Prevalence of Alveolar Bone Dehiscence and Fenestration in Adults with buccally positioned canines-A CBCT Study

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KEYWORDS
prevalence; alveolar bony dehiscence; dehiscence; fenestration

ABSTRACT
Detecting alveolar bone fenestrations and dehiscences before orthodontic treatment is imperative due to their potential implications. These defects can contribute to gingival recession and diminish the support structure of canine teeth. Failure to recognize buccal alveolar bone issues increases the risk of treatment relapse.The aim of this study was to determine the prevalence of alveolar bony dehiscence and fenestration in adults with buccally positioned canines. Thirty individuals aged between 18 and 35 undergoing orthodontic treatment in the Department of Orthodontics in the institution were chosen randomly for this study. Their CBCT records were obtained from the Department of Oral Medicine and Radiology, S******* Dental College and Hospital. Statistical analysis was conducted using IBM SPSS Version 23. The chi-square test was employed to explore the relationship between fenestrations, dehiscences, and gender. It was observed that 40% of females had dehiscence, while 36% of males exhibited this condition. Fenestrations were present in 35% of males and 40% of females. In the context of this study's limitations, a statistically significant relationship was found regarding dehiscence width among females (p=0.019, p<0.05), highlighting a heightened vulnerability compared to males. Conversely, the association of fenestration prevalence between males and females did not reach statistical significance (p=0.178, p>0.05). These findings suggest that females may have a greater propensity for bony alveolar dehiscence and fenestration relative to males.

1. Introduction

Pit and fissure sealants Identifying alveolar bony fenestrations and dehiscences prior to commencing orthodontic intervention holds significant clinical relevance for orthodontists owing to a multitude of factors [1]. Empirical evidence suggests that the presence of alveolar bone dehiscence and fenestration may precipitate gingival recession and diminish the osseous support of teeth [2]. Failure to detect and diagnose buccal alveolar bone defects portends a heightened susceptibility to treatment relapse, potentially resulting in compromised treatment outcomes and increased dental hypersensitivity [3,4]. Furthermore, inadequately executed orthodontic procedures may exacerbate the manifestation of fenestrations and dehiscence.

The identification of alveolar bony dehiscence and fenestration poses challenges with conventional 2-dimensional imaging modalities. However, the introduction of Cone Beam Computed Tomography (CBCT) has revolutionized the visualization of these defects in a three-dimensional context [5]. Timock et al. have demonstrated that CBCT enables accurate and reliable measurements of buccal bone height and thickness, thereby enhancing diagnostic capabilities [6]. Various studies have utilized CBCT to investigate alveolar bony dehiscence in diverse populations, including children with cleft lip and palate, adolescents undergoing rapid maxillary expansion, and individuals with different malocclusions [7–9].

Curiously, there is a marked shortage of studies investigating alveolar bony defects in adults undergoing orthodontic intervention. It is essential for orthodontists to comprehend the anatomical constraints of tooth displacement to foresee potential periodontal complications that could escalate during orthodontic procedures [10][11]. Despite its notable specificity and negative predictive value for identifying both dehiscence and fenestration, CBCT displays a low positive predictive value [12]. Research into early caries, root canal treatments, orthodontic bacterial landscapes, and root resorption patterns illuminates the vital role of biological factors in disease progression [13–16].

Leung et al. emphasized the notable precision of CBCT in identifying dehiscence and fenestration, underscoring its significance in orthodontic diagnosis [1]. Employing information on bony defects as a preemptive measure before treatment can be perceived as leaning towards caution rather than disseminating misinformation. As long as clinicians grasp the extent of CBCT's accuracy, they can still integrate data concerning bony defects while adhering to the cautious approach. Therefore, the aim of this study was to ascertain the prevalence of posterior alveolar bony dehiscence and fenestration in adults receiving orthodontic treatment.

2. Materials And Methodology

2.1Study design

This investigation adopted a retrospective approach. Cone Beam Computed Tomography (CBCT) scans previously taken as a diagnostic record of 30 adult individuals, aged between 18 to 35 years before undergoing orthodontic treatment, were retrieved from the patient archives of those undergoing orthodontic treatment at the Department of Orthodontics, Saveetha Dental College.

2.2The selection criteria for the study were as follows

The study included subjects with Class 1 malocclusion, buccally positioned maxillary canines. Exclusion criteria encompassed evident pathologies such as cysts or tumors, bony abnormalities, and congenital defects. Additionally, individuals with multiple carious lesions, dental restorations, abfractions, or abrasions, as well as those with missing posterior teeth or a history of prior orthodontic treatment, were eliminated. Following the application of these stringent criteria, CBCT scans of 10 males and 10 females were meticulously selected for inclusion in the study.

