# Comparison of collum angle and labial crown-root angle of maxillary central incisor in Class I and Class II division 2 malocclusion

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**ABSTRACT**

**Introduction:** Variation in tooth morphology widely influences the achievement of optimum esthetics and stable occlusal relationship. This study was conducted to compare the collum angle and labial crown root angles in class I, class II division 2 malocclusions, using cephalometric radiographs, and to find a correlation between these angles. **Methods**: This cross-sectional study was conducted from March 2018 to January 2021 among patients visiting the department of Orthodontics at Gandaki Medical College. A total of 62 lateral cephalograms were included and equally divided into 2 groups: Angle's Class I and Class II division 2. Cephalometric tracing was done to measure the collum angle and labial crown root of maxillary central incisors. Pearson's correlation test and independent t-test were used. **Results:** There was a weak positive correlation (r=+0.348) between the angles in Class I group, (p=0.27) and a moderate positive correlation (r=+0.547) between the angles in Class II division 2 group (p<0.001). The mean collum angle was found to be greater in class II division 2 (11.90±6.86) than in class I (4.51±4.13) which was statistically significant (p<0.001). The mean labial crown root angle was found to be greater in class II division 2 (39.65±8.57) than in class I (30.23±5.20) which was statistically significant (p<0.001). **Conclusions:** There was no statistically significant correlation between collum angle and labial crown-root angle in class I groups. The mean of collum angle and labial crown-root angle was found to be greater in class II division 2 which were statistically significant in both angles.

**Keywords:** Class II division 2, collum angle, labial crown-root angle.

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## INTRODUCTION

The stability in occlusal relationship is influenced widely by the anatomy of the dentition.[1] According to Andrews, for the establishment of the proper occlusion, the labiolingual inclination of teeth is one of the important factors. It is generally assumed that longitudinal axis of the crown and root coincides with each other but, studies have shown that the crown of maxillary incisors is angled in a peculiar way to the root of a tooth.[2] This variations in the crown-root angle has been described by several authors as occurring in various types of malocclusions, particularly class II division 2 patients.[3,4] The crown-root angulation occurring in class II division 2 malocclusions may impede orthodontic intrusion and torque of the incisors and, in severe cases, may give rise to the hazard of perforating the palatal cortical plate.[5] Thus, for the greater predictability in root position, and to predict difficulties with different mechanics like intrusion, extrusion, or torquing, we should have a thorough understanding of crown-root relationships in the bucco-lingual plane. A new crown-to-root angle has been defined by Bauer and is known as "labial crown root angle" (LCRA).[6] This angle can be easily identified on lateral cephalometric radiographs, and may have the closer approximation

with the particular position of the straight wire bracket on the labial surface of an incisor. If the LCRA is correlated with the collum angle (CA) of a given tooth, then difficulties with abnormal root positioning might be anticipated directly from this easy measurement.

There are few studies in the literature, regarding the comparison of CA and LCRA.[6-8] However, no study has been conducted so far in Nepalese population. Thus, the aim of this study was to compare the CA and LCRA in class I malocclusion and class II division 2 malocclusions and to correlate LCRA with the CA.

