

Establishment of norms for crown angulation and inclination among Maratha population: Cross-Sectional Study

Sheetal Kamble¹, Sonali Vijay Deshmukh², Sachin Durkar³, Jayesh Rahalkar⁴

^{1,2,3,4}Dept. of Orthodontics & Dentofacial Orthopedics, Dr. D.Y. Patil Dental College & Hospital, Dr. D.Y. Patil University, Pune, Maharashtra

***Corresponding Author:**

Email: kamblesheetal1990@gmail.com

Abstract

Objectives: Selection of an appropriate bracket prescription for any particular individual or population facilitates idealistic and realistic goals for different esthetic around the world. As Caucasian norms show a great degree of variation when applied to different populations, it becomes necessary to establish the norms for every ethnic group. The present study was designed to derive norms of crown angulation and inclination for the Maratha ethnic population, which would be compared with Caucasian norms.

Materials and Method: The sample consisted of 100 adult subjects (50 males and 50 females) of Maratha ethnic origin with traced back to two generations, age group of 18 years and above. Acceptable and straight profiles; Class I molar relation on both sides; with normal overjet and overbite; well aligned arches. Orthodontic Torque Angulation Device (TAD) was used to measure the crown angulation and inclination. Comparison of these values with those established by Andrews is done using unpaired *t*-test. Comparison of these values with Group I and Group II is done using paired *t*-test.

Result: The study group exhibited statistically significant values of maxillary and mandibular teeth showed positive crown angulation, maxillary central and lateral incisor showed positive inclination and all other teeth showed negative crown inclination. Maxillary lateral incisor, canine and premolars were less angulated whereas mandibular crown angulation indicates lesser angulation for anterior teeth. Maxillary and mandibular incisors and molars is more positively inclined. And no sexual dimorphism was seen.

Conclusion: Tip and torque modification are suggested for the fine finishing, idealistic and realistic occlusion in Maratha population.

Keywords: Angulation, Inclination, Maratha, Angulation device, Tip, Torque.

Introduction

Various malocclusions of the jaws are treated with orthodontic therapy and aim is to establish functional, esthetic and harmonious occlusion. At present the stress is on to treat not just the occlusion but face as a whole. John Hunter as early as the 18th century describe Ideal occlusion.⁽⁶⁾ To understand the relationship of the teeth most comprehensive and exhaustive study was undertaken in 1964 by Andrew.^(1,2,3) Extensive measurement was made on 120 normal occlusion of White North American origin to develop his 'six key to normal occlusion.'^(1,2)

Andrews six keys help the orthodontist in establishing the occlusion and assist as a yardstick for treatment results. For proper occlusion a definite proportionality should exist between tooth angulation and inclination. Therefore, at the initial stages of treatment, an important tool is the ability to analyze the proportionality of the maxillary and mandibular teeth.^(1,2)

Selection of an appropriate bracket prescription for any particular individual or population facilitates the quality of finish and the obligatory time to achieve the objectives. Over 30 prescriptions are commercially available. Choosing an appropriate one for a given population needs methodical research. Although craniofacial and dental features of "well-balanced

faces" of two racially diverse groups are fundamentally different, similarity is evidenced within races.^(7,11) Hence choosing prescriptions that might suit most people of one particular race becomes prudent for consistently achieving good results.

Therefore in orthodontics an individualization of treatment leads to more effective outcome by working within patient's natural teeth angulation and inclination instead of making patients fit to single standard. In this study, an attempt is made to evaluate crown angulation and inclination in a sample of Maratha population so as to individualize protocols for better results.

A Maratha individual belongs to a group of people inhabiting the state of Maharashtra in west-central India. The Maratha caste consists of mainly rural cultivators, landowners and soldiers segregated during the medieval times and accounts for more than 50% of Maharashtrian population, thereby providing a reliable sample to estimate the crown angulation and inclination of this community.^(12,13) Hence, this present study was carried out among Maratha population to collect relevant data,

A modified protractor is the measuring device used in this investigation. The Angulation Device) device used for measure crown angulation and inclination in a precise and objective fashion.^(6,10)

Aim

- To establish the norms of crown angulations and crown inclinations in Maratha population.

