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Vol 12 No 1 (2024) DOI 10.5195/d3000.2024.620

Prevalence of dehiscence and fenestration in Iraqi population: CBCT-based analysis

Hayder Sadiq Baker[1], Hamsa Jamal Mahdi[1], Ahmed Saad Ajeel[1]

[1] *Al-Bayan University , College of Dentistry*

Abstract

Objective: This study utilized the cone-beam computed tomography (CBCT) to investigate the prevalence of lower and upper jaw fenestration and dehiscence in individuals with normal patterns, with a particular focus on central incisors to first molars on the two sides.

Materials and Methods: An analysis was conducted on a cohort of 415 patients treated from January 2022 to December 2022 in the periodontal departments of Baghdad, Sulemania, Basra, and Najaf. There was a total of 174 males and 241 females that had Class I characteristics with normal anterior region patterns. The study focused on the occurrence of fenestration and dehiscence in the dentated area of both the right and left sides. These occurrences were subjected to statistical analysis.

Results: Dehiscence has been seen in 4.89% of the assessed mandibular teeth, whereas fenestration was observed in 0.73% of the same teeth. Dehiscences were seen in 9.78% of the examined cases in the upper jaw, while fenestrations were discovered in 5.13% of the cases. These findings indicate a significant difference in the frequency of these conditions between the upper and lower jaws.

Conclusion: The occurrence of dehiscence in both jaws was found to be greater than the occurrence of fenestration. The observed patterns suggested that these findings are more possibly to be attributed to physiological instead of pathological factors.

Keywords: Periodontal disease, Dehiscence, Fenestration, CBCT, Upper Jaw, Lower Jaw.

Citation: Baker, HS et al. (2024) Prevalence of dehiscence and fenestration in Iraqi population: CBCT-based analysis. Dentistry 3000. 1:a001 **doi: 10.5195/d3000.2024.620**
Received: November 3, 2023
Accepted: January 13, 2024
Published: February 13, 2024

Email: hayder.sadiq@albayan.edu.iq

Introduction

The health of alveolar bone, which acts as a foundation for the teeth, is commonly overlooked both prior to and following orthodontic treatment. Patients with high-angle malocclusion have the least amount of alveolar bone thickness [1-4]. Misapplied mechanotherapy may lead to alveolar bone thinning, an elongation of the gap between cementoenamel junction (CEJ) and the alveolar bone (dehiscence), and root penetration into the alveolar bone (fenestration) [5].

The presence of alveolar bone fenestration and dehiscence may result in a reduction in the overall strength of the bone support around teeth. Gingival inflammation induced by plaque may have negative implications for both dental and periodontal health when orthodontic movement is performed without adequate bone support [2]. The presence of an undiagnosed buccal alveolar bone deficit may lead to an increased likelihood of treatment relapse [3] and the development of gingival recession, resulting in an aesthetically unfavorable outcome of orthodontic treatment and sensitivity of teeth [4].

Bony fenestrations and dehiscences in the alveolar

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ridge cannot be seen with conventional 2D imaging, but can be assessed by CBCT. CBCT was utilized for research on alveolar bone abnormalities in kids with cleft lip and palate [5], adults with varying vertical skeletal patterns [6,7], fast maxillary growth in teenagers [8,9], and a range of skeletal malocclusions [10]. Although posterior crossbite in adults is common, no research has investigated alveolar bony abnormalities.

The comprehensive evaluation of preexisting alveolar bony deficiencies is a crucial diagnostic measure in orthodontic therapy for posterior crossbite, since there is a risk of tooth movement through a thin osseous plate [11, 12] in these patients. To avoid aggravating preexisting periodontal issues, orthodontists should be familiar with the anatomical constraints on tooth mobility [12].

Many distinct kinds of fenestration and dehiscence of alveolar bone have been seen in dry skull investigations of people of diverse racial and cultural backgrounds [13-22]. Bone dehiscence is seen in 0.99–13.4% of cases, whereas fenestration occurs in 0.23–16.9% of cases [23]. Alveolar bone dehiscence was linked to gingival recession

[24], and there is evidence to suggest that orthodontic therapy may exacerbate periodontal disease in patients with alveolar bone shortage [24-27].

