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Original Research

PREVALENCE AND DISTRIBUTION PATTERN OF DILACERATED TOOTH AMONG ORTHODONTIC PATIENTS USING CONE-BEAM COMPUTED TOMOGRAPHY: A PROSPECTIVE MULTICENTER STUDY.

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Abstract

Objectives: The objectives of this study were to ascertain the prevalence, distribution pattern, and root shape of dilaceration for each type of tooth, and to examine the association between dilaceration and gender.

Material and Methods: The study was carried out at multiple centers- College of Dentistry at Hawler Medical University, Azadi Dental Center and Khanzad Teaching Center in Erbil City, from 2019-2023. 1420 patients received treatment and were assessed, of which 389 individuals (age range 17-45 years) satisfied the inclusion criteria. Among these, 143 were males (36.8%), 246 were females (63.2%). Three orthodontists conducted clinical examinations using standard diagnostic techniques. Cone beam computed tomography (CBCT) was utilized to determine the location of root deviation, whether it was in the apical, middle, or coronal third of the root.

Results: Statistical analyses employed Pearson's chi-square test and Fisher's exact test. The occurrence of root dilacerations in the jaw was highest in the third molars (79.5%), followed by first molars (6.8%), second molars (6.8%), and second premolars (6.8%). Root dilacerations were most prevalent in the lateral incisors (40.2%) within the maxilla, followed by the canine (26.1%) and central incisors (14.1%). Females had a higher prevalence of tooth dilacerations compared to males. The majority of dilacerations occurred at the apical region (66.1%), with the middle region accounting for 30.6% and the coronal region accounting for 3.3%.

Conclusion: Based on these findings, it is advised that orthodontists conduct a thorough examination of dilacerated teeth during orthodontic treatments. CBCT can serve as a supplementary technique for identifying the arrangement of root dilaceration. Our findings highlight the significance of doing a diagnostic radiographic evaluation prior to devising a treatment plan for permanent teeth.

Keywords: Dilaceration, CBCT radiography, Pattern of distribution, Prevalence.

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INTRODUCTION

Dilaceration refers to an abnormality in the form of a tooth that occurs during its development. Dental angulation is the term used to describe a pronounced bend or curve in either the root or crown of a fully developed tooth. [1] This condition primarily impacts the maxillary incisors and typically manifests in the permanent set of teeth. [2] A tooth is deemed dilacerated by many writers if its root is tilted mesially or distally at an angle of 90° or greater in relation to the tooth or root axis. [3-5]

Dilaceration is believed to result from the displacement of pre-existing hard tissue during the formation of soft tissue, typically due to trauma. Nevertheless, the validity of this pathophysiology has been challenged, and an alternative conjecture posits that the deformity arises from the ectopic formation of the tooth germ rather than as a consequence of trauma. However, trauma is still acknowledged as a potential factor in root dilaceration, especially in the anterior region, despite its infrequent occurrence. [6,7]

The majority of papers on dilaceration consist of case reports that detail a multidisciplinary approach to addressing this condition. Scant articles have documented the frequency of dilaceration. According to Hamasha et al [8], dilaceration occurs in 3.8% of cases and is most frequently observed in the lower third molars (19.2%), lower first molars (5.6%), and upper second premolar (4.7%).

Nabavizadeh et al [9] found that root dilaceration is predominantly observed in the apical third of the incisors and the middle third of the molars. Additionally, it is more frequently encountered in the maxillary arch compared to the mandibular arch. A consensus among authors exists that mandibular third molars are the most commonly impacted. Furthermore, permanent teeth are more susceptible to being impacted compared to deciduous teeth. Numerous investigations have consistently found no discernible disparities between the genders.[10-12] To diagnose root dilaceration, a radiographic examination is necessary. An accurate diagnosis of dilaceration is crucial when doing root canal therapy, extraction, or orthodontic procedures. [13,14]

The objective of our study was to prospectively analyze the distribution pattern and root shape of dilaceration in different types of teeth and to examine the association between these factors and gender in a substantial group of adult orthodontic patients. The dilaceration of each tooth type and root dilaceration configuration were identified using dental cone beam computed tomography (CBCT) radiographs.

