Dentoskeletal morphology in adults with Class I, Class II Division 1, or Class II Division 2 malocclusion with increased overbite

Fatma Deniz Uzuner, Belma Işık Aslan, and Müfide Dinçer
Ankara, Turkey

Introduction: The treatment options for adults with increased overbite are limited to dentoalveolar changes that camouflage the condition. Because of high relapse tendency, defining the problem area is important when creating a treatment plan. This study aimed to evaluate dentoskeletal morphology in skeletal Class I and II anomalies associated with Angle Class I, Class II Division 1 (Class II/1), and Class II Division 2 (Class II/2) malocclusions with increased overbite compared with normal occlusion. **Methods:** Pretreatment cephalograms of 306 patients (131 men, 175 women; overall ages 18-45 years) were evaluated. Four groups were constructed. Three groups had increased overbite (>4.5 mm): group 1 (n = 96) skeletal Class I (ANB = 0.5°-4°), group 2 (n = 85) skeletal Class II (ANB >4.5°) with Class II/1; and group 3 (n = 79) skeletal Class II with Class II/2 malocclusion. Group 4 as a control (n = 46) skeletal Class I normal overbite. Dental and skeletal characteristics of the groups were compared by sex. For statistical evaluations, analysis of variance followed by Tukey post hoc, Mann-Whitney *U*, and Kruskall-Wallis tests were used. Additionally correlation coefficients between overbite and skeletal/dental parameters were calculated. **Results:** Between sexes, with regard to skeletal parameters, the men had greater values in millimetric measurements, and the women had higher SN/GoGn values. Maxillary/mandibular molar heights and the mandibular incisor heights were higher in men. In group 1, decreased lower anterior facial height (LAFH), retrusive mandibular incisors, and increased interincisal degree were determined. The maxillary molars were intrusive, whereas the vertical position of the mandibular molars and incisors in both jaws were normal. In group 2, retrognathic mandible, increased LAFH and mandibular plane angle, extrusive maxillary/mandibular incisors, protrusive mandibular incisors, and decreased interincisal degree were found. In group 3, decreased LAFH, increased interincisal degree, and retrusive incisors in both jaws were determined. There were significant negative correlations between SN/GoGN, palatal plane, and overbite in group 2 and between ANS-SN and overbite in group 3, and positive correlation between interinsical angle and overbite in all increased overbite groups. **Conclusions:** Dental morphology seems to be the main factor of increased overbite. Differences between groups were related primarily to inclinations and vertical positions of the incisors, rather than molar positions. (Am J Orthod Dentofacial Orthop 2019;156:248-56)

Increased overbite (IO) is a difficult problem to treat in orthodontics owing to the high relapse tendency. Because of lack of growth, the treatment alternatives are reduced for adults with deep bite.[1] Rather than functional therapy, in adults the treatment is limited to only dentoalveolar structures by orthodontic camouflage treatment. Suggested treatment alternatives are intrusion of the anterior teeth, extrusion of molars, or both.[2-4] To decide whether to intrude the incisors or to extrude the molars is the primary question in the treatment of these patients. Furthermore, associated skeletal problems in addition to IO can be treated in combination with orthognathic surgery.[5] As a result, defining the problematic area is important for the treatment plan.

IO may be related to both dentoalveolar and morphologic features of both jaws.[6-8] Determining the influence of each factor is a significant step toward orthodontic

Department of Orthodontics, Gazi University Faculty of Dentistry, Ankara, Turkey.
All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.
Address correspondence to: Assoc Prof Fatma Deniz Uzuner, Department of Orthodontics, Gazi University Faculty of Dentistry, Biskek Cd (8 Cd) 82 Sk No: 4 06510 Emek, Ankara, Turkey; e-mail, fduzuner@yahoo.com.tr.
Submitted, April 2018; revised and accepted, March 2019.
0889-5406/$36.00

https://doi.org/10.1016/j.ajodo.2019.03.006

diagnosis and can make the difference between success or failure of treatment.[9] However, no clear connection between occlusal characteristics and craniofacial morphology has been demonstrated.[10] As reported in the literature, in different craniofacial morphologies, the same occlusal types may occur.[11] Thus, the determination of the relation between IO and different sagittal and vertical skeletal morphology may be beneficial for treatment success.

The literature still reports controversial results among studies considering the factors of IO. Many of these studies[8,10,12-14] evaluated the features of Class II Division 2 (Class II/2) malocclusion.[8,15-17] Several reported that Class II/2, or deep bite cases, have a relatively unspecific skeletal morphology but a predominantly dentoalveolar manifestation.[8,10,18] Conversely, others emphasized a characteristic skeletal pattern with a typical combination of alterations in the vertical skeletal pattern.[16,19] Conflicting results might be due to several factors: differences in study groups (eg, sample selection criteria, age range, ethnicity, and sample size), variations in the definition and identification of cephalometric landmarks, and the types of statistical tests used.[8,12,14-17,20-22]

In most studies, patients were skeletally and dentally heterogeneous.[23-25] Deep bite may include individuals with Class I molar relationships as well, which may occur at a 20%-40% rate of incidence.[26] Therefore, deep bite groups could include both skeletal Class I and Class II patients.[23-25] Consequently, if overbite magnitude is the only selection criterion, there may be a bias in the study results. In addition, we noted that in previous studies Class II/2 subjects were generally compared with Class I or Class II Division 1 (Class II/1) individuals, without considering overbite amount, and, frequently, growing patients were part of groups without regarding changes in overbite amount during the growth period.[17,23-25]

Taking all these factors into consideration, it would be beneficial to evaluate and compare dental and craniofacial morphology of nongrowing (adult) subjects with IO with different sagittal skeletal classifications on the bases of detailed subgroups. Thus, this study aimed to assess the relation between IO and the maxillary and mandibular dentoskeletal morphology in skeletal Class I and Class II adult patients and to compare it with skeletal Class I adults with normal overbite. In addition, we aimed to determine sex differences.

MATERIAL AND METHODS

For this retrospective study 3038 patients' pretreatment lateral cephalograms and clinical reports were collected from the archives of the Orthodontics Department of the Gazi University Faculty of Dentistry. Permission was given to use the department's archive materials. Patients with complete eruption of second molars, those in cervical vertebral stage 6,[27] having no anterior or posterior crossbite and no history of previous orthodontic or prosthodontic treatment or serial extraction, with no acquired or congenitally missing teeth (except third molars), having no stainless steel crowns or large restorations, facial or dental trauma, or craniofacial anomalies were selected. Also, all subjects were Turkish Caucasian to avoid ethnic differences in the craniofacial morphology. Finally, the sample was composed of 306 Caucasian patients (131 men, 175 women), ranging in age from 18 to 45 years.

