

Skeletal, Dentoalveolar and Soft tissue Components of Skeletal Class II Malocclusion among Nepalese Orthodontic Patients: A Cephalometric Study

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ABSTRACT

Introduction: The understanding of the craniofacial morphology of skeletal Class II malocclusion is a key element in planning orthodontic treatment. The aim of this study was to describe various skeletal, dentoalveolar, and soft tissue components of skeletal Class II malocclusion in Nepalese orthodontic patients.

Materials and Method: This cross-sectional study was carried out at the Universal College of Medical Sciences (UCMS) in the Department of Orthodontics and Dentofacial Orthopedics. Lateral cephalograms of 70 patients with skeletal class II malocclusion of age greater than 18 years, and ANB $\geq 4^\circ$, were traced. Various skeletal, dentoalveolar, and soft tissue measurements were taken. Descriptive statistics were performed followed by an independent sample t-test to find the difference in mean of various cephalometric parameters between males and females.

Result: Among 70 subjects, 54 samples had class II div 1 malocclusion and 16 had class II div 2 malocclusion. Mandibular retrognathism was seen in 37 subjects having skeletal Class II Div 1 malocclusion and in 9 subjects with Class II Div 2 malocclusion. The mean value of SNA was $82.91^\circ \pm 2.87^\circ$, SNB was $76.81^\circ \pm 2.97^\circ$, and ANB was $6.11^\circ \pm 1.22^\circ$ in Class II Div 1 subjects. In subjects with Class II Div 2, the mean value of SNA was $82.31^\circ \pm 3.19^\circ$, SNB was $76^\circ \pm 4.08^\circ$, and ANB was $5.44^\circ \pm 1.21^\circ$. Mean value of U1 to NA degree and linear measurement was Class II div 1 was $28.30^\circ \pm 6.86^\circ$ degree and 5.56 ± 2.76 mm respectively. Similarly, mean value of L1 to NA degree and linear measurement was $31.93^\circ \pm 5.96^\circ$ and 6.16 ± 2.37 mm respectively. Mean and standard deviation value of upper lip to S-line and lower lip to S-line was 2.85 ± 2.13 mm and 3.54 ± 2.47 mm respectively in Class II Div 1 subjects. Similarly, in Class II Div 2 it was 1.50 ± 2.16 mm and 0.13 ± 2.66 mm respectively. Mean and standard deviation value of nasolabial angle was $93.69^\circ \pm 12.91^\circ$ in Class II div 1 and $96.38^\circ \pm 12.26^\circ$ degree in Class II Div 2. The mean values of most cephalometric parameters did not differ statistically between male and female subjects with Class II div 1 malocclusion.

Conclusion: In subjects with skeletal Class II mean value of SNA was within normal range whereas SNB was decreased. Retrognathia and a small mandible in relation to the cranial base with a well-positioned maxilla were observed in the majority of subjects. Mean U1 to NA angular and linear measurement was increased in Class II Div 1, whereas they were decreased in Class II Div 2.

KEYWORDS: Cephalometric; Malocclusion; Mandibular Retrognathism; Skeletal Class II

INTRODUCTION

Skeletal Class II malocclusion is a common condition encountered during orthodontic practice. Class II malocclusion is a deviation from normal occlusion and may arise from the combination of different craniofacial

components.¹ Skeletal Class II malocclusion may be either due to retrognathic mandible, prognathic maxilla, or a combination of both. In orthodontics, there is a long history of considering class II mandibles as retrognathic.² The dentoalveolar and skeletal

morphology of Class II malocclusion has been investigated in several cephalometric studies.¹⁻⁵ To obtain an accurate orthodontic diagnostic assessment of the facial type of an individual in various skeletal malocclusion is an essential key factor. The lateral cephalogram is presented in the literature as a relevant resource for this purpose.