MATERIALS AND METHODS

Study setting

The study was carried out between 2019 and 2023 in the Orthodontic Clinic of the College of Dentistry at Hawler Medical University, as well as the Orthodontic Departments of the Azadi Dental Center and Khanzad Teaching Center, which are part of the General Directorate of Hawler, Ministry of Health-Iraq. The study was conducted in Erbil City. The study assessed patients who sought orthodontic treatment for a range of reasons, such as orthodontic diagnosis, treatment planning, and implants. Before obtaining informed consent from patients, a concise overview of the study was provided. The patients under examination were not subjected to superfluous

radiation. This study only included Iraqi patients between the ages of 17 and 45. The Research Ethics Committee of the College of Dentistry at Hawler Medical University granted ethical approval for this study.

Study subjects

The cases that were treated were chosen based on clinical and radiographic evaluation conducted by a single investigator as part of the normal examination for admission to the Orthodontic Clinic. Out of the total number of patients investigated, which was 1420, only 389 individuals satisfied the specific criteria for inclusion and exclusion. Among them, there were 143 men and 246 females. The participants' ages varied between 17 and 45 years (mean = 26.97 ± 9.10 years).

Examination

Three orthodontists assessed the chosen cases utilizing conventional diagnostic techniques with a clinical evaluation form derived from prior research. [15,16] The clinical evaluation comprised ocular inspection and radiographical assessment using CBCT. The deviation was allocated to either the apical, middle, or coronal third of the roots. A tooth with multiple roots was identified as dilacerated when at least one root displayed dilaceration upon radiographic examination using CBCT (Cone Beam Computed Tomography) with the following parameters: a field of view of 15 × 3 × 15 cm, an X-ray voltage of 110 kV, and a current range of 1–20 mA (in pulsed mode). The imaging was performed with a voxel resolution of 0.3 mm isotropic and an exposure time of 10 seconds. We conducted a study on the geographical distribution and extent of deviation of dilacerated teeth, as well as their distribution among different genders. We manually examined teeth bulges and deviations using tactile examination to identify dilacerated teeth in both the buccal and palatal directions. A thorough occlusal examination was conducted to assess the alignment and placement of the teeth. [17,18]

The criteria for inclusion were as follows:

1. Individuals between the ages of 17 and 45.

2. Underwent orthodontic treatment.

3. Possess a complete set of permanent teeth.

4. Absence of systemic diseases, craniofacial abnormalities, or syndromes.

5. Citizen of Iraq.

The criteria for exclusion were as follows:

There was no specific measurement, either in terms of quantity or quality, for assessing crowding and spacing in either of the dental arches. Instead, it was simply noted if crowding or spacing was present or missing in either arch. The upper and lower arches were not separated.

The tooth dilaceration assessment sheet consisted of two sections:

1. Demographic information about the patient:

The information encompassed their age, gender, personal background, familial background, medical background, and dental background.

