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A review of the etiology, symptoms, diagnosis, and treatment of the cracked tooth

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Abstract

Introduction: Cracked tooth is a current hard tissue affection; the type of cracks directly affects the selection of treatment and restoration.

Objective: To evaluate the literature about cracked Tooth, its etiology, symptoms, diagnosis and treatment.

Methodology: A review was carried out in the databases Scopus, PubMed and Google Scholar with the keywords "Cracked tooth", "etiology", "diagnosis", "treatment", "Subgingival margin".

Results: Bad oral habits, such as eating habits, unilateral chewing, bruxism and premature occlusion, promote dental fissures, cracked teeth are most frequently involved in mandibular and maxillary molars. Cracked teeth may be associated with pain, especially pain on biting, and to a lesser degree cold and spontaneous pain. Early diagnosis can help prevent the spread of a crack into the pulp chamber or subgingival level. The dental operating microscope can fundamentally change a dentist's ability to diagnose such conditions. Ceramic inlay and onlay restorations are advantageous methods to prevent further crack propagation. Dentists can effectively evaluate patient, tooth and crack level characteristics to determine which teeth with cracks require treatment and which only require monitoring.

Conclusions: The dentist should know well how to diagnose the cracked tooth, perform diagnostic tests together in order to have the accurate diagnosis.

Keywords: Cracked tooth, etiology, symptoms, treatment, diagnosis, endodontic

1. Introduction

The rate of cracked teeth increased during the initial outbreak of the COVID-19 pandemic and 1 year later. Patients' habits may have increased during the pandemic as a result of increased anxiety or depressive symptoms^[1].

Cracked tooth syndrome is defined as "a flat fracture of unknown depth and direction through the tooth structure that, if not already involved, may progress to communicate with the pulp and/or periodontal ligament"^[2].

Cracked tooth syndrome is a common presentation in general dental practice. Diagnosis and management of teeth with cracked tooth syndrome can be difficult because the extent of the fissure is unknown^[3].

Multiple factors, such as bite force and thermal cycling, can cause cracking of the tooth or damage to the tooth structure. The direction and depth of the fracture surface are usually difficult to predict. Dentin hypersensitivity is a common patient complaint that can present with a number of associated factors, such as erosion and abrasion^[4].

Current clinical diagnostic approaches for cracked tooth have been extensively investigated on the basis of X-ray, optical light, ultrasound waves, etc^[5].

Intervention should aim to alleviate symptoms and strengthen the remaining tooth structure effectively against further bending^[3].

General dentists, prosthodontists and endodontists differ in their diagnosis, prognosis and treatment of cracked teeth.

Future research and education is needed to provide evidence-based guidelines in the management of cracked teeth so that patients with cracked teeth can receive standardized care [6].

After performing a literature review about Cracked Tooth Syndrome it is evident that there is no adequate update about certain relevant aspects of this syndrome, therefore, the aim is to evaluate the literature about Cracked Tooth, its etiology, symptoms, diagnosis and treatment.

2. Materials and methods

Information from articles published in PubMed, SCOPUS and Google Scholar was analyzed with emphasis on the last 5 years. The quality of the articles was evaluated based on the standard guidelines, i.e., identification, review, choice, and inclusion. The quality of the review was assessed using the measurement instrument for evaluating systemic reviews. The search was performed using Boolean logical operators AND, OR and NOT. It was realized with the words "cracked tooth", along with the following terms: "etiology", "symptoms", "diagnosis" and "treatment". Keywords were used individually and also as a whole, Boolean logical operators AND, OR and NOT were used.

3. Results

3.1 Etiology

Poor oral habits, such as eating habits, long-term unilateral chewing, sleep bruxism and early occlusion, promote dental fissures, fissured teeth are most frequently involved in mandibular and maxillary molars at the age of 50 years [7].

3.1.1 Age and stress

Constant physiological stress along with any pathological stress such as trauma or iatrogenic causes can lead to the development of microcracks in teeth [8]. Stress, anxiety syndromes and genetic disposition seem to be dominant factors leading to increased muscle tension [9]. Aging is one of the most important factors in the etiology of dental cleft syndrome [2].

3.1.2 Occlusal disorders

Malocclusion is a highly prevalent public health problem and several studies have shown its negative correlation with quality of life, self-esteem, and social perceptions [10].

3.1.3 Habits

Bruxism is a repetitive chewing muscle activity, which is a risk factor for several serious health complications. It is characterized by clenching, teeth grinding and/or jaw thrusting [11]. Grinding or clenching of teeth, is common in the population. Bruxism is a major risk factor for tooth structure and dentures [9]. It is known to cause masticatory muscle pain, temporomandibular joint pain, headaches, mechanical wear of teeth, prosthetic complications, and cracked teeth [12]. It is a common clinical condition that often goes unnoticed and often results in pain or damage to teeth and restorations [13].

