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A Cephalometric Study for Evaluation and Comparison of the Cranial Base Angles and Cranial Base Length and the Effective Maxillary and Mandibular Lengths in Class I, Class II, and Class II Subdivision Malocclusion among Male and Female Adults in Kundrathur Population

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ABSTRACT

Introduction: The relationship between malocclusions and skeletal morphology is a popular topic of maxillofacial developmental research. As one of the most common diagnostic records is the cephalogram, the relationship among cranial base angle, cranial base length, maxilla, and mandible can easily be determined. Using Steiner's cephalometric analysis, malocclusions can be easily classified by ANB angle.

Materials and Methods: A total of 60 cephalograms (30% males and 30% females) were available for the present study). The inclusion criteria were patients with Natives of Kundrathur.

Results: The mean maxillary length and mandibular length was highest among the study subjects of Class I malocclusion.

Conclusion: Sexual dimorphism was statistically significant as the males have increased maxillary length, and mandibular length than females.

Key Words: Class I, Class II & class II subdivision malocclusion Cranial base angle, Cranial base length, Mandibular length, Maxillary length

INTRODUCTION

A developmental abnormality called malocclusion may have skeletal or dental roots. The cranial base, maxilla, and mandible have aberrant shapes, sizes, and placements, which result in malocclusions with skeletal inconsistencies in the craniofacial area.[1]

Treatment with orthodontics requires an understanding of the maxillofacial skeleton's growth and development. The relationship between malocclusions and skeletal morphology is a popular topic of maxillofacial developmental research. As one of the most common diagnostic records is the cephalogram, the relationship among maxilla, and mandible can easily be determined. Using Steiner's cephalometric analysis, malocclusions can be easily classified by ANB angle.[2,3,4,5]

However, the mandibular growth continues well after the latter ages and reaches its final dimensions at about the age of 20 years in males and 18 years in females. Treatment outcomes for Class II and Class III skeletal malocclusions are highly dependent on the precise timing of orthodontic interventions. The frontal sinus surface area may be utilized as an indicator to predict mandibular development, according to Rossouw et al.[6-9]

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Though several cephalometric analyses exist, McNamara analysis is not only sensitive to the position of the teeth but also to the cranial base structures. McNamara analysis has given values specific for growing children from 6 years of age and more importantly these are linear measurements than angular measurements[10-13]

Cephalometric norms for different ethnic and racial groups have previously established in many studies. Most investigators have concluded that there is significant difference between the diverse ethnic and racial groups and many cephalometric standards have been developed for different racial groups must be treated according to their own characteristics.[14-16]

Therefore, the purpose of this study is to examine the class I, class II, and subdivision types of malocclusions in the Kundrathur population using the cranial base angle, cranial base length, and effective maxillary and mandibular length.

MATERIAL AND METHODS

This study was conducted as a cross sectional study, in the dept of orthodontics, Madha Dental College and Hospital, Kundrathur from January 2022- November 2023. Considering the exclusion and inclusion criteria, and with an error of 6%, the sample size required for the present study was 60 patients for the total study population. The data was collected from the cephalograms and study models available, for patients with class I, class II and Class II MO, reporting for treatment in the department of orthodontics. The sample belonged to the age group 18-25 years (mean age = 19.25 years). The study models were analysed and the subjects were categorized into Category I (class I malocclusion). Measurements of length, angle, and linearity were obtained while the cephalograms were traced digitally using FAÇADE software. For uniformity, the interobserver and interobserver errors were examined. Statistics were used to analyze the data.

A total of 60 cephalograms (30% males and 30% females) were available for the present study). The inclusion criteria were patients with Natives of Kundrathur

Individuals with age ranging from 18 to 30 years

Skeletal and dental classes I, II and class II subdivision

No missing teeth (except wisdom teeth)

No prior orthodontic care.

Mandibular and maxillary arches in a well-aligned position with a crowding or separation of less than two millimetres their cephalograms were included in the study. The exclusion criteria were dental anomalies, proximal decay, and previous orthodontic therapy. Effective maxillary and mandibular lengths, as well as the mean parameter of the cranial angle and SN length, were computed [FIGURE NO 1]. A connection was conducted between the mandibular and maxillary effective lengths, the cranial angle, and the cranial base length. [FIGURE NO2]

Description of landmarks

Go = The most posterior-inferior point at the mandibular angle, found by cutting the angle produced by the lines perpendicular to the mandibular inferior border and the posterior border of the ramus in half. The deepest portion of the curve between the alveolar crest, which supports the maxillary central incisor, and the anterior nasal spine (ANS) is known as the "A-point." Co = Condylion, the mandibular condylar outline's highest and lowest point Ba: Basion, the foramen magnum's lowest point on its anterior edge. The anterior point where the frontal and nasal bones converge is known as the NASION (N). S: Sella (the center of Sella turcica's hollow).

