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# Cracked teeth in the East Indian population: An abridged overview of diagnosis, management and prognosis

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**Abstract:**
Cracked tooth syndrome poses a major diagnostic and therapeutic challenge in clinical dentistry due to its varied aetiology and biomechanical behaviour. Therefore, it is of interest to evaluate the characteristics of cracked teeth in the East Indian population using CBCT-based radiological assessment of intact cracked teeth. Cracked teeth were more prevalent in males and predominantly affected individuals aged 40–59 years, with maxillary first molars being the most commonly involved teeth. Most cracks extended to the apical third of the root and were frequently associated with combined endodontic-periodontal pathology. Thus, data shows the demographic and radiographic patterns of cracked teeth, emphasising the importance of early CBCT-based diagnosis and timely intervention for improved prognosis.

**Keywords:** Cracked tooth, cone beam computed tomography, root fracture, split tooth

**Background:**
Cracked teeth pose a considerable diagnostic challenge even for experienced clinicians. The difficulty lies not merely in detecting a crack but in accurately determining its extent and direction, making this condition a foremost concern in restorative dentistry **[1]**. Since the 1950s, numerous classification systems have been proposed to characterise incomplete fractures and their clinical presentations. Gibbs was among the first to document the clinical signs and symptoms of incomplete fractures affecting posterior cusps, describing the condition as cuspal fracture odontalgia. Cameron subsequently introduced the term "cracked tooth syndrome" to encompass the distinctive signs and symptoms associated with cracked teeth **[2]**. The term "cracked tooth syndrome" can, however, be misleading, as the associated symptoms do not always follow a predictable or consistent pattern. Clinical presentation may differ considerably depending on the status of the pulp. Teeth with vital, inflamed, or necrotic pulps, as well as those that have undergone root canal treatment, may display markedly different features. Consequently, the symptoms of cracked teeth are often inconsistent and contingent upon pulpal health **[3]**. In May 2014, the American Association of Endodontists (AAE) convened a Special Committee on Cracked Tooth Initiatives to establish uniform terminology for the AAE Glossary of Endodontic Terms. The committee defined a cracked tooth as "a thin surface disruption of enamel and dentine and possibly cementum, of unknown depth or extension." **[4].** Potential aetiological factors include excessive masticatory forces, occlusal discrepancies, trauma, resorption, dental caries, weakened tooth structure, iatrogenic dental procedures and parafunctional habits **[5]**. Regardless of extent, direction, or location, cracks are invariably associated with bacterial biofilm accumulation. Depending on crack severity, bacterial infiltration may extend into the pulpal tissues, potentially culminating in pulp necrosis. If left untreated, cracks may propagate into complete fractures, resulting in serious complications such as split teeth and, ultimately, tooth loss **[6]**. Cracks have traditionally been associated with endodontically treated or heavily restored teeth; however, recent evidence indicates a rising incidence in intact teeth **[7]**. Therefore, it is of interest to assess the characteristics of cracked teeth in the East Indian population and to provide an overview of diagnosis, management and prognosis.

**Methodology:**
Ethical approval was obtained from the Institutional Ethics Committee. A retrospective observational study was conducted using CBCT scans of patients who presented with cracks in intact teeth. The scans were collected from patients attending the dental outpatient department between December 2023 and January 2025. Only intact teeth showing evidence of cracks were included in the study. Teeth with extensive carious lesions, endodontically treated teeth and teeth with large restorations were excluded. All CBCT scans were acquired using uniform parameters. Imaging was performed using a CS 3D 9600 Scanner (Care stream Dental, Atlanta, GA, USA) with an exposure of 120 kV, 6.3 mA and a voxel size of 75 µm. The collected data were tabulated and subjected to descriptive statistical analysis using MS Excel, Microsoft Office 2021 (Redmond, WA, USA).

