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Original Research Article

ANALYSIS BETWEEN THE THICKNESS OF ALVEOLAR BONE AND POSITION OF INCISOR IN CLASS I AND II MALOCCLUSIONS THROUGH LATERAL CEPHALOGRAMS

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Abstract: *To assess the inclination of incisors and thickness of alveolar bone in malocclusions of Class I and Class II. A comparative study was conducted on 114 individuals in which incisor inclinations and their relationships with the alveolar bone were assessed by using lateral cephalograms. In the study individuals with Class I malocclusion, with a mean age of 18.6 years were recruited along with the individuals of Class II malocclusions with a mean age of 18.27 years. Almost, 114 lateral cephalograms were taken from the individuals. Out of them, 51 had class II malocclusion and 63 had class I malocclusion. The overall mandibular alveolar thickness showed no statistically significant difference between class I and class II malocclusion (P=.086), while there was a slight but statistically significant variation in the maxillary alveolar thickness (P=0.029). There was no significant distinction in the maxillary incisor inclination between the two groups (P=.603), whereas the root apex location lower labial was considerably more posterior (P <.001). However, it was discovered that Class II malocclusion patients had a substantially higher mandibular incisor inclination (P=.004). In the study, the position of the mandibular incisor root apex varied significantly across classes I and II. The mandibular incisor root apex was therefore more posteriorly positioned in class II relative to the alveolar center.*

Keywords: Alveolar Bone Thickness, Incisor Inclinations, Lateral Cephalograms, Malocclusion

Introduction

Orthodontic tooth movement is the process of applying force to cause bone apposition on the tension side and bone resorption on the pressure side. The degree and direction of orthodontic tooth movement may not always coincide with the modifications made to the anterior alveolar bone (Yodthong et al., 2013). The basic principle of orthodontics is that "bone explores tooth movement," which means that if orthodontic tooth movement occurs, the surrounding bone of the alveolar socket will remodel to a corresponding extent (Jäger et al., 2017). On the other hand, this rule may not always be true, and incisor retraction could result in an adverse consequence of bone. An uneven bone ridge, for example, and apparent bone exostosis are caused by additional bone due to the placement of the cortical plate labially, which is usually more than the displacement of the tooth (Villela et al., 2020).

A standard part of clinical records obtained for orthodontic diagnosis and treatment planning is the lateral cephalometric radiograph. The relationship between the central incisor inclination and the surrounding alveolar bone, as well as its location, can be assessed using lateral cephalometric radiographs. This information helps make treatment decisions, such as moving the jaw incisors anteriorly or posteriorly. Additionally, cephalometric radiographs assess the overall impacts of the growth of the craniofacial complex as well as the relative position of the teeth as a result of orthodontic movement (Proffit et al., 2019).

The movement of orthodontic teeth is limited by the cortical surface of the alveolar bone; beyond this, fenestration may occur. To ensure effective treatment planning and to avoid the development of alveolar bone dehiscence, it is essential to assess the morphology of both the lingual and buccal bone plates through radiographs before initiating orthodontic therapy. External root resorption can also result from contact between the incisor root and the alveolar cortex (Andrews et al., 2022). Compared to the maxilla, the mandible anterior lingual surfaces showed a greater reduction in bone height (Medrano et al., 2019). Compared to hypodivergent patients, hypodivergent patients appear to have thinner bone plates at the level of the root apex of the permanent teeth (Sun et al., 2021). It has also been demonstrated that contact roots and incisor canals of maxillary incisors are risk factors for external root resorption, which further restricts the amount of space in which individuals with treatment choices intended to lessen these iatrogenic effects can be supported by defining anatomical limitations for safe incisor root mobility in each jaw (Pan et al., 2019). Previous researchers assessed root position in specimens with different malocclusions that were left untreated (Khawaja et al.,2021).

However, these research findings frequently fail to offer helpful recommendations about where to put roots (Charles et al., 2016). Congested arches are more prone to ectopic tooth eruption, which may have an impact on the perceived thickness of bone in the alveolar area around the roots. In addition, inappropriate myo-functional behavior, natural tooth compensation, and other environmental factors may be linked to misalignment and negatively impact the incisors' observable position within the alveolar process (Haneen et al., 2023). However, analyzing the placement of roots in specimens that naturally display perfect occlusion clarifies the anatomical relationship between roots and alveolar bone which is notable. Applying pressure to a tooth that is limited in its mobility against the cortical bone may not be beneficial. To avoid unfavorable iatrogenic outcomes, this type of procedure needs to be properly monitored (Oh et al., 2020). In the study, lateral cephalograms were used to assess the position of central incisors and thickness of alveolar bone in those individuals who have both classes of malocclusion.

Methodology

A comparative study was carried out in a private dental hospital in Karachi, Pakistan. A total of sixty-three lateral cephalograms from individuals with malocclusion Class I, belonging to the age group of 18.6 years was compared with a sample size of 51 lateral cephalograms from individuals presenting Class II malocclusions with a mean age of 18.27 years. The participants who were recruited in the study belong to the age group of 12 to 22 years. The research was conducted between the duration of June 1, 2023, and December 31, 2023. The Jinnah Medical and Dental College and Hospital review board granted ethical approval, and before enrollment, each patient was provided with comprehensive information regarding the study. Those who did not fit the selection criteria were not included. Patients were asked to give their informed consent after receiving a clinical diagnosis. Every lateral cephalogram was hand drawn in pencil on acetate paper by a single researcher. Consequently, the following parameters were noted: mandibular central incisor root position, mandibular alveolar process thickness, maxillary central incisor root position, and incisor inclination.

