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Research Article

A Study of Anteroposterior Dental and Skeletal Components of Class II Division 1 and Division 2 Malocclusion

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ABSTRACT

Objective: This study aimed to investigate the prevalence of subdivision Class II/1 and II/2 malocclusion, and analyse the anteroposterior skeletal characteristics associated with Class II/1 and II/2 malocclusion.

Methods: Records of patients diagnosed with class II malocclusion between June 2012 and January 2017 were obtained from the LASUTH orthodontic clinic archive excluding those with incomplete records. Their lateral cephalographs were traced and analyzed. Parameters for Class II/1 and Class II/2 malocclusions were compared with each other and with normative values obtained from a Nigerian sample population.

Results: There was no significant gender difference ($p > 0.05$) in the distribution of Class II malocclusion divisions among the subjects. Class II/1 subjects had more subdivision presentations than Class II/2 patients although there were no significant differences ($p > 0.05$). Patients with Class II/1 malocclusion showed a statistically significant higher ANB value than their Class 1 controls and Class II/2 subjects ($p < 0.05$). Class II malocclusion patients aged 15 – 18 years had a significantly reduced SNB value compared to their Class I occlusion control ($p < 0.05$).

Conclusion: Class II/1 and Class II/2 can occur with a variety of skeletal and dental components in the anteroposterior dimension.

INTRODUCTION

In 1899 Edward H. Angle proposed a classification system based on the relationship of the mandibular first molars to the maxillary first molars. He characterized the Class II malocclusions as having a distal relationship of the mandibular teeth relative to the maxillary teeth of more than one-half the width of the cusp.[1] Angle[1] characterized two types of Class II malocclusions based on the inclination of the maxillary central incisors.

Class II division 1 (II/1) was described as when Class II molar relationship is present with proclined upper central incisor and there is an increase in overjet. The condition when Class II molar relationship is present with retroclined upper central incisors, upper lateral incisors may be proclined or normally inclined and overjet is usually minimal or may be increased was described as Class II division 2 (II/2). In addition, Class II subdivision was described as a condition when the Class II molar relationship exists on only one side with normal molar relationship on the other side.

Two types of Class II subdivision malocclusion have been identified: type 1, characterized by distal positioning of the mandibular first molar on the class II side with coincidence of the maxillary dental midline with the facial midline and deviation of the mandibular midline, and type 2, characterized by mesial positioning of the maxillary first molar on the Class II side with coincidence of the mandibular dental midline with the facial midline and deviation of the maxillary midline.[2]

The prevalence of malocclusion has been reported to vary from nation to nation and among diverse gender and age groups. The prevalence of Class II malocclusion was reportedly lower than Class I malocclusion but higher than Class III malocclusion among various populations with 17.5%, 14% and 12.9% reported among Jordanian,[3] Nigerian[4] and Tanzanian[5] populations respectively.

Class II/1 was reportedly more common, with 24.1% reported in an Iranian population while a prevalence of 3.4% was found for Class II/2 malocclusion.[6] Similarly, a prevalence of 19% and 5% were found for Class II/1 and Class II/2 malocclusion respectively among a Turkish population.[7] Among Nigerian study population, while a prevalence of Class II/1 malocclusion was reported as 1.1% - 3.9%,[8-10] Class II/2 was however reported as 0.5% - 2.4%.[9,10]

The dento-skeletal morphology of Class II malocclusion has been examined in a number of cephalometric investigations with varying results.[11-13] Some studies found that the maxilla in Class II/1 patients was more protrusive, while the mandible was normal in size and position.[14]

In contrast, other studies found the maxilla in a normal position in relation to the cranial base while the mandible was retrusive in some Class II/1 patients.[11,12] Another study found that the Class II skeletal pattern in Class II/1 patients was due to both maxillary protrusion and mandibular retrusion.[13]