Two main groups were formed according to the amount of overbite. The control group had a normal overbite (1-4 mm), and the IO (>4.5 mm) patients were considered separately. Overbite was measured as the distance between the incisal tips of the mandibular and maxillary central incisors perpendicular to the occlusal plane. In addition, we measured whether the maxillary central incisors covered more than one-third of the mandibular incisors' crown.

The IO group was divided into 3 subgroups based on sagittal skeletal relation, as follows: group 1 (n = 96) skeletal Class I subjects (ANB 0.5°-4°); group 2 (n = 85) skeletal Class II (ANB >4.5°) with Class II/1 malocclusion; and group 3 (n = 79) skeletal Class II with Class II/2 malocclusion. Class II/1 or Class II/2 malocclusions were defined according to the British Standards Institute classification of malocclusion.[28]

Subjects with both skeletal (ANB 0.5°-4°) and dental Class I relationship, normal overjet (0.5-4 mm) and overbite (1-4 mm), and minor crowding (3-4 mm) were included in the control group (group 4; n = 46).

In addition, each group was divided into 2 subgroups according to sex.

All lateral cephalograms were taken in natural head position and the teeth with full intercuspidation.

The cervical vertebral maturation stages were visually assessed on the lateral cephalograms by one investigator and confirmed by the second one.[27] Disagreements were resolved to the satisfaction of both observers.

Nine angular and 15 linear measurements were used to assess the maxillary and the mandibular dentoskeletal morphologies. The landmarks, reference lines, and measurements are shown in Figures 1 and 2. Two additional parameters were derived from those measured directly on the lateral cephalometric radiographs:[8] U1-U6/U6 × 100 is the difference between maxillary incisal and molar heights measured in relation to maxillary molar height; L1-L6/L6 × 100 is the

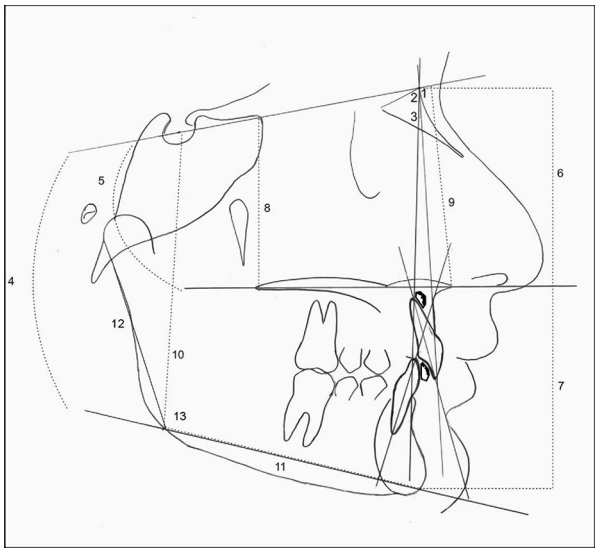

Fig 1. Linear and angular measurements on lateral cephalograms to determine skeletal morphology: 1: SNA; 2: SNB; 3: ANB; 4: SN/GoGN; 5: SN/PP; 6: N-ANS; 7: ANS-Gn; 8: PNS-SN; 9: ANS-SN; 10: S-Go; 11: Go-Gn; 12: Ar-Go; 13: gonial angle.

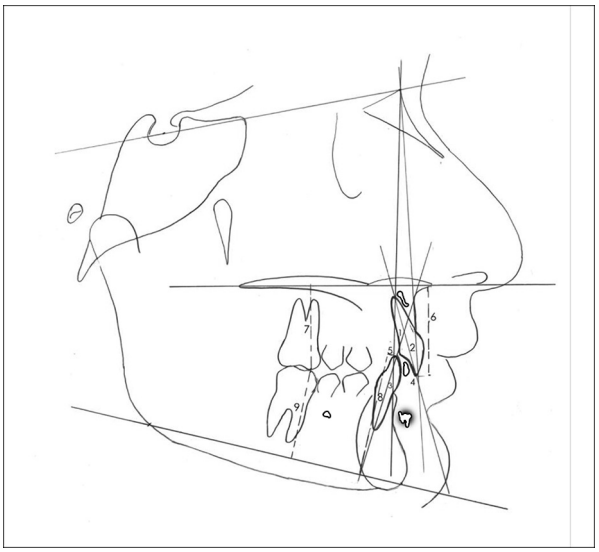

Fig 2. Linear and angular measurements on lateral cephalograms to determine dental morphology: 1: interincisal angle; 2: U1-NA (°); 3: L1-NB (°); 4: U1-NA (mm), 5: L1-NB (mm); 6: U1-PP (mm); maxillary incisal height; 7: U6-PP (mm; maxillary 1.molar height: the length of a line perpendicular to the palatal plane extending from the palatal plane to the mesial cusp tip of the maxillary first molar); 8: L1-GoGn (mm; mandibular incisal height); 9: L6-GoGn (mm; mandibular 1.molar height: the length of a line perpendicular to the mandibular plane extending from the mandibular plane to the mesial cusp tip at the occlusal plane of each mandibular molar).

difference between mandibular incisal and molar heights measured in relation to mandibular molar height.

Each cephalometric radiograph was traced and all parameters were measured by the same investigator. The tracing and measurements were repeated by the same investigator on 40 randomly selected radiographs after an interval of 2 weeks. The error of the method and the intraobserver reliability were determined by the Dahlberg formula, $Si = \sqrt{\sum d^2/2n}$, and a paired t test. The error of the method did not exceed 0.25 mm and 0.25° for any of the variables investigated, and no statistically significant difference was found between the 2 sets of measurements.

Statistical analysis

All statistical analyses were performed with the use of SPSS software for Windows (version 20; IBM SPSS, Chicago, Ill). Statistical significance was set at $P < 0.05$ for all tests.

The data obtained were submitted to a variance homogeneity test (the Levene test) and normality tests (the Kolmogorov-Smirnov test). Next, the parameters that would be analyzed with the use of the parametric and nonparametric tests were determined. For statistical evaluations, analysis of variance was performed, followed by the Tukey post hoc test. The Mann-Whitney U test and the Kruskall-Wallis test were also used. Relationships between the overbite and the skeletal/dental parameters were evaluated with the use of the Spearman correlation test.

Power analysis showed that 46 patients per group would achieve a statistical power of ~80% at a significance level of 0.05.

