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REVIEW ARTICLE

Types and incidence of cracks in posterior teeth: an updated review

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ABSTRACT

Background: Cracked teeth (CT) are a potential issue in restorative dentistry as they can result in structure loss. A teeth crack is a deformation that displays as a break within the structure of teeth with no actual separation of the dental hard tissue. Posterior teeth (PT) cracks can be a source of pain and anxiety for the patient and the dental operator. Extension of the crack may lead to bone dehiscence. Nonetheless, the great focus is generally on cracks in teeth, with little focus on cracked PT.

Aim: To overview the cracks in PT.

Methods: The searching process was adopted to obtain related articles; this procedure involved using related terms, which were used in varied combinations through the search engine. The eligible research findings were all types of articles that reported PT cracks as the main title of the article or subtitle were eligible.

Results: The discussion was categorized into three major titles, with treatment titles including three subtitles to cover the subject as possible.

Conclusion: Cracks of the PT are frequent and relevant issues; however, there is an inaccurate determination of their incidence and prevalence. The risk factors of such cracks lack consensus as cracks are linked with multifactorial variations. The management of cracks can be hard due to the unknown extension of the crack and the late identification of the crack.

Keywords: Incidence, types, PT, cracks, risk factors.

Background

Cracks in teeth are a considerable issue in dentistry as they result in pain and structure loss. Moreover, early identification and treatment is a clinical challenge. Teeth crack is a plastic deformation that displays as a break within the structure of teeth with no actual separation of the dental hard tissue [1]. In 1964, Cameron defined crack tooth syndrome (CTS) as a critical posterior teeth (PT) imperfect fracture that involves the extension of dentine to the pulp [2]. In 2001, a new definition was proposed by Ellis [3], and it stated that CTS is a fracture plane of unknown direction and depth passing through the structure of a tooth that may progress to communicate with the periodontal ligament and/or pulp if not already involved [3].

The prevalence of fissures in natural teeth is 4%-5% for every 100 adults [4]. The causes of cracks include age, stress, occlusal diseases, and several habits, such as bruxism [5]. PT crack can be a huge source of pain and anxiety for the patient and the dental operator [6]. The principal issue of CT is the possibility of bacterial infection following bacterial penetration to the pulp, which can result in pulpitis [7]. The crack extension may lead to bone dehiscence with a deep periodontal pocket [8]. In addition, cracks, splits, and fractures were demonstrated as the third most frequent cause of tooth loss in developed countries recently [9].

The management of CT is a challenge as there is no consensus regarding their treatment [10]. Therefore, the identification of PT cracks is crucial; however, the great focus is on cracks in teeth generally, and there is not plenty of research on cracks in PT. Moreover, no previous review focused on PT cracks. Therefore, this review was

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established to highlight and overview the cracks in PT as much as it is reported in previous literature.

Materials and Methods

This review focused on cracked PT; hence, the searching procedure involved searching for related articles. The search process involved using related terms such as "Cracks, Posterior, Teeth, Prevalence, Incidence, Types, Risk factors, Determinants, Treatment, Management, and Therapy," which were used in varied combinations through the search engines PubMed, Google Scholar, and Science Direct. The research findings were reviewed for titles to preclude irrelevant articles and case reports, as well as letters to the editor. Also, the language of the findings was checked, and non-English articles were excluded. All types of articles reported PT cracks as the main title of the article or subtitle were eligible. The discussion was categorized into three major titles, with treatment titles including three subtitles to cover the subject as possible.

Discussion

Incidence and types of cracks

Generally, the incidence of CT is not well established in the adult population [11]; however, the prevalence of CT was reported to range from 10% to 70% [12]. In 2011, practice-based research revealed that 70% of cases had at least one posterior tooth with visible fracture lines [13].

The majority of studies investigating cracks of PT are ancient [14-17]. The prevalence/incidence rates of cracked PT vary from 20.5/1000 individuals/year [16] to 69.9/1000 individuals/year [17]. The incidence of cracks in molars and premolars was displayed to be 3.1/100 adults and 1.3/100 adults, respectively, from the overall frequency of fractures of the PT [3,18].

A study published in 2020 enrolled 64370 PT that were examined for cracks among 3345 patients and revealed a crack prevalence of 4.5% based on the number of patients and a prevalence of 0.4% based on the number of teeth. Furthermore, among the patients who displayed cracks, the prevalence of cracks was 9.1% [19]. Despite the great variations in rates of cracks in PT, such rates displayed that such cracks are frequent and relevant issues due to insufficient scientific knowledge [14,17,20].

Cracks were found to be more common in PT, especially the maxillary and mandibular molars, as well as maxillary first premolars [21,22]. One study reported a prevalence of mandibular first molar crack of 19.7%, which was the most predominant cracked tooth [19].

The cracks generally extend from mesial to distal, and the second lower molars display the highest incidence [23]. Many studies revealed that the most affected PT are the lower molars [21,24,25], and the second lower molar is the most involved tooth with a prevalence of crack of 25.3% in some studies [8,26], whereas the prevalence in the first lower molar was found to be 27.8% in another study[27] and the prevalence of cracks in the first upper molar was found to be 28% in another report [28].

The higher incidence of cracks in lower molars and the higher prevalence in upper molars is due to the cuspid-fossa relationship as a result of the lingual inclination of the lower antagonists [29]. Cracked natural teeth occur in 4%-5% of 100 adults, and it was demonstrated that molars represent more than 75% of cases with cracks, whereas premolars represent the rest proportion [4]. CT are most commonly involved in maxillary and mandibular molars at the age of 50 years [30]. The variation in prevalence and incidence of cracked PT may be influenced by the characteristics of the enrolled population and the difficulties in crack identification [19].

