COMPARATIVE EVALUATION OF COLLUM ANGLE OF MAXILLARY CENTRAL INCISOR IN PATIENTS WITH ANGLES CLASS I, CLASS II DIVISION 1 AND CLASS II DIVISION 2 MALOCCLUSIONS – A CEPHALOMETRIC STUDY

Dr. Nivedita A. Nandeshwar, Dr. Sujoy Banerjee, Dr. Usha Shenoy, Dr. Pankaj Akhare, Dr. Ananya Hazare, Dr. Himija Karia, Dr. Sangeeta Bhattacharya.

ABSTRACT

Background:
Variations in anatomic features of the maxillary central incisors (MCI) can affect either the treatment or the retention phase of orthodontic therapy. Collum angle (CA) of single rooted teeth is of particular interest to orthodontists as any variation in root angulations leads to unpredictable axial force application in movements such as intrusion and extrusion which cause roots to violate labial/lingual cortical boundaries when being repositioned.

Aim:
Comparative evaluation of (CA) of (MCI) in patients with Angles class I, class II division 1 and class II division 2 malocclusions.

Materials and method:
Sample size of 90 is obtained for the study, divided into 3 groups based on type of malocclusion, with an age ranging from 18-30 years and (CA) of (MCI) in each group is measured by sketching it from lateral cephalogram then superius point (sp) on incisal edge, middle point of (CEJ) and root apex are marked. Long axis of crown is drawn by joining (sp) on incisal edge and middle point of (CEJ) and root apex are marked. Long axis of root is drawn by joining middle point of (CEJ) and root apex. (CA) is then measured by joining the long axis of root and crown.

Results:
Statistical analysis is performed using SPSS version 22, which showed exceeding values of (CA) of (MCI) in patients with Class II division 2 malocclusion.

Conclusion:
The larger (CA) is an etiological factor in the development of a deep bite. In addition, larger (CA) may limit biomechanical movements during orthodontic treatment.

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INTRODUCTION
Variability in tooth morphology is an important consideration in the attainment of an aesthetic, functional and optimal occlusion of teeth.²

The improvement in facial aesthetics is one of the most important motivating factors for patients to seek orthodontic treatment.³

Smile plays a critical role in dental aesthetics and social behaviour.³ Smiling aesthetics, especially frontal smiling aesthetics, have been frequently studied in dental literature and thus formed the basis of this study.³ The angulation of the root to the crown, particularly of the single rooted anterior teeth is known as Collum angle.⁹

Variations in anatomic features of the maxillary central incisors can affect either the treatment or the retention phase of orthodontic therapy.² According to Taylor, the relation of the root to the crown varies considerably because both are subject to variations in curvature.⁹

Normal Collum angle in incisor plays important role in development of dentition and occlusion.³

Collum angle of single rooted teeth is of particular interest to orthodontists as any variation in root angulations leads to unpredictable axial force application in movements such as intrusion and extrusion. This may also cause roots to violate labial/lingual cortical boundaries when being repositioned.⁹

In relation to orthodontics and bracket positioning, the variability in labial crown curvature affects the slot of a bracket and its relationship to the occlusal plane (Bryant, 1984). Likewise, the axial inclination of a tooth is a key variant in anatomical morphology.⁹ When looking at axial inclination, one is typically inclined to evaluate only the crown, assuming that the root follows the same axis. On inspection of most anterior teeth, it can be noted that the longitudinal axis of the crown of a tooth can vary significantly from the longitudinal axis of the root.⁹ In this study, the crown to root angle of the anterior teeth will be measured and correlated to different types of malocclusions classified in orthodontics.¹

As the supplementary angle of the crown to root angulation, the collum angle is used to more comprehensively demonstrate the amount of labio-lingual angulation of the crown to the root.² Specifically, the collum angle will be used to quantify the crown to root angle measurements in this study.

MATERIALS AND METHOD
Subjects of this study were patients from Department of Orthodontics and Dentofacial Orthopaedics at VSPM’s Dental College and Research Centre, Nagpur (Central India Population). Radiographs of 90 patients were traced and studied, including 45 male and 45 female patients. The ages ranged 18–30 years. Sample of 90 patients were categorized into three groups according to the malocclusion type using Angle’s classification by a model analysis: Class-I, Class-II division-1 and Class-II division-2 malocclusions.

COLLUM ANGLE MEASUREMENTS
After sketching the maxillary central incisor type from lateral cephalogram the superius point on incisal edge, middle point of cementoenamel junction and root apex are marked.
Long axis of crown - is drawn by joining superior point on incisal edge and middle point of cementoenamel junction.

Long axis of root - is drawn by joining middle point of cementoenamel junction and root apex.

Collum angle is then measured by joining the long axis of root and long axis of crown.

INCLUSION CRITERIA
- Patients age = (18-30) years.
- Permanent dentition with full complement of teeth and fully developed roots.
- No history of previous orthodontic treatment.
- Patients desiring orthodontic treatment.

EXCLUSION CRITERIA
- Patients with history of orthodontic treatment.
- Patients with history of prosthesis (posts, dental implants, or fixed partial dentures) present in anterior zone.
- Patients with craniofacial anomalies (cleft palate and cleft lip).
- Patients with history of trauma.
- Patients with history of abrasion, attrition with maxillary central incisor.
- Patients with morphological alteration of maxillary central incisor.

