# SKELETAL CLASS 1 & 2 MALOCCLUSION EVALUATION IN JMDC ORTHODONTIC PATIENTS

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## ABSTRACT

*The study was carried out to investigate the etiological skeletal factors differentiating class 2 malocclusions from class one malocclusion patients at Jinnah Medical & Dental College, Orthodontics department.*

*A total of 34 (M:F ratio 13: 2 1) skeletal class 1 malocclusion patients (group A) and 39 (M:F ratio 23:16) severe class 2 division one malocclusion (group B) patients were selected at the department of orthodontics, Jinnah Medical & Dental College, Karachi. The age ranged between 18-22 years (mean age 19.8 years). All group A cases selected had ANB angle range of 2-4 ° (mean value 2.7 °) indicating skeletal class one antero-posterior relationship, while the group B had ANB angle greater than 4° (mean value 8.3 °) indicating skeletal class two malocclusion with severe antero-posterior discrepancy. Lateral cephalogram radiographs were traced for both Group A and B, and composite cephalometric analysis comprising skeletal, dental and soft tissue parameters were noted and the mean value obtained by SPSS 10.0 statistical evaluation program.*

*Group A patients had less cranial base length (S-N), less cranial base angle (S-N-Ar) and greater SNB angle values as compared to the Group B class 2 patients. Furthermore, group B demonstrated backward mandibular rotation tendency (mean Y-axis angle value 65.8 °), high angle tendency and sagittal mandibular deficiency.*

*Cranial base morphology has a significant effect on the underlying skeletal relationship of the jaws. Class two malocclusions have obtuse cranial base angle and longer cranial base lengths. Clock-wise mandibular growth rotation pattern may contribute to the mandibular skeletal deficiency in class two patients.*

***Keywords:*** *orthodontics, malocclusion, skeletal, cranial base.*

## INTRODUCTION

During orthodontic assessment, skeletal class one malocclusion is the most prevalent and commonly encountered discrepancy in the general population, followed by class two malocclusion1[-2]. According to anthropologists [3-4], the main distinguishing feature between the two common malocclusions is the positioning of the jaws with mandibular retrognathism and maxillary prognathism the main differentiating skeletal features of skeletal class two malocclusion.

Previous researchers [5-6] investigating to classify skeletal malocclusions found evidence of cranial base morphology as the main contributing factor to skeletal deviations. Furthermore, most authors [7-8] agree that

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cranial base anatomy influences the skeletal positioning of the underlying maxilla and mandible. The anterior and posterior parts of the cranial base forms a flexion of 130-135° at sella, with the maxilla attached to the anterior part and the mandible to the posterior part, therefore, variations in cranio-facial growth and orientation may effect jaw positioning leading to malocclusions.

As we know, the cranial base develops from chondrocranium and depicts both neural and somatic growth patterns, both effecting the finaljaw position and shape [9]. Furthermore, recent research[10,11] has shown that even brain growth, cranial synchondrosis development, enlargement of frontal sinuses and anterior surface remodeling of nasion affects the final positioning of the underlying skeletal structures.

Therefore, the aim of our study is to investigate the common skeletal and dental morphological features differentiating skeletal class one and two malocclusions, and to verify the contributing factors involved in causing skeletal discrepancies.

## MATERIALS & METHODS

A total of 34 (M: F ratio 13: 21) skeletal class 1 malocclusion patients (Group A) and 39 (M:F ratio 23:16) severe class 2 division one malocclusion (Group B) patients were selected at the department of orthodontics, Jinnah Medical & Dental College, Karachi. The age ranged between 18-22 years (mean age 19.8 years). Since mandibular growth continues till adulthood, a relatively stable age group was selected for reliable results. It should be noted that class 2 division two malocclusions were omitted due to lack of sizeable patient samples in the orthodontic department.

The skeletal, dental and soft tissue measurements were investigated using pre- treatment lateral cephalometric tracings exposed at the beginning treatment. All radiographs were taken in standing position, with the frankfort horizontal plane parallel to the floor, the dentition in centric occlusion and the lips relaxed.

