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Cracked Tooth Syndrome (CTS) - A Review and Updates

Abstract

Till date, in the current dental practices, dentists often come across with few critical dental situations that remain undiagnosed or not managed properly. They should be careful about such conditions. Cracked tooth syndrome (CTS) may be one of those conditions. The diagnosis of CTS at an early stage may lead to successful restorative management and good outcomes. Purpose of this article is to provide an overview of the clinical features, diagnosis, classification, and management of cracked teeth which may be a diagnostic challenge in clinical practice.

Keywords: Endodontics, Cracked teeth, Pulpitis, Microleakage, Temporo-mandibular joint.

Introduction

Despite numerous advances in endodontic practice, practitioners still remain perplexed regarding the detection of cracked teeth, perhaps because patient's symptoms are often vague and radiographs are usually normal. This resulting delay in diagnosis and treatment can allow further longitudinal progression of the fracture, both in time and spatial dimension,¹ leading to eventual extraction. Correct diagnosis of a fractured tooth in its earliest possible stage encourages more conservative treatment options as well as an improved prognosis.

Definition

Several authors were given credit for various terminologies and classification considering cracks in teeth. At beginning, Gibbs² first explained "cuspal fracture odontalgia" as clinical presentation of incomplete fracture of posterior teeth with cuspal involvement. The term "cracked tooth syndrome" was elaborated by Cameron³ explaining the signs and symptoms related to cracked teeth. However, overlapping of different ideas or theories regarding CTS may lead to misconception. For example, CTS has been defined as an "incomplete fracture of a vital posterior tooth involving the dentin and possibly the dental pulp,"⁴ which may not support the theory of Cameron³ who believed that only 75% of teeth with CTS may have vital pulps.

The terminology used by several inventors may create a dilemma while describing the teeth with "cracked tooth syndrome," which actually may represent the teeth with vertical root fractures.⁵ The term CTS is misnomer as they do not have any conspicuous and definite pattern of symptoms. These symptoms may show variations with teeth having varying conditions like healthy pulp, pulpal inflammation, necrotic pulp or root canal-treated teeth.

Considering the incomplete tooth fracture, Ellis⁶ explained it as a "fracture plane of unknown depth and direction passing through tooth structure that, if not already involving, may progress to communicate with the pulp and/ or periodontal ligament." Cracks in teeth can represent both symptomatic as well as asymptomatic nature, and may be a causative factor in pulpal disease. The bacteria present in the cracks via fracture extension may involve the pulp chamber directly⁷ or indirectly through microleakage of bacterial toxins.⁸

Classification

Several authors have proposed classifications which are generally based on either the type or location of the crack, the direction and extent of the crack, and/ or the

risk of symptoms and/ or pathological processes. The American Association of Endodontists, in a document titled *Cracking the Cracked Tooth Code*⁹ identified five types of cracks which are given in Table 1.

Table 1. Classification of Cracked Tooth Syndrome (CTS)

S.No.	Classification	Originate	Direction	Symptom	Pulp Status	Prognosis
1.	Craze Line	Crown	Variable	None	Vital	Excellent
2.	Fractured cusp	Crown	M-D and/ or F-L	Mild and generally, to biting and cold	Usually vital	Good
3.	Cracked tooth	Crown + Root	M-D, often central	Acute pain on biting occasionally sharp pain to cold	Variable	Questionable; depends on depth, extent of crack
4.	Split tooth	Crown + Root	M-D	Marked pain on chewing	Often root filled	Poor unless crack terminate subgingivally
5.	Vertical root fracture	Roots	F-L	Vague pain mimics periodontal disease	Mainly root filled	Poor: Root resection in multirrooted teeth

Etiology and Incidence

Common causes include masticatory accidents, such as biting on a hard, rigid object with unusually high force,¹⁰ or excessive removal of tooth structure during cavity preparation. Stress concentration during restorative procedures is also a major factor in CTS. Para-functional habits such as bruxism are also associated with the development of this condition.¹¹ The higher incidence of CTS in mandibular second molars may be associated with their proximity to the temporo-mandibular joint, based on the principle of the “lever” effect the mechanical force on an object is increased at closer distances to the fulcrum. CTS have been reported in un-restored teeth or in those with minor restorations, which has led to the suggestion that there may be developmental weaknesses (arising within coalescence of the zones of calcification) within those teeth. Thermal cycling and damaging horizontal forces or para-functional habits have also been implicated in the development of enamel cracks in such un-restored teeth, with subsequent involvement of the underlying tooth.^{3,4}

