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Original Article

Cephalometric Characteristic of Skeletal Class II Malocclusion in Javanese Population at Universitas Airlangga Dental Hospital

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Abstract

Introduction: To describe the cephalometric characteristic of skeletal Class II malocclusion in Javanese Population at Universitas Airlangga Dental Hospital. **Methods:** A total of 118 lateral cephalograms of preorthodontic patients with skeletal Class II malocclusion were obtained from Universitas Airlangga Dental Hospital. The lateral cephalograms were analyzed using digital cephalometric analysis to determine the ANB, mandibular length, facial axis, Y-axis, sella to nasion-mandibular plane (SN-MP), and lower anterior facial height (LAFH). Correlation between mandibular length and other variables was analyzed using Pearson correlation test with $P < 0.05$. **Results:** There was an increase of ANB, Y-axis, SN-MP, and LAFH. While SNB was decrease and mandibular length was shortened. There was a significant correlation between mandibular length and other variables, such as facial axis, SN-MP, LAFH, and ANB. **Conclusions:** Skeletal Class II malocclusion in Javanese Population at Universitas Airlangga Dental Hospital was characterized by short mandibular length and large ANB mostly not by the increased of SNA but by the lack of SNB. The length of mandible correlated with facial axis angle, lower anterior facial height, and mandibular plane angle.

Keywords: *Javanese, mandibular length, skeletal Class II malocclusion*

Introduction

Human malocclusion is a disarrangement of dentocraniofacial development, including dental, skeletal, and soft tissues, which may lead to a distorted facial appearance, a limited masticatory function, an increased risk for dental trauma, and a compromised quality of life.[1] A multifactorial malocclusion etiology has generally been assumed, with both genetic and environmental contributions such as ethnicity, functional, also pathologic condition has a role in the variability of dentocraniofacial growth and development.[2]

Class II malocclusion is a common malocclusion with the prevalence ranging between 5% and 29%. Skeletal Class II malocclusion is present in 15% of the US and 35% of West Europe population. The prevalence of skeletal Class II Division 1 (14.9%–24%) found in Colombia and Iran population was higher than the Division 2 (3.4%–5.9%). These data showed that the prevalence of skeletal Class II malocclusion was huge among the worldwide population.[3-5] A more than one-half the width of one cusp distal relation of the lower to the upper permanent first molar combined with protrusive maxillary incisors was defined as Class II malocclusion by angle.[6] This may be due to the maxilla being hyperplastic, the mandible being hypoplastic, or a combination of both with ANB angle ≥4°, and mostly convex facial profile.

Some reports have indicated that the maxilla in Class II Division 1 patients was more protrusive and the mandible was normal in size and position. Other study found that the maxilla was in a normal position in relation to the cranial base while the mandible was retrusive. Other found that Class II skeletal pattern is due to both maxillary protrusion and mandibular retrusion. It seems that ethnic backgrounds of the sample used in these studies have played a role in determining the craniofacial characteristics of the Class II pattern.[7]

The studies of correlation among different cephalometric analyses that define facial types help orthodontist observe the many variations of these analyses, allowing them to decide the best measure to more accurately

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Access this article online
Website: www.contempclindent.org
DOI: 10.4103/ccd.ccd_465_18
Quick Response Code:

How to cite this article: Ardani IG, Sanjaya ML, Sjamsudin J. Cephalometric characteristic of skeletal Class II malocclusion in Javanese Population at Universitas Airlangga Dental Hospital. Contemp Clin Dent 2018;9:S342-6.

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define the diagnosis and treatment for their patients.[8] A study by Riedel[9] informed about the importance of the angle between the cranium base (sella to nasion [SN]) at the base of the mandible (Gonial to Gnathion [GoGn]) to determine the aspects of current and future growth. For Tweed,[10] the direction of facial growth is considered normal if the Frankfort mandibular plane (MP) angle presents values between 20° and 30°. Steiner[11] developed a cephalometric analysis adjusting the Y-axis of Downs, while Mcnamara using facial axis angle thus defining the results of anterior and lower growth vector of the mandible.

In order to optimize working time, to avoid errors in diagnosis and to reduce the orthodontic treatment duration, this study aimed to describe the cephalometric characteristic of skeletal Class II malocclusion with mandibular micrognathia in Javanese population at Universitas Airlangga Dental Hospital by measuring different cephalometric measurement such as ANB, mandibular length, facial axis, Y-axis, SN-MP, and lower anterior facial height (LAFH).

