The Crown Root Morphology of Central Incisors in Different Skeletal Malocclusions Assessed With Lateral Cephalogram

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Abstract

Background and Aim: The primary goal of this study was to compare the crown-root morphology of the maxillary and mandibular central incisors across various types of skeletal malocclusion with an average growth pattern utilizing lateral cephalogram for the correct torque expression of anterior teeth and to prevent alveolar fenestration and dehiscence.

Material and Method: The retrospective study was conducted in the Department of Orthodontics and Dentofacial Orthopedics at Rama Dental College Hospital and Research Centre, Kanpur on 45 patients. All these samples were selected on the basis of Steiner's ANB angle Class I (ANB 2-4˚), Class II (ANB>4˚), Class III (ANB<2˚) for skeletal malocclusion and Mandibular plane angle (27˚≤SN-MP≤37˚) for the average growth pattern**.**

Results: The mean Collum Angle for Maxillary CI (central incisor) was 4.3±4.6degrees, 7.1±4.5 degrees and 6.1±5.2 degrees in Class I, II and III, respectively and for Mandibular CI was 1.7±4.6 degrees, 2.1±3.1 degrees and 4.2±4.1 degrees, respectively. The mean labial surface angle for Maxillary CI was 16.2±4.1degrees, 18.7±3.1degrees, 15.4±4.1 degrees in Class I, II and III, respectively and for Mandibular CI was 11.4±3.7 degrees, 12.1±2.8 degrees and

14.7±5.8 degrees, respectively. Our results proved that the Lateral cephalogram is good enough to get a conclusive idea about the collum angle and labial surface angle.

Conclusion: The collum angle and labial surface angleare crucial to accomplish our ultimate goal of an attractive smile and having a good facial aesthetics. These criterias will serve as a constant reference point for our research as we strive for the perfect outcome.The morphologies of these teeth play significant roles in torque changes, dehiscence, fenestration, and root resorption because of the root bending towards lingual cortical alveolar bone.Because of this, it's important to evaluate the variability of the crown-root morphology before placing a bracket.

Keywords: Collum Angle(CA), Labial surface Angle(LSA), Lateral Cephalogram, Maxillary CI, Mandibular CI.

Introduction

The importance of tooth morphology in dental treatments has received a lot of attention. The maxillary central incisors are the most apparent teeth when making spontaneous facial movements. They are the most representative of the tooth mold design and distinguish themselves from the other teeth in the oral cavity.[1] Adequate labial or lingual inclination of the anterior teeth is essential for the best anterior occlusal connection and appropriate cosmetic impact in orthodontics. Yet, orthodontic treatment doesn't always move teeth as far as it should in the alveolar bone.Researchers have focused a lot of their attention over the past two decades on alveolar height and thickness while paying less attention than usual to tooth morphological variability.[2] One distinguishing feature was the crown-root angulation (Collum angle, CA) in the labiolingual direction, which was produced by the long axis of the crown and root and may have a protective influence on how far the incisor roots can be turned lingually for articulation with the lingual cortical plate of bone.Later, a number of current research proposed that the periodontal ligament underwent an abnormal distribution of stress when teeth shifted as a result of the CA.[3,4] Moreover, researchers found that the mean CA for Angle Class II division 2 malocclusions was significantly higher than it was for Class II division 1 and Class III malocclusions. The research stated above inspired us to conduct a more thorough investigation of the various skeletal malocclusions.[1,2,5] The other feature is the labial surface angle (LSA), which is created by a tangent to the bracket location on the labial surface and the long axis of the crown from a proximal view. A significant variation in LSA may have an effect on accuracyof axial inclination and torque expression.[4] Using a tangent to the labial surface of the crown at a gingival distance of 3.5 to 5.0 mm, Kong measured the LSA of 77 incisors. Because he demonstrated that the differences in LSA were greater than those in the various types of preadjusted appliances, the straight-wire technique still required that the brackets be manufactured to order. Preoperative assessment of each LSA is necessary to ensure the proper torque expression.[4] The maxillary incisor crown-root angles are notably different in Class II, division 2 malocclusions compared to the other classes of malocclusions. Among these variations shorter roots, larger crowns, and greater axial curvatures, as well as thinner labiopalatal tissues. These significantly recessed incisors with abnormal crown-root angles have been found to make orthodontic operations more difficult (e.g., by reducing the amount of palatal root torque required).[6] As a result of this LSA fluctuations were greater than those in the introduction of various types of preadjusted appliances, the straight-wire approach was adopted but the brackets still needed to be made to order. Preoperative examination of each LSA was essential to achieving the right torque expression.Previous studies have used CBCT to determine the crown root morphology of the central incisor.This study's main objective is to employ a Lateral Cephalogram to look into changes in the morphology of the CA and LSA, as well as the maxillary and mandibular central incisors. The impact of the varied anatomic characteristic on torque expression in distinct skeletal malocclusions was covered last.The main aim of this study is to assess the disparity between the crown-root morphology of the maxillary and mandibular central incisors using the Collum angle (CA) and Labial Surface Angle among various kinds of skeletal malocclusion with an average growth pattern utilizing a later cephalogram. Also, to offer instructions for the correct torque expression of anterior teeth and to prevent alveolar fenestration and dehiscence.