Clinical Findings

The clinical signs and symptoms may vary according to the position and extent of the incomplete fracture.¹² Classically, the symptoms related to these teeth are pain on biting and sensitivity to thermal changes, particularly cold.¹³ Pain associated with the release of pressure, “rebound pain” is also a consistent finding. Occasionally, there is sensitivity to sweets. A chronic pulpiti with no clinical symptoms can exist as a result of microleakage

of bacterial by-products and toxins. Pulpal and periodontal symptoms may occur when the fracture extends to involve the pulp.¹⁴

Diagnosis

Diagnosing CTS has been a challenge to dental practitioners. Patients with cracked tooth syndrome usually report episodic vague and unlocalized symptoms, making it difficult to determine the presence or location of a tooth fracture. In addition, radiographic detection of cracked teeth is difficult since most fractures are incomplete and are surrounded by normal tooth structure somewhere either buccally or lingually. Unless the central ray is exactly parallel to the crack, it will not be visible on a periapical or bitewing radiograph.

Dental History

While asking about patient’s dental history, few definite and relevant points can emerge.¹⁵ The patient may give idea about course of previous extensive dental therapy which may further reveal persistence of symptoms in spite of undergoing repeated occlusal adjustments or replacement of restorations.

The patient will confirm about pain while biting on a particular tooth. Also, the patient may have thermal sensitivity, especially cold. Often, they feel sensitivity to sweets. On the other hand, it will be interesting to note that patient may remain asymptomatic for a long duration. Patients with existing cracked tooth may show the occurrence of other cracked teeth. Some habits like

clenching or grinding, chewing ice, pen, hard candy, or other similar objects are supposed to contribute for cracked teeth.

Clinical Examination

The diagnosis of such tooth becomes difficult as it is not possible to visualize the extent of the crack through clinical examination alone. Other relevant findings on examination may have the presence of facets on the occlusal surfaces (that may give suspicion of eccentric contact and risk of damaging lateral forces), localized periodontal lesion (in case of subgingival extension of cracks), or sensitivity provoked via sweet or thermal stimuli. Once the tooth becomes identified, it is supposed to remove existing restorations and do staining to further visualize the crack. For this, it is better to apply rubber dam, which may enhance the visualization of these cracks via tooth isolation, providing a contrasting background and a saliva-free zone.

Visual Examination

Visualization through eyes under illumination is an important prospect of clinical inspection of tooth, but cracks are seldom visible via naked eye. But these can be seen with the aid of magnifying loupes or operating microscope. However, cracks are not always readily apparent.

Tactile Test

In case, crack is present, the tip of an explorer may catch in crack while scratching the tooth surface with a sharp explorer,

Exploratory Excavation

Exploratory excavation may sometimes be required in order to support a visual diagnosis. This excavating action should be started only after the patient's consent since it does not give surety about the presence of cracks underneath any removed restoration. But often, removal of restorations may expose the fracture lines.

Percussion Test

On apical percussion of offending tooth, they seldom show tenderness to percussion.

Periodontal Probing

When the fracture line extends subgingivally (causing a localized periodontal defect), the periodontal probing becomes important to differentiate between a cracked

tooth and a split tooth. In case of suspected cracks, careful probing is needed to detect an isolated shallow periodontal pocket. However, an isolated deep probing may often give indication of split tooth, which generally results in poor prognosis.

Dye Test

Gentian violet and methylene blue are the dyes which help in detecting the fracture lines.¹⁶ But this method has drawback as it is long-time-taking procedure (at least 2-5 days) to show its effectiveness and it may need provisional restoration till the time. Placement of such restoration may further propagate the crack.

Transillumination

Transillumination can be a major adjunct in identifying the crack (either incomplete as in CTS, or a complete vertical root fracture).¹⁶ It is probably the most common method for traditional crack detection. For the transillumination procedure, the tooth is properly cleaned and the light source should be placed directly over the tooth. Any presence of crack involving the dentin will result in disruption of light transmission. If it is used without any magnification aid, it may have certain drawbacks. Hence, transillumination with a fiber optic light along with magnification aid will easily identify the presence of a crack.¹⁷

Bite Tests

Bite tests can be done over the suspected tooth using orange-wood sticks, cotton wool rolls, or rubber abrasive wheels such as Berlew wheels. While performing the test with orange-wood sticks, the patient is instructed to bite separately on the individual cusps. This method may be useful to isolate the fractured cusp.

Management

The treatment requirement of a cracked tooth is dependent on the position and extent of the fracture.¹⁸ An assessment of the stimuli, character and duration of the pain is also an influential guide for treatment.

