

## CLINICAL METHODS FOR ASSESSING PULP VIABILITY

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**Abstract:** Dental pulp (pulpa dentis) is a specialized type of loose fibrous connective tissue rich in blood vessels and nerve fibers that fills the tooth cavity, i.e. the pulp chamber and root canals. Due to the presence of a large number of receptor nerve endings in it, the pulp provides a very high pain sensitivity of tooth tissues to the effects of mechanical, physical, and chemical stimuli. Examination of the pulp involves attempts to get a response from the sensitive neurons of the pulp. Examination of the pulp involves thermal or electrical stimulation of the tooth to obtain a subjective response from the patient (i.e., it is necessary to find out whether the nerve endings of the pulp are functioning). The study can also be more objective if devices are used to determine the safety of pulp vessels.

**Keywords:** pulp, root canals of the tooth, carbon dioxide, electroodontometry.

Unfortunately, a quantitative assessment of the pulp condition can only be carried out with histological examination: it has been found that there is not always a correlation between objective clinical signs, symptoms and the histological structure of the pulp.

a) Temperature test. Various methods and materials were used to determine the sensitivity of the pulp to temperature stimuli. A normal reaction to cold or heat is a sensation that the patient feels, but which passes immediately after the stimulus is eliminated. Deviations from the norm can be different: lack of response to the stimulus, an increase in the duration or intensity of pain after the stimulus is eliminated, or instantaneous, unbearable pain at the time of applying the stimulus to the tooth.

The cold test is widely used as a primary method for assessing the condition of the pulp. This method is especially useful in patients with porcelain jacket or ceramic-metal crowns when there is no access to the natural surface of the tooth (or a large amount of metal is present). If the doctor decides to use ice sticks for this study, the use of rubberdam is recommended, since melting ice will fall on the gums and adjacent teeth, which will lead to false positive results.

Frozen carbon dioxide, also known as dry ice, or carbon snow, or solid CO<sub>2</sub>, is a reliable diagnostic tool for obtaining a positive tooth reaction with a preserved viable pulp. It was found that the vital tooth would react to both frozen CO<sub>2</sub> and a spray containing chloroethane, with chloroethane causing the reaction a little faster. Frozen carbon dioxide has also shown its effectiveness in determining the pulp reaction of teeth covered with crowns, for which other research methods, such as electrodiagnosis, are not applicable.

Carbon dioxide applicators are used for the study, which are obtained by placing gaseous CO<sub>2</sub> in a special plastic cylinder. The applicator is applied to the outer surface of the tooth or crown. One applicator can be used to examine several teeth. At the same time, the teeth must be isolated, and the soft tissues of the oral cavity must be protected from contact with frozen CO<sub>2</sub> using a 5x5 cm gauze swab or a cotton roller. Since frozen carbon dioxide has an extremely low temperature (-69°F to -119°F; -56 °C to -98 °C), there is a risk

of soft tissue damage. An experiment on extracted teeth demonstrated that the application of frozen CO<sub>2</sub> causes a significantly stronger decrease in intrapulpal (VP) temperature than chloroethane and ice. It also turned out that CO<sub>2</sub> applications do not cause irreversible changes in the pulp and do not lead to cracks in the enamel.

The most popular method of conducting a cold test is the use of a cooling spray. The spray is ready to use, easy to use, and provides reliable and reproducible results equivalent to those obtained using frozen CO<sub>2</sub>. One of the existing products contains 1,1,1,2-tetrafluoroethane, which has zero ozone depletion potential and is environmentally friendly. Its temperature is -26.2 °C. The spray is most reliable in diagnosis if applied to the tooth on a large cotton swab of size No. 2 (diameter — 5.56 mm). In one study, when using a cotton ball of size No. 2 moistened with a cooler, a significantly lower VP temperature was obtained than when using a smaller cotton ball of size No. 4 (diameter — 3.18 mm.) or a cotton applicator. A moistened cotton ball should be placed in the middle of the vestibular surface of the tooth or crown. As with other methods of assessing the condition of the pulp, it is necessary to check the reaction of adjacent normal teeth and teeth from the opposite side in order to determine the normal reaction. It was found that the use of frozen CO<sub>2</sub> and cooling spray is superior to other cold methods, as well as equally and even superior to electrical methods for determining pulp vitality. However, it has been found that loss of periodontal attachment and gum recession can affect pain sensitivity to cold.

For reliability, a cold test should be performed in combination with electrodontometry (the method is described below in a separate article on the website) so that the results of one study confirm the results of another. If a mature non-injured tooth does not react to either cold or electrical stimuli, its pulp is considered necrotic. However, a multi-root tooth can react to cold and electrical impulses if there is a living pulp in at least one root.

Another temperature examination method is the use of heat. A heat test is especially relevant if the patient's main complaint is severe toothache from contact with hot food or drink. The use of this method is advisable when the patient cannot identify a disturbing tooth. Each tooth is isolated with a rubber stamp, starting from the posterior tooth in this area. The syringe for rinsing is filled with a liquid (most often plain water), the temperature of which is close to that which causes pain. The isolated tooth is sprayed with liquid from a syringe to determine how it reacts: within normal limits or not. The doctor continues to move along the quadrant, isolating each tooth, until the affected tooth is detected. This tooth will react to heat with immediate severe pain. With this method, the reaction may be delayed, so it is necessary to wait 10 seconds between studies for symptoms to manifest. This method is also used when cold is an irritating stimulus and it is necessary to immerse the entire crown of the tooth in cold water.

Another thermal examination method is applying a heated gutta—percha or wax stick to the surface of the tooth. In this case, the tooth surface should be lubricated with a thin layer of lubricant to prevent the adhesion of gutta-percha or wax to the dry surface of the tooth. Heat can also be obtained by rubbing a dry rubber polishing head at high speed over the dry surface of the tooth. However, the latter method is rarely used today and is not recommended for use. Another approach is to use electric heating tools. If the heat test confirms the results of other methods of examination of the pulp, you can start providing emergency care. Often, a tooth that is sensitive to heat can be the cause of spontaneous pain. The patient may come with a cold liquid in his hand, which he uses to reduce pain. In this case, applying cold to a particular tooth can reduce pain and greatly help in diagnosis. Usually, a tooth that reacts to heat and calms down from cold is necrotized.

b) Electrodontometry. Assessment of the reaction of pulp neurons (vitality) it can also be performed by electrodontometry. For this purpose, electrodontometers of various types and manufacturers are used. Electrodontometry should be an integral part of any dental practice. It should be noted that the vitality of the pulp is determined by the integrity and health of the vascular system, and not by the condition of the nerve

fibers of the pulp. Despite the fact that some progress has been made in determining the viability of the pulp based on blood supply, this technology is currently not sufficiently advanced to use it on a regular basis in a clinic setting. The electrodontometer has a number of limitations in providing information about the viability of the pulp. The reaction of the pulp to electricity does not reflect the histological picture of the normal condition or disease of the pulp. The reaction of the pulp to an electric current indicates only that it contains viable nerve fibers capable of reacting. The digital readings of the electrodontometer are important only if they differ significantly from the readings obtained during the examination of the control tooth of the same patient, provided that the electrode was placed in the same area of the tooth. However, in most cases, the presence or absence of a reaction is assessed. Studies have shown that the results of electrodontometry are most accurate when any current strength does not cause any reaction. This lack of response is most often observed in necrotic pulp.

**Conclusion.** In addition, it is possible to receive a false negative or false positive reaction, and the doctor should take this into account when making a final diagnosis.

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