

## Cephalometric characteristics of Class II Division 2 malocclusion: A comparison with normal children

Khosravanifard B<sup>a</sup>, Fetrati A<sup>b</sup>, Rahimi H<sup>b</sup>, Asadi E<sup>b</sup>

### Abstract

Since the publication of Angle's definition of malocclusion types, many cephalometric researches have been carried out to determine characteristics of Class II division 2 malocclusions; however controversies still remain.

Considering the fact that a high percentage of patients seeking orthodontic treatment have this malocclusion, the present study was conducted in order to investigate Cross-Sectionally the cephalometric characteristics of Class II/2 malocclusions in 8-12 years old patients of Tehran Orthodontic Clinics.

Patients' files and pretreatment dental casts were screened, 30 Class II Division2 (17 girls, 13 boys) and 30 normal occlusion subjects were selected, each lateral cephalograms was traced and 36 dental and skeletal parameters were measured. Moreover student t test was carried out to assess the differences between malocclusion groups.

Besides maxillary incisal position (retruded in class II/2 group) which was used as an inclusion criterion, the following differences were observed:

- 1-The maxillary position is retruded compared to normal group.
- 2-The mandibular length is longer but its sagittal position is retruded.
- 3-The chin is more prominent.
- 4-The mandibular growth vector is horizontally oriented and the mandibular plane is flat, creating the appearance of a hypodivergent facial pattern. So Lower anterior facial height was on average smaller.
- 5-And finally retroclination of mandibular incisors compared to normal group is evident.

These findings indicate that besides the dental characteristics, Class II/2 malocclusion patients are also skeletally different from normal occlusion group to a certain extent.

In orthodontic disorders a thorough knowledge of dental and skeletal characteristics of particular malocclusion is very essential because they can influence our approach to treatment; the key to success of any orthodontic treatment is correct diagnosis.

Class II malocclusion is a common type of malocclusion which can result from numerous combinations of skeletal and dentoalveolar components<sup>1,2</sup>. Among these, class II/2 is relatively rare and comprises 1.5% to 7% of all malocclusions found in white western population<sup>3,4</sup>.

Several studies have considered the components of class II division2 malocclusion, but there was not an agreement on skeletal or dental imbalances. According to some researchers, with the exception of retroclined upper incisors, class II/2 has not a particular skeletal pattern

<sup>a</sup>Assistant professor, orthodontic department of Islamic Azad University Dental Branch, Tehran, Iran

<sup>b</sup>Postgraduate student of orthodontic department of Islamic Azad University Dental Branch, Tehran, Iran

when compared to class II/1 5-9 but others showed that this malocclusion is a distinct dentoskeletal deformity<sup>5, 10</sup>. Some studies have found no maxillomandibular dentoalveolar discrepancy<sup>5, 11, 12</sup>. However, Pancherz et al. (1997)<sup>7</sup> stated that mandibular retrusion was a common characteristic not only of Class II division 1 subjects but also of division 2 subjects. This controversy might be the result of sample size, sample selection criteria, age range, the cephalometric points identified, and the types of statistical tests used.

Class II/2 malocclusion is usually associated with an increased posterior facial height<sup>13</sup>, a reduced mandibular plane angle<sup>14,15</sup>, a reduced anterior facial height, a more horizontal growth vector,<sup>16</sup> prominent chin, retroclined incisors<sup>17,18,19</sup> and class II molar relationship<sup>20</sup>.

Cephalometric characteristics considering class II/2 for those of Caucasians might not be suitable to apply in different racial or ethnic groups. This study was carried out to describe the Cephalometric characteristics of Class II/2 in our region.

### Methods and Material

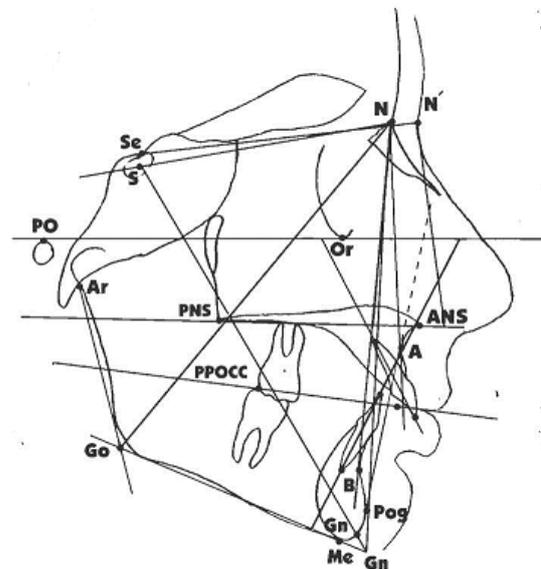
The patient's records of four universities (Tehran, Beheshti, Shahed, Azad) and seven private practice in Tehran were screened. Among them 30 patients with normal occlusion as a control group and 30 patients with class II/2 malocclusion with age range of 8-12 years were selected. In order not to be influenced by skeletofacial morphology, subject selection was based exclusively on dental cast analysis. Strict criteria for inclusion were used. Inclusion criteria for class II/2 were the following:

1. No history of previous orthodontic treatment
2. Bilateral distal molar relationship of more than one-half cusp width.

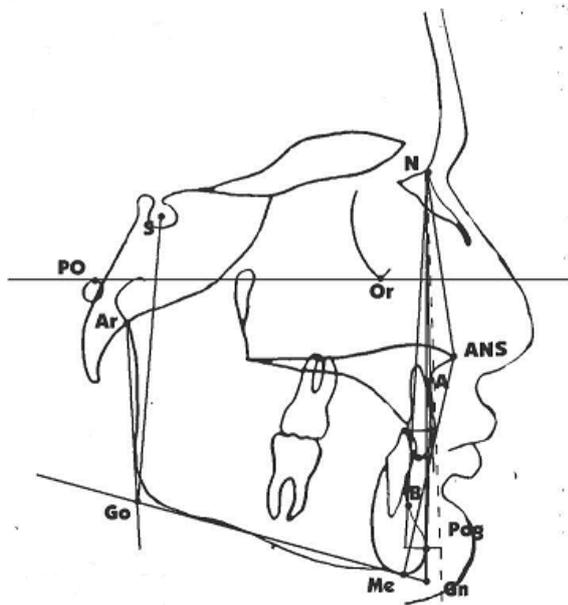
3. Retroclination of maxillary front teeth (at least two central incisors) and deep bite.

All cases were accepted after agreement of two specialists. Class I group included 15 girls and 15 boys with the age range of 10.4+1.3 and class II/2 group included 17 girls and 13 boys with the age range of 10.24+1.22.

Cephalometric landmarks were marked on lateral cephalograms of each patient. Each landmark was determined by two orthodontists. The cephalometric landmarks were later digitized. The cephalometric landmarks and measurements were calculated with an analysis program developed in the department. Angular and linear measurements are shown in figure 1 and 2 respectively.



**Figure 1: Cephalometric landmarks and angular measurements for each head film**



**Figure 2: Cephalometric landmarks and linear measurements.**

The following skeletal parameters were used:

Sagittal variables:

SNA, SNB, ANB, SN-Pog, Pog-NPerp, facial angle, angle of convexity

Vertical variables:

Inclination angle, Y-axis angle, mandibular plane angle, palatal-mandibular plane angle, N-ANS, ANS-Me, gonial angle

Mandibular measurement:

Ramus height (Ar-Go), body length (Go-Gn), Pog-NB

Dental parameters were used:

Interincisal angle, upper one to Frankfort horizontal, upper one to NA (mm), upper one to NA (angle), upper one to A-pog, lower one to Frankfort horizontal, lower one to mandibular plane, lower one to occlusal plane, lower one to NB (mm), lower one to

NB (angle), lower one to A-pog (mm), lower one to A-pog (angle).

To analyze the measurements error they were traced 2 month later. Paired T-test showed no statistically significant differences between two measurements. All measurement error coefficients were found to be greater than 0.90 and within acceptable limits using Dahlberg's (1940) formula.

Statistical analysis:

Comparison of experimental group and control group were made by One-sample z-test except inclination angle and palatal-mandibular plane angle which were done by using One-sample t-test.

$P < 0.05$  was considered a statistically significant difference.

## Results

A comparison between the boys and girls in each group indicated no differences between the genders, so the results for both genders were pooled.

The records of the skeletal and dental variables describing the morphology of the class II division 2 malocclusion and normal occlusion are shown in table 1.