STATISTICAL ANALYSIS
The statistical analysis was done using the Statistical Package for the Social Science (SPSS version 22, Armonk, NY: IBM Corp). Gender-wise distribution amongst the three malocclusion types i.e. Class I, Class II div 1 and Class II div 2 were recorded using descriptive statistics. The recorded values were statistically evaluated using the one-way analysis of variance test (ANOVA), followed by Tukey post hoc test for multiple comparisons. The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences between the means of two or more independent (unrelated) groups.

RESULTS

Tab. 1 Gender-wise distribution amongst the three malocclusion types

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>Total sample size (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>Class I</td>
<td>15 (50)</td>
<td>15 (50)</td>
</tr>
<tr>
<td>Class II div 1</td>
<td>15 (50)</td>
<td>15 (50)</td>
</tr>
<tr>
<td>Class II div 2</td>
<td>15 (50)</td>
<td>15 (50)</td>
</tr>
</tbody>
</table>

Tab. 2. Distribution of mean values of Collum angle amongst the three malocclusion types

<table>
<thead>
<tr>
<th>Group</th>
<th>Total sample size (N)</th>
<th>Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>30</td>
<td>4.13 ± 1.8</td>
<td></td>
</tr>
<tr>
<td>Class II div 1</td>
<td>30</td>
<td>6.23 ± 2.8</td>
<td>0.001*</td>
</tr>
<tr>
<td>Class II div 2</td>
<td>30</td>
<td>12.66 ± 4.4</td>
<td></td>
</tr>
</tbody>
</table>

*p≤0.001 highly significant using one way ANOVA; SD- standard deviation
Tab. 2 shows the distribution of mean values of Collum angle amongst the three malocclusion types. It revealed that the mean of the Class II div 2 group was greater (12.66± 4.4) followed by Class II div 1 (6.23 ± 2.8) while it was lowest for Class I group (4.13 ± 1.8) (fig 1).

Table 3: ANOVA Table

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1186.156</td>
<td>2</td>
<td>593.078</td>
<td>57.109</td>
</tr>
<tr>
<td>Within Groups</td>
<td>903.500</td>
<td>87</td>
<td>10.385</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2089.656</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P Value</td>
<td></td>
<td></td>
<td>.0001*</td>
<td></td>
</tr>
</tbody>
</table>

*p≤0.001 highly significant

Tab. 4. Multiple comparison amongst the three malocclusion types

<table>
<thead>
<tr>
<th>Malocclusion type</th>
<th>Mean difference (I-J)</th>
<th>p-value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) group</td>
<td>(J) group</td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>Class II div 1</td>
<td>-2.10</td>
</tr>
<tr>
<td>Class II div 2</td>
<td></td>
<td>-8.5</td>
</tr>
<tr>
<td>Class II div 1</td>
<td>Class I</td>
<td>2.10</td>
</tr>
<tr>
<td>Class II div 2</td>
<td>Class I</td>
<td>8.53</td>
</tr>
</tbody>
</table>

*p≤0.05 statistically significant

This difference was highly significant (p≤0.001) using one way ANOVA. Tab. 4 depicts the multiple comparisons between all the three groups using Tukey post hoc test.

Tab. 5 (a,b,c) shows the gender-wise comparison between the three groups. It depicted that females had significantly higher values of collum angle when compared with males in all the three groups. (fig 2)

Tab. 5. Gender-wise comparison amongst the three malocclusion types

Tab. 5a. Class I malocclusion

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean ± SD</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>15</td>
<td>3.1 ± 1.6</td>
<td></td>
<td>0.001*</td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>5.2 ± 1.4</td>
<td></td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*p≤0.001 highly significant using independent sample t-test

Tab. 5b. Class II malocclusion div 1

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean ± SD</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>15</td>
<td>4.6 ± 1.6</td>
<td></td>
<td>0.001*</td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>7.8 ± 2.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p≤0.001 highly significant using independent sample t-test

Tab. 5c. Class II malocclusion div 2

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>15</td>
<td>8.9 ± 2.1</td>
<td>0.001*</td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>13.9 ± 4.5</td>
<td></td>
</tr>
</tbody>
</table>

*p≤0.001 highly significant using independent sample t-test
ANOVA Collum angle

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>4.769</td>
<td>1</td>
<td>4.769</td>
<td>.201</td>
<td>.655</td>
</tr>
<tr>
<td>Within Groups</td>
<td>2084.887</td>
<td>88</td>
<td>23.692</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2089.656</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1 Distribution of mean values of Collum angle amongst the three malocclusion types

Fig. 2 Gender-wise distribution amongst the three malocclusion types
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 and Class II division 1 malocclusions. The maxillary central incisor crown-root shape, however, was not significantly different among the Class I and Class II division 1 malocclusion groups. 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. This parameter could prove to be important in the etiology and management of Class II division 2 malocclusions.

The crown of maxillary central incisor in 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, Division 2 patients. In severe crown-root angulation, it should be taken into consider that there may be the possibility of impingement of root in 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 study concludes that central incisor position need to be carefully scrutinized in patients exhibiting teeth with crown-root angulation variations thus, anatomic variation in tooth and/or palatal morphology should be taken into account.

**CONCLUSION**

The mean Collum Angle in Class II division 1 malocclusions is statistically different from zero degrees unlike assumed by Andrews. Based on cephalometric study the assessment of collum angle in various skeletal malocclusions showed that Collum angle between the crown axis and root axis in maxillary central incisors, in Class-II division-2 malocclusion group had a significantly greater Collum angle as compared to the other malocclusion. (Table 2, Figure 1, figure 3).

Tab. 5 (a,b,c) shows the gender-wise comparison between the three groups. It depicted that females had significantly higher values of collum angle when compared with males in all the three groups. (fig.2)

**REFERENCES**

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