Original Research Article

A COMPARATIVE CEPHALOMETRIC EVALUATION OF MAXILLARY CENTRAL INCISOR CROWN ROOT RELATIONSHIPS IN VARIOUS MALOCCLUSIONS

Abstract

An attractive smile is a pleasant effect of Orthodontic treatment which has got a lot of emotional benefits. The variation in tooth morphology of anterior and its angulations and Inclinations play an important role in Smile Aesthetics.' Angulations of the root to the crown of a single rooted anterior teeth is known as Collum angle. The Collum angle of a single- rooted teeth is of particular interest to an Orthodontist because any variation in root angulations can cause unpredictable axial force application in movements such as intrusion and extrusion.

The aim of the study is to compare the Collum angle, Labial crown root angle and Torque angle of class I with that of class II and class III using Lateral cephalometric radiographs.

In conclusion **CA**, LCRA, Torque angle of Class II div 2 malocclusion showed significantly greater value, when comparing with other classes of malocclusion.

Key words: *collum angle, labial crown root angle, Torque angle, lateral cephalograms.*

Background

Aesthetics is the most important factor which attracts both young and adult patients for orthodontic treatment. Orthodontic treatment helps to ensure the proper functioning of teeth and create healthy smiles. An a

ttractive smile is a pleasant effect of orthodontic treatment which has got a lot of emotional benefits. Orthodontic treatment brings teeth, lips, and face

into proportion which improves the self-confidence and self-esteem of the patient.

The anterior teeth have a great influence on personality because they are the only perceptible teeth in both smiling and talking. The variability in tooth morphology plays an important role in attaining good aesthetics. The variations can occur both in the angulations and inclinations of anterior teeth.

The angulation of the root to the crown specifically for a single-rooted anterior teeth is known as Collum Angle[1]. An Incisor, with a normal collum angle, plays an important role in the development of dentition and occlusion. The Collum angle of single-rooted teeth is of greater interest to an orthodontist because any change in root angulations can cause unpredictable axial force application in movements such as intrusion and extrusion. It may also lead the roots to violate labial/lingual cortical boundaries when being repositioned. The Collum angle is the angle formed by joining the long axis of the crown and root using lateral cephalogram.

According to Bryant[2] et al. the crown-root angle can show the extent to which the root can be torqued palatally due to an increase in the proximity of the roots to the palatal cortical plate of the alveolar ridge. Harris[3] et al. conducted a study to find the variations in the tooth morphology and crown-root angulations. The Palatal bending of the crown of the maxillary central incisor is the most important feature of class II div 2 malocclusions.

The increased angulation between the long axis of the crown and root of the retroclined maxillary incisor can be assessed using a lateral cephalogram. Taylor[4] conducted a study on the variation in the morphology of the maxillary central incisor and conclude that morphological variation has got a strong influence from environmental, genetic, and physical factors. Collum angle also varies according to this. The retroclination of the maxillary incisor was strongly influenced by the sagittal relationship of jaws.

For identifying the collum angle, points are marked using cephalogram. Collum angle of maxillary incisor is defined by three points U1 central incisor tip (incisor superius), the intersection points of labial and palatal cementoenamel junctions, and root apex. Carlsson[5] and Ronnerman conducted a study to find the amount of abrasion in accordance with changing angulations and concluded that the angles examined differ widely from tooth to tooth therefore the incision superius tend to move facially as abrasion progresses. The desired torque has been defined as a tangent point at various levels on the clinical crown. This study suggests new angular measurements of crown-root angulation and torque that are built by visible anatomic points, in the assumption of increasing their reliability and usefulness.

This study is to compare the variations in the crown-root angle or “collum angle"(CA), labial crown root angle (LCRA), and torque angle in class I, class II, and class III malocclusions. This helps to attain greater predictability in root positions and to expect difficulties with intrusion, extrusion, or torquing mechanics and their implementation to clinical practice.

