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Anterior Alveolar Dimensions for Class I Normal Occlusion and Class II Malocclusion of Iraqi Adults

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ABSTRACT

Aims of the study: To evaluate the measurements of the upper and lower anterior alveolar dimension for both class I normal occlusion and class II malocclusion, and to correlate these measurements with other cephalometric measurements.
Materials and methods:(81) subjects divided into two groups, (41) subjects with class I normal occlusion and (40) subjects with class II malocclusion, then lateral cephalometric radiograph were taken, the width and height of the alveolar bone surrounding upper and lower central incisors, Upper and lower incisor inclination and mandibular plane angle were measured. The data analyzed by using independent samples *t*– test and Pearson correlation coefficient for males, females and total sample.
Result: significant differences were found between males and females regarding upper labial and lingual alveolar bone thickness in class I normal occlusion subjects, in addition, significant differences between the two gender were found in upper lingual and superior alveolar bone thickness, lower labial and inferior alveolar bone thickness in class II subjects . Also, vary degree of correlation between all variables in class II malocclusion subjects were found.
Conclusion: no significant differences in the alveolar bone thickness were found between class I normal occlusion and class II malocclusion, with sexual dimorphism was noticed in labial and palatal alveolar bone thickness of maxilla and mandible for both class I and class II malocclusion subjects.
Key words: Anterior alveolar dimension, class I, class II

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INTRUDUCTION

Orthodontic tooth movement is the process whereby the application of force induce bone resorption on the pressure side and bone apposition on the tension side.[1] The management of different skeletal pattern depends on the amount of possible buccal or lingual movement of incisors, especially in patients with severe skeletal discrepancies or orthodontic-surgical cases.[2,3] In general, when the roots are approximating the lingual or facial bony cortical plates, there is increased apical root resorption.[4]

Remodeling capacity of the alveolar bone has been demonstrated to be tapering from the height of alveolar process in the direction of the root apex. [5].This biological limitation to orthodontic tooth movement, especially at the level of root apex, has focused the attention of orthodontic literature on the relationship between different orthodontic tooth movements of anterior teeth and the anterior alveolus. [6,7] The aim of the present investigation was to establish the width and height of the maxillary and mandibular anterior alveolar apical bases surrounding the maxillary and mandibular central incisors for class I normal occlusion and class II skeletal malocclusion and some selected lateral cephalometric measurements (mandibular plane inclination, upper and lower incisal inclinations,inter- incisal inclinations) for Iraqi sample, to demonstrate the gender differences between the two classes, and also investigate the relationship between these measurements and anterior alveolar dimensions.

MATERIALS AND METHODS

The samples of this study consisted of standardized lateral cephalometric radiograph of (81) Iraqi subjects subdivided into 2 groups: class I occlusion (21) males, and (20) females, And class II malocclusion (20) males, and (20) females who were 18-25 years old because the width of the alveolar base is usually accomplished upon complete eruption of the permanent teeth [8]. The selection criteria for subjects with class Iocclusion to be included in the study were: Class I molar and canine relationship with normal over bite and over jet, ANB angle ≤ 4mm, No history of previous orthodontic treatment, No obvious craniofacial deformities. The selection criteria for subjects with class II malocclusion to be included in the study were: Class II molar and canine relationship, and ANB angle > 4mm. Lateral cephalometric radiograph was obtained for each subject using Cranex 3+ ceph machine (Sordex Orion Corporation, Helsinki, Finland), were subjects in centric occlusion with head in natural head position and lips in repose state. The cephalometric measurements for the anterior alveolus used in this study are presented in (Figure 1) and included: [9]

