

## Evaluation of root fracture in permanent teeth according to season

### Ocena złamań korzeni zębów stałych w odniesieniu do pory roku

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#### Abstract

**Aim of the study.** Root fractures which occur as a result of dental trauma may change according to school and holiday periods, and seasons. The aim of our study was to evaluate their incidence as dental trauma based on seasonal variation in children between 8-15 years of age. **Material and method.** This epidemiological study was performed on 76 children patients who sustained root fracture. Root fractures were diagnosed using cone beam computed tomography and conventional radiography. The incidence of root fracture was examined and compared according to the seasons when patients presented for treatment. The study's data were applied to chi-square test. **Results.** As a result of our study, it was found that root fractures often occur in winter and in males rather than females. When the distribution of root fractures in boys and girls is examined according to season, it is noted that

#### Streszczenie

**Cel pracy.** Występowanie złamań korzeni powstających w następstwie urazów może ulegać zmianie w zależności od ferii szkolnych, wakacji oraz pór roku. **Celem pracy** była ocena tego typu obrażeń w różnych porach roku u dzieci w przedziale wiekowym 8-15 lat. **Materiał i metody.** Badanie epidemiologiczne przeprowadzono na 76 dzieciach, które doznały złamań korzeni. Złamania diagnozowano za pomocą CBCT i tradycyjnej radiografii. Występowanie złamań korzeni badano i porównywano wg kryterium pory roku, w której zgłoszono się na leczenie. Dane poddano testowi chi-kwadrat. **Wyniki.** Stwierdzono, że złamania korzeni często występują w zimie, z przewagą chłopców nad dziewczętami. Kiedy rozkład złamań korzeni u chłopców i dziewcząt bada się pod kątem pory roku, można zaobserwować, że najczęściej przypadków występuje w zimie, ale nie dowiedziono różnicy istotnej

#### KEYWORDS:

season, dental trauma, root fracture

#### HASŁA INDEKSOWE:

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the highest frequency of cases occurs in winter, but a statistically significant difference was not determined ( $P>0.05$ ). **Conclusion.** Root fractures can often occur due to excess of activities in childhood compared with other life periods. The incidence of root fractures increases when children perform a variety of activities in unsuitable areas during winter season.

## Introduction

Although dental caries and periodontal problems are decreased owing to increase in preventive dentistry applications, epidemiological studies show that traumatic dental injuries still constitute a significant percentage in children.<sup>1-3</sup> Root fractures are less widespread compared to other damages in classification of dental trauma-based damages. Root fracture is a rare occurrence in comparison with other traumatic dental injuries. Root fractures occur at a rate of 0.5-7% in permanent dentition injuries and 2-4% in primary dentition injuries.<sup>4,5</sup>

Root fractures occur as a result of a severe facial trauma with more frequent incidence in maxillary teeth compared to mandibular teeth.<sup>6</sup> Frequency of traumatic injuries is reported to be higher in the first ten years of life. In further years this frequency decreases and it is reported that dental injuries are less frequently encountered at and above 30 years of age. They commonly occur between the age group of 11 to 20 years.<sup>7</sup>

A previous histological and clinical study has shown that four location modalities exist for root fractures: apical root fractures, mid-root fractures, cervical-mid-root fractures and cervical fractures. There are also three healing modalities for root fractures: hard tissue fusion, periodontal ligament interposition with and without bone, and non-healing with interposition of granulation tissue owing to coronal pulp necrosis.<sup>8</sup>

Root fractures occur in the root of coronal 1/3, medium and apical 1/3 fractures according to their localization. There are several classifications such as horizontal, oblique, vertical and horizontal/oblique root fracture according to fracture line.<sup>8,9</sup>

