

The Occurrence of Root Dilacerations in Patients Reporting to Islamabad Dental Hospital: A Retrospective Study

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ABSTRACT

Objective: Dilaceration of the root is a dental anomaly characterized by an abnormal curvature of the tooth root, which can complicate orthodontic, endodontic or extraction procedures as well as cause issues with the tooth eruption. This present study aimed to determine the prevalence of root dilacerations in patients reporting to a tertiary dental hospital in Barakahu, Islamabad.

Materials and Methods: This retrospective study was conducted in Islamabad Dental Hospital from January 2019 to July 2019. 1010 non-syndromic patients were selected ranging in age from 12 to 45 years. The data were collected from the examination of periapical radiographs. The periapical films were viewed using a magnifying lens and an X-ray viewer. Exploratory data analysis was performed using SPSS software (Statistical Package for Social Sciences) version 23.0.

Results: Out of a total of 1010 records examined, the prevalence of root dilaceration in the studied sample was 9% (91), with a higher incidence in females 58.0% (586) than in males 42% (424). Maxillary second premolars were the most affected teeth at 2.28% (23). In the mandible, dilacerations were less common 18.3% than in the maxilla 81.7%.

Conclusion: It is concluded that root dilaceration is an uncommon developmental anomaly which occurs mostly in the posterior teeth. Early diagnosis of the said anomaly will facilitate endodontic, orthodontic and surgical treatment.

Keywords: Complications, Diagnosis, Etiology, Permanent Dentition, Radiograph, Tooth Abnormality

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INTRODUCTION

Anomaly means any condition that deviates from normal such as the number, shape, colour, contour and size of teeth either because of local or systemic factors. It might be present before or after birth thus affecting both deciduous and permanent teeth. Such anomalies have been found in numerous populations and hence are studied for their importance in genetics, forensic odontology and pathology amongst other scientific fields. The aetiology of dental discrepancies is multifactorial and can occur either due to physiological, pathological reasons or genetics.¹ These factors can affect a single tooth or several teeth¹ and can manifest themselves as a change in shape, number, size, and colour of dental crowns and roots amongst other features. Such conditions can range from gemination, fusion, and concrescence to dilaceration, Talon's cusp, peg lateral and taurodontism.² Conditions affecting the shape of teeth-crown or root is a common findings in patients that come to dental practices annually. Hence a dentist needs to be knowledgeable and cautious of the difficulties such dental anomalies can cause before, during or after interventional therapies.^{1,2} For this paper, one such dental anomaly i.e., root dilaceration has been chosen to be studied in a local population who visited this hospital frequently since the data collection was accessible for the researchers.

Any tooth with a morphologically straight root is considered a standard but in reality, it's an exception since most teeth show some curvature of the root. In 1848, a researcher- Tomes called these curves and bends dilacerations.^{3,4} It denotes an angulation or a sharp turn or an arch in the root of a tooth or a deviation in the ratio of the long axis between the crown of a tooth and its root. A tooth is said to be dilacerated either medially or distally if there is a 90° angle or greater along the axis of the tooth or root. Also, deviation of root morphology from the normal and disturbances in the eruption of a tooth have been associated with several diseases.⁴

Deformities to permanent teeth may be an outcome of trauma to the primary teeth during the progress of its permanent successor because of which the calcified portion of the tooth is positioned at an angulation to the rest of the tooth. Dilaceration is supposed to be owed to trauma through the phase in which dental teeth are developing. Epithelial-mesenchymal interactions when disturbed due to trauma or any other reason can change

the normal process of odontogenesis causing a developmental anomaly. The location of the mineralized part of the tooth as a result is altered and the rest of the tooth is shaped at an angle. The existence of this bend may act as a hurdle in root canal treatment and instrumentation. Interventional dental treatments may lead to complications such as apical transportations, blockages and perforations when dealing with dilacerated teeth. In teeth with dilacerated root anatomy, since the root canals adapt to the curves or bends of dilaceration, the canal exploration step might cause some procedural errors such as ledge, apical zipping, canal straightening, elbow, fracture, leading to incomplete shaping of the root canal system and probable failure of the root canal treatment in the future.⁵ Managing such bent root canals is an endodontic trial; so, for effective therapy, a thorough knowledge of root morphology is essential along with having a familiarity with the frequent variations and complexities of each tooth. It is also important for dental practitioners to know the importance of pre-operative radiographs and analysis before access cavity preparation, which is frequently underestimated by clinicians. Dilacerated teeth frequently present difficult problems at the time of extraction.

