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The collum angle of Maxillary Central Incisors in different skeletal malocclusions – A Cephaometric study

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Abstract
Variability in tooth morphology is an important consideration in the attainment of an aesthetic, functional and optimal occlusion of teeth. Crown to root angulation of maxillary central incisors may limit the degree to which the roots of these teeth can be torqued lingually when related to the maxillary lingual cortical plate of bone. The angulation of the root to the crown, particularly of the single rooted anterior teeth is known as Collum angle. It is the angle formed by the intersection of the long axis of the crown and root and it is measured using the lateral cephalogram. Gingival recession due to improper movement of tooth during orthodontic treatment may lead to cosmetic defects. The extent of recession is related to the bending angle. Therefore, understanding the crown-root angle in patients with different types of malocclusion is a critical issue. The present study was done to assess the collum angle in Urban population of Karnataka.

Keywords: Collum, root, angle, cephalogram

Introduction
Variability in tooth morphology is an important consideration in the attainment of an aesthetic, functional and optimal occlusion of teeth. The angulation of the root to the crown, particularly of the single rooted anterior teeth is known as collum angle. Collum angle is the angle formed by the intersection of the long axis of the crown and root using the lateral cephalogram. Crown to root angulation of maxillary central incisors may limit the degree to which the roots of these teeth can be torqued lingually when related to the maxillary lingual cortical plate of bone. Deviant root angulation confound intended axial loads for intrusion and extrusion and may cause the root to encroach on the labial or lingual cortical plate when repositioned [1].

Variations in anatomic features of the maxillary central incisors can affect either the treatment or the retention phase of orthodontic therapy. According to Taylor, the relation of the root to the crown varies considerably because both are subject to variations in curvature. In other words, when one views the central incisor from the proximal, as on a cephalometric radiogram, a line drawn from the root apex to incision superius may not pass through the center of the tooth at the cementoenamel junction. The crown may appear "bent" to the lingual or labial in relation to the root [2].

In a study by Delivanis and Kuftinec," it was found that in Class II, Division 2 patients the crowns of the maxillary central incisors tended to be "bent" to the lingual more often than in patients with other types of malocclusion [3] This tendency has long been noted by orthodontists and was even postulated by Backlund [4] to be a contributing factor in the development of Class II, Division 2 malocclusions. It has been suggested by Delivanis and Kuftine that the crown-root angulation described as occurring in Class II, Division 2 malocclusions may complicate orthodontic intrusion and torque of the incisors and, in severe cases, may increase the danger of perforating the palatal cortical plate [3]

Previous studies indicated that the Collum angle differs among groups with different types of malocclusion. To the present, no related research reports (research on the crown-root angle or Collum angle) regarding Urban population of Karnataka exist. The aim of this study was therefore to determine the Collum angle of the maxillary central incisors in Urban Karnataka population with different types of skeletal malocclusion using lateral cephalograms.

When these parameters are known, the optimal crown and root positions still need to be established. When all of these factors are known, the ideal bracket slot position and the necessary variation in this position will be clear so that a straight arch wire can produce an ideal dental occlusion

Materials and methodology

The present study includes patients attending the out- patient section of the Department of Orthodontics, V. S Dental College and Hospital, Bengaluru.

The study included lateral cephalograms of 799 patients, including 378 male and 421 female patients. The orthodontists categorized patients into four groups according to the malocclusion type using Angle's classification of malocclusion as: Class-I, Class-II division-I, Class-II division 2, and Class-III malocclusions.

In order to clearly measure the Collum angle of the maxillary central incisors on lateral cephalometric radiographs of all patients, researchers had to be able to identify the natural tooth axis of the maxillary central incisors; therefore, no prostheses (posts, dental implants, or fixed partial dentures) could be present in the anterior zone.

Additionally, lateral cephalometric radiographs showing severe crowding or mixed dentition in the anterior zone were excluded from the analysis.