Thermal cyclic eating habits are strongly associated with cracked teeth, while eating coarse foods, chewing hard objects and unilateral chewing were also independent risk factors for cracked teeth [14].

The rate of cracked teeth increased during the initial outbreak of the COVID-19 pandemic and 1 year later. Patients' habits may have increased during the pandemic as a result of increased anxiety or depressive symptoms [1].

The etiology of cracked tooth syndrome is very varied since it can be caused by ingesting a very hard food and cracking the

tooth or it can be caused by a long-term habit such as bruxism, this being the main etiological factor of cracked teeth.

3.2 Symptoms

Pain is defined as an "unpleasant sensory and emotional sensation that is associated with actual or potential tissue injury or expressed in terms of such injury", dental pain is the most common acute pain presenting in the orofacial region [15]. Toothache represents the most common example of orofacial pain [16].

Cracked tooth syndrome presents with varied clinical signs and symptoms, depending on the position and extent of the incomplete fracture [17]. Cracked teeth may be associated with pain, especially pain on biting, and to a lesser degree cold and spontaneous pain. These pains remain constant, develop or resolve over time [18]. Cracked tooth is often associated with extraneous symptoms that may complicate the diagnosis and may persist for many years [19]. Previous studies mention that overall 45% of cracked teeth have one or more symptoms [20]. Symptoms will vary with teeth that have healthy pulps, teeth with inflamed or necrotic pulps and teeth that have been endodontically treated [21].

3.2.1 Thermal pain

Cold pain is the most common symptom, occurring in 37% of cracked teeth. Biting pain (16%) and spontaneous pain (11%) were less frequent. 65% of symptomatic cracked teeth had only one type of symptom, of these 78% were painful only to cold [22]. Symptoms include sensitivity to biting certain foods, often poorly localized, and occasional thermal sensitivity [23].

Cracked tooth syndrome presents as pain associated with biting and sensitivity [24]. Pulp necrosis, when caused by cracked tooth, can manifest with pain frequencies and durations that are unusual for pulpitis [25]. Mandibular and maxillary first and second molars are among the highest affected teeth with thermal symptoms and fissures [26].

3.2.2 Asymptomatic patients

Symptomatic and incompletely fractured posterior teeth can be a great source of anxiety for both the dental patient and the dental operator [27]. Therefore, clinicians should consider these factors when planning treatment and predicting the prognosis of patients [28]. Diagnosis and treatment planning of cracked teeth depend on understanding how the cracks affect the surrounding tissues [29].

Symptoms of cracked teeth can become confused with common symptoms of other dental conditions. Sensitivity and pain on chewing being the main symptoms of cracked teeth.

3.3 Diagnosis

Early diagnosis of cracked tooth syndrome is crucial for optimal treatment and symptom reduction. Cracked tooth syndrome is a common occurrence in general dental practice and can be difficult to diagnose, especially in terms of the extent and direction of the crack [30]. Visual inspection does not provide detailed information and is limited by the resolution of human eyes. This can be overcome with magnifying lenses or contrast enhancers, but the diagnosis will still largely depend on the clinicians' experience [31]. It can be a perplexing disorder to diagnose and manage [32].

Cracks will commonly be found in lower second molars and intact teeth [33]. Current clinical diagnostic approaches for cracked tooth have been extensively investigated based on X-ray, optical light, ultrasound waves, etc [5].

3.3.1 Imaging

X-rays can detect problems that would be missed by just looking inside your mouth, such as: an infection in your tooth or tooth root, decay between teeth or under fillings, problems with tooth development, bone loss from severe gum disease, as well as very frank tooth cracks or fractures^[34].

Optical coherence tomography (OCT) is an imaging technique that can visualize internal biological structure without X-ray exposure^[35]. OCT is a promising diagnostic method for creating cross-sectional images of internal biological structures by measuring backscattered light echoes^[36]. Cone beam computed tomography (CBCT) has been widely used in the diagnosis of root fractures or fissures in recent years^[37]. Even on CBCT, incomplete crack lines are often too narrow to be detected. Therefore, CBCT is rarely used to diagnose cracked teeth, and studies evaluating the use of CBCT in cracked teeth are much fewer than those evaluating the use of CBCT in dental fractures^[38].

Micro-CT is also used to identify fracture modes^[39]. Compared with the routine scanning mode, more crack lines could be detected in the enhanced scanning mode using meglumine diatrizoate as contrast medium^[40].

