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Cracked tooth syndrome : A Review

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Abstract

A cracked tooth is a tooth in which there exists a partial or complete fracture of a stress plane that commonly occurs in that tooth. A tooth stress plane results from occlusal forces that are commonly imposed on that tooth that may cause, during a masticatory cycle, an instance of higher energy to occur within the stress plane. The American Association of Endodontists has classified five specific variations of cracked teeth; craze line, fractured cusp, cracked tooth, split tooth, and vertical root fracture. Common symptoms include an uncomfortable sensation or pain from a tooth that occurs while chewing hard foods and which ceases when the pressure is withdrawn. The patient is often unable to identify the offending tooth or quadrant involved and may report a history of numerous dental procedures with unsatisfactory results. Cracked teeth can present a clinical challenge due to their complex diagnosis and unpredictable prognosis. Management options depend on the nature of the symptoms and the extent of the lesion. These options include routine monitoring, occlusal adjustments, placement of a cast restoration, and endodontic treatment. Early diagnosis has been linked with successful restorative management and good prognosis.

This article provides detailed literature on the causes, classification, signs and symptoms, diagnosis, and treatment planning of cracked tooth syndrome and the advantages of high magnification loupes or the surgical operating microscope, combined with coaxial or head-mounted illumination when observing teeth for microscopic crack lines or enamel craze lines.

Keywords: Crack Tooth, Pain ,Biting, Cuspal Fracture

Introduction

The condition known as cracked tooth syndrome (CTS) describes an incomplete fracture involving the dentine and, on rare occasions, the pulp of a vital posterior tooth.[1-3].

In 1964, Cameron initially coined the phrase and found a link between the size of restorations and the prevalence of CTS. The nature of this ailment is described in a more recent attempt as "a fracture plane of uncertain depth and direction traveling through tooth structure that, if not

already implicated, may progress to interact with the pulp and/or periodontal ligament."[4-7]

Patients between the ages of 30 and 50 are more likely to develop the illness. Equal impact occurs on both men and women.[8-11] The teeth that are afflicted the most frequently are the mandibular second molars, mandibular first molars, and maxillary premolars. While the crack tends to have a mesiodistal orientation in most teeth, it may run buccolingually in mandibular molars.[2,12]

There are two typical crack development patterns. The first situation happens when the crack is in the middle and may continue via the dentinal tubules to the pulp; the second situation is when the crack is more peripherally oriented and may lead to cuspal fracture. The components of a broken tooth separate along the crack when pressure is applied to the tooth's crown. Such dentine separation causes fluid to move through the dentinal tubules,[3] triggering the pulp's odontoblasts and the tubule's stretching and rupturing odontoblastic processes, which in turn activate the pulp's nociceptors. Saliva leaking into the fracture may make the dentine more sensitive. If the break penetrates into the pulpal tissues, direct stimulation of those tissues[13]

Classification: The American Association of Endodontists, in a document titled “Cracking the Cracked Tooth Code”40 identified five types of cracks in teeth which are as follows [14]

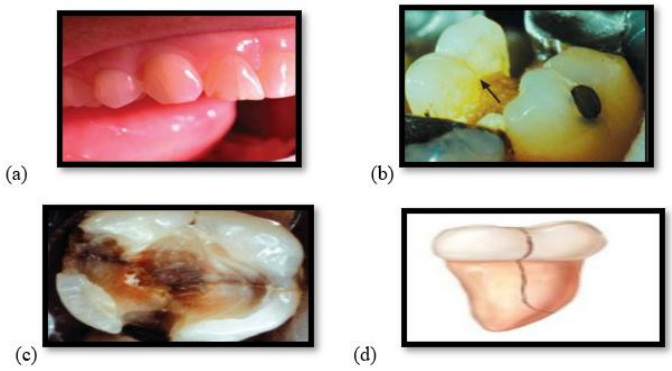
Classification	Originate	Direction	Symptoms	Pulp Status	Prognosis
Craze Line	Crown	Variable	None	Vital	Excellent
Fractured cusp	Crown	M-D and/or F-L	Mild and generally, only to biting and cold	Usually vital	Good
Cracked tooth	Crown±Root	M-D often Central	Acute pain on biting Occasionally sharp pain to cold	Variable	Questionable: Dependent on depth and extent of the crack
Split tooth	Crown+Root	M-D	Marked pain on chewing	Often root filled	Poor unless crack terminates just subgingivally
Vertical root fracture	Roots	F-L	Vague pain Mimics periodontal disease	Mainly root filled	Poor: Root resection in multi-rooted teeth

