

# Clinical and Diagnostic Criteria for the Occurrence of Cracks and Fractures of Teeth

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## ABSTRACT

One of the most difficult cases that a dentist may encounter is the detection of a root crack, which may present difficulties in diagnosis and further treatment. There are several clinical signs on the basis of which a clinician may suspect this type of pathology.

**KEYWORDS:** crack, fracture, bone destruction, pin, injury, gum, resection.

The variety of types of cracks and fractures, as well as the associated signs and symptoms, often makes it difficult to diagnose them. The depth of the crack or fracture line can directly affect the prognosis of the tooth and should be determined before deciding on treatment. Certain types of cracks can be simple, for example, a surface crack of enamel, or noticeable, like a fracture of a hillock.

The crack can spread through the root system of the tooth up to the involvement of the pulp or it can split the tooth into two separate fragments; it can be oblique and spread in the cervical region so that after removing the crown fragment of the tooth, the question arises about the possibility of its restoration. Any described situation may be accompanied by mild, moderate or severe symptoms or be asymptomatic.

## Types of cracks

Depending on the type of crack, you can evaluate the prognosis of the tooth and make alternative treatment options. Unfortunately, it is often very difficult to determine the depth of a crack without tooth extraction. Cracked teeth can be divided into 3 main categories:

- cracks in the enamel;
- fractures (or cracks) of teeth;
- split teeth/roots.

Enamel cracks, as a rule, are located within the enamel, not spreading to the dentin, and occur naturally or as a result of injury. They are mainly found in permanent teeth, more often on the teeth of the lateral group. When transilluminating such teeth, the cracks will look like thin lines in the enamel capable of transmitting light, which indicates that the crack is located in a special way. Optical coherence tomography has been proposed to detect cracks in the enamel. Cracks in enamel are usually asymptomatic and do not require treatment unless they create a cosmetic defect. The tooth crack spreads deeper into the dentin than the surface cracks of the enamel, and primarily spreads mesiodistally, involving the marginal ridges. Staining and transillumination will help identify a potential root fracture.

Symptoms of a tooth fracture can range from complete absence to severe pain. A tooth fracture does not always mean that the tooth is split into two parts; however, with inactivity or the presence of provoking factors such as supracontacts, the fracture can turn into a split root. A tooth

fracture can be treated with conventional restoration, endodontically (non-surgically or surgically) and even tooth extraction, depending on the extent and location of the crack, the severity of symptoms and the possibility of their elimination. Because of this, it is quite difficult and unpredictable to observe teeth with cracks. A certain combination of factors, signs and symptoms observed simultaneously, which allows the doctor to suspect a certain pathology, is called a syndrome. However, given that a tooth root crack can be accompanied by many signs and symptoms, making a definitive diagnosis can be difficult. Therefore, the term "cracked tooth syndrome" should be avoided.

Subjective and objective factors in the case of a cracked tooth are usually diverse, so a preliminary diagnosis of a cracked tooth is likely to be an assumption. Once this assumption is made, the patient should be carefully informed of any possible deterioration in the prognosis of the upcoming treatment. Since the degree of success in restoring cracked teeth is limited, early detection and prevention, as well as detailed informed consent, are crucial. A split of teeth/roots occurs when a crack spreads from one tooth surface to another, dividing it into two segments. If the crack is oblique and a smaller fragment can be removed, the tooth can probably be restored, for example, with a fracture of the tubercle. However, if the crack spreads below the bone level, the tooth may not be able to be restored, and endodontic treatment will not bring the desired success. Careful forecasting is necessary before starting any dental treatment, however, in the case of cracked teeth, it is often difficult. Due to doubts about the long-term success of the treatment of detected or suspected cracks, the doctor should carefully decide on further treatment and avoid endodontic treatment with a confirmed diagnosis of a split root.

## Vertical fracture of the root

One of the most common causes of recurrence of endodontic pathology is a vertical fracture of the root, a deep tooth crack extending longitudinally along the long axis of the root (Figs. 1 and 2). It often passes through the pulp towards the periodontium. A vertical fracture is usually located centrally, rather than obliquely, and usually passes through the marginal ridges. These fractures may occur before or as a result of endodontic treatment, or develop after treatment.

Since the diagnosis of vertical fractures can be difficult, they often remain undiagnosed, therefore it is necessary to determine the presence and depth of a vertical root crack before starting restorative or endodontic treatment — this can significantly affect the success of the entire treatment. The patient agreeing to endodontic treatment should be informed that the prognosis of the tooth is questionable. The doctor should be able to recognize subjective and objective signs indicating a vertical fracture of the root or a split tooth,

make a prediction about the possibility of a cure and convey this information to the patient.

### Perforations

Root perforation is a clinical complication that can lead to a lack of success in treatment. The communication formed during perforation between the root canal system and the periradicular tissues or oral cavity may worsen the prognosis of treatment. Root perforation may be the result of extensive carious lesion, resorption, or a doctor's error during instrumental treatment of the root canal or preparation for a pin. The prognosis for the treatment of perforations depends on the size, location, time of detection and treatment, the degree of damage to the periodontium, as well as on the tightness and biocompatibility of the repair material. It was found that the success of treatment mainly depends on the immediate closure of the perforation and careful control of infection. To close the perforations, a mineral trioxide aggregate (MTA), Super EVA (zinc oxide cement kneaded on a compound of eugenol and epoxybenzoic acid), temporary reducing material IRM, glass ionomer cement (SIC) and composites are usually used.

### Treatment

If the clinician has confirmed the presence of a tooth root crack, it is necessary to make an adequate decision regarding subsequent treatment. In such cases, the discomfort associated with such cracks is often not acute and patients endure it for years. Some refuse to remove the causal tooth. Nevertheless, it must be remembered that as long as there is such a defect, bone destruction continues and will continue as long as the affected tooth remains in the dentition. Therefore, the pathological process associated with the destruction of bone tissue may limit the patient's choice of treatment tactics. Thus, it is recommended to remove a tooth with a vertical crack as soon as it becomes appropriate. Multi-root teeth can be successfully treated by resection of the affected root, amputation or hemisection. For lateral teeth, the prognosis is good, provided that the crack is completely eliminated. The results of the study of teeth with resected roots report 5-year dental preservation in 94% of cases and 10-year dental preservation in 68% of cases. For single-root teeth, the prognosis is generally unfavorable, and tooth extraction is often required.

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