3.3.2 Fluorescent devices

Optical light can outperform X-rays in dental examinations and avoids the use of ionizing radiation^[41]. Cracks originating at the junction of dental enamel and enamel tufts, crack deviations and the initiation of new cracks within the enamel (Internal cracks) are observed as bright areas^[42]. The use of a quantitative light-induced fluorescence device detects fluorescence reactions with visible light (405 nm) visually identifies microscopic dental cracks during the diagnosis and treatment of cracked teeth^[43].

Diode laser is a complementary tool for early detection and treatment of symptomatic fissures with the potential to improve long-term survival^[44].

3.3.3 Microscopy

Dental operating microscopy at 16x magnification can fundamentally change a clinician's ability to diagnose such conditions (Clark DJ *et al.*, 2003)^[45].

3.3.4 Clinical testing

Performing tests should seek to reproduce the presenting symptoms in a predictable manner and locate the source of the pain. Percussion in the occlusal-apical direction is often painless, while lateral percussion may elicit characteristic symptoms^[46]. The combined use of several examination methods is recommended to detect cracks and thoroughly inspect all directions of a tooth^[47]. However, techniques to reliably determine the depths of tooth crack extension prior to treatment are lacking^[48]. Early diagnosis can help prevent the propagation of a crack into the pulp chamber or subgingival level^[49].

Diagnosing a cracked tooth is very complicated and not only one of the mentioned diagnostic tests should be done, several tests should be performed in order to have a more accurate diagnosis.

3.4 Treatment

The management of cracked teeth represents a difficulty because their diagnosis is complex and there is no consensus regarding their treatment^[50]. The treatment plan for cracked teeth depends on the extent of the crack. A tooth with an extensive fissure is more likely to require root canal treatment^[27].

3.4.1 Direct restorations

Bonded indirect resin composite onlays can be successful in the treatment of cracked and painful teeth^[51]. In view of the relatively high survival rate, endodontic treatment should be considered instead of extraction for cracked teeth^[52]. The use of a bidirectional splinting method provides good results for these teeth^[53].

3.4.2 Endodontic treatment

In fissured teeth that may require endodontic treatment, clinicians may wonder whether endodontic treatment is the appropriate course of action^[54]. Results from studies suggest that fissured teeth that received root canal treatment may have prognoses with higher success rates than those that do not have root canal treatment^[55]. Therefore, the possibility of fissure presence should be considered before and after endodontic treatment and before the initiation of periodontal/prosthetic treatments^[56]. A systematic approach should be used to treat cracked teeth with reversible pulpitis to maintain tooth vitality and survival. Percussion sensitivity is an important prognostic indicator of pulp vitality and whether root canal treatment should be initiated^[53].

3.4.3 Indirect restorations

Ceramic inlay and onlay restorations, and gold crown with resin filling inside, are advantageous methods to prevent further crack propagation^[57]. Compared with crown restoration, fiber-reinforced composites and onlays can improve the fracture resistance of cracked teeth^[58].

3.4.4 Treatment success

Recent data favor follow-up, especially in the absence of symptoms or compromised tooth structure. When endodontic intervention is required, current evidence suggests that, together with appropriate restorative treatment, the outcomes of fissured teeth may be comparable to those of non-fissured endodontically treated teeth^[59].

The presence of a periodontal pocket associated with a fissured tooth results in a lower survival rate^[60]. The absence of discomfort to preoperative palpation, spontaneous pain and minimal mobility, as well as the presence of pulp vitality were associated with higher survival rates of fissured teeth^[61].

Patients diagnosed with cracked tooth syndrome should be counseled on strategies to prevent it in other teeth^[62].

In a 3-year study in the USA, the survival rate of posterior teeth with a visible crack exceeded 85%. Dentists can effectively evaluate patient, tooth and crack level characteristics to determine which teeth with cracks require treatment and which only require monitoring^[63].

There is controversy about the best treatment for cracked tooth syndrome, which will depend on the depth of the crack. Endodontic treatment and final restoration, either inlay or crown, are the most appropriate treatments to avoid tooth extraction.

4. Conclusions

Cracked tooth is becoming more and more common in the dental office. Cracked teeth have a very varied symptomatology in which patients report a lot of pain on mastication and hypersensitivity. The dentist should know well how to diagnose cracked teeth, there are different diagnostic tests that must be performed together in order to have the correct diagnosis, the most common are radiography and clinical examination. Most cases are treated with endodontics and placing a restoration to prevent the tooth

from cracking. The fissured pieces need to be kept under control with the dentist in order to avoid tooth extraction.

5. Conflict of Interest

Not available

6. Financial Support

Not available

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