Root malformations most commonly arise from either developmental disorder of the root alone or as a part of a general tooth dysplasia affecting the roots.⁶ While dilaceration of a dental crown can be clinically detected in an intraoral examination, a radiographic examination is essential to diagnose a dilaceration of the dental root. The standards for identifying root dilaceration can differ in the scientific literature. When we studied the literature with the help of the PubMed Database (National Library of Medicine), most publications regarding dilacerations were case reports. As there are inadequate epidemiologic statistics, there is negligible data about the accurate frequency of this abnormality. Also, a diverse range of results was seen in these studies due to a vast regional, cultural, and ethnic diversity, and various environmental factors affecting tooth development.⁷ Diagnosis of root dilaceration can be easily accomplished by studying the degree of dilaceration in either mesial/distal or labial, buccal/palatal, or lingual aspects. Dilaceration can be classified according to Santana, Consolaro and Tavano as mild, moderate and severe. Mild; if the root angulation lies between 20-40 degrees, Moderate; if root angulation is

between 41-60 degrees, Severe; if root angulation is equal to or more than 61 degrees.⁸

Root dilacerations when present may have long-term clinical effects. They can result in hindering surgical procedures and make it more difficult to perform orthodontic and endodontic treatments resulting in compromised esthetics of an individual. The scope of this study is only to find out the prevalence of dilaceration since a thorough study of literature found online has shown that there is a definite lack of data and conclusive evidence concerning dilaceration. More recent and up-to-date knowledge is a prerequisite for patient and operator satisfaction in the field of dentistry. It also presents us with a wide range of possibilities when diagnosing a patient and coming up with a suitable treatment plan.

MATERIALS AND METHODS

This retrospective descriptive study was conducted on the residents of Bharakahu, Islamabad. The objective was to evaluate the frequency of dental anomaly specifically dilaceration in permanent dentition in patients with malocclusion reporting to the orthodontic department of Islamabad Dental Hospital. Ethical approval was taken from the Institutional Review Board of Islamabad Dental Hospital (Ref #IMDC/DS/IRB/213) and permission was also taken from the Orthodontic Department of Islamabad Dental Hospital. A total of 1281 records were taken into consideration as records were being studied in retrospect, for a period of 7 months from January 2019 to July 2019. In this retrospective study, the complete enumeration approach was preferred because it is expected to provide complete statistical coverage over space and time. Out of a total of 1281 records 271 records were discarded due to the absence of radiographs and other concerns listed in the exclusion criteria given ahead. So, the total sample size checked by the examiners was 1010.

All examinations were done in 2 phases. First, the data was collected by the 2 junior dentists. Then the same records were re-examined by 2 senior experienced examiners to cater to inter-examiner reliability. Panoramic radiographs were standardized and obtained by the same machine. All radiographs showing maximum sharpness, medium contrast and density,

were studied in the sample. The X-ray examinations of patients under the age of seven years and permanent incisors with less than two-thirds of roots formed were excluded from the sample. The radiographs were interpreted in the dark with the aid of a magnifier (2x magnifying capacity) on a lightbox with black cardboard masks, the panoramic measuring 15 x 30 cm. 424 radiographs were of males while 586 radiographs belonged to female patients. If the patient did not present with root dilaceration, only the identification data were noted (gender and age).

Inclusion criteria were the patients reporting to the orthodontic department in the period from January 2019 to June 2019 having permanent dentition. Exclusion Criteria were the patients with one or more of the following: syndromic disorders, dental anomalies i.e., hypoplasia secondary to amelogenesis imperfecta, or dental fluorosis, a hereditary condition, cases of cleft lip and palate, trauma, or jaw fracture that may affect the development of the permanent dentition, already extracted permanent or supernumerary teeth, incomplete patients' data.

The data were classified in SPSS v. 23.0 (Statistical Package for Social Sciences). Exploratory data analysis was performed with the construction of single-frequency and double-entry tables, as well as statistical result graphs. Standardization between the 4 qualified examiners was conducted to eliminate inter-examiner discrepancies. The value of alpha 0.79 suggested an acceptable level of inter-examiner reliability.

RESULTS

From the evaluated radiographs of 1010 patients, 58.0% (586) were females and 42.0% (424) were males. Records of patients between the ages of 12 to 45 years were examined in this study. Out of the total no. of patients, 9.1% (91) presented with dilaceration, as shown in Table 1. 90.9% of the patients presented without dilacerations. The prevalence of root dilaceration in the sample was affecting the maxilla (81.7%) more than the mandible (18.3%). In 32 cases the upper second premolars exhibited dilaceration making it the most affected tooth (2.28%), followed by 5 cases of the upper lateral incisors (0.4%).

