The morphology and texture of Iraqi skeletal class II young adults (Cephalometric study)

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ABSTRACT
Background: Different studies concerning craniofacial morphology of skeletal Class II have reported a lot of controversies in their results. The aim of the present study is to study the types of class II that can be found what are the texture and craniofacial growth pattern in each type rather than in the loose context of "Class II".

Materials and methods: The skeletal class II sample included 104 pretreatment digital lateral cephalometric radiographs (18-30 years) who were selected on the basis of Beta angle (<27°) and divided into five groups according to the location of maxilla and mandible in relation to the anterior cranial base (SNA and SNB angles). Another 30 radiographs were selected as a control group (normal SNA and SNB angles, Beta angle 27°-35°). Fourteen angular and nine linear measurements were digitized and recorded using AutoCAD 2010 computer program.

Results and conclusions: In comparison with skeletal class I, skeletal class II had no significant difference in anterior and posterior cranial base lengths and facial heights. The individuals with orthognathism of upper jaw and retrognathism of lower had the highest anterior facial height and the least mandibular base length, while those with prognathism of upper jaw with orthognathism of lower had the highest gonial angle with least articular angle. Combination of prognathism of maxilla with retrognathism of mandible showed vertical growth pattern with most convex profile. Retrognathism of both upper and lower jaws appeared in individuals with highest saddle and palatal plane angle with the least gonial angle, while individuals with prognathism of both jaws showed horizontal growth pattern with highest posterior facial height and least mandibular plane angle and anterior facial height.

Key words: Skeletal class II, class II, cephalometrics. (J Bagh Coll Dentistry 2011;23(3): 137-143)

INTRODUCTION
The skeletal relationship is not only important in the part it plays in occlusal development; it also plays a major part in orthodontic treatment. It seems likely that orthodontic treatment which is confined to tooth movement has little effect on the size, shape or relative positions of the basal parts of the jaws. Its only direct effect is on tooth position and on alveolar bone position and form. Therefore, as the teeth must be positioned on the basal bones, the skeletal relationship must limit the amount of tooth movement which can be achieved (1). An analysis of maxillary and mandibular skeletal positions is essential in planning dentofacial orthodontic treatment or orthognathic surgery. The skeletal nature of the patient may have an effect on the choice of the appliance and the evaluation of the treatment result (2). The relative size and anteroposterior position of the maxilla and the mandible in relation to the rest of the craniofacial complex has been one of the major problems dealt by investigators in the fields of orthodontics and anthropology (3). There are numerous angular and linear measurements to assess the sagittal discrepancy between maxilla and mandible, which is of prime importance in diagnosis and treatment-planning, all these measurements have shortcomings (4).

One of the approaches for assessment of anteroposterior dysplasia was developed and named the Beta angle which does not depend on any cranial landmarks or dental occlusion would be especially valuable whenever previously established cephalometric measurements, such as the ANB angle and the Wits appraisal, cannot be accurately used because of their dependence on varying factors (5).

It is important to identify whether the etiology of skeletal Class II is the maxilla, the mandible or combination of both of them and as the treatment should be planned according to the location of the discrepancies diagnosed in each individual patient.

MATERIALS AND METHODS
The sample
Out of 679 collected pretreatment digital true lateral cephalometric radiographs from the files of the patients who attended different Iraqi specialist dental centers, class II skeletal dysplasia were only identified in 104 radiographs according to Baik and Ververido (5) (Beta angle less than 27°). The control group consisted from 30 pretreatment digital true lateral cephalometric radiographs; that had a skeletal class I relationship (Beta angle 27° - 35°).

The Inclusion Criteria:
1. The samples were adult with an age ranged between 18-30 years.
2. All individuals had no apparent oro-facial deformity, such as cleft palate.

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(2) Professor, Orthodontic department, College of Dentistry, Baghdad University.
3. No apparent jaw fracture or surgical treatment.
4. Accepted quality cephalometric x-rays.
5. Individuals with open bite are excluded.

The methods

Cephalometric analysis

Firstly, to identify the individuals with skeletal class II (the sample) and those with skeletal class I (the control group), each lateral cephalometric radiograph was analyzed by using AutoCAD program to measure the Beta angle which should be less than 27° in skeletal class II and 27°- 35° in skeletal class I.

After importing the picture to the AutoCAD program, the points were localized, the planes were determined, and the angles and distances were measured. The angles were measured directly as they were not affected by magnification, while the linear measurements were divided by scale for each picture to overcome the magnification.

