

## Review

# Types, Diagnosis, and Treatment of Dental Fractures

Tarik Alakkad<sup>1\*</sup>, Abdulrahman Alwadei<sup>2</sup>, Khadijah Saidi<sup>3</sup>, Abdullah Alanazi<sup>4</sup>, Maha Hezam<sup>5</sup>, Manal Ajina<sup>6</sup>, Ziyad Aljohani<sup>7</sup>, Saeed Al Afraa<sup>8</sup>, Ahmed Alanazi<sup>9</sup>, Ghufra Almarwani<sup>10</sup>, Lamia Alshowail<sup>8</sup>

<sup>1</sup> Department of Restorative Dentistry, Al Thager Hospital, Jeddah, Saudi Arabia

<sup>2</sup> Dental Department, Kingdom Hospital, Riyadh, Saudi Arabia

<sup>3</sup> General Dentist, Ministry of Health, Mecca, Saudi Arabia

<sup>4</sup> Department of Restorative Dentistry, Hail Dental Center, Hail, Saudi Arabia

<sup>5</sup> General Dentist, Prince Mohammed bin Abdulaziz Hospital, Medina, Saudi Arabia

<sup>6</sup> General Dentist, Al Qurayyat General Hospital, Al Qurayyat, Saudi Arabia

<sup>7</sup> General Dentist, King Abdulaziz Hospital, Mecca, Saudi Arabia

<sup>8</sup> College of Dentistry, King Khalid University, Abha, Saudi Arabia

<sup>9</sup> General Dentist, Directorate of Health Affairs, Hafer Al Batin, Saudi Arabia

<sup>10</sup> College of Dentistry, Vision Colleges, Riyadh, Saudi Arabia

**Correspondence** should be addressed to **Tarik Alakkad**, Department of Restorative Dentistry, Al Thager Hospital, Jeddah, Saudi Arabia, email. Email: [tm.akkad@gmail.com](mailto:tm.akkad@gmail.com)

Copyright © 2023 **Alakkad**, this is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received: 10 December 2023, Accepted: 20 December 2023, Published: 24 December 2023.

### Abstract

Enamel fractures are often caused by trauma. Can be seen as visible irregularities that require early intervention to prevent aesthetic issues. Dentin fractures are marked by increased sensitivity. Require tailored interventions such as desensitizing agents or restorations to address symptoms and maintain tooth integrity. Root fractures present with localized pain and swelling, posing challenges that require a management approach. Vertical fractures affecting both the crown and root need assessment using imaging techniques to guide treatment decisions. Cracked tooth syndrome involves fractures that may be managed holistically through measures or endodontic therapy in severe cases. This comprehensive review explores the world of fractures, examining their various types, symptoms and treatment strategies. It covers fractures in enamel, dentin, roots, and vertical ones that affect both the crown and root as cracked tooth syndrome. The study emphasizes the importance of diagnosis and effective treatment for the presentation of fractures. The study also highlights the integration of expertise with advanced tools like cone beam computed tomography (CBCT) for more precise dental diagnostics. Adhesive dentistry is recognized as an aspect of invasive restorations that aim to preserve natural tooth structure. This review underscores the significance of intervention and patient education while recognizing the interplay between traditional practices and modern modalities in managing dental fractures. Each type of fracture requires an approach addressing anything from cosmetic concerns like enamel fractures to more complex issues like root fractures. It is crucial to intervene relying on clinical examinations and advanced diagnostic tools for guidance.

**Keyword:** *Dental fractures, Enamel fractures, Dentin fractures, Root fractures, Adhesive dentistry*

**Introduction**

Fractures, in the field of dentistry come in types, causes and severities. It is crucial to have an understanding of the intricacies surrounding fractures to ensure accurate diagnosis and effective treatment (1). Among the types of fractures is enamel fracture, which specifically affects the outermost layer of the tooth. These fractures often occur due to trauma or excessive force during activities like biting down on substances while eating (2). Diagnosis involves an examination sometimes assisted by imaging to determine the extent of enamel damage. Treatment typically involves procedures such as bonding or veneers to restore the tooth's appearance and provide protection against harm. Another significant category is dentin fractures that extend beyond the enamel and affect the dentin layer. Dentin fractures expose the portion of the tooth leading to increased discomfort and vulnerability to bacterial invasion (3-5). Diagnosing fractures requires evaluation potentially utilizing tools like transillumination for improved visibility. Common treatment strategies involve applying bonding agents or in severe cases using dental crowns for structural support and symptom relief. Root fractures represent a form of dental injury as they involve damage to the root structure beneath the gumline. These fractures can be either horizontal or vertical in nature (6). Their diagnosis requires a combination of clinical examination techniques along with imaging methods such as cone beam computed tomography (CBCT). Treatment methods differ depending on where and how extensive the fracture is. They can range from using splints to stabilize the tooth to measures like root canal therapy or, in cases, extracting the tooth altogether (7, 8). Fractures that run vertically through a tooth can be quite tricky to identify as they affect both the part of the tooth (crown) and the root. Detecting fractures requires an examination, sometimes with the help of magnification tools (9). The treatment options depend on where the fracture is located. If it's in the crown, it can often be fixed by placing a crown over it. However, if it's a fracture that reaches down into the root, extraction may be necessary because predicting outcomes becomes more challenging. It's