2. The configuration of root dilaceration (Figure 1):

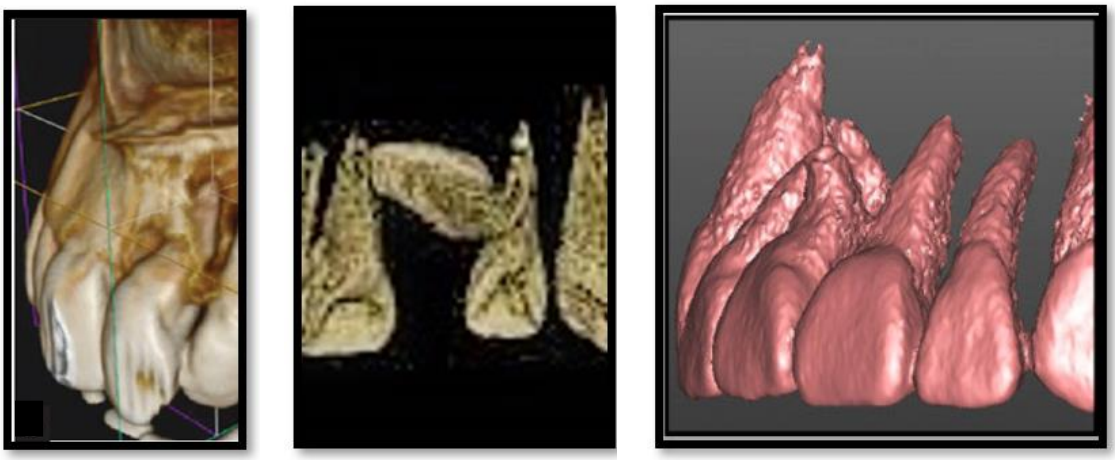
a. Coronal third root dilaceration.

b. Dilaceration of the root in the middle third.

c. Apical third root dilaceration.

STATISTICAL ANALYSIS

The data were analyzed using the Statistical Program for Social Sciences software (version 24; SPSS, Chicago, IL, USA). The proportion of dilacerations was determined based on gender, jaw, and deviation of the root segment. The possible association between genders and location (upper and lower jaw) and between genders and root segment deviation was evaluated using Pearson's chi-square test and Fisher's exact test. A p-value below 0.05 was deemed to have statistical significance.

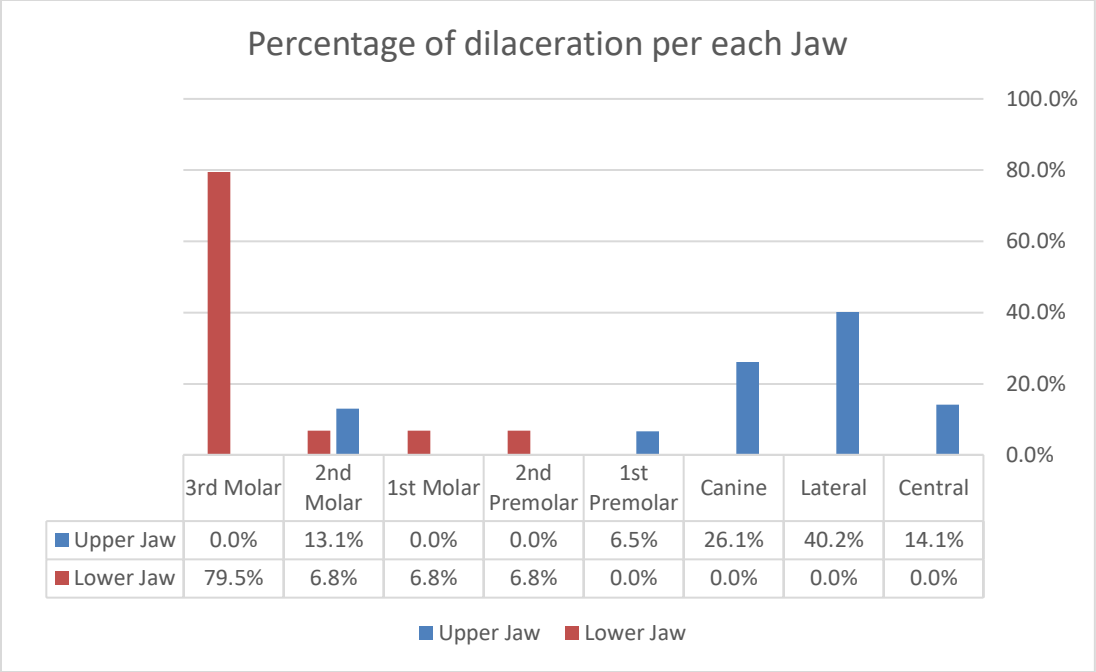


A. B. C.

Figure 1: Root dilaceration configuration: (a) coronal third (b) middle third (c) apical third root dilaceration.