After measuring the Beta angle, fourteen angular and eight linear measurements were recorded for each selected radiograph and all measurements were put in excel sheet for the statistical analyses.

Then the sample with class II skeletal dysplasia was divided into 5 groups according to the location of the problem; the position of the maxilla and the mandible in relation to the anterior cranial base using the SNA and SNB angles (5); yet, these two angles were normal in the control group (SNA= 81°-82°; SNB= 78°- 79°) (6).

**Group 1:** individuals with normal position of maxilla and retruded mandible in relation to the anterior cranial base.

**Group 2:** individuals with normal position of mandible and protruded maxilla in relation to the anterior cranial base.

**Group 3:** individuals with protruded maxilla and retruded mandible in relation to the anterior cranial base.

**Group 4:** individuals with retruded maxilla and mandible in relation to the anterior cranial base.

**Group 5:** individuals with protruded maxilla and mandible in relation to the anterior cranial base.

Cephalometric landmarks, planes, and measurements

I. Cephalometric Landmarks

1. Point S (Sella): The midpoint of the Sella turcica (pituitary gland fossa) (7).
2. Point N (Nasion): The most anterior point on fronto-nasal suture in the median plane (8).
3. Point Ar (Articulare): The point of intersection of the external dorsal contour of the mandibular condyle and the temporal bone (8).
4. Point ANS (Anterior Nasal Spine): The tip of the anterior process of the maxilla and is situated at the lower margin of the nasal aperture (7).
5. Point PNS (Posterior Nasal Spine): This is a constructed radiological point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose. It marks the dorsal limit of the maxilla (7).
6. Point A (Subspinale): The deepest midline point on the premaxilla between the Anterior Nasal Spine and Prosthion (7).
7. Point B (Supramentale): The deepest midline point on the mandible between Infradentale and Pogonion (7).
8. Point Pog (Pogonion): It is the most anterior point on the mandible in the midline (7).
9. Point Me (Menton): The lowest point on the symphyseal shadow of the mandible seen on a lateral cephalograms (9).
10. Point Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and inferior border of the mandible (9).
11. Point Ii (Incisor inferius): The tip of the crown of the most anterior mandibular central incisor (7).
12. Point Is (Incisor superius): The tip of the crown of the most anterior maxillary central incisor (7).
15. Point C (The center of the condyle): Found by tracing the head of the condyle and approximating its center (5).

II. Cephalometric planes

1. Sella-Nasion plane (S-N).
2. Sella-Articulare plane (S-Ar).
4. Mandibular plane (MP).
5. Ramus plane (RP).
6. Long axis of the upper incisor (U1).
7. Long axis of the lower incisor (L1).
8. N- A line.
10. Denture base limit (AB plane).

III. Cephalometric measurements

A. Angular measurements

1. Beta angle (5).

The Beta angle is a new measurement for assessing the skeletal discrepancy between the maxilla and the mandible in the sagittal plane. It uses 3 skeletal landmarks:

- A point (Subspinale), B point (Supramentale), the center of the condyle (C)
Next, defining 3 lines:
- Line connecting the center of the condyle C with B point (C-B line).
- Line connecting A and B points.
- Line from point A perpendicular to the C-B line.

Finally, measuring the Beta angle which is the angle between the perpendicular line from point A to CB line and the A-B line. Its values are:
- Class I ($27^\circ$ - $35^\circ$), Class II $< 27^\circ$ and Class III $> 35$.

**Figure 1: Beta angle**

2. SNA angle: the anteroposterior position of maxilla relative to anterior cranial base (7).
3. SNB angle: It is the anteroposterior position of mandible relative to the anterior cranial base (7).
4. SN plane-Mandibular Plane Angle (SN-MP): This angle gives the inclination of the mandible to the anterior cranial base. It is formed at the point of intersection of the S-N plane and mandibular plane. This angle can give an indication to the type of rotation of the mandible (10).
5. SN plane-Maxillary Plane Angle (SN-Max.P): The angle of maxillary plane (ANS-PNS) inclination in relation to anterior cranial base, it is formed at the point of intersection of the S-N plane and maxillary plane (7).
6. Gonial Angle (Ar-Go-Me): The angle between posterior border of the ramus (Ar-Go) and the mandibular plane (Go-Me) (7).
7. Articulare angle (S-Ar-Go): This angle formed at the point of intersection of the S-Ar plane and the Ar-Go plane (7).
8. Inclination of lower incisor (L1/MP): The angle between long axis of lower incisor and mandibular plane (7).
9. Inclination of upper incisor (U1/Max.P): The angle between the long axis of upper incisor and maxillary plane (11).
10. Inter-incisal angle (U1-L1): The angle formed by the intersection of the lines representing the long axes of the most labial maxillary and mandibular incisors, posteriorly (3).
11. Basal plane angle (PP-MP): This defines the angle of inclination of the mandible to the maxillary base (7).
12. SN- AB plane angle: The angle between the S-N plane and the AB plane, posteriorly (12).
13. Saddle angle (N-S-Ar): It is the angle between the anterior and posterior cranial base (7).
14. Sum of the posterior angles: it’s the sum of saddle (NSAr), articular (S-Ar-Go) and gonial angle (Ar-Go-Me) (7).

