



## International Journal of Applied Dental Sciences

ISSN Print: 2394-7489  
ISSN Online: 2394-7497  
IJADS 2023; 9(4): 299-302  
© 2023 IJADS  
[www.oraljournal.com](http://www.oraljournal.com)  
Accepted: 14-11-2023

Author's details are given below  
the reference section

### Cracked teeth: A scoping review

**Diego Tapia Ornelas, Laura Elena Villarreal Garcia, Sonia Martha Lopez Villarreal, Osvelia Esmeralda Rodriguez Luis, Juan Carlos Medrano Rodriguez, Nubia Maricela Chavez Lamas, Ana Karen Gonzalez Alvarez, Cristina Oriett Martinez Galvan and Dr. Juan Manuel Solis Soto**

DOI: <https://doi.org/10.22271/oral.2023.v9.i4e.1884>

#### Abstract

**Introduction:** Cracked teeth is one of the most common cause of tooth loss in developed countries.

**Objective:** To analyze the literature on cracked teeth, mainly its etiology, diagnosis, prevalence and treatment.

**Methodology:** A compilation was made of articles published in the last 5 years using the electronic database PubMed, Scopus and Google Scholar. Abstracts and full texts were identified that included information on cracked teeth: "cracked", "teeth", "etiology", "diagnosis", "prevalence" and "treatment".

**Results:** Having knowledge of the etiology allows the dentist to detect it in time, thus avoiding the propagation of cracks and complications associated with it. Early diagnosis can be a simple restoration, if it progresses it is often necessary to treat the root canal and restore the cusp coverage. The number of cases has increased due to the lack of information for early diagnosis. The treatment of the affected tooth and its prognosis is generally difficult to determine. It depends more on the location, extent and magnitude of the damage caused by the fissure when diagnosed and the time of treatment.

**Conclusion:** Cracked teeth is one of the main causes of extractions. The use of conventional radiographs does not allow us to make an adequate diagnosis. There is a high prevalence of this problem in older adults, since most of the teeth are treated in some way, and the treatment of a cracked tooth depends on the complexity of the case.

**Keywords:** Cracked teeth, etiology, diagnosis, prevalence, treatment

#### 1. Introduction

Cracked teeth is one of the most common cause of tooth loss in developed countries and is one of the easiest dental disorders to diagnose and treat <sup>[1]</sup>. Mainly in an older population, which has had teeth treated for many decades, resulting in an increase in the prevalence of this type of syndrome <sup>[2]</sup>.

Cracked teeth have a fracture of unknown depth, which may originate in the crown, may cross the tooth structure and extend subgingivally, and may also cause damage to the pulp and periodontal ligament <sup>[3]</sup>. A crack should not be viewed as a disease in itself, but as a potential cause of pulpal and periradicular disease <sup>[4]</sup>.

The American Association of Endodontists determines the cracked tooth in five classifications. Generally, when there are only crack lines it is asymptomatic <sup>[5]</sup>, when the cusp is fractured the pain is generally mild when biting <sup>[6]</sup> and in the cold when there is intense pain when biting we can speak of a cracked tooth <sup>[7]</sup> or a broken tooth and when we find immense pain and with a poor prognosis, we speak of vertical root fractures <sup>[2]</sup>.

One of the main problems is that it is very difficult to be diagnosed or treated due to the undetectable microcracks and imperceptible clinical symptoms <sup>[8]</sup>. If not properly treated, the cracks will expand and in the future lead to pulpitis or fracture of the entire tooth <sup>[9]</sup>. Bacterial invasion of the pulp is one of the characteristics of cracked teeth. The deeper the fissure, the greater the inflammatory reaction <sup>[10]</sup>. Subgingival fissures give rise to narrow and isolated periodontal pockets that can favor bacterial invasion and lead to tooth loss <sup>[11]</sup>.

It is important that the clinical characteristics of cracked teeth are known by the health professional and can differentiate the discomfort that the patient experiences when chewing,

**Corresponding Author:**  
**Diego Tapia Ornelas**  
Master of Sciences student,  
Universidad Autonoma de  
Nuevo Leon, Facultad de  
Odontologia, Monterrey, Nuevo  
Leon, 64460 ZIP, Mexico

Since the pain provoked when the patient stops biting is a characteristic diagnostic difference. The aim of this work is to analyze the literature on cracked teeth, mainly its etiology, diagnosis, prevalence and treatment.