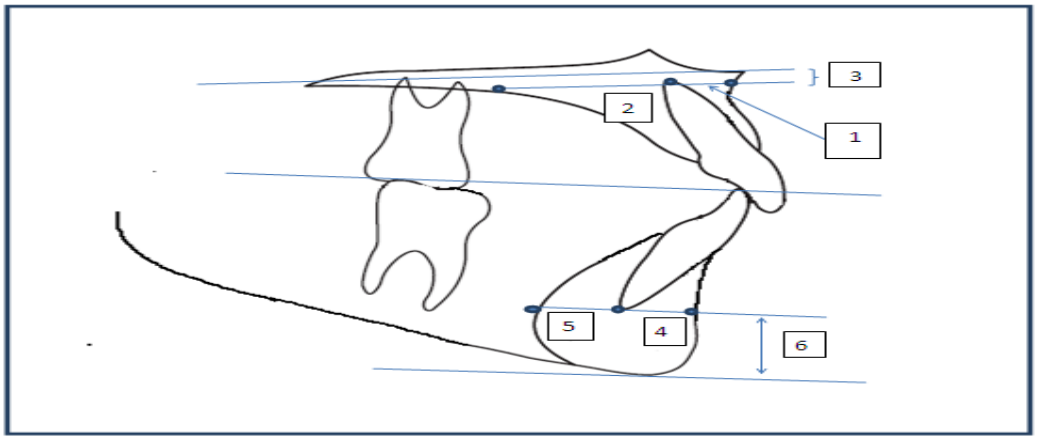

Figure (1): 1: Bone anterior to upper incisor apex, 2: Bone posterior to upper incisor apex, 3: Bone superior to upper incisor apex. 4: Bone anterior to mandibular incisor apex, 5: Bone posterior to mandibular incisor apex. 6: Bone inferior to mandibular incisor apex.

UA: Bone anterior to upper incisor apex. Apex of maxillary central incisor to the limit of the palatal cortex, along a line parallel to the palatel plane, drawn through the apex. **UP:** Bone posterior to upper incisor apex. Apex of maxillary central incisor to the limit of the labial cortex, along a line parallel to the palatel plane, drawn through the apex. **UH:** Bone superior to upper incisor apex. The shortest distance from the maxillary incisor apex to the palatal plane.**LA:** Bone anterior to mandibular incisor apex. Apex of mandibular central incisor to the limit of the labial cortex, along a line parallel to the occlusal plane, drawn through the apex **LP:** Bone posterior to mandibular incisor apex. Apex of mandibular central incisor to the limit of the lingual cortex, along a line parallel to the occlusal plane, drawn through the apex. **LH:** Bone inferior to mandibular incisor apex. The shortest distance from the mandibular incisor apex to the lowest point on the mandibular symphysis that is transect by a line parallel to the occlusal plane.

Other cephalometric measurements:

SN-MP angle: (mandibular plane angle), angle between Menton –Gonion line and SN line. [10]**U1-L1 angle:** (Inter-incisal angle), angle between the long axis of upper central incisor and long axis of the lower central incisor. [10]**U1-SN angle:** (upper incisor inclination), angle between upper central incisor and SN line.[11]**L1-MP angle:**(lower incisor inclination), angle between lower central incisor and mandibular plane.[12] The data were analyzed using SPSS statistical software. Descriptive statistics for all variables were used. Also difference between class I and class II groups were tested using independent samples t-test at P≤ 0.05 level of significance. Correlation between alveolar measurements and other cephalometric parameters was used using Pearson correlation coefficient.

RESULTS

Descriptive statistic (mean, standard deviation) with comparison between males and females for all variables for class I normal occlusion and class II malocclusion subjects are presented in (Table1and 2). For class I subjects, a significant differences were found between males and females for the thickness of the alveolar bone anterior and posterior to the upper incisor apex, and inferior to the lower incisor apex.

Table (1): Descriptive statistics for class I normal occlusion group with comparison between males and females.

