

## Hard palate in fetal and early neonatal periods of human ontogenesis

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Manuscript received October 30, 2018; revised manuscript December 10, 2018

### Abstract

**Background:** This investigation is important to reveal hard palate ontogenetic transformations in fetal and early neonatal periods, which is important for the facial surgery in fetuses, newborns.

**Material and methods:** Investigations have been performed in 53 cadavers of fetuses from 4 to 10 months of development, and in 9 cadavers of newborn children of both genders, who died of the reasons not connected with digestive system diseases or anomalies, and were without external signs of anatomic deviations or abnormalities, and were without evident macroscopic deviations of skull structure. Adequate anatomic methods have been used for investigation: macropreparations, topographic anatomical sections, morphometry, and statistical analysis.

**Results:** Variants of the hard palate shapes during fetal and early neonatal periods of ontogenesis are the following: trapezium (15%), square (10%), and ellipse (7%) shapes. The shapes of the trapezium were detected in most cases in 6-7-month fetuses (20%), and in equal percentage proportion in early and late fetuses (12%). The square form is a characteristic variant form in early fetuses (17%), with fetuses age increase this form was detected in less cases, in 6-7-month fetuses – in 10%, in late (8-10 month) fetuses – in 8%, and within the newborn period the square form was not observed. The form of the ellipse was observed in larger percentage proportion in late fetuses and in newborns (12%), in less proportion (5%) – in 6-7-month fetuses, in early fetuses this form was not detected at all. Forms of the ellipse and of the trapezium were observed in equal number of cases in 8-10-month fetuses and newborns. With fetuses development the hard palate form in sagittal and frontal planes changed from arcuate to flat one.

**Conclusions:** An ascertainment of typical and variant anatomy of hard palate forms and types would promote implementation of the new methods of major and reconstructive surgical invasions in face and skull.

**Key words:** hard palate, anatomy, fetus, newborn, human.

### Introduction

Cleft lip and hard palate rank first by rate in the structure of dentofacial region development defects, and rank third among all types of congenital anomalies, and belong to the heaviest development defects, leading to significant anatomic (cosmetic) and functional abnormalities. 70% of them are congenital cleft upper lip and palate, and 30% are craniofacial dysostoses. The most various are congenital defects of hard palate development, determined by its size, form, and position variations [1, 11, 12].

The establishment of anatomical variability of organs, structures and their parts at all stages of human development is very relevant. Anomalies of the teeth-jaw system take one of the main places among the pathologies of the maxillofacial area and, according to various authors; their prevalence is from 70 to 80%. One of the common congenital malformations of the maxillofacial area is the cleft lip and cleft hard palate, which are called “hare-lip” and “wolf’s jaw”. The severity of birth defects is expressed not only by external distortions and functional disorders but also by a negative influence on the child’s mental development [10, 17].

The hard palate, which separates oral and nasal cavities, undergoes complex development, and is tightly connected with formation of craniofacial region, dento-mandibular complex, and the skull as a whole. Therefore, knowledge of its individual anatomic variability is important not only for functional anatomy and medical craniology, but also

has direct application significance in solving of numerous problems of stomatology, otorhinolaryngology, and mandibulofacial surgery. Wide application of morphometric methods in anatomic sphere investigations would permit to reveal significant signs of certain structure components, objectively reflecting changes, which take place in human ontogenesis [2, 3, 6, 7, 15].

This investigation priority is revealing of hard palate ontogenetic transformations in fetus and neonatal periods, which is important for facial congenital pathology surgery in fetuses, newborns and infants [4, 5, 8, 9, 16, 13, 14].

**Investigation objective:** to determine forms and types of hard palate in fetuses and newborns.

### Material and methods

Investigations have been performed in 53 cadavers of fetuses from 4 to 10 months of development, and in 9 cadavers of newborn children of both genders, who died of the reasons, not connected with digestive system diseases, and were without external signs of anatomic deviations or abnormalities, and were without evident macroscopic deviations of skull normal structure. Adequate anatomic methods have been used for investigation: macropreparations, topographic anatomic sections, morphometry, and statistical analysis. This work has been performed in compliance with general provisions of WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Sub-

jects (1964-2000) and Ministry of Health of Ukraine (Order No 690 of 23.09.2009), and it is a fragment of the complex planned initiative research work of M. Turkevich from Human Anatomy Department, Anatomy, Topographic Anatomy and Operative Surgery Department of Bukovinian State Medical University: "Peculiarities of morphogenesis and topography of organs and systems in pre-natal and post-natal ontogenesis periods" (State Registration No 011U002769).

Macroscopic investigation makes it possible to study peculiarities of the structure and different topographic anatomic relationships of maxilla and hard palate structures, in particular, during fetal and early neonatal periods of ontogenesis. On specimens of maxillae palatine processes and horizontal plates of palatine bones, their anatomic peculiarities were investigated. Linear dimensions were measured with centimeter stripe, trammel, small caliper and slip compass. Further forms and types of hard palate were determined. To determine hard palate types its index was used. Hard palate index was calculated with the formula: maximal hard palate width was divided by its maximal length, and multiplied by 100. Calculated index within 100.0-110.0 indicated dolichouranic type of the hard palate, within 110.1-120.0 – mesouranic type, within 120.1-130.0 – brachyuranic type, within 130.1-140.0 and more – hyperbrachyuranic type [10, 17].

