ORIGINAL RESEARCH

Assessment of Anterior Dentoalveolar Dimensions in Yemeni Population with Different Skeletal Patterns

Talat H Al-Gunaid

Abstract

Objectives: The objectives of this study were to identify the mean anterior dentoalveolar dimensions of the Yemeni population, identifying possible gender differences and comparing maxillary and mandibular anterior dentoalveolar sizes across short-, average- and long-face groups.

Materials and methods: This study comprised of taking cephalometric radiographs of 82 subjects (42 male, 40 female) with a mean age of 21.9 ± 2.8 years. The sample was divided into three groups: short-face group: FMA <25°; average-face group: FMA ≥25° to <30°, and long-face group: FMA ≥30°. Eight angular and seven linear measurements were taken and compared between the groups.

Results: Significant gender differences between men and women were found in the mandibular dentoalveolar dimensions. In the short-face group, the maxillary upper dentoalveolar length and height was lower than the average-face group. Additionally, the ANB angle was the most pronounced parameter to be correlated with the anterior dentoalveolar dimensions, followed by FMA angle.

Conclusion: The results of this study could act as a useful clinical instrument for orthodontic practice in Yemen. Understanding the association between sagittal and vertical relations with anterior dentoalveolar dimensions is essential in achieving optimal anteroposterior orthodontic tooth movement in cases with different sagittal and vertical jaw relationships.

Keywords: Dentoalveolar dimensions, Skeletal patterns, Yemenis.

Journal of Contemporary Dentistry (2019): 10.5005/jp-journals-10031-1256

Introduction

Much attention has been paid to the position of upper and lower anterior teeth in relation to their supporting bone; it is one of the essential factors in the planning of orthodontic treatment and the determination of its results.[1–3] It has been reported that if the root apex of the incisor is moved against the alveolar bone's cortical plate, damaging effects such as root resorption and bone loss may occur.[2] It is widely accepted that there is an association between vertical facial morphology and the cant of the mandible. As a result, the correlation between anterior dentoalveolar dimensions and various skeletal jaw relationships has become a subject of interest for many researchers.[4–6] It has been reported that in deep and open bite cases, a relationship between anterior dentoalveolar maxillary and mandibular structures and lower face height may exist.[7] Some researchers have reported significant differences between patients with normal bites and those with deep bites with regard to the anterior dentoalveolar height,[8] while others have noted a smaller dentoalveolar height.[9–11] Beckmann et al.,[7] stated that long-faced patients often have narrow and lengthened maxillary and mandibular projections in the midsagittal plane. This suggests the existence of a compensatory reaction that increases the vertical extents simultaneously, while also decreasing the labiolingual size of the alveolar bone in the front part of the two jaws.

This study was designed to determine the mean anterior dentoalveolar dimensions of Yemenis, identifying any possible sex differences, and comparing the anterior maxillary and mandibular dentoalveolar sizes across short, average, and long facial groups.

Materials and Methods

The present research was endorsed by the College of Dentistry's Ethical Committee, Taibah University. The material of this study comprised of cephalometric radiographs of 82 subjects (42 male, 40 female) with a mean age of 21.9 ± 2.8 years. These were recruited by university students at Ibb University, as well as from the author's private dental clinic in Ibb city, Yemen. The sampling technique used was accidental sampling. The selection criteria were as follows: Yemeni citizen; class I malocclusion; no previous or ongoing orthodontic treatment; no prosthodontic treatments; no craniofacial anomalies, and all cephalometric radiographs were of good quality.

The recruited sample was divided into three different groups based on the Frankfort-mandibular plane angle (FMA):

Group I: short-face group: FMA <25°
Group II: average-face group: FMA ≥25° to <30°
Group III: long-face group: FMA ≥30°

Cephalometric Analysis

On the lateral cephalograms, 7 linear and 4 angular measurements were traced and measured (Figs 1 and 2). This task was undertaken manually by the same investigator.

