Prevalence of root dilaceration in adult dental patients in Croatia

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Objective. To determine the prevalence and distribution of dilaceration in all tooth groups by using radiographs.
Study design. The sample included 953 periapical intraoral radiographs and 488 panoramic radiographs from different caucasian patients. The ages of the patients ranged from 18-65 years. Dilaceration of the root was detected by measuring the degree of deviation from the long axis (deviation ł 90°), and evaluating the "bull's eye" appearance. The prevalence of root dilaceration for each tooth-type was expressed in percentages.
Results. The teeth showing the highest prevalence of root dilaceration were mandibular third molars (24.1%), maxillary first molars (15.3%), second molars (11.4%) and third molars (8.1%). In the mandible, dilacerations were less common than in the maxilla.
Conclusions. In the adult population examined in Croatia, dilaceration was most frequently found to affect posterior teeth.
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Dilaceration refers to an angulation that may occur anywhere along the length of the tooth, that is, its crown, amelocemental junction, along the root, or by only involving the apex of the root.[1,2] Dilacerations had been considered to originate from traumatic displacement of already formed hard tissue in relationship to the developing soft tissue;[3,4] however, this pathogenesis has been questioned,[5-7] and it has been alternatively proposed that the deformity exists due to the ectopic development of the tooth germ rather than as a result of trauma. Nonetheless, trauma is still accepted as one possible cause of root dilaceration, particularly in the anterior region,[4] even if it is not a common cause.[7]

To diagnose dilaceration of the root, radiographic examination is required.[8,9] The direction of radiographically evaluated dilacerations of roots can be read in 2 planes and categorized as mesial, distal, or orofacial. Most papers concerning dilacerations are case reports describing a multidisciplinary approach to the anomaly.[4,7,10-12] Only a few deal with the prevalence of dilaceration.[13-15] Hamasha et al.[13] reported the prevalence of dilaceration to be 3.8%, and it was highest in lower third molars (19.2%), lower first molars (5.6%), and upper second premolars (4.7%). Thongudomporn and Freer[14] reported that dilaceration is the least prevalent anomaly of the 5 dental anomalies studied in a group of orthodontic patients. The deviation of the roots of upper lateral incisors from the normal axis by more than 20°, was reported to be 97.9% of cases.[15] Recognizing root dilaceration is important during root canal treatment, it was proposed that failure to diagnose root dilaceration contributes to a higher rate of endodontic treatment failures.[13,15]

The aim of our study was to determine retrospectively the prevalence and distribution of the dilaceration of root for each tooth-type in a sample of Caucasian adult dental patients in Croatia. Periapical and panoramic radiographs were used to detect the dilacerations of roots, and the dilaceration of the root was assigned to the coronal, the middle, or the apical third of the tooth root.

MATERIALS AND METHODS

Intraoral radiographs and panoramic radiographs of endodontic and periodontal patients were used. One thousand twenty-eight intraoral periapical radiographs and 507 panoramic radiographs were collected for the study from 500 records chosen at random from the data record of the Department of Endodontics and Restorative Dentistry and the Department of Periodontology, Faculty of Dental Medicine, University of Zagreb. The patients were adult Caucasians; their ages ranged from 18-65 years. Exclusion criteria for the collected radiographs were more than 1 record of the same region in the same patient (radiograph before and after endodontic treatment) or more than 1 panoramic radiograph of the same patient, patients less than 18 years old, and radiographs of poor quality. The final sample