Table 1: Frequency of Dilaceration

Dental Anomaly	Frequency	Percentage %
Patients with Dilaceration	91	9.1
Patients without Dilaceration	919	99.9
Total number of patients	1010	100.0

DISCUSSION

Dilaceration is a developmental anomaly in which there is partial or complete curvature of the crown or root at the long axis of the tooth.^{6,7} The resultant percentage of dilaceration in the present study is 9.1% which coincides with research by *Milogu et al* on a Turkish population, where the percentage of dilaceration was 9.5%.⁹ In contrast, another research, by *Blige et al* showed the prevalence of dilaceration within the Turkish population as 16.3%.¹⁰ A study conducted by *Malik et al* in their local population of Taxila showed that dilaceration had a prevalence of 5.7%. They studied 450 periapical radiographs out of which 26 showed evidence of dilacerations.¹¹ As compared to Taxilla, the local Bhabra population showed a higher prevalence of dilaceration. The prevalence of dilaceration varies in different studies. Some studies show male predilection while others reported female preference. Of the two studies conducted in India one showed partiality to males where the prevalence of dilaceration was 0.39% whereas the other showed partiality to females and the prevalence was 16.48%. The dissimilarities in the result are chiefly due to the sampling technique, a racially diverse range of population and dissimilar inclusion standards. The same study by *Goswami, Bhardwaj and Grewal* states that the prevalence of dilaceration in an Iranian and French population was 5.29% and 0.18% respectively.⁷ There have been very limited studies conducted on the prevalence of dilacerations in the Pakistani population.

Dilaceration can be anywhere along the length of the root. It is occasionally seen at the cervical one-third or equidistant along the root or simply at the root apex. This is based on the degree of injury inflicted upon the root during its formation that causes the location of the calcified portion of the root to change and the rest of the tooth is moulded at an angulation.^{2,5,9} *Malic'ic et al.* when studying the maxillary central incisor reported a prevalence of 1.2% dilacerations on periapical radiographs and 0.53% with the help of Orthopantomogram (OPG). Furthermore, *Malic'ic et al* also documented in 2005

that the anterior teeth's apical third of the root seems to be the most commonly affected area in this regard. On the other hand, in the case of molars and third molars, the middle and cervical thirds are the most widely affected root areas respectively. *Malic'ic et al* also documented a higher frequency of prevalence of dilaceration in maxillary dentition as compared to mandibular i.e., 4.6% and 1.3% correspondingly.¹² A similar trend was seen in our study as more maxillary teeth (81.7%) were affected by dilaceration than the mandibular teeth (18.3%). A review of the literature shows a case reported by *Nagpal and Gurharikar* where trauma to the deciduous dentition resulted in impaction and dilaceration of the permanent incisor as a result of trauma to the deciduous predecessor.¹³

Dilaceration is an outcome of an unforeseen alteration in the axial tilting between the crown and root of the tooth. The standards in literature for identifying root dilaceration differ from one researcher to the next. An accepted range of angulation in cases of dilaceration is ninety degrees to twenty degrees. Conceivable causes of dilacerations may include trauma and developmental disturbances. In numerous occurrences of dilacerations, researchers have found a preceding injury to the precursor primary incisor. Studies have reported a high prevalence of traumatic injuries in the deciduous dentition ranging from 11% to 30% but the incidence of dilaceration in permanent teeth is minimal because most of the traumatic injuries do not damage the permanent succedaneous tooth.³ This fact represents the ideology that trauma is not the only cause of dilaceration.

When the intrabony space is reduced as a result of any high-risk injury such as intrusion or ankylosis of the primary tooth, dilaceration may or may not occur in the permanent dentition.^{3,13} 8% to 62.1% of children between 2 and 5 years old are affected by traumatic dental injuries. This age period is of utmost importance since the development of body balance and motor coordination is taking place and thus unfortunately dental injuries due to trauma result in poor esthetics, and psychological aftermaths ultimately having a negative