## 2. Materials and Methods

Articles on the subject published through the PubMed, Scopus and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was assessed using the PRISMA guide, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for assessing systematic reviews (AMSTAR-2). The search was implemented using the AND, OR, NOT operators. The keywords used for the search were cracked teeth, etiology, diagnosis, prevalence and treatment. The keywords were used individually, as well as each of them related to each other.

## 3. Results and Discussion

### 3.1 Etiology

The cracked teeth has two factors, one that includes the developmental and functional state, as well as pathological processes (non-iatrogenic) and the other in which it is the dentist who could cause the tooth to crack [8]. Among the non-iatrogenic factors is aging. As the individual grows older, tooth fatigue increases, the hard tissues become fragile and dentin loses its elasticity, which leads to cracking of the teeth [12]. Deep and large occlusal grooves or bifurcations and extensive pulps are factors that cause cracked tooth syndrome [8].

Other non-iatrogenic processes include oral habits, among which long-term unilateral chewing, bruxism and cyclical eating habits stand out [13]. Among the factors produced by the dentist we find head and neck radiotherapy, since this impacts on the flow of saliva making the enamel brittle and also changes the distribution of mechanical stress, increasing the probability of crack lines [14].

The incidence of cracks and defects in dentin is higher after endodontics, as dentin undergoes stress due to the contact between the instrument and the canal wall, inducing the appearance of cracked teeth. Intracanal post placement, the use of a higher concentration of sodium hypochlorite and obturation techniques can also contribute to the appearance of vertical root fractures [15]. The structural design of the teeth, in combination with chewing forces, creates internal shear and tensile stresses that invite complete or incomplete vertical root fracture [16].

The possibility of cracked teeth should be considered when the patient complains of pain when chewing or biting. Having knowledge of the etiology allows the dentist to detect it in time, thus avoiding the propagation of cracks and complications associated with it.

### 3.2 Diagnosis

Diagnosis should have complete examinations, including history of symptoms, bite tests, pulp vitality tests, visual inspection, radiographic examination and periodontal evaluation [17]. Visualization is difficult even if the X-ray beam is parallel to the fissure plane, due to overlapping structures and the limited spatial resolution of radiographs also varies according to the position and extent of the fracture [18]. There are several diagnostic methods to confirm this type of fracture, including visual inspection with transluminal instruments [19], autofluorescence [20], tomography [21], and percussion [22]. Visualization without ocular aid impairs the

dentist's ability to assess the presence or severity of cracks. The use of magnification (from 14x) provides several information including the translucent nature of the enamel, subtle color changes in the enamel which may indicate early deterioration, microleakage and lack of structural integrity of the dentin and enamel [17]. Autofluorescence is a wavelength of visible light with a special filter can quantify the depth of enamel cracking by calculating the loss of green autofluorescence of the tooth due to backscattering caused by decreased mineral levels [20]. Recent studies have shown that computed tomography is more efficient for the detection of fractures compared to two-dimensional radiography [23]. Percussion is a mechanical diagnostic evaluation of tooth stability, providing a new diagnostic tool. It allows the dentist to assess the structural health of the dentition through the perception of mastication and parafunction [22]. In translumination, fracture lines diffract light in such a way that fractured segments are illuminated differently. Transilluminated crack lines produce changes in contrast that can make interpretations difficult, as they can be visualized as structural cracks [19].

Early diagnosis may result in treatment with a simple restoration, however, if it progresses to communicate with the pulp, root canal treatment and restoration of cusp coverage is often necessary.