Variables	Gender	No.	Mean	±SD	t-value	Significance
ANB angle	Male	21	2.071	1.398	-1.893	.066
	Female	20	2.825	1.127		
SN-MP angle	Male	21	31.738	6.040	-1.547	.130
	Female	20	34.825	6.734		
U1-SN angle	Male	21	106.857	7.365	1.403	.169
	Female	20	104.025	5.344		
L1-MP angle	Male	21	95.238	5.462	-.049	.961
	Female	20	95.350	8.883		
U1-L1 angle	Male	21	128.095	7.479	.576	.568
	Female	20	126.350	11.588		
UA	Male	21	5.452	1.836	2.036	.049*
	Female	20	4.400	1.438		
UP	Male	21	12.333	2.780	3.425	.001**
	Female	20	9.825	1.771		
UH	Male	21	6.809	2.358	-.775	.443
	Female	20	7.325	1.858		
LA	Male	21	5.785	2.411	-.104	.917
	Female	20	5.850	1.358		
LP	Male	21	4.595	.768	.543	.590
	Female	20	4.400	1.447		
LH	Male	21	21.928	3.896	2.645	.012*
	Female	20	19.350	2.000		

UA: Bone anterior to upper incisor apex, UP: Bone posterior to upper incisor apex, UH: Bone superior to upper incisor apex, LA: Bone anterior to mandibular incisor apex, LP: Bone posterior to mandibular incisor apex, LH: Bone inferior to mandibular incisor apex.

*significant difference at $p<0.05$; **significant difference at $p<0.01$.

Table (2): Descriptive statistics for class II malocclusion group with comparison between males and females

Variables	Gender	No.	Mean	±SD	t-value	Significance
ANB angle	Male	20	7.119	2.897	2.061	.046*
	Female	20	5.657	1.118		
SN-MP angle	Male	20	35.375	9.526	.355	.724
	Female	20	34.450	6.692		
U1-SN angle	Male	20	105.975	8.633	1.871	.069
	Female	20	101.575	6.007		
L1-MP angle	Male	20	97.000	6.718	-1.405	.168
	Female	20	99.700	5.359		
U1-L1 angle	Male	20	122.050	13.377	-.172	.865
	Female	20	122.650	8.085		
UA	Male	20	6.050	2.999	1.970	.056
	Female	20	4.625	1.212		
UP	Male	20	9.600	4.182	-2.119	.041*
	Female	20	12.050	3.038		
UH	Male	20	9.100	3.679	2.528	.016*
	Female	20	6.800	1.735		
LA	Male	20	4.700	1.908	-3.109	.004**
	Female	20	6.225	1.081		
LP	Male	20	4.670	1.680	.926	.360
	Female	20	4.270	.952		
LH	Male	20	25.000	3.990	5.413	.000**
	Female	20	19.425	2.301		

UA: Bone anterior to upper incisor apex, UP: Bone posterior to upper incisor apex, UH: Bone superior to upper incisor apex, LA: Bone anterior to mandibular incisor apex, LP: Bone posterior to mandibular incisor apex, LH: Bone inferior to mandibular incisor apex.

*significant difference at p<0.05; **significant difference at p<0.01.

For class II subjects, a significant difference between males and females for the alveolar bone anterior and inferior to the lower incisor apex, superior and posterior to the upper incisor apex. The results of this study indicate that there is a significant difference between males with class I normal occlusion and class II malocclusion regarding superior and lingual to the upper incisor and inferior to the lower incisor as shown in (Table 3).

Table (3): Comparison between class I and class II adult males

Variables	Class	No.	Mean	t-value	Significance
SN-MP angle	I	21	31.738	-1.467	.150
	II	20	35.375		
U1-SN angle	I	21	106.857	.353	.726
	II	20	105.975		
L1-MP angle	I	21	95.238	-.923	.361
	II	20	97.000		
U1-L1 angle	I	21	128.095	1.797	.080
	II	20	122.050		
UA	I	21	5.452	-.774	.444
	II	20	6.050		
UP	I	21	12.333	2.476	.018*
	II	20	9.600		
UH	I	21	6.809	-2.385	.022*
	II	20	9.100		
LA	I	21	5.785	1.593	.119
	II	20	4.700		
LP	I	21	4.595	-.197	.845
	II	20	4.675		
LH	I	21	21.928	-2.494	.017*
	II	20	25.000		

UA: Bone anterior to upper incisor apex, UP: Bone posterior to upper incisor apex, UH: Bone superior to upper incisor apex, LA: Bone anterior to mandibular incisor apex, LP: Bone posterior to mandibular incisor apex, LH: Bone inferior to mandibular incisor apex.