An understanding of the craniofacial morphology of skeletal Class II malocclusion is a key element in planning orthodontic treatment for this type of malocclusion. The clinically widely used term “skeletal class II” does not clearly specify whether the mandible is retruded in relation to the maxilla or the maxilla is protruded in relation to the mandible.³ The dental, skeletal, and soft-tissue characteristics of a particular malocclusion can differ based on ethnicity, race, age, sex, and geographical location.⁴ Previous studies suggest that different racial groups must be treated according to their characteristics.¹

Several studies have been conducted in different populations to describe the dentoskeletal features of skeletal Class II malocclusion. Only a few studies have investigated the skeletal, dentoalveolar, and soft tissue characteristics of skeletal class II malocclusion in Nepalese populations. The aim of this study was to describe various skeletal, dentoalveolar, and soft tissue components of skeletal Class II malocclusion in Nepalese orthodontic patients.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Universal College of Medical Sciences (UCMS), Bhairahawa. The duration of the study was from Nov 2021- July 2022. Ethical clearance for the study was obtained from the Institutional Review Committee of the Universal College of Medical Sciences (UCMS/IRC/161/21). Lateral cephalograms of 70 patients with skeletal class II malocclusion undergoing orthodontic treatment and fulfilling the inclusion criteria were collected from the orthodontic records archives of the Department of Orthodontics and Dentofacial Orthopedics, UCMS-TH. All the cephalograms were obtained with a cephalostat (VATECH, Korea) and Pax-Image capturing software. All the cephalograms were taken in Natural Head Position (NHP) with a relaxed lip posture. Inclusion criteria were a cephalogram of a Nepalese individual with an age greater than 18 years, ANB $\geq 4^\circ$, complete eruption of permanent dentition (except third molars), and a good quality cephalogram.

Exclusion criteria were a cephalogram of patients with a history of previous orthodontic treatment, a history of dentofacial trauma, a history of temporomandibular joint disorder, and the presence of a dentofacial deformity. Cephalogram of patients with proclined maxillary anterior teeth with overjet greater than 3 mm is classified under Class II Div 1 and retroclination of maxillary teeth (at least 2 central incisors) and increased overbite greater than 3 mm is classified under class II Div 2.

All the cephalograms were traced manually on 0.004-inch acetate paper using a 3H pencil by a single examiner to avoid inter-observer bias. After manual tracing of the cephalograms, all the required landmarks and reference lines were drawn. Various skeletal, dentoalveolar, and soft tissue angular and linear measurements were performed. Cephalometric linear and angular measurement was carried out with the help of a digital vernier caliper, ruler, and protractor. A description of various cephalometric parameters used in the study is given in Table 1. 20 randomly selected cephalograms were retraced at an interval of 2 weeks to check intraobserver reliability. After carrying out the measurement, data was collected and entered in SPSS Version 20 (Statistical Package for Social Sciences) for further processing.

Table 1 Description of Cephalometric parameters

Cephalometric Parameters	Description
Anterior Cranial length	Linear measurement from Sella turcica (S) to Nasion (N)
SNA	Angle between Sella(S) –Nasion (N) Plane to Nasion(N) –point A plane
SNB	Angle between Sella(S) –Nasion (N) Plane to Nasion(N) –point B plane
ANB	Angle between SNA and SNB
Beta Angle	Angle formed between plane of Point A – Point B and line perpendicular from Point A to C- B line
Effective maxillary length	Linear distance between Condylion (Co)- to point A
Effective mandibular length	Linear distance between Condylion(Co) to gnathion(Gn)
SN-MP	Angular measurement between Sella(s)- nasion (N)line and mandibular plane

Y axis	Angle between Sella(S) - Gnathion(Gn) to Frankfort horizontal plane
U1 to SN degree	Angle between Long axis of central incisor to Selle(S)-Nasion(N) line
U1 to PP degree	Angle long axis of central incisor to Palatal plane
U1 to NA degree	Angle between long axis of upper central incisor to N-A line
U1 to NA linear	Linear Distance between upper central incisor to NA line
L1 to NB degree	Angle between long axis of lower incisor to N-B line
L1 to NB linear	Linear Distance between lower central incisor to NB line
Upper lip to S line	Linear distance between upper lip to S-line
Lower lip to S Line	Linear distance between upper lip to S-line
Nasolabial angle	Angle between tangent to lower border of Nose and tangent to upper lip

Frequency analysis was performed to find the frequency of the type and cause of skeletal class II malocclusion. Descriptive statistics were performed to find the mean and standard deviation of various cephalometric parameters. An independent sample t-test was performed to find the difference in the mean of various cephalometric parameters between males and females. Interclass Correlation Coefficient (ICC) analysis was done to check the intra-observer reliability.