Materials and method

Patient with skeletal class I, class II, class III malocclusion between Age group 20 to 30 years with full complement of teeth were selected. Lateral cephalometric radiographs of acceptable quality were used. Lateral cephalometric radiographs can be scanned ,digitized, and loaded into Nemoceph software for landmark identification and measurement .The study population consisted of subject with different class I, class II,class III malocclusion, without prior Orthodontic treatment of their teeth .This is a comparative study to measure the changes seen in CA,LCRA and torque angle of maxillary central incisors of patients with class I,class II,class III dental malocclusion .The class I is compared with class II,class III

malocclusion .Ideal lateral cephalometric radiograph is used for identification and measurements.

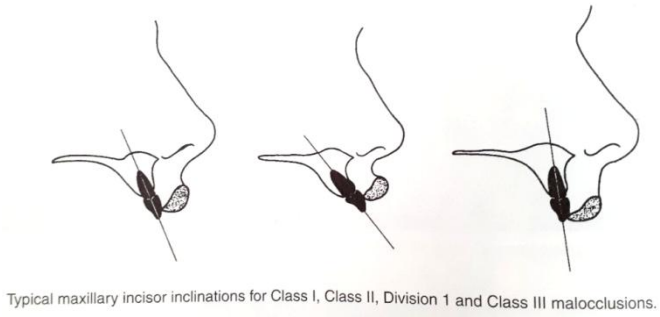


Figure 1. Maxillary incisor inclinatons

The CA is traditionally measured according to three points on the most anterior maxillary central incisor: the undamaged incisal edge [incisor superius, or IS] (Rakosi 1982), the constructed bisection of the facial and lingual cementoenamel junctions (FCEJ and ICEJ, respectively), and the anatomic root apex [upper incisor apicale, or UIA] (Rakosi 1982). The CA is the supplement (180 degrees - x) of this angle. A straight tooth will have a CA of zero, a lingually inclined root will have a positive angle, and a labially inclined root will have a negative angle. The traditional CA measurement, used in this study, is illustrated in Figure: 2 and 3

Figure 2. The traditional CA measurement

Figure:3 Labially inclined root

The labial crown root angle (LCRA) is constructed on a cephalometric radiograph with three points on the most anterior maxillary central incisor: IS, FCEJ, and UIA. The LCRA is the supplement (180 degrees – x) of this angle. It may be more clinically useful than the CA, because the plane defined by IS and FCEJ, more closely approximates the labial surface of the upper central incisor crown. The points of this measurement, however, depends on how it correlates with the CA, since the ultimate goal of the LCRA is to describe crown-to-root angulation. The labial crown-root angle is illustrated in figure: 4

