Diagnosis and Management of Maxillary Left Second Molar with Cracked Tooth Syndrome: A Case Report

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Abstract

Cracked tooth syndrome is known as a major diagnostic challenge in clinical practice. Successful diagnosis and management of this condition requires an awareness of its existence and appropriate diagnostic tests. The aim of this article is to report a clinical case of a cracked tooth syndrome appeared in maxillary left second molar and emphasize on its diagnosis and management. A 45-year-old female patient reported with pain on her maxillary left second molar for the past two months, which increased when biting or chewing. The tooth was tender on palpation and fistula was seen on the gingival region. Radiograph examination revealed a radiolucent area on the apical region. A fracture line running mesio-distally on the occlusal surface was visible using a staining technique. The tooth was diagnosed with chronic periapical abscess et causa necrotic pulp. An orthodontic band was cemented onto this tooth prior to root canal treatment and full-crown was cemented as post-endodontic restoration. The absence of pathological sign and symptoms, and healing of the periapical lesion which can be seen in radiograph examination after 1 month follow-up showing a successful treatment of this case.


Keywords: Cracked tooth, molar, diagnosis, management.

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Introduction

The term cracked tooth syndrome was initially introduced by Cameron in 1964. It defined as an incomplete fracture of a vital posterior tooth that involves the dentin and occasionally extends into the pulp.¹ The American Association of Endodontics identified and classified five types of cracks in teeth, from least to most severe: craze lines; fractured cusp; cracked tooth; split tooth; vertical root fractured.²

Cracked tooth itself was defined as a condition of an incomplete longitudinal fracture which usually directed mesiodistally and may extend through either or both of the marginal ridges and through the proximal surface of the tooth. The fracture line may be located in the crown only or may extend for varying distance to the proximal root.² The condition Cracked tooth may be caused by excessive forces from occlusion or mastication, either because of large forces that being applied on the tooth or normal forces on a weakened tooth caused by complex restoration or endodontic treatments.³

Cracked tooth is most commonly occurred in patients over 40 years old, affected women more than men, although there are studies that revealed an almost equal distribution between gender group.¹,⁴ Most of the studies agreed that cracked teeth were most prevalent in mandibular molars, followed by maxillary premolars and maxillary molar teeth – while mandibular premolar teeth was reported to be the least affected.¹,⁴,⁵ Another study by Roh and Lee reported that cracked teeth were found most frequently in the maxillary molars (33.8% in first molar, 23.4% in second molar) than in the mandibular molars (20.1% in first molar, 16.2% in second molar).⁴ The prevalence of cracked tooth which running mesiodistally was 81.1%.⁵ Cracked tooth was also commonly associated with intracoronal restoration, though it also may occur in healthy and sound tooth.³⁶

The diagnosis of cracked tooth can be challenging for dentist in clinical practice.⁶ The
condition might not be visually apparent and may present with a variety of symptoms ranging from slight to severe spontaneous pain consistent with irreversible pulpitis, pulp necrosis or apical periodontitis. Patients usually reported sharp pain when biting that ceases after the pressure has been withdrawn or increases as the applied occlusal force is raised. Dentist should remember that cracks are findings, not a diagnosis, thus it cannot be used to describe the status of the pulp or periapical tissue. The finding of cracks need to be followed by several diagnostic tests that will help clinician to diagnose the teeth, give information about the etiology, and decide appropriate treatment modalities.

The prognosis of a cracked tooth depends on the extent of fracture. A cracked tooth if it’s not being treated immediately may either evolve into a split tooth or result in severe pulpal disease or periodontal defects, that can cause tooth loss eventually. Therefore early diagnosis and appropriate treatment are important for saving these teeth. This case report will present a diagnostic procedure and treatment of maxillary left second molar with a cracked tooth syndrome.