impact on the patient's quality of life.¹⁴ After an unexpected trauma occurs to a tooth, the traumatic impact force travels through a vertical path along the longitudinal axis of the primary tooth and it may be transferred in a more cervical direction via the apex, to the non-mineralized or partially developed tooth germ of its permanent succedaneous tooth.^{13,14} In the coming years as the tooth development advances, the tooth bud of the permanent tooth such as an incisor matures in a labial direction, close to the resorbing primary root. Since the direction of the force is more important than the magnitude of the force, thus the impact of this traumatic force will be moved along an imaginary path in an oblique line that runs via the incisal edge of the permanent incisor towards a point on the newly developed root.¹⁴ Cases have been reported where the traction of an impacted tooth dilacerated root had to be carried out. When the traction of the tooth was done using the closed eruption technique, the root dilaceration caused little or no effect on root development and alveolar bone mass.^{15,16} There is a reduced incidence of dilaceration in deciduous dentition and no sex preference.^{3,7,13}

Studies have also reported a greater number of cases in the upper posterior teeth with fewer occurrences in the anterior and mandible. Although any tooth may be affected by dilaceration, there is no consistency amid the most and least affected teeth reported with this anomaly.³ In this study the most commonly dilacerated tooth was the maxillary second premolar with an occurrence of 32 cases (2.28%) followed by maxillary lateral incisors with an occurrence of 5 cases (0.4%).

When studying dilacerations, periapical radiographs are a reliable diagnostic tool for root dilacerations. A shortcoming of radiographic investigations is that it's a two-dimensional representation of an otherwise three-dimensional object. Proximal bends (mesial or distal) in dilacerated root specimens are apparent on the periapical radiograph as reported by White and Pharoah.¹⁷ But if the arc lies in a labial-buccal track, the central x-ray beam passes almost parallel to the dilacerated segment of the root. Consequently, the dilacerated root portion is missed as it looks like a normal morphological root with a circular radiopaque region around a dark central radiolucent spot, which signifies the apical foramen as well as a portion of the root canal.¹⁸

To overcome such inherent limitations of radiographs, cone-beam computed tomography (CBCT) has been advocated as an accurate, innovative and non-invasive radiographic technique for the diagnosis of dilaceration that enables dentists to examine a tooth or teeth under consideration in three dimensions.^{19,20} Cases of root dilacerations as a result of trauma to deciduous forerunner teeth have been assessed by CT scans in various studies. For measuring the root formation of these permanent teeth after trauma or for reaching a diagnosis about its location in the alveolar process special software programs are used.²⁰ *Nallanchakrava et al* in their study described the management of impacted maxillary central incisor with severe root dilacerations. To assess the detailed three-dimensional positioning of the root in orthogonal and oblique planes, cone-beam computed tomography was advised, which revealed that the dilaceration had an angulation of 90° and the crown was directed toward the anterior nasal spine. They used cone-beam computed tomography (CBCT) to assess the position of the dilacerated root and its developmental stage.²¹

Our results have shown differences and varying prevalence in comparison to previously published literature. These may be attributed to the sample selection, the research methodology employed, and the geographic location of patients studied, that advocate racial and genetic differences which in turn may have contributed to the varying dissimilarities.

Additional research for the causation or development of dental anomalies in adult patients in the region is recommended to generate awareness and prevent the associated dental problems. An AutoCAD software is needed, that superimposes measured values and radiographs to give angles and indexes for accurate measurement of the degree of dilaceration. The aforementioned software was not available for this study. A concern for the complete enumeration technique for sampling is the risk of negative bias as there is always a part of the population which is not accounted for by data collection. The strength of this study is that it is the first original study on dental anomalies in this region and standardization between four qualified experienced examiners was conducted to eliminate inter-examiner discrepancies.

Due to the relatively high prevalence of dilaceration in this study and the vastness of the Pakistani population,

this epidemiological data cannot be generalized to the whole country. Therefore, it is recommended that similar studies with larger sample sizes and in different parts of the country be conducted using cone-beam computed tomography (CBCT). This would also make it possible to study the frequency of dilaceration according to the various classifications given.

CONCLUSION

The patient population reporting to Islamabad Medical and Dental College in Bharakahu showed a noticeable prevalence of dilaceration in permanent tooth roots. The impact of dilaceration in dental practice should not be undervalued since it is the main reason for a tooth's impaction and results in complex treatment plans and low prognosis. The etiology of the condition is not entirely clear even though its clinical implication is significant.

DISCLAIMER

None to declare.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

ETHICAL STATEMENT

Ethical approval was provided by the Institutional Review Board at Dental Section, Islamabad Medical and Dental College, Barakahu, Islamabad (Ref# IMDC/DS/IRB/213).

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AUTHORS CONTRIBUTION

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