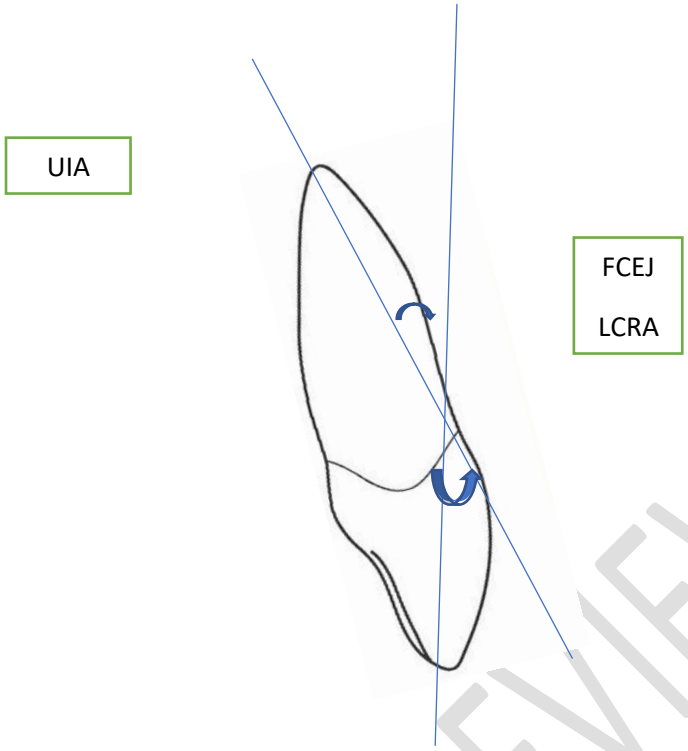


Fig. 4. Labial crown-root angle

Torque is defined in this study as an angle formed by two lines. The first line is formed by FCEJ and IS. This differs from previous definitions of torque that have utilized a tangent line on the labial surface of the crown. The second line is drawn perpendicular to the occlusal plane through IS, where the occlusal plane is identical to that originally defined by Downs: a line from the bisection of U6 occlusal and L 6 occlusal surfaces to the bisection of U1 incisal edge and L 1 incisal edge (Downs 1948). A positive torque angle indicates buccal crown inclination, and a negative torque angle indicates lingual crown inclination. The torque angle used in this investigation is illustrated in Figure: 5.

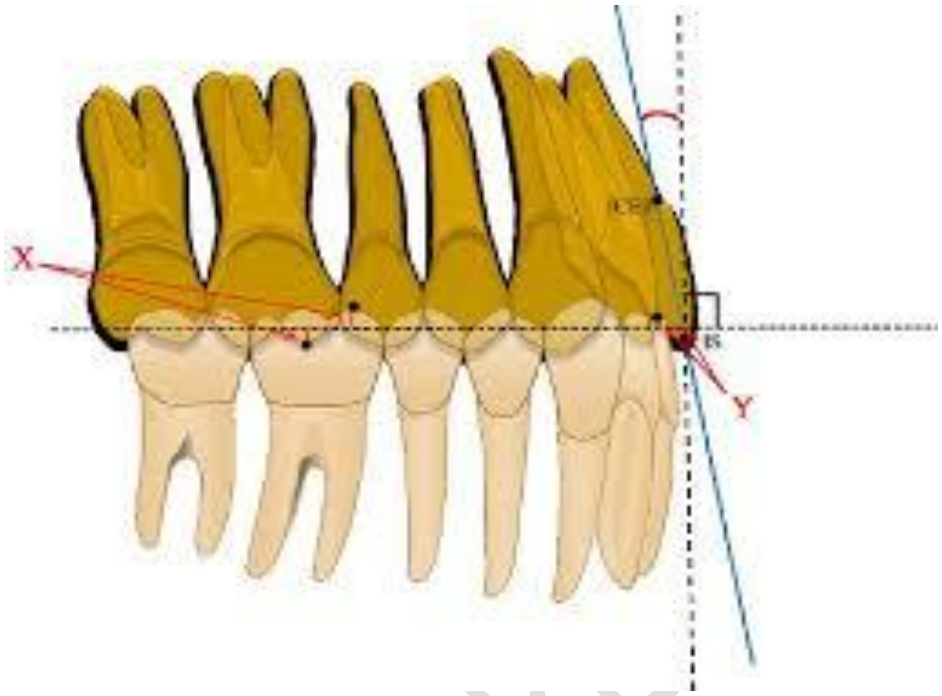


Figure: 5 The torque angle used in this investigation

Result

The pre-treatment lateral cephalograms were used for evaluating collum angle, labial crown root angle and torque angle of class I, class II Division 1, class II Division 2 and class III malocclusion using nemoceph software. Results were tabulated on MS EXCEL and statistical evaluation was done. The statistical calculations were performed using the software SPSS for windows (statistical presentation system software, SPSS Inc.1999, New York) version 19.

TABLE – 1: COMPARISON OF COLLUM ANGLE IN DIFFERENT CLASSES OF MALOCCLUSION

Malocclusions	N	Collum Angle		P
		Mean	Sd	
Class I	15	7.25	0.92	<0.001
Class II a	15	7.90	0.83	
Class II b	15	11.68	1.12	
Class III	15	7.96	0.76	

FIGURE – 6: representing bar diagram showing collum angle in different classes of malocclusions, with collum angle plotted in X axis and vertical bar representing each classes of malocclusion.