Methodological Error

To evaluate the method's error, 30 cephalograms were randomly selected and measured twice, the second measurement being taken

Department of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Taibah University, Madina, Kingdom of Saudi Arabia; Department of Orthodontics and Pediatric Dentistry, Faculty of Dentistry, Ibb University, Yemen

Corresponding Author: Talat H Al-Gunaid, Department of Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Taibah University, Madina, Kingdom of Saudi Arabia; Department of Orthodontics and Pediatric Dentistry, Faculty of Dentistry, Ibb University, Yemen, Phone: +966 505354055, e-mail: gunaid2000@hotmail.com

How to cite this article: Al-Gunaid TH. Assessment of Anterior Dentoalveolar Dimensions in Yemeni Population with Different Skeletal Patterns. J Contemp Dent 2019;9(2):59–63.

Source of support: Nil

Conflict of interest: None

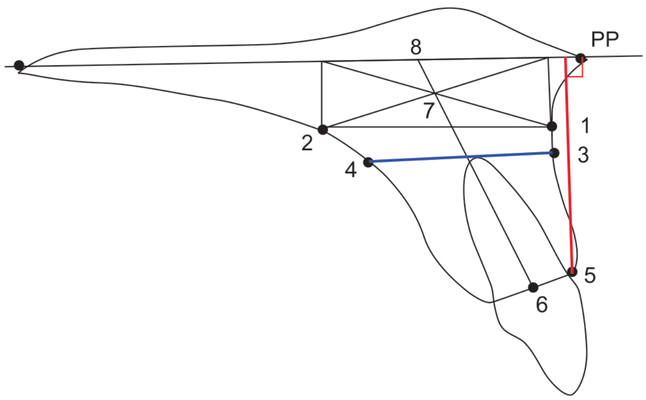

Fig. 1: Maxillary measurements. Cephalometric landmarks: (1) Point A (subspinale); (2) Corresponding point of A point (same distance from palatal plane as point A); (3 and 4) Anterior and posterior point of a line parallel to the palatal plane and passing through the apex of upper incisor; (5) Prosthion (Pr); (6) Center of the alveolar meatus of the upper central incisor; (7) Center of rectangular bordered by a line connecting point (1) and point (2) and palatal plane; (8) A constructed point at the intersection between a line connecting point (6) and (7) and palatal plane. Measurements: maxillary anterior width (MxAW): measured from point (3) to (4). Maxillary anterior height (MxAH): the distance along a perpendicular line from point (5) to palatal plane maxillary anterior length (MxAL): measured from point (6) to (8) passing through point (7)

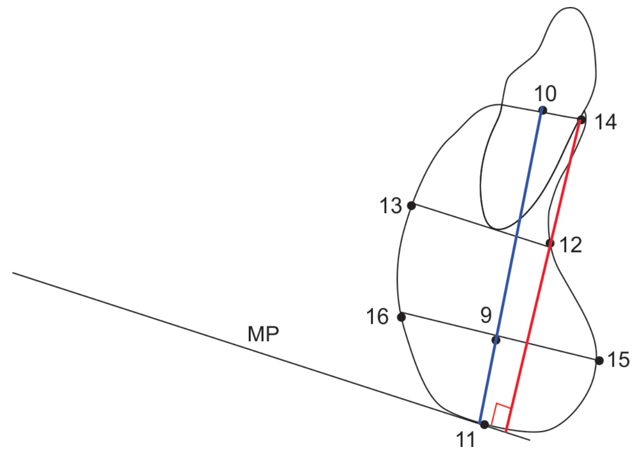

Fig. 2: Mandibular measurements. Cephalometric landmarks: (9) Midpoint of the mandibular symphysis; (10) Midpoint of the alveolar meatus of lower central incisor; (11) A constructed point at the intersection between a line connecting point (10) and (9) and mandibular plane; (12) Point B (supramentale), the deepest point on the outer contour of the mandible; (13) Corresponding point of B point (same distance from mandibular plane as point B); (14) Infradentale (Id); (15) The point of greatest convexity on the anterior border of the mandibular symphysis; (16) Corresponding point of point (15). Measurements: mandibular anterior width (MdAW): measured from point (12) to (13). Mandibular anterior height (MdAH): the distance along a perpendicular line from point 14 to mandibular plane. Mandibular anterior length (MdAL): measured from point (10) to (11) passing through point (9)