**Results:**
A total of 100 patients meeting the inclusion and exclusion criteria were enrolled in the study. Cracked teeth were observed

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more frequently in males (62%) than in females (38%). The age group of 40–59 years recorded the highest prevalence (53%), followed by 60–79 years (25%) and 20–39 years (22%) **(Table 1).** Maxillary teeth (54%) were more commonly affected than mandibular teeth (46%). Among maxillary teeth, the maxillary first molar showed the highest prevalence; in mandibular teeth, first and second molars were equally involved **(Table 2).** With respect to root involvement, the palatal root was most frequently affected in maxillary molars, whereas equal involvement of the mesial and distal roots was observed in mandibular molars **(Table 3).** Crack lines extending to the apical third of the root were the most frequently observed (40%), followed by the coronal third (26%), the middle third (19%), the furcation region (14%) and the crown alone (1%) **(Table 4).** Representative CBCT scans illustrating the observed crack patterns and their relationship with periapical pathology are shown in the representative images. Combined endodontic-periodontal lesions constituted the most common periapical pathology and were predominantly associated with cracks extending to the apical third of the root. When the crack was limited to the coronal third, periapical abscess was the most frequently observed pathology **(Table 5)**.

**Table 1:** Age distribution of cases

| Age Group | Prevalence |
|---|---|
| **20–39 years** | 22% |
| **40–59 years** | 53% |
| **60–79 years** | 25% |

**Table 2:** Distribution of cases by tooth involved

| Tooth | Maxillary | Mandibular |
|---|---|---|
| **1st molar** | 23% | 20% |
| **2nd molar** | 13% | 20% |
| **3rd molar** | 2% | 1% |
| **1st premolar** | 6% | 0% |
| **2nd premolar** | 9% | 5% |
| **Central incisor** | 1% | 0% |

**Table 3:** Distribution of cases by root involved in molar teeth

| **Maxillary Molar** | | | **Mandibular Molar** | | |
|---|---|---|---|---|---|
| **Root involved** | **No. of Teeth** | **Percentage** | **Root Involved** | **No. of Teeth** | **%** |
| **Palatal root** | 13 | 34.21% | Mesial root | 14 | 34.14% |
| **MB root** | 9 | 23.68% | Distal root | 14 | 34.14% |
| **MB and palatal root** | 4 | 10.52% | | | |
| **MB and DB root** | 3 | 7.89% | Mesial and distal root | 4 | 9.75% |
| **DB root** | 1 | 2.63% | | | |

**Table 4:** Distribution of cracks by location within the tooth

| Location | Percentage |
|---|---|
| **Apical third** | 40% |
| **Coronal third** | 26% |
| **Middle third** | 19% |
| **Furcation** | 14% |
| **Crown only** | 1% |

**Table 5:** Association between periapical pathology and crack location

| Location | Combined Endo-Perio Lesion | Apical Periodontitis | Periapical Abscess | Periapical Cyst |
|---|---|---|---|---|
| **Apical third** | 26 | 2 | 12 | 1 |
| **Coronal third** | 4 | 4 | 14 | – |
| **Middle third** | 7 | 1 | 11 | – |
| **Furcation** | 5 | – | 10 | – |
| **Crown only** | – | – | 1 | – |

## Discussion:

Cracked teeth continue to represent a significant diagnostic and therapeutic challenge in contemporary dental practice because of the variability in clinical presentation and the difficulty associated with identifying crack lines. Symptoms are often vague and inconsistent, frequently resembling other odontogenic conditions such as periodontal disease, reversible pulpitis, or temporomandibular disorders **[8]**. Furthermore, many cracks are incomplete, extend subgingivally, or remain obscured beneath restorations, thereby limiting direct visualisation during routine clinical examination. The pathogenesis of crack formation is closely related to the concentration of occlusal stresses within tooth structure. Repeated occlusal loading generates localised stress planes that disrupt the chemical bonds of enamel and dentine, eventually initiating crack propagation **[9]**. Over time, cyclic fatigue and increased tooth flexure may produce symptoms such as pain on biting, thermal sensitivity and pulpal or periodontal involvement. In certain cases, acute trauma may directly initiate and propagate the fracture **[10]**. Several classification systems for cracked teeth have been proposed; however, the classification by the American Association of Endodontists (AAE) remains the most clinically relevant and widely accepted. The AAE system categorises cracks according to their origin, direction, pulpal involvement, symptoms and prognosis, thereby aiding clinicians in diagnosis and treatment planning. Previous investigations have extensively evaluated the prevalence, demographic distribution, diagnostic approaches and management strategies associated with cracked teeth in both intact and endodontically treated dentitions **[11]**. The present study showed that cracked teeth were most prevalent in individuals aged 40–59 years, which is in agreement with the observations of Cameron, Udoye and Jafarzadeh and Roh and Lee, all of whom reported peak incidence during the fourth and fifth decades of life. This age