Objectives

- To measure the crown angulations and inclination among Maratha population with normal occlusion. To compare the obtained data with that of the original values of Andrew. And to identify possible gender difference between the value.

Materials and Method

The study is a cross-sectional study observational study carried out in the Department of Orthodontics & Dentofacial Orthopedics of Dr. D. Y. Patil Dental College, Pune. Study was approved by the ethics committee at Dr. D. Y. Patil University, Pune. The samples were selected was statistically computed. One hundred adults of age 18 and above selected, with Angle's class I normal occlusion model casts were taken from the archives (informed and/or patient came to the department an informed consent was taken from each subject for the study. Pilot study was performed.

Selection criteria included: Maratha (ethnicity verified to two generations) with Class I canine-molar relations; normal overjet-overbite; well-aligned arches (no spacing, rotation, crowding); full complement of permanent dentition, caries free; no supernumerary teeth; pleasing facial profiles, no history of previous orthodontic treatment and normal growth. For new patients impression was made using alginate impression material and cast were poured using dental stone. On prepared cast, all teeth (except the third molar) were evaluated with the Orthodontic Angulation Device, Two times evaluation was carried out. The cast was fixated on an adjustable table such a way the Horizontal Occlusal Line (HOL) was parallel to the TAD platform. The HOL is an imaginary line which connects the right and left mid crown molar point and the average of the clinical mid crown on the central incisors.

The crown angulation was measured according to Andrew.⁽⁴⁾ On the labial surface of the clinical crown of every tooth the Long Axis of Clinical Crown (LACC) was drawn.

On the LACC of each tooth, the midpoint of the clinical crown (LA point) was marked. Midpoint was constructed by equally dividing the height of the clinical crown (with 1.0mm added for the gingival sulcus) on the LACC.

The cast was then moved towards the blade of the TAD. At the same time, the table was adjusted in height. When the blade is running along the LACC, the crown angulation was recorded. (Fig. 1)

The crown inclination was measured by moving the model until the middle of the blade coincided with the LA point and the curvature of the blade fitted

optimally the vestibular surface of the tooth being measured. After this adjustment, the crown inclination was recorded. Each reading repeated twice and average value was taken. (Fig. 2)



Fig. 1



Fig. 2

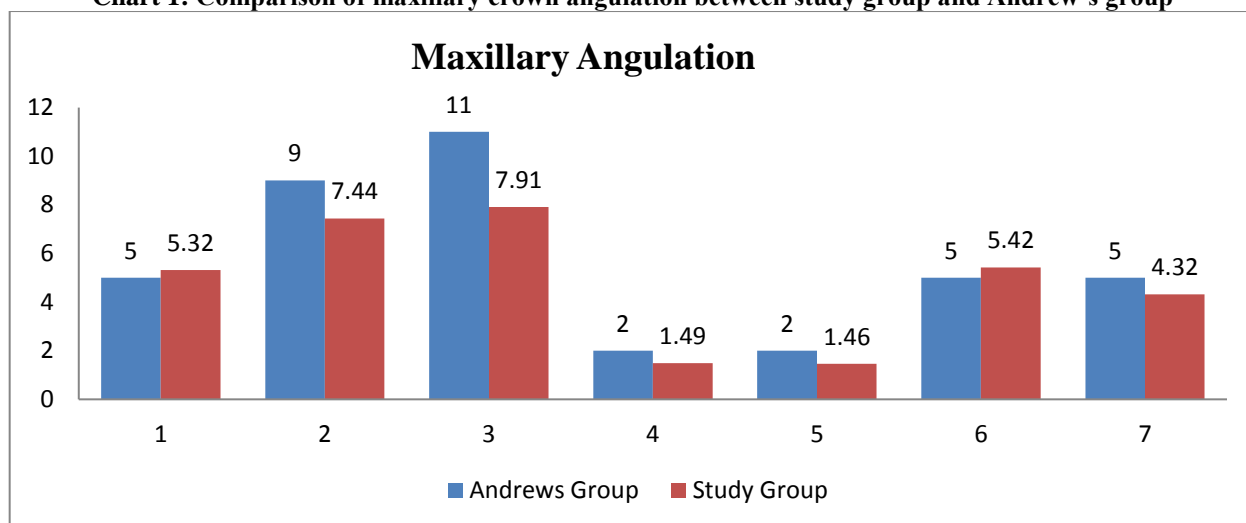
Statistical Analysis: The measurements were statistically analyzed by calculating their means and standard deviations (SD). Then the means of Maratha ethnic population were compared with means of Caucasian population with the help of Student's unpaired *t*-test. And comparison of these values with 50 male (group I) and 50 female (group II) is done using paired *t*-test.