Methods

Sample

Preliminary research consisted of 465 lateral cephalometric X-rays of Javanese (Deutro-Melayu) adult population who were seeking orthodontic treatment at Universitas Airlangga Dental Hospital, from April 2015 to April 2016. From the total sample, there were 202 patients with skeletal Class I malocclusion (ANB = 1°–3°), 171 patients with skeletal Class II malocclusion (ANB ≥4°), and 92 patients with skeletal Class III malocclusion (ANB ≤0°).

Inclusion criteria of samples selection include Javanese individuals, ANB ≥4°, and complete permanent dentition. Exclusion criteria of samples selection include there is a history of orthodontic treatment, dentofacial trauma or temporomandibular joint disorders, genetic syndrome, missing teeth, and supernumerary teeth. From 171 patients, 118 samples were found eligible based on above criteria with age range of 15 to 35 years of which 24 were male and 94 were female.

Lateral cephalometric was then taken for each patient in natural head position while patient closes their teeth in centric occlusion and lips were in relaxed position. Cephalometric analysis performed using OrthoVision (Vatech, Gyeonggi-do, Korea) digital cephalometric by a single examiner. Reference lines and landmark to be analyzed:

1. ANB: Angle between SNA and SNB
2. Mandibular length: A line measured from the Condyle (Co) to the anatomic Gnathion (Gn)
3. SN-MP: Angle between SN and GoGn
4. Facial axis: Angle between basion to nasion and posteriosuperior aspect of pterygomaxillary fissure to constructed gnathion
5. Y-axis: Angle between Frankfort horizontal and sella to gnathion
6. LAFH: A line measured from the anterior nasal spine to the menton.

Statistical analysis

The mean and standard deviation for cephalometric measurement obtained were calculated using SPSS version 17.0 (IBM Company, New York, USA). Data distribution was analyzed using Kolmolgorov–Smirnov-*Z* and to determine the possible correlation between mandibular length and other variables, Pearson correlation test was used.

Results

The mean and standard deviation value for cephalometric analysis measurement was presented in Table 1.

There was some variation of skeletal Class II malocclusion that has been identified from this research: The most frequent variation of skeletal Class II malocclusion was combination of normal maxilla and mandibular length deficiency (97 patients), followed by excessive maxilla and normal mandibular length (10 patients), excessive maxilla and mandibular length deficiency (9 patients), and normal maxilla and mandibular length (2 patients) [Figure 1].

Pearson correlation test showed that there was a significant correlation between mandibular length and other variables, such as facial axis ($r = 0.273$; $P = 0.003$), SN-MP ($r = -0.214$; $P = 0.02$), LAFH ($r = 0.344$; $P = 0.00$), and ANB ($r = -0.319$; $P = 0.00$). However, there is no significant correlation between mandibular length and Y-axis ($r = -0.132$; $P = 0.154$).

Discussion

Longitudinal studies indicated that Class II dentocraniofacial can appear during the primary dentition. Although in some individual, this condition could be self-corrected during the growth period, in general, these discrepancies could not be self-corrected due to the difference in the magnitude and the direction of growth between individuals with Class II and Class I malocclusion. The most recent study of Class II

Table 1: Descriptive data of cephalometric analysis measurement

Measurement	Mean±SD
SNA (°)	82.34±3.49
SNB (°)	75.91±3.77
ANB (°)	6.42±1.70
Mandibular length (mm)	107.87±8.54
Facial axis (°)	−6.02±4.70
Y-Axis (°)	71.04±5.89
SN-MP (°)	38.88±6.30
LAFH (mm)	66.83±8.37

LAFH: Lower anterior face height; SD: Standard deviation

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variation, which evaluated 309 Class II Caucasian adults, resulted in seven principal components explaining 81% of the variation. Some of the seven principal components were vertical mandibular rotation, incisor angulation, and the size of the ramus and body of the mandible. Thereby it is important to know the variation of a limited number of principal components affects the craniofacial complex.[1]

In this study, skeletal Class II malocclusion with anteroposterior skeletal discrepancies are characterized by a large ANB (6.42 ± 1.70°), reflecting the malrelationship between the maxilla and mandible.[12] From Table 1, skeletal Class II have increased ANB, mostly not by the increased of SNA (82.34 ± 3.49°) but by the lack of SNB (75.91 ± 3.77°).