Table I. Percentage of men and women in each group and the statistical comparison of the sex distribution between the groups by means of Fisher exact test

Group	*Total*	*Men*	*Women*	P
Group 1 (Class I)	96	47	49	0.162
Group 2 (Class II/1)	85	34	51	
Group 3 (Class II/2)	79	27	52	
Group 4 (control)	46	23	23	

RESULTS

There were no differences in the distribution of sex in each group (Table I). On the other hand, significant differences were found in the age of the subjects by sex ($P < 0.01$; Supplementary Table I, available at www.ajodo.org). The women were younger than the men.

When comparing sex differences in the malocclusion samples, statistically significant differences were found for the following: The N-ANS, ANS-Gn, PNS-SN, Ar-Go, S-Go, and Go-Gn linear measurements had greater values in men; and the SN-GoGn angular measurement had a greater value in women ($P < 0.01$; Supplementary Table I).

In all groups, no significant differences were found in incisors' inclination [1-NA (°), 1-NB (°), interincisal degree] and sagittal position [1-NA (mm), 1-NB (mm)] between the sexes, whereas the maxillary and mandibular molar heights (6-ANSPNS, 6-GoGn) showed significant differences between the sexes (both $P < 0.001$) and were higher in men. Furthermore, the maxillary and mandibular index values (U1-U6/U6 × 100, L1-L6/L6 × 100) were found to be significantly lower in men ($P < 0.01$ and $P < 0.001$, respectively), which means that molar heights were greater than incisal heights (Supplementary Table II, available at www.ajodo.org).

The records of skeletal and dental variables describing the morphology of the Class I, Class II/2, and Class II/1 malocclusions in the 10 groups and the control group, and comparisons between groups according to sex, are presented in Supplementary Tables I and II.

There were significant differences in the sagittal position of the maxilla (SNA) between the Class I 10 and Class II/2 groups ($P < 0.05$). The mandible showed similarly retrognathic position (SNB) in the skeletal Class II groups (Class II/1 and Class II/2). In the Class II/1 group, the SNB value was significantly lower than in the Class I groups (Class I 10 and control; both $P < 0.001$). As expected, the ANB value was significantly different between the Class I and II groups (all $P < 0.001$). No difference was observed in mandibular corpus length (Go-Gn) between groups.

No significant difference was found in upper anterior facial height (N-ANS) between the groups. In the Class I 10 and Class II/2 groups, lower facial height (ANS-Gn) was significantly decreased compared with the control group (both $P < 0.001$). The Class II/1 group had significantly increased lower facial height (ANS-Gn) than the other 10 groups (both $P < 0.05$).

A significant difference was found in Ar-Go value between the Class II/1 group and the control group ($P < 0.05$): Ar-Go distance was smaller in the Class II/1 group. In addition, in the Class II/1 group, SN/GoGn was significantly higher than in other 10 groups (both $P < 0.001$). However, no significant difference was found between 10 groups and the control group in SN/GoGn value.

Only 5 of the parameters, N-ANS, ANS-SN, Ar-Go, S-Go, and SN/GoGn, were found to have statistically significant interactions between group × sex factors.

In the Class II/2 group, more retroclined (1-NA°) and retrusive (1-NA mm) maxillary incisor positions were found compared with all other groups (all $P < 0.001$). Whereas mandibular incisors were significantly more protrusive (1-NB mm) in the Class II/1 group than in the other 10 groups (both $P < 0.001$).

Interincisal angle was significantly higher in the Class II/2 group than in the other groups (all $P < 0.001$), and it was lower in the Class II/1 group than in the other 10 groups.

Maxillary incisor height (1-ANSPNS) was significantly greater in the Class II/1 group than in the other 10 groups. There were no significant differences in maxillary incisor height (1-ANSPNS) between the 10 groups and the control group.

In the control group, the maxillary molar height (6-ANSPNS) was greater than those in groups Class I 10 ($P < 0.01$) and Class II/2 ($P < 0.001$). In the 10 groups, a significant difference was found between groups Class II/1 and Class II/2 ($P < 0.05$), with the molars more extrusive in the Class II/1 group.

Mandibular incisor height (1-GoGn) was significantly greater in the Class II/1 group than in all other groups. The mandibular molar heights were similar in both 10 and Control groups.

When the index values (U1-U6/U6 × 100) were taken into consideration, the 10 groups' index values were greater than the control group's, which meant that maxillary incisor height was greater than maxillary molar height in the 10 groups.

The mandibular index value (L1-L6/L6 × 100) was greater in the Class II/1 and Class II/2 groups than in the control group ($P < 0.001$ and $P < 0.05$, respectively). When comparing between 10 groups, no significant differences were found in index values.

Overbite was significantly higher in the Class II/2 group than in the other groups.

Correlations between overbite and skeletal/dental parameters are presented in Table II.

There were significantly positive correlations between interincisal angle and overbite in all 10 groups (all $P < 0.001$), whereas only in the Class II/2 group negative correlation was found between mandibular molar height (6-GoGn) and overbite ($P < 0.01$).

When the correlations between the parameters considering vertical skeletal morphology and 10 were evaluated, there were significant negative correlations between SN/GoGN, palatal plane (PP), and overbite in the Class II/1 group ($P < 0.05$ for each) and between ANS-SN and overbite in the Class II/2 group ($P < 0.05$).

Table II. Correlations between overbite and skeletal/dental parameters

	Group 1 (Class I)		*Group 2 (Class II/1)*		*Group 3 (Class II/2)*		*Group 4 (control)*	
Parameters	*r*	P	*r*	P	*r*	P	*r*	P
N-ANS	0.020	0.828	−0.125	0.262	−0.070	0.551	−0.164	0.293
ANS-Gn	0.015	0.873	−0.210	0.063	−0.129	0.289	−0.027	0.874
PNS-SN	−0.039	0.669	0.025	0.822	0.046	0.693	−0.204	0.184
ANS-SN	−0.161	0.086	−0.056	0.626	−0.233	0.046*	−0.289	0.060
PP	0.030	0.744	−0.261	0.017*	−0.094	0.410	−0.085	0.585
S-Go	0.047	0.606	0.019	0.863	−0.118	0.305	−0.133	0.394
GoGn/SN	−0.100	0.272	−0.251	0.022*	−0.100	0.383	0.141	0.360
Gonial	−0.075	0.412	0.045	0.687	−0.092	0.422	0.160	0.298
1-ANSPNS	0.129	0.156	−0.017	0.875	0.059	0.605	0.162	0.292
6-ANSPNS	0.022	0.807	−0.253	0.020*	−0.100	0.381	−0.026	0.871
1-GoGn	0.037	0.691	−0.153	0.168	−0.186	0.106	0.168	0.283
6-GoGn	0.009	0.924	−0.201	0.067	−0.351	0.002†	−0.059	0.702
1/1	0.402	0.000‡	0.379	0.000‡	0.571	0.000‡	0.078	0.613

*$P < 0.05$; †$P < 0.01$; ‡$P < 0.001$.

