

CRACKED TOOTH - DIAGNOSIS AND MANAGEMENT

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Quote : 'The professional man has no right to be other than a continuous student' G.V. Black

Cracked tooth or its often misleading diagnostic term as a cracked tooth syndrome have always puzzled many dentists in its aetiology, diagnosis and management.

In this article, we will discuss the aetiology, diagnosis and treatment for cracked teeth but given the limitation of space and time, it will not be an absolutely complete article on this subject and the reader is advised to refer to the references for further reading. Much of the information about cracked tooth and tooth fracture is derived from the 2nd edition of Principles and Practice of Endodontics by Walton and Torabinejab. The rest is taken from various texts, journals, lectures and articles which the author had read and attended over the years.

INTRODUCTION

In 1954, Gibbs first described the pain associated with an incomplete vertical fracture of a tooth as 'Cuspal fracture odontalgia'. Ten years later the term 'Cracked tooth syndrome' was introduced by Cameron. More recently, Ehrmann and Tyas have defined cracked tooth syndrome as 'an incomplete fracture of a vital posterior tooth involving the dentine and possibly the pulp'.

In Walton and Torabinejab's Principles and Practice of Endodontics, fractures in the vertical plane, that is, the long axis of the crown or root are categorised as:-

- * Craze line
- * Fractured cusp
- * Cracked tooth
- * Split tooth
- * Vertical root fracture

1. and 2. are clinically not critical in the sense of its ease in diagnosis and treatment as well as having a generally good prognosis. This shall not be discussed here.

Classification of cracked tooth was more elaborately described by R.C. Tatum in his article on Classifying propagating cracks. According to this author, new and revealing clinical data suggest that there are many other types of tooth structure cracks which have not been addressed and remain unclassified. He proposed 2 new classification systems called Surface and Position Crack Classification and Directional Crack Propagation System.

The frequency of cracked tooth or fracture of teeth is unknown but it is a general perception amongst general dentists that it is apparently increasing. Older patients predominate, although cracked teeth may occur at any age in adults.

The teeth most frequently involved are mandibular molars (both restored and not restored) followed by maxillary premolars and then by maxillary first molars. The true cracked tooth does not occur on anterior teeth and rarely on mandibular premolars. Furthermore, class I restored teeth fracture as frequently as do class II teeth, particular molars. Therefore, the phenomenon is not always dependent on violation of tooth structure by access preparations, caries, or restorations.

AETIOLOGY AND PATHOGENESIS

Many aetiological factors have been

mentioned. It ranged from damaging oral habits related to excessive masticatory forces over a long period of time, iatrogenic factors such as overpreparation of teeth for restorative purposes to differential expansion of tooth and restorative materials in the oral cavity. However, cracked teeth are often minimally restored or not restored at all. Continued and repeated forces finally cause fatigue of tooth structure thus resulting in fracture followed by continued growth of that fracture. Less acceptable or more speculative and occasionally mentioned factors include trauma or forces from occlusal dysfunction. As stated previously, cracked teeth tend to be dependent on time and patient habits. Obviously, forces in excess of dentin strength are responsible; these forces are greater in the posterior region, i.e. close to the fulcrum of the mandible, invoking the 'nutcracker effect'.

It is the latter factor that stirs my interest. My observation and a review of some articles and texts led me to believe that there is something more to occlusal dysfunction or malocclusion in the aetiology of a cracked tooth. It is highly probable that an occlusal disharmony may lead to equally, if not more, damaging forces especially when they are present in addition to constant parnormal oral habits which is cited so frequently in the literature as the most or more likely aetiology.

In order to understand this hypothesis, the reader is advised to refer to the basic principles of occlusion as illustrated in various texts on this subject such as Shillingburg's *Fundamentals of Fixed Prosthodontics*, 3rd Edition. Further references are from articles by Wise and Sumiya Hobo. Both have written books and articles on occlusion and fixed prosthodontics.

In 1992, Wise reported on the relationship between the vertical : horizontal ratio (calculated from measurements made at the incisal pin of a Denar MK2 articulator) and the movement made at the incisal pin of a Denar MK2 articulator) and the movement of the transverse condylar axis in 42 subjects free from temporomandibular disorders. He concluded from his studies that when the mandible moves from centric relation contact position to the intercuspal position and

vice versa, the dimensions of the horizontal movement of the transverse axis of the condyles is directly related to the vertical: horizontal ratio measured at the front of the mandible.

As mentioned in Walton and Torabinejab, cracked teeth are almost invariably mesiodistal fractures, although mandibular molars occasionally fracture to the facial-lingual aspect.

More importantly, the more centered the fracture initiated on the mid-occlusal surface, the force initiating the crack could be directed more apically and leads to a greater probability of a vertical fracture before it shears toward the root surface. The more centered the fracture, the greater the chance of pulp exposure now or later. Occlusal forces may exacerbate and contribute more damaging forces to the teeth which are anatomically more susceptible to a fracture.