The measurement of mandibular length using GoGn as reference had been approved for long time as it is reliable and has a high consistency value.[13] The results this study

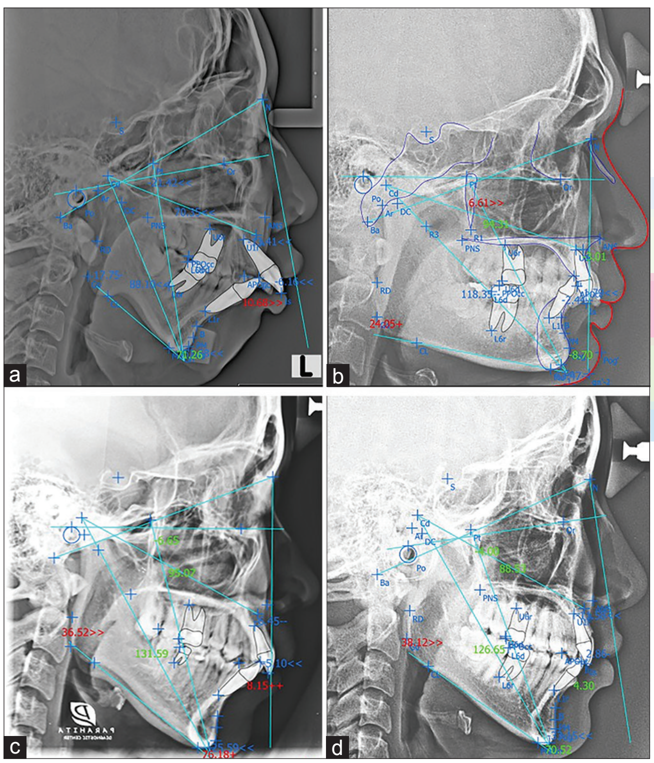

Figure 1: Variation of skeletal Class II malocclusion in Javanese population: (a) Normal maxilla with short mandible. (b) Large maxilla with short mandible. (c) Large maxilla with normal mandible. (d) Normal maxilla and mandible

showed the mean value if mandibular length on skeletal Class II malocclusion was 107.873 ± 8.54503. While various variation of mandible length in different ethnic was presented in Table 2. These results agree with the previous study which stated that Class II have smallest mean of mandibular length compare to Class I and III.[17] Kerr and Hirst[18] showed a significant difference of mandible length on normal group compared to Class II malocclusion. Class II patient had a convex profile with a distoocclusion pattern; the mandible is significantly more retruded than in Class I patients with the body of mandible smaller and overall mandibular length shorter.[19] Trend of skeletal Class II malocclusion pattern in Javanese population examined in this study has a convex facial profile as >80% of patients has a similarity in craniofacial growth pattern, which was the deficiency of mandibular length termed as mandibular micrognathia.

McNamara[20] mentioned that excessive vertical development is indicated by negative values (<90°) while deficient vertical facial development is indicated by positive values (>90°), which is obtained by measuring the angle formed of basion-PTM-gnathion and expected to have perpendicular relationship in a balanced face. The mean value of facial axis found in this study was −6.0134 ± 4.69692. This is in accordance with previous studies which stated that the facial axis angle in Class III females had the greatest degree, while Class II males and females had the smallest degree.[17]

Y-axis and SN-MP found in this study have bigger value than normal range, while the LAFH is above normal range. The respective values were also found greater compared to other ethnic with Class II malocclussion as presented in Table 2 which shows the variation of facial pattern in skeletal Class II was affected by different ethnic background.[7,14,15,17,21] It shows us the important role of genetic influence on every malocclusion type. As the previous study said that there will be significant difference cephalometric value between two different races.[16]

In this study, Pearson correlation coefficients were used to find out the interrelationship among variable measurement. From several measurements recorded in this study, there was significant correlation within the mandibular length and other variables, such as facial axis. The smaller mandibular length will have impact to the more negative value of

Table 2: Cephalometric characteristic of skeletal Class II malocclusion in different ethnic

Ethnic	SNA	SNB	ANB	SNGoGn	Y-axis	Facial axis	LAFH	CoGn
French Canadian[14]	80.51±3.44	76.09±3.16	4.43±1.81	35.54±5.29	-	-	-	105.80±5.69
China[7]	80.88±3.25	74.71±3.29	6.16±2.18	35.88±6.65	66.96±4.42	-	-	-
Nepal[7]	81.22±4.30	76.52±4.00	4.75±2.95	29.13±8.21	61.37±5.21	-	-	-
Saudi[15]	81.32±3.12	75.25±2.99	6.00±2.33	36.35±3.71	70.00±3.09	-	54.54±3.04	-
Italy[16]	80.4±2.2	73.5±1.6	6.8±1.7	37.5±3.3	-	-	-	94.5±3.1
Iraqi[17]	87.3±2.00	-	-	34.59±3.49	-	−0.60±0.169	63.63±2.96	102.30±3.25