Craze line : The majority of adult teeth have craze lines, which only affect enamel. Craze lines are typically seen in posterior teeth, often extending along buccal and lingual surfaces and crossing marginal ridges. In front teeth, long vertical craze lines are common.(Fig a)

Fractured cusp: Fractured cusps frequently develop from insufficient cusp support when the marginal ridge is reduced by an intra-coronal restoration. The crack typically finishes in the cervical region either parallel to the gingival margin or somewhat subgingival, and it frequently involves one or both marginal ridges as well as a buccal or lingual groove.(Fig b)

Cracked Tooth: A cracked tooth is one in which the two segments of the tooth are not separated by the crack that extends from the occlusal side of the tooth apically. The crack may involve one or both marginal ridges and is typically mesiodistally centered. (Fig c)

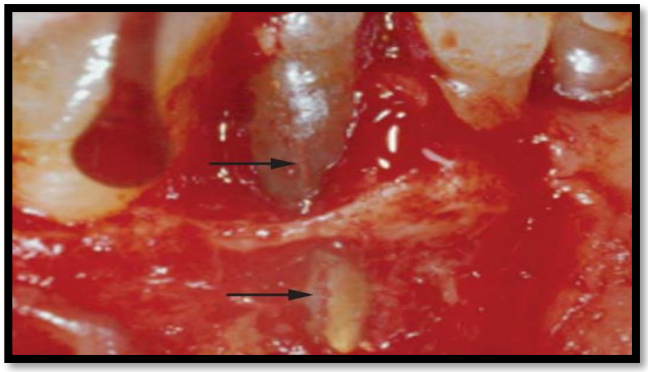
Split Tooth: A split tooth is characterised by a crack that extends through both marginal ridges, typically in a mesio-distal direction, totally dividing the tooth into two distinct parts.The crack is generally located centrally in the tooth and this entity is the result of crack propagation of a cracked tooth.(Fig d)



Vertical Root Fracture

Usually, bucco-lingual is the direction in which vertical root fractures start. While the crack may be partial or only affect one surface, it is typically total. A segment of the

root may only be affected by the crack or the entire root may be affected.(Fig e)[14]



Courtesy: (Kahler The cracked tooth conundrum: Terminology, classification, diagnosis, and management American Journal of Dentistry, Vol. 21, No. 5, October, 2008)

Etiology

Classification	Factors	Examples
Restorative procedures	Inadequate design features	Over-preparation of cavities Insufficient cuspal protection in inlay/onlay design Deep cusp–fossa relationship
	Stress concentration	Pin placement Hydraulic pressure during seating of tightly fitting cast restorations Physical forces during placement of restoration, e.g., amalgam or soft gold inlays (historical) Non-incremental placement of composite restorations (tensile stress on cavity walls) Torque on abutments of long-span bridges
Occlusal	Masticatory accident	Sudden and excessive biting force on a piece of bone
	Damaging horizontal forces	Eccentric contacts and interferences (especially mandibular second molars)
	Functional forces	Large untreated carious lesions Cyclic forces
	Parafunction	Bruxism
Developmental	Incomplete fusion of areas of calcification	Occurrence of cracked tooth syndrome in unrestored teeth
Miscellaneous	Thermal cycling	Enamel cracks
	Foreign body	Lingual barbell
	Dental instruments	Cracking and crazing associated with high-speed handpieces