important to note that diagnosing fractures isn't solely reliant on examination but is greatly aided by advancements in diagnostic tools. Radiographic techniques like panoramic radiographs are crucial in visualizing fractures, especially those involving the root. Cone beam computed tomography (CBCT) provides detailed three-dimensional images helping dentists accurately assess fracture patterns and their impact on surrounding structures (10). When it comes to treating fractures, adhesive dentistry has revolutionized how we manage them. Adhesive materials like resins allow for invasive restorations while preserving as much natural tooth structure as possible. This aligns with care's focus on conservative approaches using advanced materials and techniques. Therefore, dental practitioners must have an understanding of the types of dental fractures—how to diagnose them and what treatments are appropriate for each one (11, 12). For example, cosmetic interventions may be needed for enamel fractures, while measures addressing sensitivity and preventing damage are necessary, for fractures. Root fractures, such as fractures, can be difficult to diagnose and treat. They often require an approach that considers factors. Incorporating tools can improve the precision of assessments, leading to more focused and successful treatment methods. The field of dentistry is centered around the idea of preserving tooth structure. Represents a move towards less invasive techniques in modern dentistry. By combining knowledge with advanced diagnostic and treatment methods, dental fracture management has evolved to provide the best possible results for patients. This study aims to examine the types of fractures, their diagnoses, and treatment options.

**Methodology**

On November 26, 2023, we conducted a review of articles from Cochrane Library, PubMed, and Scopus. The purpose of this review was to analyze the types of dental fractures, their diagnosis, and treatment options. Specifically focusing on studies conducted in English since 2008 that prioritize well-being when dealing with fractures. The main objective of this review was to shed light on assessment methods and early warning systems that

can aid healthcare professionals in ensuring safety during dental care procedures.

## **Discussion**

Having an understanding of fractures which can occur from enamel to root is crucial for effectively managing them and addressing their various clinical manifestations. While enamel fractures are primarily cosmetic, they can worsen if left untreated underscoring the importance of intervention. Minor enamel fractures can be successfully treated with approaches like bonding highlighting the need for treatments based on the severity of the fracture (13). Dentin fractures can cause increased sensitivity. Require targeted interventions such as desensitizing agents or restorations to alleviate discomfort. Diagnosing these fractures accurately often involves a combination of evaluation and diagnostic tools. Root fractures challenges that demand a nuanced approach. While dental splinting may be sufficient for root fractures vertical fractures require imaging techniques and a range of treatment options. The integration of tools like radiography and CBCT has revolutionized dental fracture diagnosis by providing a comprehensive view of the fracture patterns and enabling precise assessments that lead to more targeted and effective treatment strategies (14, 15). Adhesive dentistry focuses on restorations aligning with the current emphasis on preserving natural tooth structure. The conversation highlights how traditional clinical knowledge and modern diagnostic and treatment methods work together to shape a changing approach to managing fractures.

### ***Clinical Manifestation***

Dental fractures come in forms and have clinical signs so it's important to understand them well for accurate diagnosis and effective treatment planning. On the milder side, we have fractures that often occur due to accidents or biting into objects. These fractures can be seen as jagged edges on the tooth surface (16, 17). While they may not cause pain, they can affect the appearance of the tooth, so it's essential to examine them and take timely action to prevent further damage. Going deeper into the layer's dentin fractures brings their set of symptoms. Dentin contains nerve endings so when it gets