after 1-month interval. The results were compared using a paired *t* test. No significant variations were discovered.

Statistical Methods

The mean and standard deviation for the total sample was determined, and comparisons between the male and female groups were conducted using a *t* test. Comparison between the short, average and long-face groups was carried out using an analysis of variance (ANOVA), followed by a Bonferroni test. Pearson's correlation coefficient was used to determine the relationship between vertical and sagittal cephalometric measurements and the anterior dentoalveolar dimensions for short, average and long-face groups. SPSS analysis software (version 20, SPSS, IBM Corporation, USA) was used to conduct statistical analyses. Our significance level was set at $p < 0.05$.

Results

Table 1 exhibits the average age, mean and standard deviations of the cephalometric characteristics of the total sample, as well as for the male and female groups.

Comparison of anterior dentoalveolar dimensions between men and women revealed no gender differences in all the maxillary parameters. In the mandible, male subjects showed a significantly longer mandibular anterior dentoalveolar length (MdAL), longer anterior mandibular dentoalveolar height (MdAH), and broader symphysis depth (SD) than females ($p < 0.05$).

Table 2 presents the mean and standard deviations of the sagittal and vertical relations, dentoalveolar dimensions and comparisons between the three groups. There were no significant variations between the groups, with the exception of the short-face group demonstrating shorter maxillary anterior length (MxAL), and shorter maxillary anterior height (MxAH) than the average-face group ($p < 0.05$).

Correlation between sagittal and vertical cephalometric variables and the anterior dentoalveolar dimensions for the three groups is presented in Table 3. The ANB angle was found to be the most prominent parameter to correlate with the anterior dentoalveolar dimensions in both the short-face group (positive correlation) and the long-face group (negative correlation). This was generally more obvious among the long-face group compared with the short and average-face groups. The ANB angle in the short-face group showed significant and positive correlations with both mandibular anterior dentoalveolar length (MdAL: $r = 0.39$; $p < 0.05$) and anterior mandibular dentoalveolar height (MdAH: $r = 0.41$; $p < 0.05$). In the long-face group, the ANB angle showed a significant negative and moderate correlation with maxillary anterior dentoalveolar width (MxAW: $r = -0.52$; $p < 0.05$), maxillary anterior dentoalveolar length (MxAL: $r = -0.47$; $p < 0.05$), mandibular anterior dentoalveolar width (MdAW: $r = -0.42$; $p < 0.05$), and symphysis depth (SD: $r = -43$; $p < 0.05$).

The average-face group showed a negative correlation between the Frankfort-mandibular plane angle and mandibular anterior dentoalveolar width (MdAW: $r = -0.57$; $p < 0.01$), and for maxillary width and height ratio (MxAW/MxAH: $r = -61$; $p < 0.01$). There was also a negative correlation between SNA angle and symphysis depth (SD: $r = -0.41$; $p < 0.05$). Finally, the ANB angle correlated negatively with the mandibular width and height ratio (MdAW/MdAH: $r = -64$; $p < 0.01$).