DISCUSSION

This is the first study in which the dentoskeletal characteristics in adults with IO associated with Class I, Class II/1, and Class II/2 malocclusions in the anteroposterior and vertical dimensions were evaluated and compared with normal occlusion (Class I) according to sex differences.

In some previous studies, a comparison between sexes in each group indicated no differences and the results for both sexes were put into the same pool.[10,14,16,] Conversely, in the present study, significant dimensional differences were detected between the sexes. Except for 1 of 7 linear skeletal measurements, men have significantly increased dimensions than women.

Subjects with IO were diagnosed according to an overbite >4.5 mm. This value is concordant with the reported average value for the definition of IO in the literature.[7,21,29] In present study, the minimum overbite was 5 mm in all IO groups. In addition, we measured whether the maxillary central incisors covered more than one-third of the mandibular incisors' crown.

The study sample was limited to adults to eliminate the influence of maturation growth on the dentoskeletal morphology. Overbite is not stable during the growth period, because it decreases with the vertical growth of the mandibular ramus and the eruption of second molars and increases with the mesialization of the molars.[10,13,21,22,30] There are few studies considering adult patients; on the contrary, most studies include patients of wide age ranges.[14,17,22] Thus, direct comparison of our results with those of previous studies is limited.

The results of the present study show that the IO groups did not show any significant difference compared with the control group according to the sagittal position of the maxilla (SNA). Within the IO groups, the maxilla was more prognathic in the Class II/2 group. This result supports the findings of some studies[23,31] and conflicts with others reporting a similar[10] or even retrognathic[16] maxilla in the Class II/2 malocclusion.

Considering the sagittal position of the mandible (SNB), the skeletal Class II groups (groups 2 and 3) were retrognathic. In addition, the Class II/2 group had a consistently intermediate value of mandibular sagittal position that was between those of the Class I (groups 1 and 4) and Class II/1 malocclusions.

It seems that in this sample, Class II morphology occurred in accordance with the spatial positioning of the mandible rather than the dimensional deficiency, because mandibular corpus length (Go-Gn) was similar between groups.

In this study, groups were constructed according to the sagittal intermaxillary relationship. Patients with skeletal Class I and II anomalies with IO were evaluated separately. Therefore, the significant differences in ANB angle between the Class I groups (groups 1 and 4) and the Class II groups (groups 2 and 3) were expected because of the selection criteria. Similarly, regarding the intermaxillary relationship, Hitchcock[32] reported a statistically significant difference of the ANB angle among the Class I normal group and the Class II/1 and Class II/2 malocclusions. However, our finding was not confirmed by another previous study[16] reporting that there was no significant difference between Class II/2 and Class I groups. In that study, only dental classifications were used as the selection criteria, so that Class II/2 groups consisted of both skeletal Class I and II subjects. That

is why some researchers have defined Class II/2 malocclusion as having a normal skeletal pattern and focusing the problem on the dentoalveolar complex.[17] Therefore, skeletal relationship should also be taken into consideration in the studies concerning Class II/2 malocclusion.

Generally, it is expected that certain occlusion characteristics may be associated with specific facial types, such as open bite in dolichofacial patients and deep bite in brachyfacial patients.[33] However, this concept should not be generalized; it is possible that specific dentoalveolar discrepancies may not follow the corresponding facial pattern scientifically.[34-36] Some authors[37-39] have reported that overbite magnitude is independent from vertical skeletal relationship and characteristics of forward mandibular rotation. In support, the results of the present study show that identical occlusal types occur in different craniofacial patterns and fail to demonstrate a characteristic craniofacial morphology.

In the literature, controversy exists about the relationships between facial height and overbite, which may be due to the age of the samples which included growing individuals.[8,40-43]

In the present study, in the Class II/1 group, a negative correlation was determined between the PP angle and increased overbite. Upper anterior facial height (UAFH) showed a negative relationship with overbite in Class II/2. However, no differences were found between the groups in terms of PP angle and maxillary vertical position (AUFH). Therefore, we can conclude that the maxillary vertical position and PP angle do not differ in IO adult individuals.

There is a general agreement that the total anterior and especially the LAFH are underdeveloped with deep bite.[8,15,17,33] In particular, reduced LAFH is one of the most frequently mentioned characteristics of Class II/2 malocclusions.[8,10,16,23] Supporting this, the Class II/2 group showed reduced LAFH. In contrast, the Class II/1 group was similar to the control group.

Several studies[31,44] are in agreement about a low mandibular plane angle in Class II/2. Other studies,[10,17,22,45] however, did not find a statistically significant difference between Class II/2 and Class I malocclusions. The present study confirms that Class II/2 could occur in faces with varying mandibular plane angles. Rather than in Class II/2, it was found that the mandibular plane angle had a negative correlation with overbite in only the Class II/1 group.

The gonial angle has been found to be acute in individuals with deep bite.[14,16,46,47] However, others[17,22,45] did not find statistically significant differences in the gonial angle between Class II/2 and Class I malocclusions. In the present study, gonial angle values did not show statistically significant differences between the IO and the control groups and no significant correlation with overbite. This conflicts with the results of el Dawlatly et al,[14] who reported that decreased gonial angle was the greatest shared skeletal component with increased overbite. The different result may be due to the age range, which was from 14 (post-adolescence) to 22 years, and not splitting the sample into subgroups according to sagittal and vertical relationships.

Conflicting results also exist in the literature regarding the posterior facial height and IO relationship.[15,16,25,42] In this study, it seems that posterior vertical morphology does not contribute specifically to the development of IO. Only the Class II/1 group showed decreased ramal height in accordance with the increased mandibular plane angle and increased lower facial height.

In general, the main dental features reported as the factors of IO are the occlusal contact point of the incisors, the interincisal degree, and the palatal surface morphology of the upper incisors.[6,44,48] In support, Bjork[41] cautioned that if there is adequate contact between the lower incisor with the lingual surface of the permanent upper incisor, there is less potential of developing deep bite.

Some oauthors[9,12] reported that IO is due to increased incisor height. Some authors[8,49-51] considered the supraeruption of mandibular incisors to be a determinant factor. Others[42] mentioned that the maxillary incisor height was found to be increased rather than the mandibular incisors. In contrast, others[24,52,53] attributed the occurrence of deep bite to a lack of vertical growth in the molar and premolar regions.