Results

Table 1: Comparison of maxillary crown angulation between study group and Andrew’s group

Maxillary Angulation					
Teeth	Andrews Group	Study Group		t-Value	P-Value
		Mean	SD		
1	5	5.32	0.47	-3.829	0.000
2	9	7.44	0.50	-3.331	0.000
3	11	7.91	0.77	-4.333	0.000
4	2	1.49	0.50	-4.848	0.000
5	2	1.46	0.50	-3.164	0.001
6	5	5.42	0.50	-6.429	0.000
7	5	4.32	0.47	-6.133	0.000

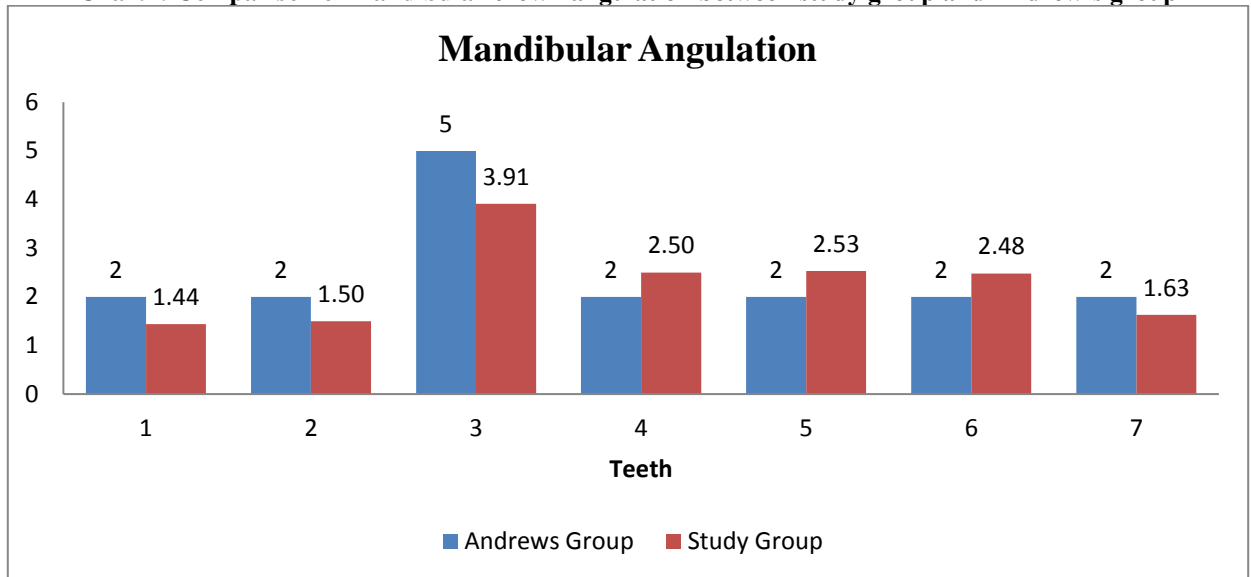
Chart 1: Comparison of maxillary crown angulation between study group and Andrew’s group