Materials and Methods

The study was carried out at the Rama Dental College Hospital and Research Centre in Kanpur, Uttar Pradesh in the Department of Orthodontics and Dentofacial Orthopedics.The study was conducted using the Lateral Cephalogram of three types of sagittal skeletal malocclusions that were chosen from the archives of the Rama Dental College Hospital and Research Center, Department of Orthodontics and Dentofacial Orthopaedics. No ethical permission was obtained for our work because it is a retrospective casecontrol study using the archive, and all of the patients underwent lateral cephalograms due to clinical orthodontic reasons. The parameters listed below were used to select the Lateral Cephalogram images of 45 patients, whose ages ranged from 18 to 30 years (mean 23.2 years). Steiner's ANB angle for skeletal malocclusion and Mandibular plane angle (27˚≤SN-MP≤37˚) for the growth pattern for cephalometric analysis were used to select all of these samples (Fig. 1). Patients were divided into groups based on standard sagittal skeletal malocclusion categorization standards. The average vertical patterns of the patients in the sagittal groups were all present, and Class I consisted of 15 patients (ANB 2˚-4˚), 15 patients were in Class II, and (ANB>4˚), in Class III there were 15 Patients. (ANB<2˚). Inclusion requirements included permanent dentition with fully formed roots, no visible bending, and no resorption, no obvious abrasion and the crown's shape is intact, mild crowding, with anterior teeth that don't appear to be rotating, no history of periodontitis, cavities, fillings, or restorations in the anterior teeth, no history of functional orthopedic treatment, orthognathic surgery, or cleft lip and palate, no facial or spinal deformities, occlusion interference, swallowing or respiratory disorders, or harmful oral habits, a lateral cephalogram provides clear imaging. Exclusion standards included anterior root harboring implanted extra teeth in alveolar bone and periapical lesions or apparent bending, crown that clearly shows wear, anterior teeth with mild to moderate crowding or clear rotation, periodontitis, filling or restoration procedures, or dental caries that causes anterior teeth to become loose, with orthodontic, functional orthopaedic treatment, cleft lip palate, and orthognathic surgery histories, with deleterious mouth habit and the mandibular positioned in functional and unstable posture, or jaw cyst, cancer, damage, and anomalies, blurred lateral cephalogram picture. These measurements and markings were made by measuring the photos (Fig. 2). The cementoenamel junction (CEJ) is located in the labium or lingual region. The root apex was at point R, while point A represented the superior incisor. Labial cementoenamel connections were represented by point B, lingual cementoenamel junctions by point L, and the midpoint between these three was represented by point O.The long axis of the crown and root were each symbolized by a straight line with the letters "AO" and "RO" respectively.The intersection of the perpendicular line of "AO" and the labial surface of the crown at point T, which was the tangent point on the labial surface of the crown and the foot point V.The line going through points T1 and T2, which were the intersections of a circle with the point T centre and 0.5mm radius on the labial surface of the crown, roughly delineated the tangent line via T.The line RO and the reverse extension line AO formed an acute angle called angle (CA).Line RO was classified as having lingual side alignment with the extension line when it did otherwise, it had labial side alignment with the extension line, and the coincidence was zero.Point P served as the vertex of the "labial surface angle (LSA)" which was created by the tangent line and forward extension of AO.

