

Evaluation of Crown Angulation, Crown Inclination and Tooth Size Discrepancies in Angle's Class II Division II Malocclusion of Gujarati Population

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Abstract

Introduction: Pre-adjusted edgewise appliances, are being extensively used all over the world. In class 2 Division II Malocclusion retroclined upper central incisor, upper lateral incisor may be proclined or normally inclined Overjet is minimal and overbite is increased.

Material & Method: Fifty patients who were visiting the Department of Orthodontics and Dentofacial Orthopedics, College of Dental Science And Hospital, Amargadh for Orthodontic treatment and diagnosed as having Angle's Class II Division 2 malocclusion. Taken alginate impression of upper and lower both arch and pour with orthocal & measured Crown Angulation (tip), & crown inclination (Torque) By Protractor device with adjustable readout arm & Tooth size discrepancy (Bolton Analysis) Through By Digital Vernier caliper .

Result: In this present study angulations of $-4.07 \pm 3.25^\circ$ for central incisors, $-4.93 \pm 3.36^\circ$ for lateral incisors, $-6.36 \pm 2.92^\circ$ for canines, $-4.47 \pm 2.91^\circ$ for first premolars, $5.93 \pm 4.07^\circ$ for second premolars, $6.1 \pm 4.47^\circ$ for first molar, and $5.55^\circ \pm 4.49^\circ$ for second molar were found. The inclination values of the present study for the mandibular arch were central incisors, $-6.76 \pm 5.43^\circ$ lateral incisors, $-7.13 \pm 5.81^\circ$, canines, $-9.9 \pm 3.26^\circ$, first premolars, $-11.1 \pm 3.47^\circ$, second premolars, $-11.16 \pm 5.07^\circ$, first molars, $-13.07 \pm 7.9^\circ$, and second molars, $-16.59^\circ \pm 6.4^\circ$.

Conclusion: In this present study the result showed some similarities with that of the Andrew's and other studies in the overall pattern of tip and torque values. Like, the positive tip of all maxillary teeth. The torque values showed a pattern of negative torque for all the other teeth. However, the values for individual teeth showed many variations.

Key Words: Angles Class II Division II Malocclusion, Crown Angulation, Crown Inclination, Tooth Size Discrepancy.

Introduction

The goal of Orthodontist is to alignment of arches and places them in harmony with each other in when in Ideal antero-posterior position.¹ They treat various malocclusions of the maxillo-mandibular malocclusions and aim to establishing esthetic, functional, and harmonious occlusion. A functional occlusion is the ideal axial inclinations of all teeth when they all are at the end stage of their active treatment.²

We have the advantage of a classic guideline in diagnosis in orthodontics, that is, the concept was given by angle a half-century ago that, as a sine qua non of proper occlusion, the cusp of the upper first permanent molar must occlude in the groove between the mesial and middle buccal cusps of the lower first permanent molar.³

Andrews was studied white North Americans to understand the relationship of teeth in people who were considered to posses normal occlusions In 1964,. The results of his study of 120 non-orthodontic normal cast was his "six-keys to normal occlusion." These keys helped the orthodontist to appreciate the significance of occlusion and served as a yardstick for critically analyzing treatment results. That's proved despite the voluminous information from studies on occlusion, occlusion could still be simply explained. Andrew's study was designed to determine whether position and

shape are constant in each tooth type. Occlusal and coronal characteristics were studied with respect to (1) vertical crown contour (2) Horizontal crown contour (3) crown angulation, (4) crown inclination (5) facial prominence of each crown (6) Maxillary molar offset (7) depth of curve of Spee. Furthermore, We determined whether our data and the data from the earlier study of 120 non orthodontic mundane occlusion casts were commensurable.⁴

In 1958 Bolton was studied and then published on the relationship of tooth size harmony to the treatment of malocclusion The study was consist of, 55 cases with excellent occlusions were evaluated the measurement of mesiodistal dimensions of the maxillary and mandibular teeth. Ratios were calculated to produce a percentage relationship of mandibular size to maxillary size. This calculation was done for both the anterior teeth (canine to canine) and for the overall dentition (first molar to first molar). A statistical analysis of these percentage relationships resulted in an average for each grouping (overall = 91.3%; anterior = 77.2%) and a standard deviation (overall =1.91%; anterior =1.65 %). The Bolton analysis has get wide acceptance and is advocated in a popular orthodontic textbook.⁵