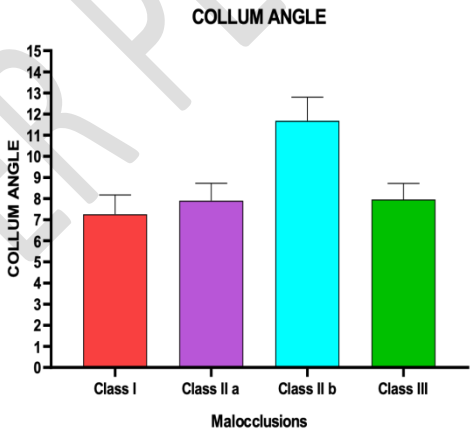


TABLE – 2: COMPARISON OF LABIAL CROWN ROOT ANGLE ON DIFFERENT CLASSES OF MALOCCLUSION

Malocclusions	N	LABIAL CROWN ROOT ANGLE(LCRA)		P
		Mean	sd	
Class I	15	28.00	1.89	<0.001
Class II a	15	28.99	1.90	
Class II b	15	38.69	2.08	
Class III	15	29.56	1.43	

FIGURE - 7, representing bar diagram showing labial crown root angle in different classes of malocclusions, with labial crown root angle in x-axis and vertical bar representing each classes of malocclusion.

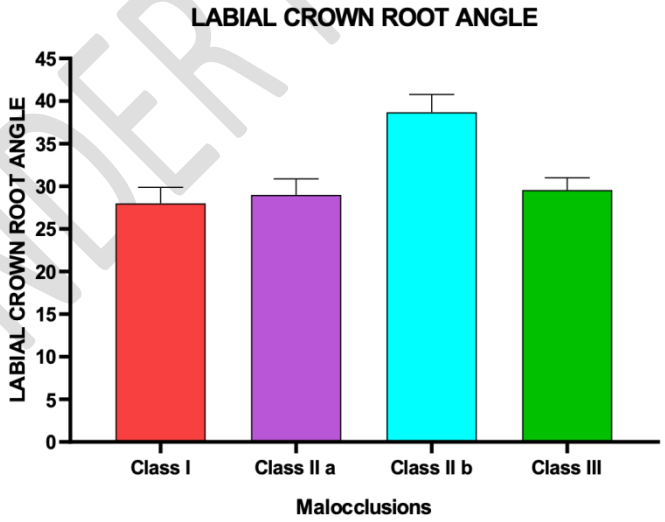
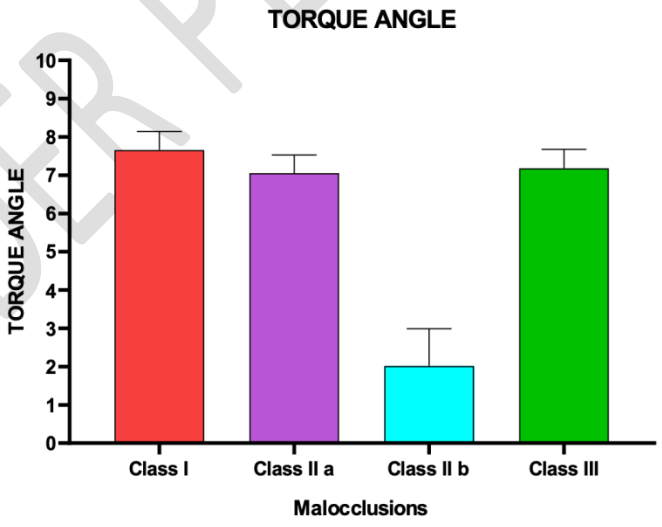


TABLE-3: COMPARISON ON TORQUE ANGLE ON DIFFERENT CLASSES OF MALOCCLUSION

Malocclusions	N	TORQUE ANGLE		P
		Mean	Sd	
Class I	15	7.660	0.484	<0.001
Class II a	15	7.055	0.473	
Class II b	15	2.015	0.974	
Class III	15	7.182	0.494	

FIGURE-8, representing bar diagram showing torque angle in different classes of malocclusions, with torque angle in x-axis and vertical bar representing each classes of malocclusion.