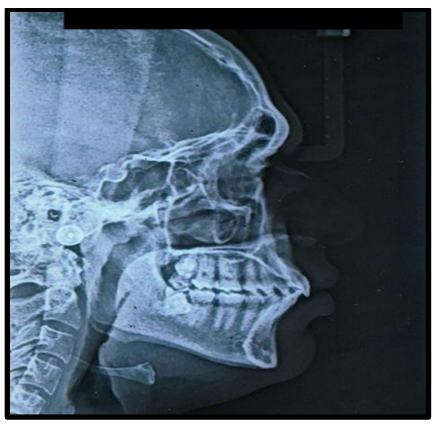


Fig: 1 Lateral cephalogram subject

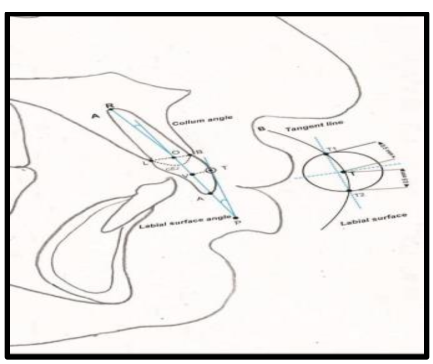


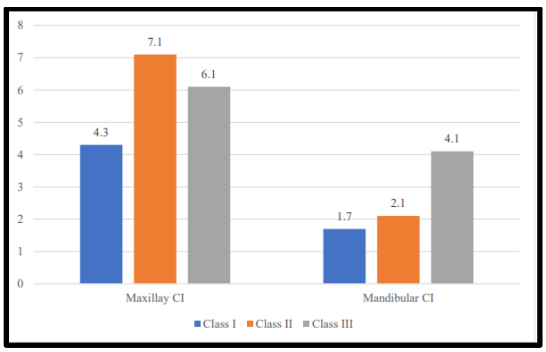
Fig 2: A, The Collum angle is formed by the extension of the long axis of the crown and the long axis of the root. B, Tangent L passes through upper and lower intersections of labial surface of crown and circle with the T center and radius of 0.5 mm.

Statistical Analysis

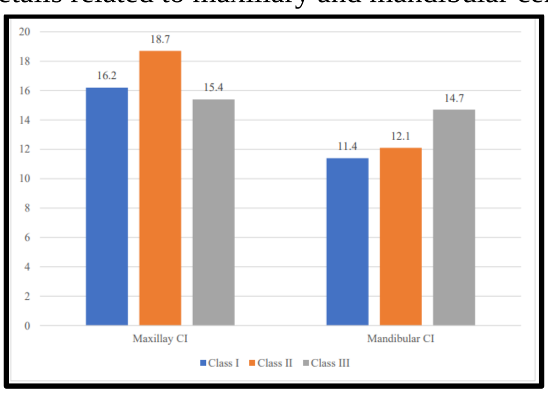
The STATA 14.2 programme was used to analyze the double-entered data. Age and angle were two continuous variables that were shown as mean, standard deviation, and range.Byusing it was possible to analyze the variables normal distribution.Test Shapiro-Wilk. Numbers and percentages were used to represent the participants gender. The Kruskal Wallis test was used to compare the groups. A 0.05 p-value was regarded as statistically significant.