Cracks that enter the pulp indicate the need for root canal treatment though Bader et al.¹⁹ reported that the majority of tooth fractures do not result in either pulp or tooth loss and can be managed successfully in a single visit using direct restorative materials. A multi-disciplinary approach involving endodontic, periodontic, orthodontic, prosthodontic and surgical intervention may be required. Fractures that involve the periodontal

attachment may require extraction, though hemisection or root amputation may be appropriate for some multi-rooted teeth.²⁰ However, teeth with cracks that are intra-osseous with periodontal-type pain often involving the mesial and distal aspects of the tooth and the cavity

floor have a hopeless prognosis.²¹ A decision flow chart for the different classifications of cracked teeth, as given by American Association of Endodontists can be seen in Fig. 1.²²

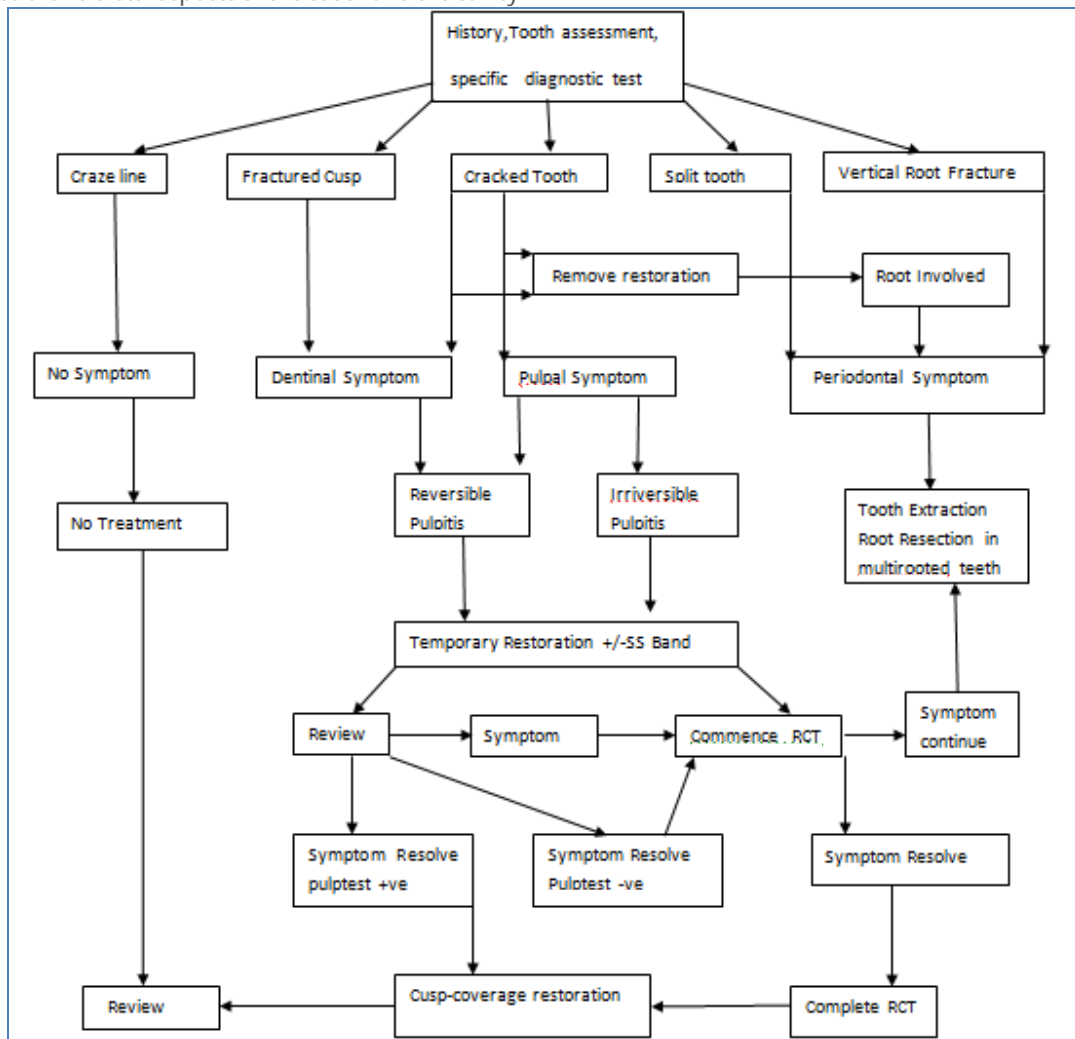


Figure 1. Decision Flow Chart for Different Classifications of Cracked Teeth

Conflict of Interest: Nil

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