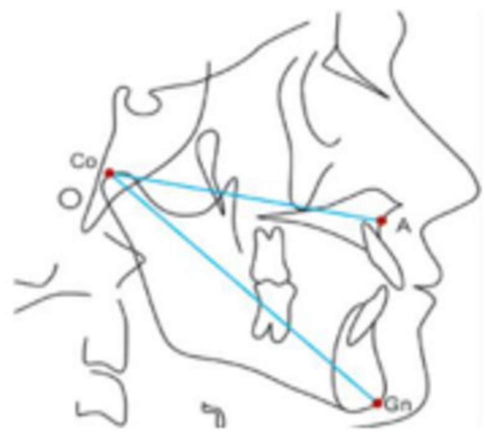

Figure 1: Schematics of effective maxillary and mandibular length used for the study

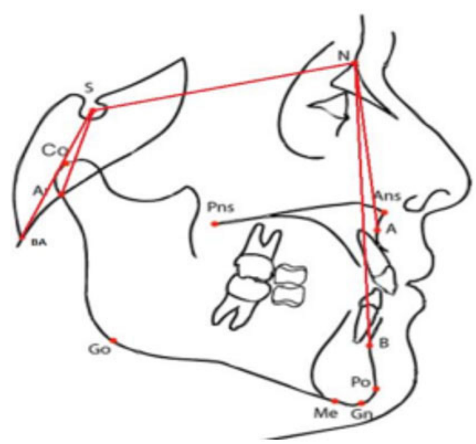

Figure 2: Schematics of cranial base angle and cranial base length used for the study

RESULTS

Based on the results, the mean age of study participants was found to be 22.25±2.04, 21.00±2.38, and 20.40±2.30 for Class I, Class II, and Class II subdivision malocclusion groups, respectively. The study participants were divided evenly among the genders. [Table1]

With articulare, the mean cranial base angle was determined to be 125.2 ±5.6, with a maximum angle value of 139° and a minimum value of 112°. In a similar vein, 132 was determined to be the mean cranial base angle with basion point. [Tables 5 and 6]

In every group, the mean maxillary length of men was greater than that of females. Still, the average variation in the average maxillary length (10.00) between the research participants who were male and female and were part of the Class II malocclusion group was discovered to be statistically significant (p – 0.002). [Table 2]

The mean mandibular length among males was higher when compared to females within all groups. However, the mean difference in the mean mandibular length between male and female study subjects belonging to the different malocclusion groups was found to be statistically not significant (p>0.05). [Table 3]

Table 1: Distribution of study subjects

		ClassI Malocclusion	Class II Malocclusion	Class II Malocclusion Subdivision
Number of study subjects		20	20	20
Age (Mean±SD)		22.25±2.04	21.00±2.38	20.40±2.30
Gender	Male	10 (50%)	10 (50%)	10 (50%)
	Female	10 (50%)	10 (50%)	10 (50%)

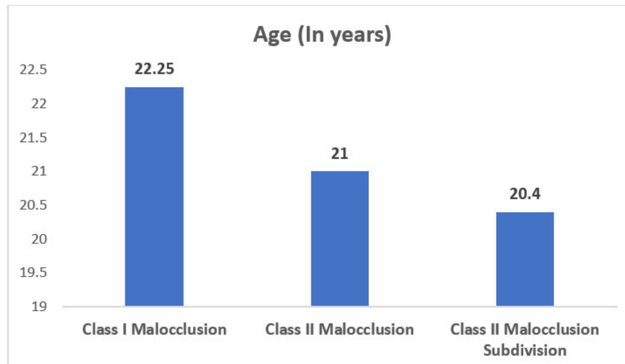

Figure 1: Mean Age of study participants among the groups

Table 2: Comparison of Mean Maxillary Length between the malocclusion groups based on Gender

Time intervals	Gender		Mean difference	t Value	p value
	Male	Female			
Class I Malocclusion	91.96±2.97	90.02±3.62	1.94	1.309	0.20
Class II Malocclusion	119.60±5.03	109.60±7.18	10.00	3.604	0.002
Class II Malocclusion Subdivision	85.10±7.54	84.70±6.20	0.40	0.129	0.89