Aims and objectives

1. To the crown angulation (tip) and crown inclination (torque) of patients is having Angle's Class II Division 2 malocclusion
2. To compare the obtained values with Andrew's and other studies and observe the variance or similarity.
3. To assess the tooth size discrepancies in which patient have Angle's Class II Division 2 patients.¹

Material & Method:**Study design**

The Sample for this study consist of 15 patients who were visited the Department of Orthodontics and Dentofacial Orthopedics, College of Dental Science And Hospital, Amargadh for Orthodontic treatment and diagnosed as having Angle's Class II Division 2 malocclusion.

Selection criteria

- **Inclusion criteria**

1. The age Group of 14–30 years

2. Angle's Class II Division 2 malocclusion

3. No Significant history of orthodontic treatment.

- **Exclusion criteria**

1. Patients with Angle's Class I, Angle's Class II Division 1, and Angle's Class III malocclusion

2. Patients with craniofacial Deformities.

Method of collection of data:

Taken Alginate impressions for, both maxillary and mandibular arches of all the Fifteen patients, poured with Orthokal or dental stone Armamentarium are use to measure tip, torque, and tooth size discrepancies (Figure 1):

- Models of maxillary and mandibular arches
- Protractor device with adjustable readout arm
- Electronic digital caliper with sharpened points
- 0.5 mm pencil.



Figure 1: Armamentarium used to measure tip, torque, and tooth size discrepancies

The measurements are carried out by protractor with adjustable readout arm [Figure 3]. The facial axis of clinical crown (FACC) and its midpoint, the facial axis point, were mark on each crown of both the maxillary and mandibular arches. The FACC was consider

the reference line from which crown angulations and inclination were measure (Figure 2, 3, 4).



Figure 2: Protractor with adjustable readout arm



Figure 3: Frontal view with the facial axis of clinical crown and facial axis of midpoint marked on each crown



Figure 4: Lateral view with the facial axis of clinical crown and facial axis of midpoint marked on each crown

Crown angulation /tip

The base of the protractor is placed on the occlusion plane parallel to a line that would connect the contact points of the crowns being measure. The protractor

readout arm is adjusted parallel to the crown's Facial Axis of clinical crown. The angulation of the crown is read from where the line of the readout arm fell on the protractor's scale (Figure 5).

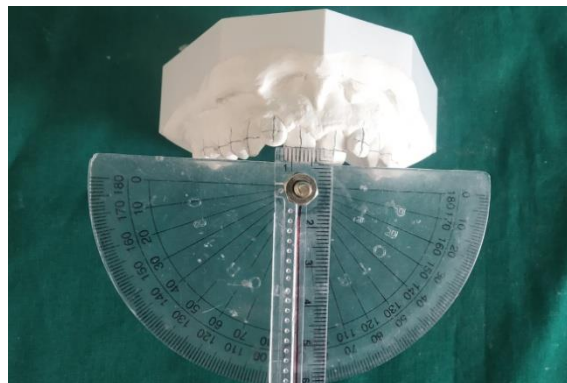


Figure 5: Protractor positioned on the trimmed cast to measure crown tip

Crown inclination/ torque

The protractor is positioned at right angle to the line that would connect the contact points of the crowns being measure.

The protractor's readout arm was adjusted parallel and tangent to the FACC at the facial axis point, and the inclination of the crown was read on the protractor's scale (Figure 6).