For crown angulation of lateral incisor in present study was 7.44° and Andrew’s value was 9°. Lateral incisor was having more positive value in Andrews.^(1,2) Crown angulation of canine in our study was 7.91° and Andrew’s value was 11°. The value of canine angulation was lesser positive than Andrews value. Value of crown angulation of first premolar and second premolar was 1.49° and 1.46° respectively in this study and Andrew’s value for first and second premolars angulation are 2°. Value of crown angulation of first molar and second molar in present study was 5.42° and 4.32° respectively and in Andrew’s study was 5°.^(2,3) Lateral incisor was having more positive value and canine, premolars and second molar was lesser than Andrew’s value which was highly significant.(Table 1, Chart 1)

Table2: Comparison of mandibular crown angulation between study group and Andrew’s group

Mandibular Angulation					
Teeth	Andrews Group	Study Group		t-Value	P-Value
		Mean	SD		
1	2	1.44	0.50	-3.842	0.000
2	2	1.50	0.50	-3.828	0.000
3	5	3.91	0.81	-4.301	0.000
4	2	2.50	0.50	-4.003	0.000
5	2	2.53	0.50	-3.929	0.000
6	2	2.48	0.50	-4.490	0.000
7	2	1.63	0.49	-6.908	0.000

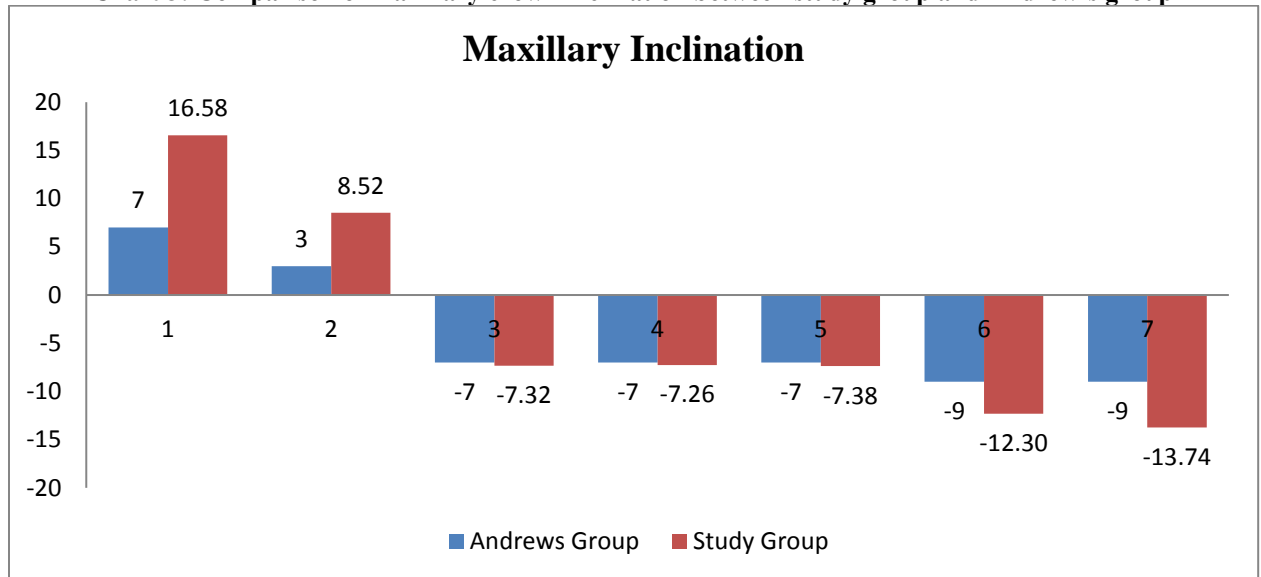
Chart2: Comparison of mandibular crown angulation between study group and Andrew's group

The crown angulation for central incisor value was 1.44° and for lateral incisor was 1.50° in our study and 2° in Andrew's experiment. The crown angulation of canine in our study was 3.91° and in Andrew's study was 5°. The crown angulation of first premolar and second premolar was 2.50° and 2.53° respectively in this study. The value of premolars in Andrew's study was 2°. The crown angulation first and second molar in our study was 2.48° and 1.63° respectively. Crown angulations of molar in Andrew's experiment are 2°. Thus crown angulation of incisor, canine, second molar is significantly lesser than Andrew's value and more upright. Whereas the crown angulation of premolars in our study was significantly higher than Andrew's value (Table 2, Chart 2)