Discussion

Although there were no variations in the maxillary measurements between males and females, significant differences, particularly in the mandibular measurements, were found. Male subjects exhibited considerably greater MdAL, greater MdAH, and broader SD than females ($p < 0.05$). A similar finding was reported by Mangla et al.,[12] who evaluated the mandibular morphology across different facial types. They discovered that males showed greater symphysis height

Table 1: Cephalometric characteristics for the total sample and comparison between male and female groups

	Total sample (n = 82)		*Male (n = 42)*		*Female (n = 40)*		
Variable/unit	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p value*
Age (years)	21.90	3.04	21.98	2.89	21.55	3.21	0.26
SNA (°)	80.73	3.06	80.86	3.42	80.60	2.68	0.71
SNB (°)	77.67	2.95	77.85	3.21	77.49	2.69	0.59
ANB (°)	3.06	1.74	3.01	1.78	3.11	1.72	0.80
FMA (°)	26.43	5.37	25.79	6.31	27.11	4.14	0.27
MxAW (mm)	18.88	5.88	19.98	6.31	17.73	5.22	0.08
MxAL (mm)	21.46	3.51	21.55	3.69	21.38	3.35	0.83
MxAH (mm)	16.20	2.73	16.15	3.11	16.25	2.29	0.88
MdAW (mm)	8.59	1.98	8.54	1.87	8.65	2.12	0.80
MdAL (mm)	34.39	3.41	35.32	3.64	33.41	2.89	0.01
MdAH (mm)	32.95	3.18	33.80	3.30	32.05	2.81	0.01
Symphysis depth (mm)	15.45	2.01	15.95	1.91	14.91	2.01	0.02
MxAW/MxAH	1.19	0.39	1.27	0.40	1.12	0.37	0.08
MdAW/MdAH	0.27	0.07	0.26	0.07	0.27	0.08	0.26

Table 2: Comparison of anterior dentoalveolar dimensions between short-, average-, and long-face groups

	Short face (n = 28)		*Average face (n = 27)*		*Long face (n = 27)*			
Variable/unit	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p value*†	*Bonferroni*
Sagittal and vertical relations								
SNA (°)	81.04	3.54	80.33	3.31	80.81	2.23	0.69	
SNB (°)	78.07	3.38	77.46	3.33	77.46	1.98	0.68	
ANB (°)	2.96	2.09	2.87	1.64	3.35	1.45	0.56	
FMA (°)	20.73	3.75	26.80	1.21	31.98	2.58	0.000	(2 > 1)***, (3 > 1)***, (3 > 2)***
Dentoalveolar dimensions (mm)								
MxAW (mm)	19.61	4.71	17.87	5.77	19.13	7.05	0.53	
MxAL (mm)	20.13	3.12	22.59	2.34	21.72	4.41	0.03	0.03 (2 > 1)*
MxAH (mm)	15.05	2.28	17.19	2.23	16.41	3.22	0.01	0.01 (2 > 1)*
MdAW (mm)	8.57	1.74	8.22	2.11	8.98	2.07	0.37	
MdAL (mm)	33.95	3.59	35.13	3.50	34.11	3.11	0.39	
MdAH (mm)	32.34	3.21	33.80	3.41	32.72	2.80	0.22	
Symphysis depth (mm)	15.96	1.94	15.11	1.65	15.24	2.35	0.24	
MxAW/MxAH	0.27	0.07	0.25	0.08	0.28	0.07	0.15	
MdAW/MdAH	2.32	4.55	1.38	5.63	1.32	5.46	0.73	

†Refers to one-way analysis of variance, *n* = number of subjects, **p* < 0.05, ****p* < 0.001