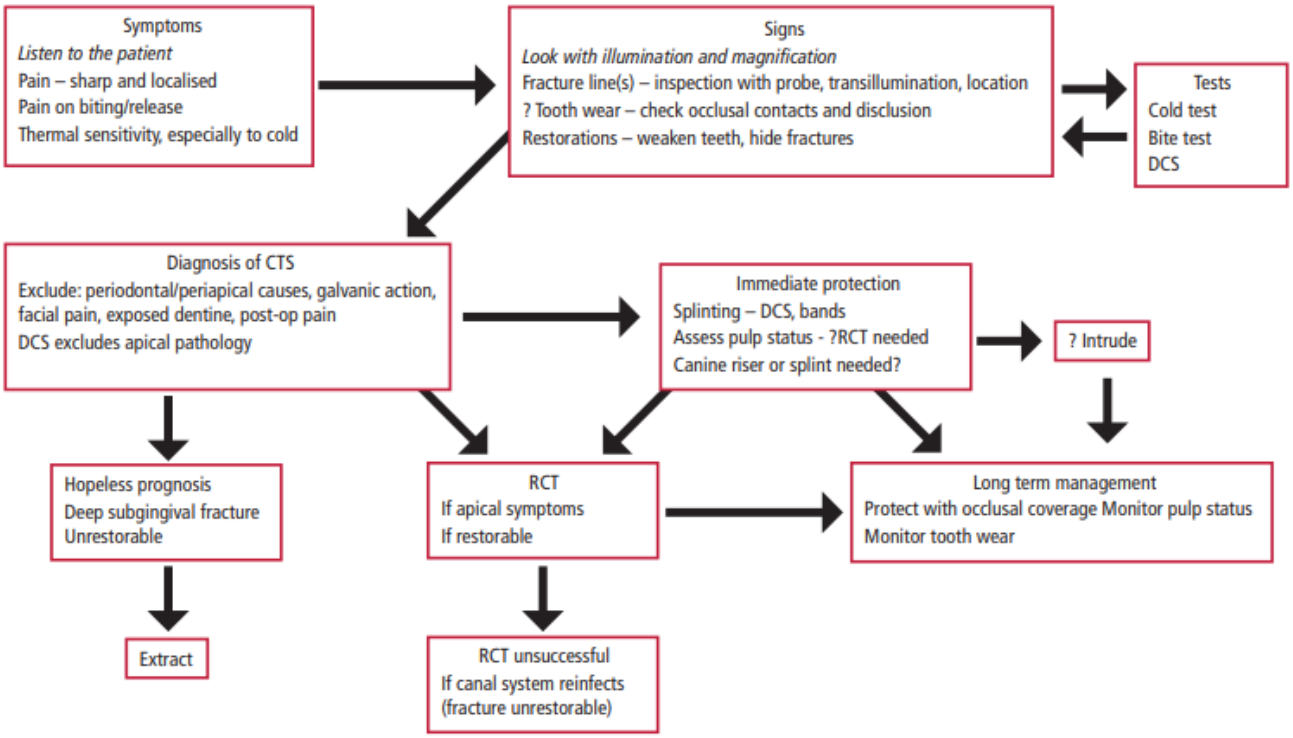
Courtesy: (Lynch, Robert mc Connell ,The Cracked Tooth Syndrome J Can Dent Assoc 2002; 68(8):470-5)

Diagnosis

A comprehensive history of the ailment can usually lead to a tentative diagnosis. Early identification is crucial because restorative action can stop the fracture from spreading, prevent microleakage that could affect the pulpal or periodontal tissues, or prevent catastrophic cusp collapse. The simplicity of diagnosis will vary depending on the position and amount of the fracture. It is advised to apply cold or hot water and to isolate the found via controlled wedging so that each cusp can be loaded and tested. "Tooth Slooth" is a suitable instrument. Once the tooth and cusp have been located, all restorations can be

removed, and the tooth can be given a complete visual inspection to determine the location and severity of the fracture. Transillumination, microscopy, and the use of dyes are all helpful tools. Testing the tooth's pulp sensitivity may reveal pulpal pathology. A tooth with a healthy pulp may resist percussion in spite of having an incomplete fracture.