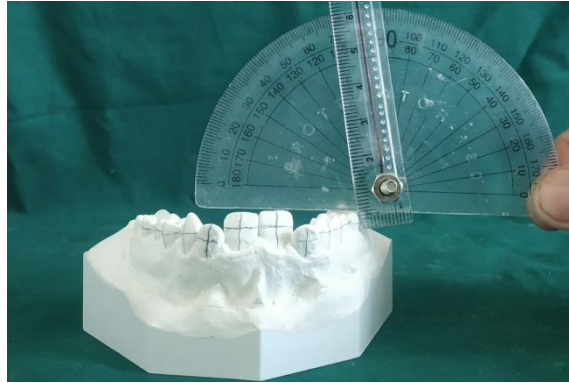


Figure 6: Protractor positioned on the trimmed cast to measure crown torque

Tooth size discrepancies

Bolton's analysis was used to determine disproportion in size between maxillary and mandibular teeth. First, the individual mesiodistal measurements of all teeth from the first molars mesially were recorded. Tooth size measurements were taken with an Electronic digital caliper, measuring the widest mesiodistal dimension of each tooth as described by Bolton. Next, the determination of tooth size discrepancy

was made according to the method outlined by Bolton. The overall ratio was calculated from the greatest mesiodistal measurement of the teeth in each arch from first molar to first molar. The anterior ratio was calculated from the greatest mesiodistal measurement of six anterior teeth in each arch. Both are as follows:



Figure 7: Electronic Digital caliper



Figure 8: Measuring mesiodistal diameter of each tooth with the help of Electronic Digital Caliper

$$\text{Overall ratio} = \frac{\text{Sum mandibular 12"} \times 100}{\text{Sum maxillary 12"}}$$

$$\text{Anterior ratio} = \frac{\text{Sum mandibular 6"} \times 100}{\text{Sum maxillary 6"}}$$

Results:

The aim of the present study was to assess the tip/ torque and tooth size discrepancies of Angle's Class II Division 2 malocclusion patients. From the sample of thirty casts, tip and torque measurements were carried out as described by Andrew's study. Anterior and posterior tooth size ratios were determined as described by Bolton.

Angulations/tip values:

Right Maxillary arch

- Maxillary central incisors: The mean tip values were found to be 4.27° with a SD of 2.12 and a range of -1° to -08°.
- Maxillary lateral incisors: The mean tip values were found to be 7.73° with a SD of 4.64 and a range of -02° to -20°.
- Maxillary canines: The mean tip values were found to be 5.2° with a SD of 3.78 and a range of -1° to -15°.

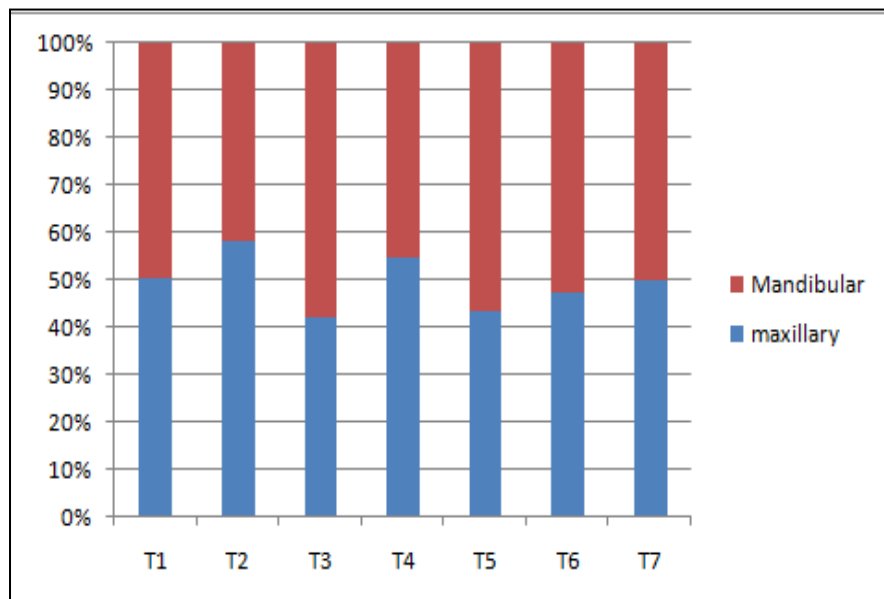
The mean, median, range, and standard deviation (SD) were calculated for both overall ratio and anterior ratio.

- Maxillary first premolars: The mean tip values were found to be 5.47° with a SD of 3.74 and a range of -3° to -12°.
- Maxillary second premolars: The mean tip values were found to be 5.4° with a SD of 4.63 and a range of -07° to -13°.
- Maxillary first molars: The mean tip values were found to be 5.2° with a SD of 3.84 and a range of -3° to -12°.
- Maxillary second molars: The mean tip values were found to be 5.5° with a SD of 3.9 and a range of -3° to -15°.