and depth than females. In his study on Saudi subjects, AlHadlaq[13] stated that the anteroposterior and vertical dimensions of the anterior alveolus might be affected by both sex and the sagittal relationship. Comparison between the groups revealed that the short-face group had a shorter MxAL than the average- and long-face groups. However, a Bonferroni analysis only showed a significant difference between the short and average-face groups ($p < 0.05$). This finding differs from that reported by Vitchuyanon,[14] who failed to identify any significant difference between groups regarding the maxillary anterior dentoalveolar length. Additionally, the short-face group displayed shorter MxAH than the average- and long-face groups ($p < 0.05$). However, the *post hoc* analysis only revealed a significant difference between the short and average-face groups. This is similar to results reported by Al-Zubaidi and Obaidi.[15] Vitchuyanon[14] found that the maxillary anterior dentoalveolar height was greater in the open bite group and shorter in the deep bite group. The present finding is partially in agreement with this report regarding the second part of the result. Other studies[8,16,17] have identified greater anterior dentoalveolar height in open bite subjects compared to those with a deep bite, but only in the maxilla. The present results support these findings; the long-face group showed a greater maxillary anterior dentoalveolar height and length than the short-face group, but the level of significance did not reach the level of $p < 0.05$.

Based on this study, the ANB angle was the most pronounced parameter to be correlated with the anterior dentoalveolar dimensions, followed by FMA angle. The ANB angle was found to be positively correlated with the anterior dentoalveolar dimensions in the short-face group, while showing a negative correlation in the long-face group.

The ANB angle in the short-face group was found to be significantly and positively correlated with the mandibular anterior dentoalveolar length (MdAL: $r = 0.39$; $p < 0.05$), as well as with the

Table 3: Correlation between anterior dentoalveolar dimensions and cephalometric measurements for three groups

	SNA (°)		*SNB (°)*		*ANB (°)*		*FMA (°)*	
Variable	*r*	*Sig.*	*r*	*Sig.*	*r*	*Sig.*	*r*	*Sig.*
Short-face group								
MxAW	0.13	0.52	0.05	0.81	0.14	0.48	−0.06	0.75
MxAL	0.05	0.80	−0.10	0.61	0.25	0.20	−0.02	0.94
MxAH	0.07	0.71	−0.11	0.57	0.31	0.11	−0.11	0.58
MdAW	−0.33	0.09	−0.25	0.20	−0.15	0.45	0.09	0.66
MdAL	0.34	0.08	0.12	0.56	0.391*	0.04	−0.16	0.42
MdAH	0.35	0.07	0.11	0.59	0.413*	0.03	−0.13	0.52
Symphysis depth	0.16	0.41	0.14	0.47	0.05	0.82	−0.28	0.15
MxAW/MxAH	−0.23	0.23	−0.12	0.55	−0.20	0.30	0.20	0.31
MdAW/MdAH	0.16	0.41	0.13	0.51	0.06	0.75	0.22	0.25
Average-face group								
MxAW	−0.07	0.73	−0.04	0.84	−0.06	0.78	−0.16	0.43
MxAL	−0.06	0.79	−0.04	0.83	−0.02	0.91	−0.21	0.30
MxAH	−0.25	0.21	−0.33	0.10	0.16	0.41	0.08	0.68
MdAW	−0.16	0.42	−0.10	0.62	−0.13	0.53	−0.579**	0.00
MdAL	0.10	0.61	−0.01	0.97	0.22	0.27	0.33	0.09
MdAH	0.04	0.85	−0.06	0.77	0.20	0.32	0.35	0.08
Symphysis depth	−0.410*	0.03	−0.27	0.17	−0.27	0.17	−0.12	0.54
MxAW/MxAH	−0.10	0.62	−0.01	0.97	−0.19	0.35	−.614**	0.00
MdAW/MdAH	−0.08	0.68	0.24	0.24	−0.648**	0.00	0.06	0.78
Long-face group								
MxAW	−0.243	0.221	0.106	0.600	−0.520**	0.01	−0.24	0.22
MxAL	−0.109	0.589	0.226	0.258	−0.477*	0.01	−0.25	0.20
MxAH	−0.094	0.643	0.034	0.866	−0.19	0.34	−0.16	0.44
MdAW	−0.036	0.858	0.272	0.171	−0.427*	0.03	−0.05	0.82
MdAL	−0.182	0.363	−0.180	0.369	−0.03	0.86	−0.14	0.49
MdAH	−0.161	0.423	−0.128	0.523	−0.07	0.72	−0.21	0.28
Symphysis depth	−0.169	0.400	0.128	0.525	−0.436*	0.02	−0.21	0.29
MxAW/MxAH	0.090	0.655	0.355	0.070	−0.35	0.08	0.12	0.54
MdAW/MdAH	0.205	0.306	0.131	0.515	0.14	0.50	−0.382*	0.05