### 3.3 Prevalence

Epidemiological studies on the incidence of cracked tooth syndrome are contradictory [24]. However, dental fissures are not rare; the literature reports an incidence of between 34% and 74% with a large increase in recent years related to the high levels of stress in the population [25]. Higher incidence is reported in lower molars and higher prevalence in upper molars due to the cuspid-fossa relationship due to the lingual inclination of the lower antagonists [26]. The prevalence of fractured teeth was reported to be higher in females [17]. In a study conducted in the national network of dental practice-based research in the United States in 2017, that the most predisposed age was 50 years old. In older adults the predisposition is related to teeth and their economic level [27]. Among the age-related changes are mechanical properties of the dental substrate, heavily restored or endodontically treated teeth, as well as masticatory and thermal fatigue [18]. Of the cases of cracked tooth syndrome detected, 97% were endodontically treated, while 2.3% were detected in teeth with vital pulps and 0.7% in teeth with non-vital pulps that did not have endodontics [16].

There has been an increase in the number of cases of cracked tooth syndrome in recent years, although the incidence is much higher due to the impossibility or little information to diagnose early this lesion which has a poor identity due to an inadequate and bizarre clinical presentation.

### 3.4 Treatment

The management of such teeth depends on the size and depth of the cracks, so that if the main problem is mild pain or sensitivity when biting, bandaging the tooth may help alleviate the pain [28]. When the crack goes beyond the pulp, the plan is pulp therapy, in which some studies indicate a 92% success rate after root canal treatment of teeth with cracks. Teeth with deep periodontal pockets have a poor prognosis [29]. According to a study carried out in 2019, it is mentioned that teeth restored with cracks involving the floor of the pulp chamber have a poor prognosis, mainly posterior teeth [28], in which the floor of the pulp chamber has less thickness and

resistance due to the presence of the furcation, which sometimes causes division of the root and exposure of the periodontal ligament to the oral flora and saliva <sup>[30]</sup>. Regarding immediate treatment, there is the occlusal adjustment <sup>[31]</sup>, among others is the use of copper rings and stainless steel bands, these are generally used for cracks that go below the gingival margin or in which one or more surfaces of the tooth are missing, these generally serve as a splint <sup>[32]</sup>. Other treatments include direct restorations, among which composite resins can be used to fill fine cracks <sup>[33]</sup>. An *in vitro* study demonstrated that inlays bonded with resins or ceramics improved the fracture resistance of prepared teeth to a level similar to that of healthy teeth <sup>[34]</sup>. Full crowns are the first choice for the treatment of cracked tooth syndrome and have a higher survival rate than the other treatments mentioned above <sup>[2]</sup>.

One of the most common causes of tooth extraction is cracked teeth due to problems in its identification. The treatment of the affected tooth and its prognosis is generally difficult to determine. It depends more on the location, extent and magnitude of the damage caused by the crack when diagnosed and the time of treatment.

#### 4. Conclusions

Cracked teeth is one of the main causes of extractions, mainly those teeth that have been treated with endodontics. The use of conventional radiographs does not allow us to make an adequate diagnosis, therefore complementary studies such as percussion, translumination, autofluorescence and tomography are necessary. There is a high prevalence of this problem in older adults, since most of the teeth are treated in some way. Treatment of a cracked tooth depends on the complexity of the case and could range from a simple restoration to extraction.