These root fractures may continue from one surface to another surface. Fracture line can be partial. Clinical and radiographic symptoms are

statystycznie ( $P>0.05$ ). **Wniosek.** Złamania korzeni często występują w wyniku nadmiernej aktywności w dzieciństwie w porównaniu z innymi okresami życia. Występowanie tego typu urazu wzrasta, kiedy dzieci są aktywne w miejscach nieprzeznaczonych do zabawy w okresie zimowym.

most important for the diagnosis of root fractures. Clinical symptoms include presence of fistulae in root fracture-affected teeth, and pain on mastication and chewing, and abscess-like manifestations as a result pulp necrosis. Radiographic views of root fracture show the fracture line. However, the fracture line may not be seen in conventional and digital x-ray radiographs, if root fractured teeth constitute an undamaged segment or because it is superimposed on the fracture segment.<sup>10,11</sup>

In these cases, cone beam computed tomography is the most important tool in the diagnosis of root fracture.<sup>12</sup>

In literature, although there are studies evaluating the relationship of seasons with dental trauma, no studies have been found related to root fracture.

The purpose of this study is to evaluate the relationship of seasons and root fractures incidence in children between 8-15 years of age.

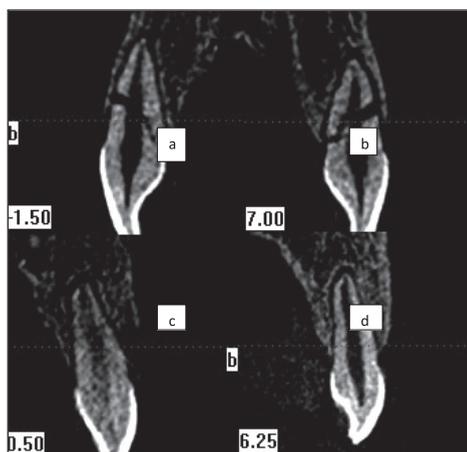
## Material and method

This epidemiological study was performed on 78 children patients who have been exposed to dental trauma, and root fracture was diagnosed radiologically (conventional radiograph and cone beam computed tomography) (Figure 1-4) between 2009 and 2015. Only patients with anterior teeth fracture who were 8-15 years of age and healthy individuals were included in this study. In all, 130 root fractured teeth were examined. We investigated the incidence of root fractures according to season based on patients' time of referral. This study was confirmed by the ethical board of Medical Faculty of Dicle University. Additionally, relevant parents' consent was obtained.

Cone Beam Computed Tomography (CBCT) images were taken from patients with diagnosed root fractures. CBCT images were obtained in



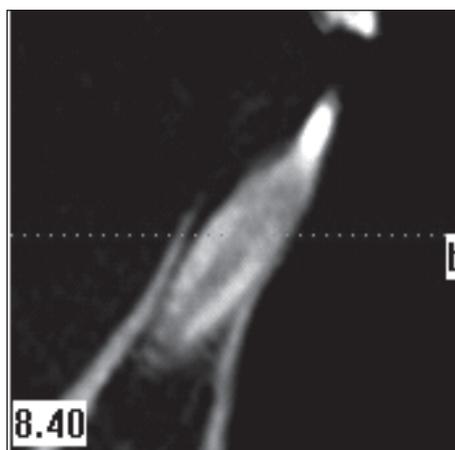
**Fig. 1.** CR view of the middle-third root fracture.



**Fig. 2.** CBCT view of the middle-third root fracture (a, b). Apical-third (c, d).



**Fig. 3.** CR view of the middle-third and apical-third root fracture.



**Fig. 4.** CBCT view of the apical-third root fracture in a mandibular tooth.

8.9 seconds with three-dimensional volumetric dental tomography device (i-CAT®, Model 17-19, Imaging Sciences International, Hatfield, Pa USA). CR images were obtained in periapical radiography (Eastman Kodak, Rochester, NY).

The patients according to clinical and radiological results, following CBCT and conventional radiograph (CR), underwent conservative and endodontic treatment.

