ORIGINAL ARTICLE

CBCT Based Assessment of First Molar Inclination in Adult Subjects

Muhammad Ashfaq[1] **BDS, FCPS**

Mubassar Fida[2] **BDS, MCPS & FCPS (Orthodontics), MCPS (Periodontology), MCPS (Community Dentistry), PGD HIMS**

Farheen Fatima[3] **BDS, FCPS**

OBJECTIVE: The ideal buccolingual (BL) inclination of posterior dentition allows maximum intercuspation and avoids occlusal interferences at rest and during jaw movements. Therefore the objective of present study was to evaluate the BL inclination of upper and lower first molars in adult patients.

METHODOLOGY: A cross-sectional study was conducted on 52 subjects visited dental clinics. The evaluation of BL inclination of maxillary and mandibular first molars was done using CBCT images on Galaxis/Galileos implant viewer software. After sagittal orientation, the angle was measured on the tranverse plane from long axis of tooth to the vertical line drawn perpendicular to horizontal reference plane.

RESULTS: Mandibular first molars were found to be lingually inclined with mean value of 14.07°±4.49°. Similarly, mean buccalinclination of maxillary first molars was found to be 9.42°±6.70°.

CONCLUSIONS: It can be concluded from this study that maxillary molars are buccally incline over the basal bone whereas, mandibular molars are lingually inclined.

KEYWORDS: Molar, maxilla, mandible, torque

HOW TO CITE: Ashfaq M, Fida M, Fatima F. CBCT based assessment of first molar inclination in adult subjects. J Pak Dent Assoc 2023;32(1):4-7.

DOI: https://doi.org/10.25301/JPDA.321.4

Received: 02 August 2022, Accepted: 01 April 2023

INTRODUCTION

The knowledge of occlusion is important to an orthodontist for proper finishing of cases to benefit the patients.[1] The occlusal plane follows the teeth's natural curvature forming an imaginary line from incisal edges of the anterior and occlusal surface of the posterior teeth. Several studies[2,3] have described number of occlusal schemes based on scientifically proven evidence and clinical applicability. It is especially true regarding the frontal view of buccolingual posterior cusp as the occlusal surfaces of the molars follow multiple planes.

The height of functional cusp affects the anterior face height. Longer functional palatal cusps and increased buccal inclinations have found to be associated with long lower anterior face height and conversely increased palatal inclination and longer buccal cusps were found in subjects having short lower anterior facial height.[4] Andrews[5] analyzed a sample of 120 subjects with normal occlusion and derivedsix keys of occlusion which were used in designing the Straight Wire Appliance. The fourth key of occlusiondescribed Curve of Wilson as a concave curve formed by the angulation of the upper posterior teeth, with molars having lingual crown torque. This curve is considered as a key factor in governing stability aftermaxillary expansion.[6] Any alteration in inclination of posterior teeth was considered asone of the most important causative factor in temporomandibular disorders.[7]

American Board of Orthodontics (ABO) suggested evaluation of differences in buccal and lingual cusps height of the posterior teeth for clinical evaluation of buccolingual inclination. Ideal inclination allows maximum intercuspation and avoids balancing interferences.[8] Ross et al[9] investigated correlation between inclination of tooth buccolingually and pattern of skeletal growth vertically however insignificant differences were found. Tsunori et al[10] (1998) evaluated mandibular first molar inclinations and its relationship to the facial type using CT scans. It was reported by authors that -7° of mean mandibular inclination was found in sample of 21 subjects with dental class I8. Introduction of CBCT

1. Senior Registrar, Department of Orthodontics, Dow Dental College, Dow University of Health Sciences, Karachi.
2. Professor, Department of Surgery, The Aga Khan University Hospital Karachi.
3. Senior Registrar, Deprtment of Orthodontics, Bahria University Medical and Dental College, Karachi.

Corresponding author: "Dr. Muhammad Ashfaq" <ashfaqyounus231@hotmail.com>

to the dental armamentarium has several advantages among which one of the major advantages is slice by slice mode of imaging. This mode allows tooth to be viewed in different planes[11] (Palomo et al, 2006).