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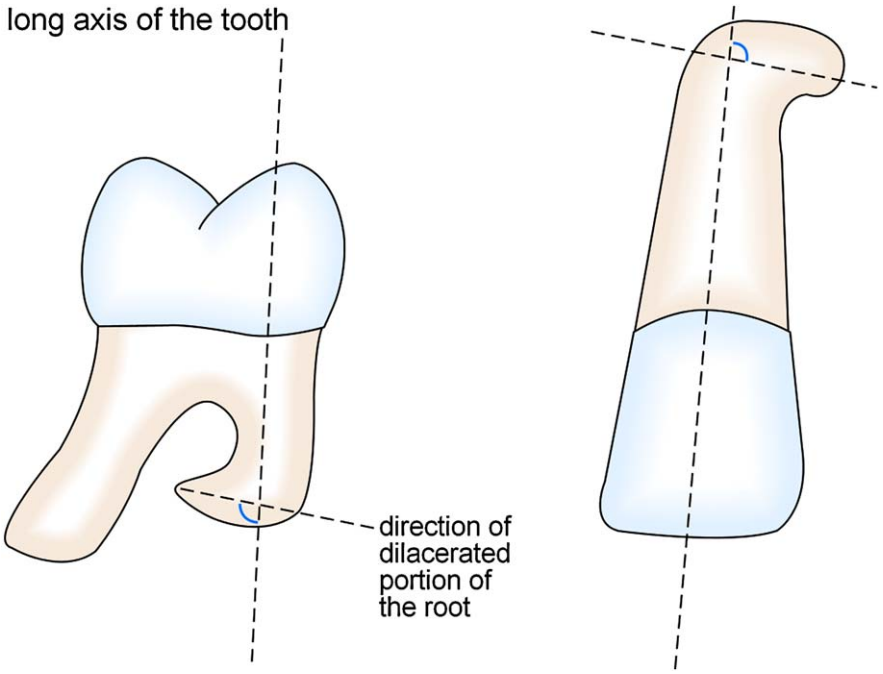

Fig. 1. Root dilacerations in mesiodistal plane were considered present if the angle between the long axis of the tooth, and the axis on which the dilacerated portion of the root lied, was ≥90°.

included 953 periapical intraoral radiographs with 2681 permanent teeth examined and 488 panoramic radiographs with 12392 permanent teeth examined.

The radiographs were studied by 3 examiners. The first and second examiner did 2 readings of the radiographs independently, and the time interval between the readings was 1 week. The third reading was done by all 3 examiners together, 1 month later. The discrepancies in interpretation were resolved in discussion during simultaneous examination. A tooth was recognized as having mesial or distal root dilaceration if there was deviation of 90° or more from the normal long axis of the tooth (Fig. 1).[13] Roots were evaluated for dilaceration with a magnifying glass (4× magnification) and x-ray viewer. A simple goniometer was used. Orofacial direction of the dilaceration was determined by evaluating the bull's eye appearance of the root, which results from the root deviation of 90° or more (Figs. 2 and 3).[8] The deviation was assigned to either apical, middle, or the coronal third of the root. In multirooted teeth, a tooth was recognized as having the dilaceration of the root if at least 1 root showed dilaceration. Multirooted teeth were further divided according to the type of root and the number of roots showing dilacerations. In calculating the prevalence of dilaceration, the multirooted teeth having 1 or more dilacerated roots were counted as 1 case of dilaceration of the root.

The data obtained were used to calculate the prevalence of dilaceration for each type of tooth observed in periapical and panoramic radiographs. The prevalence of root dilacerations for each tooth-type was expressed in percentages, and descriptive statistics were used in interpreting the results.

RESULTS

The teeth showing the highest prevalence of root dilaceration were mandibular third molars (24.1%), maxillary first molars (15.3%), second molars (11.4%), and third molars (8.1%). Mandibular first and second molars exhibited root dilaceration in fewer cases (2.2% and 1.7%, respectively). Maxillary premolars and anterior teeth exhibited dilacerations more commonly (4.6%) than mandibular teeth of the same region (1.3%). The prevalence of dilacerations for both jaws and both radiographic image sources is shown in Tables I to IV.

DISCUSSION

The most appropriate method for evaluating unextracted teeth for root dilaceration is radiographic examination.[8] This study was based on the analysis of periapical and panoramic radiographs. Muhammed et al.[16] did not find a statistically significant difference in detecting periapical pathoses by using panoramic and intraoral radiographs. However, it was reported that panoramic radiographs are not as precise as periapical radiographs in epidemiological studies.[17,18] Gröndahl et al.[18] have reported on greater varability between examiners in reading panoramic radiographs

Fig. 2. "Bull's eye" apperance of orofacially directed dilaceration of the root of maxillary central incisor before endodontic treatment. The rarefaction is associated with periapical process after combined surgical and orthodontic pull-out therapy.