Standardized cephalometric radiographs measuring 8" X 10" were taken using a Siemens Orthophos-C cephalostat with settings of 14mA, and between 73 and 77 kV. Exposure time varied between 0.5 and 0.63 seconds. The film used was either Kodak TMG-RA1 or DuPont Ultravision G, with a developing time of 90 seconds using a Kodak N35 developer.

Parameters measured in this study are explained below:

### 1. Skeletal Parameters

**SNA:** Sella-Nasion to Point A (82° ± 2°)

**SNB:** Sella-Nasion to Point B (80° ± 2°)

**ANB:** A point/Nasion/B point angle difference (2° ± 2°).

**SN Length:** Sella-Nasion Length measured in millimeters (normal 70 mm)

**Cranial Base Angle (Saddle Angle)** Nasion-Sella to Articulare (123° ± 5°)

**FMA:** Frankfort Horizontal (Orbitale- porion)-mandibular plane (gonion-menton)

**SN/Go-Gn:** Sella-Nasion to Gonion-Gnathion angle (32° ± 4°)

**Y-Axis:** Frankfort Horizontal- Sella Gnathion (59.4° ± 6 °)

### 2. Dento-Skeletal Parameters

**U.I/FH:** Upper incisor-frankfort horizontal plane angle (112°± 2°)

**U.I/ANS-PNS:** upper incisor-maxillary plane angle (108° ± 2 °)

**IMPA:** lower incisor-mandibular plane (90 ° ± 5°)

**Inter Inc. angle:** upper & lower inter-incisor angle (135° ± 5°)

### 3. Soft Tissue Parameters

**U.Lip/E:** Upper lip to esthetic plane (-3 mm ± 1 mm)

**L.Lip/E:** Lower lip to esthetic plane (0 to —1 mm)

**Naso-labial angle:** Nose to upper lip angle (102° ± 8 °)

**Convexity angle:** Soft tissue Nasion- pronasale to soft tissue pogonion (124 ° ± 5 °)

All group A cases selected had mean ANB angle range of 2-4° indicating skeletal class one antero-posterior relationship, while the group B had ANB angle range beyond 4° indicating skeletal class two malocclusion with severe antero-posterior discrepancy.

Lateral cephalogram radiographs were traced for both Group A and B, and composite cephalometric analysis comprising skeletal, dental and soft tissue parameters were noted **(Tables 1, 2 & 3)**

## STATISTICAL EVALUATION

SPSS 10.0 statistical evaluation program (Statistical Package for Social Sciences) was used to obtain mean values.

## RESULTS

**Group A & B Skeletal Parameters:** As evident, the Group A mean ANB value (2.7°) confirms the skeletal class one discrepancy as compared to the Group B value of 8.3 °. Furthermore, Group B patients had combination of slight maxillary prognathism (mean value 84.6°) combined with large mandibular retrognathism (mean value 76.3°). As compared to Group A, Group B patients also had downward mandibular rotation pattern as evident from the Y Axis mean value of 65.80°, which increased the FMA to 30.6° and the SN/GoGn angle mean value to 36.3°. The group B patients demonstrated more cranial base length (mean value 79.24 mm) as compared to the Group A mean value of 68.42 mm, showing a mean difference of 10.82 mm. In addition, the cranial base angle showed a mean difference of 12.6 with Group B having a mean value of 127.8° compared to Group A value of 115.2°.

**Group A & B Dento-Skeletal Parameters:** As observed, Group B patients demonstrated more upper incisor proclination (mean value 122.7°) as compared to Group A (mean value 115.3 °), as evident from the UI/ FH plane angle, showing a mean difference of 7.4 °. Both groups demonstrated lower incisor proclination with IMPA showing a mean value difference of 1.9 °with group B (mean value 96.7°) showing more lower labial segment proclination as compared to Group A (mean value 94.8 °).

**Group A & B Soft tissue Parameters:** Group B patients demonstrated more retrusion of the lower lip when compared to the Ricketts esthetic plane (mean value - 2.47 mm), while Group B also showed less nasolabial angle (mean value 94.8°) as compared to Group A (mean value 98.6 °) due to more upper incisor proclination in the class two patients. The convexity angle was reduced in Group B (mean value 128.6 °) as compared to group A (mean value 132.7 °) due to the mandibular retrognathism in class two patients.