RESULTS

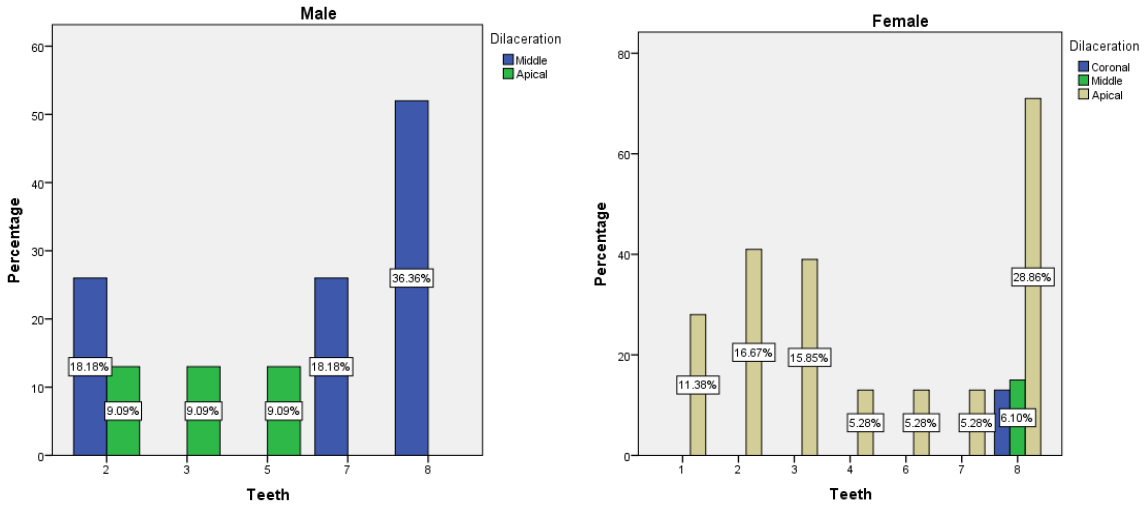
The investigation encompassed a total of 389 patients, with 143 (36.2%) being male and 246 (63.2%) being female. The average age of the individuals was 26.97 ± 9.10 years. Root dilacerations were predominantly observed in the third molars (79.5%) of the jaw, with lesser occurrences in the first molars (6.8%), second molars (6.8%), and second premolars (6.8%). Root dilacerations were most prevalent in the lateral incisors (40.2%) within the maxilla, followed by the canines (26.1%) and central incisors (14.1%; Figure 2).



	3rd Molar	2nd Molar	1st Molar	2nd Premolar	1st Premolar	Canine	Lateral	Central
Upper Jaw	0.0%	13.1%	0.0%	0.0%	6.5%	26.1%	40.2%	14.1%
Lower Jaw	79.5%	6.8%	6.8%	6.8%	0.0%	0.0%	0.0%	0.0%

Figure 2: Percentage of dilaceration involving the maxillary and mandibular jaws.

Females had a higher prevalence of tooth dilacerations than males, except for the second premolar and second molar. Female individuals exclusively exhibited dilacerations in the central incisors, first premolars, and first molars, whereas male individuals exclusively exhibited dilacerations in the second premolars (Figure 3).



a. b.

Figure 3: Percentage of dilaceration regarding gender; (a) males; (b) females.

The majority of dilacerations occurred in the apical region (66.1%), with the middle region being the second most common (30.6%), and the coronal region being the least common (3.3%) (Figure 4). All teeth had apical root

dilacerations. Additionally, the lateral incisors, second molars, and third molars displayed middle root dilacerations. However, apical root dilacerations were only observed in the third molar.