RESULTS

Among a total of 70 subjects with skeletal Class II malocclusion, 54 samples had Class II Div 1 malocclusion, and 16 samples had Class II Div 2 malocclusion. Among 54 Class II Div 1 samples, 20 were male and 34 were female. Among 16 class II Div 2 subjects, 12 were female and 4 were male. Mandibular retrognathism was seen in 37 subjects; maxillary prognathism was observed in 10, and a combination of maxillary prognathism and mandibular retrognathism was found in 7 subjects among the patients having Class II Div 1 malocclusion. Among the patients having skeletal Class II Div 2 malocclusion, mandibular retrognathism was seen in 9, maxillary prognathism in 6, and a combination of maxillary prognathism and mandibular retrognathism was found in 1 subject (Table 2).

Table 2 Descriptive statistics

Variable	Sample n	Total N
Male Class II div 1	20	54
Female Class II Div 1	34	
Male Class II Div 2	4	16
Female Class II Div 2	12	
Class II div 1 due to maxillary prognathism(SNA>83.10degree)	10	54
Class II div 1 due to mandibular retrognathism(SNB<79.76)	37	
Class II div 1 due to combination of maxillary prognathism and mandibular retrognathism	7	
Class II div 1 due to maxillary prognathism	6	16
Class II div 1 due to mandibular retrognathism	9	
Class II div 1 due to combination of maxillary prognathism and mandibular retrognathism	1	

In subjects of class II Div 1 malocclusion, the mean and standard deviation (SD) value of SNA was $82.91^\circ \pm 2.87^\circ$, SNB was $76.81^\circ \pm 2.97^\circ$ and ANB was $6.11^\circ \pm 1.22^\circ$. In subjects with class II Div 2 mean value of SNA was $82.31^\circ \pm 3.19^\circ$, SNB was $76^\circ \pm 4.08^\circ$ and ANB was $5.44^\circ \pm 1.21^\circ$ (Table 3). The mean value of U1 to NA degree and linear measurement is Class II Div 1 was $28.30^\circ \pm 6.86^\circ$ and 5.56 ± 2.76 mm respectively. Similarly, mean value of L1 to NA degree and linear measurement was $31.93^\circ \pm 5.96^\circ$ and 6.16 ± 2.37 mm respectively. In subjects with Class II Div 2 mean value of U1 to NA degree and linear measurement was found to be $15.50^\circ \pm 5.14^\circ$ degree and 1.56 ± 2.56 mm respectively. Similarly, mean value of L1 to NA degree and linear measurement was $26.06^\circ \pm 8.57^\circ$ and 4.19 ± 2.69 mm respectively. The mean and standard deviation value of upper lip to S-line and lower lip to S-line was 2.85 ± 2.13 mm and 3.54 ± 2.47 mm respectively in Class II Div 1 subjects. Similarly, in Class II Div 2, it was 1.50 ± 2.16 mm and 0.13 ± 2.66 mm respectively. The mean and standard deviation value of nasolabial angle was $93.69^\circ \pm 12.91^\circ$ in Class II Div 1 and $96.38^\circ \pm 12.26^\circ$ in Class II Div 2. The mean and standard deviation values of all the cephalometric parameters are presented in Table 3.

Table 3 Mean and Standard deviation for various Cephalometric parameters For Class II div 1 and Class II div 2