Discussion

The shape and size of Maxillary Incisors play an important role in Orthodontics. Historically it was assumed that the long axis of the crown and root of a maxillary

central incisor are identical, and so it was concluded that the Collum angle is zero. This assumption was originated with the studies of Andrew's[6](1976) and Brayant[7]et al (1984), with cephalometric tracing templates. Andrew's pre-adjusted straight wire concept was based on the six keys of ideal occlusion.

The importance of Collum Angle has been studied in various publications. Srinivasan[8]et al. conducted a study on the effect of various kinds of Orthodontic forces and lip pressure on the Collum angle and concluded that the variations in the lip line found to be an important etiologic factor for the changes in Collum angle. The study of Heravi[9] et al. stated that the Maxillary Central incisor's ligament experiences much more stress during retraction when there was an increased Collum angle and vice versa. They also concluded that the intrusive forces experienced by teeth with larger Collum angles which appears to be lower as compared to ones with smaller Collum angle.

Williams[9] et al. conducted a study on the Crown Root angle of Maxillary Central Incisor on different classes of malocclusions and found that the Crown Root angles significantly differ when comparing Class II div 2 and Class II div 1 malocclusion. Bauer[10] et al. concluded in his study, where he compared the Collum angle of Class II div 2 samples with Class I and showed a statistically greater value in Class II div 2 patients.

Shen[11] et al. conducted a study on the Collum angle of different types of malocclusions and concluded that the Collum angle of Class II div 2 malocclusion shows significant difference because of the differences in hereditary genes between western and Oriental races. He also concluded that there is an increased tooth axis bending compensating bony protrusion.

In this study, the collum angle, the labial crown root angle is compared with class I and class II div 1, class II div 2 malocclusion and class III. The mean value shows no significant difference regarding the collum angle, except for class II div 2. The mean values show significant difference in the Labial crown root angle in the case of class II div 2 patients. The studies of Delivanis [12]and Kuftinec

appears to be more correlated with this study. He conducted a study on the change in crown root morphology of maxillary central incisor in class II div 2 malocclusion and concluded that the crowns of the maxillary central incisors tended to “bend” more lingually inpatients with class II Division 2, than in with other types of malocclusions. This tendency has also been studied by Backlund[53] and concluded that this bending was an important factor contributing to the development of class II Division 2 malocclusions. The significance of Delivanis and Kuftinec study was that, the crown-root angulation appearing in class II Division 2 malocclusions may complicate torque of the incisors and orthodontic intrusion, in more complicated cases, this may increase the danger of perforating the palatal cortical plate.

This study was conducted to find the difference in collum angle, labial crown root angle and torque angle in different classes of malocclusion. Collum angle of class I was compared with class II div 1, class II div 2, and class III malocclusion. The values shows that collum angle of class II div 2 shows significant difference when compared with that of class I, class II div I, and class III. While planning an intrusion mechanics, for such patient’s care should be taken to avoid the impingement in palatal cortical plate.

The labial crown root angle of class I was compared with class II div 2, class II div 1 and class III malocclusion. The labial crown root angle of class II div 2 shows significant difference when compared with that of class I, class II div 1 and class III malocclusions. Class III shows a greater variation when compared with that of class I and class II div 1 shows a greater value when compared with that of class I.

The torque angle of class I is compared with that of class II div I, class II div 2 and class III malocclusions. Class II div 2 shows significant change in the values when compared with other class of malocclusion. Class III, class II div 1 shows a lesser variation on comparison with class I malocclusion.