The distribution of dilacerations in the upper and lower jaws did not exhibit a statistically significant difference based on gender ($\chi 2 = 2.943$, degree of freedom = 1, $p = 0.930$). Nevertheless, there was a significant difference in the distribution of dilaceration types (coronal, middle, or apical) based on gender (Fisher's exact test, $P < 0.001$). When comparing the data of males and females, it was found that coronal dilacerations were exclusively observed in females. In addition, 72.2% of the men and 6.1% of the females have intermediate roots. Conversely, 88.6% of females and 27.3% of males have apical dilacerations.

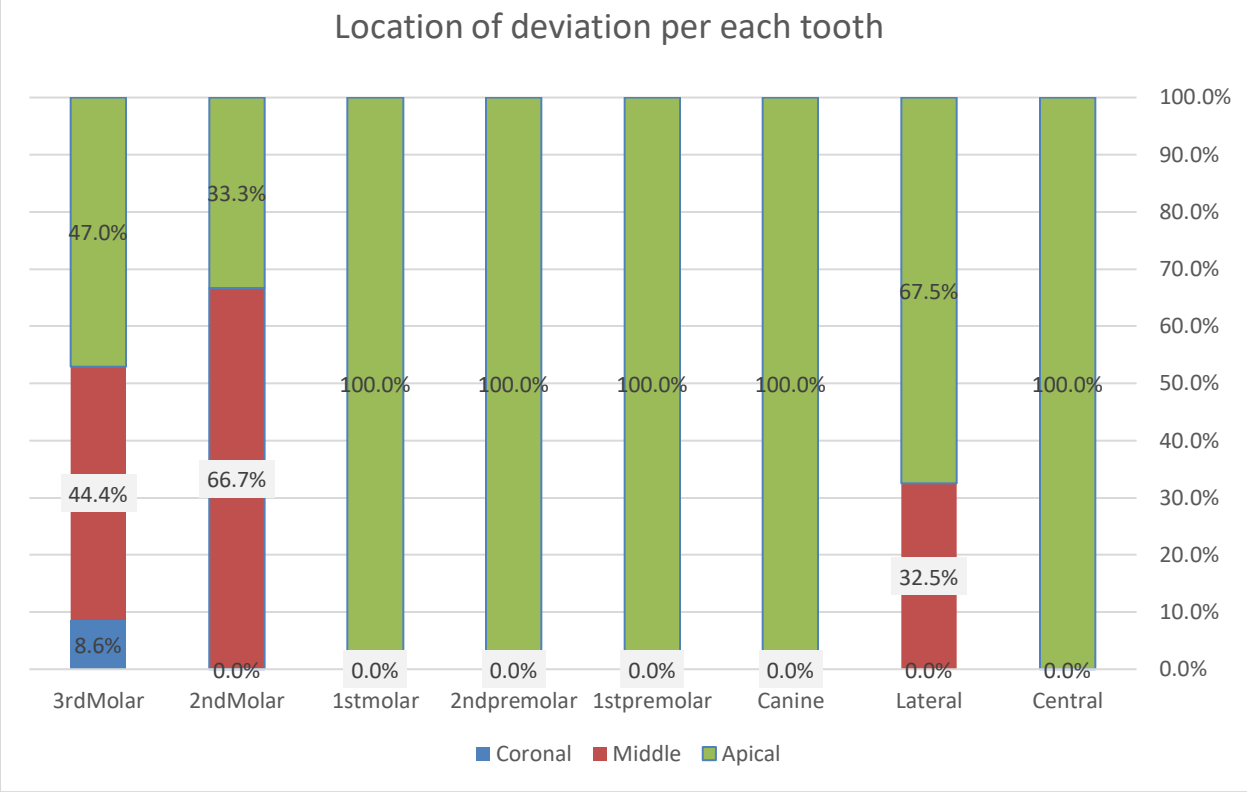


Figure 4: Percentage and location of deviation area in teeth.