r = Pearson correlation coefficient, *$p < 0.05$, **$p < 0.01$

anterior mandibular dentoalveolar height (MdAH: $r = 0.41$; $p < 0.05$). Beckmann et al.[7] reported that a large ANB angle is associated with a small mandibular alveolar index—a finding that would support this current result. This suggests that the MdAL and height increase as the sagittal jaw relationship deteriorates towards mandibular retrognathism.

With regard to the average-face group, the maxillary anteroposterior position (SNA angle) was significantly and negatively correlated with the symphysis depth (SD: $r = -0.41$; $p < 0.05$). Contrasting findings were reported by Nanda,[18] who investigated the influence of the sagittal relations on the SD and height in cases with different skeletal jaw relationships. He stated that the sagittal relationship was not linked to the shape of the symphysis. Furthermore, the average-face group showed a significant and negative correlation between the Frankfort-mandibular plane angle (FMA angle) and mandibular anterior dentoalveolar width (MdAW: $r = -0.57$; $p < 0.01$). This indicates that the mandible becomes more retrusive or protrusive as FMA decreases or increases in compensatory changes related to variations in vertical relation of the jaws. This could be a reflection of the clockwise and counterclockwise rotation of the mandibular plane and is in agreement with a previous report.[19–21] Additionally, the Frankfort-mandibular plane angle (FMA angle) was negatively correlated with maxillary width and height ratio (MxAW/MxAH: $r = -61$; $p < 0.01$), meaning that the maxilla tries to recompensate for the downward and backward mandibular rotation.

Regarding the long-face group, the ANB angle exhibited a significant and negative correlation with maxillary anterior dentoalveolar width and length (MxAW: $r = -0.52$; $p < 0.01$, MxAL: $r = -0.47$; $p < 0.05$), mandibular anterior dentoalveolar width (MdAW: $r = -0.42$; $p < 0.05$) and symphysis depth (SD: $r = -43$; $p < 0.05$). This correlation indicates that the maxillary width and length, mandibular width, and SD become smaller as the ANB angle increases. Ceylan et al.[22] studied the dentoalveolar compensation impacts of overjet. They found that vertical and sagittal dentoalveolar compensatory changes are related to variations in overjet patterns. Their report would support the present finding.

Conclusion

The results of this study could act as a useful clinical tool for orthodontic practice in Yemen. Understanding the association between sagittal and vertical relations with anterior dentoalveolar dimensions is essential in achieving optimal anteroposterior orthodontic tooth movement in cases with different sagittal and vertical jaw relationships.