The results of the present study reveal that there are significant differences in the maxillary and mandibular dentoalveolar morphology among the IO groups and the control group. Regarding incisor inclinations, significant differences were found between groups. The Class I IO group had rather normal inclination of maxillary incisors whereas the mandibular incisors were found to be retrusive and retroclined. In the Class II/1 group, the lower incisors were proclined and the interincisal angle was reduced, which may be due to compensation for the increased overjet. In the Class II/2 group, however, the maxillary and mandibular incisors were retrusive, and the interincisal angle was significantly increased.

These results are in full agreement with the results of the other studies, which reported extreme retroclination of the maxillary central incisors,[17,23] an obtuse interincisal angle,[8,22,54] and a deep overbite.[32,54] In Class II/2, maxillary incisors seem to compensate for the underlying skeletal disorders. Also, the influence of

lip pressure may be another factor in increased retroclination. The retroclination in mandibular incisors can be explained by the unstable interincisal contact. The maxillary incisors' retroclination may contribute to the spontaneous retrusion of the mandibular incisors. In keeping with our results, some studies[15,32] found lower incisors to be retrusive, whereas other studies[10,17] reported normal inclination. The conflicting results may be due to the reference lines used in those studies.

El Dawlatly et al[14] reported that the exaggerated curve of Spee was the greatest dental component in increased overbite, and overeruption of the maxillary incisors was the second highly contributing dental component.

In the present study with regard to the incisors' vertical positions; in the Class II/1 group, both maxillary and mandibular incisors were more extrusive than those in the other IO groups and the control group. As the skeletal deviation in the sagittal direction increases, the resultant failure in interincisal contact will cause an increase in the extrusion of mandibular incisors in Class II/1.[9]

In contrast to the expectation that incisors may show relative extrusion with the effect of excessive retroclination[55] in the Class II/2 group, the vertical position of the incisors in both jaws was within normal ranges. It seems that the main factors in IO in the Class II/2 group were the retroinclination of the incisors rather than their vertical position and the contribution of decreased LAFH.

Although the vertical positions of incisors were more extrusive in Class II/1 group, overbite was found to be more pronounced in the Class II/2 group. This might be due to the effect on skeletal morphology of decreased LAFH and to the retroinclinations of the incisors in the Class II/2 group.

Contrary to the expectations, in all IO groups the mandibular molar heights were similar to those of the control group. When the maxillary arch was considered, in the Class I IO and Class II/2 groups, molar heights were shorter than the Control group's values. Similarly in the literature,[42] in Class II/2 individuals, the molar heights are reported to be less than in the normal group. This could be explained by Björk and Skieller's[56] study finding that the incisal occlusion could affect the development of dentoalveolar height as well as the mandibular rotation pattern. Thus, if the incisal occlusion is stable, the mandible would rotate anteriorly on a center with the mandibular incisors. At the same time, there would be a differentiated eruption of the incisors and molars in both jaws. Molars would erupt more than the incisors as compensation for the jaw rotation. If the incisal occlusion is unstable, a skeletal deep bite could develop. The center for the anterior mandibular rotation did not then lie with the mandibular incisors but farther back with the premolars. In such cases, a differentiated eruption of the incisors and molars would not occur. In Class II/1, because there is no stable incisor contact that causes the extrusion in incisors, the molars in both jaws may be expected to be intrusive. Whereas in this study, in the Class II/1 group the maxillary molar heights were similar to the control group.

Supporting the results of incisor and molar vertical position, the dentoalveolar ratios in the IO groups were greater, which means that the incisor height was greater than the molar height. In another words, it can be said that incisor extrusion is the dominant factor in the development of IO.

Furthermore, we may comment that the mandibular dentoalveolar ratio value was greater than the maxillary ratio. This result can be interpreted as the elongation of the mandibular incisors being the dominant effect in the formation of the IO. Clinically, this result shows that rather than molar extrusion, intrusion of incisors could be considered for the treatment plan. This result is in accordance with Kale et al,[2] who reported that the mandibular incisor intrusion with the use of a utility arch can be considered as an effective and stable treatment protocol in the correction of deep bite in nongrowing patients.

The results of this study could be of interest in view of the potential clinical implications in orthodontics in the selection of the proper treatment mechanism such as molar extrusion, incisor intrusion, or the combination of them for stable results.

Limitations of this study include the sample size in the control group being rather smaller than the IO groups. Because this study was a retrospective study, we were limited in finding patients with the minimum amount of crowding to construct a control group.

Also, the study was limited to dentoskeletal evaluation. Soft tissue was not considered. Increased resting lip pressure via the incisal occlusion may be the causative effect of IO. Also, the increased level of the lower lip dorsal line plays a role as a causative factor in the retroclination of the maxillary central incisors.[57]

CONCLUSIONS AND CLINICAL IMPLICATIONS

The results of this study reveal that IO may occur in different craniofacial patterns and fail to demonstrate a characteristic craniofacial morphology. The sagittal position of both jaws did not have any influence on the amount of overbite. Dental morphology seems to be the main factor of increased overbite.

In the Class I IO group, decreased LAFH, retrusive mandibular incisors, and increased interincisal degree were found. Maxillary molars were intrusive, whereas

the vertical positions of mandibular molars and incisors in both jaws were normal.

In the Class II/1 group, retrognathic mandible, increased LAFH and mandibular plane angle, extrusive maxillary and mandibular incisors, protrusive mandibular incisors, and decreased interincisal degree were found.

In the Class II/2 group, decreased LAFH, increased interincisal angle, and retrusive incisors in both jaws were found.

The differences between the groups were related mostly to the vertical position and inclinations of the incisor teeth as opposed to the molar teeth. In support, in the IO groups the dentoalveolar ratio was greater than in the control group, which showed that incisor extrusion was the dominant factor. Clinically, this result shows that rather than molar extrusion, intruding incisors could be considered as a treatment plan. Especially in Class II/1 malocclusion, incisor extrusion is greater in both jaws, and lower incisors are more extrusive than maxillary ones. Lower incisor intrusion seems to be the main treatment concept in Class II/1 malocclusion. Whereas in the Class II/2 anomaly, the best alternative is correction of the axial positions of the incisors.

When the maxillary arch was considered in the Class I IO and Class II/2 groups, molar heights were shorter than in the control group. If there is enough freeway space, in addition to incisor intrusion, upper molar extrusion also may be planned for patients in Class I IO and Class II/2 groups.