Left Maxillary Arch

- Maxillary central incisors: The mean tip values were found to be 4.07° with a SD of 1.75 and a range of -02° to -08°.
- Maxillary lateral incisors: The mean tip values were found to be 6° with a SD of 4.42 and a range of -06° to -12°.

- Maxillary canines: The mean tip values were found to be 4.07° with a SD of 2.46 and a range of -1° to -10° .
- Maxillary first premolars: The mean tip values were found to be 5.33° with a SD of 2.44 and a range of -2° to -10° .
- Maxillary second premolars: The mean tip values were found to be 3.08° with a SD of 2.93 and a range of -03° to -08° .
- Maxillary first molars: The mean tip values were found to be 5.07° with a SD of 3.24 and a range of -3° to -12° .
- Maxillary second molars: The mean tip values were found to be 5.4° with a SD of 3.12 and a range of -5° to -15° (Graph 1).



Graph 1: Mean Crown Angulation/ Tip values

Right Mandibular arch

- Mandibular central incisors: The mean tip values were found to be -5.47° with a SD of 3.53 and a range of -11° to -2° .
- Mandibular lateral incisors: The mean tip values were found to be -4.87° with a SD of 2.90 and a range of -10° to -01° .
- Mandibular canines: The mean tip values were found to be -5.73° with a SD of 2.79 and a range of -11° to -3° .
- Mandibular first premolars: The mean tip values were found to be -4.27° with a SD of 2.94 and a range of -9° to -3° .
- Mandibular second premolars: The mean tip values were found to be 5.53°

with a SD of 3.73 and a range of -2° to 14° .

- Mandibular first molars: The mean tip values were found to be 5.07° with a SD of 3.52 and a range of -3° to -12° .
- Mandibular second molars: The mean tip values were found to be 5.2° with a SD of 3.25 and a range of -13° to -20° .

Left Mandibular Arch

- Mandibular central incisors: The mean tip values were found to be -3.93° with a SD of 2.97 and a range of -9° to -1° .
- Mandibular lateral incisors: The mean tip values were found to be 5° with a SD of 3.83 and a range of -11° to -1° .
- Mandibular canines: The mean tip values were found to be -7° with a SD of 3.05 and a range of -12° to -3° .
- Mandibular first premolars: The mean tip values were found to be -4.67° with a SD of 2.89 and a range of -9° to 4° .
- Mandibular second premolars: The mean tip values were found to be 6.33° with a SD of 4.41 and a range of -02° to -15° .
- Mandibular first molars: The mean tip values were found to be 7.2° with a SD of 5.42 and a range of -02° to -17° .

- Mandibular second molars: The mean tip values were found to be 5.64° with a SD of 3.79 and a range of -03° to -15° .

Inclinations/torque values:

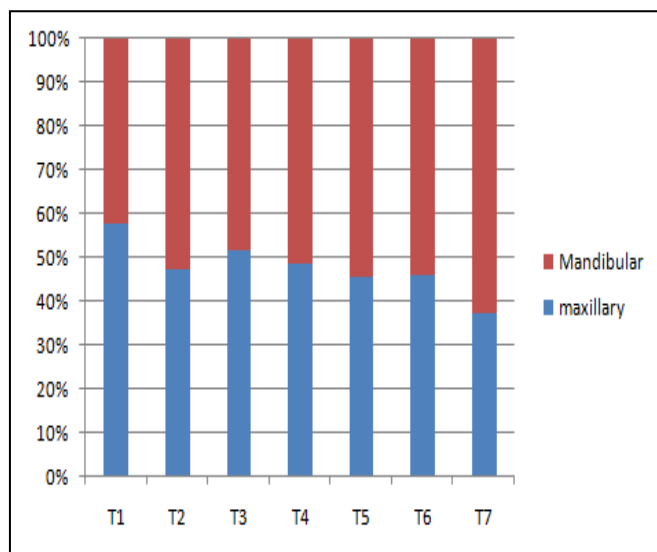
Maxillary arch

- Maxillary central incisors: The mean torque values were found to be -9.13° with a SD of 5.44 and a range of -16° to -5° .
- Maxillary lateral incisors: The mean torque values were found to be -6.8° with a SD of ± 3.43 and a range of -15° to -3° .
- Maxillary canines: The mean torque values were found to be -11.53° with a SD of 5.79 and a range of -24° to -6° .
- Maxillary first premolars: The mean torque values were found to be -10.27° with a SD 4.89 and a range of -20° to -1° .
- Maxillary second premolars: The mean torque values were found to be -9.27° with a SD of 4.33 and a range of -21° to -4° .
- Maxillary first molars: The mean torque values were found to be -11.47° with a SD of 5.11 and a range of -25° to -6° .
- Maxillary second molars: The mean torque values were found to be -10.6° .

with a SD of 6.65 and a range of -23° to -05° .

Left Maxillary arch

- Maxillary central incisors: The mean torque values were found to be -09.47° with a SD of 5.14 and a range of -16° to -5° .
- Maxillary lateral incisors: The mean torque values were found to be -6° with a SD of 3.38 and a range of -15° to -2° .
- Maxillary canines: The mean torque values were found to be -9.87° with a SD of 6.37 and a range of -21° to 6° .
- Maxillary first premolars: The mean torque values were found to be -10.8°



Graph 2: Mean crown Inclination/torque values

with a SD 4.86 and a range of $-6-9^{\circ}$ and a range of -17° to -7° .

- Maxillary second premolars: The mean torque values were found to be -9.27° with a SD of 3.83 and a range of -12° to -7° .
- Maxillary first molars: The mean torque values were found to be -10.73° with a SD of 4.45 and a range of -20° to -3° .
- Maxillary second molars: The mean torque values were found to be -9.8° with a SD of 6.65 and a range of -21° to 05° (Graph 2).

Right Mandibular arch

- Mandibular central incisors: The mean torque values were found to be -7.06° with a SD of 5.97 and a range of -13° to -3° .

- Mandibular lateral incisors: The mean torque values were found to be -8.2° with a SD of 6.73 and a range of -14° to -4° .
- Mandibular canines: The mean torque values were found to be -10.53° with a SD of 3.85 and a range of -14° to -4° .
- Mandibular first premolars: The mean torque values were found to be -10.93° with a SD of 3.59 and a range of -21° to -6° .
- Mandibular second premolars: The mean torque values were found to be -11.13° with a SD of 4.75 and a range of -20° to -5° .
- Mandibular first molars: The mean torque values were found to be -13.47° with a SD of 7.59 and a range of -30° to -5° .
- Mandibular second molars: The mean torque values were found to be -16.59° with a SD of 8.4 and a range of -30° to -31° .
- Mandibular canines: The mean torque values were found to be -9.4° with a SD of 2.67 and a range of -15° to -6° .
- Mandibular first premolars: The mean torque values were found to be -11.27° with a SD of 3.35 and a range of -20° to -7° .
- Mandibular second premolars: The mean torque values were found to be -11.2° with a SD of 5.4 and a range of -23° to -4° .
- Mandibular first molars: The mean torque values were found to be -12.67° with a SD of 8.21 and a range of -30° to -4° .
- Mandibular second molars: The mean torque values were found to be -17.50° with a SD of 7.4 and a range of -28° to -5° .

Left Mandibular arch

- Mandibular central incisors: The mean torque values were found to be -6.47° with a SD of 4.90 and a range of -15° to -4° .
- Mandibular lateral incisors: The mean torque values were found to be -6.06° with a SD of 4.9 and a range of -11° to -2° .