Fig. 3. The same tooth as in Fig. 2 after endodontic treatment (conventional step-back and cold lateral condensation technique).

compared with intraoral radiographs. That is why we separately report the prevalence of dilaceration by using periapical radiographs and panoramic radiographs. Because we did not analyze the full mouth series corresponding to panoramic radiographs, we could not compare the difference in diagnosing dilaceration of the root by using periapical and panoramic radiographs.

The criteria in the literature for recognizing root dilaceration vary. Chohayeb[15] had very strict criteria for recognizing root dilaceration of upper lateral incisors, that is, only straight teeth (deviation $<20°$) were not recognized as being dilacerated. They have reported that the frequency of dilaceration in upper lateral incisors is 97.9%. It is questionable whether 97.9% of teeth can be classified as having deviation. Moreover, distal direction of the root of the upper lateral incisor is considered to be normal anatomy of the tooth-type.[19] The data reported by Chohayeb[15] are not consistent with our results, where the prevalence of dilaceration for the upper lateral incisor is 7% and 1.43% for the periapical and panoramic radiographs, respectively. Hamasha et al.[13] reported on the prevalence of dilaceration amongst different tooth-types, and the upper lateral incisor was 1.2%. Our results show that the prevalence is greater in posterior regions, the same as that reported by Hamasha et al.[13]

As far as the etiology of dilaceration is concerned, much controversy exists. In the case reports on dilacerations in the anterior region of the permanent dentition, the view that trauma precedes the development of the deformity of the root prevails.[4,12,20-22] Maragakis[22] even refers to dilaceration as an injury to the developing tooth. Dilacerations were reported to account for 3% of "injuries" to developing teeth.[23] However, cases of dilacerations have been reported with no history of trauma.[5,6] Chadwick and Millet[7] reported a case of dilaceration with no history of trauma, but the histologic finding was consistent with trauma. Andreasen et al.[5]

Table I. Prevalence of dilacerations of the roots of maxillary teeth detected by using periapical radiographs

*Tooth**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
No. teeth examined	242	213	193	220	270	247	211	86
Total dilacerations (unit tooth)	3	15	7	10	18	38	24	7
Coronal third	1	0	0	1	3	1: mb†	1mb	2
Middle third	1	2 (of¶)	1	2	4	8: mb 2: b and db‖ 2: p§ (2 of¶)	10: mb 1: db‡ 2: b and db	3
Apical third	1 (of¶)	13	6	7 (1 of¶)	11 (1 of¶)	18: mb 4: mb and db 3: p (2 of¶)	7: mb 1: db 2: p (2 of¶)	2
Dilaceration prevalence (%)	1.2	7.0	3.6	4.5	6.7	15.	11.4	8.1

*Tooth type: *1,* permanent central incisor; *2,* permanent lateral incisor; *3,* permanent canine; *4,* first premolar; *5,* second premolar; *6,* first permanent molar; *7,* second permanent molar; *8,* third permanent molar.
†Mesiobucal root dilacerated in a multirooted tooth.
‡Distobucal root dilacerated in a multirooted tooth.
§Palatal root dilacerated in a multirooted tooth.
‖Mesiobucal and distobucal roots dilacerated in a multirooted tooth.
¶Orofacial direction of dilacerations.

Table II. Prevalence of dilacerations of the roots of maxillary teeth detected by using panoramic radiographs

*Tooth**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
No. teeth examined	947	907	940	753	708	599	740	532
Total dilacerations	5	13	7	25	29	42	58	45
Coronal third	0	0	0	0	0	1: mb†	0	0
Middle third	0	0	0	7	4	18: mb 2: db‡ 1: p§ (1 of¶)	23: mb 1: db 1: p (1 of¶)	12: mb 7: 1 root
Apical third	5 (3 of¶)	13 (1 of¶)	7 (1 of¶)	18 (4 of¶)	25 (2 of¶)	16: mb (3 of¶) 2: db 2: p (1 of¶)	26: mb 3: db 2: p (1 of¶) 2: 1 root‖	12: mb 14: 1 root
Dilaceration prevalence (%)	0.53	1.43	0.74	3.32	4.10	7.01	7.84	8.46