REFERENCES

1. Pollard D, Akyalcin S, Wiltshire WA, Wellington JR. Relapse of orthodontically corrected deepbites in accordance with growth pattern. Am J Orthod Dentofacial Orthop 2012;141:477-83.
2. Kale Varlık S, Onur Alpakan Ö, Türköz Ç. Deepbite correction with incisor intrusion in adults: A long-term cephalometric study. Am J Orthod Dentofacial Orthop 2013;144:414-9.
3. Nanda R, Kuhlberg A. Management of deep overbite malocclusion. In: Nanda R, editor. Biomechanics and esthetic strategies in clinical orthodontics. Saint Louis: Elsevier Saunders; 2005. p. 131-55.
4. Burstone CR. Deep overbite correction by intrusion. Am J Orthod 1977;72:1-22.
5. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 4th ed. Saint Louis: Mosby Elsevier; 2007. p. 751.
6. Beckmann SH, Kuitert RB, Prahl-Andersen B, Segner D, Tuinzing DB. Alveolar and skeletal dimensions associated with overbite. Am J Orthod Dentofacial Orthop 1998;113:443-52.
7. Richardson A. Dento-alveolar factors in anterior open-bite and deep overbite. Dent Pract Dent Rec 1970;21:53-7.
8. Karlsen AT. Craniofacial characteristics in children with Angle Class II-2 malocclusion combined with extreme deepbite. Angle Orthod 1994;64:123-30.
9. Marques LS, Armond MC, Ramos-Jorge ML, Vieira de Andrade RG, Bolognese AM. Correlations between dentoskeletal variables and deep bite in Class II Division 1 individuals. Braz Oral Res 2011; 25:56-62.
10. Pancherz H, Zieber K, Hoyer B. Cephalometric characteristics of Class II Division 1 and Class II Division 2 malocclusions: a comparative study in children. Angle Orthod 1997;67:111-20.
11. Bibby RE. Incisor relationships in different skeletofacial patterns. Angle Orthod 1980;50:41-5.
12. Karlsen AT Craniofacial morphology in children with Angle Class II-1 malocclusion with and without deepbite. Angle Orthod 1994;64:437-46.
13. Giri BT, Jyothikiran H, Shivalinga BM, Sanju Somaiah MK. Cephalometric evaluation of dentoalveolar and morphological changes associated with overbite in maxilla and mandible in 13-18 year old adolescents. Int J Contemp Dent 2011;2:35-46.
14. El-Dawlatly MM, Salah Fayed MM, Mostafa YA. Deep overbite malocclusion: analysis of the underlying components. Am J Orthod Dentofacial Orthop 2012;142:473-80.
15. Bratu DC, Bălan RA, Szuhanek CA, Pop SI, Bratu EA, Pop G. Craniofacial morphology in patients with Angle Class II Division 2 malocclusion. Rom J Morphol Embryol 2014;55:909-13.
16. Brezniak N, Arad A, Heller M, Dinbar A, Dinte A, Wasserstein A. Pathognomonic cephalometric characteristics of Angle Class II Division 2 malocclusion. Angle Orthod 2002;72:251-7.
17. Godiawala RN, Joshi MR. A cephalometric comparison between Class II division 2 malocclusions and normal occlusion. Angle Orthod 1974;44:262-7.
18. Lux CJ, Raeth O, Burden D, et al. Sagittal and vertical growth of the jaws in Class II, Division 1 and Class II, Division 2 malocclusions during prepubertal and pubertal development. J Orofac Orthop 2004;65:290-311.
19. Siriwat PP, Jarabak JR. Malocclusion and facial morphology—is there a relationship? An epidemiologic study. Angle Orthod 1985;55:127-38.
20. Isik F, Nalbantgil D, Sayinsu K, Arun T. A comparative study of cephalometric and arch width characteristics of Class II Division 1 and Division 2 malocclusions. Eur J Orthod 2006;28:179-83.
21. Baccetti T, Franchi L, McNamara JA Jr. Longitudinal growth changes in subjects with deepbite. Am J Orthod Dentofacial Orthop 2011;140:202-9.
22. Fischer-Brandies H, Fischer-Brandies E, Konig A. A cephalometric comparison between Angle Class II Division 2 malocclusion and normal occlusion in adults. Br J Orthod 1985;12:158-62.
23. Al-Khateeb EA, Al-Khateeb SN. Anteroposterior and vertical components of Class II Division 1 and Division 2 malocclusion. Angle Orthod 2009;79:859-66.
24. Popovich F. Cephalometric evaluation of vertical overbite in young adults. J Can Dent Assoc 1955;21:209-22.
25. Nanda SK. Patterns of vertical growth in the face. Am J Orthod 1998;93:103-16.
26. Schulze C. Lehrbuch der Kieferorthopadie. Berlin: Quintessenz; 1993. p. 280-300. Quoted in: Lapatki BG, Mager AS, Schulte-Moenting J, Jonas IE. The importance of the level of the lip line and resting lip pressure in Class II, Division 2 malocclusion. J Dent Res 2002;81:323-8.
27. Bacetti T, Franchi L, Mc Namara JA. The cervical vertebral maturation (CVM) method for the assessment of optimal treatment timing in dentofacial orthopedics. Semin Orthod 2005;11:119-29.
28. British Standards Institue. Glossary of dental terms. London: BS 4492; 1983.
29. Schütz-Fransson U, Bjerklin K, Lindstein R. Long term follow up of orthodontically treated deepbite patients. Eur J Orthod 2006;28: 503-12.