## Discussion

The finding of this study revealed that Class II division 2 malocclusion is not a single clinical entity. To facilitate reading, cephalometric measures will be discussed in topics:

### Sagittal maxillary position (SNA):

Compared with normal occlusion the SNA angle was smaller in class II division 2 sample ( $p < 0.0001$ ). This finding is highly controversial with series of other studies which concluded that class II/2 malocclusion cases has normal<sup>5,6,8,16,20</sup> or slightly protruded<sup>8,21</sup> position. But our finding was consistent with Panchez findings, in which he compared a sample of

**Table 1. statistical comparison of cephalometric measurements between class II/2 and normal occlusion. SD, standard deviation,\* p<0.05**

Variable	Normal occlusion		Class II/2		comparison significance
	N=30 Mean	Age:10.4 SD	N=30 Mean	Age:10.24 SD	
Sagittal jaw position and relation					
SNA	81.76	2.93	78.83	3.87	0.000*
SNB	78.33	2.75	72.55	3.10	0.000*
ANB	3.42	1.50	6.28	1.80	0.000*
SN-pog	79.00	3.00	74.37	3.36	0.000*
Pog-N Perp	-7.00	1.00	-8.40	5.55	0.000*
Facial angle	85.57	3.97	85.40	3.10	0.818
Angle of convexity	7.04	5.62	10.07	5.20	0.003*
Vertical jaw position and jaw relation					
Inclination angle	85.00	—	83.68	3.61	0.55
Y-axis	62.15	4.43	58.47	3.53	0.000*
Mandibular plane angle	27.88	5.7	22.50	5.17	0.000*
Palatal-mandibular plane angle	25.00	—	22.82	4.82	0.020*
N-ANS	52.35	3.10	52.60	3.29	0.66
ANS-Me	65.94	4.61	63.18	4.40	0.001*
Gonial angle(Ar-Go-N)	51.31	5.90	50.70	3.71	0.569
Gonial angle(N-Go-Gn)	75.68	4.60	70.22	4.71	0.000*
Gonial angle(sum)	128.28	5.96	120.92	6.88	0.000*
Mandibular measurements					
Ramus height(Ar-Go)	40.35	2.96	43.02	3.68	0.000*
Body length(Go-Gn)	71.82	2.74	74.52	4.71	0.000*
Pog-NB(mm)	0.87	1.31	3.10	1.89	0.000*
Dental measurement					
Interincisal angle	125.38	8.20	146.20	7.81	0.000*
1 to Frankfort Horizontal	109.00	7.00	96.17	5.47	0.000*
1 to NA(mm)	4.73	1.73	1.97	0.99	0.000*
1 to NA(angle)	21.21	5.53	6.07	6.00	0.000*
1 to A-Pog(mm)	5.82	2.1	2.25	2.03	0.000*
1 to Frankfort Horizontal	55.48	7.76	62.02	7.52	0.000*
1 to mandibular plane	7.62	7.91	5.45	6.73	0.134
1 to occlusal plane	23.51	7.38	17.45	6.00	0.000*
1 to NB(mm)	6.38	2.22	4.18	1.65	0.000*
1 to NB(angle)	28.51	5.41	21.52	6.68	0.000*
1 to A-Pog(mm)	2.00	3.00	-2.07	1.91	0.000*
1 to A-Pog(angle)	24.00	5.00	17.65	5.31	0.000*

class II/2 samples with the Michigan and London reference data and found SNA angle being smaller in his samples<sup>7</sup>.

#### **Sagittal mandibular position (SNB,SNPg, Pg-NPerp):**

The mandible in patients with Class II/2 malocclusion is widely described in the literature as being retrognathic<sup>6,8,14,16,22-25</sup> when compared with the mandible in patients with Class I occlusions. The results of the present study agree with these findings. Both the SNB angle and SNPg was significantly smaller in class II division 2 samples (Table 1). Other studies<sup>14, 16, 22, 26</sup> have reached similar conclusions regarding the intermediate value of the mandibular sagittal position in Class II/2 malocclusion, whereas Blair<sup>21</sup> described a mild prognathic mandible. Renfroe<sup>22</sup> found a comparatively longer mandible in Class II/2 malocclusion, and Kerr et al<sup>26</sup> and Kerr and Adams<sup>27</sup> found no difference in the morphology of the mandible of Class II/1 and Class II/ 2 malocclusions.

When using Pg-Nperp to evaluate sagittal mandibular position a pattern similar to that of SNB and SNPg was found.

#### **Sagittal maxillary/mandibular relationship (ANB):**

Compared with normal occlusion the ANB angle was greater in class II division 2 samples  $p < 0.0001$ .

With respect to intermaxillary relationship, Hitchcock and Pancherz reported a statistically significant increase of the ANB angle in Class II/2 malocclusions<sup>7, 16</sup> similar to our findings.

#### **Facial angle and angle of convexity:**

Although Angle of convexity had a significant increase in class II/2 samples compared to class I occlusion ( $p < 0.01$ ) Facial angle differences between this two was not statistically significant.

#### **Vertical skeletal Parameters:**

The vertical characteristics of Class II/2 malocclusion include a flat mandibular

plane, an acute gonial angle, an enlarged posterior facial height, a reduced anterior facial height, and a more horizontal growth vector as indicated by the Downs Y-axis and Ricketts facial axis. The preceding list describes a definite hypodivergent facial pattern in the Class II/2 malocclusion group.