exposed due to fractures patients might experience increased sensitivity. They may feel pain when exposed to temperature changes or certain foods like sweets or acidic items even air can trigger discomfort. Look out for cracks or dark lines on the tooth as these are signs of dentin involvement that require a thorough clinical evaluation for proper detection. Root fractures are dental injuries with a combination of symptoms. Localized pain that worsens during biting or chewing and swelling of gums around the area are signs of root fractures. However, identifying root fractures through examination can be challenging due to their subtle nature. It becomes clear that a thorough approach is necessary as diagnostic tools and additional assessments often play a role in confirming the diagnosis. Clinical challenges arise when vertical fractures occur affecting both the crown and the root. Diagnosing issues can be challenging due to symptoms like occasional pain while chewing, discomfort when biting or unexplained swelling (18, 19). To accurately assess these conditions advanced imaging techniques such as cone beam computed tomography and magnification play a role in the evolving field of diagnostics. One clinical manifestation called cracked tooth syndrome involves fractures extending through the dentin. Patients often experience sharp pain when biting or chewing making it difficult to pinpoint the source of discomfort. Although visible cracks on the tooth surface may be observed during an examination, further diagnostic evaluation is often necessary to determine the extent of the fracture for treatment planning. It is important to conduct an examination that combines tactile assessments to understand dental fractures fully. Patient-reported symptoms like pain, sensitivity or visible irregularities provide clues. However, it is crucial to recognize that presentations may vary, and asymptomatic fractures can exist which require both expertise and advanced diagnostic tools for assessment. Therefore, dental fractures can range from concerns to severe symptoms of pain and swelling. Enamel fractures mainly affect aesthetics, while dentin fractures cause sensitivity. Root and vertical fractures are characterized by pain and swelling, in areas while cracked tooth syndrome presents the difficulty of

sporadic discomfort that is difficult to pinpoint. The complex nature of these scenarios underscores the importance of conducting an examination and in many instances employing advanced diagnostic techniques to ensure accurate diagnosis and effective treatment planning for dental fractures.

### **Management**

Effectively managing fractures requires a multifaceted approach that takes into account the unique characteristics of each type of fracture as well as the extent and location of the damage. The main goal of management is to alleviate symptoms, preserve tooth structure and restore optimal oral function. The different types of fractures such as enamel, dentin, root, vertical and cracked tooth fractures all require an understanding and individualized treatment plan (20). Enamel fractures are often seen as concerns because they cause irregularities on the tooth's surface. For enamel fractures conservative methods like polishing or bonding can effectively restore the tooth's appearance without intervention. However complex cases with edges may require smoothing or reshaping procedures to improve both patient comfort and reduce the risk of soft tissue irritation. Dentin fractures are characterized by heightened sensitivity due to exposed nerve endings, which necessitates interventions aimed at relieving discomfort and protecting the tooth. Desensitizing agents like varnishes or specialized toothpaste are tools in managing dentin hypersensitivity. When a significant portion of the tooth is fractured dental procedures such as fillings or dental crowns are used. These treatments provide support to the structure of the tooth. Also, protect the exposed dentin by reducing sensitivity and maintaining tooth strength. Root fractures, which often cause localized pain and swelling can be quite complex for clinicians to handle. The management approach depends on factors, like the location and severity of the fracture (21). In cases of root fractures, dental splinting can be used to stabilize the tooth and promote natural healing. However, when dealing with situations such as vertical root fractures or fractures that extend into the root canal the outlook is less optimistic. In some cases, endodontic therapy

or even tooth extraction may be recommended (22). The main goal is to treat any infection and ensure health preservation. Diagnosing and managing fractures that affect both the crown and root adds another layer of complexity. If the fracture is limited to the crown, measures like crowns or onlays can be considered. However, if the fracture extends into the root advanced treatments such as therapy or occasionally extraction may be necessary. Diagnostic tools like Cone-beam Computed Tomography (CBCT) play a role in assessing and guiding treatment decisions in these cases. Cracked tooth syndrome, which involves fractures in dentin requires a management approach due to its elusive symptoms. Conservative measures, like bonding or placing a crown, can effectively stabilize the tooth. Alleviate associated symptoms. However, if the crack reaches the pulp, it may be necessary to consider treatments, like endodontic therapy. Detecting and diagnosing the crack at a stage is crucial as it helps prevent damage and reduces the likelihood of requiring invasive procedures. The main focus of treating fractures is to protect the structure of the tooth, improve its function and maintain its appearance. It is important to have follow-up appointments to ensure that the interventions are effective, and any emerging issues are addressed promptly. Educating patients plays a role in promoting oral hygiene practices and reducing the risk of further damage or fractures. The management of fractures is a process that requires careful consideration of each type of fracture. Whether it's using methods for enamel fractures or involved treatments for root fractures, the goal remains the same: preserving oral health, function, and aesthetics. Early detection customized treatment plans and patient education are elements of clinical management, in dealing with dental fractures.

### **Conclusion**

In summary dental fractures pose a challenge for dentists requiring an understanding to diagnose and effectively treat them accurately. Each type of fracture requires an approach addressing anything from cosmetic concerns like enamel fractures to more complex issues like root fractures. It is crucial

to intervene relying on clinical examinations and advanced diagnostic tools for guidance. The field of diagnostics is continuously evolving with innovations such as CBCT, which greatly enhances the accuracy of assessment. When it comes to treatment, a range of options exist—from measures to interventions—aiming to preserve tooth structure, function and aesthetics. By combining expertise with modern diagnostic and therapeutic approaches we can achieve the best possible outcomes for our patients. As the field continues to progress ongoing research and the integration of cutting-edge technologies will further refine our methods of diagnosing and managing fractures, ultimately improving the quality of patient care in practice.