TABLE 1: GROUP A & B SKELETAL CEPHALOMETRIC PARAMETERS MEASURED.

| Skeletal Analysis | Group A (Class 1) | Group B (Class 2) | Mean Diff. |
|---|---|---|---|
| **SNA<** | 83.9° | 84.6 ° | 0.7 ° |
| SNB< | 81.2° | 76.3° | 4.9° |
| ANB< | 2.7° | 8.3° | 5.6° |
| S-N Length (mm) | 68.42 mm | 79.24 mm | 10.82 mm ** |
| Cranial Base < | 115.2° | 127.8° | 12.6$^{0}$** |
| FMA< | 27.45° | 30.6° | 3.15° |
| SN-Go-Gn < | 31.5° | 36.3° | 4.8° |
| Y-Axis < | 59.32° | 65.80° | 6.28$^{0}$** |

** Statistically significant ($p<0.05$)

TABLE 2: GROUP A & B DENTO-SKELETAL CEPHALOMETRIC PARAMETERS MEASURED.

| Dento-Sk. Analysis | Group A (Class 1) | Group B (Class 2) | Mean Diff. |
|---|---|---|---|
| **UI-** FH plane < | 115.3° | 122.7° | 7.4$^{0}$** |
| UI- Max < | 111.2° | 113.4° | 2.2 ° |
| IMPA | 94.8° | 96.7° | 1.9 ° |
| Inter.Inc < | 127.8° | 124.1° | 3.7° |

** Statistically significant ($p<0.05$)

TABLE 3: GROUP A & B SOFT TISSUE PROFILE CEPHALOMETRIC PARAMETERS MEASURED.

| Soft tissue. Analysis | Group A (Class 1) | Group B (Class 2) | Mean Diff. |
|---|---|---|---|
| **Upper lip- E** | - 1.06 mm | -2.83 mm | 1.77 mm |
| Lower lip- E | -1.63 mm | -2.47 mm | 2.16 mm ** |
| Naso-Labial | 98.6° | 94.8° | 3.8 ° |
| < Convexity < | 132.7° | 128.6° | 4.1 ° ** |

** Statistically significant

(p<0.05) **DISCUSSION**

As observed, the investigations in our study depended solely on lateral cephalometric analysis. Normal Caucasian cephalometric parameters were taken to measure the skeletal, dento-skeletal & soft tissue parameters [12]. As noted in **table 1,** our cephalometric tracings confirmed the presence of skeletal class one and two malocclusions. In the study, we laid more emphasis on contribution of skeletal and cranial base morphology as compared to dental and soft tissue parameters to verify our claims. Our investigations correspond with previous researchers [13-14], who also solely investigated cranial base anatomy with skeletal orthodontic malocclusions with little regard to soft tissue parameters.

In our study, the skeletal class one and class two were selected according to the ANB values **(Table.1).** Due to lack of class three malocclusions in our department patient samples, we only concentrated on comparing skeletal class one and class two division one malocclusions with increased overjet. Values beyond 4 ° were categorized as skeletal class 2 cases, while 2-4 ° were selected as skeletal class one malocclusions. As evident, our class one (Group15) patients had normal upper and lower incis16-17linations within the normal standard deviation range **(Table.2).** However, the prevalence of bi-maxillary proclination in class one malocclusion should not be ruled out [19]. But as investigated by previous authors [118-17], no correlation whatsoever was found between class one malocclusion and cranial base morphology.