30. Wylie WL. The relationship between ramus height, dental height and overbite. Am J Orthod 1946;32:57-67.
31. Blair ES. A cephalometric roentgenographic appraisal of the skeletal morphology of Class I, Class II Division 1, and Class II Division 2 malocclusions. Angle Orthod 1954;24:106-19.
32. Hitchcock HP. A cephalometric distinction of Class II Division 2 malocclusion. Am J Orthod 1976;69:447-54.
33. Schudy FF. The rotation of the mandible resulting from growth: Its implications in orthodontic treatment. Angle Orthod 1965;35:36-50.
34. Trouten J, Enlow D, Rabini M, Phelps A, Swedlow D. Morphologic factors in open bite and deep bite. Angle Orthod 1983;53:192-211.
35. Keeling SD, Riolo ML, Martin RE, Ten Have TR. A multivariate approach to analyzing the relation between occlusion and craniofacial morphology. Am J Orthod Dentofacial Orthop 1989;95:297-305.
36. Claro CA, Abrao J, Reis SA. Association between overbite and craniofacial growth pattern. Braz Oral Res 2010;24:425-32.
37. Wees JM. Short lower anterior face height: phenotypic diversity: Master thesis. University of Iowa; 2015. Available at: http://ir.uiowa.edu/etd/1795.
38. Solow B. The pattern of craniofacial associations. Acta Odontol Scand 1966;46:45-75.
39. Solow B. The dentoalveolar compensatory mechanism: background and clinical implications. Br J Orthod 1980;7:145-61.
40. Atherton JD. The influence of the face height upon the incisor occlusion and lip posture. Dent Pract Dent Rec 1965;15:227-31.
41. Bjork A. Prediction of mandibular growth rotation. Am J Orthod 1969;55:585-99.
42. Mete L. The morphology of Angle Class II Division 2 malocclusions and the aetiology of deepbite. Master thesis. Ankara University; 2000.
43. Moyers RE, Riolo ML, Guire KL, Wainright RL, Brookstein FL. Differential diagnosis of Class II malocclusions. Part 1. Facial types associated with Class II malocclusions. Am J Orthod 1980;78:477-94.
44. Houston WJB. Incisor edge-centroid relationships and overbite depth. Eur J Orthod 1989;11:139-43.
45. Kerr WJS, Miller S, Ayme B, Wilhem N. Mandibular form and position in 10-year-old boys. Am J Orthod Dentofacial Orthop 1994;106:115-20.
46. Ceylan İ, Eröz ÜB. The effects of overbite on the maxillary and mandibular morphology. Angle Orthod 2001;71:110-5.
47. Renfroe EM. A study of the facial patterns associated with Class I, Class II Division 1, and Class II Division 2 malocclusions. Angle Orthod 1948;18:12-5.
48. Ludwig M. A cephalometric analysis of the relationship between facial pattern, interincisal angulation and anterior overbite changes. Angle Orthodontist 1967;37:194-204.
49. Kim YH. Overbite depth indicator with particular reference to anterior open-bite. Am J Orthod 1974;65:586-611.
50. Fleming HB. An investigation of the vertical overbite during the eruption of the permanent dentition. Angle Orthod 1961;31:53-62.
51. Samuelson G, Garner LD, Potter R. Tooth movements associated with deep overbite correction in class II division 1 malocclusions. Int J Orthod 1989;27:3-8.
52. Lewis P. Correction of deep anterior overbite. A report of three cases. Am J Orthod Dentofacial Orthop 1987;91:342-5.
53. Steadman SR. Overbites and overjets. Angle Orthod 1974;44:156-61.
54. Mills JR. The problem of overbite in Class II, Division 2 malocclusion. Br J Orthod 1973;1:34-48.
55. Sangcharearn Y, Christopher HO. Effect of incisors angulation on overjet and overbite in Class II camouflage treatment. Angle Orthod 2007;77:1011-8.
56. Skieller V, Björk A, Linde-Hansen T. Prediction of mandibular growth rotation evaluated from a longitudinal implant sample. Am J Orthod 1984;86:359-70.
57. Lapatki BG, Mager AS, Schulte-Moenting J, Jonas IE. The importance of the level of the lip line and resting lip pressure in Class II, Division 2 malocclusion. J Dent Res 2002;81:323-8.

APPENDIX

Supplementary Table I. Comparison of mean age and skeletal values of the groups according to sex, group, and group-sex interactions

Parameter	Group	Group 1 (Class I)	Group 2 (Class II/1)	Group 3 (Class II/2)	Group 4 (Control)	P (sex)	P (group)	P (group × sex)	Comparison between groups					
									1 vs 2	1 vs 3	1 vs 4	2 vs 3	2 vs 4	3 vs 4
SNA (°)	Male	80.38 ± 3.55	81.47 ± 3.73	81.61 ± 3.40	81.35 ± 4.77	0.164	0.006†	0.348	0.056	0.016*	1.000	1.000	0.548	0.231
	Female	79.70 ± 3.29	81.45 ± 3.65	81.89 ± 3.46	79.32 ± 3.28									
SNB (°)	Male	78.02 ± 3.46	75.28 ± 3.51	76.33 ± 3.58	79.21 ± 4.87	0.068	0.000‡	0.178	0.001‡	0.247	1.000	0.826	0.001‡	0.058
	Female	76.88 ± 3.40	75.61 ± 3.59	76.28 ± 3.43	76.91 ± 2.80									
ANB (°)	Male	2.38 ± 0.95	6.22 ± 1.64	5.31 ± 1.27	2.13 ± 1.07	0.299	0.000‡	0.152	0.000‡	0.000‡	0.875	0.035*	0.000‡	0.000‡
	Female	2.82 ± 0.85	5.83 ± 1.40	5.61 ± 1.31	2.40 ± 1.48									
N-ANS (mm)	Male	51.26 ± 3.90	53.47 ± 4.23	51.71 ± 4.31	51.89 ± 4.49	0.003†	0.718	0.034*	–	–	–	–	–	–
	Female	51.09 ± 3.13	50.12 ± 3.01	50.95 ± 3.37	50.72 ± 3.72									
ANS-Gn (mm)	Male	61.86 ± 4.85	63.19 ± 4.14	60.44 ± 5.16	64.19 ± 5.35	0.000‡	0.000‡	0.240	0.015*	1.000	0.000‡	0.013*	0.350	0.000‡
	Female	57.34 ± 3.83	60.32 ± 5.05	58.24 ± 4.41	62.80 ± 4.12									
PNS-SN (mm)	Male	44.41 ± 3.01	45.80 ± 3.17	44.05 ± 3.12	44.58 ± 3.11	0.000‡	0.073	0.291	–	–	–	–	–	–
	Female	43.58 ± 2.54	43.54 ± 3.03	43.09 ± 3.04	42.38 ± 2.59									
ANS-SN (mm)	Male	51.52 ± 3.41	52.16 ± 3.37	53.03 ± 4.44	53.99 ± 3.53	0.063	0.537	0.004†	–	–	–	–	–	–
	Female	53.10 ± 3.09	51.46 ± 3.23	51.40 ± 3.39	51.52 ± 3.48									
SN/PP (°)	Male	8.51 ± 3.22	9.55 ± 3.34	8.69 ± 2.93	8.22 ± 3.84	0.121	0.985	0.190	-	–	–	–	–	–
	Female	9.40 ± 3.55	8.75 ± 3.57	9.47 ± 3.43	9.87 ± 2.22									
Ar-Go (mm)	Male	48.63 ± 4.83	49.11 ± 4.33	48.57 ± 5.15	53.48 ± 3.64	0.000‡	0.026*	0.003†	1.000	1.000	0.119	1.000	0.026*	0.056
	Female	46.33 ± 4.51	44.83 ± 4.69	45.70 ± 4.32	45.28 ± 3.57									
S-Go (mm)	Male	79.56 ± 5.52	79.98 ± 5.77	79.40 ± 6.89	83.78 ± 6.43	0.000‡	0.250	0.005†	-	–	–	–	–	–
	Female	75.66 ± 4.87	72.55 ± 6.45	74.13 ± 6.15	72.58 ± 4.24									
Go-Gn (mm)	Male	72.40 ± 5.21	70.57 ± 4.72	70.16 ± 7.79	70.68 ± 6.80	0.016*	0.054	0.790	–	–	–	–	–	–
	Female	70.56 ± 4.22	68.33 ± 4.37	69.59 ± 5.09	69.17 ± 3.80									
SN/GoGn (°)	Male	27.3 ± 4.58	31.20 ± 5.85	26.42 ± 5.89	26.48 ± 5.99	0.000‡	0.000‡	0.008†	0.000‡	1.000	0.063	0.000‡	0.435	0.620
	Female	27.75 ± 5.81	32.77 ± 6.58	28.33 ± 5.34	33.75 ± 4.08									
Gonial angle (°)	Male	121.01 ± 4.95	121.84 ± 5.72	119.80 ± 6.33	122.22 ± 3.95	0.297	0.090	0.207	–	–	–	–	–	–
	Female	120.65 ± 5.48	120.03 ± 16.44	121.91 ± 8.44	126.74 ± 5.27									
Age (y)	Male	21.43 ± 3.91	20.20 ± 2.65	21.67 ± 6.58	21.55 ± 1.64	0.002†	0.426	0.425	–	–	–	–	–	–
	Female	19.14 ± 2.42	19.76 ± 4.71	19.92 ± 3.26	20.33 ± 3.14									