The data was analyzed using the most recent version of (SPSS) software. Each measured variable's descriptive statistics, such as the mean, were calculated. The age and gender distribution between classes I and II were investigated using an independent samples t-test and a chi-square test, respectively. The alveolar bone thickness of the maxilla and mandible and positions of the incisor such as inclination, palatal, and labial sites were compared between both classes of malocclusion using t-tests.

Results

In the study, a total of 114 lateral cephalograms were taken. Out of which 63 were from class I malocclusion and 51 were from class II malocclusion. Comparisons between both classes of malocclusion are shown in Table II. There was a slight but statistically significant variation in the whole maxillary alveolar thickness (P=0.029) in both classes of malocclusion on the contrary there was no statistical difference in the total mandibular alveolar thickness (P =.086). The maxillary incisor inclination did not change substantially (P=.603). However, the root apex position lower labial was significantly more posterior (P <.001). However, it was found that Class II malocclusion patients had a substantially higher mandibular incisor inclination (P=.004). In Table 3 comparison between positions of roots is shown. In both classes of malocclusion, there was a statistically significant difference (P<.001) between upper palatal and upper labial.

Table 1: Demographic characteristics of patients

Variables	Class I	Class II	Total	*P*-value
Male	16	15	31	0.676
Female	47	36	83	
Age	63	51	114	0.715

Table 2: Comparison between Class I and Class II malocclusion

	Class I(N=63)	Class II (N=51)	
Measurements of tooth surfaces	**Mean**	**Mean**	***P*-value**
Maxillary Alveolar	11.41	10.94	0.029
Mandibular Alveolar	11.62	11.48	0.086
Upper Central Incisor Palatal	7.20	6.96	0.312
Upper Central Labial	4.21	3.96	0.004
Lower Central Lingual	6.16	5.83	0.217
Lower Central Labial	5.89	6.38	<0.001
Upper Central Incisor Inclination	30.21	28.97	0.603
Lower Central Incisor Inclination	21.54	23.89	0.004

Table 3: Comparison of positions of roots between Class I and Class II malocclusion

	Palatal/Lingual	Labial	
Incisor	**Mean**	**Mean**	***P-value***
Maxillary (Class I)	7.20	4.21	<0.001
Maxillary (Class II)	6.96	3.96	<0.001
Mandibular (Class I)	6.16	5.89	0.451
Mandibular (Class II)	5.83	6.38	<0.001

Discussion

Orthodontic treatment planning is a crucial step in achieving optimal outcomes for patients. It involves a comprehensive assessment of the patient's dental measurements, bone structure, and aesthetic concerns (Christensen., 2019). Additionally, demographic factors, such as age and gender, can also impact treatment planning decisions. Therefore, a thorough understanding of the implications of dental measurements on orthodontic treatment planning is

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essential (Alsaggaf., 2022.). In recent years, several studies have highlighted the significance of accurate dental measurements in predicting treatment outcomes and assessing the effectiveness of orthodontic interventions. These measurements include tooth size, arch length, inter-canine width, and other parameters that play a crucial role in the diagnosis and treatment of malocclusions (Choi et al., 2017). The results of the current study suggest that there were no significant differences in gender proportions or ages between the samples, indicating that any observed differences in dental measurements are less likely to be confounded by demographic factors. The study found that there was a statistically significant difference between the two groups of malocclusions in total mandibular alveolar thickness but not in total maxillary alveolar thickness. In 2022, the Andrews et al., study, also observed differences in alveolar bone thickness between untreated samples, supporting the notion that inherent variations exist in maxillary bone structure (Andrews., 2022). Similarly, Lund et al., and Wang et al., reported changes in alveolar bone thickness following orthodontic treatment, underscoring the dynamic nature of alveolar bone remodeling. These studies collectively emphasize the importance of considering alveolar bone morphology in treatment planning to achieve optimal outcomes (Lund et al., 2012 & Wang et al., 2023). However, the mandibular incisor inclination was found to be considerably larger in one of the malocclusion classes, but the maxillary incisor inclination was not significantly different between the two groups. This difference in mandibular incisor inclination could influence the aesthetic outcome of orthodontic treatment and may require different treatment approaches for each group which was similar to the findings of Sarikaya (Song et al., 2020). This suggests that variations in incisor position may be influenced by underlying skeletal discrepancies. Additionally, Gracco et al., and Baysal et al., demonstrated associations between incisor position and bony support, highlighting the interplay between dental and skeletal factors in determining tooth position (Gracco et al., 2009 and Baysal et al., 2013). To diagnose and treat orthodontic conditions, the observed variations in alveolar bone thickness and incisor location are clinically significant. The results underscore the need for personalized treatment approaches tailored to the specific anatomical characteristics of each patient. This aligns with the recommendations of several previous studies emphasizing the importance of considering individual variability in orthodontic treatment (Chaimongkol et al., 2018; Ahmad et al., 2022.). By considering individual variability in alveolar thickness, incisor inclination, and root position, orthodontists can optimize treatment outcomes and enhance patient satisfaction.

Conclusion

The study concludes that there are notable distinctions between class I and class II malocclusion in terms of the root apex location of the mandibular incisors. In particular, the mandibular incisor root apex position in class II was more posterior to the alveolar center as compared to class I malocclusion.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
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Approved
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Conflict of interest

The authors declared the absence of a conflict of interest.

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Study Design, Review of Literature.
Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript
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