Sampling method:

To mitigate sampling bias, simple random sampling was conducted. The investigator, H.N., was blinded to the subject-specific demographic information contained in the CBCT DICOM files until after the study was finalized.

2.3Method to measure the bony defect

Each CBCT image underwent rigorous examination and measurement using Dolphin Imaging 11.8 premium software, under the exclusive supervision of investigator H.N. To maintain consistency, the image orientation employed the Frankfurt Horizontal (FH) line, aligning it parallel to the floor, while ensuring perpendicular alignment of the midsagittal plane to the FH plane. Each anterior quadrant underwent meticulous scrutiny through a multiplanar view, magnified threefold to enhance precision. Subsequently, after magnification, alignment of the anterior segment in the anteroposterior direction on the axial view facilitated precise measurement.

To qualify as a dehiscence, a lesion had to measure at least 2 mm vertically from the Cementoenamel Junction (CEJ). This criterion aimed to prevent the erroneous identification of normal bone levels, usually found 1.5-2mm below the CEJ, as dehiscences. Conversely, no specific minimum size requirement was set for fenestrations. Any degree of bone loss on the root surface, without continuity with the marginal bone, was deemed and measured as a fenestration.

2.4Statistical Analysis

The entirety of statistical analyses was executed utilizing IBM SPSS version 23. Employing a Chi-square test, the investigation sought to discern any potential correlation between alveolar bony defects and gender across the male and female subjects.

3. Results

A tooth was deemed to possess a bony defect if a defect was observed on either the mesial or distal side, or on both sides. Table 1 presents the mean and standard deviation of bony defects, while Table 2 elucidates the correlation between fenestrations and dehiscence across genders. Interestingly, females exhibited wider dehiscence defects compared to males, a finding that attained statistical significance through the Chi-square test ($p=0.019$, $p<0.05$). Conversely, there were no significant discrepancies in fenestration defects between males and females, as indicated by the Chi-square test ($p=0.178$, $p>0.05$). Figures 1 and 2 depict the relationship of fenestrations and dehiscence in males and females, respectively.

Table 1: Association between the average width of fenestrations and dehiscence across genders in the study cohort.

Gender		N	Mean width (Mean ∓ SD)
Dehiscence	Males	5	1.40∓.416
	Females	7	1.60∓.453
Fenestration	Males	10	1.35∓.263
	Females	10	1.44∓.100

Table 2: Association of fenestrations and dehiscence of the genders in the study population

Pearson's chi-square		Value	df	Asymptotic Significance (2 sided)
	Dehiscence	5.638	1	0.019
	Fenestration	1.854	1	0.178

Depicting chi-square test for associations between the genders

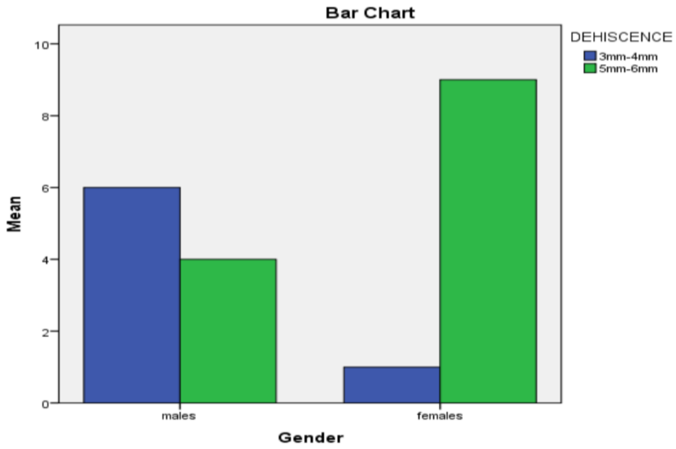

Fig 1. A bar chart visually depicting the correlation between gender and the presence of dehiscence. On the chart, the X-axis corresponds to the width of the dehiscence, while the Y-axis represents gender. The statistical analysis unveiled a Pearson's chi-square value of 5.49, accompanied by a p-value of 0.019 (less than 0.05), suggesting statistical significance.

