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Diagnosis And Treatment Planning Of Cracked Teeth– A Review

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ABSTRACT

Cracked teeth continues to pose a significant challenge to dentists due to its variable, unusual clinical presentation, unpredictable symptoms and diagnostic conundrum.This article addresses the common clinical examples of cracked teeth, such as cusp fractures, fractures involvingfurcationsand root fractures, as well as the diagnosis and treatment of cracked teeth. This article also enlightens the advantages of using the Dental Operating microscope and high magnification loupes that aids in detecting microscopic crack lines or enamel craze lines.The article investigates what biomechanical factors contribute to the formation of cracks in teeth and when a full coverage crown may be advised to avoid future propagation of a fracture plane.

Keywords: Cracked teeth, Microscopes, tooth fractures, Fracture Plane

INTRODUCTION

A cracked tooth is a tooth with a partial or complete fracture of a stress plane that usually occurs within the tooth. [1] A tooth stress plane is caused by occlusal forces that are often applied on that tooth, producing an instance of increased energy to occur within the stress plane during a masticatory cycle.This higher energy occurrence results in the fracture of some of the natural tooth structure's chemical bonds that cross the stress plane. A clinically significant fracture plane on the stress plane may develop after several masticatory cycles. The rate of fracture of the stress plane potentially accelerates as the fracture plane expands, due to correspondingly higher stress being applied to the remaining non-fractured area of the stress plane.If the stress plane is contiguous with the periodontal ligament or the pulp chamber, or if such flexure results in fluid movement within

odontogenic processes, occlusal pressures becomes capable of causing the tooth structure surrounding the fractured area to flex, resulting in hyper-sensitivity. [2]

The biomechanical and periodontal prognosis of a cracked tooth, as well as the treatment requirements, are dependent on which aspects of the tooth are intersected by the existing partial fracture of the stress plane or would be intersected if the stress plane fractured completely. A tooth stress or fracture plane may be entirely supragingival and may or may not intersect the pulp chamber, or it may intersect the pulp chamber (potentially causing pulpal necrosis), a furcation (causing potential tooth root disconnection), a subgingival aspect of the root surface (causing potential chronic periodontal inflammation), or a tooth root (potentially destroying the root or making it impossible to endodontically seal the root). Depending on the structures with which the stress or fracture planes intersect, many types of cracks–furcation fractures, cuspal fractures, root fractures, gingival interface fractures, or craze lines may be developed. [3]

This article analyses the available literature on cracked tooth diagnosis and treatment, proposes a new paradigm for describing, diagnosing, and treating the cracked tooth.

Diagnosis of Cracked teeth

Cracked teeth are typically diagnosed visually (with the aid of a microscope if the tooth is cracked). [4]

A crack is frequently diagnosedby observing a crack line, which is a line segment from the periphery of a fracture plane that is visible on the tooth surface. The crack line does not always correspond to the size and shape of the fracture plane. If a direct restoration is present with a crack line that is contiguous with the restoration margin, it may be prudent to remove the restoration in order to view the full extent of the fracture line beneath it.

The mandibular molars are the most commonly fractured teeth, probably because of pointed, protruding maxillary molar palatal cusps occluding forcefully into the mandibular molar central grooves. [5, 6]

Maxillary premolars, which frequently have steep inclines on non-functional cusps that generate torque forces during mastication, are more prone to cracking than mandibular premolars, which mostly experience compression forces as opposing teeth occluding into the mandibular premolar buccal cusps. [2]

The other methods to diagnose cracked teeth are transillumination with a fiber optic light and bite test. [7]The tooth slooth is a unique plastic bite block used in the bite test that is used to diagnose cracks by applying masticatory force to a specific cusp. Classically the patient experiences pain when the masticatory force is released. [8]

Role of Microscopes in Diagnosis of cracked teeth

When examining cracked teeth, Mamoun JS et al 2009suggests employing microscopes (6–8 magnification or greater) and shadow-free coaxial illumination that is equivalent to the dentist's viewing axes, rather than unaided vision, entry level 2.5 magnification, or shadow-forming overhead lighting.[9]

Microscopes allow visualization of microscopic crack lines that exhibit only minimal colour contrasts against a desiccated tooth surface, without the requirement for trans-illumination or dyes. Microscopically precise tactile sensation allows for crack verification by correlating the tactile sensation of an explorer tip falling into a cleft with the microscopic point on a crack line where the tip is positioned. Microscopes enable the detection of minute amounts of debris in the cleft, as well as differences in the respective directions of movement of distinct tooth structures shifting independently around a cleft. Stripping a microscopic layer from a surface with a deep craze line may reveal uncracked tooth structure beneath, indicating that the crack is superficial.

