

Structural peculiarities of the maxilla and its surfaces in the perinatal period of ontogenesis

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Abstract

Background: Congenital clefts of the upper lip and palate are not more often as a part of this or that syndrome, but as an independent congenital disease in the form of an isolated developmental defect of separate organs. Therefore, it is necessary to detect and systematize peculiarities of the development and structure of the maxilla and its body in the perinatal period of ontogenesis.

Material and methods: The study was conducted on 53 dead 4-10-month fetuses and 11 newborns (5 isolated organ complexes in particular) of both sexes without external signs of anatomical defects or abnormalities and without vivid macroscopic deviations from the normal structure of the skull. Before the beginning of the craniometric examination every specimen was fixed in craniostat in the horizontal auricular-ocular plane, in so-called "Frankfurt horizontal line". All the measurements on the skulls were made by means of a tape measure, caliper, slide compasses and dial calipers.

Results: With the age of fetuses a short and wide shape of the upper jaw changes into a high and narrow one. The absence of the zygomatic-cellular crest is a characteristic sign of the fetuses of all the age groups and newborns. During perinatal period of ontogenesis infraorbital opening is usually projected in the point of crossing of the line connecting a lateral angle of the eye with the wing of the nose and the line passing from the medium angle of the eye to the angle of the mouth.

Conclusions: A typical shape of the maxilla during the perinatal period is short and wide found in early fetuses (4-5 month) – in 94% of cases, in fetuses of 6-7 months of age – in 82% and in fetuses of 8-10 months of age (late fetuses) – in 68% and newborns. A typical shape of the anterior surface of the maxilla for early fetuses is irregular trapeziform, and for 6-7-month fetuses, late fetuses and newborns – an elongated triangle shape.

Key words: fetus, maxilla, infraorbital opening, ontogenesis.

Introduction

According to statistical data of the Ministry of Public Health (MPH) of Ukraine occurrence of congenital defects

among children at the age under 17 in Ukraine for the recent decade has a convincing tendency to increase from 19.49% to 26.7% [5].

Congenital defects of the muscular-skeletal system occupy the second place among all the congenital developmental defects [6]. Every year in Ukraine over 600 children are born with congenital developmental defects of the maxillary-facial area including 400-450 cases with congenital cleft of the upper lip and palate [3, 5]. Congenital clefts of the upper lip and palate are not most often a part of this or that syndrome, but as an independent congenital disease in the form of an isolated developmental defect of separate organs [7, 8]. Availability of comorbid dental pathology requires mutual efforts and cooperation of both theoretical and practical medical men of various specialties to introduce a complex of measures directed to the prevention and timely diagnostics of occurrence of dental-maxillary defects as well as improvement of dental health of children [1, 2, 4].

Therefore, insufficient and fragmentary study of the evidence of structural peculiarities of the maxilla and its body, peculiarities of the formation of the shape and topographic-anatomical interrelations of the upper jaw in the perinatal period of ontogenesis require a careful investigation.

Material and methods

The study was conducted on 53 dead 4-10-month fetuses and 11 newborns (5 isolated organ complexes in particular) of both sexes without external signs of anatomical defects or abnormalities and without vivid macroscopic deviations from the normal structure of the skull. The study was conducted according to the methodical recommendations "Keeping to ethical and legal standards and requirements in making scientific morphological studies" and followed the main directions of Helsinki declaration of the World Medical Association concerning ethical principles to conduct scientific-medical investigations with human participation (1964-2000) and the Order of the MPH of Ukraine dated 23.09.2009 № 690.

The organ and cranial metric results were analyzed on common craniometric points, distances between them, and along the main special planes and lines according to the Recommendations on Anthropologic and Medical Craniology (V. P. Vorobyov, 1932; V. N. Shevkunenko, 1947; V. V. Bunak, 1941, 1953; Y. Y. Roginskyi, M. G. Levyn, 1955; V. P. Alekseyev, G. F. Debets, 1964; V. G. Koveshnikov, 1965; V. S. Speranskiy, 1991). Before the beginning of the craniometric examination every specimen was fixed in craniostat in the horizontal auricular-ocular plane, in so-called "Frankfurt horizontal line". All the measurements on the skulls were made by means of a tape measure, caliper, slide compasses and dial calipers.

Results and discussion

On the basis of the analyzed results of our own study we can state that in early fetuses (4-5 month) – in 94% of cases, in fetuses of 6-7 months of age – in 82% and in fetuses of 8-10 months of age (late fetuses) – in 68% and newborns a typical shape of the maxilla is short and wide. A short and wide shape of the maxilla changes into a high and narrow one with age. In 4-5-month fetuses a high and narrow shape of the maxilla

is 6%, in 6-7-month fetuses – 18% and in 32% of late fetuses (8-10 month) and newborns (fig.1).