#### **a) inclination angle**

Compared to normal occlusion the decrease in inclination angle in class II/2 samples is not significant ( $P = 0.055$ )

#### **b) Y-axis**

Regarding Y-axis there is a significant difference between class I occlusion and samples of class II/2, Y axis is smaller in class II/2 samples ( $P < 0.0001$ ).

Brezniak findings is similar to ours<sup>28</sup>.

#### **c) mandibular Plane angle**

Compared to normal occlusion group mandibular plane angle is significantly smaller in class II/2 patients ( $P < 0.0001$ ). A review of the literature reveals a wide agreement regarding the inclination of the mandibular plane, several studies<sup>14,15,21,29</sup> are in agreement with the present one, indicating a low mandibular plane angle in Class II/2.

#### **d) palatal-mandibular plane angle**

The present study, as well as those of Ingervall and Arvystas found a more acute angle in Class II/2 malocclusion in comparison with Class I occlusion<sup>7, 30</sup>.

But Fischer Brandies<sup>8</sup> described no significant difference compared with a Class I group.

#### **e) N-ANS**

Compared to normal occlusion there is no significant difference regarding this index ( $P = 0.66$ )

#### **f) ANS-Me**

Unlike N-ANS distance, ANS-Me which indicates lower anterior face height, is decreased significantly in comparison to normal occlusion group ( $p < 0.001$ ). This finding is in agreement with Karlson findings<sup>6</sup>.

### g) Gonial Angle

Our findings as well as Blair<sup>21</sup> and Brezniak's<sup>28</sup> indicated that gonial angle was smaller in class II/2 patients. ( $p < 0.0001$ ) Noteworthy that, this was mainly because of smaller G2 (N-Go-Gn) in class II/2 samples ( $P < 0.0001$ ) rather than G1 (N-Go-Ar) ( $P = 0.569$ ).

### Mandible:

Mandibular dimensions (ramus height and body length) is suspected to many controversies, The mandible in patients with Class II/2 malocclusion is described in the literature as being small<sup>6, 7, 15, 20, 21, 25, 31</sup> when compared with the mandible in patients with Class I malocclusions<sup>10</sup> our findings on the other hand regarding both Ramus height and body length is in contrast with some of these finding. These dimensions are both greater in class II/2 samples:

#### a) Ramus height (Ar-Go):

Compared to class I occlusion Ramus Height is greater ( $P < 0.0001$ ).

b) Body Length (Go-Gn):

As in ramus height, mandibular body length is significantly greater in Class II/2 samples ( $P < 0.0001$ )

### Dentoalveolar parameters:

Angle's<sup>32</sup> original definition of Class II/2 malocclusion is based solely on dentoalveolar criteria. Therefore, it is not surprising to find broad agreement in the literature regarding the most evident dentoalveolar cephalometric characteristics of this malocclusion, such as a pronounced retroclination of the upper central incisors (Upper one to FH, NA, and A-Pog) an obtuse interincisal angle<sup>5,6,8,24,33</sup> and a deep overbite<sup>15, 16, 23, 24, 34</sup>. These findings are in full agreement with the results of the present study (Table 1).

With regards to the lower incisors, numerous studies have described these incisors as having a retroclined position<sup>23-26, 31, 34, 35</sup> whereas other studies<sup>5,7,20</sup> have

found them to have a normal inclination. In this study we found both, retroclination to the Frankfort Horizontal, and in normal position to the mandibular plane and NB (angle and distance). These results may explain the apparently contradictory results published in the literature<sup>10</sup>.

### Conclusions

Compared to Class I normal occlusion, Class II/2 malocclusion has the following cephalometric characteristics:

1. The maxillary position is retruded.
2. The mandibular length is longer but its sagittal position is retruded.
3. The chin is prominent.
4. The mandibular growth vector is horizontally oriented and the mandibular plane is flat, creating the appearance of a hypodivergent facial pattern.
5. The gonial angle is acute.
6. The upper central incisors are in pronounced retroclination.
7. The lower incisors have a normal inclination relative to the mandibular plane but are retroclined relative to various facial planes.
8. The interincisal angle is obtuse.
9. The overbite is deep, probably due to extreme skeletal mandibular counterclockwise rotation rather than dentoalveolar overeruption.

Finally, we conclude that Angle Class II/2 malocclusion has not only a pathognomonic dental appearance, but also several skeletal, sagittal, and especially vertical attributes that differentiate it from both Class I occlusion.

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