Measurement of Collum angle

After sketching the maxillary central incisor type from the lateral cephalometric radiographs, the superius point of the incisal edge and the middle point of the cementoenamel junction were joined to depict the crown axis, and then the middle point of the cementoenamel junction with the root apex to depict the longitudinal axis were joined. The Collum angle was then measured. (Fig 1)

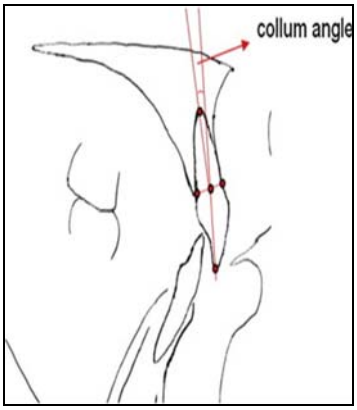

Fig 1: Measurement of collum angle

The SNA, SNB and ANB angles were also measured for every lateral cephalogram.

The findings will be used to interpret the observed variations in the comparative study of the malocclusions. It is then subjected to statistical analysis using ANOVA and Tukeys multiple post-hoc test

Statistical method

Table 1: Distribution of samples by gender

Gender	No of samples	% of samples
Male	378	47.31
Female	421	52.69
Total	799	100.00

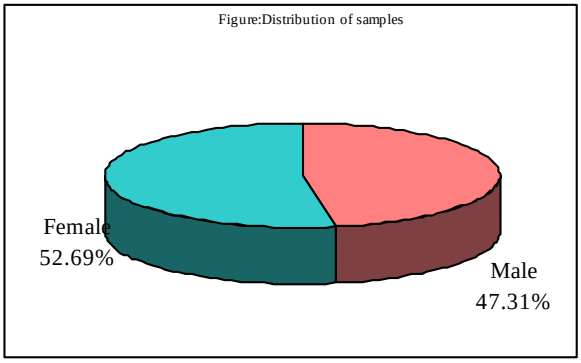

Fig 2: Pie distribution of the samples by gender

Table 2: ANOVA analysis

Dental malocclusion	Mean	Std.Dev.
Class I	6.04	5.15
Class II Div 1	6.12	5.21
Class II Div 2	12.00	6.67
Class III	5.28	5.34
Total	6.20	5.35
F-value	11.4368	
p-value	0.00001*	
Pair wise comparison by Tukeys multiple posthoc procedures		
Class I vs Class II Div 1	P=0.9976	
Class I vs Class II Div 2	P=0.00001*	
Class I vs Class III	P=0.6949	
Class II Div 1 vs Class II Div 2	P=0.00001*	
Class II Div 1 vs Class III	P=0.6520	
Class II Div 2 vs Class III	P=0.00001*	

*p<0.05

Table 3: Correlation between collum angles with SNA and ANB angles by Karl Pearson's correlation coefficient method

variable	Correlation between collum angles with		
	r-value	t-value	p-value
SNA angle	0.0337	0.9525	0.3411
ANB angle	0.0261	0.7381	0.4607

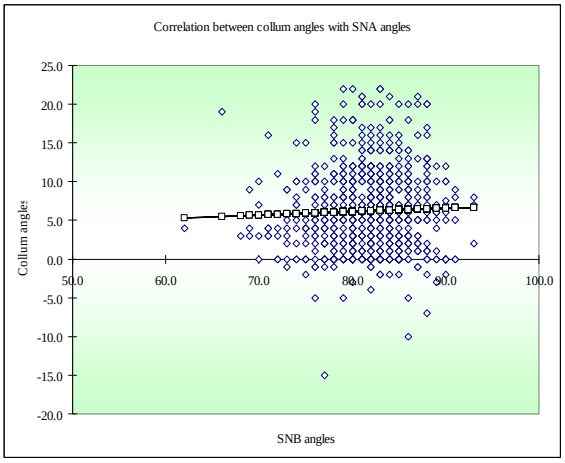

Fig 3: Correlation between collum angles with SNA angle

Table 4: Comparison of male and females with respect to collum angles by t test

Gender	n	Mean	SD	t-value	P-value
Male	378	6.64	5.31	2.2459	0.0250*
Female	421	5.80	5.35		

