



RESEARCH ARTICLE

CRACK TOOTH SYNDROME AND ITS MANAGEMENT.

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Abstract

Cracks and fractures in teeth are relatively common problems in general and specialist dental practices. The CTS presents both a challenge and an opportunity for the dentist. The possibility of CTS must always be considered when a patient complains of pain or discomfort on chewing or biting. In spite of CTS being a diagnostic challenge, having knowledge and awareness of CTS should enable the dental practitioner to detect the same, thereby preventing further crack propagation and complications associated with crack tooth.

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Introduction:-

Cracks and fractures in teeth are relatively common problems in general and specialist dental practices. Tooth fractures include trauma-related crown, crown-root, and root fractures and a broad group of cracked teeth. Bader et al. reported that approximately one in 20 people fracture a tooth each year. Since, these fractures had varying consequences ranging from no treatment being required to extraction of the tooth, it is likely that some of these fractures are crack.

Classification of crack tooth syndrome:-

The American Association of Endodontists (AAE)¹ has identified five types of cracks in teeth :

- Craze lines - visible fractures that only involve enamel
- Fractured cusps -originate in the crown of the tooth, extend into dentin, and the fracture terminates in the cervical region
- Cracked tooth -crack extending from the occlusal surface of the tooth apically without separation of the two segments
- Split tooth - extends through both marginal ridges usually in a mesiodistal direction, splitting the tooth completely into two separate segments
- Vertical root fracture - originate in the root, and are generally complete, although they may be incomplete

Definition:-

Cameron in 1964 coined the term cracked tooth syndrome² which is as “an incomplete fracture of a vital posterior tooth that involves the dentin and occasionally extends to the pulp.”

In recent times, the definition has been modified as follows: “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”.³

Incidence:-

Crack tooth syndrome occurs primarily in adulthood. Cameron et al² reported that 80% of 102 cracked teeth occurred in patients over 40 years of age. Men and women are found to be equally affected.

Most commonly associated with heavily restored mandibular tooth. Mandibular second molars are most commonly affected followed by mandibular first molar and maxillary premolars. While the crack tends to have a mesiodistal orientation in most teeth, it may run buccolingually in mandibular molars. Wedging effect of the prominent mesiopalatal cusp of the maxillary first molar may be a predisposing factor.⁴ The transverse ridge of maxillary molars may provide reinforcement and account for lower incidence of fracture in these teeth.⁴

Non-functional cusp may be more susceptible than functional cusp⁵ as functional cusps are significantly larger in buccolingual dimension and covered with a thicker layer of enamel.⁶ In molars, non functional cusps are found to have a steeper cuspal incline. Cuspal inclines are the guiding planes for lateral excursive movements for group functional occlusal relationships thus non functional cusps may be subjected to greater occlusal forces.

Higher incidence of Crack tooth syndrome in mandibular second molar may be associated with the proximity to the temporomandibular joint, based on the principle of the “LEVER EFFECT”- the mechanical force on an object is increased at closer distances to the fulcrum.⁷

Etiology:-

The etiology of crack tooth syndrome is multifactorial. Guersten et al⁸ stated that ‘*excessive forces applied to a healthy tooth or physiologic forces applied to a weakened tooth can cause an incomplete fracture of enamel or dentine*’

Lynch et al⁹ subdivided the causes of cracks into four major categories:

1. Restorative procedures
2. Occlusal
3. Developmental
4. Miscellaneous

Classification	Factors	Examples
1. Restorative procedures	Inadequate design features	<ul style="list-style-type: none"> Over-preparation of cavities Insufficient cuspal protection in inlay/onlay design Deep cusp-fossa relationship
	Stress concentration	<ul style="list-style-type: none"> 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
2. 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
3. Developmental	Incomplete fusion of areas of	Occurrence of cracked tooth syndrome in

	calcification	unrestored teeth
4. Miscellaneous	Thermal cycling	Enamel cracks
	Foreign body	Lingual barbell
	Dental instruments	Cracking and crazing associated with high-speed handpieces

Signs and symptoms:-

Two classic patterns² of crack formation are present

- ☐ Crack – centrally located- Follow dentinal tubules → extend to pulp
- ☐ Crack – more peripherally directed → may result in cuspal fracture

A suspicion of infraction is raised when symptoms of toothache are not readily connected to evidence of caries, periodontal disease or recent trauma. Many patients with infected teeth may suffer symptoms for long periods of time before a correct diagnosis is made.

Most common symptoms^{10,11} associated with symptomatic tooth infractions are-

- Pain on chewing
- Pain on exposure to cold food

Not all teeth with infractions are symptomatic. Symptoms develop when infraction involves the pulp, especially when infractions become populated with bacteria^{12,13} and localization may also be possible when infraction reach the periodontal ligament, usually starting in the area of crestal ligament.¹⁴

These symptoms can be explained by Hydrodynamic theory of pain.¹⁵ Sutton et al¹⁶ suggested that the occasional sharp, momentary lancinating masticatory pain was due to bending and rubbing of dentin along fracture lines.