DISCUSSION

Tom's definition differentiates dilaceration from the infrequently employed term flexion, which refers to a tooth with a root that is curved or bent in a hooked manner. [19,20] Stewart compared tooth dilaceration to the hand of a traffic policeman [21], while Moreau referred to this condition as scorpion tooth. [22] The majority of articles on dilacerations are case reports. [23,24] Only a limited number of studies have provided data on the prevalence of dilacerations, with reported rates varying from 0.32% to 98% among different teeth. [25,26]

Traditional radiographs typically offer two-dimensional insight into root morphology, lacking precise details on the third dimension and the specific positioning of root dilaceration. [27]

Recent research on dental anatomy has shown that integrating modern technologies like CBCT with traditional radiography can improve the detection of anatomical abnormalities in teeth. CBCT radiography has been extensively utilized in investigations concerning root morphology. It provides a three-dimensional representation of the tooth's structure and accurately measures the angles of root curvature. This aids in enhancing our comprehension of the negative impact teeth have on orthodontic mobility. [28-30] Our research is among the pioneering studies conducted in Iraq to examine the frequency of tooth dilaceration in both upper and lower jaws, utilizing CBCT images.

The cause of this abnormality is a subject of debate. [31] The most likely reason for this is physical injury to the hardened part of a growing tooth. [32] Other potential factors contributing to this condition include syndromes [33] and abnormal development of tooth germs. [34] However, when a tooth with a distorted or twisted shape is positioned towards the front of the mouth. The most probable cause appears to be trauma. [35] Oginni and Otuyemi documented a prevalence rate of 14.5% for trauma affecting the front teeth in rural Nigerians. [36]

A comprehensive examination of the literature indicates significant disparity in the frequency of dilaceration among diverse populations. Our findings indicate that root dilacerations were most prevalent in the jaw, with the highest occurrence observed in the third molars (79.5%), followed by the first molars (6.8%), second molars (6.8%), and second premolars (6.8%). Root dilacerations were most prevalent in the lateral incisors (40.2%) within the maxilla, followed by the canines (26.1%) and central incisors (14.1%). The results of this study do not align with the findings of Hamasha et al [8] and Kuzekanani et al [37], most likely because of variations in methodologies (they employed conventional radiography), sample sizes, and definitions of dilaceration. The findings shown by Chohayed, [38] align closely with our own results, with a prevalence rate of 88.5% for the upper lateral incisors. The upper lateral incisors were the most commonly affected group, with a prevalence of 60.95% in observed cases of root dilacerations. This was followed by the lower lateral incisors (19.04%), lower central incisors (13%), and upper central incisors (7%). These findings align with Silva et al [39] research, which also found that the upper lateral incisors were the most frequently affected by dilaceration, with a prevalence of 22.1% among all incisors. Nevertheless, our results contradict the findings of Silva et al [39], who observed that the central incisors had the highest prevalence of damage (70.6%), followed by the lateral incisors (20.6%) and lower incisors (8.8%). The disparity is probably a result of their intimate topographical association with deciduous teeth, which are frequently subject to injury. Furthermore, our findings align with those of Tanaka et al [40] and Miloglu et al [41] who observed a greater occurrence of dilaceration in the posterior teeth, particularly the mandibular third molar.

Our study discovered that tooth dilacerations are more prevalent in females than males, except for the second premolar and second molar. Only females were found to have dilacerations of the central incisors, which contradicts the findings of Ezoddini et al [19], who indicated that root dilaceration was more prevalent in males than females. In their study, Malcic et al [17] showed that the prevalence of the condition was greater in the maxilla and saw no disparity in occurrence between males and females. The variations can be attributed to local environmental factors, racial disparities, specific age cohorts, and varying sample sizes.