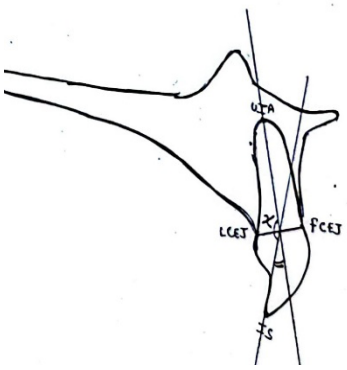


**Fig 1:** Collum Angle

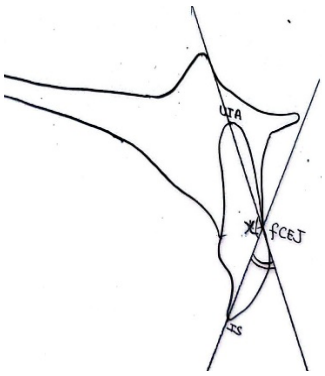


**Fig 2:** Labial crown root angle

## METHODS

This is a hospital based cross-sectional study which included lateral cephalograms of patients dated from March 2018 to January 2021 in the Department of Orthodontics at Gandaki Medical College. Ethical approval for the study was obtained from institutional review board (Ref no: 122/2077/2078). Sample size calculation was based on 80% power and based on the standard deviation of 3.10.9 Now applying the formula, N= 2 SD2 (Zα + Zβ)2 / d2, N= 2 x 9.61 (1.96+0.84)2/ 4.79 = 31.4 where, d=mean difference N= sample size. The total sample was calculated as 62 with 31 samples in each group. The inclusion criteria were 1) Angle's Class I malocclusion, 2) Angle's Class II division 2 malocclusion, 3) Proper image quality and clarity of cephalograms. A total of 62 cephalograms which fulfilled the inclusion criteria were studied of which 35 were female and 27 were male. The study was categorized into two groups using study model based on the Angle's classification of malocclusion: Class I malocclusion and Class II division 2 malocclusion. The cephalometric tracings of included samples were done. Cephalometric tracings of maxillary central incisors was done on lead acetate paper. The measurements of CA and LCRA of maxillary central incisors was recorded for each patient and was compared between the two groups. All the measurements were taken by single examiner (principal author) to reduce inter-examiner variability.

### Description of Measurements

The CA is measured by the three points on the most anterior maxillary central incisor: the incisal edge (incisor superius, IS), the bisection of the facial and lingual cementoenamel junctions (fCEJ and lCEJ, respectively), and the anatomic root apex (upper incisor apicale, UIA). The CA is the supplement (180 degrees - x) of this angle.[10] 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.[6]

The statistical analysis was done using IBM SPSS (statistical package for social science) statistical version 16.0. All quantitative variables were assessed using measures of central location (mean) and measures of dispersion (standard deviation). The comparison of angles between the two groups was done by comparing the means using independent t- test where, p-value <0.05 was considered to be statistically significant. For the correlation of two parameters, Pearson's correlation test was used

**Table 1:** Interpretation of Pearson's correlation coefficient

| | |
|---|---|
| 0.0 - 0.19 | No correlation |
| 0.20 - 0.39 | Weak correlation |
| 0.50 - 0.59 | Moderate correlation |
| 0.60 - 0.79 | Strong correlation |
| 0.80- 1.0 | Perfect correlation |

## RESULTS

Among the total sample of 62 lateral cephalograms, 31 samples were in Class I group and 31 samples were in Class II Division 2 group. The age ranges from 13 to 35 years. The average age in class I group was 18.87±4.82 with 15 females and 16 males. Similarly, the average age in class II division 2 group was 18.96±4.30 years with 20 females and 11 males.

Table 2 shows the correlation between CA and LCRA in class I and class II division 2 group. The correlation between CA and LCRA in class I group showed weak positive correlation(r=+0.348) which was statistically insignificant (p=0.27). The correlation between CA and LCRA in class II division 2 group showed moderate positive correlation (r= +0.547) which was statistically significant (p= 0.001) (Table 2).

**Table 2:** Correlation between CA and LCRA in Class I and Class II division 2 group

| Pearson Correlation in Class I and Class II division 2 group | | | | | |
|---|---|---|---|---|---|
| | | Collum Angle | | Labial Crown Root Angle | |
| | | Class I (n=31) | Class II div2 (n=31) | Class I (n=31) | Class II div2 (n=31) |
| CA | Pearson's Correlation | 1 | 1 | +0.348 | +0.547 |
| | p-value | | | 0.27 | 0.001* |
| LCRA | Pearson's Correlation | +0.348 | +0.547 | 1 | 1 |
| | p-value | 0.27 | 0.001* | | |

*Statistically significant

When comparing the mean CA and mean LCRA in Class I and Class II division 2 malocclusion, both of the angles i.e., CA and LCRA was found to be greater in Class II division 2 group when compared with Class I group which was found to be statistically significant (Table 3).

**Table 3:** Comparison of mean CA and LCRA in Class I and Class II division 2 group

| Angle | Class I group Mean ± SD (n=31) | Class II Div 2 group Mean ± SD (n=31) | Mean Difference | p-value | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower limit | Upper limit |
| CA | 4.51±4.13 | 11.90±6.86 | -7.39 | <0.001* | -10.26 | -4.51 |
| LCRA | 30.23±5.20 | 39.65±8.57 | -9.42 | <0.001* | -13.02 | -5.81 |

*Statistically significant

## DISCUSSION

The treatment or the post-treatment phase of orthodontic treatment can be affected by the discrepancies in morphologies of the maxillary central incisor. With the development of cephalometry, the angulation of central incisors has been evaluated and studied.