For Class II/2 malocclusion, while most of the studies found that the maxillary anteroposterior position is similar to that of Class I or Class II/1 subjects,[15-17] others indicated a more prognathic position of the maxilla.[18,19] However, Ballard1[20] reported a retrognathic maxilla while some reports indicated a retrognathic mandible in Class II/2 malocclusion.[13,21,22]

There is a need to understand the underlying aetiology of Class II malocclusion and its subdivisions in order to institute treatment for better outcomes and patient satisfaction. The objectives of this study were to investigate the prevalence of subdivision malocclusions in Class II/1 and II/2, and analyse the anteroposterior skeletal characteristics associated with Class II/1 and II/2 malocclusion in a Nigerian sub-population of orthodontic patients.

MATERIALS AND METHODS

This retrospective study was performed through an examination of case records including study models, cephalometric radiographs and orthodontic treatment case notes of patients that presented with Angles Class II malocclusion between June 2012 and January 2017 at the orthodontic clinic of the Lagos State University Teaching Hospital in Lagos, Nigeria. This study was carried out with approval from the Research and Ethics committee of the Lagos State University Teaching Hospital.

Selected participants were healthy patients of Nigerian origin with presence of all maxillary and mandibular permanent teeth up to the first molars, had no history of previous orthodontic treatment, with complete pre-treatment records and good quality radiographs. Patients with incomplete records and poor quality of cephalometric radiographs were excluded from the study.

Subjects with the mesiobuccal cusp of the maxillary permanent first molar occluding anterior to the buccal groove of the mandibular first permanent molar on at least one side, proclination of maxillary incisors, and overjet >4mm were diagnosed as Class II/1 malocclusion. Subjects with the mesiobuccal cusp of the maxillary permanent first molar occluding anterior to the buccal groove of the mandibular first permanent molar on at least one side with retroclination of maxillary central incisors were diagnosed as Class II/2 malocclusion.

They were thereafter divided into three age groups, group 1 (10 – 14 years), group 2 (15 – 18 years) and group 3 (19 years and above).

Control subjects for groups 1 and 2 were selected from cephalometric radiographs of healthy Nigerian school children, who consented to participate in a previous study. Their radiographs and data were retrieved with permission from the author.[23] They were divided into two age groups, 12 – 14 years and 15 – 16 years old. They had balanced faces and acceptable profiles, Class I occlusion with normal overjet and overbite, no crowding or spacing, no history of orthodontic treatment, and born of Nigerian parents. An age-matched control group was selected for group 3 from consecutive untreated patients with Angles Class I malocclusion, crowding or spacing less than 4mm, normal overjet and overbite, who presented within the same period as the text subjects at the orthodontic clinic of the Lagos State University Teaching Hospital in Lagos, Nigeria.

The cephalometric radiographs were taken on Planmeca ProMax (Planmeca USA Inc, IL, USA) at an exposure of 68KV, 13.0mA and 15.8s.

All radiographs were viewed and traced manually with acetate tracing paper in a dark room using an x-ray viewer (Slim-Line™ View Box, Select Dental Manufacturing Inc, NY, USA). Cephalometric landmarks were made on each cephalograms by the same investigator, (Figure 1) and angular measurements of the following variables were made using a protractor:

SNA (º): Assessment of the antero-posterior position of the maxilla relative to the cranial base formed by the intersection of lines S – N and N – A planes.

SNB (º): Assessment of the antero-posterior position of the mandible relative to the cranial base formed by the intersection of lines S – N and N – B planes.

ANB (º): The difference between angles SNA and SNB.

To assess the measurement error, 10 lateral cephalograms were randomly selected and steps of tracing, landmarks identification and measurement were repeated by the same investigator after three weeks of initial examination, thus generating a new set of measurements. Intra-class correlation coefficients were performed to assess the reliability for the measurements (Table 1).