#### 5. References

- Mathew S, Thangavel B, Mathew CA, Kailasam S, Kumaravadeivel K, Das A, *et al.* Diagnosis of cracked tooth syndrome. *J Pharm Bioallied Sci.* 2012 Aug;4(Suppl 2):S242-4.
- Li F, Diao Y, Wang J, Hou X, Qiao S, Kong J, *et al.* Review of cracked tooth syndrome: Etiology, Diagnosis, Management, and Prevention. *Pain Res Manag.* 2021 Dec 15;2021:3788660.
- Hasan S, Singh K, Salati N. Cracked tooth syndrome: Overview of literature. *Int J Appl Basic Med Res.* 2015 Sep-Dec;5(3):164-8.
- Noma N, Shimizu K, Watanabe K, Young A, Imamura Y, Khan J, *et al.* Cracked tooth syndrome mimicking trigeminal autonomic cephalalgia: A report of four cases. *Quintessence Int.* 2017;48(4):329-337.
- Davis MC, Shariff SS. Success and survival of endodontically treated cracked teeth with radicular Extensions: A 2- to 4-year Prospective Cohort. *J Endod.* 2019 Jul;45(7):848-855.
- Nguyen Thi W, Jansson L. Survival rate after endodontic treatment in general dentistry for cracked teeth with different coronal restorations. *Acta Odontol Scand.* 2021 May;79(4):256-261.
- Wu S, Lew HP, Chen NN. Incidence of pulpal complications after diagnosis of vital cracked teeth. *J Endod.* 2019 May;45(5):521-525.
- Zhang S, Li X, Qi Y, Ma X, Qiao S, Cai H, *et al.* Comparison of autogenous tooth materials and other bone grafts. *Tissue Eng Regen Med.* 2021 Jun;18(3):327-34
- Wang Z, Yang J, Jiang H, Fan X. CNN Training with twenty samples for crack detection via data augmentation. *Sensors (Basel).* 2020 Aug 27;20(17):4849.
- Yang SE, Jo AR, Lee HJ, Kim SY. Analysis of the characteristics of cracked teeth and evaluation of pulp status according to periodontal probing depth. *BMC Oral Health.* 2017 Nov 28;17(1):135.
- Yu M, Li J, Liu S, Xie Z, Liu J, Liu Y, *et al.* Diagnosis of cracked tooth: Clinical status and research progress. *Jpn Dent Sci Rev.* 2022 Nov;58:357-364
- Qiao F, Chen M, Hu X, Niu K, Zhang X, Li Y, *et al.* Cracked teeth and poor oral masticatory habits: A Matched case-control study in China. *J Endod.* 2017 Jun;43(6):885-889.
- Edelhoff D, Güth JF, Erdelt K, Brix O, Liebermann A. Clinical performance of occlusal onlays made of lithium disilicate ceramic in patients with severe tooth wear up to 11 years. *Dent Mater.* 2019 Sep;35(9):1319-1330.
- Madrid CC, de Pauli Paglioni M, Line SR, Vasconcelos KG, Brandão TB, Lopes MA, *et al.* Structural analysis of enamel in teeth from head-and-neck cancer patients who underwent Radiotherapy. *Caries Res.* 2017;51(2):119-128.
- Lima CO, Barbosa AFA, Ferreira CM, Ferretti MA, Aguiar FHB, Lopes RT, *et al.* Influence of ultraconservative access cavities on instrumentation efficacy with XP-endo Shaper and Reciproc, filling ability and load capacity of mandibular molars subjected to thermomechanical cycling. *Int Endod J.* 2021 Aug;54(8):1383-1393.
- Chen YT, Hsu TY, Liu H, Chogle S. Factors Related to the outcomes of cracked teeth after endodontic treatment. *J Endod.* 2021 Feb;47(2):215-220.
- Hilton TJ, Funkhouser E, Ferracane JL, Schultz-Robins M, Gordan VV, Bramblett BJ, *et al.* Recommended treatment of cracked teeth: Results from the National Dental Practice-Based Research Network. *J Prosthet Dent.* 2020 Jan;123(1):71-78
- Patel S, Bhuva B, Bose R. Present status and future directions: vertical root fractures in root filled teeth. *Int Endod J.* 2022 May;55 Suppl 3(Suppl 3):804-826.
- Kim JH, Eo SH, Shrestha R, Ihm JJ, Seo DG. Association between longitudinal tooth fractures and visual detection methods in diagnosis. *J Dent.* 2020 Oct;101:103466.
- Jun MK, Park SW, Lee ES, Kim BR, Kim BI. Diagnosis and management of cracked tooth by quantitative light-induced fluorescence technology. *Photodiagnosis Photodyn Ther.* 2019 Jun;26:324-326.
- Shimada Y, Yoshiyama M, Tagami J, Sumi Y. Evaluation of dental caries, tooth crack, and age-related changes in tooth structure using optical coherence tomography. *JPN Dent Sci Rev.* 2020 Nov;56(1):109-118.
- Sheets CG, Zhang L, Wu JC, Earthman JC. Ten-year retrospective study of the effectiveness of quantitative percussion diagnostics as an indicator of the level of structural pathology in teeth. *J Prosthet Dent.* 2020 May;123(5):693-700.
- Gao A, Cao D, Lin Z. Diagnosis of cracked teeth using cone-beam computed tomography: literature review and clinical experience. *Dentomaxillofac Radiol.* 2021 Jul 1;50(5):20200407.
- Dias DR, Iwaki LCV, de Oliveira ACA, Martinhão FS, Rossi RM, Araújo MG, *et al.* Accuracy of high-resolution

