

Using conic-beam computer tomography in diagnosing post-trauma root fractures in children

Abstract

As protective dentistry applications become more popular, frequency of tooth decays and periodontal problems in children decreased, but field and epidemiological studies show that tooth injuries caused by traumas is still a very serious problem in children. In classifying injuries caused by dental traumas, root fractures are seen less frequently compared to other injuries. Root fractures are classified according to the localisation and type of fracture line. Root fractures must be diagnosed by joint evaluation of radiographic and clinical findings. Root fractures can have good prognosis with early diagnosis and a suitable treatment. For this purpose the importance of being knowledgeable about the advantages and disadvantages of conic-beam computer tomography (CBCT) by dentists, as well as its usage areas in dentistry, is increasing on a daily basis.

Keywords: trauma, cbct, root fractures, periapical radiolusentness

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Abbreviations: CBCT, conic-beam computer tomography; TME, temporomandibular joint; PDL, periodontal ligament

Introduction

Dental traumas in children can cause injuries from enamel crack to avulsions, tooth coloration, malformations and loss of teeth. Serious problems can arise which can affect Temporomandibular joint (TME). For this reason, dentists who are supposed to treat children must have sufficient knowledge and equipment about diagnosis and treatment of injuries caused by traumas.¹ When taking the anamnesis of the patient suffering from dental injury, such questions as “when did the accident happen?”, “where and how did it happen?”, “how much time did pass after the trauma?” must be asked. The period passed after injury will help determine the treatment method of the dentist.²⁻⁴

The pattern of injury helps determine the strength of the impact and whether the child needs a tetanus vaccine.²

In intraoral examination all teeth and nearby tissues must be controlled. Lips or cheeks must be checked to see whether there are broken teeth particles or foreign materials in slits. Extracting broken tooth particles and foreign materials from soft tissues eliminate the possibility of chronic infection and fibrosis. Every fractured tooth must be examined in terms of pulp opening and dislocation. In addition to dental mobility, dislocations must also be checked. Palpation and percussion sensitiveness of the teeth must be controlled. Sensitiveness for percussion is an indicator of damage to periodontal ligament (PDL) or the existence of root fracture.^{4,5}

Radiographic inspection has an important place in diagnosing and treating trauma injuries. Radiographies help the dentist to determine root fractures, the development level of root, the relation of the injury with pulp room, periapical radiolusentness, resorption, dislocation level of the tooth, position of non-driven teeth, mandibular fractures, and tooth particles in soft tissue and other foreign materials.^{4,5} Radiographies and digital radiographies can be used for this purpose.

The most traumatic milk teeth belonging to early childhood era are maxillary incisor milk teeth. Milk molar teeth are rarely injured and their injuries are mostly formed by the traumas which are caused by impact from lower end-of-chin causing forceful closing of the mandibular towards maxilla instantly.

Compared to permanent teeth, it is seen that milk teeth have lower root/crown length rate and spongios bone of children is soft and flexible, which is the reason for more frequent occurrence of luxation injuries compared to crown or root fractures.

It is reported that milk tooth injuries mostly occur at the ages of 2 to 4 when the motive power of children develop. According to researches, one-third of boys and one-fourth of girls as of the age of 5 suffer from dental trauma. It is reported that children with malocclusion and especially protrusion are more frequently exposed to dental trauma compared to children with normal occlusion.²

Contrary to milk teeth series, luxation injuries in permanent teeth series mostly consist of crown fractures. Low crown-root ratio in permanent tooth series and harder alveolar bone structure contribute to this phenomenon. In permanent tooth series, similar to milk teeth series, the most damaged teeth are maxillary incisors.³

Rare root fractures among dental injuries include by pulp, dentine and cement. Root fractures are less often in milk teeth compared to permanent teeth.

In root fractures of milk teeth, crown part can be separated from apical part and frequently be located in lingual position so as to prevent occlusion, in which case crown fracture piece must be extracted. Extracting apical part is avoided as it can damage the permanent tooth which is shooting from below. Usually the fractured tooth piece in the apical is resorbed. Unlike permanent teeth, root fracture does not tend to be cured with calcific tissue in milk teeth.^{4,6}

In teeth which received endodontic treatment, root fractures are frequent and their prognosis is bad; it ends with the extraction of the tooth with root fracture. Root fractures constitute 0.2 to 7 percent of permanent tooth traumas.^{1,3,7-10}

Clinical and radiological findings must be evaluated jointly when diagnosing root fractures. We might not be able to see root fractures with traditional radiography which is taken right after post-traumatic injury. However, it can be said that in routine follow-up controls, the fracture line can be better viewed. This is due to the fact that haemorrhage which is formed between fracture particles and following formation of granulation tissue leads to the rising of crown part. One study suggested that films with 15-20degrees angle should

be taken in order to identify the fracture line with traditional or digital radiography.¹¹

When traditional radiography techniques are used, it might be that root fractures can be identified with mistake or not identified at all due to superposition of dental structures, formation of artefacts and anatomic entities. Some researchers reported that if the patient does not show any symptoms, it is extremely difficult to identify root fractures with periapical radiographies.¹² In intra-oral traditional or digital radiographies, three-dimensional anatomic dental structures can be viewed as 2-dimensional. On the other hand, conic-beam dental tomography devices provide sagittal, axial, coronal and cross-sectional views, which allow the clinician to identify root fractures which were wrongly diagnosed or not diagnosed root fractures in routine applications.¹³

In dental traumas root fractures are more frequently seen in maxillary incisors and most of the fractures are in apical 1/3 or middle 1/3 of the root.⁴⁻¹²

Root fractures are not widely witnessed in teeth which completed their root development.¹⁴ Root fractures can be seen as oblique, vertical or horizontal and a combination of oblique fractures.^{7,14}

It is reported that horizontal root fractures are witnessed in 3% of all dental traumas and or frequently at the maxillary incisors of which root formation is completed. It is reported that in 80% of cases the recovery began in horizontal root fractures.¹⁴⁻¹⁶

Root fractures are classified into three groups, namely coronal 1/3, middle 1/3 and apical 1/3^{14,17} (Figure 1).