*significant difference at p<0.05; **significant difference at p<0.01.

No significant differences for all variables except for upper lingual alveolar bone for femaleswith class I normal occlusion and class II malocclusion as seen in (Table 4).

Table (4): Comparison between class I and class II adult females

Variables	Class	No.	Mean	T-value	Significance
SN-MP angle	I	20	34.825	.177	.861
	II	20	34.450		
U1-SN angle	I	20	104.025	1.363	.181
	II	20	101.575		
L1-MP angle	I	20	95.350	-1.875	.068
	II	20	99.700		
U1-L1 angle	I	20	126.350	1.171	.249
	II	20	122.650		
UA	I	20	4.400	-.535	.596
	II	20	4.625		
UP	I	20	9.825	-2.829	.007**
	II	20	12.050		

UH	I	20	7.325	.923	.362
	II	20	6.800		
LA	I	20	5.850	-.966	.340
	II	20	6.225		
LP	I	20	4.400	.323	.749
	II	20	4.275		
LH	I	20	19.350	-.110	.913
	II	20	19.425		

UA: Bone anterior to upper incisor apex, UP: Bone posterior to upper incisor apex, UH: Bone superior to upper incisor apex, LA: Bone anterior to mandibular incisor apex, LP: Bone posterior to mandibular incisor apex, LH: Bone inferior to mandibular incisor apex.

*significant difference at p<0.05; **significant difference at p<0.01.

When comparing class I normal occlusion and class II malocclusion subjects, no significant differences were found between all variables except for inter-incisal angle and lower incisal inclination as shown in (Table 5)

Table (5): Comparison between class I normal occlusion and class II malocclusion groups

Variables	Class	No.	Mean	±SD	t-value	Significance
ANB	I	41	2.439	1.314	-9.512	.000**
	II	40	6.425	2.330		
SN-MP angle	I	41	33.243	6.498	-1.021	.310
	II	40	34.912	8.139		
U1-SN angle	I	41	105.475	6.538	1.075	.286
	II	40	103.775	7.671		
L1-MP angle	I	41	95.292	7.239	-2.046	.044*
	II	40	98.350	6.152		
U1-L1 angle	I	41	127.243	9.619	2.142	.035*
	II	40	122.350	10.914		
UA	I	41	4.939	1.718	-.868	.388
	II	40	5.337	2.370		
UP	I	41	11.109	2.639	.391	.697
	II	40	10.825	3.815		
UH	I	41	7.061	2.118	-1.520	.132
	II	40	7.950	3.069		
LA	I	41	5.817	1.945	.869	.387
	II	40	5.462	1.714		
LP	I	41	4.500	1.140	.090	.929
	II	40	4.475	1.363		
LH	I	41	20.670	3.345	-1.809	.074
	II	40	22.212	4.278		

UA: Bone anterior to upper incisor apex, UP: Bone posterior to upper incisor apex, UH: Bone superior to upper incisor apex, LA: Bone anterior to mandibular incisor apex, LP: Bone posterior to mandibular incisor apex, LH: Bone inferior to mandibular incisor apex.

*significant difference at p<0.05; **significant difference at p<0.01.

When correlating the anterior alveolar dimension with other cephalometric measurements in class I normal occlusion subjects, the inter-incisal anglehas a positive correlation with the upper lingual alveolar bone, and negative correlation with the bone superior to the upper incisor apex as illustrated in (Table 6).

Table(6): Correlation of alveolar dimensions and other cephalometric parameters for class I normal occlusion group.