The majority of dilacerations seen in our study were located in the apical region (66.1%), with the middle region being the second most common (30.6%), and the coronal region being the least common (3.3%). There was no significant

difference in the position of dilacerations between males and females in both the upper and lower jaws. Nevertheless, there was a significant difference in the distribution of dilaceration types (coronal, middle, or apical) based on gender (Fisher's exact test, $P < 0.001$). This finding aligns with the study conducted by Benitha et al [42], which demonstrated comparable distributions in both the upper and lower jaws. Nevertheless, a separate study observed that approximately 66% of dilacerations occurred in the mandible. The findings align with the studies conducted by Malcić et al [17] and Hamasha et al [8], which indicated that dilacerations were more prevalent in the maxilla compared to the mandible. However, these results contradict the findings of Milogu et al [41], who found no significant disparity between the two jaws. This observation may indicate a traumatic element that impacts the upper front teeth of children in the primary dentition phase, particularly the upper incisors, as a result of their location.

Concerning the site of dilacerations, around 80.2% were found at the apical third, which is consistent with the findings of Malcic et al. [17]The middle section had a prevalence of 30.6%, while the cervical third had a prevalence of 3.3%. These rates are comparable to the rates of 13.0% and 2.3% reported by Malcic et al [17] respectively. The likely cause of this discovery is the vertical impact force on the front tooth, which is transferred in a straight line along the length of the tooth and may affect the developing permanent tooth that is not fully formed or partially formed.

The inherent arrangement of a possible abutment tooth's structure greatly affects its ability to bear weight. Hence, dilaceration can also impact the stability and durability of an abutment. [43] A finite element stress study has demonstrated that root dilaceration leads to the concentration of stresses in the supporting structures when the dilacerated tooth is utilized as an abutment for a dental prosthesis. Therefore, this should be regarded as a risk factor when choosing an abutment. The heightened stress could potentially impact the stability and durability of both the abutment tooth and the prosthesis. One possible option to consider in certain circumstances is to use splinting to connect a dilacerated abutment tooth to an adjacent tooth, resulting in a multi-rooted abutment [44] The orthodontic repositioning of teeth with abnormal root curvature may result in significant and irreversible root resorption, leading to complications in the subsequent endodontic treatment of these teeth. [45,46]

Various research studies have examined the frequency of root dilaceration, but their approaches have differed. Certain individuals utilized periapical radiographs, whereas others employed a combination of panoramic and periapical radiographs. In addition, a prior investigation [47] employed extracted teeth to identify root dilaceration, potentially leading to an underestimation of their occurrence due to the susceptibility of curved-root teeth to breakage during extraction. The primary objective of our study was to analyze CBCT radiographs. In their study, Muhammed et al [48] observed that there was no statistically significant disparity in the ability of panoramic and intraoral radiography to identify periapical disease. Contemporary studies indicate that in cases where unusual physical structure is suspected, advanced radiographic techniques like helical or spiral computed tomography are employed with traditional radiography to achieve a more precise diagnosis. CBCT can serve as a dependable, non-intrusive, and practical approach for comparing the findings of research on the gender and bilateral occurrence of root dilacerations in various ethnic groups. CBCT images provide a comprehensive view of tooth structures in three dimensions, enabling precise measurements of angles and distances. This information assists orthodontists in making accurate diagnoses,

developing effective treatment plans, and selecting optimal techniques for moving misaligned teeth while minimizing impact on the surrounding periodontal tissue. [49]

CONCLUSION

Root dilacerations refer to atypical deformations in the root of a tooth, commonly observed in orthodontic patients. Identifying these deformations at an early stage is crucial for effectively addressing the related issues. Nevertheless, additional extensive research is necessary to evaluate their frequency in the whole population and to compare it across different ethnicities. Orthodontists should thoroughly assess the teeth with dilaceration in both males and females during orthodontic procedures, as they may significantly influence treatment results. CBCT can serve as a supplementary technique for identifying dilaceration in these instances.

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Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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