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N.S. Korchynska, O.M. Slobodian, V.O. Kostyuk
Department of Anatomy, Topographic Anatomy and Operative Surgery (chief – prof. O.M. Slobodian)
Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi

FETAL ANATOMY OF THE MAXILLARY CELLULAR PROCESS

ФЕТАЛЬНА АНАТОМІЯ КОМІРКОВОГО ВІДРОСТКА ВЕРХНЬОЇ ЩЕЛЕПИ

Резюме. В статті наведено дані щодо фетальної анатомії коміркового відростка, визначеної методами морфометрії, рентгенографічного дослідження, комп'ютерної томографії, макроскопічного дослідження, термохімічної та механічної обробки кісток черепа, статистичної обробки отриманих даних. Дослідження коміркового відростка верхньої щелепи проведено на 53 трупах 4-10-місячних плодів та 11 новонароджених. Встановлено, що з 6-го місяця внутрішньоутробного розвитку всі структури верхньої щелепи рентгенконтрасні. На рентгенівських знімках чітко виявляються обриси верхньої щелепи, її лобовий, виличний і комірковий відростки. У 8-10-місячних плодів і новонароджених добре диференціюються комірки зачатків молочних зубів та міжкоміркові перегородки. Висота коміркового відростка обох верхніх щелеп (на різних ділянках) у перинатальному періоді суттєво збільшується на 6-му, 8-10 місяцях та у новонароджених, а найменше – на 4-5-му та 7-му місяцях внутрішньоутробного розвитку. Довжина коміркового відростка правої та лівої верхньої щелепи у плодів і новонароджениххсуттєво збільшується впродовж 7-10 місяців та у новонароджених, а найменше – впродовж 4-6 місяців внутрішньоутробного розвитку.

Ключові слова: верхня щелепа, комірковий відросток, фетальна анатомія, людина.

Every year over 600 children in Ukraine are born with congenital defects of the maxillary-facial are a (1:600-1:700 of deliveries), including 400-450 cases with congenital cleft lip or palate [1].

Severity of facial developmental defects is manifested not only by external deformity and pronounced functional disorders, but it produces a negative imprint on psychic development of a child [2, 3]. Understanding of the regularities in the development of structures and topography of the fetus is of great importance for interpreting a real direction of organogenesis processes, mechanisms of normal formation, occurrence of anatomical variants and congenital defects [4]. Without awareness of the processes of a normal organism development to understand its structural-functional organization of organs and systems is next to impossible [5]. Mean while the notion of the norm in order to compare it with real results of the examination is nowadays a complicated and in sufficiently known issue [6]. The data concerning organometric parameters of the maxilla during the perinatal period of development make a basis to determine certain congenital facial defects and formation of physiological occlusion.

The morphological study conducted differs from those common ones that the development and formation of the maxillary structures are determined in the perinatal period of human ontogenesis, while the majority of studies [7-10] deals with investigation of topographic-anatomical peculiarities of the maxilla in the postnatal period of human ontogenesis.

The objective of the research: to find out the chronological sequence of changes in parameters, the formation of the structure and the topography of the cellular process of the maxilla during the fetal period.

Material and methods. *The study was performed on 53 dead 4-10-month fetuses and 11 newborns of both sexes without any external signs of anatomical deviations or abnormalities, and without vivid macroscopic deviations from the normal cranial structure.*

The study was conducted according to the methodical guidelines"On Keeping to Ethicand Legal Norms and Requirements while Conducting Scientific Morphological Research" [11], the main principles of the World Medical Association (WMA) Declaration of Helsinki as a statement of ethical principles for medical research involving human subjects(1964-2000) and the Order of the Ministry of Health of Ukraine № 690 dated 23.09.2009.

Modern adequate morphological and statistical methods were applied during investigation: morphometry, X-ray examination, computed tomography, macroscopic examination, thermochemical and mechanical processing of the cranial bones, statistical processing of the data obtained.

Before starting the research occipital-calcaneal length (OCL) of the fetus was measured. After OCL was measured the specimens of dead fetuses were fixed in 10 % neutral formalin solution during 2-3

weeks followed by their storage in 5 % neutral formalin solution [12].

Results of the research and their discussion. Anlage of the cellular process of the maxilla occurs during the 4-week of the intrauterine development. The cellular process grows from the maxilla till the 3rd month of the intrauterine development. The cellular process emerges arch-like along the perimeter from the maxillary lower margin. It is less marked in the 4-5-month fetuses and resembles a semicircular groove.