Cephalometric parameters	Class II Div 1		Class II Div 2	
	Mean	SD	Mean	SD
Anterior cranial base length	63.81	2.22	67.00	3.60
SNA	82.91	2.87	82.31	3.91
SNB	76.81	2.97	76.00	4.08
ANB	6.11	1.22	5.44	1.21
Beta Angle	28.13	4.40	27.19	4.31
Effective maxillary length	80.06	6.98	84.75	4.27
Effective mandibular length	100.31	6.42	103.81	6.43
SN-MP	32.30	5.53	29.81	6.15
Y axis	63.92	5.00	64.00	5.90
U1 to SN degree	111.19	8.90	95.13	10.26
U1 to PP degree	113.83	13.46	96.56	13.27
U1 to NA degree	28.30	6.86	15.50	5.14
U1 to NA linear	5.56	2.76	1.56	2.56
L1 to NB degree	31.93	5.96	26.06	8.57
L1 to NB linear	6.61	2.37	4.19	2.69
Upper lip to S line	2.85	2.13	1.50	2.16
Lower lip to S Line	3.54	2.47	0.13	2.66
Nasolabial angle	93.69	12.91	96.38	12.26

*SD=Standard Deviation

There was no statistically significant difference (P<0.05) in mean value of various cephalometric parameters except SN-MP, Y-axis, and U1 to PP among male and female subjects with Class II div 1 malocclusion (Table 4).

With repeated measurements of 20 samples at intervals of 15 days, various cephalometric values showed ICC values ranging from 0.86-0.99, showing good intra-observer reliability.

Table 4 Comparison of Cephalometric parameters between genders in Class II div 1 malocclusion

Cephalometric Parameters	Male		Female		P value
	Mean	SD	Mean	SD	
Anterior cranial base length	64.45	4.29	63.44	3.39	0.47
SNA	82.55	3.56	83.12	2.41	0.12
SNB	76.75	3.18	76.85	2.88	0.96
ANB	5.90	1.07	6.24	1.30	0.09
Beta Angle	28.55	3.93	27.88	4.69	0.58
Effective maxillary length	77.95	10.45	81.29	3.34	0.08
Effective mandibular length	99.05	6.57	101.06	6.31	0.99
Saddle angle	124.25	6.63	124.91	5.79	0.34
SN-MP	31.80	3.52	32.59	6.47	0.04*
Y axis	62.53	3.64	64.74	5.53	0.02*
U1 to SN degree	110.10	10.88	111.82	7.61	0.11
U1 to PP degree	109.80	16.53	116.21	10.86	0.03*
U1 to NA degree	28.65	8.50	28.09	5.81	0.07
U1 to NA linear	4.75	2.36	6.03	2.93	0.26
L1 to NB degree	33.00	6.48	31.29	5.63	0.55
L1 to NB linear	6.60	2.30	6.62	2.44	0.66
L1 to A-pog					
Upper lip to S line	3.30	2.41	2.59	1.94	0.54
Lower lip to S Line	3.85	2.80	3.35	2.28	0.54
Nasolabial angle	91	10.05	95.26	14.24	0.08
H angle	19.85	2.72	19.85	3.42	0.27

Independent Sample t-test to compare statistical significant difference in mean of cephalometric parameters between genders,*Significant at p<0.05

DISCUSSION

Class II malocclusion might be considered skeletal when jaws are involved, and dental when only dentoalveolar components are involvement; however, in most of the

cases, there is a combination of both skeletal and dental factors.⁶ Skeletal Class II malocclusion can be characterized by retrognathic mandible, prognathic maxilla, or a combination of both.⁶ Ethnic and racial variation plays an important role in the morphologic variation of malocclusions.⁷ The present study aimed to investigate the cephalometric characteristics of skeletal Class II malocclusion among orthodontic patients which describe various skeletal, dentoalveolar and soft tissue features of class II malocclusion.

The majority of the subjects investigated in the present research showed retrognathic mandibles in relation to the cranial base as compared to Nepali and Caucasian norms. 68.52% of the sample with Class II Div 1 malocclusion and 56.25% of the sample with Class II Div 2 malocclusion had a retrognathic mandible. Maxillary prognathism was seen in 18.52% and 37.5% of the sample among Class II Div 1 and Div 2, respectively. The mean SNA value was within the range of Nepalese norms among subjects from both Class II Div1 and Div2, whereas the mean SNB value was lower when compared to Nepalese and Caucasian norms. These findings suggest that the majority of the Nepalese orthodontic patients with skeletal Class II malocclusion had mandibular retrognathism as a morphological feature of Class II malocclusion, followed by maxillary prognathism and combinations of maxillary prognathism and mandibular retrognathism. The finding of the present study was in concordance with the study conducted by Bajracharya M et al. which concluded that mandibular retrognathism was a major cause of skeletal Class II malocclusion in Nepalese population.¹ Majority of the other studies conducted had also concluded mandible to be retrognathic as a major cause of skeletal Class II malocclusion.^{6, 8-10}