Results

The analysis was done using 45 patients findings, 15 of whom had Class I, II, and III malocclusions respectively. The study took into account no missing values. The participants ages ranged from 18 to 30 years, and their mean age was 23.2 + 1.1 years. There were 45% female participants and 51% male ones.In Class I, II, and III, respectively, the mean Collum Angle for the maxilla was 4.3± 4.6, 7.1 ±4.5, and 6.1± 5.2 degrees; for the mandible, it was 1.7± 4.6, 2.1± 3.1, and 4.2 ±4.1 degrees. For both the maxillary and mandibular CI, a statistically significant difference was seen between the research groups. The mean Labial Surface Angle for Mandibular CI was 11.4 ± 3.7, 12.1 ± 2.8, and 14.7 ± 5.8 degrees, respectively. The mean Labial Surface Angle for Maxillary CI was 16.2 4.1, 18.7 3.1, and 15.4 ± 4.1 degrees in Class I, II, and III, respectively. For maxillary CI, there was a statistically significant difference between the study groups, however there was no statistically significant difference for mandibular CI.



Graph 1: Details related to maxillary and mandibular central incisors



Graph 2: Details related to maxillary and mandibular central incisors

Discussion

To attain the desired aesthetic result, it is crucial to understand tooth morphology, particularly that of the mandibular and maxillary central incisors, and its associated variations. Yet, it was shown that the orthodontists usually disregarded this characteristic. Bryant was the first to investigate the disagreement between various malocclusions and establish three anatomic features in order to examine the variety in the permanent incisor morphology in 1984.[3]In our research, we chose two crucial characteristics. The first was the labiolingual direction of the crown-root angulation (Collum angle, CA). Knowing this characteristic was crucial because aberrant crown-root angles could make orthodontic treatments more difficult (e.g., limit the amount of palatal root torque needed) The labial surface angle (LSA), which was the second parameter we chose, is crucial for attaining the best torque expression during treatment. There haven't been many studies on this subject before. Every previous study that has been done has used CBCT.45 patients who met our inclusion and exclusion criteria were included in the study. This investigation used lateral cephalograms. As a basic pre-diagnostic radiograph for patients receiving orthodontic treatment, a lateral cephalogram is also more readily available and less expensive than a CBCT. Steiner's ANB angle for skeletal malocclusion was used to select the samples for our retrospective case-control study. Patients were divided in 3 Class as: Class I comprised 15 patients (ANB 2-4˚), Class II comprised 15 patients and (ANB >4˚), Class III comprised 15 Patients, (ANB <2˚), and Mandibular plane angle $27^{O} \leq$SN-MP$\leq 37^{O}$ for the growth pattern for cephalometric analysis. The primary goals of this study were to evaluate the changes in the morphology of the CA and LSA, as well as the maxillary and mandibular central incisors, and to discuss the impact of these variations on torque expression for various skeletal malocclusion types. Moreover, due to the demonstrated obvious CA in the maxillary central incisor, we removed samples of Angle Class II division 2. Participants in our study ranged in age from 18 to 30, with a mean age of 23.2 ±1.1 years. Participants were split 49 % female and 51% male. This age range was chosen because patients in this age range are more worried about their dental aesthetics because it may negatively impact their social relationships and psychological wellbeing. In our research, we discovered that the mean Collum Angle for Maxillary CI (Central Incisor) was 4.3 ± 4.6, 7.1 ± 4.5, and 6.1± 5.2 degrees in Class I, II, and III, respectively. This indicates that the Class II malocclusion has a relatively high Collum Angle, followed by Class III and Class I, respectively. The highest Collum Angle was found in Class III. However, for both the maxillary and mandibular CI, a statistically significant difference was seen between the research groups. The long axis of an incisor's crown and root are typically thought to be the same. Cephalometric tracing templates for incisors and molars use this convention, as Bryant et al. have noted.