The macroscopic examination found three large cells of the primary teeth rudiments in 11,8% of early fetuses, and four cells – in 88,2 % of 4-5-month fetuses. The apex of the cell of the primary middle incisor rudiment is located 0,4±0,01 mm lower from the caudal border of the piriform opening on the right maxilla, and 0,38±0,01 mm lower on the left maxilla. The apex of the cell of the primary canine rudiment is located 0,4±0,01 mm higher from the piriform opening on the right maxilla, and 0,37±0,02 mm higher on the left maxilla. The apex of the cell of II primary tooth rudiment is located in the point of cell connection of the I and III primary teeth rudiments. The top surface of the cells is covered with thin osseous tissue and downwards it is covered with the connective tissue. The apex of the cell of the III primary tooth rudiment is separated from the lower wall of the infraorbital opening by very thin osseous lamina.

In 5-month fetuses all the four cells of the primary teeth rudiments are well marked, and intercellular septa are less marked. The apex of the cell of the I primary tooth rudiment is located 0.43±0.01 mm lower from the caudal margin of the piriform opening on the right maxilla, and 0.40±0.02 mm – on the left one. The cell of the primary canine rudiment on the right maxilla is located 0.25±0.02 mm higher from the caudal border of the piriform opening and 0.26±0.01 mm – on the left maxilla. In early fetuses the longest height of the cellular process is found in the area of cells of the I and III primary teeth rudiments. It is 5.71±0.09 mm on the right maxilla and 5.57±0.08 mm on the left one. The shortest height of the cellular process is determined in the area of cells of the II and IV primary teeth rudiments. It is 3.25±1.14 mm on the right maxilla and 3.22±1.12 mm – on the left one.

In 4-month fetuses the length of the cellular process of the right maxilla is19.44±1.34 mm and the left one – 19.25±1.45 mm, in 5-month fetuses its length is 21.18±1.89 and 20.87±1.67 mm respectively. It is 2.1±0.23 mm thick on the right maxilla and 2.0±0.25 mm thick on the left one in the place of location of the cellular rudiments. And the cells of the IV primary tooth rudiment – 1.5±0.12 and 1.35±0.15 mm respectively.

X-ray detects the most marked infraorbital border and cellular arch of the maxilla in early fetuses. Four cells are found in every maxilla in all the 6-7-month fetuses. The sizes of the cellular processes of the right and left maxillae do not differ considerably and are within the following parameters: the width of the cellular process of the maxilla in 6-month fetuses in the area of cells of the I, II and II primary teeth rudiments is similar along the full length. It is 2.5±0.12 mm. The cells of the IV primary tooth rudiment are 1.67±0.14 mm, and they are 6.76±0.48 and 3.5±0.54 mm high respectively. In 7-month fetuses the width of the cellular process of the maxilla in the area of the cell of the I primary tooth rudiment is 2.7±0.11mm; the cell of the II primary tooth rudiment – 2.34±0.27 mm; the cell of the III primary tooth rudiment – 2.74±0.25 mm and the cell of the IV primary tooth rudiment – 1.8±0.22 mm. The cells of the I,II and III primary teeth rudiment are 7.53±0.58 mm high, and the cell of the IV primary tooth rudiment – 3.8±0.67 mm.

The apex of the cell of the I primary tooth rudiment in the maxilla is located 0.28±0.09mm lower from the caudal border of the piriform opening in 6-month fetuses on the right maxilla, and 0.25±0.07 mm – on the left one. In 7-month fetuses it is – 0.13±0.04 mm and 0.12±0.02 mm respectively.The apex of the cell of the III primary tooth rudiment in 6-month fetuses in the right maxilla is 0.1±0.07 mm higher and in the left one – 0.12±0.05 mm. In 7-month fetuses it is located on the level of the caudal border of the piriform opening. In 6-month fetuses the cellular process of the right maxilla is 21.64±2.02 mm long, and of the left one – 21.38±1.62 mm. In 7-month fetuses it is 26.08±2.01 mm and 25.43±2.51 mm respectively.