Maxillary & Mandibular tooth size relationship/ discrepancies were calculated using Bolton's analysis, and the mean anterior ratio was found to be 80.79% with a SD of 2.86 while the overall ratio was found to be 92.74% with a SD of 3.34

DISCUSSION:

The occlusal plane was constructed with the buccal cusp tips of lower premolars and first molars and this is comparable to the functional occlusal plane.² Based on the study of a 120 non orthodontic normals, Andrews's fully programmed appliance was developed.⁴

The term crown angulation refers to angulation (or tip) of the long axis of the crown, not to angulation of the long axis of the entire tooth. As orthodontists, we work specifically with the crowns of teeth and, therefore, crowns should be our communication base or referent, just as they are our clinical base. The gingival portion of the long axis of each crown was distal to the incisal portion, varying with the individual tooth type. The long axis of the crown for all teeth, except molars, is judged to be the mid developmental ridge, which is the most prominent and centermost vertical portion of the labial or buccal surface of the crown. The long axis of the molar crown is identified by the dominant vertical groove on the buccal surface of the crown. Crown inclination (labiolingual or buccolingual inclination) refers to the labiolingual or buccolingual inclination of the long axis of the crown, not to the inclination of the long axis of the entire tooth. The inclination of all the crowns had a consistent scheme.

A. ANTERIOR TEETH (CENTRAL AND LATERAL INCISORS): Upper and lower anterior crown inclination was sufficient to resist over eruption of anterior teeth and sufficient also to allow proper distal positioning of the contact points of the upper teeth in their relationship to the lower teeth, permitting proper occlusion of the posterior crowns.

B. UPPER POSTERIOR TEETH (CANINES THROUGH MOLARS): A lingual crown inclination existed in the upper posterior

crowns. It was constant and similar from the canines through the second pre-molars and was slightly more pronounced in the molars.

C. LOWER POSTERIOR (CANINES THROUGH MOLARS): The lingual crown inclination in the lower posterior teeth progressively increased from the canines through the second molars.⁴

Upper and lower crown inclinations are intricately complimentary and significantly affect overbite and posterior occlusion. Properly inclined anterior crowns contribute to normal overbite and posterior occlusion; when too straight up and/or down, they lose their functional harmony resulting in over eruption which is seen normally in Angle's Class II Division 2 malocclusion patients. When the crowns of upper anterior teeth are insufficiently inclined, the crowns of upper posterior teeth are forwardly tilted from their normal positions, while when they are properly inclined, the upper posterior teeth are seen in their normal positions. The contact points move distally in concert with the increase in positive anterior crown inclinations.³ Specific dimensional relationships must exist between the maxillary and mandibular teeth to ensure normal overjet and overbite. Achieving a good functional occlusion with proper overjet and overbite requires the maxillary and mandibular teeth to be proportional in size. Inter-arch tooth size discrepancies hinder achieving an ideal occlusion. A proper relationship of the total mesio-distal width of the maxillary

dentition to the mandibular dentition favors an optimal post treatment occlusion.⁷

The prescription built into his appliance was based on the 1964 sample. The average values of crown angulation, inclination, and relative crown prominence were calculated and used as the fundamental guidelines for determining the standard bracket prescription. Even after completing his study of 120 non orthodontic normal casts, Andrews did not stop his search for better casts. In fact, to this day, the search for superior casts continues. In 1988, the new norms for average angulation, inclination, and relative crown prominence were published based on the best of 120 casts to that date.⁷

The present study was conducted with a goal to assess the tip, torque, and Bolton's tooth size discrepancies in patients exhibiting Angle's Class II Division 2 malocclusion. The sample was consisted of fifteen patients within the age group of 14–30 years. The study model was prepared for the selected patients. A customized protractor with adjustable readout arm was used to measure the tip and torque values. Bolton's tooth size discrepancies were also measured for each patient. This study was not taken into consideration the established bracket prescription for comparison. The maxillary arch readings for crown angulations in the present study were $4.17 \pm 1.93^\circ$ for the central incisors, $6.86 \pm 9.06^\circ$ for lateral incisors, $4.63 \pm 3.12^\circ$ for canines, $5.38 \pm 3.09^\circ$ for first premolars, $4.6 \pm 3.78^\circ$ for second premolars,