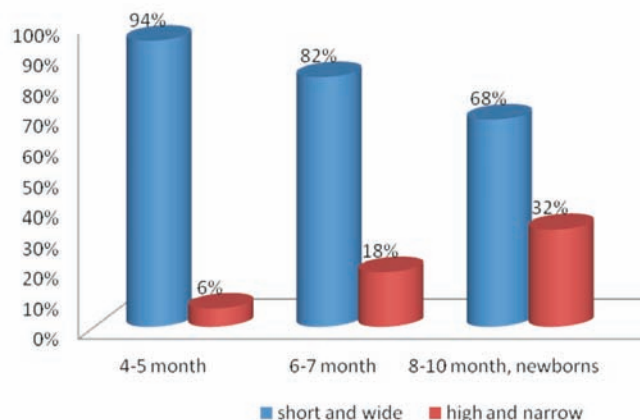


Fig. 1. Variants of the maxillary shape.

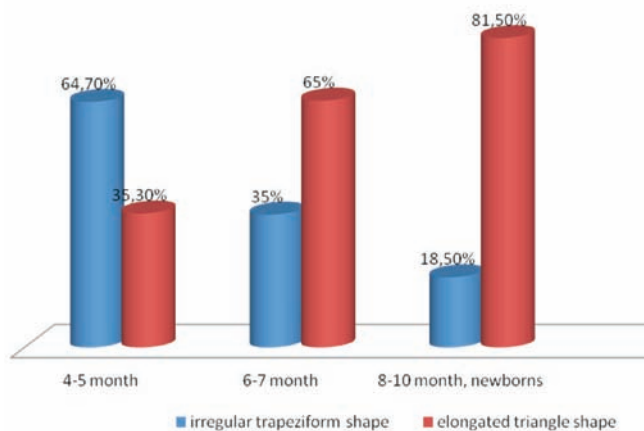


Fig. 2. Structural variants of the anterior surface of the maxilla.

A typical shape of the anterior surface of the maxilla for early fetuses (4-5 month) is irregular trapeziform in 64.7%, and for 6-7-month fetuses – 35%, late fetuses (8-10 month) and newborns – in 18.5%. In 35.3% of 4-5-month fetuses, in 65% of 6-7-month fetuses and in 81.5% of 8-10-month fetuses and newborns the anterior surface of the maxilla becomes of an elongated triangle shape.

It is indicative of the fact that a typical shape of the anterior surface of the maxilla for early fetuses is irregular trapeziform, and for 6-7 month, late fetuses and newborns – an elongated triangle shape (fig.2). In the perinatal period of ontogenesis all the objects of the study had a rough surface of the maxilla formed of a spongy substance.

With the age of fetuses the relief of the anterior surface of the maxilla changes. Thus, a flat anterior surface of the maxilla is found in 4-month fetuses, it changes into a little concave one in the area of the infraorbital opening in 5-month fetuses. In 6-7-month fetuses the surface is more concaved passing from the base of the frontal process to the infraorbital opening. In 8-10-month fetuses and newborns a deep concavity is found near the cellular process from the nasal incisures to infraorbital opening. In the perinatal period of ontogenesis the height of the anterior surface increases by 2,3 times, and the length – by 2,1 times as much. The height and length of

the anterior surface of the maxilla increase most intensively in 8-10-month fetuses and newborns, and the slowest – in 5-month fetuses of the intrauterine development.

The absence of the zygomatic-cellular crest is a characteristic feature of fetuses in all the age groups and newborns. Therefore, the anterior surface of the maxilla without clear borders passes into the infratemporal one. The border between these two surfaces is a projection extension of the base of the zygomatic process to the cellular process. In all the fetuses and newborns infratemporal surface is prominent, rough, and directed from the anterior surface dorsally and parallel to the median plane and upwards. Externally and upwards it is covered by the zygomatic bone and zygomatic process of the maxilla. In the perinatal period of ontogenesis the height of the infratemporal surface becomes by 2,3 times as much, and its length – by 1,7 times as much. A considerable increase of the height and length of the infratemporal surface of the maxillary body occurs in 8-10-month fetuses and newborns, and it is the slowest in 5-month fetuses. The ratio of the height of the anterior surface to the height of the infratemporal surface in the perinatal period is in an average 1:1 (1:1,03 – in 5-month fetuses and 1:1,25 – in 6-month fetuses), which is indicative of the similarity of the height sizes of these surfaces. The ratio of the length of the anterior surface of the maxillary body and the length of the infratemporal surface in the perinatal period ranges between 3,1:1 (in 4-month fetuses) and 4,2:1 (in 8-10-month fetuses), which is indicative of a considerable development of the anterior surface in its length which is connected with the development of the cellular process.

During the study the infraorbital opening was found in all the objects. In all 4-5-month fetuses the infraorbital opening is oval in its shape and is located in the center of the anterior surface of the maxillary body. In 15% of 6-7-month fetuses this opening becomes round, and in other 85% – it is oval. During this period the infraorbital opening is shifted upwards and located in the center in the upper third of the anterior surface. Beginning with the 8th month of the intrauterine development the infraorbital opening moves laterally and is located in the center between the median and distal third of the anterior surface of the maxillary body and preserves its oval shape. An oval shape of the infraorbital opening should be considered a typical one, and a round one – as a variant of it.