**B. Linear Measurements**
1. S-N: A distance from Sella to Nasion (7).
2. S-Ar: A distance from Sella to Articulare (7).
4. Mandibular length: the distance from Gonion to Menton (11).
5. Ramus length: The distance between Ar and Go (7).
6. Upper anterior facial height (UAFH): It’s measured from N to ANS (13).
7. Lower anterior facial height (LAFH): measured from ANS to Me (13).
8. Posterior facial height (PFH): measured from S to Go (13).

**Statistical Analyses**
2. Inferential Statistics: Paired sample t-test: for intra-examiner and inter-examiner calibration, ANOVA test: for the comparison among the groups and Least significant difference test LSD test: for variables that show significant differences among the study groups in ANOVA test.

**RESULTS AND DISCUSSION**

The sample in this study was selected at age between eighteen and twenty nine years old to minimize the effect of any remaining skeletal growth (22) as the majority of facial growth is usually complete by 16-17 years of age (23). According to the collected sample with skeletal class II relationship, different relations were found between the maxilla and mandible in their relation to the anterior cranial base. The result of this study showed that each group had nearly similar percentage of the total sample, as the individual with retrogнатic maxilla and mandible and individuals with combination of prognathic maxilla and retrogнатic mandible had about 21% followed by individual with normal maxilla and retrogнатic mandible (20%); on the other hand individuals with prognathic maxilla and normal mandible and individuals.
with prognathic maxilla and mandible had almost the same percentage of about 19%.

The comparison between different groups of skeletal Class II and skeletal Class I group showed that there are great differences in the craniofacial features as manifested in the lateral cephalometric radiograph. The differences between the results of the present study and other studies may be attributed to different sample size, criteria of sample selection, or ethnic group.

**Group one:**

Individuals in this group displayed a significant retrognathic skeletal profile which was because of retrognathic mandible combined with a normal maxilla in relation to the anterior cranial base.

The slight anterior articulation of the condyle and the increased articular angle was not enough to bring the mandible in its normal position, thus the shortest mandible showed a backward rotation, moreover the gonial angle was slightly increased and the ramus length was almost normal. The palatal plane length was increased and maxillary plane angle was slightly decreased. It had the highest of each anterior facial height, lower anterior facial height and posterior facial height. The dentoalveolar pattern characterized by protrusive mandibular incisors, normal inclination of the upper incisors and decreased interincisal angle. The direction of growth pattern was within normal range.

**Group two:**

Group two had convex profile due to maxillary prominence associated with normally positioned mandible in relation to the anterior cranial base. The articulation of the condyle was slightly anterior in relation to the cranial base, in addition to the presence of the most reduced articular angle, it tend to bring the mandible in normal position in spite of the presence of backward rotation with the most significant increase in the gonial angle.

The upward rotated palatal plane was slightly increased, whereas the mandibular length and ramus length was slightly decreased. The anterior facial heights were almost normal while the posterior facial height was slightly decreased. The upper and lower incisors were protrusive in relation to their apical bases with decreased interincisal angle. The direction of growth pattern was within normal.

**Group three:**

It had the most convex profile because of the combination of protruded maxilla and retruded mandible in relation to the anterior cranial base. The cranial base characterized by significant decrease in the saddle angle that led to anterior articulation of the condyle, but the highest articular angle brought the mandible in a retruded position. The mandibular length was significantly decreased, moreover both the ramus length and posterior facial height were the shortest. This group had the greater backward rotation of the mandible (highest mandibular plane and basal plane angles), also the gonial angle was increased, all led to an increased anterior and lower anterior facial heights. The length of the maxilla was slightly increased with almost normal palatal plane angle.

It expressed the most inclined maxillary and mandibular incisors in relation to their apical bases; the interincisal angle was significantly the
least as compared to other groups. Significant vertical direction of growth can be seen in this group.