*p<0.05

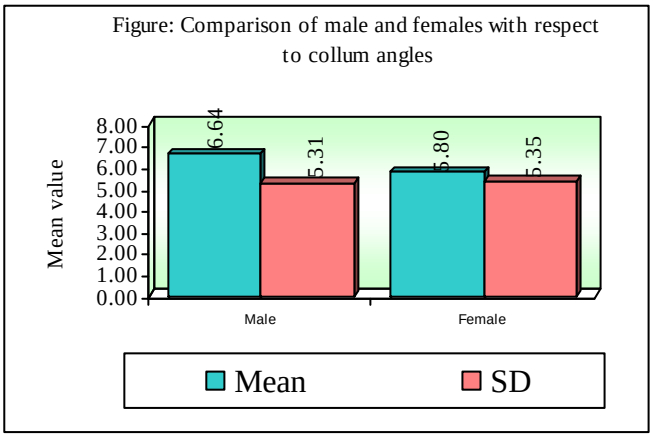

Fig 4: Comparision of gender with collum angles

Discussion

The results of the present study indicate that there is a wide variation in the shapes and forms of maxillary central incisors within the general population. Although these variations have been noted by orthodontists, there have been relatively few comprehensive studies to quantify them.

This study found that the crown-root shape of the permanent maxillary central incisor in Class II division 2 malocclusions differs from that of Class I, Class II division 1, and Class III malocclusions. The crown-root shape of the maxillary central incisor, however, was not significantly different among the Class I, Class II division 1, and Class III malocclusion groups.[3] The shape characteristics of the Class II division 2 permanent maxillary central incisor involved axial bending and a reduced labiopalatal thickness. This is in accordance with previous studies. Furthermore, a shorter root and a longer crown were also identified as important characteristics of the Class II division 2 permanent maxillary central incisor. No previous cephalometric study has investigated this crown-root relationship among all the incisal classes. This parameter could prove to be important in the etiology and management of Class II division 2 malocclusions. No significant incisor shape difference was found between our Class III group and any of the other malocclusion groups. This conflicts with the findings of Harris *et al.* [6] Despite excluding Class II division 2 cases from their sample, they detected a difference in the crown-root angulation of Class III maxillary central incisors in comparison with Class I and Class II division 1 incisor relationships.

The maxillary central incisor crowns of Class II, Division 2 patients were found to be “bent” lingually in relation to their roots. This abnormal configuration has been suggested as a contributing factor in the development of the deep bite seen in Class II, Division 2 patients. Whether the “bending” of the crown on the root is genetically determined or occurs because of physical factors during tooth development is unknown and may be a difficult question to answer. In either case, the extreme retroclination of the central incisor crowns is evidently due not only to improper positioning of the tooth within the maxilla but also to an abnormal crown-root angulation. This fact may possibly cause complications in the treatment of Class II, Division2 patients. In the event of severe crown-root angulation, one must consider the possibility of impingement of the root on palatal cortical bone when torqueing in a palatal direction. While some may claim that it is the position of the crown and not of the root that is important, it may be advisable to evaluate more closely the position of the central incisor roots and also the anatomic form of the surrounding bone in Class II, Division 2 patients. The conclusions drawn from cephalometric evaluations of central incisor position need to be carefully scrutinized in these patients exhibiting teeth with crown-root angulation variations. Anatomic variation in tooth and/or palatal morphology needs to be taken into account.

Conclusion

Based on the cephalometric study done to assess the collum angle in various skeletal malocclusions showed thst the Collum angle between the crown axis and root axis in maxillary central incisors, the class-II division-2 malocclusion group showed a significantly greater Collum angle as compared to the other malocclusion. (Table 3, Figure 3 and table 4 figure 4).

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