Assessment Chart



Courtesy:(S. Banerji,S. B. Mehta ,B. J. Millar The Management Of Cracked Tooth Syndrome In Dental Practice British Dental Journal | Volume 222 No. 9 | May 12 2017)

Treatment

Recognition of risk factors, identification of symptoms, and provision of suitable restorations that guard against fracture should all be part of the management of fractured teeth. Root canal therapy is required when cracks reach the pulp. It may be necessary to use a multidisciplinary strategy that includes endodontic, periodontic, orthodontic, prosthodontic, and surgical intervention. When a tooth's periodontal connection is broken, extraction may be necessary; however, in some cases, multi-rooted teeth can benefit from hemisection or root amputation. However, teeth with intra-osseous cracks and pain of the periodontal type that frequently affects the mesial and distal portions of the tooth as well as the cavity floor have little chance of recovery. In order to accurately determine the degree of the fracture, the initial therapy entails removing any current restorations .

For examining broken teeth, the authors advise against utilising unassisted vision, entry-level 2.5 magnification, or shadow-forming overhead lighting in favour of microscopes (6-8 magnification or better) and shadow-free co axial illumination that is coincident with the dentist's viewing axes.[17,18]

Clark & Caughman64 have categorized the prognosis of cracked teeth as excellent, good, poor and hopeless.

1. Excellent: (a) Cuspal fracture confined within the dentin that angles from the facio-pulpal or linguo-pulpal line angle of a cusp to the cemento-enamel junction or slightly below. (b) Horizontal fracture of a cusp not involving the pulp.

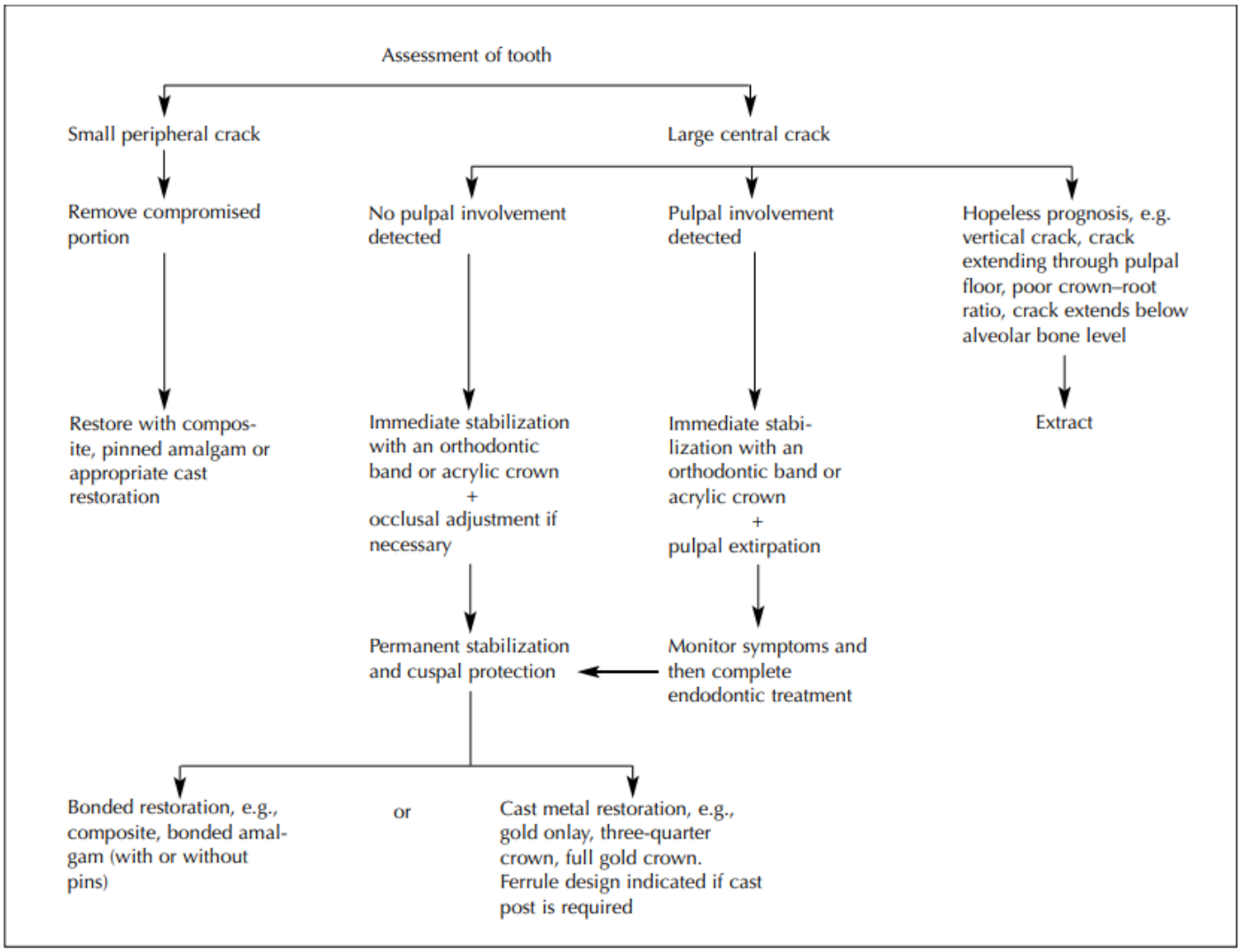
2. Good: A coronal vertical fracture that runs mesio-distally into the dentin but not into the pulp.