Data were analysed in SPSS for Windows (SPSS, version 21.0, Chicago, IL, USA). The mean and standard variation for each variable was calculated. The chi square test was used to reveal any differences in the distribution of Class II malocclusion when stratified by gender and between the division groups based on the presence and location of a subdivision. Comparison between Class II/1 and Class II/2 groups and with the means of the variables for Class I normal occlusion subjects for all measured parameters were made using independent Student's t-test. A p-value of < 0.05 was taken as statistically significant.

RESULTS

Out of 648 patients diagnosed with malocclusion within the study period, 98 patients were diagnosed with Angles Class II malocclusion. A total of 49 patients, 17 males (34.7%) and 32 females (65.3%) with a mean age of 11.7 ± 1.6years met the inclusion criteria for group 1.There were 34 (69.4%) with Class II/1 while 30.6% (N = 15) had Class II/2. Group 2 had a total of 25 patients, 7 males (28%) and 18 females (72%) with a mean age of 16.6 ± 1.1years.There were 21 (84%) with Class II/1 while 16% (N = 4) had Class II/2. Group 3 had a total of 19 patients, 2 males (10.5%) and 17 females (89.5%) with a mean age of 24.2 ± 4.9years.There were 16 (84.2%) with Class II/1 while 15.8% (N = 3) had Class II/2.

There was no significant gender difference ($p > 0.05$) in the distribution of Class II malocclusion divisions among the patients in the three groups(Table 2).

The distribution of the Class II malocclusion subjects by groups based on their subdivisions is presented in Table 3.

Class II/1 subjects had more subdivision presentations than Class II/2 patients although there were no significant differences ($p > 0.05$).

The mean and standard deviation of each measured skeletal variable for male and female subjects were calculated in each group (Table 4). Females with Class II/1 in group 1 had a significantly higher ANB than their male counterparts ($p < 0.05$). Group 2 Class II malocclusion patients showed males with higher SNA and SNB than their female counterparts. However, no significant gender difference was observed among group 3 Class II subjects ($p > 0.05$).

Table 5 shows the result of comparison of measured cephalometric variables between Class II/1 and Class II/2 malocclusion patientsand with Class I occlusion controls. Patients with Class II/1 malocclusion in the three groups showed a statistically significant higher ANB value than their Class 1 controls ($p < 0.05$) and those in group 2 had a significantly reduced SNB value ($p < 0.05$). Group 2 Class II/2 patients showed a significantly reduced SNA and SNB compared to their Class I occlusion control ($p < 0.05$). The ANB angle was significantly different between the two divisions in the three age groups ($p < 0.05$).

Table 1. Method Error

Variable	Method Error
SNA (º)	0.99
SNB (º)	0.99
ANB (º)	0.77

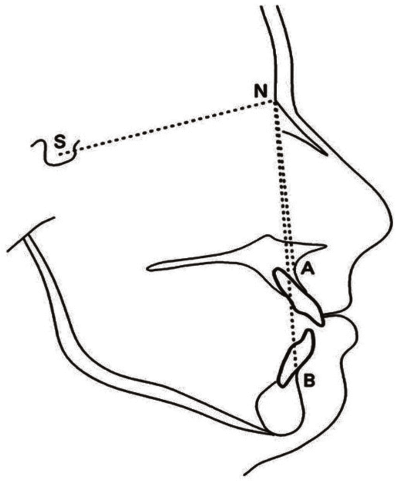

Figure 1. Cephalometric landmarks: Sella (S) The midpoint of sella turcica; Nasion (N) The most anterior point on the frontonasal suture; A point represents the most concave point of the anterior maxillary base; B point represents the most concave point of the anterior contour of mandibular symphysis.