Independent samples t Test

p value <0.05 – statistically significant

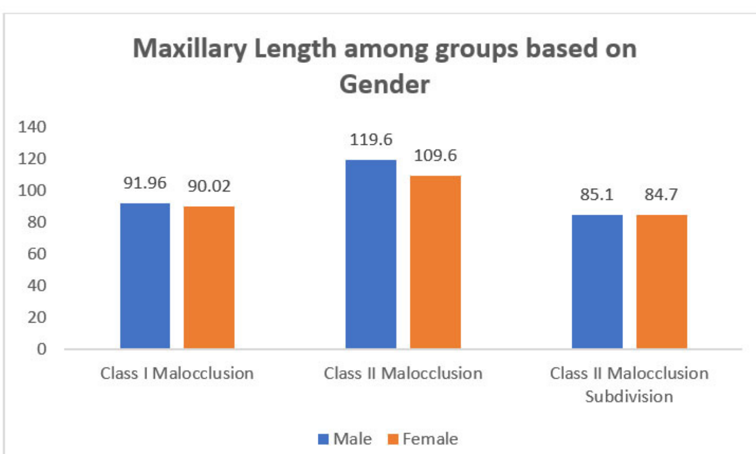

Figure 2: Comparison of Mean Maxillary Length between the malocclusion groups based on Gender

Table 3: Comparison of Mean Mandibular Length between the malocclusion groups based on Gender

Time intervals	Gender		Mean difference	t Value	p value
	Male	Female			
Class I Malocclusion	108.30±9.48	106.40±6.81	1.90	0.514	0.613
Class II Malocclusion	88.50±3.17	86.30±4.42	2.20	1.278	0.217
Class II Malocclusion Subdivision	109.60±5.96	109.10±7.70	0.50	0.162	0.873

Independent samples t Test
p value <0.05 – statistically significant

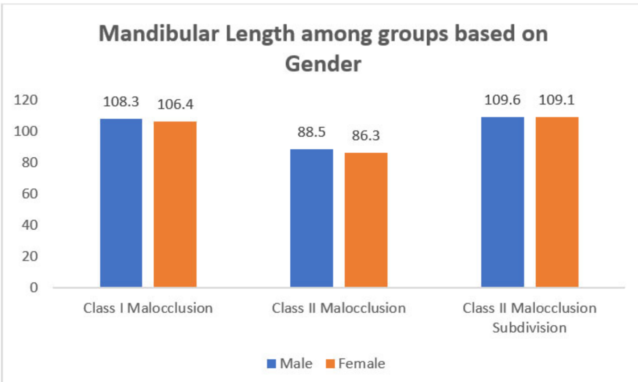

Figure 3: Comparison of Mean Mandibular Length between the malocclusion groups based on Gender

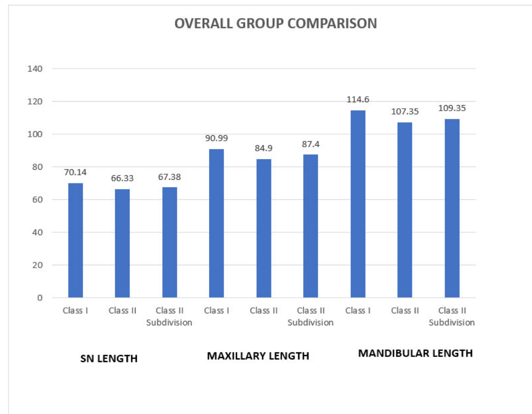

Figure 4: Comparison of Mean SN length and maxillary length Mandibular Length between the groups based on malocclusion

Table 4: Comparison of Mean SN length and maxillary length Mandibular Length between the groups based on malocclusion

Parameter	Malocclusion	N	Mean value (mm)	Std Deviation	P value (ANOVA)
SN LENGTH	Class I	20	70.14	6.827	0.001
	Class II	20	66.33		
	Class II subdivision	20	67.38		
Maxillary Length	Class I	20	90.96	7.84	0.001
	Class II	20	84.67		
	Class II subdivision	20	87.40		
Mandibular Length	Class I	20	114.60	4.850	0.01
	Class II	20	107.35		
	Class II subdivision	20	109.35		