- small-volume cone-beam computed tomography in the diagnosis of vertical root fracture: An *in vivo* analysis. J Endod. 2020 Aug;46(8):1059-1066.
25. Guo J, Wu Y, Chen L, Long S, Chen D, Ouyang H, *et al.* A perspective on the diagnosis of cracked tooth: Imaging modalities evolve to AI-based analysis. Biomed Eng Online. 2022 Jun 15;21(1):36.
  26. Kakka A, Gavriil D, Whitworth J. Treatment of cracked teeth: A comprehensive narrative review. Clin Exp Dent Res. 2022 Oct;8(5):1218-1248.
  27. De-Deus G, Cavalcante DM, Belladonna FG, Carvalhal J, Souza EM, Lopes RT, *et al.* Root dentinal microcracks: a post-extraction experimental phenomenon? Int Endod J. 2019 Jun;52(6):857-865.
  28. Mahgoli HA, Arshad M, Rasouli K. Restoration of endodontically treated cracked maxillary teeth: A case series. Clin Case Rep. 2019 Sep 1;7(10):1951-1956.
  29. Leong DJX, de Souza NN, Sultana R, Yap AU. Outcomes of endodontically treated cracked teeth: a systematic review and meta-analysis. Clin Oral Investig. 2020 Jan;24(1):465-473.
  30. Brignardello-Petersen R. There seems to be a high average survival rate of cracked teeth that have undergone endodontic treatment. J Am Dent Assoc. 2020 Jun;151(6):e52.
  31. Banerji S, Mehta SB, Kamran T, Kalakonda M, Millar BJ. A multi-centred clinical audit to describe the efficacy of direct supra-coronal splinting- a minimally invasive approach to the management of cracked tooth syndrome. J Dent. 2014 Jul;42(7):862-71.
  32. Yap EXY, Chan PY, Yu VSH, Lui JN. Management of cracked teeth: Perspectives of general dental practitioners and specialists. J Dent. 2021 Oct;113:103770.
  33. Naka O, Millar BJ, Sagris D, David C. Do composite resin restorations protect cracked teeth? An in-vitro study. Br Dent J. 2018 Aug 10;225(3):223-228.
  34. Taha D, Spintzyk S, Schille C, Sabet A, Wahsh M, Salah T, *et al.* Fracture resistance and failure modes of polymer infiltrated ceramic endocrown restorations with variations in margin design and occlusal thickness. J Prosthodont Res. 2018 Jul;62(3):293-297.

#### Author's details

##### Diego Tapia Ornelas

Master of Sciences student, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

##### Laura Elena Villarreal Garcia

Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

##### Sonia Martha Lopez Villarreal

Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

##### Osvelia Esmeralda Rodriguez Luis

Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

##### Juan Carlos Medrano Rodriguez

Professor, Universidad Autónoma de Zacatecas, Ciencias de la Salud, Unidad Académica de Medicina Humana, Zacatecas, Mexico

##### Nubia Maricela Chavez Lamas

Professor, Universidad Autónoma de Zacatecas, Ciencias de la Salud, Unidad Académica de Odontología y Ciencias de la Salud, Zacatecas, Mexico

##### Ana Karen Gonzalez Alvarez

Professor, Universidad Autónoma de Zacatecas, Ciencias de la Salud, Unidad Académica de Odontología y Ciencias de la Salud, Zacatecas, Mexico

##### Cristina Oriett Martinez Galvan

Dentistry Student, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

##### Dr. Juan Manuel Solis Soto

Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, 64460 ZIP, Mexico

#### How to Cite This Article

Ornelas DT, Garcia LEV, Villarreal SML, Luis OER, Rodriguez JCM, Lamas NMC, *et al.* Cracked teeth: A scoping review. International Journal of Applied Dental Sciences. 2023;9(4):299-302.

#### Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.