In order to mitigate the potential for post-treatment complications, one must critically assess the interaction between roots and bones prior; particularly identifying any abnormalities in alveolar bone. Conventional imaging techniques, however--despite their competence in numerous areas--fall short when it comes to reliably detecting alveolar bone dehiscence and fenestration (28-30). Contrastingly: CBCT emerges as an exceptional tool with a proven track record of accurate identification. Both in vivo and in vitro studies have examined CBCT's viability as a diagnostic tool for alveolar bone abnormalities; these investigations aim to ascertain its strengths and weaknesses. In cases of both dehiscence and fenestration, CBCT robustly demonstrates a negative predictive value; however, its positive predictive value is limited [1,31].

As a result, CBCT has the potential to exaggerate bone abnormalities, particularly fenestration. When it comes to orthodontists utilizing bone defect data as a precaution before treatment, however, overestimation might be seen as adding to the side of caution rather than supplying false information. If doctors are aware of the overestimation constraint, they may still utilize the bone defect information obtained by CBCT.

It is also unclear if such flaws are uncommon or prevalent, or whether they are causally linked to the development of malocclusion. Therefore, we set out to use CBCT to look at the frequency of bilateral anterior alveolar bone dehiscence as well as fenestration in people with normalcy patterns.

Materials and Methods

A total of 415 cases were screened in the periodontal departments of Baghdad, Sulemania, Basra, and Najaf from January 2022 to December 2022, and Class I persons with normal patterns in anterior area have been chosen. The individuals

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included in the study were selected based on the condition of their upper and lower front teeth. The criteria for evaluating dental occlusion include the following: (1) the presence of bilateral Class I molar and canine relationships; (2) an ANB angle within the range of 0° to 3°; (3) the absence of abnormal anterior and posterior teeth overjet and overbite; (4) the presence of properly aligned anterior teeth with minimal crowding (<2mm) and negligible spacing between teeth (<0.5mm); (5) a Spee curve depth measuring (<2mm); and (6) the absence of significant rotation (<5°) in anterior region.

Individuals with evident wear were excluded. Also, those with defective dentition or supernumerary teeth were not included. Patients with periodontal disease or attachment loss exceeding 30% were also excluded from the study. Furthermore, people who had previously had restorations, orthodontic treatment, or maxillofacial surgery were excluded from the study. In addition, participants presenting with craniofacial syndromes or evident diseases were also removed from the research. In accordance with the aforementioned criteria, the present study had a sample size of 415 individuals, including 174 males and 241 females. The participants' ages ranged between 17 and 35 years, with a mean age of 26 years.

Before this study began, all participants received thorough information regarding the utilization of their CBCT data. Figure 1 illustrates how they offered informed consent by signing the required forms.

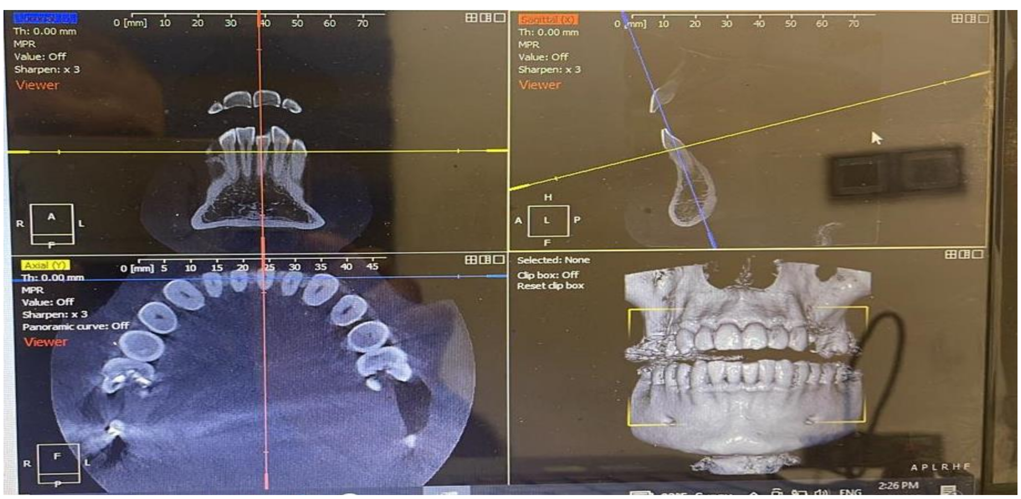

Figure 1. For this research, we utilized CBCT data that participants willingly provided their informed consent for by signing pertinent papers.