predilection may be attributed to cumulative occlusal loading, long-term functional fatigue and age-related reductions in dentinal elasticity and fracture resistance. With advancing age, dentine becomes more brittle because of sclerosis and dehydration, increasing susceptibility to crack initiation and propagation. The findings of the present study therefore support the hypothesis that cracked teeth are strongly associated with age-related biomechanical changes within the dentition. A male predominance was also observed in this study, consistent with earlier reports in the literature. The higher prevalence among males may be explained by the greater maximal bite force values generally recorded in men compared with women. Increased occlusal loading may predispose teeth to stress concentration and structural fatigue, thereby increasing the likelihood of crack formation. This observation further emphasises the role of functional occlusal forces in the aetiology of cracked teeth. In contrast to study by Güneç *et al.* (2025) **[12]** which identified mandibular molars as the most frequently affected teeth, the present study found a higher prevalence in maxillary molars, particularly maxillary first molars. This discrepancy may reflect population-specific occlusal patterns, dietary habits, parafunctional activity, or anatomical differences influencing stress distribution. Such findings suggest that regional and ethnic variations may influence the location and pattern of crack development, highlighting the importance of population-based investigations. Diagnosis of cracked teeth requires a comprehensive approach involving detailed history taking, clinical examination and adjunctive diagnostic methods. Patients commonly report pain on biting and sensitivity to cold stimuli. Clinical signs such as localised periodontal pockets, wear facets and positive bite tests may provide valuable clues. Nevertheless, clinical examination alone is often insufficient to determine the complete orientation and extent of the crack. Adjunctive aids including staining dyes, magnification, dental loupes, microscopy and fibre-optic transillumination significantly improve crack detection **[13]**. Among imaging modalities, CBCT offers valuable three-dimensional visualisation of crack extent and orientation, although image artefacts and radiation exposure remain limitations. Advanced technologies such as OCT, micro-CT and SWIFT-MRI have showed superior sensitivity and specificity in crack detection; however, their limited availability restricts routine clinical use **[14]**. Management of cracked teeth depends primarily on pulpal status, crack extent and periodontal involvement. Early diagnosis and timely intervention are critical for improving prognosis and preventing progression to pulpal necrosis or tooth loss. Conservative restorative approaches, including casual coverage restorations and splinting, may stabilise the tooth and limit crack propagation **[15]**. Endodontic treatment becomes necessary in cases involving irreversible pulpitis, pulp necrosis, or persistent symptoms. Prognosis is highly dependent on the depth and direction of the crack, with fractures extending into the root generally carrying a poor or hopeless prognosis. Overall, the present study reinforces existing evidence regarding the multifactorial nature of cracked teeth while contributing valuable regional data on their demographic and radiographic characteristics in the East Indian population **[16]**.

**Conclusion:**

Cracked teeth are a prevalent clinical condition resulting from traumatic injury or cumulative occlusal fatigue, with crack development influenced by the biomechanical integrity of the tooth structure. Accurate assessment of the size, extent and orientation of cracks is essential for appropriate diagnosis, treatment planning and prognosis determination. Despite advances in diagnostic imaging, the management of cracked tooth syndrome remains challenging, highlighting the need for more accessible and reliable diagnostic modalities for early detection and intervention.

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