**Disclosure**

***Conflict of interest***

There is no conflict of interest.

***Funding***

No funding

***Ethical consideration***

Non applicable

***Data availability***

Data that support the findings of this study are embedded within the manuscript.

***Author contribution***

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

**References**

1. Abbott PV. Diagnosis and management of transverse root fractures. *Dent Traumatol.* 2019;35(6):333-47.
2. Lacruz RS, Habelitz S, Wright JT, Paine ML. DENTAL ENAMEL FORMATION AND IMPLICATIONS FOR ORAL HEALTH AND DISEASE. *Physiol Rev.* 2017;97(3):939-93.

3. Brüllmann D, Schulze RK, d'Hoedt B. The treatment of anterior dental trauma. *Dtsch Arztebl Int.* 2010;108(34-35):565-70.
4. Krastl G, Weiger R, Filippi A, Van Waes H, Ebeleseder K, Ree M, et al. Endodontic management of traumatized permanent teeth: a comprehensive review. *International Endodontic Journal.* 2021;54(8):1221-45.
5. Güngör HC. Management of crown-related fractures in children: an update review. *Dental Traumatology.* 2014;30(2):88-99.
6. Khasnis SA, Kidiyoor KH, Patil AB, Kenganal SB. Vertical root fractures and their management. *J Conserv Dent.* 2014;17(2):103-10.
7. Rangareddy MS, Daga A, Vishnu Vardhan Y, Daneswari M. Management of root fracture: a novel, noninvasive treatment approach. *Case Rep Dent.* 2013;2013:653261.
8. Sartoretto SC, Shibli JA, Javid K, Cotrim K, Canabarro A, Louro RS, et al. Comparing the Long-Term Success Rates of Tooth Preservation and Dental Implants: A Critical Review. *J Funct Biomater.* 2023;14(3).
9. 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;2021:3788660.
10. Venkatesh E, Elluru SV. Cone beam computed tomography: basics and applications in dentistry. *J Istanbul Univ Fac Dent.* 2017;51(3 Suppl 1):S102-s21.
11. Dugar M, Ikhara A, Nikhade P, Chandak M, Rathi S. Ultraconservative and Aesthetic Approach for Rehabilitation of Complicated Crown Fracture of Tooth. *Cureus.* 2022;14(6):e26259.
12. Jain A. Principles and Techniques of Exodontia. In: Bonanthaya K, Panneerselvam E, Manuel S, Kumar VV, Rai A, editors. *Oral and Maxillofacial Surgery for the Clinician.* Singapore: Springer Nature Singapore; 2021. p. 259-97.
13. Ni J, Xu L, Lin Y, Lai D, Huang X. Effects on different full-coverage designs and materials of

crack propagation in first mandibular molar: an extended finite element method study. *Front Bioeng Biotechnol.* 2023;11:1222060.

14. Jaju PP, Jaju SP. Clinical utility of dental cone-beam computed tomography: current perspectives. *Clin Cosmet Investig Dent.* 2014;6:29-43.

15. 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;21(1):36.

16. Yahyazadehfar M, Ivancik J, Majd H, An B, Zhang D, Arola D. On the Mechanics of Fatigue and Fracture in Teeth. *Appl Mech Rev.* 2014;66(3):0308031-3080319.

17. Gould TE, Piland SG, Caswell SV, Ranalli D, Mills S, Ferrara MS, Courson R. National Athletic Trainers' Association Position Statement: Preventing and Managing Sport-Related Dental and Oral Injuries. *J Athl Train.* 2016;51(10):821-39.

18. Mathew S, Thangavel B, Mathew CA, Kailasam S, Kumaravadivel K, Das A. Diagnosis of cracked tooth syndrome. *J Pharm Bioallied Sci.* 2012;4(Suppl 2):S242-4.

19. Fukuda KI. Diagnosis and treatment of abnormal dental pain. *J Dent Anesth Pain Med.* 2016;16(1):1-8.

20. Hasan S, Singh K, Salati N. Cracked tooth syndrome: Overview of literature. *Int J Appl Basic Med Res.* 2015;5(3):164-8.

21. Mane NA, Shetty P, Borkar AC, Mujumdar SV, Mujawar A. Healing After Horizontal Root Fracture of Maxillary Central Incisor: A Case Report With 24-Month Follow-Up. *Cureus.* 2023;15(8):e43373.

22. Parirokh M, Zarifian A, Ghoddusi J. Choice of Treatment Plan Based on Root Canal Therapy versus Extraction and Implant Placement: A Mini Review. *Iran Endod J.* 2015;10(3):152-5.