

## **THE OBVIOUS AND THE OBSCURE: STEPS FOR CRACK DETECTION AND CONFIRMATION**

If you do not look for cracks and fractures in teeth, you will not likely find them. If a crack is suspected, several steps should be taken to confirm the suspicion. The tests performed and results achieved will vary between teeth that have or have not had endodontic treatment.

If the suspect tooth has been endodontically treated, symptoms will be limited to those caused by the affected periodontium because the tooth has no remaining vital pulp tissue. For the tooth that has a vital pulp, the following steps will only confirm the presence or absence of a crack. Further pulpal and periodontal testing will be necessary to develop a diagnosis and determine the need for endodontic treatment. Remember, cracks in teeth are findings, not diagnoses.

The steps to identify a crack or fracture include:

- Dental History
- Subjective Examination
- Objective Visual Examination
- Tactile Examination
- Periapical Tests
- Bite Tests
- Vitality Testing
- Periodontal Probing
- Radiographic Examination
- Restoration Removal
- Staining
- Transillumination
- Wedging Forces
- Surgical Assessment

Most of these tests are also necessary to determine pulpal and/or periapical diagnosis; detection of cracks and diagnosis of pulp are two separate entities.

### **Dental History**

Check for a history of:

- Repeated occlusal adjustments with only temporary relief of symptoms or evaluation by several practitioners without a conclusive diagnosis.
- Periodontal disease with extensive bone loss in the area. Decreased bone support has been thought to lead to increased stress on dentin, predisposing the roots of a tooth to cracking.
- Other cracked teeth, because many of the anatomical and behavioral factors that predispose teeth to cracks often affect more than one tooth.

### **Subjective Examination**

Ask the patient:

- To point to the tooth that is sensitive, keeping in mind, however, that patients might not be able to identify the problem tooth.
- If they remember accidentally biting a hard object. Such an incident may correspond to a sudden onset of pain.
- About any damaging habits, such as clenching or grinding the teeth, or chewing on ice, pens, hard candy or other objects. Many patients have had a history of having a crack in their tooth and some can help you by making their own diagnosis.

### **Objective Visual Examination**

Check the:

- Face, checking for enlarged jaw muscles, which may indicate a habit of overstressing the teeth during mastication. Also look for wear facets, which may indicate a history of clenching, bruxism, or biting and chewing with excessive force.
- Teeth for cusp-fossae relationships that may cause excessive occlusal stresses. Note any steep cusps or developmental grooves, because these may predispose teeth to cracks.
- Tooth surfaces carefully in a dry field. Note any craze lines or darker cracks. Generally, the darker the stain in a crack, the longer the crack has been present. Also look for cracked restorations or unusual gaps between restorations and tooth structure.

Enhanced magnification and illumination can be helpful in visual identification of a crack.

### **Tactile Examination**

- Scratch the surface of the tooth with the tip of a sharp explorer; the tip may catch in a crack.
- Palpate the gingiva around the tooth, checking for possible evidence of an underlying dehiscence or fenestration.

### **Periapical Tests**

Percussion is usually beneficial in determining whether a crack is present that initiates from the crown. Especially helpful is the use of angular percussion (as opposed to direct vertical percussion), which may cause separation of the crack line and stimulation of periodontal ligament fibers or fluid movement in the dentinal tubules.

Palpation, while a very helpful test for other situations, is usually not beneficial in determining the existence of a crack.

### **Bite Tests**

- Use a rubber wheel, wood stick or other instrument to focus biting pressures on specific cusps to reproduce the patient's complaint (specially designed instruments are commercially available).

- Place the instrument on each cusp or fossa and have the patient bite down with moderate pressure and release. Explain to the patient that they will “bite slightly, squeeze tightly, open quickly.”
- Test several teeth and cusps; be sure to use controls.
- Watch the patient’s facial expression for response to pain upon biting pressure or release. If the patient has a painful response, ask if the pain is the same as he or she has been experiencing.

Pain during biting or chewing is considered a classic symptom and may be the only conclusive evidence early in the crack’s development. The absence of pain during biting, however, does not rule out the possibility of a crack.

### **Vitality Testing**

Establishing pulp vitality determines the pulpal diagnosis, but has little bearing on crack detection. However, a crack that extends to the pulp may allow bacterial contamination, which probably affects the pulp status.