3. Poor: A coronal vertical fracture that runs mesio-distally into the dentin and pulp but is confined to the crown.

4. Hopeless: A coronal vertical fracture that runs mesio-distally through the pulp and extends into the root.[15]

Crack Types and Possible Treatment Outcomes

Type of crack	Possible treatment options
Cuspal fracture, with fracture plane completely supra-gingival, or no more than 1-3mm. Sub-gingivally	• Polish tooth and watch, without making a direct restoration • Place a direct restoration • Place a crown if the remaining tooth structure does provide enough retention to retain a direct restoration • If the cuspal fracture plane is bounded by a direct restoration, the crack may have resulted from the stress on the tooth structure caused by the act of retaining the restoration. Consider placing a crown, particularly if, after removing the old restoration, the remaining tooth structure shows cracks • Assess the need for endodontic treatment if remaining tooth structure is cracked
Cuspal fracture, with fracture plane more than 3mm. Sub-gingivally	• Consider extraction • Restoration may be possible with crown lengthening surgery or if a very small segment of the tooth cross-sectional perimeter is deeply sub-gingival • Endodontic treatment may be needed if fracture plane intersects pulp chamber
Furcation fracture, with fracture plane not into pulp chamber roof or floor	• If the patient is relatively young and tooth is in occlusion, consider a crown • If the patient is relatively old, and fracture is incipient, consider watching • If the tooth is not in occlusion or is opposed by a full denture, consider watching • A posterior tooth with a class II restoration occupying one marginal ridge and a crack in the unrestored marginal ridge, may require a crown to prevent further crack propagation
Furcation fracture, with fracture plane into pulp chamber roof or side	• Endodontic treatment, then place a crown
Furcation fracture, with fracture plane into pulp chamber floor	• Often a catastrophic fracture requiring extraction, especially if there is clefting in pulp chamber floor • Consider endodontic treatment and then place a crown, if only a hairline fracture is visible in pulp chamber floor • Hemi-section may be possible with isolated root fractures in molars. However, extracting the tooth and placing an implant may be a more predictable treatment
Root fracture	• Often a catastrophic fracture requiring extraction • A root fracture where the root has a preexisting post is not likely to become more stable by re-making the post, core, and crown
Gingival interface fracture	• If the gingival interface is completely fractured, the fracture is usually catastrophic, although occasionally crown lengthening surgery followed by a crown can salvage tooth • If the fracture is incipient, with <1/3 of the gingival interface area fractured, consider endodontic treatment, post, and crown
Enamel craze line	• In general, no treatment is required



Courtesy : (Lynch, Robert mc Connell ,The Cracked Tooth Syndrome J Can Dent Assoc 2002; 68(8):470-475)

Conclusion

Every practitioner needs to be aware that CTS exists, and it should always be taken into account whenever a patient complains of pain or discomfort when chewing or biting. In order to arrive at a diagnosis, a thorough history is essential. A thorough clinical examination and inspection will be conclusive, along with specific testing such the non-axial application of pressure on cusps. The location and size of the crack will determine how CTS is treated. Treatment methods range from replacing the broken cusp with a straightforward restoration to placing an extracoronal restoration with sufficient cuspal protection, depending on the clinical situation. If the dental professional has the required knowledge and diligence, diagnosing and treating CTS shouldn't be too difficult.

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