Table 2: Distribution of Class II malocclusion subjects according to Gender

	Group 1			Group 2			Group 3		
Variable	**M N(%)**	**F N(%)**	**Total N(%)**	**M N(%)**	**F N(%)**	**Total N(%)**	**M N(%)**	**F N(%)**	**Total N(%)**
Class II/1	11(22.4)	23(46.9)	34(69.4)	6(24.0)	15(60.0)	21(84.0)	2(10.5)	14(73.7)	16(84.2)
Class II/2	6(12.2)	9(18.4)	15(30.6)	1(4.0)	3(12.0)	4(16.0)	0(0)	3(15.8)	3(15.8)
Total	17(34.7)	32(65.3)	49(100.0)	7(28.0)	18(72.0)	25(100.0)	2(10.5)	17(89.5)	19(100.0)

$X^2 = 0.967$ $p = 0.325$ $X^2 = 0.021$ $p = 0.884$ $X^2 = 0.419$ $p = 0.517$

Table 3: Distribution of subdivision malocclusion within each Class II division group

	Group 1			Group 2			Group 3		
Variable	**R N(%)**	**L N(%)**	**Total N(%)**	**R N(%)**	**L N(%)**	**Total N(%)**	**R N(%)**	**L N(%)**	**Total N(%)**
Class II/	2(15.4)	7(53.9)	9(69.2)	1(25.0)	3(75.0)	4(100.0)	2(66.7)	0(0)	2(66.7)
Class II/2	3(23.1)	1(7.7)	4(30.8)	0(0)	0(0)	0(0)	0(0)	1(33.3)	1(33.3)
Total	5(38.5)	8(61.5)	13(100.0)	1(25.0)	3(75.0)	4(100.0)	2(66.7)	1(33.3)	3(100.0)

$X^2 = 3.259$ $p = 0.07$

Table 4. Comparison of mean and standard deviation of measured variables for male and female subjects in each group

Group	Variable	Class I Male	Class I Female	Class II division 1 Male	Class II division 1 Female	Class II division 2 Male	Class II division 2 Female
1	SNA	84.8 ± 3.1	85.7 ± 3.5	85.2 ± 4.2	87.7 ± 3.8	83.7 ± 3.6	87.1 ± 6.2
	SNB	81.7 ± 2.7	82.4 ± 3.6	81.2 ± 4.9	81.2 ± 3.0	81.1 ± 2.7	84.1 ± 6.4
	ANB	3.1 ± 0.9	3.3 ± 0.8	4.0 ± 2.5	6.7 ± 3.0*	2.7 ± 3.4	3.0 ± 3.3
2	SNA	85.4 ± 4.5	87.6 ± 2.7	89.3 ± 7.8	82.9 ± 3.4*	85.5 ± 0.0	78.2 ± 0.6†
	SNB	82.4 ± 4.3	84.2 ± 2.7	84.3 ± 5.9	77.9 ± 3.9†	82.8 ± 0.0	75.8 ± 1.4
	ANB	3.0 ± 0.9	3.3 ± 0.9	5.3 ± 3.0	5.0 ± 2.3	2.7 ± 0.0	2.3 ± 2.0
3	SNA	84.2 ± 4.6	87.1 ± 4.9	90.0 ± 12.7	85.8 ± 4.4	-	84.8 ± 6.5
	SNB	80.8 ± 4.4	83.7 ± 4.6	85.3 ± 8.87	9.6 ± 4.9	-	80.8 ± 4.9
	ANB	3.4 ± 0.9	3.4 ± 0.7	5.3 ± 4.6	6.3 ± 1.0	-	4.0 ± 1.7

$^{*}P < 0.05$, $^{\dagger}P < 0.01$

Table 5. Comparison between mean and standard deviation of measured variables in Class II division 1 and Class II division 2 with Class I normal occlusion