LAFH: Lower anterior face height

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facial axis angle, as a compensation of facial growth and development. This excessive vertical development will cause mandible to seem retruded and long type face profile. On mandible growth process, the length of a long bone increase in a rectilinear direction along its long axis, then condylar process grows in a wide range of direction from anterosuperior to posterior. This divergent growth allows for highly diverse growth and morphology of mandible.[22] Condyle growth relates to the displacement direction of the mandible (transposition) and vertical jaw deviation. Negative facial axis means an increase of mandibular angle which characterized by posterosuperior condyle growth, apposition of inferior gonial, and inferoposterior mandible displacement. In other side, small mandibular angle was characterized by anterosuperior condyle growth, absorption of inferior gonial and anterior mandible displacement.[23]

There was significant correlation between mandibular length and ANB. The smaller mandibular length will cause bigger ANB, vice versa. There was also significant correlation between mandibular length and SN-MP. The shorter mandibular length, the bigger MP angle. Mean value of SN-MP was 38.89 ± 6.30°. According to Jacobson,[24] normal value of mandibular angle is 32° as the more or less value shows unfavorable growth pattern and will affect the treatment results. SN-MP describes the relation between mandible base to cranium. Large angle indicates domination of vertical growth and small angle indicates horizontal growth.[25]

While the mean value of Y-axis was 71.04 ± 5.89° with no significant correlation to mandibular length. Facial pattern on Class II malocclusion has larger Y-axis compared to Class I and III. Increasing Y-axis shows vertical growth of the mandible. Standard value of Y-axis in normal condition was range between 53 and 66.[24]

LAFH mean value is 66.83 ± 8.37 mm with significant correlation to mandibular length. Ali[17] described that LAFH (ANS–Me) had the greatest values in males of Class II group, this was in line with McNamara[20] who mentioned that if LAFH is increased, the mandible will appear to be more retrognathic and if this height decreased the mandible will appear to be more prognathic.

Hyperdivergent patients exhibit an increase of LAFH, while hypodivergent patients have a shorter LAFH. The results of this study are in accordance to the previous studies stated that the increase of LAFH was caused by the backward rotation of mandible, where maxilla also descends down to compensate the mandibular growth. Opdebeeck and Bell[26] suggested that long face syndrome was attributed to clockwise rotation of mandible and short face syndrome attributed to counterclockwise rotation of mandible.

According to Björk and Skieller,[22] forward mandibular rotation occurs when posterior facial height (PFH) overdevelops relative to anterior facial height (AFH). However, many literature were more focused in the AFH and LAFH values as it has been confirmed to have a strong influence on the formation of vertical facial disproportions. A high or low MP angle might not necessarily be accompanied by long or short anterior face height, respectively. Rather than AFH, PFH is assumed to play a key role in the vertical facial type, whereas AFH seems to undergo relatively intrinsic growth. The reason for mandibular forward rotation is not caused by the combination of PFH increase and AFH decrease, but due to their different dimension increase. Van Spronsen *et al*.[27] also proposed that musculoskeletal interaction might differ between populations with normal faces and selected group of individuals with long faces.

It can be assumed that mandibular length has important role to manifest the dentocraniofacial type of skeletal Class II malocclusion. Skeletal state of Class II will be exacerbated by the discovery of short mandibles relative to maxillary length, thus giving convex facial profiles and higher anterior face height with a steep mandibular angle and a large Y-axis angle. These features may favor specific treatment concepts when treating Javanese ethnic with skeletal Class II malocclusion.

Conclusions

Skeletal Class II Malocclusion with mandibular micrognathia in Javanese Population at Universitas Airlangga Dental Hospital was characterized by an increased ANB, short mandibular length, negative value of facial axis, large value of MP angle, Y-axis, and LAFH. There was also a significant correlation between mandibular length and various variables, namely, facial axis, MP angle, ANB angle, and LAFH.

Financial support and sponsorship

Research grant is funded by Annual Work Plan and Budget of Faculty of Dental Medicine, Universitas Airlangga No: 0279/UN3.1.2/2017.

Conflicts of interest

There are no conflicts of interest.

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