Case Report

A 45-years-old female patient came to University Dental Hospital-Faculty of Dentistry Universitas Indonesia and reported with pain on her maxillary left second molar. There was history of severe and throbbing pain happened about 2 months ago, so that the patient came to a dental clinic for treatment. The former dentist gave a temporary filling and antibiotics (amoxicillin 500 mg). The pain was gradually decreased, but the patient noticed a swelling that turned to a white spot in her gingiva above the tooth she was complaining about 2 weeks after the tooth being treated. By the time the examination take place, patient reported she was still experiencing a slightly disturbing pain which aggravated on chewing and biting. Patient remembered having sensitivity towards cold and hot drinks or food since 6 months ago.

The tooth was tender on palpation, positive on percussion, and fistula was seen on the gingival region of the tooth (Figure 1). Vitality test showed negative respond. A site 1, size 2 temporary filling was found. Radiograph examination revealed restoration which extend to dentin (D4), and radiolucency area on the apical region of palatal root (Figure 2). Periodontal probing depths were normal (3 mm).

Figure 1. Fistula was seen in gingival region of maxillary left second molar.

Figure 2. Diagnosis radiograph tooth 27. Noted the radiopacities on the crown which extend to dentin displaying a restoration. Also noted the radiolucency area at apical third of palatal root.

Since etiologic factors causing periapical disease usually involving deep caries lesion, large restoration, or deep periodontal pocket was not found in this case, other suspected factor was predicted such as cracked tooth syndrome. A staining technique was used, with the help of magnifying loupe (PeriOptix, CA), and a fracture line running mesiodistally on the center of occlusal surface was visible (Figure 3). Removal
of the temporary filling revealed a shallow cavity extend to dentin, and the fracture line was more visible. Using an explorer, a gentle wedging force was applied to the fracture line to differentiate a cracked tooth with a split tooth. The fracture could not be separated which means the remaining tooth was still intact. The diagnosis of this tooth was chronic periapical abscess et causa necrotic pulp. Based on the diagnosis, this tooth was planned to receive a root canal treatment with a full-crown (porcelain fused to metal) as post-endodontic final restoration.

**Figure 3.** A fracture line was noticed running mesiodistally on the occlusal surface.

**Figure 4.** After temporary filling was removed and an orthodontic band was placed and cemented on tooth 27.

**Figure 5.** Access opening of tooth 27. Three orifices was found (MB, DB, P). Notice the fracture line running mesiodistally and extend to marginal ridges, but not visible on the pulp floor. This indicates that the fracture was still affected the crown portion and not yet involving the pulp floor.

**Figure 6(a).** Clinical image of tooth 27 after root canal preparation was completed.

An orthodontic band was cemented onto the tooth using Type I GIC luting cement (GIC Fuji I, GC Corporation, Japan) and the teeth was disoccluded (Figure 4). After isolation using rubber dam (Optra dam, Ivoclar Vivadent), an
access opening was performed by using diamendo bur (Dentsply Maillefer, Switzerland). After access was completed, the presence of palatal, mesiobuccal, and distobuccal orifices was visible (Figure 5). A number #10 ProFinder (Dentsply Mallefer, Switzerland) was used to negotiate through each canal. Working length was measured with electronic apex locator (Root Mini ZX, J Morita) and confirmed with radiograph examination. Working length for palatal canal and distobuccal canal was 20.5 mm, while mesiobuccal canal was 19.5 mm.

Figure 6(b). Radiograph after root canal preparation was completed and master cone gutta-percha was inserted for working length confirmation. Noted the radiolucencies area on the apical third of palatal root.

Figure 7. Comparison of the gingiva condition in second (a) and third appointment (b). The fistula was already disappear in the third appointment.