Variables	SN-MP angle	U1-SN angle	L1-MP angle	U1-L1 angle
UA	-.133	.044	-.056	.061
UP	-.098	-.067	-.212	.343*
UH	.160	.087	.189	-.356*
LA	-.198	.134	.218	-.077
LP	-.053	.015	-.162	.187
LH	.095	.033	-.017	-.098

*significant difference at p<0.05; **significant difference at p<0.01.

Also, many correlations were noticed between the anterior alveolar dimension and other cephalometric measurements in class II malocclusion subjects as illustrated in (Table 7).

Table (7): Correlation of alveolar dimensions and other cephalometric parameters for class II malocclusion group

Variables	SN-MP angle	U1-SN angle	L1-MP angle	U1-L1 Angle
UA	.251	.584**	.110	-.538**
UP	0.580**	-.615**	-.030	.705**
UH	.577**	.391*	-.327*	-.481**
LA	-.339*	-.190	.563**	-.006
LP	-.108	-.347*	-.356*	.537**
LH	.300	.303	-.390*	-.127

*significant difference at p<0.05; **significant difference at p<0.01.

DISCUSSION

It is well documented that determination of the anterior alveolar thickness is a clinical diagnostic prerequisite for biologically sound orthodontic tooth movement of upper and lower incisors. [13,14]

In class I subjects, a significant differences were found between the two gender in regard to the upper lingual bone and the bone inferior to the lower incisor apex. This result come in agreement with the study of Al-Barakati and Al-Hadlaq.[15]

In general, males possess higher mean values for all anterior alveolar dimensions (except upper superior alveolar bone and lower buccal bone), this come in accordance with other studies.[16,17]The craniofacial size differences between genders are caused by differences in growth patterns and rates. In women, craniofacial growth slows down after the age of 13, while in men, it continues until adulthood. [18]

In class II subjects, the superior and inferior alveolar bone of both upper and lower incisors were significantly differ between the two gender, the same finding was reported by Al-Hadlaq.[19]

No significant differences were detected between class I and class II subjects for all anterior alveolar dimensions, this result come in agreement with the study reported by Handelman [9], but come in contrast to the study of Al-Hadlaq[19] and this may be due to differences in sample size and variability of racial back ground between the two studies.

Upper posterior alveolar bone thickness was less in class II malocclusion group than the class I normal occlusion, which come in contrast to the study of Shyagali and Dixit[20]

Upper alveolar height has been reported to correlated negatively with interincisal angle, that is mean, increase alveolar height was correlated with bimaxillary dento-alveolar protrusion, which come in agreement with other studies. [14,15]

Subjects with class II malocclusion possess less mean values for the alveolar bone posterior to the upper incisor than that in class I normal occlusion subjects, so, unlimited tooth movement is not possible during retraction of the incisor. Negative correlation was found between lower incisor inclination and lower lingual bone width and positive correlation with lower buccal bone width, also,the lower labial alveolar bone is greater than the lower lingual alveolar bone,so, care should be given during proclination of the lower incisors with tipping may cause damage as the apex of the tooth moves too close to the lingual cortex. This result come in agreement with the study of Baysal etal. [21]

A negative correlation was found between mandibular plane angle and the alveolar bone posterior and above the upper incisor and anterior to the lower incisor *i.e* the range of movement of the incisors is limited in high- angle cases. Similar finding was obtained by Gracco etal [22], who reported that the distance between the apex the internal surface of the vestibular cortex is greater in short face than in long face subjects.

The best choice of correction malocclusion with thin alveolar bone is following the interdisciplinary approach like going for the selective alveolar decortication (SAD) or periodontally accelerated osteogenic orthodontics (PAOO) technique or else orthognathic surgeries. [23-25] The former two techniques don't rely on the existing alveolar bone thickness.

CONCLUSION

Many variables of the maxillary and mandibular anterior alveolar bone were significant differ between the two gender for both class I normal occlusion and class II malocclusion in many anterior alveolar. The results of the present study indicate that the alveolar bone thickness was not significantly different in class I normal occlusion and class II malocclusion groups.

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