Table 3: Comparison of maxillary crown inclination between study group and Andrew's group

Maxillary Inclination					
Teeth	Andrews Group	Study Group		t-Value	P-Value
		Mean	SD		
1	7	16.58	0.50	-3.834	0.000
2	3	8.52	0.50	-3.833	0.000
3	-7	-7.32	0.47	-4.370	0.000
4	-7	-7.26	0.44	-3.833	0.000
5	-7	-7.38	0.49	-3.833	0.000
6	-9	-12.30	0.97	-3.870	0.000
7	-9	-13.74	0.44	-3.913	0.000

Chart 3: Comparison of maxillary crown inclination between study group and Andrew’s group

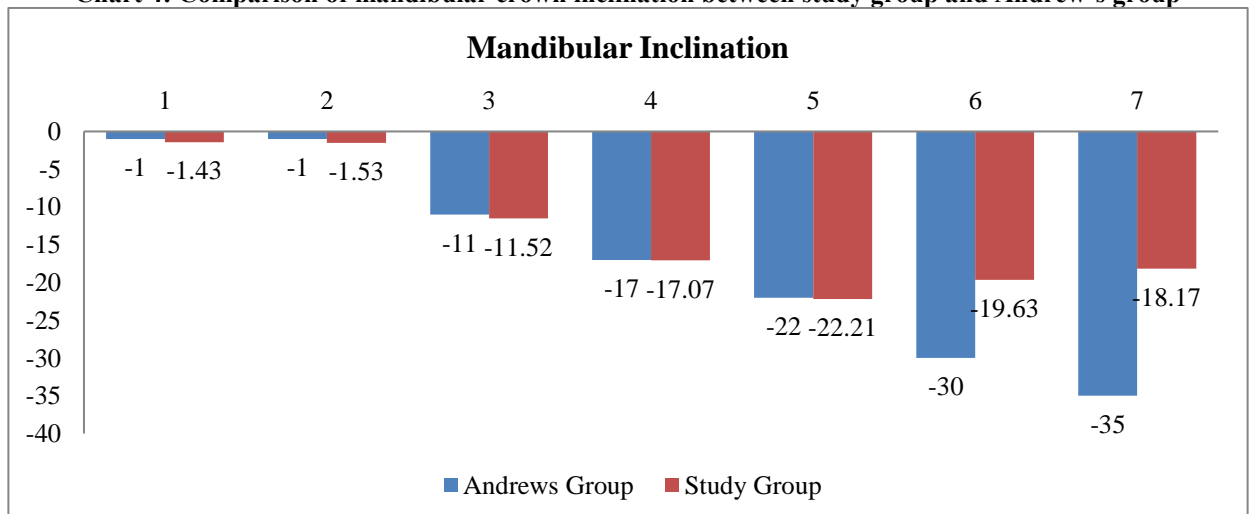


We observed positive crown inclination for central was 16.58° and lateral 8.52° incisors and Andrews original findings suggest an inclination of 7° for central incisors, 3° for lateral incisors.^(2,3) First molar inclination in this study is -12.30° and second molar inclination is -13.74°. Andrews experiment value for molars is -14°. Thus the value of upper molars inclination was more significant than Andrew’s value. (Table 3, Chart 3)

Table 4: Comparison of mandibular crown inclination between study group and Andrew’s group

Mandibular Inclination					
Teeth	Andrews Group	Study Group		t-Value	P-Value
		Mean	SD		
1	-1	-1.43	0.56	-3.219	0.001
2	-1	-1.53	0.76	-3.821	0.000
3	-11	-11.52	0.75	-4.405	0.000
4	-17	-17.07	0.59	-3.206	0.001
5	-22	-22.21	0.91	-3.884	0.000
6	-30	-19.63	0.95	-4.217	0.000
7	-35	-18.17	0.81	-4.581	0.000

Chart 4: Comparison of mandibular crown inclination between study group and Andrew’s group



Value obtained in this study for central incisor inclination-1.43°, and for lateral incisor inclination-1.53°. Andrews experiment value for incisors was -1°. Canine inclination in this study is -11.52° and Andrew's value for canine inclination was -11. First molar inclination in this study was -19.63° and second molar inclination is -18.17° in this study Andrew's value for first and second molar was -30° and -35° respectively. Thus the value of this study was significantly less negative than Andrew's value.