Preparation of root canals was performed using Universal Protaper hand use (Dentsply Mallefer, Switzerland) accompanied by the use of EDTA gel as a lubricant (RC -Prep , Premier® Dental Products Company) started from #S1 to #F2 on mesiobuccal and distobuccal canal, and #F3 on palatal canal (Figure 6a). Root canals were intermittently and copiously irrigated with NaOCl 2,52% after each instrument change using a notched tip irrigating needle (ProRinse, Dentsply, Maillefer, Switzerland). Sonic irrigating technique was also used (Endo Activator, Dentsply Mallefer, Switzerland) to improve the efficacy of irrigating solution. Patency was assured on each of the root canals with a size 10 K-file. A radiograph confirming master cone was taken (Figure 6b). The canals were dried with sterile paper points and calcium hydroxide paste (Calcipex®, Nippon Sika-Yakuhin, Shimonoseki, Japan) was placed as inter-appointment medication on each root canal, then the cavity was filled with temporary filling (Caviton, GC Corporation, Japan). The tooth was evaluated in second appointment that take place almost two weeks after the first appointment. The pain was already gone and the patient was only experienced a slight different sensation when an occlusal force was applied on the tooth, compared with other sound tooth. Fistula was still seen, but reduced in size (Figure 7a). The
irrigating procedure with the use of NaOCL 2.52%, with the help of sonic irrigating device was performed and calcium hydroxide paste was once again placed as inter-appointment medication.

Figure 8. Post-obturation radiograph.

Figure 9. Porcelain-fused-to-metal crown was cemented as the final post-endodontic restoration.

Evaluation on third appointment three weeks later showed healing of the gingiva region. There are no sign of fistula (Figure 7b), and no pain occurred when an occlusal force was given unto the tooth. Calcium hydroxide dressing was removed, canals were irrigated then dried with sterile paper-points. Gutta-percha master cones (F2, size 25 for mesiobuccal and distobuccal canal; F3, size 30 for palatal canal) were adapted into the root canals to confirm that there no changes on working length. Each selected master cone was then cemented into the root canal with AH Plus sealer (Dentsply Maillefer, Balaigues, Switzerland). Then, a post-obturation radiograph was taken. (Figure 8)

Figure 10. Radiograph taken right after crown cementation(a) and after one month follow-up(b). Notice the healing of periapical lesion in the apical area.

Two weeks follow-up revealed no sign and symptoms of pathological condition. The tooth then prepared for a full-crown restoration, and impression was taken with polyvinyl-siloxane double-impression material (Exaflex®, GC America, USA). An acrylic temporary crown was used as an intermediate restoration. Three weeks later, a porcelain fused to metal crown was cemented using Type I Glass ionomer cement (Fuji I, GC Corporation, Japan) (Figure 9), and an post-cementation radiograph was taken (Figure 10a). One month follow-up showing a periapical healing with no sign of abnormalities (Figure 10b).
Discussion

The diagnosis of cracked tooth syndrome is often problematic and has been known to be a challenge for dental operators. An early diagnosis was very important in this condition, regarding the nature of the crack that keep progressing over time. In some cases, the fracture line was not visually apparent, it needed several diagnostic test to help clinician to diagnose the teeth and decide appropriate treatment modalities.

The fracture line in cracked teeth was not always visible. The help of magnification was suggested, either with the use of magnifying loupe or dental operating microscope. In this case, a 3.5 magnification dental loupe was used. Wear facet or cervical lesion such as abfraction should be noticed as probability sign of trauma. In this patient, both of the sign was apparent. The use of rubber wheel, wooden stick, cotton rolls, or tooth sloth fracture detector can be used to help clinician in diagnostic procedure. A tooth sloth can be placed on the cusp of suspected tooth and the clinician can ask the patient to bite down with moderate pressure and then release. Pain produced by release of pressure confirms a case of cracked tooth syndrome.

A staining technique can also be used to enhance the visualization of fracture line. 2% Methylene blue, 0.25% sodium fluorescein ophthalmic solution, snoop caries detecting dye can identified a crack on the suspected tooth. The used of trans-illumination fiber-optic light could help in visualization of cracks. The light beam is directed in a horizontal direction perpendicular to the plane of the suspected crack. Crack will not allowed the light to pass through, whereas sound teeth will transmit light through the crown. Wright in his study revealed that methylene blue along with trans-illumination was the best diagnostic test for crack detection. In this case, povidone iodine was used to help crack identification, although may not be as effective as using methylene blue as staining device. Trans-illumination was also used and a fracture line running mesiodistally on the occlusal surface extending towards both marginal ridge area was visible. This finding coincide with study conducted by Roh & Lee reporting a high prevalence of a cracked tooth with fracture line running mesio-distally (81.1%) .

