DOI: https://doi.org/10.53350/pjmhs22162370

ORIGINAL ARTICLE

Comparative Analysis of Incisor Positioning and Alveolar Bone Thickness using Lateral Cephalograms

SADIA NISAR AHMAD[1], ASHFAQ AHMAD[2], SAQIB ULLAH[3], HARMAIN KAYANI[4], RABIA KHATTAK[5], SAIF ULLAH[6]
[1]Assistant Professor, [2]Medical Officer, [3-6]Hosue Officers, Department of Orthodontics, Bacha Khan College of Dentistry, Mardan
Correspondence to: Dr. Sadia Nisar Ahmed, E-mail: dr.sadianisar@gmail.com, Cell: 0331-9410964

ABSTRACT
Objective: To find the comparative analysis of incisor positioning and alveolar bone thickness using lateral cephalograms.
Study Design: Cross-sectional analytical study
Place and Duration of Study: Department of Orthodontics, Bacha Khan College of Dentistry, Mardan from 4th August 2021 to 31st December 2021.
Methodology: Fifty class II malocclusion participants were enrolled having deviation from 1mm of root positioning. Lateral-cephalometric images were taken and compared with standard 50 normal optimal occlusions. L1-lab to L1 ling distance was added for calculating the total mandibular alveolar process thickness and wits calculated. The inclination between maxilla and mandibular central incisor and was measured through formation of acute angle between teeth long axes and perpendicular line with occlusal plane.
Results: In cases of class II malocclusions majority of the patient were within the age of 15-30 years with a mean age as 38.3±3.9 years. Wits was -0.72±2.5 in normal optimal occlusion verses 2.47±1.88 in class II malocclusion.
Conclusion: A significant variance was observed between alveolar (AV) processes of class II malocclusion patients with their comparative lateral cephalogram imaging of normal optimal occlusion.
Key words: Incisor positing, Alveolar bone thickness, Lateral cephalograms

INTRODUCTION
Lateral cephalogram (LC) is commonly applied in central incisor positioning as a diagnostic tool in orthodontic surgeries. The predisposition of central-incisors and its association with alveolar bone in surrounding area required assessment before any decision for treatment which involves AP movement of incisor inside the jaws. Considering orthodontic movement of teeth alveolar bone is considered as limitation factors which can result in fenestration or as well as dehiscence.[1–10]External root resorption is also deeply affected by the contact of incisor-roots with the cortical-bone.[11-13]

The protrusion as well as maxillary-incisors vestibularization might result into dehiscence of cortical labial bone. The retraction of teeth in addition also effects the palatal-bone plate. This effect can be resolved by returning the teeth in their actual position. Scheming the tooth limited movement pre orthodontic treatment can be highly significant especially in cases where severe discrepancies in maxilla or mandible bone skeleton is required.[13]

In the present study the positioning of central-incisors of maxilla and mandible were analyzed through lateral cephalogram considering their long axis predisposition and their AP root positioning in comparison to alveolar bone. The main purpose of this study was to identify any anatomical association between incisors roots present in center as well as alveolar-bone specifically in individuals who are not treated and are with or without malocclusions.

MATERIALS AND METHODS
This cross-sectional analytical study was conducted at Department of Orthodontics, Bacha Khan College of Dentistry, Mardan from 4th August 2021 to 31st December 2021. A total of 50 participants were registered who had a deviation from 1mm of root positioning with 5% margin of error, 1.5mm standard deviation and 80% as power of test. This study was approved through Ethical Board prior its initiation. Lateral-cephalometric images were taken and compared with standard 50 normal optimal occlusions. Patients having nil orthodontic treatment history were included in this study. The quality of imaging was not sacrificed in this study. Patients who were selected were between the age group of 15-40 years. Age, gender, incisor root positioning, dispositioning was entered in a well-organized questionnaire. Class II malocclusions who came for treatment were undergone lateral cephalogram. Patients with class II molar association ≥3mm at one or both of the sides were included in the study. The lateral-cephalograms were manually traced using a pencil over an acetate paper by the examiner. The inferences were then made from the traced structure about maxilla, inner/outer cortical-surfaces, mandible, 1st molars, as well as incisors present in center. Furthermore, the occlusal planes, edges of incisor, root-apices, long axes of incisor, maxillary-incisor and root midpoint were further identified. The measurements of roots of maxilla central incisor were performed by considering distance midpoint of root to outer cortical-surface specific to labial and palatal sides and perpendicular with long tooth axis of the alveolar process. Further alveolar-process thickness of maxilla as well as root positions of mandibular incisors in center was also analyzed. L1-lab to L1 ling distance was added for calculating the total mandibular alveolar process thickness, whereas the inclination between maxilla and mandibular central incisor was measured through formation of acute angle between teeth long axes and perpendicular line with occlusal plane. Wits-appraisal was performed for assessing AP jaw association. Data was analyzed by SPSS version 25.0 using independent t test with p value less than 0.05 as significant.