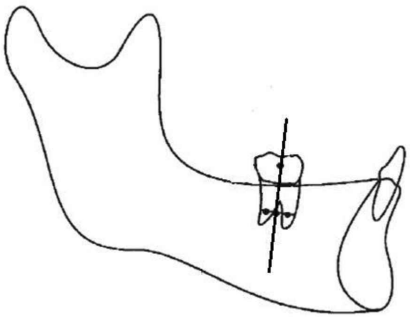
Buccolingual inclination of a tooth is important when torque is expressed in a straight wire appliance and successful treatment outcomes and stability are not guaranteed until ideal buccolingual inclinations are expressed for individual patients. In past long axis inclinations of tooth were determined on the basis of crown position however, uneven cuspal wear or tooth morphology may result in uncertainty. Therefore, using CBCT provides an advantage of visualization of both crown and root. According to pertinent literature survey, no local study has yet reported the buccolingual angulations of mandibular and maxillary first molars in our population. This could help us develop buccolingual prescription for our population.

Therefore, objective of the study was to determine the buccolingual inclinations of mandibular and maxillary first molars in adults using CBCT.

METHODOLOGY

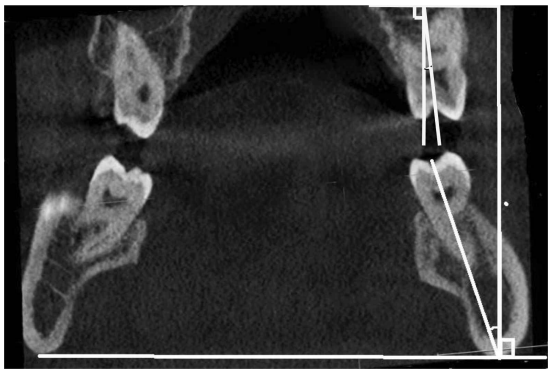
A cross-sectional analytical study was conducted after the exemption taken from the ethical review board (5223-Sur-ERC-18). CBCT images of the patients who have visited dental clinics at AKUH were included in the study. The CBCT was done for routine diagnosis and treatment planning. The sample size was calculated using WHO 7.1 calculator using the findings reported by Alkhatiba[12] who reported mean buccolingual inclination of 12.59° and standard deviation of 5.47°. A total of 52 subjects were required to achieve power of 80%, keeping margin of error as 0.05. The non-probability purposive sampling technique was used to obtain data. The subjects in age range of 18 to 65 years with no previous orthodontic therapy, minimum tooth wear, arch length discrepancy of less than 5 mm per arch with no hypodontia other than third molars, were included in the study. Subjects with posterior crossbite, prosthetic crowns or significant fillings on any of the first molars, retained primary teeth and craniofacial deformities were excluded. Using Galaxis/Galileos implant viewer, CBCT images were oriented and standardized. A reference line connecting lower border of mandible was drawn parallel to the floor. In sagittalview, a line was drawn passing through the midpoint of the crown mesiodistally and the mid of both the mid points of each of the mesial and distal roots at one-third the distance from the apex as described by Masumoto et al[13] (2001) (Figure 1). Long axis of maxillary molars by connecting a line between furcation and central groove of the molar After achieving sagittal orientation, the angle was

Figure 1: Saggital orientation of mandibular molar



Saggital orientation of mandibular molar

Figure 2: Buccolingual inclination measurement from line passing through long axis of tooth and true vertical plane.



measured from long axis of both maxillary and mandibular molars drawn from transverse view to the true vertical reference line perpendicular to horizontal reference line (Figure 2). Data were collected by the principal investigator (A.Y). The analyses were done using SPSS software for Windows (version 20.0, SPSS). Mean and standard deviations for maxillary and mandibular first molar inclinations were calculated. Frequency and percentages were calculated for the gender. The comparison of maxillary and mandibular first molars buccolingual inclinations between genders was done using independent sample T test.

RESULTS

There were 52 patients who were included in this study including 30 males and 22 females. The mean age of the sample was 32.2±13.8 years.The mandibular first molars were found to be lingually inclined with mean value of 14.14°±6.33°and 14.00°±5.20° for right and left side, respectively (Table 1).Statistically insignificant differences were found between both the sides. Maxillary first molars were found to be bucally inclined with mean buccolingual inclination of 10.06°±7.31° and 8.79°±8.10° for right and

left side, respectively with insignificant differences (Table 2). Insignificant differences were found in maxillary and mandibular molar inclinations among the genders (Table 3).

The radiographs were reassessed by the examiner (A.Y) after 3 weeks and intraexaminer reliability was tested using intraclass correlation coefficient and excellent correlation was found between two sets of reading.