There are two typical patterns of crack formation: one where the crack is centered and may spread to the pulp and root via the dentinal tubules, resulting in a split tooth, and another where the crack is more peripherally oriented and may cause a cuspal fracture [31]. Most cracks run in the mesiodistal way. Central lines of cracks are the most common. One study demonstrated that posterior cracks were centrally located (91.7%) and ran in a mesiodistal way (61%) [19].

The longitudinal tooth fractures have been divided into five categories in 1997 for consistency's sake [31]. Craze lines are visible cracks contained within the enamel. In PT, such lines are usually observed crossing the marginal ridges and/or extending along lingual and buccal surfaces. Fractured cusps start at the tooth's crown, travel through the dentin, and terminate in the tooth's cervical region. They typically occur in teeth with extensive restorations, resulting in cuspal enamel that is not supported. A cracked tooth describes a crack that starts from the occlusal surface apically with no separation of the two fragments. The crack is generally detected at the tooth center in a mesiodistal direction and may encompass one or both marginal ridges. A split type describes a crack expanding through both marginal ridges, commonly in a mesiodistal way, splitting the tooth entirely into two separated fragments. The crack occurs at the teeth center. The crack may involve either the whole root or only a portion [32].

Risk factors

There is a lack of consensus regarding the etiology of cracked or fissured PT as it is linked with other factors such as epidemiological data, restorative materials, dental characteristics, para-functional habits, and diet [15,16]. The determinants of cracks include poor oral habits such as long-term unilateral chewing, eating habits, early occlusion, and bruxism that promote dental cracks [30].

The elastic limit of a tooth is dependent on the quantity and quality of the tooth structure and its capability of withstanding the force acting on the tooth [33]. It was stated that various factors such as thermal cycling and bite force can result in crack lines or damaged structure of the tooth [34]. The predisposing factors of cracks are those

increasing the force that acts on the teeth or those reducing the resistance of the teeth to the chewing force [35].

The progression and nature of cracks are different between unrestored and restored teeth. It was suggested that the formation of cracks can occur in two methods, through excessive force exerted on a healthy tooth or through physiological force exerted on a weakened tooth [33,36]. In unrestored teeth, it was proposed that hard food wedged between the lingual and buccal cuspal inclines could considerably introduce lateral tensile forces, which are poorly adapted by PT [1].

Oral habit can be incorporated into crack development, including sleep bruxism, long-term unilateral chewing, and precocious occlusion [37]. Excessive stress exerting on teeth may occur if patients have parafunctional habits such as bruxism. The bite force of such subjects is reported to be fourfold more than the average [38,39].

Also, thermal cyclic eating is linked with CT, and eating coarse foods and chewing hard objects are determinants for CT [34]. PT may be subjected to harmful crack-inducing lateral forces by the loss of anterior guidance due to tooth wear [40]. The defects in tooth structure, such as deep occlusal and large vertical radicular grooves, can initiate cracks [41]. Moreover, the disocclusion of PT could be hindered by shallow anterior guidance during the lateral excursion, which results in elevated lateral forces acting on the cusp of the PT [1].

In the case of restored teeth, the existence of premature contact interference on the restoration in PT can result in destructive wedging and displacing forces on the axial walls, leading to the progression of cracks [1]. Also, following endodontics, the incidence of cracks is higher as dentin experiences stress due to the contact between the canal wall and the instrument that induces the appearance of CT [42]. In one study, it was found that the detected cracks were prevalent among 97% of those who endodontically managed [43]. Another study revealed that cracks of PT were associated with class II & II restorations [44].

Another factor that may relate to cracks of teeth is gender; it was reported that the prevalence of CT was higher among females [45]. Also, age and economic levels can be contributing factors; one study revealed that the most predisposing age was 50 years old, and among older adults, the predisposition was related to their economic level [46]. One report revealed that the majority of cracks occurred in PT among cases aged 40-49 years [44].

Case-control research was conducted on subjects with cusp fractures. Another study detected cracks in 152 patients and revealed that cracks were predominant among males and older age ($p = 0.007$) [19].

Management of PT cracks

The treatment of CT is dependent on the depth, direction, and size of the cracks [32].

However, the management of CT can be hard due to the unknown extension of the fissure [5]. Therefore, there is controversy regarding the best management modality for teeth crack [5]. One study revealed that 71.4% of enrolled dentists reported a poor understanding of cracked tooth biomechanics, and 46.8% preferred extraction if the tooth with root canal treatment had a crack with a 5 mm probing pocket depth. Such findings indicate that there is a need for more well-controlled studies in clinical biomechanics and treatment approaches for cracked PT [12].

The suitable strategy of management for CT is dependent on many factors; one study conducted on 209 dentists treated 2,858 patients with PT with at least one crack revealed that one-third of the CT were advised for restoration. However, restoration recommendation was associated with the presence of biting pain, caries, and radiographic evidence of crack [45].

Conclusion

Cracks of the PT are frequent and relevant issues due to insufficient scientific knowledge that led to a lack and inaccurate determination of their incidence and prevalence. However, the lower molars are the teeth most affected by cracks. Additionally, the risk factors of such cracks lack consensus as cracks are linked with multifactorial variations and their association with other factors. The determined risk factors of cracks include poor oral habits such as long-term unilateral chewing, eating habits, bite force, early occlusion, and bruxism. The management of cracks depends on the direction, depth, and size of the cracks, as well as the quality and amount of other remaining tissues. The early detected minimal cracks can be managed by adhesive procedures, whereas larger extensive ones may require endodontic treatment and other procedures. The management of cracks can be hard due to the unknown extension of the crack.

Consent to participate
Not applicable.

Ethical approval
Yes.

Conflict of interest
The authors declare that they have no conflict of interest regarding the publication of this article.

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