The teeth with post-traumatic luxation were splinted. Generally, orthodontic wire, composite splint was applied so that physiological movement of teeth could be allowed (0.5 mm orthodontic wire, Kuraray 3M ESPE composite).

### Statistical methods

All data were entered into SPSS. The distribution of root fractures in boys and girls, according to seasons, was examined with Pearson Chi-Square tests.

### Result

As a result of more detailed analysis of the images obtained with CBCT and CR, root fracture injuries were identified in a total of 130 teeth of the 78 children between 8 and 15 years of age who were exposed to trauma. It has been observed that frequency of root fractures was higher in males (60.25%) compared to females (39.75%).

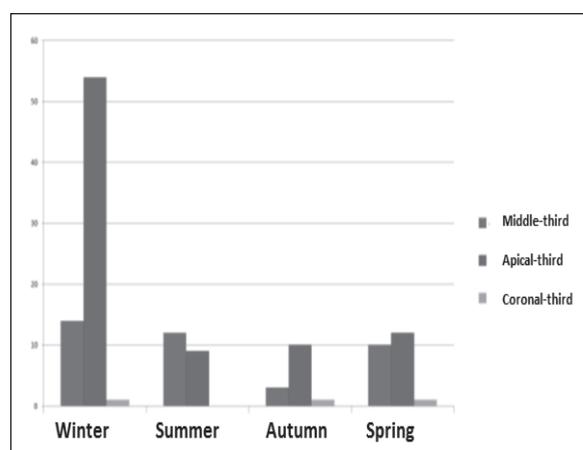
**Table 1.** The distribution of children according to season

	Male	Female	Total
Winter	23	18	41
Summer	11	6	17
Autumn	4	2	6
Spring	9	5	14
Total	47	31	78

Root fractures observed in 130 teeth included 81 horizontal root fractures, 44 oblique root fractures, 2 fragmentary fractures and 3 vertical root fractures. An examination of the root fractures showed that 129 of the 130 teeth were maxillary incisors and one was mandibular.

The study found high incidence of root fracture in winter compared with other seasons (Table 1). Root fractures for females had maximum rate of 58.06% in winter and minimum rate of 0.6% in autumn; root fractures in males had maximum rate of 48.9% in winter season and minimum rate of 0.85% in autumn (Table 1). In summer and spring, both female and male patients had the same rate of root fracture. When the distribution of root fractures in boys and girls is examined according to season, it is found that the highest frequency is in winter, but a statistically significant difference was not determined ( $P>0.05$ ).

When root fractures were analyzed according

**Fig. 5.** The distribution of root fractures according to localization and season.

to location, apical 1/3 root fractures were found to be the most frequently occurring type of root fracture and higher in winter than in any other season (Figure 5). Root fractures of maxillary central teeth were identified more frequently than of other teeth (Figure 6).

## Discussion

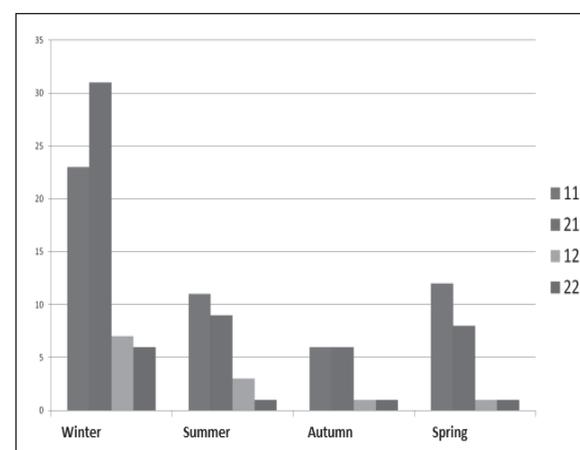
We evaluated changes in the incidence of root fracture according to seasons in this epidemiological study. When literature was reviewed, it transpired that there had been no similar studies thus far. However, when epidemiological studies on dental injuries were examined, the results of the present study were similar to their results. The results from this epidemiological study showed that root fracture is more common in males (60.25%) compared to females (39.75%) and higher in maxillary anterior teeth.