Time and space do not permit the author to elaborate further. At the moment, I am still reviewing the limited literature in my hands to substantiate this hypothesis. Hopefully, I will be able to write a separate article with more details and supporting evidence on this subject in the next bulletin.

These hypotheses are difficult to prove clinically nor can it be simulated in any studies on other non-human subjects. The assumptions and suppositions made do not universally apply in all clinical situations. However, the author feels very strongly that as a clinician, we have to continuously look out for possible aetiological cause in one's endeavour to perform a more comprehensive treatment plan. We cannot treat a clinical problem without identifying the cause of the problem. As Einstein said "The solution to a problem requires a higher level of thinking than when it was first created". We cannot solve a problem at the same level of thinking!

DIAGNOSIS

Cracked teeth show a variety of test results, radiographic findings, and signs and symptoms depending on many factors. This variety and unpredictability often make the cracked tooth a

perplexing diagnostic and treatment entity.

Subjective findings, objective tests and radiographic findings may vary from those found with very severe spontaneous pain consistent with irreversible pulpitis, pulp necrosis or apical periodontitis to relatively slight symptoms such as characterized in so called cracked tooth syndrome, with acute pain on mastication and sharp, brief pain with cold.

When a crack is suspected, it is most important to try to visualize the length and location of the fracture. Occlusal and proximal restorations are removed. Then transillumination, which often shows a characteristic abrupt blockage of transmitted light, is performed. Staining with methylene blue or iodoine may also disclose the fracture, although not predictably.

If a fracture is detected, and an instrument is placed in the cavity with moderate pressure exerted on opposing walls to try to separate the segments. If no movement is detected, the classification is a cracked tooth; when the segments separate it is a split tooth. It is debatable whether wedging should be performed; wedging may split the tooth iatrogenically. However, if controlled force exacerbates the crack, certainly the tooth is predisposed to a later split anyway.

Periodontal probing is important and may disclose the approximate depth and severity of the fracture. Removal of the interproximal restorations is helpful because it allows improved access for the periodontal instrument. However, subgingival fractures often do not create a probing defect. Therefore, absence of deep probing does not preclude a cracked tooth. Presence of deep probing is serious and indicates an adverse prognosis.

TREATMENT

Five important considerations should be reviewed:

- * Cracks result from excessive forces, usually (but not always) long term forces.

- * Visualization of the presence of the crack may be difficult to identify clinically; they are often tiny and are not demonstrable until growth or expansion occurs. Also, they may be hidden under bone and gingiva and thus not be visible even after flap reflection.
- * With time, crack spaces tend to stain and become more visible.
- * Cracks have a tendency to grow, although initially they are very small. This propagation may be slow.
- * Signs and symptoms often are not present early but become manifest months, years or decades after crack initiation.

When both the patient and the clinician are aware of the complications and questionable outcomes, a treatment plan is formulated. Extraction is reasonable in many situations. Much depends on the nature (depth and location) of the crack. The segments must not separate on applying a controlled force. Many treatment alternatives can be used to retain the tooth intact. If the occlusal proximal crack is centered in the facial lingual aspect and involves the floor of the cavity preparation, root canal treatment is performed in most cases.

After access has been gained, the chamber floor is examined.

- * If the crack is detected through the chamber floor, generally further treatment is hopeless and extraction is preferred. An exception is the maxillary molar, which may be hemisected along the fracture saving half (of both halves) of the crown and supporting roots. Many of these treatments are complex, and the patient should be referred to the endodontist.
- * If a partial crack of the chamber is detected, the crown is bound with a well-fitting cemented orthodontic band or temporary crown to protect the cusps until final restoration is performed. This also helps to determine whether symptoms decrease during root canal treatment. The rationale (unsupported) is that if pain symptoms are not relieved, the prognosis is significantly poorer i.e. a split tooth or vertical root fracture, and an extraction may be necessary.

If a crack appears to be incomplete (not terminating on a root surface), the tooth is restored to bind the fractured segments (barrel-stave effect) and also to protect the cusps. For a permanent (I prefer to use the word fixed, because nothing is permanent) restoration, a full crown is indicated, avoiding posts/pins and internally wedging foundations. Root canal treatment may not be required. Acid-etch dentin bonding resins may help to provide a foundation for a crown to prevent crack propagation.

CONCLUSION

Prevention is the keyword here. If a symptomatic tooth is suspected to be cracked then the treatment and management has highly unpredictable outcome. Nobody will be able to diagnose accurately a case of only a crack and not a split tooth with or without a vertical root fracture. The latter may manifest several months or years later and the only treatment then is extraction. How can anyone justify spending all the time and money to do a root canal treatment and a full crown which will last less than 5 years.

Generally, patients are encouraged to forego destructive habits such as ice chewing. In addition, most suggestions made earlier relative to the prevention of cusp fractures apply here. Deep Class I and Class II restorations should be minimized, particularly on maxillary premolars (cusp protection may be helpful). Walton and Torabinejab said that altering the occlusal anatomy or changing occlusal relationship is not useful.

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