As evident from the present study, Group A patients had shorter cranial base length and cranial base angle as compared to Group B. Group A patients had cranial base length mean value of 68.42 mm combined with a cranial base angle mean value of 115.2 °. In comparison, Group B patients had more obtuse cranial base angle (mean value 127.8 °) and larger cranial base lengths (mean value 79.24 mm). Our findings agree with the results of Kerr & Herst [18] who found the cranial base angle as the best discriminator between Edward Angle's class one and two malocclusions with more obtuse angulations in class two malocclusions. Anderson & Popovich [19] investigating the Burlington Growth Center material also found larger cranial base angles and lengths in class two patients as compared to class one patients. To further support our findings, Singh et al [2°] and Baccetti et a1[21] also reported class two division one malocclusions with longer cranial base length and more obtuse cranial base angles, contributing to the skeletal positioning of the jaws. Furthermore, Dibbets [22] selected 140 cephalograms of mean age 12.5 years and found that cranial base angle and length was shortened systematically from class two to class one. However, bacon et al [23] disagrees with the co25-26ion and found no relationship between cranial base morphology and malocclusion. Other workers [24] also found no correlation between cranial base angle and skeletal malocclusions, while other recent investigations [26'28] wereunable to link cranialinvestigator,27-28d length with class two patterns.

In our study, we used articulare to measure the saddle angle due to lack of identification of basion, which is difficult to locate in lateral cephalograms. Previous investigator3[0,7-28] recommend even basion and Bolton points to measure the angle. Hopkin et a1[29] recommends articulare to construct the saddle angle, due to its ease of identification with the naked eye on x-rays. Varjanne & Koski ", however, strongly recommend basion, inspite ofpotential identification difficulties with articulare. However, previous authors [31-32] found the cranial growth pattern, whether they used articulare or basion, to be similar.

In the present study, the relationship of cranial base length on saggital maxillary position was noted.

Maxillary antero-posterior position was judged by the SNA angle. As evident in our sample, the cranial base length mean value difference of 10.82 mm (Group A value 68.42 mm/Group B value 79.24 mm) could be responsible for the slight maxillary prognathism (Group B SNA mean value 84.6 °). Our findings could support recent studies [33-34] agreeing that cranial base length effects maxillary positioning, with class two malocclusions having more length as compared to class one and three malocclusions. Furthermore, Thordarson A et.al [35] andAntonini A et.al [39] have emphasized direct claims that maxillary prognathism is solely due to increased anterior cranial base length from sella to nasion.

Also evident from our study is that class two patients (Group B) suffered from mandibular retrognathism causing convex facial profiles **(Table.3).** The mean ANB value 8.3° combined with the mean SNB value of 76.3 ° confirmed the severity of the class two skeletal malocclusions with mandibular saggital deficiency in our Group B patient samples. Furthermore, Group B also had tendency towards high angle rather than established high-angle with both FMA and SN- GoGn angle towards the upper limit of the normal range **(Table.1).** According to the Y-Axis mean value obtained (65.80 °) the Group B patients also demonstrated backward and downward mandibular growth rotation pattern, as compared to Group A (mean Y-Axis value 59.3 °). These results agree with the findings of Sukhia HR & Anjum Z [37] who reported increased prevalence of mandibular retrognathism in class two malocclusions in their Pakistani patient samples. The cranial base angle increase of 127;8 ° in our class two subjects (mean value difference of 12.6°) could be linked to mandibular retrognathism. To confirm these results, Gilmore [38] also found smaller mandibles in class 2 patients ranging from 16-42 years age attributed to larger cranial base angle and blamed backward mandibular rotations as etiological factor towards convex class two facial profiles. However, Menezes [39] in a cross sectional study disagreed with these findings and reported no mandibular retrognathism associated with large cranial base angles and blamed mandibular corpus length (Gonion-Menton) deficiency as contributing to convex facial profiles with small mandibles. Enlow DH[4°] also found no correlation with cranial base morphology and mandibular retrognathism.

## CONCLUSION

Cranial base morphology has a significant effect on the underlying skeletal relationship of the jaws. Class two malocclusions could be differentiated from class one malocclusions due to obtuse cranial base angle and longer cranial base lengths. Furthermore, the clockwise mandibular growth rotation pattern is debatable. In our study, the vertical analysis shows upper limit of the normal range, where as clock-wise rotation is suggestive of established high angle cases, thereby contributing to the sagittal skeletal deficiency in class two division one patients, exaggerating the convex profile.

However, skeletal class three malocclusions should be included in future studies to verify the effect of cranial base morphology on prognathic mandibles and hypoplastic maxillary complexes.

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