-sided prevalence during the senile age period and 2.1 mm or 4.7% in females during the II adulthood period. In males, there was no significant difference between the indicators of the same-named sides of adjacent age groups. In females, it was revealed that the prevalence of this distance, is 3.6 mm or 8.0% right-sided during I adulthood in comparison with adolescence, 3.2mm or 7.0% right-sided ($p_l<0.05$) during II adulthood in comparison with elderly age, 2.1 or 5.0% left-sided during elderly in comparison with senile age. A comparative analysis of the sex characteristics of the studied distance showed that the studied parameter has right-sided prevalence during puberty and adolescence periods (3.3 mm or 7.4% and 3.5 mm or 8.4%, $p_k<0.05$, respectively) and bilateral prevalence during I and II adulthood periods in females compared to males ($p_k<0.001$, $p_k<0.01$).

A comparative analysis of the study of the variability of the distance between the PMF and the ILOA in males showed that CV has a right-sided prevalence in the elderly, and left-sided in puberty, adolescence, and senile age periods. In females, the value of this indicator varied slightly (CV=10.0%), with right-sided prevalence during puberty, adolescence, II adulthood, and senile age periods, and left-sided prevalence during the adolescence period.

In males, the distance between the middle of the posterior wall of the PMF and the zygomatic arch (ZA) increases on the left side of I adulthood (40.2±0.8mm; 3.9mm or 10.6%), on the right side of II adulthood (38.6±0.6mm; 3.6 mm or 10.4%) in comparison with the puberty (35.0±0.8mm on the right side and 36.3±0.8mm on the left side, respectively) and reaches to the highest point on the right side in the elderly age (40.0±0.8mm; 5.0mm or 14.3%). The value of the studied distance in females increases on both sides of the I adulthood period (on the right side 5.1mm or 12.0%; on the left side 3.9mm or

13.1%) in comparison with adolescents (on the right side – 39.5±1.0mm; on the left side – 39.0±1.0mm) and on average contains 44.6±0.9mm and 44.2±0.9mm ($p_0<0.05$).

Although comparison of the average value of the mentioned distance in males between opposite sides of the same age group revealed a 2.3mm or 6.1% left-sided prevalent of the morphometric index of I adulthood period (on the right side – 37.9±0.7mm, on the left side – 40.2±0.8mm; $p_t<0.05$), this difference was not observed in females ($p_t>0.05$). In males, no significant difference was found among the same-name sides of adjacent age groups ($p_l>0.05$). It was revealed that, in females, the same distance has 5.7mm or 12,9% prevalence on the right side; 4.0mm or 8.9% prevalence on the left side in the I adulthood period (44.6±0.9mm and 44.2±0.9mm, respectively) in comparison to II adulthood period (38.9±0.6mm and 40.2±0.6mm, respectively), 2.4mm or 5.8% prevalence on the right side in the elderly age period (right side – 41.3±0.5mm) in compared to II adulthood period. The morphometric parameters of that distance are 4.5mm or 12.9% more on the right side, 2.7mm or 7.5% on the left side of the puberty period and 6.7mm or 17.9% on the right side, 4.0mm or 9.9% on the left side of the I adulthood period, 5.3mm or 14.5% more on the right side during adolescence period in females in comparison with males ($p_k<0.001$, $p_k<0.01$).

According to the results obtained, in males, the CV of the distance between PMF and ZA is left-sided prevailing during adolescence, I and II adulthood, and right-sided during the elderly age period. In females, the value of CV for the mentioned distance is right-sided prevailing during puberty, II adulthood, elderly and senile age period, and left-sided during adolescence and I adulthood period.

RESULTS

1. In males, the height of the pterygomaxillary fissure for opposite sides of each age group is more on the left side during II adulthood period (11.2%), and for the same sides of the adjacent age groups during I adulthood period on the right side (12.8%) compared to the II adulthood period. In females, the indicators of the

opposite sides and the same sides of adjacent age groups prevail on the right side (23.2%) during the I adulthood period. The height of the pterygomaxillary fissure in males is more than in females on the left side of the I adulthood period [1,4,5,10].

2. In females, the values of the width parameters of the pterygomaxillary fissure for the opposite sides of different age groups are statistically prevalent on the right side (22.6%) during the adolescence period, and for the same sides of the adjacent age groups prevalent on the left side during elderly (22.2%) age period compared to II adulthood period. The morphometric indicators of the width of the pterygomaxillary fissure are bilaterally prevailing in males than in females during I-II adulthood and senile age period [1,4,5,10].

3. The coefficient of variation of the height of the pterygomaxillary fissure varies moderately (CV=11.0–25.0%) changing between 10.8-17.8% in males, and between 12.8-16.5% in females, but the same indicator of the width varies strongly, changing between 25.3-33.5% in males, and varies moderately and strongly having a wider range (20.9-32.5%) in females [6,10,11].

4. On both sides, the triangular shape of the pterygomaxillary fissure is prevailing in males (42.9% on the right side, 37.1% on the left side), and the crescent shape in females (30.0% on the right side, 35.0% on the left side). Medium and low-wide type of pterygomaxillary fissure is more common in males, and medium and narrow-high type in females [1,2,8,10,12].

5. According to the results obtained, the narrow-high (mesocrane – 49,5%, brachychrane – 42.5%), medium (mesocrane – 46.5%, brachychrane – 42.0%), and wide-low types (mesochrane – 44.5%, brachycran – 41.0%) of the pterygomaxillary fissure are found more commonly in mesochranic and brachycranic forms of the cranial vault. The narrow-high (mesen – 42.6%, lepten – 30.0%) and medium (mesen – 43.6%, lepten – 33.0%) types of the same derivative are prevalent in mesen and lepten forms, while wide-low type is prevalent in mesen (58.0%) and euryone (24.0%) shapes of facial skull [7,13,14].

6. The results of morphometric studies showed that the average value of the distance between the middle of the posterior wall of the pterygomaxillary fissure and the adjacent bone structures (anterior foramen of pterygoid canal, foramen rotundum, sphenopalatine foramen, greater palatine canal, inferior-lateral orbital angle, and zygomatic arch) had statistically significant individual, age and sex characteristics. The results obtained can serve as the basis for a high level of endoscopic vascular and nerve surgery [6,11,15,16, 17,18,19,20,21].

PRACTICAL RECOMMENDATIONS

1. Data on the linear dimensions of the pterygomaxillary fissure and the distance between that fissure and adjacent anatomical structures can be used as additional material in the interpretation of parameters obtained during X-ray and computed tomography examinations, in the selection of new surgical methods that need to be performed on the neurovascular bundles located in the pterygopalatine fossa.

2. The results obtained with craniometric, X-ray, and computer-tomographic studies can be used during forensic medical examination of the fragmented skull, as well as for pathological anatomical examination of the skull.

3. The obtained results can be used in lectures and practical classes on Human Anatomy, Forensic medicine, Pathological anatomy, Oral and Maxillofacial surgery, and Otorhinolaryngology. The obtained information can be used to develop methodological guidelines, tutorials, and monographs on “Craniometry”.

LIST OF SCIENTIFIC WORKS PUBLISHED ON THE TOPIC OF THE DISSERTATION

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9. Шадлинский В.Б., Исаев А.Б., Гулиева К.Дж. (Shadlinskiy V.B., Isaev A.B., Gulieva K.Dzh.) Особенности индивидуально-типологической изменчивости крыловидно-верхнечелюстной щели // – Воронеж:Журнал анатомии и гистопатологии. – 2017. Т.6, №3, с.82-85.

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