References

1. Aasen TO, Espeland L. An approach to maintain orthodontic alignment of lower incisors without the use of retainers. Eur J Orthod 2005;27(3):209–214. DOI: 10.1093/ejo/cji012.
2. Richmond S, Klufas ML, Sywanyk M. Assessing incisor inclination: a non-invasive technique. Eur J Orthod 1998;20(6):721–726. DOI: 10.1093/ejo/20.6.721.
3. Zubaidi SH, Al, Alfakhry HHS. Anterior alveolar dimensions for class I normal occlusion and class II malocclusion of Iraqi adults. Int J Enhanc Res Sci Technol Eng 2018;7(6):51–57.
4. Edwards JG. A study of the anterior portion of the palate as it relates to orthodontic therapy. Am J Orthod 1976;69(3):249–273. DOI: 10.1016/0002-9416(76)90075-0.
5. Wonglamsam P, Manosudprasit M, Godfrey K. Facio-lingual width of the alveolar base. Aust Orthod J 2003;19(1):1–11.
6. Bills DA, Handelman CS, BeGole EA. Bimaxillary dentoalveolar protrusion: traits and orthodontic correction. Angle Orthod 2005; 75(3):333–339. DOI: 10.1043/0003-3219(2005)75[333:BDPTAO]2.0.CO;2.
7. Beckmann SH, Kuitert RB, Prahl-Andersen B, et al. Alveolar and skeletal dimensions associated with overbite. Am J Orthod Dentofacial Orthop 1998;113(4):443–452.
8. Lopez-Gavito G, Wallen TR, Little RM, et al. Anterior open-bite malocclusion: a longitudinal 10-year postretention evaluation of orthodontically treated patients. Am J Orthod 1985;87(3):175–186. DOI: 10.1016/0002-9416(85)90038-7.
9. Lowe AA. Correlations between orofacial muscle activity and craniofacial morphology in a sample of control and anterior open-bite subjects. Am J Orthod 1980;78(1):89–98. DOI: 10.1016/0002-9416(80)90042-1.
10. Nahoum HI, Horowitz SL, Benedicto EA. Varieties of anterior open-bite. Am J Orthod 1972;61(5):486–492. DOI: 10.1016/0002-9416(72)90153-4.
11. Weinbach JR, Smith RJ. Cephalometric changes during treatment with the open bite bionator. Am J Orthod Dentofacial Orthop 1992;101(4):367–374. DOI: 10.1016/S0889-5406(05)80330-0.
12. Mangla R, Dua V, Khanna M, et al. Evaluation of mandibular morphology in different facial types. Contemp Clin Dent 2011;2(3):200. DOI: 10.4103/0976-237X.86458.
13. AlHadlaq A. Anterior alveolar dimensions among different classifications of sagittal jaw relationship in Saudi subjects. Saudi Dent J 2010;22(2):69–75. DOI: 10.1016/j.sdentj.2010.02.004.
14. Vitchuyanon H. Anterior dentoalveolar bone width, height and length in orthodontic patients with various vertical skeletal patterns. Master thesis. Mahidol University, Thailand; 2005.
15. Al-Zubaidi SH, Obaidi HAA. The variation of the lower anterior facial height and its component parameters among the three over bite relationships (Cephalometric study). Al-Rafidain Dent J 2006;6(2): 106–113.
16. Ellis E, McNamara JA, Lawrence TM. Components of adult class II open-bite malocclusion. J Oral Maxillofac Surg 1985;43(2):92–105. DOI: 10.1016/0278-2391(85)90055-2.
17. Frost DE, Fonseca RJ, Turvey TA, et al. Cephalometric diagnosis and surgical-orthodontic correction of apertognathia. Am J Orthod 1980;78(6):657–669. DOI: 10.1016/0002-9416(80)90205-5.
18. Nanda SK. Morphology of the human chin from cephalometric measurements. J Dent Res 1965;44(4):828–828. DOI: 10.1177/00220345650440043601.
19. Tanaka R, Suzuki H, Maeda H, et al. Relationship between an inclination of mandibular plane and a morphology of symphysis. Nihon Kyosei Shika Gakkai Zasshi 1989;48(1):7–20.
20. Sadek MM, Sabet NE, Hassan IT. Alveolar bone mapping in subjects with different vertical facial dimensions. Eur J Orthod 2014;37(2): 194–201. DOI: 10.1093/ejo/cju034.
21. Hoang N, Nelson G, Hatcher D, et al. Evaluation of mandibular anterior alveolus in different skeletal patterns. Prog Orthod 2016;17(1):22. DOI: 10.1186/s40510-016-0135-z.
22. Ceylan I, Yavuz I, Arslan F. The effects of overjet on dentoalveolar compensation. Eur J Orthod 2003;25(3):325–330. DOI: 10.1093/ejo/25.3.325.