According to the illustrations of crown inclination given by Andrews,[11] this may have assumed that the CA is zero for each tooth. This assumption may have originated with development of the straight wire appliance. Andrews never addressed the possibility that the crown and root of a tooth may be inclined relative to each other. Most of the treatment approaches in the various techniques are based on this assumption, but over time, various authors have found this belief to be incorrect.[2-4]

It is noted that, root resorption occurs to some degree in most patients undergoing orthodontic treatment,[12] but it has been reported to occur more frequently and more severely in maxillary incisors whose roots are translated into the palatal cortex.[13–15]

The crown-root angulation occurring in class II division 2 malocclusions may impede different types of orthodontic tooth movement like intrusion and torque of the incisors. and, in severe cases, may give rise to the hazard of perforating the palatal cortical plate.[5] To avoid excessive palatal displacement and root resorption, the torquing mechanics in class II division 2 need to be moderated.

In the study conducted by Baumrind et al. have shown that the amount of error in landmark identification increases when it is constructed (a bisection or tangent line), interpreted (a point on a curve), or confounded by noise of adjacent structures (superimposition).16 Since CA of maxillary central incisor is constructed by drawing a line from incisal edge bisecting the fCEJ and lCEJ and anatomic root apex, this measurement may have poor reliability and this limits the clinical utility because it is constructed and the point is often superimposed by other structures. Due to all these disadvantages, the point on the labial surface of cementoenamel junction was proposed by Bauer.6 The advantage of the point was easy location by different observers.

In this study, the correlation between CA and LCRA in class I group showed weak positive correlation and in Class II division 2 group showed moderate positive correlation. The study conducted by Bauer also showed the positive correlation between CA and LCRA in both Class I and Class II division group.6 In the study conducted by Singh, showed that there was a positive significant correlation between CA and LCRA in Class I, Class II division 1 and Class II division 2 groups.[7]

This study was also conducted to compare the mean CA in Class I and Class II division 2 groups. The results of this study shows that the CA in Class II division 2 malocclusion group is significantly greater than the Class I group, which is similar to the studies conducted by Delivanis, Bryant and Williams.[3,4,17]

Bauer conducted the study to compare the means of CA and LCRA in Class I and Class II division 2 group, which showed that the mean CA as well as mean LCRA in the Class II division 2 group was significantly greater than that in the Class I group.[6] In our study also, the means of both the CA and LCRA was significantly greater in Class II division 2 groups. In the study conducted by Singh, comparison of mean of LCRA in different malocclusion showed that there was no significant difference between Class I and Class II division 1 group, but there was a statically significant difference between Class I and Class II division 2 groups.[7] Since there was a positive correlation between CA and LCRA in Class I and Class II division 2 groups in this study, relatively easily identified angle, LCRA also can be used like a CA to access crown and root angle of a given tooth.

Only handful studies have been conducted regarding LCRA angle. Hence, this study introduces a newer yet relatively easily identifiable angle that can help clinicians to assess crown-root angulation. To reduce the bias, this simple cephalometric technique, could be applied on other

malocclusions like Class II division 1 and Class III in future studies. The study could be conducted among a greater number of sample size and in different ethnicity. Since this study was done in maxillary central incisor, which is typically the only tooth that is measurable on a standard lateral cephalometric radiograph. With the introduction of cone beam computed tomography (CBCT), similar future studies could be conducted for every tooth, using analogous measurements.

**CONCLUSIONS**

A statically insignificant correlation was seen between CA and LCRA in class I groups. Statistically significant correlation was seen between CA and LCRA in class II division 2 groups. Comparing the mean CA and mean LCRA in Class I and Class II division 2 malocclusion, both of the angles i.e., CA and LCRA was found to be greater in Class II division 2 group when compared with Class I group which was found to be statistically significant.

**CONFLICTS OF INTEREST:** None declared

**SOURCE OF FUNDING:** None

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