p value <0.05 – statistically significant

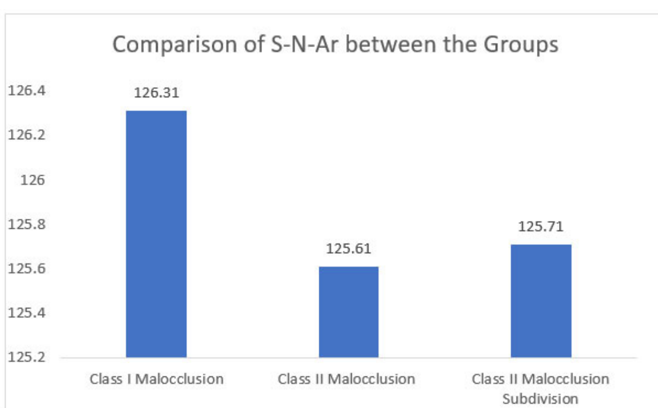

Figure 5: Comparison of Mean cranial base angle between the groups based on malocclusion

Table 5: Comparison of Mean cranial base angle between the groups based on malocclusion

	Malocclusion	N	Mean	Std deviation	P value
S-N-Ar	Class I	20	125.31	5.149	
	classII	20	125.61	5.744	0.442
	Class II subdivision	20	125.71	6.977	

p value <0.05 – statistically significant

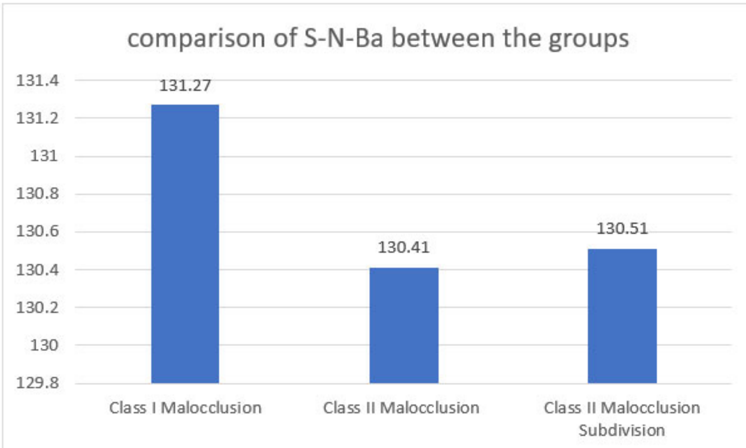

Figure 6: Based on malocclusion, the mean cranial base angle was compared between the groups.

Table 6: Based on malocclusion, the mean cranial base angle was compared between the groups.

	Malocclusion	N	Mean	Std deviation	P value
S-N-Ba	Class I	20	131.27	5.342	
	classII	20	130.31	4.235	0.332
	Class II subdivision	20	130.52	4.316	

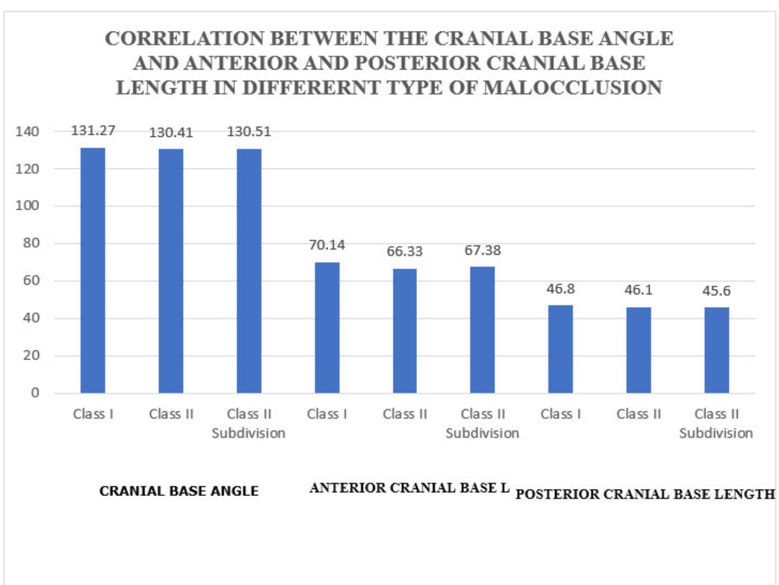

Figure 7: Based on malocclusion, the mean cranial base angle and cranial base length were compared between the groups.

Table 7: Based on malocclusion, the mean cranial base angle and cranial base length were compared between the groups.