Most studies have reported that dental trauma increased in summer compared with winter.<sup>13-16</sup>

Another study reported that the frequency of dental trauma increased in March and September. In addition, root fractures have been reported to occur in 2.4% of cases. It indicated that maxillary incisors were the most frequently injured teeth.<sup>17</sup>

Altay et al. reported that in the spring-summer period more traumatic injuries occur, but they claimed it was not statistically significant.<sup>18</sup>

Gassner et al. reported that craniomaxillofacial trauma peaked in the summer season in August (10%) and during the spring season in May (9.2%)

**Fig. 6.** Root fracture occurrence in teeth according to season.

and revealed the lowest occurrence in the fall season in November (5.9%).<sup>19</sup>

One previous study assessed dental injuries according to season. In that study, dental injuries statistics were 52.3% for females and 47.7% for males, and there was no statistical difference between genders. The highest dental trauma frequency was noted in spring and summer.<sup>20</sup> However, in our study in males it occurred more frequently in winter.

Cvek et al. showed that root fracture occurred most frequently in maxillary incisors rather than mandibular incisors. Furthermore, they said that it was more common in males. They found that root fractures according to localization are more frequent in the mid-third than in the apical or cervical regions.<sup>21</sup>

Andreasen et al. performed a study on root fractures. They researched 400 intra-alveolar root fractures. They showed that root fractures are common in maxillary central incisors and middle-third root fracture.<sup>4</sup> In our study, it was observed that root fractures occurred in apical 1/3 in 84 teeth, middle-third in 40 teeth and in coronal 1/3 area in 5 teeth; in that sense our study differs from the literature.

In the study by Majorana et al., the prevalence of root fractures is more frequent in permanent teeth than primary teeth, and root fractures affected most frequently maxillary incisors.<sup>22</sup> Cvek et al. specified that middle-third root fracture is more common when compared with other studies related to root fracture. They investigated 534 root fractured teeth.<sup>23</sup>

In our study, root fractures occurred commonly in the apical 1/3. However, root fractures in primary teeth were not examined in our study.

## Conclusion

The excess of activities can cause common dental trauma in childhood. These activities vary depending on the seasons in our country and region. In this study, we examined distribution of root fractures according to seasons, with dental injuries being a result of various factors in children. We believe that increase in the number of cases of trauma in winter results from children performing a variety of activities in unsuitable areas. However, root fractures are common during school period due to over capacity of students in classes at school with no playgrounds in the school yard.

## References

1. Caldas AF, Burgos MEA: A retrospective study of traumatic dental injuries in a Brazilian dental trauma clinic. *Dent Traumatol* 2001; 17: 250-253.
2. Lauridsen E, Hermann NV, Gerds TA, Kreiborg S, Andreasen JO: Pattern of traumatic dental injuries in the permanent dentition among children, adolescents, and adults. *Dent Traumatol* 2012; 28: 358-363.
3. Malmgren B, Andreasen JO, Flores MT, Robertson A, DiAngelis AJ, Andersson L, et al.: International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition. *Dent Traumatol* 2012; 28: 174-182.
4. Andreasen JO, Andreasen FM, Meja`re I, Cvek M: Healing of 400 intra-alveolar root fractures. 1. Effect of pre-injury and injury factors such as sex, age, stage of root development, fracture type, location of fracture and severity of dislocation. *Dent Traumatol* 2004; 20: 192-202.
5. Heithersay GS, Kahler B: Healing responses following transverse root fracture: a historical review and case reports showing healing with (a) calcified tissue and (b) dense fibrous connective tissue. *Dent Traumatol* 2013; 29: 253-265.
6. Andreasen JO, Andreasen FM, Meja`re I, Cvek M: Healing of 400 intra-alveolar root fractures. 2. Effect of treatment factors such as treatment delay, repositioning, splinting type and period and antibiotics. *Dent Traumatol* 2004; 20: 203-211.
7. Malhotra N, Kundabala M, Acharaya S: A review of root fractures: diagnosis, treatment and prognosis. *Dental Update* 2011; 38: 615-628.
8. Andreasen JO, Ahrensburg SS, Tsilingaridis G:

- Root fractures: the influence of type of healing and location of fracture on tooth survival rates—an analysis of 492 cases. *Dent Traumatol* 2012; 28: 404-409.
9. *Maccari PC, Cosme DC, Oshima HM, Burnett LH Jr, Shinkai RS*: Fracture strength of endodontically treated teeth with flared root canals and restored with different post systems. *J Esthet Restor Dent* 2007; 19: 30-36.
  10. *Tsesis I, Kamburoğlu K, Katz A, Tamse A, Kaffe I, Kfir A*: Comparison of digital with conventional radiography in detection of vertical root fractures in endodontically treated maxillary premolars: an ex vivo study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008; 106: 124-128.
  11. *Kajan ZD, Taromsari M*: Value of cone beam CT in detection of dental root fractures. *Dentomaxillofac Radiol* 2012; 41: 3-10.
  12. *Kaan O, Umut A, Atakan K*: Cone-Beam Computed Tomographic Evaluation of Spontaneously Healed Root Fracture. *J Endod* 2010; 36: 1584-1587.
  13. *Kargül B, Çağlar E., Tanboğa I*: Dental trauma in Turkish children, Istanbul. *Dent Traumatol* 2003; 19: 72-75.
  14. *Wright G, Bell A, McGlashan G, Vincent C, Welbury RR*: Dentoalveolar trauma in Glasgow: an audit of mechanism and injury. *Dent Traumatol* 2007; 23: 226-231.
  15. *Çaglar E, Ferreira L, Kargul B*: Dental trauma management knowledge among a group of teachers in two south European cities. *Dent Traumatol* 2005; 21: 258-262.
  16. *Saroglu I, Sönmez H*: The prevalence of traumatic injuries treated in the pedodontic clinic of Ankara University, Turkey, during 18 months. *Dent Traumatol* 2002; 18: 299-303.
  17. *Eyuboglu O, Yilmaz Y, Zehir C, Sahin H*: A 6-year investigation into types of dental trauma treated in a paediatric dentistry clinic in Eastern Anatolia Region, Turkey. *Dent Traumatol* 2009; 25: 110-114.
  18. *Altay N, Güngör HC*: A retrospective study of dentoalveolar injuries of children in Ankara, Turkey. *Dent Traumatol* 2001; 17: 201-204.
  19. *Gassner R, Tuli T, Hächl O, Moreira R, Ulmer H*: "Craniomaxillofacial trauma in children: a review of 3,385 cases with 6,060 injuries in 10 years." *J Oral Maxillofac Surg* 2004; 62: 399-407.
  20. *Vuletić M, Škaričić J, Batinjan G, Trampuš Z, Čuković Babić I, Jurić H*: A retrospective study on traumatic dental and soft-tissue injuries in preschool children in Zagreb, Croatia. *Bosn J Basic Med Sci* 2014; 14: 12-15
  21. *Cvek M, Andreasen JO, Borum MK*: Healing of 208 intraalveolar root fractures in patients aged 7-17 years. *Dent Traumatol* 2001; 3: 53-62.
  22. *Majorana A, Pasini S, Bardellini E, Keller E*: Clinical and epidemiological study of traumatic root fractures. *Dent Traumatol* 2002; 18: 77-80.
  23. *Cvek M, Tsilingaridis G, Andreasen JO*: Survival of 534 incisors after intra-alveolar root fracture in patients aged 7-17 years. *Dent Traumatol* 2008; 24: 379-387.

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