The use of sharp explorer or probe may also help detect ‘catches’ in the cracks. Using an explorer, a gentle wedging force can be applied to the fracture line to differentiate a cracked tooth with a split tooth. In this case, the fracture could not be separated which means the remaining tooth was still intact. Removal of restoration, especially that covers large occlusal area, allows better visual examination of the crack line. Marginal ridges should be closely examined for a crack. In this case, a temporary filling in occlusal area of tooth 27 was removed, and the crack line was found more visible afterwards. Surgical exploration, consists of full thickness flap and examination of bone and roots directly under high magnification and illumination, remains the last option when all the other diagnostic test had failed to detect a crack. Performing diagnostic surgery can visualize crack line along the root surface thus helping to detect untreatable situation avoiding the need of any complex treatment in hopeless cases. A radiograph examination in teeth affected with cracked tooth syndrome was not helpful since the radiographic plane was usually parallel with the fracture plane.

The prognosis of a tooth affected by cracked tooth syndrome is determined by three principal factors: the extent and location of the fracture, the point in time when restoration intervention is initiated, and by the type of restoration applied to splint the fracture . Prognosis is considered excellent for cracks that are limited to dentin and not involving the dental pulp, or for those fractures which are limited to a single marginal ridge which do not extend more than 2-3 mm below the periodontal attachment. The prognosis becomes poor in cases involving both marginal ridges, or already affecting the pulp. In cases which present with complete mesio-distal fractures or diagnostic surgery does not exposed the fracture segment, the prognosis is defined to be hopeless . In this case, after access opening was completed, a fracture line was visible running mesiodistally and extend to marginal ridges, but not visible on the pulp floor. This indicates that the fracture was still affected the crown portion and not yet involving the pulp floor. The tooth was already non-vital and a periapical lesion was apparent. So, it can be concluded that the prognosis of this tooth was poor. An appropriate treatment need to be done for saving this tooth.
In order to avoid irreversible damage, a cracked tooth must be treated as soon as possible\(^9\). Occlusal adjustment of affected teeth must be done immediately to reduce stress on the tooth, and prevent further extension of the crack line. In cases of cracked tooth, immediate immobilization should be employed, using an immediate extra-coronal circumferential splint. A stainless steel orthodontic band can be used for this purpose\(^9\). Another available option is the use of full coverage acrylic provisional crowns or the use of bonded composite resin to splint the teeth\(^9,11\). In this case, an orthodontic band was cemented on tooth 27 with Type I GIC luting cement, and occlusal adjustment was performed.

A proper classification is essential for appropriate treatment plan. According to American Association of Endodontics classification, this case was classified as a cracked tooth, meaning as an incomplete fracture initiated from the crown and extending subgingivally and usually directed mesiodistally. Pulpal and periapical diagnosis determines the treatment plan for this condition\(^2,6\). If the pulp remains vital, and the sign of reversible pulpitis may present, the tooth can be restored with a full crown that covers the crack margin. If symptoms of irreversible pulpitis appear, or in some cases involving periapical area, root canal treatment can be performed followed by full crown restoration\(^2,6\).

The diagnosis of this case was chronic periapical abscess et causa necrotic pulp, therefore a root canal treatment need to be performed to eliminate the infection before the final restoration. Post-obturation evaluation showing a positive response toward the endodontic treatment with the absence of pathological sign and symptoms. A porcelain fused to metal crown was chosen as post-endodontic restoration in this case. Conventional full-coverage crowns and onlays have known as a gold standard for restoring teeth with cracked tooth syndrome\(^9,11\). A proper endodontic treatment and full coverage crown when being performed properly would increase the prognosis outcome of the tooth\(^11\).

**Conclusions**

An early detection, proper diagnosis, and immediate treatment are important in management of cracked teeth. It will improve the prognosis of the tooth, thus increasing the survival chance of the tooth. The absence of pathological sign and symptoms, and healing of the periapical lesion which can be seen in radiograph examination after 1 month follow-up showing a successful treatment of this case.

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**Declaration of Interest**

The authors report no conflict of interest.

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