Group	Variable	Class I	Class II division 1	Class II division 2
1	SNA	85.3 ± 3.3	86.9 ± 4.0	85.8 ± 5.4
	SNB	82.1 ± 3.2	81.2 ± 3.6	82.9 ± 5.4
	ANB	3.2 ± 0.9	5.8 ± 3.1‡	2.9 ± 3.2
2	SNA	86.3 ± 3.9	84.7 ± 5.7	80.0 ± 3.7†
	SNB	83.2 ± 3.7	79.7 ± 5.3†	77.6 ± 3.7†
	ANB	3.1 ± 0.9	5.1 ± 2.4‡	2.4 ± 1.7
3	SNA	86.1 ± 4.8	86.3 ± 5.4	84.8 ± 6.5
	SNB	82.7 ± 4.6	80.3 ± 5.4	80.8 ± 4.9
	ANB	3.4 ± 0.7	6.1 ± 1.5‡	4.0 ± 1.7

$^{\dagger}P < 0.01$, $^{\ddagger}P < 0.001$

DISCUSSION

This study revealed that a higher proportion of patients had Class II/1 compared to Class II/2 (Table 2). This agrees with previous studies that reported that Class II/1 was more common than II/2 among varying population.[9,24]

Sexual dimorphism in the frequency of occlusal relationship was not observed in current study (Table 2). This agrees with previous study among Nigerian school children which found no influence of gender on occlusal traits.[9] It, however, differs from a study among orthodontic patients at a Nigerian dental centre which found class II malocclusion more prevalent in males than females.[25] In another study, a statistically significant gender difference in occlusal traits was reported among Lebanese school children[24] with class II division 1 more in males and class II division 2 more among females.

The present study found the occurrence of subdivisions higher in Class II/1 than in Class II/2 malocclusion patients (Table 3) in the three age groups. This finding is in contrast to findings by Anderson et al.,[26] who studied the aetiology and prevalence of class II subdivision using CBCT and reported significantly greater prevalence of unilateral Class II malocclusion in Class II/2 patients than in Class II/1 patients. They, thereby, suggested that asymmetry was one of the features that commonly characterized class II/2 malocclusion.

The aetiology of asymmetry in class II malocclusion had been reported to be mainly dento-alveolar[26] leading to an observation of 2 types of Class II subdivision malocclusion. The type 1 characterized primarily by distal positioning of the mandibular first molar on the class II side with a mandibular dental midline deviation toward the class II side[2,27,28] or the type 2 secondarily by mesial positioning of the maxillary first molar on the class II side with a maxillary dental midline deviation away from the class II side[29]

However, Class II subdivision had been related to mandibular asymmetry that is shorter and more posteriorly positioned on the class II side,[30,31] while other studies found no skeletal asymmetry of the mandible in Class II subdivision cases.[27] Minich *et al* [29] found that the maxilla was positioned more anteriorly on the class II side relative to cranial base in subdivision Class II malocclusion cases. However, some studies found that both skeletal and dento-alveolar factors contributed to the asymmetric buccal segment relationship present in subdivision Class II malocclusion cases.[2,28] Therefore, larger population studies would be needed to better estimate the true prevalence and aetiology of subdivision in Class II/1 and Class II/2 populations.

The present study found no significant difference ($P = 0.07$) in the side of the jaw with the subdivision (Table 3). A previous study reported that the most commonly affected side with subdivision among patients with Class II/1 patients was the right side.[32]

The normative values for SNA and SNB among Nigerians were 85.5 degrees ± 3.5 and 82.7 degrees ± 3.2 respectively, and the mean ANB values were 3.1 degrees ± 0.8.[33] In the present study, the maxilla was orthognathic in Class II/1 and Class II/2 subjects examined in the present study among the three age groups with the exception of Class II/2 patients in group 2 where maxillary retrognathism was observed (Table 5). A number of cephalometric studies that dealt with Class II malocclusions indicated that the relationship of the maxilla to the cranial base showed no significant differences between Class II/1 individuals and matched normal subjects.[18,34,35] However, some studies found the maxilla to be more protusive in Class II/1 subjects[13,14] and Class II/2 individuals[18,19]while a more retrognathic maxilla was reported in Class II/2 subjects.[20]

The mandible was orthognathic in Class II/1 and Class II/2 patients in groups 1 and 3 but significantly retrognathic in Class II/1 and Class II/2 in group 2. (Table 5). A previous report[34] indicated that mandibular retrognathism was a commoner characteristic of Class II/1 than II/2 malocclusion. Another study reported mandibular retrusion in Class II/1 subjects.[1,22]while some indicated mandibular retrognathism as a common characteristics of both Class II/1 and Class II/2 malocclusion.[13] The variation in results could be due to differences in age of the samples studied.