### Results and discussion

In fetuses and newborns, the hard palate form syntopically depends on the cellular maxillary process structure. In accordance to geometric figures, five its forms were distinguished: oval form, semicircular form, ellipse form, trapezium form, and square form. It is significant, that typical hard palate forms during fetal and early neonatal periods of ontogenesis are oval (47%) and semicircular form (21%) (tab. 1). Oval form, in percentage proportion, is mostly detected in newborn period (56%), during fetal period this form varies from 40% to 50%. The most seldom was the oval form observed in 7-month fetuses (33%). The highest indices of the hard palate oval form were in 6-7-month fetuses, in early fetuses (4-5 month) – in 24% of cases, in later fetuses (8-10 month) and in newborn period – 16%.

Variant forms of hard palate during fetal and early neonatal periods of ontogenesis are trapezium form (15%), square form (10%), and ellipse form (7%) (tab. 1). Trapezium form was detected mostly in 6-7-month fetuses (20%),

in equal percentage proportion– in early and later fetuses (12%). Square form is typical variant form of early fetuses (17%), with age this form was detected in less number of cases, in 6-7-month fetuses – in 10%, later (8-10-month) fetuses – 8%, in newborn period square form was not observed. Ellipse form in larger percentage proportions was observed in later fetuses and in newborns (12%), in lesser ones (5%) – in 6-7-month fetuses, in early fetuses this form was not detected at all. In equal number of cases trapezium and ellipse forms were observed in 8-10-month fetuses and in newborns.

Table 1

Hard palate forms in fetal and early neonatal periods of human ontogenesis

Age, months	Objects number	Oval form	Semi-circular form	Ellipse form	Trapezium form	Square form
4-5	17	47%	24%	-	12%	17%
6-7	20	40%	25%	5%	20%	10%
8-10	16	50%	13%	13%	12%	12%
Newborns	9	56%	22%	11%	11%	-
		47%	21%	7%	15%	10%

Within fetuses development the hard palate shape in sagittal and frontal planes changes. Whereas in 4-9-month fetuses hard palate in macropreparations of sagittal topographic sections was of the arch form, which convexity was directed cranially to the nasal cavity, in 10-month fetuses and newborns it was flat, convexity was evident in anterior part of the hard palate, near palatine processes of maxilla. During the perinatal period hard palate in frontal plane in equal distance from maxillary palatine processes edge and soft palate looked like an arch, its convexity was directed cranially towards nasal cavity. Dorsally hard palate changes its form from arch-like to flat one, and near transition point of hard palate into the soft one, it becomes flat.

During fetal and early neonatal periods of ontogenesis, based on hard palate index determination, its types were established. The characteristic type of hard palate is dolichouranic one, which in this age period was detected in 64% of cases. Dolichouranic type of hard palate structure in 4-5-month fetuses was detected in 71% of cases, in 6-7-month – in 45%, in 8-10-months – in 63%. In newborns this type of hard palate structure was observed in all cases

Table 2

Hard palate types in fetus and early neonatal periods of human ontogenesis

Age, months	Objects number	Dolichouranic type	Mesouranic type	Brachyuranic type	Hyperbrachy-uranic type
4-5	17	71%	29%	-	-
6-7	20	45%	30%	10%	15%
8-10	16	63%	13%	6%	18%
Newborns	9	100%	-	-	-
		64%	21%	5%	10%

(100%), but in 8-month fetuses the dolichouranic type was not detected.

Mesouranic, hyperbrachyuranic, and brachyuranic types of the structure are variation ones, their proportions in fetuses and newborns are 21%, 10% and 5% of cases correspondingly (tab. 2). Mesouranic type of the hard palate is typical in 5-7-month fetuses, it was observed averagely in 30% of cases, more rarely – in 4-, 8-, 9-month, and this type was never detected in 10-month fetuses. Hyperbrachyuranic and brachyuranic types of the hard palate were observed in 6-8-month fetuses only, these types were detected in early (4-5-month) and in 9-10-month fetuses. The largest indexes of hyperbrachyuranic and brachyuranic types of the hard palate are typical in 6-7-month fetuses, their indexes are 15% and 10% of cases correspondingly.

### Conclusions

1. During fetal and early neonatal periods the oval (47%) and semicircular (21%) forms of hard palate are typical, and are characteristic for dolichouranic and mesouranic types.

2. Variant shapes of hard palate are trapezium form (15%), square form (10%), and ellipse form (7%). These shapes are characteristic for hyperbrachyuranic and brachyuranic types. Ellipse form of hard palate may be linked with brachyuranic type, and trapezium and squareforms – with hyperbrachyuranic one.

3. With fetuses development the hard palate form changes its shape in sagittal and frontal planes from arcuate to flat one.

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