The value of crown angulation and inclination was similar in male and female, there is no sexual dimorphism was seen.

Discussion

Different races in the world are having dissimilar ethnic parentage. Crown angulation and inclination parameters are not similar for all ethnic groups. Hence, same bracket prescription of one population cannot be applied to other groups population. Hence the designed of study is to determine the crown angulation and inclination in Maratha samples and compare this data from Andrew's norms to determine the need for finishing bends that might require to attaining optimal result in Maratha population. The Normal occlusion depends on suitable distal crown angulation, mainly for the anterior teeth of maxillary arch as they have the longest crown. The incisor angulation degree determines the amount of mesio-distal space, they ingest and therefore has a considerable effect on the Posterior Occlusion and anterior aesthetics.

Upper crown angulation: Crown angulation of central incisor is slightly more positive than Andrew's value. In our study, value of central incisor angulation is similar to Roth. The crown angulation of upper lateral incisors exhibited the maximum correction with Andrew's data, hence minimize the excessive positive tip in lateral incisor. Lateral incisor is more upright in our study. Value of lateral incisor angulation in our study is in between MBT and Roth prescription.^(4,5,8) The value of canine angulation is near to value of MBT indicating canine are more upright, which might tax less anchorage than Roth having more positive angulation. Crown angulation of molars is more in our study than Roth and MBT prescription.^(4,5,8)

Lower crown angulation: Crown angulation of incisor is significantly lesser than Andrew's value and more upright. The crown angulation value of incisors in our study is lesser Roth and more value than MBT prescription. The crown angulation value of canine is significantly lower than Andrew's value, thus canine are more upright. The crown angulation of premolars is positive in our study as compare with Roth value and more than MBT prescription.^(2,3) The crown angulation of first molars in our study is significantly more than Andrew's value, whereas second molar angulation is significantly lesser than Andrew's value.

Upper crown inclination: The crown inclination of incisors in our study is significantly more than Andrew's value. There is more positive torque in upper incisor than Caucasians. Manan et al conducted study showed cephalometric proclined upper and lower incisor and convex profile in Maratha population than Caucasian group due to ethnic group difference.⁽¹⁴⁾ Upper central incisor value is in between MBT and Roth value.^(4,5,8)

Lower crown inclination: The value of incisors in this study is slightly higher than Andrew's value. The present study shows torque difference between central and lateral incisor, it could be assumed that mandibular lateral incisor are more upright than relatively proclined central incisor. It would be variation in crown root angle and also the anatomical difference. The buccolingual dimension of mandibular lateral incisor is slightly greater than central incisor. This anatomical difference might have place lateral incisor more upright than central incisor. Premolars inclination in this study is slightly higher than Roth first premolar and second premolar. First and second molar inclination is less negative than Roth molars inclination.

Dravidian's and general population having negative tip and Maratha and South Indian population is having positive tip value. Maratha and Dravidian population is having similar molar tip upper molar torque is similar between South Indian population and Maratha population. Thus negative lower molar torque in Dravidian and Maratha population is similar.^(9,13,15)

There is significant difference of tip and torque in Caucasian and Maratha population. In the Maratha group, the maxillary and mandibular incisors are much more proclined and face is convex slightly. There is no sexual dimorphism was seen in Maratha group.