In 8-month fetuses the cell of the V primary tooth rudiment is slightly marked. In newborns all the cells of the cellular process are well marked. The sizes of the cellular process on the right and left maxillae do not differ much and are within the following parameters: in 8-month fetuses the cellular process of the maxilla in the area of the cell of the I primary tooth rudiment is 2.9±0.54 mm thick,the cell of the II primary tooth rudiment– 2.45±0.32 mm,the cell of theIII primary tooth rudiment– 3.1±0.13 mm,the cell of theIV primary tooth rudiment – 1.95±0.34 mm,the cell of the V primary tooth rudiment – 1.46±0.22 mm. The cells of the I, II and III primary teeth rudiment are 7.91±0.14 mm high, the cell of the IV primary tooth rudiment – 4.03±0.23 mm, the cell of the V primary tooth rudiment – 2.05±0.16 mm. In 10-month fetuses the cellular process of the maxilla in the area of the I primary tooth rudiment is 3.15±0.44 mm wide,the cell of theII primary tooth rudiment – 2.85±0.32 mm, the cell of theIII primary tooth rudiment – 3.24±0.14 mm,the cell of the IV primary tooth rudiment – 2.12±0.31 mm,the cell of the V primary tooth rudiment – 1.57±0.28 mm. The cells of the I, II

and III primary teeth rudiments are 8.2±0.53 mm high,the cell of the IV primary tooth rudiment – 4.27±0.39 mm, the cell of the V primary tooth rudiment – 2.29±0.23 mm. In newborns the cellular process of the maxilla in the area of the cell of the I primary tooth rudiment is 3.4±0.46 mm wide,the cell of theII primary tooth rudiment – 3.13±0.11mm,the cell of the III primary tooth rudiment – 3.57±0.36 mm,the cell of the IV primary tooth rudiment – 2.35±0.29 mm,the cell of the V primary tooth rudiment – 1.82±0.45 mm. The cells of the I, II та III primary teeth rudiments are 9.08±0.85 mm high, the cell of the IV primary tooth rudiment – 4.68±0.44 mm, the cell of the V primary tooth rudiment – 2.45±0.31 mm. In 8-10-month fetuses the apices of the cells of the I and III primary teeth rudiments of the right and left maxillae are located on the level of the caudal border of the piriform opening. Intercellular septa are marked and deep. In 8-month fetuses the cellular process of the right maxilla is 26.5±2.06 mm long, and the left one – 26.10±2.01 mm. In 10-month fetuses the cellular process is 28.6±1.9 mm and – 28.2±1.8 mm long respectively. Macroscopic examination determined that in newborns the cellular process of the right maxilla is 31.1±1.9 mm long and the left one – 30.8±1.9 mm.

At the end of the fetal period the cellular process of the maxilla is well marked with a wide cellular canal. In 8-month fetuses the cellular groove is completely closed in the anterior part, at the same time it is not completely closed in the lateral part. In 10-monthfetusesthe cellular groove is completely closed.

Intercellular septa of the maxilla in the early period of ontogenesis are slightly marked. Till the end of the perinatal period the intercellular septa between all the cells of the primary teeth rudiments are clearly outlined. Since the 6th month of the intrauterine development all the structures of the maxilla are radioopaque. The outlines of the maxilla are clearly seen on the radiograms including its frontal, zygomatic and cellular processes, and the piriform opening. In 8-10-month fetuses and newborns the radiograms show clear outlines of the maxilla and zygomatic bone, frontal, zygomatic and cellular processes. The cells of the primary teeth rudiments and intercellular septa are well differentiated.

Macroscopic examination determined that the height of cellular process of the right maxilla in the area of the cells of the I and III primary teeth rudiments in fetuses and newborns increases from 5.71±0.09 mm to 9.41±0.2 mm,and the cellular process of the left maxilla – from 5.57±0.08 mm to 9.24±0.1 mm, which is indicative of an even increase of this parameter1,68 times as much.The height of the cellular process of the right maxilla in the area of the cells of the II and IV primary teeth rudiments in fetuses and newborns increases from 3.25±1.14 mm to 9.41±0.2 mm, and the cellular process of the left maxilla – from 3.22±1.12 to 9.24±0.1 mm, which is indicative of an even increase of this parameter 1,68 times as well.This parameter becomes much larger on the 6th, 8-10th months and newborns. It is the least – on the 4-5th and 7th months of the intrauterine development for the cellular processes of both right and left maxillae.

The length of the cellular process of the right maxilla in fetuses and newborns increases from 19.44±1.34 mm to 38.29±0.31 mm, and the length of the cellular process of the left maxilla – from 19.25±1.45 mm to 38.05±0.29 mm, which is indicative of an even increase of this parameter twice as much from both sides. This parameter increases considerably during 7-10 months and newborns, and it is the least – during 4-6 months of the intrauterine development for both maxillae.

