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AMELOGENESIS AND DENTINOGENESIS OF THE TOOTH: MECHANISMS OF FORMATION OF HARD TISSUES

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Annotation.: The formation of hard tooth tissues is a complex multi-stage biological process involving the development of enamel and dentin. Amelogenesis and dentogenesis occur during embryonic and postnatal development and ensure the formation of structures necessary for the normal functioning of the dental system. The purpose of this article is to consider the main stages of enamel and dentin formation, the cellular mechanisms of these processes, as well as the factors influencing their normal course. An analysis of modern scientific data shows that disruption of the processes of amelogenesis and dentogenesis can lead to various dental development abnormalities and increase the risk of dental diseases.

Keywords: tooth, amelogenesis, dentinogenesis, enamel, dentin, odontoblasts, ameloblasts, tooth development.

Introduction. Dental development is a complex morphogenetic process that involves the interaction of epithelial and mesenchymal cells. During this process, the main hard tissues of the tooth are formed — enamel and dentin. Enamel is the most mineralized tissue of the human body, while dentin forms the bulk of the tooth and performs supporting and protective functions.

The formation of these tissues occurs due to two interrelated processes — amelogenesis and dentinogenesis. They begin at the stage of development of the dental bud and continue until the formation of the tooth crown is completed. The study of these processes is of great importance for understanding the pathogenesis of congenital and acquired diseases of the hard tissues of teeth.

Amelogenesis: the formation of enamel

Amelogenesis is the process of enamel formation, which is carried out by specialized cells — ameloblasts. These cells originate from the internal epithelium of the enamel organ and play a key role in the synthesis and mineralization of the enamel matrix.

The process of amelogenesis is conventionally divided into several successive stages.

1. The stage of differentiation.

At this stage, the cells of the inner enamel epithelium turn into ameloblasts. At the same time, the cells of the dental papilla differentiate into odontoblasts, which begin to form dentin. The formation of dentin is a prerequisite for the start of enamel synthesis.

2. Secretory stage.

At this stage, ameloblasts begin to actively synthesize the organic enamel matrix. The main proteins of the enamel matrix are amelogenins, emelines and ameloblastins. These proteins form the basis for subsequent tissue mineralization.

3. The stage of maturation.

At the final stage, intensive mineralization of the enamel occurs. Minerals, mainly hydroxyapatite crystals, gradually replace the organic matrix. As a result, the content of mineral components in mature enamel reaches approximately 96%, which makes it the hardest tissue in the body.

Dentinogenesis: the formation of dentine

Dentinogenesis is the process of dentin formation carried out by odontoblast cells that originate from the mesenchyme of the dental papilla. This process begins earlier than amelogenesis and plays an important role in the formation of the tooth structure.

Dentinogenesis also includes several stages.

1. Differentiation of odontoblasts.

The cells of the peripheral zone of the dental papilla differentiate into odontoblasts. These cells are located on the periphery of the tooth pulp and begin the synthesis of the organic dentin matrix.

2. Predentin formation.

Odontoblasts secrete an organic matrix called predentine. It consists mainly of collagen fibers and non-collagen proteins.

3. Mineralization.

Predentin gradually mineralizes, turning into mature dentin. Mineralization occurs due to the deposition of hydroxyapatite crystals between the collagen fibers.

Unlike enamel, dentin retains the ability to form throughout a person's life. Depending on the conditions, primary, secondary and tertiary dentin can be formed.

The relationship between amelogenesis and dentinogenesis

Amelogenesis and dentinogenesis are closely related. Dentin formation begins earlier and serves as a signal for the onset of enamel formation. This process is regulated by complex molecular mechanisms and the interaction of various growth factors.

Disruption of the interaction between ameloblasts and odontoblasts can lead to defects in the tooth structure. The most common pathologies include enamel hypoplasia, amelogenesis imperfecta, and dentinogenesis imperfecta.

Factors affecting the formation of hard tooth tissues

The processes of amelogenesis and dentinogenesis can be influenced by various internal and external factors. The main ones include:

- genetic features of the body;
- Vitamin and mineral deficiencies;
- infectious diseases during the period of tooth formation;
- exposure to toxic substances;
- metabolic disorders.

A particularly sensitive period is childhood, when active formation of dental tissues occurs. Any adverse factors during this period can lead to permanent changes in the structure of enamel and dentin.

Conclusion.

Amelogenesis and dentinogenesis are key processes in the formation of hard tooth tissues. Their normal course ensures the correct structure and functional stability of the teeth. Violations of these processes can lead to various dental pathologies, which underlines the importance of their study in modern dentistry.

Understanding the cellular and molecular mechanisms of enamel and dentin formation makes it possible to develop new methods for the prevention and treatment of diseases of the hard tissues of teeth, as well as to improve approaches to restorative dentistry.

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