$5.13 \pm 4.03^\circ$ for first molars, and $-2.89^\circ \pm 7.42^\circ$ for second molars while Andrew's original findings had confirmed an angulation of 5° for central incisors, 9° for lateral incisors, 11° for canines, 2° for first and second premolars, and 5° for the first and second molars. The findings of the present study were found to be less than those of Andrew's values for central as well as lateral incisors, canines, and first and second molars.⁶ The study by Currim and Wadkar⁴ indicated lower values for lateral incisors, canines, first premolar, and first molar ($3.30^\circ, 4.22^\circ, 2.66^\circ, 2.6^\circ, 4.53^\circ$ respectively) than our values ($4.17, 6.86^\circ, 4.63, 5.38^\circ$, and 5.13° , respectively). They also found higher values for, second premolars, and second molars (5.07° , and 3° , respectively) than seen in the present study.⁴

Andrew's original findings had confirmed angulations of 2° for mandibular central and lateral incisors, 5° for canines, 2° for first and second premolars and first and second molars.⁴ In the present study, angulations of $-4.07 \pm 3.25^\circ$ for central incisors, $-4.93 \pm 3.36^\circ$ for lateral incisors, $-6.36 \pm 2.92^\circ$ for canines, $-4.47 \pm 2.91^\circ$ for first premolars, $5.93 \pm 4.07^\circ$ for second premolars, $6.1 \pm 4.47^\circ$ for first molar, and $5.55^\circ \pm 4.49^\circ$ for second molar were found. The values obtained in the present study were higher than that of Andrew's study for incisors, canines, and premolars & Molars.⁶ The study by Currim and Wadkar indicated negative angulation values of -0.23° for central incisors, -0.43° for lateral incisors, -1.17° for canines, and -0.32°

for first premolars which were less than the present study. Positive angulation values of 1.54° for second premolars, 1.67° for first molars, and 2.12° for second molars.⁴

The findings of crown inclinations of the present study were compared with Andrew's,⁶ Currim and Wadkar's,³ Vardimon and Lambertz's, and Morrow's original values.^{4,6,8}

Andrew's original findings suggest an inclination of 7° for central incisors, 3° for lateral incisors, -7° for canines, first and second premolars, and -9° for first and second molars.⁵ In the present study, an inclination of $-9.3 \pm 5.29^\circ$ for central incisors, $6.4 \pm 3.40^\circ$ for lateral incisors, $-10.7 \pm 6.08^\circ$ for canines, $-10.53 \pm 4.87^\circ$ for first premolars, $-9.27 \pm 4.08^\circ$ for second premolars, $-11.1 \pm 4.78^\circ$ for first molars, and $-8.6^\circ \pm 6.65^\circ$ for second molars were obtained. The study by Currim and Wadkar³ confirmed an inclination of $5.80^\circ \pm 3.44^\circ$ for maxillary central incisors, $4.44^\circ \pm 4.16^\circ$ for lateral incisors, $-5.99^\circ \pm 5.82^\circ$ for canines, $-8.40^\circ \pm 5.24^\circ$ for first premolars, $-9.88^\circ \pm 6.10^\circ$ for second premolars, $-11.27^\circ \pm 7.17^\circ$ for first molars, and $-9.95^\circ \pm 6.87^\circ$ for second molars.⁴ In the study by Vardimon and Lambertz, an inclination of $0.74^\circ \pm 4.45^\circ$ for central incisors, $-0.96^\circ \pm 5.16^\circ$ for lateral incisors, and negative values of -8.39° for canines, -8.44° for premolars, -10.50° for first molars, and -9.28° for second molars of the upper posterior segment were seen.⁸ Morrow's study showed very low inclination values for

maxillary central and lateral incisors (3.76° and 1.16°) while the premolars values were found to be closure to the values obtained in the present study (-6.53° and -6.83°). The values for the first molars were more negative although less negative for the second molars than the present study (-6.86° and -2.22°).⁸