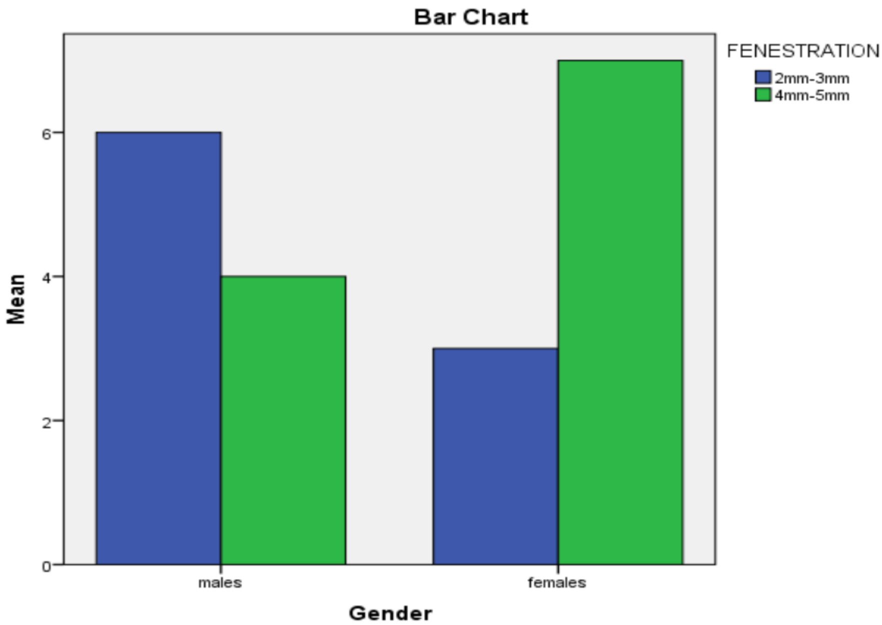

Fig 2. A bar chart to illustrate the correlation between gender and the frequency of fenestration occurrence, wherein the X-axis displays the width of the fenestration, while the Y-axis depicts gender. Statistical analysis yielded a Pearson's chi-square value of 1.818, with a p-value of 0.178 (above 0.05), indicating that the association does not reach statistical significance.

4. Discussion

Upon scrutinizing the prevalence of fenestration and dehiscence across genders, a statistically significant disparity was noted, with females displaying a higher prevalence of dehiscence compared to males. Conversely, no statistically significant association between genders was observed for fenestration. In terms of patient selection, individuals in active growth stages were excluded from the study due to evidence suggesting that age-related hormonal and functional changes may impact cortical bone thickness [17,18]. The utilization of CBCT was preferred due to its capacity for comprehensive 3-dimensional visualization of the entire dentition and craniofacial structures, rendering it the imaging modality of choice in contemporary orthodontics. However, it is crucial to exercise caution regarding the routine use of CBCT in orthodontic practice, considering potential concerns related to radiation exposure [19].

Rupprecht et al. conducted a prevalence study focusing on dehiscence and fenestration in contemporary American skulls. Their investigation unveiled that African-American males and Caucasian females exhibited a significantly elevated likelihood of dehiscences, whereas African-American females demonstrated a noteworthy predisposition to fenestrations [20]. However, it's imperative to acknowledge that their study relied on craniometric methods, in contrast to our utilization of CBCT imaging. Similarly, Goyal et al. observed a higher proportion of teeth with substantial bone loss in females, especially among the postmenopausal population, although this disparity did not attain statistical significance [21]. Choi et al. identified a heightened prevalence of total bony defects and dehiscences among adults with crossbite; nevertheless, they did not delve into gender associations [22]. Investigations into early dental caries, root canal procedures, bacterial profiles within orthodontics, and root resorption trends underscore the significant impact of biological factors on the pathogenesis of diseases [23–26]. In another study, fenestration was associated with certain malpositioned teeth like buccally placed lateral incisors and canines, whereas dehiscence was largely associated with mandibular canines, especially among older males with a previous history of orthodontic treatment [27]. A retrospective study reported that greater buccolingual inclination of molars was associated with greater palatal depth, which was deemed important in identifying a dental/skeletal crossbite, which was usually associated with greater risk of dehiscence [28]. Another retrospective study reported that molar teeth with buccolingual (BL) tilts exceeding 9º exhibit an increased likelihood of buccal-side dehiscence, while those with BL angles below 9º are more prone to dehiscence on the lingual side. This pattern highlights a possible connection between the degree of angulation and the specific site of bone exposure on molars, indicating that inclination direction may influence the susceptibility to dehiscence on particular surfaces [29].

The general agreement across existing literature corroborates the findings of this study. However, a significant limitation was the small sample size. Furthermore, as a retrospective study, the settings of the CBCT images were not standardized. It's worth noting that dehiscences and fenestrations lack a defined geometric shape, thus alterations in image orientation may lead to slight variations in measurements, particularly concerning the vertical diameter.

Future prospects entail conducting pre- and post-orthodontic treatment investigations, necessitating larger sample sizes and evaluating a greater number of teeth. Furthermore, it's imperative to consider the specific type of malocclusion in the analysis.

5. Conclusion

Within the constraints of this study's limitations, it can be deduced that dehiscence defects in females demonstrated greater width compared to males. Nevertheless, no significant gender association was discerned for fenestration.

Conflict of Interest: Nil

Funding Information: Nil

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