During perinatal period the sizes of the infraorbital opening range from 0,7×0,6 mm (in 4-month) to 2,0×1,2 mm (in newborns). The distance from the center of the infraorbital opening to the orbit border of the same name is on average 1,5-1,7 mm in 4-month fetuses; 1,8-2,0 mm in 5-month fetuses; 1,8-2,2 mm in 6-month fetuses; 2,1-2,4 mm in 7-month fetuses; 1,8-3,0 mm in 8-10-month fetuses and 2,5-4,0 mm in newborns. The direction of the infraorbital opening passes upwards and from the periphery to the median plane.

During the perinatal period of ontogenesis the infraorbital opening is usually projected in the point of crossing of the line connecting the lateral angle of the eye with the nasal wing and the line passing from the median angle of the eye to the angle of the mouth. In early (4-5-month) fetuses this projection of the infraorbital opening is found in 70.6% – in the right and

64.7% – in the left, in 6-7-month fetuses in the right – in 75% and in the left – 80%, and in late fetuses (8-10-month) and newborns – in 74% and 77.7% respectively.

At the same time, during the study different variants of location of the infraorbital opening were found. This opening was located higher or lower of the typical projection 0,3-0,5 mm to the right, and 0,4-0,8 mm to the left. In 4-5-month fetuses a variant projection was found in the right in 29.4% (23.52% higher and 5.88% lower) and in the left – in 35.3% (23.52% higher and 22.76% lower), in 6-7-month fetuses: in the right – in 25% (15% higher and 10% lower) and in the left – in 20% (15% higher and 5% lower), and in 8-10-month fetuses and newborns in 26% (18.5% higher and 7,4% lower) and 22.3% (14.9% higher and 7,4 lower) respectively. In the variant structure the location of the infraorbital opening higher of the typical projection is found more frequently (fig. 3 and fig.4).

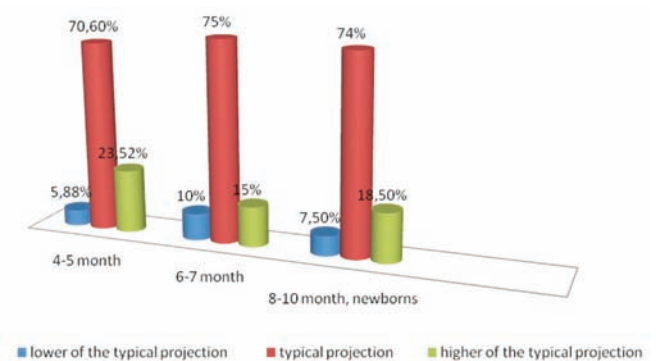


Fig. 3. Projection of the infraorbital opening on the right upper jaw.

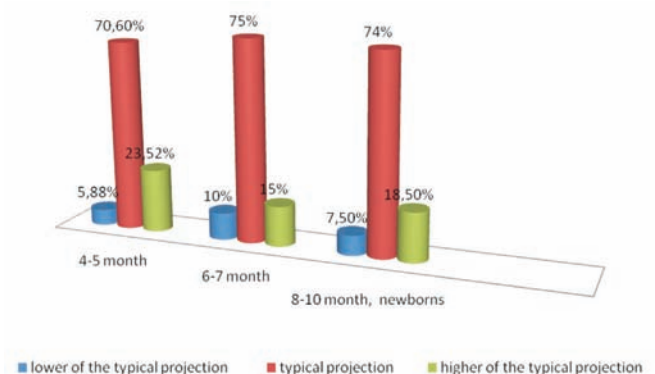


Fig. 4. Projection of the infraorbital opening on the left upper jaw.

Conclusions

1. A typical shape of the maxilla during the perinatal period is short and wide and is found in early fetuses (4-5 month) – in 94% of cases, in fetuses of 6-7 months of age – in 82% and in fetuses of 8-10 months of age (late fetuses) – in 68% and newborns. A short and wide shape of the maxilla changes into a high and narrow one with age.

2. A typical shape of the infraorbital opening is oval, and round is considered to be as a variant of it. During the peri-

natal period of ontogenesis the infraorbital opening is usually projected in the point of crossing of the line connecting the lateral angle of the eye with the nasal wing and the line passing from the median angle of the eye to the angle of the mouth. In early (4-5-month) fetuses this projection of the infraorbital opening is found in 70.6% – in the right and 64.7% – in the left, in 6-7-month fetuses in the right – in 75% and in the left – 80%, and in late fetuses (8-10-month) and newborns – in 74% and 77.7% respectively.

3. A typical shape of the anterior surface of the maxilla for early fetuses is irregular trapeziform, and for 6-7 month, late fetuses and newborns - an elongated triangle shape. The ratio of the height of the anterior surface to the height of the infratemporal surface in the perinatal period is on average 1:1 (1:1,03 – in 5-month fetuses and 1:1,25 – in 6-month fetuses), which is indicative of the similarity of the height sizes of these surfaces. The ratio of the length of the anterior surface of the maxillary body and the length of the infratemporal surface in the perinatal period ranges between 3,1:1 (in 4-month fetuses) and 4,2:1 (in 8-10-month fetuses), which is indicative of a considerable development of the anterior surface in its length which is connected with the development of the cellular process.

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