In this present study upper incisor, canine and all premolars torque value is greater than the all above mentioned study.^{1st} and ^{2nd} molar torque value is greater than the Andrew's, Vardimon and Lambertz, & Morrow's study but its less than the Currim and Wadkar study. The inclination values of the present study for the mandibular arch were central incisors, $-6.76 \pm 5.43^\circ$ lateral incisors, $-7.13 \pm 5.81^\circ$, canines, $-9.9 \pm 3.26^\circ$, first premolars, $-11.1 \pm 3.47^\circ$, second premolars, $-11.16 \pm 5.07^\circ$, first molars, $-13.07 \pm 7.9^\circ$, and second molars, $-16.59^\circ \pm 6.4^\circ$. Andrew's values were -1° for incisors, -11° for canines, -17° for first premolar, -22° for second premolar, -30° for first molars while -35° for second molars, suggesting higher values found for incisors in Andrew's study.⁶ In the study by Currim and Wadkar (1.36° and 0.88°) which is in contrast to the present study wherein negative crown inclination for incisors was seen. Higher negative values for canines (-8.20°), first premolar (-14.6°), second premolar (-18.5°), first molar (-27.4°), and second molar (-33.6°) were found in the study conducted by Currim and Wadkar.⁴ The values obtained by Vardimon and Lambertz were lower; central

incisors, 2.24° , lateral incisors, -0.90° , canines, -9.69° , first premolar, -16.40° , second premolar, -22.53° , first molar, -26.89° , and second molar, -36.41° .⁸In this present study the torque value of lower incisor is greater than the mentioned above the study. canine torque value is less than Andrew's study but it's greater than the Currin and Wadkar & Vardimon and Lambertz.^{1st}& ^{2nd} premolar and molar value is less than the all above mentioned study .

Maxillary-to-mandibular tooth size relationship was calculated using Bolton's analysis. The overall ratio was calculated from the greatest mesio-distal measurements of the teeth in each arch from the first molar on one side to the first molar on the other side. The anterior ratio was calculated from the greatest mesio-distal measurements of the six anterior teeth in each arch. The present study found nearly identical values to Bolton's study for anterior ratio and overall ratio. Smith et al. evaluated Bolton's interarch ratios in three populations, Blacks, Hispanics and Whites and evaluated the variation in genders. They found significantly different relationships between the lower and upper teeth. In addition, significant gender differences were observed for the overall and posterior ratios but not for the anterior ratio.⁹The anterior ratio ($80.79 \pm 2.86\%$) evaluated in the present study was lower than that found by Smith et al. for the three populations. The overall ratio ($92.74 \pm 3.34\%$) was also found to be lower in the present study. Similarly, Lavelle showed

that there was sexual dimorphism in tooth dimensions and in the ratio of upper and lower arch tooth size. Lavelle found that Blacks have larger overall and anterior ratios than the Whites and Asians although the actual differences were not tested and the arch segments responsible for the differences were not evaluated. He also showed that the overall and anterior ratios were consistently larger in males than in females regardless of the race.¹⁰

The tooth size The results of the present study showed some similarities with the Andrew's and other studies in the overall pattern of tip and torque values, for example, the positive tip of all maxillary teeth except second molars. The torque values showed a pattern of positive torque for maxillary lateral incisors while negative torque for all the other teeth. However, the values for individual teeth showed many variations. The upper incisor torque obtained in the present study was considerably lower than all the other studies compared with the difference between central and lateral incisor torque being more than double (16.68° and 8.93°). The torque value of the second mandibular molar (-18.59°) obtained in the present study differed from all the previous studies in being much higher and following the progressively increasing negative inclination seen in all the other studies from canine to second molar. The lower incisors in the present study were found to be more upright than all the other studies with a higher negative torque (-6.65° and

-6.48°). The other studies either showed positive torque for central incisors or mild negative torque for both lower incisors. All these findings indicated the possible racial and ethnic factors contributing to a difference in readings. Furthermore, Bolton's analysis did show minor tooth size discrepancies reported by Moorrees et al. implied gender differences in the overall ratio.⁹ Stifter replicated Bolton's study in Angle's Class I dentitions and reported similar results.¹¹

Conclusions:

The results of the present study showed some similarities with the Andrew's and other studies in the overall pattern of tip and torque values, for example, the positive tip of all maxillary teeth. The torque values showed a pattern of negative torque for all the other teeth. However, the values for individual teeth showed many variations. The upper incisor, canine and premolar torque obtained in the present study was considerably higher than all the other studies. The lower 1st, 2nd premolar and molar value is higher than all the mentioned study. All these findings indicated the possible racial and ethnic factors contributing to a difference in readings. Furthermore, Bolton's analysis did show minor tooth size discrepancies.

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