RESULTS
The present study presented that 36% normal optimal occlusion were within the age of 15-30 years while 64% were in 31-40 years. In cases of Class II malocclusions majority of the patient were within the age of 15-30 years followed by 31-40 years. The mean age was 27.1±4.5 years in normal optimal occlusion standard control while it was 38.3±3.9 years in class II malocclusion patients. There were more males than females in both groups (Table 1).

The study showed a significant variance between Alveolar (AV) process thicknesses of class II malocclusion patients with their comparative lateral cephalogram imaging of normal optimal occlusion. Similarly, the wits analyses also showed a significant variance in Class II findings (Table 2).

Table 1: Age and gender comparison of normal optimal occlusion with class II malocclusion

Variable	Normal optimal occlusion (n=50)	Class II malocclusions (n=50)
Age (years)		
15-30	18 (36%)	30 (60%)
31-40	32 (64%)	20 (40%)
Gender		
Male	28 (56%)	27 (54%)
Female	22 (44%)	23 (46%)

The class II malocclusion in mandibular and maxillary imaging showed significant difference than normal optimal occlusion images with their labial values higher in mandibular Class II against mandibular normal optimal occlusion, while it was vice versa in maxillary Class II in comparison with maxillary normal optimal occlusion. Considering palatal/lingual values it was lower in mandibular and maxillary Class II than normal optimal occlusion (Fig. 1).

Table 2: Comparison of incisor position and alveolar bone thickness in normal optimal occlusion with class II malocclusion

Variable	Normal optimal Occlusion	Class II malocclusions	P value
Maxilla AV	10.32±1.0	9.81±1.1	0.032
Mandibular AV	10.4±2.2	11.1±2.0	0.09
U1 pal	6.5±1.0	6.2±1.23	0.3
U1 lab	3.85±0.5	3.5±0.49	0.008
L1 ling	5.3±1.2	5.0±1.1	0.3
L1 lab	5.0±1.39	6.2±1.8	<0.01
Wits	-0.72±2.5	2.47±1.88	<0.01
U1 incl	28.2±4.7	27±9.2	0.57
L1 incl	19±5.1	22±6.2	0.03

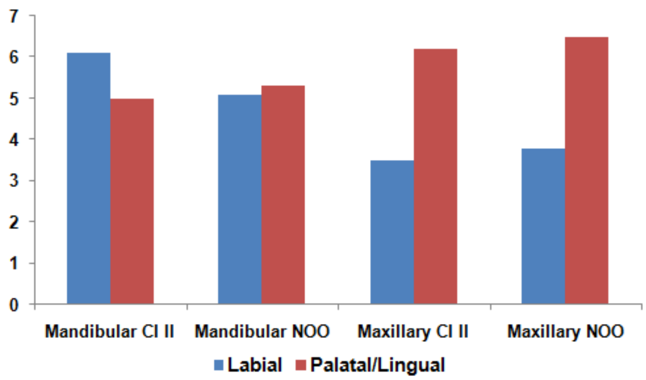

Fig. 1: comparison of labial and palatal/lingual values in normal optimal occlusion with class II malocclusion

DISCUSSION

Lateral cephalogram is commonly applied in central incisor positioning as a diagnostic tool in orthodontic surgeries.[14] Cephalometric values provides useful information in orthodontic practices. Cone-beam computed tomography is also used but it cannot still replace cephalometric radiography due to sufficient reported data.[15] De Angelis showed the alveolar bone (AB) bending capacity and it highlighted that AB retained its morphological properties as it moves along fixed position and axis.[16] Melsen[17] demonstrated that resorption mainly occurs at compression site and also reduce activity in tension zone. One study also suggests that incisor inclination also elevates the chances of alveolar bone loss.[18]

Root resorption is determined as a common and the most reported side effect of orthodontic treatment, mainly with tooth movement. Kaley and Phillips[19] showed that contact between cortical bone and root is critical for root resorption. Therefore, bone width of alveolar should be carefully determine and consider before the treatment that can be the cause of root resorption. Al-Abdwani et al[20] and Al-Nimri et al[21] reported incisal inclinations but did not focus on alterations caused by vertical and sagittal movement of incisor. Al-Abdwaniet al[20] also states that inclinations also lead to significant change in horizon plate. On the other hand, Hassan et al[22] and Sun et al[23] showed contrasting results and proved that no inclination is observed due to vertical and horizontal displacements.

CONCLUSION

A significant variance between alveolar (AV) process of class II malocclusion patients with their comparative lateral cephalogram imaging of normal optimal occlusion. There was a significant variation in U1 lab, L1 lab, wits and L1 incl values of class II malocclusion against standard normal optimal occlusion.