[3] However, closer examination reveals that the root shape and the collumangle.It is clear from the chronological order of the development of the crown and then of the root that deflections in the crown and root axes arise from changed function during root creation. The circumstances governing the position and structure of the roots are, however, poorly understood.Although there is diversity both within and among tooth types, teeth typically erupt when their roots are about halfway grown, with the incisor root typically being less developed. The mandibular central incisors erupt earlier than their maxillary rivals in both deciduous and permanent dentitions.[7] As a result, the developing overjet-overbitc relationships dictated by the location of the lower incisors (and, in turn, by the anteroposterior relationship of the supporting basal bones of the two arches) will play a significant role in determining the axial inclination of the upper incisors.Normal collum angles (approximately 0°) are present in Class I and Class II, Division 1 cases where the upper incisors eruptive course is directed into an adequate overjet relationship by tongue pressure and the lower incisors on the lingual surface and lip pressure on the buccal surface.[8] Our findings also agreed with those made by Kong W.D et al. in 2016 who noted significant individual differences in the labial crown morphologies and collum angles of maxillary anterior teeth. According to him, their research shows that these teeth's morphologies do affect torque variations.[4] The aforementioned data also suggest that because the roots of these teeth bend towards the lingual cortical alveolar, they have important effects on root resorption, dehiscence, and fenestration in addition to torque changes. Therefore, it is crucial to evaluate the variation in crown-root morphology before the procedure while putting a bracket.[2] Equally significant is labial surface angle (LSA). In our study, we found that the mean LSA for maxillary CI was 16.2 ±4.1, 18.7±3.1, and 15.4±4.1 degrees in Class I, II, and III, respectively, and for mandibular CI was 11.4±3.7, 12.1±2.8, and 14.7±5.8 degrees. In comparison to Class I and Class III, there was a statistically significant difference between the research groups for maxillary CI, which warns us about the challenges we would have in reaching the required ideal torque expression in class II malocclusion. When LSA was detected at 4.5mm from the occlusal surface, it produced a wide range of torque from 12.3 to 24.9°.[9] In addition, Kong discovered that the value of LSA varied substantially with height from the incisor edge, and that the torque decreased by 1.5° for every 0.5 mm rise in height from the incisor edge.[4] Our research showed that, compared to other 37 face categories, the maxillary incisor of sagittal skeletal Class II malocclusion and the mandibular incisor of Class III had higher LSA values. Hence, larger torque expression variance may occur in the two patient groups when treating the same type of incisor with brackets with the same prepared torque at the same vertical height from the incisal edge. As a result, it was harder to prevent dehiscence and the root tip became simpler to contact the lingual cortical alveolar.[4] The aforementioned information can be used as a guide to help us not only achieve the desired aesthetic outcome but also help the orthodontist and patient save a lot of time.since it greatly reduces a lot of complexity. Also, it will assist in determining the qualities of the orthodontic appliance that should be used to achieve the best results.Our research also enabled us to foresee potential problems with intrusion, extrusion or torquing mechanics.We may draw the conclusion that these two characteristics, namely collum angle and labial surface angle, are crucial to accomplishing our ultimate goal of an aesthetic smile in order to have a proper facial aesthetic. However, other elements are equally crucial, with lower lipline being one that Srivasan B et al. (2013) indicated. He talked about how the lower lip line may have contributed to the development of the collum angle.[8] These criteria will serve as a constant reference point for our research as we strive for the perfect outcome. For more information on this subject, additional research with a larger sample size is generally advised.

Conclusion

Both the Labial Surface angle of the mandibular incisors in patients with Class III malocclusion and the Collum angle of the maxillary incisors in those with sagittal skeletal Class II malocclusion exhibit exceptional crown-root angulation. The morphologies of these teeth play significant roles in torque changes, dehiscence, fenestration, and root resorption because of the root bending towards lingual cortical alveolarbone.Because of this, it's important to evaluate the variability of the crown-root morphology before placing a bracket.

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