

Mechanisms of Dentin and Pulp Pain Formation and Perception

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The basic task of dentistry from the beginning to the present day is the relief, establishment and early removal of pain. Toothache and periodontal pain are the most common reasons for a patient to enter the dental clinic. The toothache can be caused by the loss of protective enamel, pulp tissue disease, periodontal disease, dental therapeutic procedures. The pain is a subjective symptom and that experience is impossible to accurately convey to another person.

The teeth are innervated by the maxillary and mandibular branches of the trigeminal nerve whose smaller branches enter the pulp through the apical opening of the root. The teeth are richly innervated. The cross-section, of e.g. the premolars in the apical region shows an average of 926 nerve fibers. The nerves pass through the pulp and branch on the periphery of the coronary pulp below the odontoblastic layer in the nerve plexus Rashkow. Rashkow's plexus consists of myelinated (A) and unmyelinated (C) nerve fibers [1]. From the Rashkow plexus a portion of the small nerve fibers (< 1 mm) remains around the odontoblast and part passes through the predentin and enters the dentinal tubules. There is no evidence of the existence of nerve fibers in the area of the enamel dentinal border, although at that site the tooth is clinically most sensitive [2].

There are many theories of pain transmission. Some of them are odontoblastic, nervous, hydrodynamic theory. Hydrodynamic theory considers that stimuli cause fluid movement in tubules and deformations of odontoblastic extensions, in that way the close contact of odontoblastic bodies with mechanoreceptors transmits these movements to the nerve endings [3]. The pain threshold represents the lowest intensity of stimulus that can for some time cause a sensation of pain. The pain threshold is individual, dependent and psychogenic characteristics of a person.

The dental pulp innervation includes afferent nerves (conducting sensory impulses) and efferent autonomic nerves (changing blood flow in the pulp).

The painful stimuli are recorded and transmitted by the myelinated nerve fibers and by the unmyelinated nerve fibers.

The painful sensations are transmitted to the CNS by fast transmission of nerve impulses and slow transmission by the passage of chemical substances (transmitters) to the nerves. Chemical mediators (transmitters) are: bradykinin, histamine, prostaglandin, serotonin, substance P, other agents. Myelinated (A) nerve fibers have relatively fast pain conduction, a relatively low irritability threshold and conduct sharp, penetrating painful impulses. Unmyelinated (C) nerve fibers have relatively slow pain conduction, a relatively high threshold of irritability, and conduct impulses of dull, prolonged pain.

Bacterial toxins and inflammatory-released chemical mediators irritate the pulp nerves, lower the nerve irritation threshold, cause vasodilatation and increased capillary permeability.

Vasodilatation and increased capillary permeability increase the pressure in the pulp which further irritates the nerves and causes pain. During the life, the number of myelinated nerves that enter the tooth decreases accordingly which causes reduction of the teeth sensitivity to pain. The types of toothache are dentinal, pulp, periodontal and reflected. The differentiation between dentinal and pulp pain is essential for the accurate diagnosis of dental disease. The dentine and pulp pain differ etiologically. The dentine pain has no direct nerve stimulation, while the pulp pain is caused by direct nerve stimulation (bacterial-toxic, etc).

The dentine painful hypersensitivity is both a symptom and also the disease itself. The dentine pain occurs with erosion of the tooth neck, gingival recession, cavity preparation and prosthetic grinding. The dentine pain is caused, sharp and short-lived. Their stimuli can be of mechanical, thermal, chemical and physical type. The mechanical stimuli occur during grinding, abrasion, attrition, probe pulling, and brushing, while the chemical stimuli occur when we eat sweet, sour, salty, medications, cavity cleansers and bacterial toxins. The physical stimuli are caused when pressure changes (flying, diving), air drying, as well as during X-rays examinations. The dentine sensitivity is reduced by tubular sclerosis, stimulus removal, impregnation of dentin tubule openings, as well as filling with dental materials. The pulp pain is just one of the symptoms of total pulp disease.

The pulp pain can be caused by mechanical injuries to the pulp, penetration of bacterial toxins into the pulp, penetration of bacteria into the pulp, and penetration of chemicals into the pulp.

The pulp pain is spontaneous and associated with histological changes in the pulp. The pulp pain occurs during the hyperemia, serous pulpitis, purulent pulpitis, necrosis and gangrene. The hyperemic pain is short-lived (a few seconds to a few minutes), external stimuli to the cold, bite, chemicals and ceases with a return to body temperature [4].

The pain of serous pulpitis is spontaneous, strong, intermittent, lasts for several hours, intensifies with cold drinks and also intensifies with heat. The pain of purulent pulpitis is spontaneous, pulsating, muffled, intensifies in the heat, intensifies at night and in a supine position. The pain of necrosis and gangrene is spontaneous, strong, continuous, muffled and irradiating. The pulp pains are widely dispersed by sensory nuclei of the trigeminal lengthening. Cerebellum, cranial nuclei of motor nerves, cerebellum, reticular formation, ventrobasal thalamus, hypothalamus, somatosensory cerebral cortex and orbital cerebral cortex (regions of the CNS).

The periodontal pain originates from the marginal periodontium, periodontal along the root and periapical periodontium. The periapical periodontal pain is acute, strong, muffled and irradiating. The reflected pain can be Irradiation (from the teeth to another area of the head and neck) or odontalgia (from some area of the head and neck to the teeth).

The irradiation is the transmission of pain caused by inflammation of the pulp, etc. from the tooth to distant sites innervating the same nerve. The odontalgia is pain that is transmitted from distant places to the tooth area (sinuses, jaw joint, sialolithiasis, neuralgia, expansive tumors, psychosomatic conditions, etc.) [5,6].

As the conclusion we can consider that pain is a symptom and a multidimensional experience that contains sensation and reaction provoked by noxae and dentin and pulp stimuli.

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