REFERENCES

1. Garib DG, Yatabe MS, Ozawa TO, da Silva Filho OG. Alveolar bone morphology under the perspective of the computed tomography: defining the biological limits of tooth movement. Dental Press J Orthod 2010;15:192-205.
2. Lund H, Grondahl K, Grondahl H-G. Cone beam computed tomography evaluations of marginal alveolar bone before and after orthodontic treatment combined with premolar extractions. Eur J Oral Sci 2012;120:201-11.
3. Evangelista K, Vasconcelos K, Bumann A, Hirsch E, Nitka M, Silva MAG. Dehiscence and fenestration in patients with Class I and Class II Division 1 malocclusion assessed with cone-beam computed tomography. Am J OrthodDentofacialOrthop 2010;138:133-5.
4. Handelman C. The anterior alveolus: its importance in limiting orthodontic treatment and its influence on the occurrence of iatrogenic sequelae. Angle Orthod 1996;66:95-110.
5. Sarikaya S, Haydar B, Ciger S, Ariyurek M. Changes in alveolar bone thickness due to retraction of anterior teeth. Am J OrthodDentofacialOrthop 2002;122:15-26.
6. Wehrbein H, Bauer W, Diedrich P. Mandibular incisors, alveolar bone, and symphysis after orthodontic treatment: a retrospective study. Am J OrthodDentofacialOrthop 1996;110:239-46.
7. Yagci A, Veli I, Uysal T, Ucar FI, Ozer T, Enhos S. Dehiscence and fenestration in skeletal Class I, II, and III malocclusions assessed with cone-beam computed tomography. Angle Orthod 2012;82:67-74.
8. Yared KFG, Zenobio EC, Pacheco W. Periodontal status of mandibular central incisors after orthodontic proclination in adults. Am J OrthodDentofacialOrthop 2006;130:6.e1-8.
9. Nauert K, Berg R. Evaluation of labio-lingual bony support of lower incisors in orthodontically untreated adults with the help of computed tomography. J OrthofacOrthop 1999;60:321-34.
10. Matsumoto K, Sherrill-Mix S, Boucher N, Tanna N. A cone-beam computed tomographic evaluation of alveolar bone dimensional changes and the periodontal limits of mandibular incisor advancement in skeletal Class II patients. Angle Orthod 2020;90:330-8.
11. Ten Hoeve A, Mulie RM. The effect of antero-posterior incisor repositioning on the palatal cortex as studied with laminography. J ClinOrthod 1976;10:804-22.
12. Horiuchi A, Hotokezaka H, Kobayashi K. Correlation between cortical plate proximity and apical root resorption. Am J OrthodDentofacialOrthop 1998;114:311-8.
13. Kaley J, Phillips C. Factors related to root resorption in edgewise practice. Angle Orthod 1991;61:125-32.
14. Andrews WA, Abdulrazzaq WS, Hunt JE, Mendes LM, Hallman LA. Incisor position and alveolar bone thickness. The Angle orthodontist 2022; 92(1): 3-10.
15. Jung PK, Lee GC, Moon CH. Comparison of cone-beam computed tomography cephalometric measurements using a midsagittal projection and conventional two-dimensional cephalometric measurements. Korean J Orthod 2015;45(6):282-8.
16. DeAngelis V. Observations on the response of alveolar bone to orthodontic force. Am J Orthod 1970;58(3):284-94.
17. Melsen B. Biological reaction of alveolar bone to orthodontic tooth movement. Angle Orthod 1999;69(2):151-8.
18. Atik E, Gorucu-Coskuner H, Akarsu-Guven B, Taner T. Evaluation of changes in the maxillary alveolar bone after incisor intrusion. Korean J Orthod 2018; 48(6):367-76.
19. Kaley J, Phillips C. Factors related to root Resorption in edgewise practice. Angle Orthod 1991;61(2):125-32.
20. Al-Abdwani R, Moles DR, Noar JH. Change of incisor inclination effects on points A and B. Angle Orthod 2009;79(3):462-7.
21. Al-Nimri KS, Hazza'a AM, Al-Omari RM. Maxillary incisor Proclination effect on the position of point a in class II division 2 malocclusion. Angle Orthod 2009;79(5):880-4.
22. Hassan S, Shaikh A, Fida M. Effect of incisor inclination changes on Cephalometric points a and B. J Ayub Med Coll Abbottabad 2015;27(2):268-73.
23. Sun Q, Lu W, Zhang Y, Peng L, Chen S, Han B.Morphological changes of the anterior alveolar bone due to retraction of anterior teeth: a retrospective study. Head Face Med 2021; 17(1): 1-12.