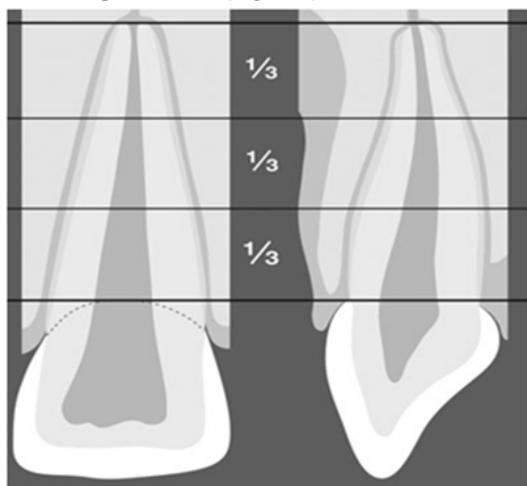


Figure 1 Classification of root fractures.

Recovery of root fractures is classified into 3 groups^{1,7,9,14}:

Recovery by formation of hard tissue between fracture particles.

1. Recovery by formation of collagen tissue between fracture particles.
2. Recovery by formation of both collagen tissue and calcific tissue between fracture particles.
3. Lack of recovery.

Ideal recovery in root fractures is the recovery with hard tissue which can occur in 12 to 14 weeks.^{1, 7,14,18} It is reported that for such recovery it was necessary that coronal fracture particle is not dislocated and the pulp is not affected. In teeth which did not complete root formation, recovery with calcific tissue is more frequent. It is

reported that in this type of recovery the recovery looks like dentine at the side of the fractured root particles close to pulp, whereas it looked like cement at the other side.¹⁸ Segment formation on fracture line is often initiated with resorption process. Usually cement does not fill the area between fracture and the cavity, as the collagen tissue developed from periodontal ligament is also placed in that area, which can be explained by the fact that different radiolucent witnessed between cement and dentin is the fracture line in the radiographies taken for root fractures recovered with hard tissue.^{10,18} In the literature it is indicated that several factors affected this type of recovery. Andreasen et al. reported in a retrospective study¹⁴ that in cases when the most suitable resorption and coronal fragment in root fracture was not more than 1mm, both hard tissue recoveries was witnessed and the risk of pulp necrosis reduced. In addition, it was reported that a few days delay in treatment did not affect recovery. However, age of the patient, root development status, mobility, dislocation of coronal piece and separation level between fractured pieces have critical importance in the recovery of root fracture.¹⁹

Pulp necrosis is rarely seen in root fractures. Pulp necrosis is witnessed in 5 to 25 percent of the affected teeth.¹⁰ Pulp necrosis ratio is high in teeth which completed their root development and in cases when crown piece is dislocated.^{14,19}

Protection of pulp vitality in teeth which did not complete their root development is usually higher compared to teeth with closed apex.¹⁰ These results show that root fractures of the teeth which did not complete their root development show better prognosis compared to the teeth which completed their root development.²⁰

Usual complications in root fractures are obliteration of canal pulp and root resorption. In recovery with calcific tissue, external resorption look in mesial and distal of fracture area in radiographic examination is characteristic.¹⁰

In the literature, different preferences have been displayed in splint types and splinting periods in root fractures. There is no unity of opinion on these issues. In our study, 2-4 months splinting period was preferred for semi-rigid splint type and coronal 1/3 root fractures, and 1 month splinting period was preferred for apical 1/3 and medium line root fractures, which stood out in generalisation. It has been witnessed that application of splint was not necessary in teeth which did not suffer from separation in fracture line and luxation.

It has been found out that age of the patient, development status of root, mobility of coronal piece, dislocation of coronal piece, level of separation in the fracture pieces and, most importantly, the following by patient of the recommendations were very effective in recovery of root fractures. For this effect it has also been witnessed that early diagnosis of the root fracture was critical.

Traditional radiography proves insufficient in evaluation of 3-dimensional anatomic constructs due to artefacts, superposition and anatomic formations. Recently CBCT has been put into use in radiographic area in order to solve such problems. CBCT gives perfect results in diagnosing root fractures as well.

Although conic beam is an innovative and promising technology, amount of effective radiation is higher compared to traditional intra-oral and panoramic graphics. For this reason, it is believed that it is early to claim that conic-beam three-dimensional dental tomography is a technique which must be used in all dental trauma cases. Today, conic-beam three-dimensional dental tomography must be considered as an alternative when traditional radiography proves insufficient in diagnosing root fractures.

Conclusion

In dentistry, utilisation of conic beam computer tomography provides valuable information to the dentist in evaluating traumatic cases. Nevertheless, it is believed that radiation doses that the patients will be exposed to must always be taken into consideration and CBCT must be avoided in cases when traditional x-ray imaging methods are sufficient.

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Conflicts of interest

Author declares there are no conflicts of interest.

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