Parameter	Malocclusion	N	Mean value	Std deviation	P value (ANOVA)
S-N-Ba (Angle)	Class I	20	131.27	5.342	0.32
	Class II	20	130.41		
	Class II subdivision	20	130.51		
Anterior cranial base length(mm)	Class I	20	70.14	6.234	0.43
	Class II	20	66.33		
	Class II subdivision	20	67.38		
Posterior cranial base length(mm)	Class I	20	46.81	2.92	0.61
	Class II	20	45.63		
	Class II subdivision	20	46.12		

p value <0.05 – statistically significant

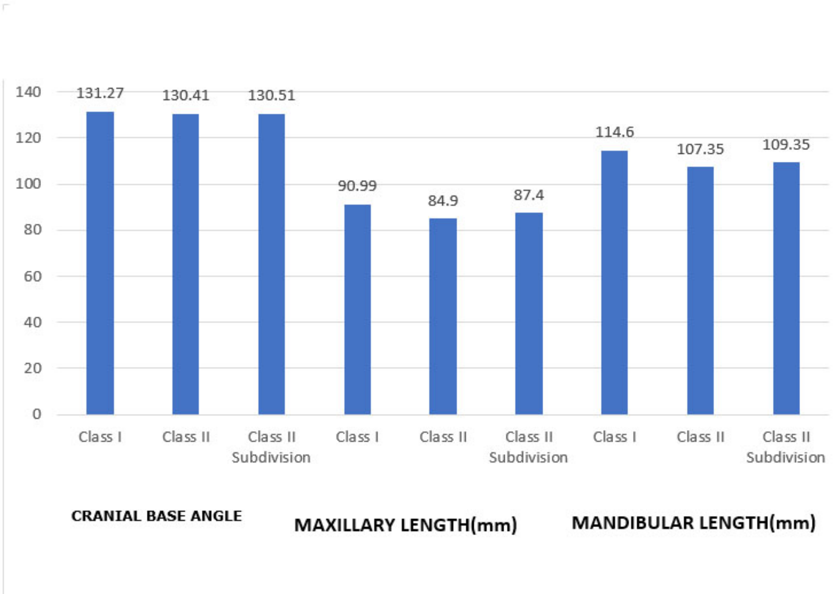

Figure 8: Based on malocclusion, the mean cranial base angle and the mandibular and maxillary lengths were compared between the groups.

Table 8: Based on malocclusion, the mean cranial base angle and the mandibular and maxillary lengths were compared between the groups.

Parameter	Malocclusion	N	Mean value	Std deviation	p value (ANOVA)
S-N-Ba (Angle)	Class I	20	131.27	5.342	0.32
	Class II	20	130.41		
	Class II subdivision	20	130.51		
Maxillary Length(mm)	Class I	20	90.96	7.84	0.43
	Class II	20	84.67		
	Class II subdivision	20	87.40		
Mandibular Length(mm)	Class I	20	114.60	4.850	0.52
	Class II	20	107.35		
	Class II subdivision	20	109.35		

p value <0.05 – statistically significant

DISCUSSION

Lateral cephalometry is often requested as a necessary record for diagnosing orthodontic issues and evaluating the efficacy of therapy. Many orthodontists are concerned about the stability of the outcomes of orthodontic treatment. One of the most significant variables influencing the course of therapy is the mandible's final size.[17]

Numerous writers have looked at the connection between skeletal malocclusion and cranial base flexion, with encouraging results. Reduction in the cranial base angle linked to class III malocclusion was described by Proffit et al.

McNamara has proposed that for young individuals with a well-balanced face, the effective midface length should be around 85mm while the effective mandibular length would be between 105mm to 108mm with a maxillomandibular differential of 20-23mm. In cephalometric analysis, measurements are done with respect to different horizontal and vertical planes.[18-20]

The most used horizontal planes are cranial base length, mandibular and maxillary lengths. The average cranial base angle, cranial base length, maxillary length, and mandibular length were the study's objectives among male and female adults in Kundrathur population.