The present results provide support for cross-sectional studies suggesting that Class II malocclusion is most often due to retrognathic, short mandibles and orthognathic maxilla,[36]Longitudinal studies using cephalometric characteristics in subjects with Class II malocclusion versus Class I controls reported that growth trends at circumpuberty period in Class II subjects are similar to those in subjects of normal occlusion.[37]Another study reported that craniofacial growth changes with untreated Class II/1 malocclusion from late puberty through young adulthood reported no significant difference from the untreated subjects with normal occlusion.[38] Conversely, other longitudinal studies reported reduced mandibular growth rates in subjects with Class II malocclusion at the growth spurt, which was maintained at the postpubertal stage.[39,40] They concluded that Class II dentoskeletal features does not tend to self-correct with growth with worsening of the deficiency in mandibular dimensions.

The mean ANB angle for Class II/1 for the three age groups was significantly increased compared with Class I and ClassII/2 groups (Table 5) indicating a Class II skeletal pattern while the mean ANB angle for Class II/2 showed a Class I skeletal pattern. This finding differs from a study of a Jordanian orthodontic population[34] which found that majority of patients in both Class II/1 and Class II/2 malocclusion had a class II skeletal pattern.

Results from this present study, thereby, agreed with Bishara,[41] who stated that describing the skeletal discrepancies accompanying Class II/1 or Class II/2 malocclusions as being a “skeletal Class II malrelationship” was a diagnostic oversimplification and of limited value in treatment planning. This is because the mandible and the maxilla may have varying relationship to each other. As a result, the clinician should evaluate and diagnose the occlusal relationships, the anteroposterior and vertical skeletal discrepancies, the soft tissue facial relationships, as well as the presence of any abnormal function in each individual patient.

Although the methods described in this study were accurate in determining the anteroposterior skeletal jaw relationships, there are inherent weaknesses that must be recognised. Cephalometric analysis done on a lateral cephalometric projection are based on an assumption that the cephalometric radiographic image is accurate in occlusal and postural positions of both hard and soft tissues. Secondly, lateral cephalometric analysis also assumes that the patient does not have any skeletal asymmetry. These assumptions may not be accurate.

Another possible limitation was that of possibilities of errors in identification of landmarks, as well as errors during the tracing procedures. However, the intra-examiner reliability assessment (Table 1) showed good reproducibility of measurements.

Furthermore, our methods analysed a 2-dimensional view of a 3-dimensional object. Recent advances in the use of 3-dimensional volumetric analysis using Cone Beam Computed Tomography has made it possible to enable more accurate assessment of skeletal morphology.

CONCLUSION

Within the parameters of this study, there is no gender difference in the distribution of Class II malocclusion. Mandibular retrognathism was observed in 15 – 18-year-old Class II malocclusion subjects compared to subjects of Class I normal occlusion. Subjects with Class II/1 malocclusion had skeletal pattern 2 while Class II/2 subjects had skeletal pattern 1.

Given the morphological differences between a Class II/1 and Class II/2 malocclusion, there is a need to avoid oversimplification by clinically grouping these two together as “Class II malocclusion”. Therefore, each Class II malocclusion case must be carefully planned by taking a careful history, performing a thorough examination, making a differential diagnosis and planning an effective orthodontic treatment.

Conflict of Interest

The authors hereby declare that there is no conflict of interest regarding the conduct of this research

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