This study aims to establish reference norms for Maratha population to help orthodontist provide optimal finishing in Maratha population. Further study with 3D scanner or CBCT for high accurate measurement of crown angulation and inclination of maxillary and mandibular teeth can be undertaken. Yet considering the major finding, it could be suggested that among the currently available prescription Roth prescription is the closer match for treating Maratha population.(Table 9)

Conclusions

Within given consensus of this study, it concluded that:

- In Maratha population maxillary and mandibular teeth showed positive crown angulation.
- In Maratha population maxillary central and lateral incisor showed positive inclination and all other teeth showed negative crown inclination.
- Maxillary lateral incisor, canine and premolars were less angulated in Maratha population as compare to Andrew's value. And mandibular crown angulation indicates lesser angulation for

- anterior teeth in Maratha population as compare to Andrew's value.
- In Maratha population maxillary and mandibular incisors and molars is more positively inclined as compare to Andrew's value. Which suggest more proclined incisors and convex profile.
 - No sexual dimorphism was seen.
 - Recommended norms for crown angulation and inclination in Maratha population is

13. Kannabiran P, Thirukonda GJ, Mahendra L. The crown angulations and inclinations in Dravidian population with normal occlusion. *Indian J Dent Res.* 2012 Jan-Feb;23(1):53-8.
14. Atit M B, Deshmukh S V, Rahalkar J S, Subramanian V, Naik C R, Darda M. Mean value of Stenier, Tweed, Ricketts and McNamara analysis in Maratha ethnic population: A cephalometric study. *ISO Trends in Orthodontics* 2013;3:137-51.

Table 9

Tooth no.	Angulation	Inclination
	Study group	Study group
Maxillary teeth		
1	5.32 ± 0.47	16.58 ± 0.50
2	7.44 ± 0.50	8.52 ± 0.50
3	7.91 ± 0.77	-7.32 ± 0.47
4	1.49 ± 0.50	-7.26 ± 0.44
5	1.46 ± 0.50	-7.38 ± 0.49
6	5.42 ± 0.50	-12.30 ± 0.97
7	4.32 ± 0.47	-13.74 ± 0.44
Mandibular teeth		
1	1.44 ± 0.50	-1.43 ± 0.56
2	1.50 ± 0.50	-1.53 ± 0.76
3	3.91 ± 0.81	-11.52 ± 0.75
4	2.50 ± 0.50	-17.07 ± 0.59
5	2.53 ± 0.50	-22.21 ± 0.91
6	2.48 ± 0.50	-19.63 ± 0.85
7	1.63 ± 0.49	-18.17 ± 0.73

References

1. Andrew LF. The six key to normal occlusion. *Am J Orthod* 1972;62:296-309.
2. Andrews LF. *Straight Wire -The Concept and Appliance.* San Diego, Ca: L. A. Wells Co.1989. p. 92-107.
3. Andrews LF. The diagnostic system: occlusal analysis. *Dent Clin N Am* 1976;20:671-90.
4. Roth RH. Functional occlusion for the orthodontist. Part I. *J Clin Orthod* 1981;15:32-51.
5. Roth RH. Functional occlusion for the orthodontist. Part IV. *J Clin Orthod* 1981;15:246-65.
6. Vardimon AD, Lambertz W. Statistical evaluation of torque angles in reference to straight-wire appliance (SWA) theories. *Am J Orthod.* 1986 Jan;89(1):56-66.
7. Lew KK. Cephalometric ideals in Chinese, Malay and Indian ethnic groups. *Asian J Aesthet Dent* 1994;2:35-8.
8. McLaughlin RP, Bennett JC, Trevisi HJ. *Systemized Orthodontic Treatment Mechanics,* Mosby Elsevier;2001: p. 9-10, 33.
9. Currim S, Wadkar PV. Objective assessment of occlusal and coronal characteristics of untreated normal: A measurement study. *Am J Orthod Dentofacial Orthop.* 2004; 125:582-8.
10. Lee SJ, Ahn SJ, Kim TW. Clinical crown angulation and inclination of normal occlusion in a large Korean sample. *Korean J Orthod.* 2005 Oct; 35(5):331-340.
11. Bai D, Luo SJ, Chen YX, Xiao LW. The clinic skill in fixed appliance based on characteristics of Chinese normal occlusion. *Hua Xi Kou Qiang Yi Xue Za Zhi* 2005;23:32-4.
12. Encyclopedia Britannica. Encyclopedia Britannica Online.