**Group four:**
Individuals were characterized by a markedly retruded profile as both the maxilla and the mandible are farther back beneath the anterior cranial base. It was the only group which showed posterior articulation of the condyle with a significant decrease in the mandibular length which led to the most retruded mandible; the ramus length was also slightly reduced.

The mandibular plane angle was slightly increased, while the basal plane angle, articular angle and the gonial angle was almost normal. The maxillary length was the shortest as compared to other class II groups with extreme steepness. The anterior, lower and posterior facial heights were slightly decreased with almost normal upper anterior facial heights. The dentoalveolar pattern characterized by lingual tipping of the maxillary incisors and protrusive lower incisors, the interincisal angle was almost normal, but it was the highest as compared to other class II groups. The growth pattern is within normal.

**Group five:**
It characterized by a prognathic skeletal relationship; both the maxillary and mandibular bases are anterior in relation to the anterior cranial base. The most significant anterior articulation of the condyle with the longest mandibular length made the mandible to appear prognathic which synchronized with the largest maxillary increment.

The mandibular and palatal plane angles were significantly decreased which mean forward rotation of the mandible and maxilla which is a unique feature for this group, while the gonial and the basal plane angles were almost normal. This group revealed the highest posterior facial height with the lowest anterior, upper and lower facial heights. The upper and the lower incisors were protrusive with decrease in the interincisal angle. The direction of growth pattern was significantly horizontal.

**The cranial base**
The saddle angle in the group four showed non significant increase compared with the control group, which agreed with Dhopatkar (11); Al-Azzawi (14) and Sanders et.al (15), group three and five had significant reduction in this angle, while group one and two showed no significant reduction, which came in agreement with Bjork (8); Wells (16); Kerr (17); Al-Saffar (18); and Al-Assal (19).

The anterior cranial base length (SN) showed no significant difference between all class II groups and control group, this was in line with Al-Saffar (18) and disagreed with Dhopatkar (11).

The posterior cranial base length (SAr) in the control group had no significant difference with all class II groups, which came in agreement with Al-Saffar (6), Rakosi (7) and Dhopatkar (11) whose found decrease in the lateral cranial base length in skeletal class II.

**The maxilla**
In the present study, the length of the maxilla in all class II groups found to have no significant difference compared with the control group which came in agreement with Al-Sahaf (6) and Al-Assal (19).

The mean value of SN-PP angle showed no significant reduction in group one, two and three compared with control group which is agreed with Al-Assal (19), group four had significant increase in this angle, on the other hand group five showed significant decrease which agreed with Palomo et al. (20).

**The mandible**
The mean value of the mandibular length (MP) in group one, three and four was significantly reduced, this agreed with Sanders et. al (15), while group two and five had no significant difference, this came in agreement with Dhopatkar (11).
Group one and five had no significant difference in ramus length, while other groups had reduced ramus length but in non significant level that came in agreement with Al-Assal (19) and Sanders et. al (15).

The SN-MP angle in group one, two and four showed no significant increase compared with the control group, that agreed with Al-Assal (18), but it was increased significantly in group three which came in agreement with Sayin et. al (21). Moreover the mean value of this angle in group five was significantly less than the control group which may be due to prognathism of the mandible that lead to forward rotation of the mandible and flatter mandibular plane angle in this group.

In this study there was no significant difference in all class II groups compared with the control group in gonial angle which is agreed with Al-Sahaf (6) and Al-Assal (18).

The Articular angle was significantly higher in group three than the control group, while the mean value in group one was non significantly higher which came in agreement with Rakosi (7) and Al-Assal (18).

Facial heights

Upper anterior facial height (UAFH) in group one and four had nearly similar mean values of control group; while in group two, three and five was non significantly reduced, this came in agreement with Kinaan et al. (22).

Lower anterior facial height (LAFH) was non significantly decreased in group four and five, while group one, two and three had no significant increase which agreed with Isik et. al (25).

The mean value of the anterior facial height (AFH) showed non significant reduction in group four and five, which came in agreement with Al Sahaf (6) and Kinaan et al. (22). Group two showed almost the same mean value as control group, while group one and four had slight increase which agreed with Isik et. al (23).

The mean value of the posterior facial height (PFH) was no significantly less in the group two, three and four that’s agreed with Kinaan et al. (22) and Sayin et. al (21). Group one and five which showed no significant increase were agreed with Al Sahaf (6).

REFERENCES

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Table 1. Descriptive Statistics of the study groups for angular and linear measurements

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