A unique pain response to chewing experienced by many patients is the pain that occurs when they release the pressure of biting, referred to as “rebound” or “relief” pain.^{11,12} Pain that is stimulated by temperature changes, particularly with application of cold stimuli, also a common feature. Often, the pain felt anterior to the tooth responsible for the symptom. Pattern of pain referral noted by Brynjulfson et al¹⁷ was that pain from mandibular teeth was frequently distributed to maxillary teeth, the neck, ear, muscles of mastication and TMJ. *An important observation was that the longer the duration of pain, the more diffuse it became and often led to headaches*

Diagnosis:-

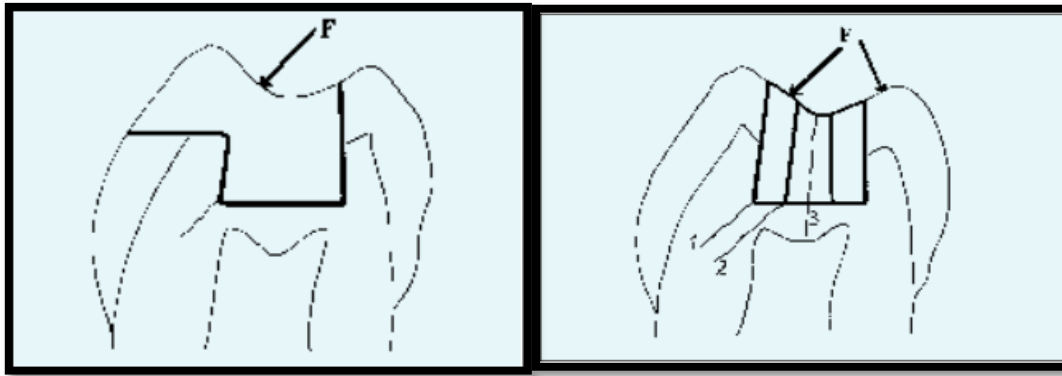
Diagnosis is often problematic and challenging. 20% patients referred to specialist endodontists with diagnostic uncertainties are eventually diagnosed with incomplete tooth fractures

Dental History:-

History of a course of extensive dental treatment involving repeated occlusal adjustments or replacement of restorations which fail to eliminate symptoms.

Patient gives a history of pain on biting on a particular tooth, often occurring with foods that have small, discrete, harder particles in them.¹⁸ Patient gives a history of sensitivity to thermal changes, particularly cold.

According to Homewood¹⁸, fractures tend to occur in a direction parallel to the forces on the cuspal incline; thus with larger restorations, cracks tend to be more superficial and thereby produce fewer symptoms, while with smaller restorations cracks tend to be deeper and closer to the pulp.



If wedging forces are placed on both buccal and lingual cuspal inclines, the resultant crack may occur in the midline of the tooth and propagate towards the pulp, especially in unrestored teeth.

Clinical Examination:-

Patient may present with facets on the occlusal surfaces of teeth, localized periodontal defects. Use of rubber dam enhances the probability of visualizing these cracks by isolating the tooth, highlighting the crack with a contrasting background.

Visual Examination:-

Reveal many instances of infractions, especially when aided by the use of transillumination and a dye.

Transillumination:-

The use of transillumination is dependent on the part of the tooth to be examined. Tooth without restoration will allow the light beam to pass through, when it encounters a fracture line in dentin, the light beam will bend and not pass through the fracture line and opposite tooth structure will be dark.¹⁰ Transillumination along with the use of magnification can help better in visualization of crack.¹⁷

Methylene blue:-

Gentian violet or methylene blue stains can be used to highlight fracture lines. Disadvantage of this technique is that it takes at least 2–5 days to be effective and requires placement of a provisional restoration. Placing a provisional restoration undermines the structural integrity of the tooth and further propagates the crack.

Bite Tests:-

Mimic the symptoms associated with incomplete fractures of posterior teeth.⁹ Objects traditionally used for this purpose include: orange wood sticks, cotton wool rolls, rubber abrasive wheels such as a Burlew wheel or the head of a number 10 round bur in a handle of cellophane tape.

The technique for the use of wood sticks²⁰ has been described. It is advocated that the stick is rested on the suspected tooth and the patient is asked to bite, by the subsequent application of the stick to each individual cusp in turn, to localize the affected cusp.

- Pain which is perceived upon release of pressure is suggested to confirm the diagnosis of crack tooth syndrome.²¹
- Commercially available diagnostic tools to undertake “bite test” include products such as *Fract finder*, *Tooth Slooth II*. Ehrmann et al²⁰ have advocated the use of this method as one with a higher level of sensitivity than that associated with the use of wood sticks.