### **Periodontal Probing**

Thorough probing in small increments around the entire circumference of the tooth may reveal a narrow, isolated periodontal probing defect, which is characteristic of a crack. If the probe extends 8mm, then the crack extends at least 8mm.

The narrow pocket that forms along a crack will restrict side-to-side motion of the probe, making it easy to differentiate from the broad-based defect characteristic of a periodontal disease pocket. Interproximal probing should be performed, especially if the crack runs in a mesiodistal direction. Interproximal restorations that are removed allow greater access to perform probing in these difficult areas.

### **Radiographic Examination**

Cracks rarely are visualized on conventional radiographs. Mesiodistal cracks can never be seen, and buccolingual cracks will only appear if there is actual separation of the segments or the crack happens to be at exactly the same angle as the x-ray beam.

Changes in the pulp chamber, canal or periapical space, however, may suggest the presence of a crack. Radiographic evidence tends to be more likely as the crack progresses and a bony defect develops. Making periapical radiographs from more than one angle and making bite-wing radiographs may increase the chance of catching a crack-induced defect early in its development. Newer techniques, such as cone-beam microcomputerized tomography, will likely be beneficial to noninvasively detect the presence and extent of cracks.

A thickened periodontal ligament space or a diffuse longitudinal radiolucency, especially one with an elliptical or J-shaped appearance apically along the root, or a U-shaped appearance involving the furcation and proximal surfaces, may indicate a crack. Check also for restorations held in place by pins, which can predispose teeth to cracking.

In endodontically treated teeth, rare but significant findings include a radiopaque line where the root canal filling material or sealer has been expressed into the crack during obturation. A consistent radiolucent line along the length of the root canal filling material may indicate space caused by a crack, but should not be considered conclusive because it could be caused by other entities.

The size, design and placement of posts often contribute to cracks, so it is best to check endodontically treated teeth for long posts, short-wide posts, custom metal posts or posts with threads that bind with tooth structure.

Radiographs can also help rule out other possible diagnoses. Look for evidence of perforations or internal or external resorption. Also check for signs that previous endodontic treatment may be recontaminated with bacteria.

### **Restoration Removal**

This allows visual examination of the remaining cavity. Carefully check the mesial and distal marginal ridges, which tend to be weak areas. Magnification, staining, transillumination and wedging forces are helpful after restoration removal.

### **Staining**

Cracks may be disclosed through staining. A dye, such as methylene blue, can be applied to the external tooth surface, in the cavity after restoration removal or on a surgically exposed root.

### **Transillumination**

In transillumination, a fiberoptic transilluminator or other similar light source (i.e., fibe-optic handpiece without water or a curing light) is applied directly to the tooth surface. All other lights sources are eliminated, the tooth is viewed in a mirror and the light beam is positioned perpendicular to the plane of the suspected crack. A crack will block the light.

Structurally sound teeth, including those with craze lines, will transmit the light throughout the tooth structure (see Bonus Material D for more information).

### **Wedging Forces**

After a crack is identified, it is important to determine if separable tooth segments exist. Application of wedging forces is used to make this determination, but only after the patient is informed of the potential for hearing cracking noises or feeling pain.

Any restorations are removed and an instrument is placed in the cavity with moderate pressure exerted on opposing walls to try to separate the segments. Movement of a tooth segment usually indicates significantly decreased prognosis unless determined to be a shallow cuspal fracture above the gingival attachment.

Clinicians and patients may be hesitant to perform wedging of the segments for fear of splitting the tooth iatrogenically or causing pain. However, if controlled force exacerbates the crack, certainly the tooth is predisposed to a later split anyway; the patient is best served to know this expeditiously.

**Surgical Assessment**

Surgical exploration allows for visual examination of the root surface for the appearance of a crack and should only be used if the crack is highly suspected and cannot be confirmed by all other possible diagnostic means. Cracks present in a buccolingual orientation are easier to detect during surgery than those that are present in a mesiodistal orientation, since visualization is impeded by adjacent teeth.

Performing diagnostic surgery, however, can help early detection of untreatable situations, sparing the need for endodontic or restorative treatment on an ultimately hopeless case. A consultation with an endodontist or periodontist may be advisable prior to surgical assessment.

Whenever surgery is performed to detect a crack, the patient should be fully informed that it is an exploratory diagnostic procedure.