Roentgenographic cephalometry was first introduced to the orthodontic specialty by Broadbent4 in 1931, mainly as a tool to study cranio-facial growth and development. Gradually it was used to study facial forms, development of norms, assessment of treatment prognosis and growth prediction for the individual patients.[21]

Bjork in 1955 found cranial development ceases at approximately 12 years of age, sutural growth in the cranial base would remain somewhat active to compensate for both upper and lower facial growth until the age of 18-20years in females and 20-24years in males. The average mandibular length for Caucasian population was observed in this study. Increased mandibular length was noted for Kundrathur population in the present study.[22]

Burstone CJ in 1978 designed cephalometries for Orthognathic Surgery (COGS) especially for the patient undergoing maxillofacial surgery... This paved way for the construction of new cephalometric norms for every individual ethnic group. The average maxillary length for Caucasian population was observed in this study. Decreased maxillary length was noted for Kundrathur population in the present study.[23]

Flynn et al. conducted a study to determine cephalometric norms for orthognathic surgery in Black American Adults in addition they compared the values obtained with White American adults. When compared with black subjects, there was greater maxillary skeletal prognathism in white subjects. Maxillary length is found to be decreased in the Kundrathur population, when compared to Black and White American Adults.[24]

Satinder Pal et al. conducted a study to establish the cephalometric hard tissue norms for North Indian subjects. The maxillary length was significantly more among North Indian females than male. The maxillary length is decreased in North Indian male and increased in North Indian female population compared to Caucasian population. The maxillary length is increased in Kundrathur male population compared to North Indian male population and the maxillary length is decreased in Kundrathur female population compared to North Indian female population.[25]

Dr. Shaji T. Varghese studied male and female individuals in class I, class II, and class II subdivision malocclusion in Kerala to find the average anterior cranial base length, maxillary length, and mandibular length. He concludes the measurements was greater in male samples. Since the variation in the average cranial base length, maxillary length, and mandibular length, it is necessary to correct these linear measurements to the norms.[26]

The current study's findings did not show a statistically significant variation in cranial base angle across the various groups examined ($p>0.05$). Dhopatkar, Polat, Guilherme Thiesen, Kasai, and Almeida came to similar conclusions. The cranial base angles for the Class I group (131.7±6.3), Class II group (130.4±7.8), and Class II subdivision (130.514±8.1) groups are displayed in our study. The averages of the cranial base lengths (NS, SBa, and NBa) and cranial base angle between the class I and class II and class II subdivision groups did not differ statistically significantly in the current study. However, Dinesh et al. (2017) discovered that there were notable variations in the cranial base angles of Indian population classes II and III, with Class II having a much higher cranial base angle.[27]

Correlation tests between SNA and cranial base angle (NSBa) in all three groups in the current study revealed negative significant results. This result is consistent with research conducted by Moyers, Hopkin et al., and Kasai et al. This study also assessed the relationship between cranial base angle and jaw length; the findings indicated that there was no significant relationship between NSBa and maxillary and mandibular lengths [table no5 and 6].[28]

A linear association between the cranial base angle and skeletal malocclusion related with the angle systematically decreasing from class II, to class I, to class III persons has been shown by Bjork and Hopkin et al. Therefore, the purpose of our research was to ascertain if, in our population sample, there was a positive correlation between cranial base flexion and skeletal malocclusion. Nonetheless, no appreciable variations in cranial base angles were discovered by our research amongst the various malocclusion groups. These outcomes agreed with the conclusions drawn by other writers.[29]

Our research revealed that compared to females, males in the Kundrathur group had longer maxillary, mandibular, and cranial bases. Decreased maxillary length and increased mandibular length was noted when compared to the Caucasians. Increased maxillary length for skeletal class I group, when compared to class II and class II subdivision groups. Increased mandibular length for skeletal class I group, when compared to class II and class II subdivision groups. It was inferred from the present study that a separate norm for normal ethnic Kundrathur adults contemplating orthodontic treatment was evaluated.

CONCLUSION

Between the three malocclusion groups, there were no statistically significant variations in the cranial base angles (S-N-Ar and S-N-Ba).

Our research indicates that male class I malocclusion participants in the Kundrathur people had longer cranial bases than class II and class III subdivision subjects

There was no discernible change in the anterior, posterior, cranial base length, or cranial base angle across Class I, II, and II subdivision groups, nor was there a significant variation in the mean values for the cranial base angle (NSBa) across the various malocclusion groups (I, II, and II subdivision). [Table no 7 and 8]

According to McNamara, the population's mean maxillomandibular difference fell within the normal range, with class II individuals showing a statistically significant decline. The effective length of the mandible and the cranial base maxilla have a substantial positive association, according to this study. It is recommended to conduct a larger-scale longitudinal study among the Kundrathur community to assess the mandible's and maxilla's serial growth trend. Also, the need to develop McNamara norms for skeletal and dental class III malocclusion individuals for appropriate comparison could be the future prospective study.

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Conflict of Interest

None

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Author Contribution

All authors have equal contribution in bringing out this research work

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