The findings of the present study showed the mean SNA value to be within the range of Nepalese norms suggesting the maxilla to be normal in relation to the cranial base as a skeletal feature of Class II malocclusion.¹¹ The findings of our study were similar to the study conducted by Bajracharya M which showed orthognathic maxilla in Nepalese subjects having skeletal Class II malocclusion. The results of this study, however, contradict the findings of other studies conducted which showed anterior positioning of the maxilla relative to other craniofacial components.^{8,12-13} The present study also showed effective mandibular length to be shorter as compared to Caucasian norms,

indicating shorter mandibular length as a morphological feature of Class II malocclusion. This is in agreement with previously published studies,^{14,15} whereas findings of other study contradict this result.¹⁶

Dentoalveolar cephalometric parameters in this study found that maxillary incisors were proclined and protruded in subjects with Class II Div 1 as compared to Nepalese and Caucasian norms. This finding is in consonance with the results of previous studies.^{1,16,17} Angular and linear measurement for the mandibular incisors (I.NB) presented increased value as compared to Caucasian and Nepalese norms. The results showed protrusion of the lower incisor in relation to their apical base, indicating tooth compensation for the skeletal discrepancy. The result of the present study is similar to that of previous studies.^{1,18} In subjects with Class II Div 2 angular and linear values of the upper incisor were decreased. Our result is in agreement regarding the most evident dentoalveolar cephalometric characteristics of Class II Div 2 malocclusion in the literature, such as a pronounced retroclination of the upper central incisors.^{9,19} In this study, with regard to the lower incisors, we found the lower incisors having a normal inclination. Numerous studies have described these incisors as having a retroclined position,^{19,21} whereas other studies have found them to have a normal inclination.^{10,21}

The mean anterior cranial base length in the present study was found to be 63.81 mm and 67 mm in Class II Div 1 and Class II Div 2, respectively. The findings of our study was similar to the study conducted by Mahato et al. in Nepalese population.²² Vertical Parameters SN-GoGn and Y axis was within normal range in Class II Div 1 patients whereas it was decreased in patients with Class II Div 2 patients. The results of our study suggesting Flat mandibular plane angle in Class II Div 1 was similar to the previous studies,^{14,23} whereas in subjects with Class II Div 1 vertical parameters showed increased value as compared to Nepalese population which was in contradiction to the previous study conducted in Nepali Population.¹ Mean value of beta angle in this study was found similar to the values given for Class II subjects from the study of CY Baik.²⁴

On soft tissue examination subjects with Class II Div 1 malocclusion showed a normal mean Nasolabial Angle with protrusive upper and lower lips, whereas subjects with Class II Div 2 showed a normal Nasolabial Angle

with normally placed upper and lower lips. Majority of Cephalometric parameters except Vertical parameters and U1 to pp showed no significant difference among genders. This finding is in agreement with the literature, which has stated that gender exerts little or no effect on skeletal and dental components in Class II malocclusions.²⁵

Limitation of the study is that it only involves small group of sample of patients seeking orthodontic treatment so it cannot be generalized to whole Nepalese population. The study also does not involve sample of different age group. Further study involving large sample of different age group can be carried if future studies.

CONCLUSION

In subjects with skeletal Class II mean value of SNA was within the normal range whereas SNB was decreased.

Retrognathia and a small mandible in relation to the cranial base with a well-positioned maxilla were observed in a majority of subjects. The craniofacial growth pattern showed a normal growth pattern in Class II Div 1 and a horizontal growth tendency in Class II Div 2. The maxillary incisors were labially inclined and protruded in Class II Div 1 and retroclined and normally placed in Class II Div 2, whereas mandibular incisors were strongly proclined and protruded in relation to the apical base in Class II div 1 and inclination and placement was normal in Class II Div 2. There was no statistically significant difference between genders among most of the cephalometric parameters.

Conflict of Interest

None



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