Acquisition of CBCT data

As part of the regular checkup, CBCT pictures (KaVo, Germany) were taken before the dental evaluation and treatment plan were made.

Ensuring the correct calibration of the CT device, we positioned the patient's head to align with both a parallel Frankfort plane and horizontal plane in central occlusion. We utilized version 2.2.1-2019 of our house's 3D planner to examine scan settings; subsequently, we reconstructed data from CBCT scans for all 415 cases—generating insightful images in this process. Specific reference points - namely, the

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cementoenamel junction and most coronal point of alveolar bone on buccal and labial aspects for upper and lower teeth - provided views to these images.

Note the omission of the third molars in our analysis: we based our selection for evaluating alveolar bone dehiscence and fenestration on Sun et al. 's methods [18,20]. They chose - as did we - the largest labiolingual section as a measurement plane; this was applied to both incisors and canines within our sample. We replicated the same measurement variables and reference points from a prior study [32]. After computing and documenting data for all 415 anterior upper and lower teeth, we analyzed the results of both initial measurements in accordance with their respective mean values.

Statistical Analysis:

Chi-square tests performed within 2018 version of SAS have been used for the purpose of determining the statistical significant differences (0.05 and 0.01 probability).

Results

In the lower jaw, we observed a higher prevalence of alveolar bone dehiscence (4.89%) compared to that in the upper jaw (9.78%). Likewise, fenestration presented itself more frequently in our findings from the lower jaw (0.73%) than it did within those obtained for the upper jaw (5.13%). We based these conclusions on an analysis involving 415 anterior teeth distributed across both maxilla and mandible regions at our disposal; this provided us with comprehensive insight into this dental phenomenon. The upper jaw exhibited the highest rates of dehiscence and fenestration, while conversely, the lower jaw manifested significantly lower rates. Tables 1, 2 and 3 describe the frequency of fenestration and dehiscence in the upper and lower jaws.

Table 1. Comparison between prevalence of lower dehiscence and fenestration in the lower jaw.

Total sample	409 (%)	P-value
Lower dehiscence	20 (4.89%)	0.0001
Lower fenestration	3 (0.73%)	---

Table 2. Comparison between prevalence of upper dehiscence and fenestration in the upper jaw.

Total sample	409 (%)	P-value
Upper dehiscence	40 (9.78%)	0.0013
Upper fenestration	21 (5.1350	---

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Table 3. Comparison between upper and lower jaws dehiscence and fenestration.

	Lower	Upper	P-value
Total sample	409	409	---
Dehiscence	20	40	0.0004
Fenestration	3	21	0.0001

Discussion

CBCT benefits must be greater than any possible risks related to the exposure to radiations. Based on As Low As Reasonably Achievable (ALARA) principle, each case must have a certain field of view (FOV) size that is carefully calculated [33]. Although traditional radiographs, like the lateral cephalogram and panoramic X-ray, could offer crucial diagnostic data, there are situations in which CBCT may be recommended when it comes to impacted canines, multiple teeth, unerupted teeth, severe root resorption, and noticeable skeletal abnormalities [28–30].

Concerning the selection of participants, individuals who were under the age of 18, often referred to as growing patients, were excluded from the study. This decision was based on prior research findings which indicated that hormonal and functional changes connected with age had an impact on cortical bone thickness [32, 36]. Individuals over the age of 35 were deliberately excluded from the research due to the heightened susceptibility to periodontitis within this demographic [37]. This decision was made to mitigate the potential influence of periodontitis-induced bone loss, which might have introduced confounding variables into the study. The study findings indicate that there have been statistically significant differences in the occurrence of total bony defects and dehiscence between individuals with posterior crossbite and those without. Moreover, these differences were also observed among the three subgroups. However,

it is worth noting that the disparities in prevalence were approximately 10%, which may not have significant clinical implications.