*Tooth type: *1,* permanent central incisor; *2,* permanent lateral incisor; *3,* permanent canine; *4,* first premolar; *5,* second premolar; *6,* first permanent molar; *7,* second permanent molar; *8,* third permanent molar.
†Mesiobucal root dilacerated in a multirooted tooth.
‡Distobucal root dilacerated in a multirooted tooth.
§Palatal root dilacerated in a multirooted tooth.
‖Mesiobucal and distobucal roots dilacerated in a multirooted tooth.
¶Orofacial direction of dilacerations.

proposed that the deformity most likely exists due to ectopic development of the tooth germ. Since no questionnaire had been completed for a history of trauma, we could not draw any conclusion on this possible cause. Nevertheless, a very high prevalence of dilacerations in third molars could suggest that the development of dilacerations in the lateral region is consistent with ectopic development of the tooth and lack of space, rather than trauma.

Diagnosing root dilaceration before endodontic treatment is an important objective in gaining control as endodontic instruments to curves in root canals. A frequent error in endodontic procedure is the failure to maintain root canal curvature, resulting in ledging, apical cavitation (transport and zipping), perforation, and instrument breakage.[24] In finger instrumentation techniques, the flexibility of instruments with respect to size must be considered. The precurvature of instruments is needed to keep instruments larger than #20 from cutting straight ahead.[24,25] The extent of the precurvature depends on the curvature of the canal, size of the instrument, and the depth at which the instrument is to be utilized in the canal.[25] Our results show that root dilacerations in incisors, canines, and premolars are most common at the apical third of the root. At the middle third of the root, dilacerations are exhibited more frequently in molars, whereas the dilacerations at the coronary third of the root are mostly detected in third molars.

Table III. Prevalence of dilacerations of the roots of mandibular teeth detected by using periapical radiographs

*Tooth**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
No. teeth examined	59	63	86	146	203	183	180	79
Total dilacerations	1	0	1	3	3	4	3	19
Coronal third	0	0	0	0	0	0	0	3: m and d[§]
Middle third	0	0	0	1	0	3: m[†]	1: m	6: m and d
Apical third	1	0	1	2 (1 of[¶])	3	1: d[‡]	1: m 1: d	10: m and d
Dilaceration prevalence (%)	1.7	0	1.2	2.1	1.5	2.2	1.7	24.1

*Tooth type: *1,* permanent central incisor; *2,* permanent lateral incisor; *3,* permanent canine; *4,* first premolar; *5,* second premolar; *6,* first permanent molar; *7,* second permanent molar; *8,* third permanent molar.
[†]Mesial root dilacerated in a multirooted tooth.
[‡]Distal root dilacerated in a multirooted tooth.
[§]Mesial and distal root dilacerated in a multirooted tooth.
[¶]Orofacial direction of dilacerations.

Table IV. Prevalence of dilacerations of the roots of mandibular teeth detected by using panoramic radiographs

*Tooth**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
No. teeth examined	942	951	970	915	806	448	655	579
Total dilacerations	4	3	9	13	16	2	13	179
Coronal third	0	0	0	0	0	0	1: m[†]	8: m 2: d[‡] (1 of[¶])
Middle third	3 (2 of[¶])	0	4	4	8	1:m	6: m 1: d	66: m 16: d (1 of[¶])
Apical third	1	3	5	9 (1 of[¶])	8 (2 of[¶])	1:m	4: m 1: d	58: m (1 of[¶]) 21: d (2 of[¶]) 8: 1 root[‖]
Dilaceration prevalence (%)	0.42	0.32	0.93	1.42	1.99	0.45	1.99	30.92

*Tooth type: *1,* permanent central incisor; *2,* permanent lateral incisor; *3,* permanent canine; *4,* first premolar; *5,* second premolar; *6,* first permanent molar; *7,* second permanent molar; *8,* third permanent molar.
[†]Mesial root dilacerated in a multirooted tooth.
[‡]Distal root dilacerated in a multirooted tooth.
[‖]Mandibular molar tooth with 1 dilacerated root.
[¶]Orofacial direction of dilacerations.

CONCLUSION

The teeth showing the highest prevalence of root dilaceration were mandibular third molars (24.1%), maxillary first molars (15.3%), second molars (11.4%), and third molars (8.1%), sites that are not particularly prone to trauma during tooth development.

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