Conclusions. 1. Beginning from the 6th month of the intrauterine development all the maxillary structures are contrast on X-ray. The outline of the maxilla, its frontal, zygomatic, cellular and pear-shaped opening processes are clearly seen on X-ray images. In 8-10-month fetuses and newborns the cells of the temporary teeth germs and intercellular septa are well differentiated. 2. The height of the cellular process of the right and left maxillae (in different areas) in the perinatal period increases considerably on the 6th, 8-10th months and newborns, and the least – on the 4-5th and 7th months of the intrauterine development. 3. The length of the cellular process of the right and left maxillae of fetuses and newborns increases considerably during 7-10th month sand newborns, and the least increase is observed during the 4-6th months of the intrauterine development.

The prospect of further recearch. To study out the chronological sequence of changes in parameters, the formation of the structure and the topography of the cellular process of the maxilla in infants.

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ФЕТАЛЬНАЯ АНАТОМИЯ АЛЬВЕОЛЯРНОГО ОТРОСТКА ВЕРХНЕЙ ЧЕЛЮСТИ

Резюме. В статье приведены данные относительно фетальной анатомии альвеолярного отростка верхней челюсти, определённые методами морфометрии, рентгенографического обследования, компьюте-

рной томографии, макроскопического обследования, термохимической и механической обработки костей черепа, статистической обработки полученых данных. Исследование альвеолярного отростка верхней челюсти проведено на 53 трупах 4-10 месячных плодов и 11 новорожденых. Выявлено, что с 6-го месяца внутриутробного развития все структури верхней челюсти рентгенконтрасные. На рентгеновских снимках чётко видны очертания верхней челюсти, её лобный, скуловой і альвеолярный отростки. У 8-10-месячных плодов и новорожденых хорошо дифференцируются альвеолы зачатков молочных зубов и межальвеолярные перегородки. Высота альвеолярного отростка обеих челюстей (на разных участках) в перинатальном периоде существенно увеличивается на 6-ом, 8-10 месяцах и у новорожденых, и менее – на 4-5-ом и 7-ом месяцах внутриутробного развития. Длина альвеолярного отростка правой и левой верхней челюсти в плодов и новорожденных существенно увеличивается напротяжении 7-10 месяцев и у новорожденных, и менее – на 4-6 месяцах внутриутробного развития.
Ключевые слова: верхняя челюсть, альвеолярный отросток, фетальная анатомия, человек.

FETAL ANATOMY OF THE MAXILLARY CELLULAR PROCESS

Abstract. The article provides data concerning fetal anatomy of the maxillary cellular process, determined methods of morphometry, X-ray examination, computed tomography, macroscopic examination, thermochemical and mechanical processing of the skull bones, and statistical processing of the obtained data. The study was performed on 53 dead 4-10-month fetuses and 11 newborns. Found that beginning from the 6th month of the intrauterine development all the maxillary structures are contrast on X-ray. The outline of the maxilla, its frontal, zygomatic, cellular and pear-shaped opening processes are clearly seen on X-ray images. In 8-10-month fetuses and newborns the cells of the temporary teeth germs and intercellular septa are well differentiated. The height of the cellular process of the right and left maxillae (in different areas) in the perinatal period increases considerably on the 6th, 8-10th months and newborns, and the least – on the 4-5th and 7th months of the intrauterine development. The length of the cellular process of the right and left maxillae of fetuses and newborns increases considerably during 7-10th month sand newborns, and the least increase is observed during the 4-6th months of the intrauterine development.
Key words: upper jaw, cellular process, fetal anatomy, human.

Відомості про авторів:
Слободян Олександр Миколайович – доктор медичних наук, професор, завідувач кафедри анатомії, топографічної анатомії та оперативної хірургії Вищого державного навчального закладу України «Буковинський державний медичний університет», м. Чернівці;
Корчинська Наталія Сергіївна – кандидат медичних наук, асистент кафедри анатомії, топографічної анатомії та оперативної хірургії Вищого державного навчального закладу України «Буковинський державний медичний університет», м. Чернівці;
Костюк В'ячеслав Олександрович – аспірант кафедри анатомії, топографічної анатомії та оперативної хірургії Вищого державного навчального закладу України «Буковинський державний медичний університет», м. Чернівці.
Information about authors:
Slobodian Oleksandr M. – Doctor of Medical Science, Professor, Chief of the Department of Anatomy, Topographic Anatomy and Operative Surgery of the Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi;
Korchyns`ka Nataliya S. – Candidate of Medical Science, assistant of the Department of Anatomy, Topographic Anatomy and Operative Surgery of the Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi;
Kostyuk Viacheslav O. – Postgraduate of the Department of Anatomy, Topographic Anatomy and Operative Surgery of the Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi.

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Рецензент – проф. Хмара Т.В. (Чернівці)