Statistical differences were not seen in all mean defect size assessments across the three categories; nonetheless, a consistent pattern was observed in all measurements. It is possible to explain the observed phenomena by thinking of teeth's buccolingual inclination as a compensatory mechanism. People who have a posterior crossbite have been shown to have dental compensation for the teeth that are not impacted by the crossbite, whereas the teeth that are affected by the crossbite retain their original position within the bone structure [6, 7]. It is clear from this that the occurrence of bone anomalies in non-crossed teeth was higher in those with crossbite. The reason behind this phenomenon could be that these teeth have been

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positioned outside of bony housing in order to correct occlusal connections.

Our investigation revealed a noteworthy observation: The frequency of dehiscence and fenestration is higher on the buccal side, in comparison with the lingual side. This significant finding aligns precisely; indeed, it mirrors identical results outlined in an earlier study [12]. The buccal side often exhibits lesser density than its counterparts (the lingual or palatal surfaces). However, potential oversight of a thin layer of bone on buccal side might have led to an exaggeration in the reported prevalence. This mistaken classification as defects could indeed reduce accuracy [1].

The first premolars demonstrated a higher dehiscence frequency compared to other posterior teeth across all categories. This phenomenon may originate from the comparatively limited width of the alveolar bone in this specific location, as opposed to broader dimensions found in other posterior areas. The narrowing pattern of alveolar bone width occurs during progression from posterior towards anterior regions within both maxilla and mandible. Two distinct root morphologies, diverging from each other, may contribute to the increased susceptibility of the maxillary first premolar to bone abnormalities.

The maxilla had a greater incidence of fenestration compared to the mandible. Similar findings have been reported in previous research (8–10,12), which indicate that the maxillary bone has a narrowing pattern from cervical to the apical level of teeth, whereas the mandible demonstrates a thicker cortical bone.

A reduced incidence of fenestration inside the maxilla was noted, specifically regarding the second premolars, when put to comparison with other posterior teeth in the maxillary area. The rationale for this is due to the fact that maxillary second

premolars exhibit a unique dental trait, since they are the only maxillary posterior teeth that possess a solitary root, devoid of the diverging root prominence often seen in teeth with multiple roots. Previous research has shown that CBCT tends to exaggerate bone abnormalities due to its poor positive predictive value, particularly in cases involving fenestration [1,38]. The prevalence of bone deformities as reported in this research is likely to be overstated and may include some false-positive numbers. Therefore, it is important to reevaluate the proportion of bone abnormalities while considering the potential occurrence of false-positive interpretations. Alveolar bone thickness and periodontal biotype are significant confounding variables that need to be considered when detecting bony defects, both within individual patients and across different subjects. The study did not include measures of alveolar bone thickness or clinical evaluation of periodontal bio-type. Instead, face data of a vertical nature was used.

Gracco et al. [39] have shown a statistically significant correlation between vertical face type and alveolar bone thickness. The researchers observed that hypo-divergent individuals had a higher degree of alveolar bone thickness compared to hyper divergent patients. Yet, it is important to note that this study just

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concentrated on the assessment of upper incisors. Subsequent research has also shown that individuals with hyper divergent and neurodivergent face types have a greater incidence of dehiscence compared to those with a hypo-divergent facial type [9].

Limitation

As described in the techniques section, we conducted the acquisition of CBCT images for this experiment using two unique settings. The existing data suffers from an inherent drawback: a lack of control over past parameters used to capture CBCT images by our investigator. However, research suggests that altering CBCT settings may not significantly affect alveolar bone measure quantification [31]. The sample selection process encountered a restriction: an exact match in the anterior-posterior skeletal pattern (ANB value) between research group and comparison group was not found. Nonetheless, it is crucial to emphasize that experts deemed the observed discrepancy of 1.56° as clinically acceptable; this underscores precision within their evaluation.

The asymmetrical geometric properties of dehiscence and fenestration potentially lead to varied measurements in the vertical dimension, depending on picture orientation. In an effort to reduce error, we optimally aligned our research's vertical distance measurement with the long axis of a tooth while positioning it perpendicular to

its occlusal plane. However, the present study faced significant constraints due to its limited sample size; determining prevalence was our primary aim despite these limitations. A higher sample size would have indeed enhanced the findings' robustness; specifically--the inclusion of confounding variables like occlusal interference and occlusal wear: these additions could have fortified the research.

Disclosure of interest

The authors declare that they have no competing interests.

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