*$P < 0.05$; †$P < 0.01$; ‡$P < 0.001$.

Supplementary Table II. Comparison of the dental values of the groups according to sex, group, and group-sex interactions

Parameter	Group	Group 1 (Class I)	Group 2 (Class II/1)	Group 3 (Class II/2)	Group 4 (Control)	P (sex)	P (group)	P (group × sex)	Comparison between groups					
									1 vs 2	1 vs 3	1 vs 4	2 vs 3	2 vs 4	3 vs 4
1-NA (°)	Male	17.37 ± 6.86	18.39 ± 8.68	3.59 ± 8.21	19.74 ± 4.15	0.502	0.000‡	0.814	1.000	0.000‡	0.755	0.000‡	0.762	0.000‡
	Female	19.98 ± 8.89	17.84 ± 8.05	3.98 ± 5.93	20.73 ± 7.01									
1-NA (mm)	Male	2.91 ± 2.45	2.59 ± 2.59	-.99 ± 2.03	3.76 ± 1.48	0.622	0.000‡	0.622	1.000	0.000‡	0.131	0.000‡	0.051	0.000‡
	Female	2.80 ± 2.83	2.74 ± 2.53	-1.78 ± 2.21	3.93 ± 2.37									
1-NB (°)	Male	16.47 ± 7.76	27.06 ± 5.04	15.69 ± 10.04	22.84 ± 5.51	0.235	0.000‡	0.512	0.000‡	1.000	0.000‡	0.000‡	0.183	0.000‡
	Female	17.65 ± 6.52	26.01 ± 5.40	17.52 ± 6.92	24.78 ± 6.18									
1-NB (mm)	Male	1.87 ± 2.20	5.53 ± 1.84	2.04 ± 2.35	4.19 ± 1.79	0.264	0.000‡	0.254	0.000‡	1.000	0.000‡	0.000‡	0.857	0.000‡
	Female	1.71 ± 2.04	4.41 ± 2.31	1.77 ± 2.28	4.58 ± 2.17									
Interincisal angle (°)	Male	143.17 ± 10.79	129.03 ± 10.29	152.79 ± 11.09	130 ± 23.28	0.670	0.000‡	0.837	0.000‡	0.000‡	0.000‡	0.000‡	1.000	0.000‡
	Female	141.77 ± 14.13	130.99 ± 10.16	153.76 ± 11.66	131.63 ± 10.04									
1-ANSPNS (mm)	Male	27.59 ± 0.87	31.25 ± 1.02	27.22 ± 1.14	28.52 ± 1.24	0.310	0.005†	0.631	0.006†	1.000	1.000	0.026*	0.476	1.000
	Female	26.04 ± 0.85	28.33 ± 0.83	26.80 ± 0.82	27.20 ± 1.24									
6-ANSPNS (mm)	Male	22.99 ± 2.24	23.44 ± 2.32	22.25 ± 2.70	25.10 ± 3.13	0.000‡	0.000‡	0.198	0.636	1.000	0.006†	0.033*	0.347	0.000‡
	Female	21.71 ± 1.48	22.44 ± 2.96	21.45 ± 2.27	22.46 ± 1.78									
1-GoGn (mm)	Male	37.82 ± 4.15	40.44 ± 3.07	38.85 ± 3.27	38.17 ± 3.54	0.000‡	0.000‡	0.263	0.001‡	1.000	1.000	0.003†	0.001‡	1.000
	Female	36.68 ± 2.63	38.04 ± 3.46	35.81 ± 3.20	35.39 ± 2.40									
6-GoGn (mm)	Male	29.97 ± 3.48	30.88 ± 3.47	29.84 ± 2.89	31.28 ± 2.99	0.000‡	0.059	0.612	–	–	–	–	–	–
	Female	27.40 ± 2.84	27.96 ± 2.64	26.62 ± 2.88	27.32 ± 1.80									
U1-U6/U6 × 100	Male	20.40 ± 8.87	22.07 ± 8.33	22.97 ± 10.71	22.91 ± 8.47	0.003†	0.000‡	0.154	0.031*	0.078	0.098	1.000	0.001‡	0.003†
	Female	20.28 ± 9.10	27.06 ± 13.88	25.44 ± 8.88	21.14 ± 6.73									
L1-L6/L6 × 100	Male	27.17 ± 15.06	31.79 ± 9.37	30.53 ± 6.74	23.02 ± 6.43	0.000‡	0.001†	0.778	0.148	1.000	0.162	1.000	0.000‡	0.019*
	Female	34.02 ± 10.74	36.68 ± 12.33	34.20 ± 8.84	29.65 ± 5.51									
Overbite (mm)	Male	6.34 ± 1.43	6.65 ± 1.50	7.57 ± 2.03	2.96 ± 1.15	0.735	0.000‡	0.549	0.759	0.000‡	0.000‡	0.010†	0.000‡	0.000‡
	Female	5.93 ± 0.88	6.45 ± 1.41	7.38 ± 1.58	2.16 ± 1.84									
Overjet (mm)	Male	3.14 ± 1.49	5.80 ± 2.63	2.48 ± 1.09	1.87 ± 0.71	0.575	0.000‡	0.711	0.000‡	0.007†	0.000‡	0.000‡	0.000‡	1.000
	Female	3.31 ± 2.04	5.43 ± 2.46	2.15 ± 0.98	1.94 ± 0.70									

*$P < 0.05$; †$P < 0.01$; ‡$P < 0.001$.