Cold stimulus application and electric pulp testing provides information about the status of the pulp and there is evidence that teeth with infraction respond at lower threshold levels to cold and electric pulp testing stimulation compared to non cracked teeth.

Percussion sensitivity is not frequently seen. If infraction is a cuspal infraction and does not directly involve the pulp, percussion may not be as likely to produce a symptomatic response as percussion of teeth with infraction in direct contact with the pulp.

Periodontal probing:-

- Helps to distinguish between a cracked tooth and a split tooth when the fracture line extends below the gingival, thereby causing a localized periodontal defect.
- For suspected cracks, careful probing must be performed to disclose the presence of an isolated periodontal pocket.
- *However, isolated deep probing often indicates the presence of split tooth, which predicts a poor prognosis.*

Radiographs:-

Radiographs are of limited use as fractures tend to propagate in a mesiodistal direction.⁹ However, of value in detecting more rarely occurring fractures which may be running in a bucco-lingual direction.²² Cracks can be detected radiographically in the rare instance in which bacteria in the infraction has stimulated clastic activity in the pulp, resulting in internal resorptive lesions.

Microscopic Detection:-

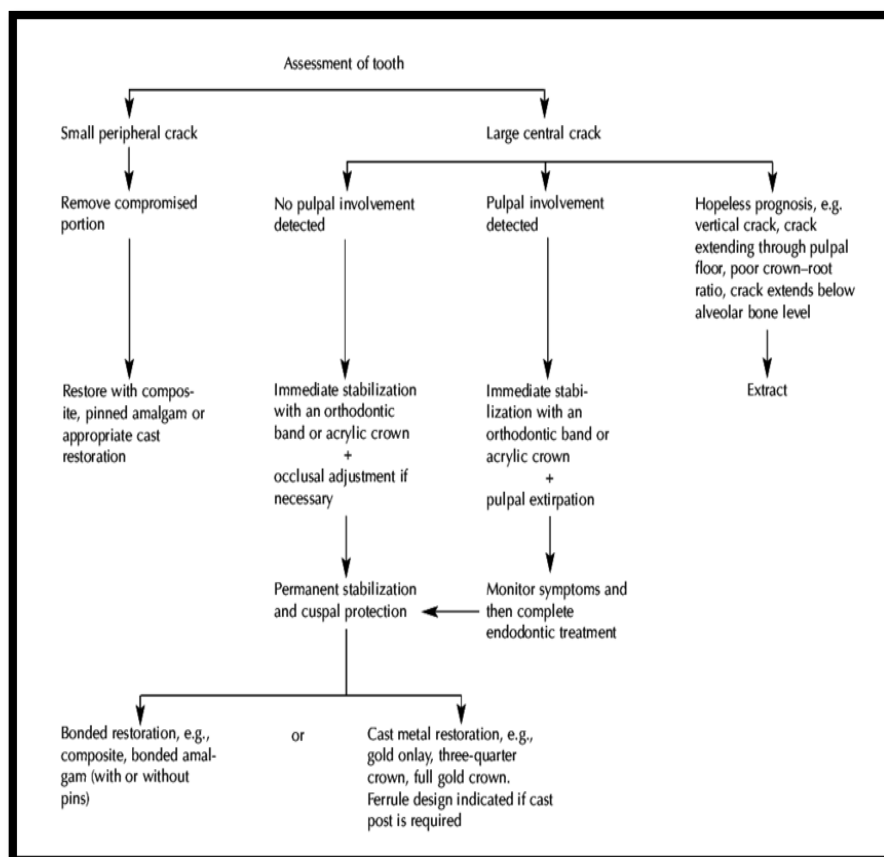
×16 provide an ideal magnification level for the evaluation of enamel cracks.²³ *Use of the clinical microscope makes possible the treatment of asymptomatic but structurally unsound posterior teeth.* It facilitates observation of microscopic crack lines that may show minimal color contrasts against a desiccated tooth surface.

Ultrasound:-

Owing to short wavelength in hard tissues and associated high resolution, ultrasound has the potential in clinical dentistry. *It has the ability to penetrate hard structures and detect hard tissue discontinuities, or pathoses, under existing radiopaque restoration.* It is also effective in detecting physical discontinuities. Therefore, ultrasound provide a significant benefit to patients by allowing early detection of dental pathology, especially cracks.²⁴

Treatment:-

Treatment of CTS will depend on the position and extent of the crack. Management options vary according to clinical need, from replacement of the fractured cusp with a simple restoration to placement of an extracoronal restoration with adequate cuspal protection or root canal treatment.



Conclusion:-

The CTS presents both a challenge and an opportunity for the dentist. The possibility of CTS must always be considered when a patient complains of pain or discomfort on chewing or biting. In spite of CTS being a diagnostic challenge, having knowledge and awareness of CTS should enable the dental practitioner to detect the same, thereby preventing further crack propagation and complications associated with crack tooth.

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