Collum angle has got a greater influence on both labial and lingual orthodontics. When there is an increase in collum angle, the stress-strain distribution also increased in both labial and lingual orthodontics. As there was a change in center of rotation cervically, the intrusion reduced when collum angle increased. This was stated by Sandesh[13] S Pai in his studies on the effect of labial and lingual retraction and intrusion force on maxillary central incisor with varying collum angles. They concluded that there is a strong correlation between Collum angle and intrusion mechanics both in labial and lingual orthodontics. Intrusion process was severely reduced with increased collum angle. This can be taken into consideration while giving Tads for intrusion mechanics.

Conclusion

The Collum angle, Labial crown root angle and Torque angle of Class II DIVISION 2 is significantly greater when comparing with other class of malocclusion.

Statement of Informed Consent

Informed consent was obtained from the subjects for the use of lateral cephalometric radiographs.

References

1. Israr J,Bhutta N,Rafique M,Chanta M.Comparison of collum angle of maxillary central incisors in class II div 1 and 2 malocclusions.Pak Oral Dent J.2016;36(1):91-94.
2. Bryant R M,Sadowsky P L,Dent.M,Hazelrig J.B.Variability in three morphologic features of the permanent maxillary central incisor.Am J Orthod Dentofacial Orthop.1984;86(1):25-32.
3. Harris F E, Hassankiadeh S, Harris T J. Maxillary incisor crown-root relationships in different Angle malocclusions.Am J Orthod Dentofacial Orthop.1993;103(1):38-53.

4. .Taylor R.M.S.Variation in form of Human Teeth: An Anthropologic and Forensic study of Maxillary incisors. J Dent Res.1967;48(1):5-16.
5. Carlsson R,Ronnerman A .Crown-Root angle of upper central incisors.Am J Orthod Dentofacial Orthop.1973;64(2):147-154.
6. Andrews L F.The Straight-wire appliance,origin,controversy,commentary.J Clin Orthod.1976;10:99-114.
7. Srinivasan B,Kailasam V,Chitharanjan A,Ramalingam A .Relationship between Crown-Root angulation (collum angle)in class II ,division 2 malocclusion and lower lip line.J. Orthod.2013;(14):66-74.
8. Heravi F.Effects of Crown-Root angle on stress distribution in the Maxillary central incisor's PDL during application of intrusive and retraction forces:a three-dimensional finite element analysis.Prog Orthod .2003;10:14-26
9. Bauer J T .Maxillary central incisor crown-root relationship in class I normal occlusion and Class II division 2 malocclusions.University of Iowa.2014
10. Devreese H,De Pauw,Van G,Maele,Jagtman K,Dermaut L .Stability of Upper incisor inclination changes in class II division 2 patients.Eur.J. Orthod.2007;(29):314-320.
11. Delivanis P H,Kuftinec M M.Variation in morphology of Maxillary central incisors found in class II,Division 2 malocclusions.Am J Orthod Dentofacial Orthop.1980;78(4):438-443.
12. Pai SS,Panda S,Pai V,Anandhu M,Vishwanath E,Suhas A S.Effects of labial and lingual retraction and intrusion force on maxillary central incisor with varying Collum angle.Athree dimensional finite element analysis.J Indian Orthod Soc.2017;51:28-37.
13. Yen-Wen,Shen,Jui-Ting Hsu,Yi-Hui Wang,Heng-Li Huang,Lih-Jyh Fuh .The collum angle of the maxillary central incisor in patients with different types of malocclusion.J Dent.2012;7(1):72-76.
14. DR.Shailaja AM,DR.Nishitha C Gowda,DR.Suvarna Gowda .The collum angle of maxillary central incisors in different skeletal malocclusions -A cephalometric study.J Orthod.2016;2(3):33-36.

15. Walkow M T, Peck S. Dental arch width in Class II Division 2 deepbite malocclusion. Am J Orthod Dentofacial Orthop.2002;122(6):608-613.

16. Logan WR. Deckbiss da clinical evaluation.Trans Eur Orthod Soc .1959;35:313-317.