Microscopes allow more precise visual examination of the steepness of cuspal inclines and also observation of a sharp lingual plunger cusp that occludes into an opposing tooth, as well as the development of a microscopic crack line surrounding this contact area. Small amounts of chalky white or beige discoloration beneath a cusp may indicate the existence of caries beneath the cusp, which may occasionally exceed a fracture plane. Microscopes enable the identification of minute gaps or elevations in the restorative margins that may signal cracks. They also aid in the knowledge of the dimensions of foreshortened surfaces. This enables visualization of a marginal ridge fracture from an occlusal viewing vantage point, allowing assessment of fractures in close proximity to the gingiva. [10]

Stress planes in a cracked tooth

1. **Furcation stress planes**

   A furcation stress plane is a stress plane in which complete fracture would result in the full separation of one tooth root from another root. To totally isolate one root from another, a fracture plane must split the tooth structure inferior to the pulp chamber floor, which helps in the connection of those two roots, as well as tooth structure superior to the pulp chamber floor, which facilitates the connection of those two roots, within the buccal and/or lingual and/or mesial and/or distal and/or occlusal walls of coronal tooth structure. Examples of furcation stress planes include:

   - A furcation stress plane that disconnects a distal root from the mesiobuccal and mesiolingual roots of a mandibular molar

- A furcation stress plane thatseparates a mesiobuccal root from the distal and mesiolingual roots of a mandibular molar.

Although extraction and placement of an implant may be a more cost-effective and predictable treatment option for furcation fractures, hemi-sectioning of roots followed by endodontic treatment of remaining roots is sometimes a viable treatment option. [11]

2. **Cuspal stress planes**

   A cuspal stress plane is a stress plane whose perimeter is precisely apical to one cusp or apical to two or more connected cusps, and whose axial aspect intersects the pulp chamber walls or roof (but not the pulp chamber floor), and the lateral aspect of the stress plane intersecting the external buccal or lingual tooth surface, and possibly a root, and may be situated subgingivally. The loss of one or more cusps results from complete fracture of a cuspal stress plane. [11]

3. **Gingival interface Stress plane**

   A gingival interface stress plane is a stress plane where the perimeter circumscribes the cross section of tooth structure positioned approximately at the interface between sub-gingival and supra-gingival tooth structure; this plane also intersects the pulp chamber.The supragingival tooth structure, which is essentially surrounded by air, can freely rotate around a fulcrum located at this interface in response to occlusal forces that stress this interface, since the subgingival tooth structure is held firmly in place by the adjacent alveolar bone and periodontal ligament.[11]

Management of cracked teeth

The treatment of a cracked tooth is determined by the location and extent of the crack. The identification of pulpal and periapical diagnosis is required before doing root canal treatment. Removal of the fracture line in the cavity floor area, allows an optimal endodontic access opening to be established, that aids in evaluating the apical extent of the crack. The recommended treatment approach is to remove any existing restorations, examine the pulp's condition and remaining coronal tooth structure, and restore with a full crown if necessary. Endodontic therapy should be performed on any tooth with irreversible pulpitis or a necrotic pulp,followed by the placement of full cover restoration (Porcelain fused to metal crown/ cast gold partial or all porcelain) so as to reinforce the strength of the remaining tooth structure.[12, 13]

Immediate immobilisation can be achieved with a copper ring, a stainless steel orthodontic band, or full coverage acrylic temporary crowns. Splinting can also be accomplished with bonded composite resin. Intracoronal restorations without cuspal coverage can be used on teeth that do not split. The

most often utilised materials for repairing fractured teeth are composite resin and glass-ionomer cements. [14]

In addition to full crown restorations, more conservative bonded restorations have been promoted to treat symptomatic cracked teeth. Both bonded and unbonded amalgam restorations, as well as bonded resin composite restorations have been discussed in the literature.[15]

A crown minimizes flexure of weakened supra-gingival tooth structures (slowing or stopping fracture plane expansion) by transmitting occlusal force stresses to the cross section of tooth structure circumscribed by the crown's margin; this cross section ultimately resists occlusal forces. [16]

In case of Cuspal fracture with fracture plane completely supragingival or not more than 1-3mm subgingivally , a direct restoration can be placed followed by a full coverage crown if the remaining tooth structure provides enough retention to retain a direct restoration

In case of cuspal fracture with fracture plane more than 3mm subgingivally, restoration with crown lengthening surgery or extraction should be considered.

In case of furcation fracture with fracture plane into pulp chamber roof or floor, endodontic treatment followed by crown is advised. In case of mandibular molars, hemi section could be a possible treatment. However, extraction followed by placement of Implant is a more viable option. [11]

CONCLUSION

The cracked teeth continue to be a challenge in diagnosis and management for clinician. Every effort should be made to diagnose the cracked teeth as soon as possible. In the dental literature, there is very little clinical data to support the usage of any definitive restorative procedures. As a result, the treatment of cracked teeth will be determined by the location and extent of the fracture. Management options range from simple replacement of the broken cusp with a basic restoration to placement of an extensive extracoronal restoration with adequate cuspal protection based on the clinical need.

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