Table 1: Buccolingual inclination of mandibular molars

Tooth	n	Mean±SD	*p* value
Mandibular right 1st molar	52	-14.14°±6.33°	0.90
Mandibular left 1st molar	52	-14.00°±5.20°	
Avg. of mandibular molars	104	-14.07°±4.49°	

SD = Standard deviation
(-) For lingual inclination
t test
p≤ 0.05

Table 2: Buccolingual inclination of maxillary molars

Tooth	n	Mean±SD	*p* value
Maxillary right 1st molar	52	+10.06°±7.31°	0.40
Maxillary left 1st molar	52	+8.79°±8.10°	
Avg. of maxillary molars	104	+9.42°±6.70°	

SD = Standard deviation
(+) For buccal inclination
t test
p≤ 0.05

Table 3: Comparison of buccolingual inclination of maxillary and mandibular molars across gender

Tooth	Male n=30	Female n=30	*p*value
	Mean ± SD	Mean ± SD	
Avg. maxillary molar	8.79±6.73	10.29±6.71	0.43
Avg. mandibular molar	-13.25±4.96	-15.19±3.58	0.12

SD = Standard deviation
(-) For lingual inclinations
t test
p≤ 0.05

DISCUSSION

Buccolingual inclination of posterior teeth plays important role in static and functional occlusion. Evaluation can be done clinically by assessing clinical crown and radiographically using CBCT. CBCT images have the advantage of visualizing complete tooth structure i.e. both crown and root. This complete visualization of tooth can help avoiding errors of inclination measurement as on dental cast due to dental wear and morphological uncertainties[14,15] although unnecessary radiation exposure requires clinical justification.

Maxillary molar inclinations on CBCT can be difficult to measure due to root divergence. Authors have reported different methods of assessment. Mitra[16] measured maxillary molars inclinations by buccal roots only using CT images. Study conducted by Alkhatiba[12] measured long axis of maxillary molars by connecting a line between furcation and central groove of the molar,similar method was used in this study.Mandibular molar roots bifurcate anteroposteriorly, therefore long axis can be drawn from central groove to root apex.[17]

The mandibular first molar in our study showed a mean lingual 14.07° while study by Alkhatiba[12] showed a lingual inclination of 12.6°. Ross et al[9] reported mean mandibular molars inclination of 7.18° in untreated normal occlusion patients, however the study was performed on dental casts and growing patients were also involved. Tsunori et al[10] in their studydetermined mandibular molar angulation of 14.2° ± 3.4and 9.8° ± 4.6in patients with average and short facial heights respectively.

In our study majority of maxillary molars showed buccal inclinations with mean inclination of 9.42° however, Alkhatiba[12] reported mean inclination of 4.85°. A study conducted byBarrera et al[14] reported4.058° of crown angulation, however this study was conducted on small sample consisting of 10 subjects only. In another study conducted by Ross et al[9] found a mean buccal angulation in maxillary molars of 8.08° ± 4.08 in a group of patients aged 9.5 to 41.5 years while using dental casts. Janson et al[18]compared vertical growth pattern in their study, he found mean buccal inclination for maxillary molars of 5.13° ±4.46 and 7.74° ±4.41 for horizontal and vertical growth patterns respectively. Andrews[19] reported maxillary inclination of 11.53° and mandibular inclination,-30°.

Mesiodistal width of posterior teeth has also an important clinical implication when there is discrepancy between tooth size and arch length. Mild to moderate discrepancy can be treated with interproximal stripping or expanding the arch.[20,21] In cases with mild to moderate crowding and constricted arch,expansion can be done however, torque control is important to achieve normal buccaolingual inclinations of posterior teeth[22] (Adkins, 1972).

Stable occlusion is important for jaw function; additionally it also has an impact on TMJ health and function. Instability in occlusion has short and long term effects on TMJ that may result in asymptomatic click and crepitus to temporomandibular dysfunction disorders. Altered

buccolingual inclination results in occlusal interference therefore norms should be established to avoid detrimental effects.

CONCLUSIONS

It can be concluded from this study that maxillary molars are more upright over the basal bone than the mandibular molars. Mean buccal inclination of maxillary molars was found to be 9.42° while mandibular molars had a mean lingual inclination of 14.07°.

CONFLICT OF INTEREST

None to declare

FUNDING DISCLOSURE

None to declare

REFERENCES

1. Mohlin BO, Derweduwen K, Pilley R, Kingdon A, Shaw WC, Kenealy P. Malocclusion and Temporomandibular Disorder: A Comparison of Adolescents with Moderate to Severe Dysfunction with those without Signs and Symptoms of Temporomandibular Disorder and Their Further Development to 30 Years of Age. Angle Orthod. 2004;74:319-27

2. Schuyler C. Correction of occlusion; disharmony of the natural dentition. N Y State Dent J. 1947;13:445-62

3. Beyron H. Optimal occlusion. Dent Clin North Am. 1969;13:537-54. *https://doi.org/10.1016/S0011-8532(22)03363-8*

4. SchudyF.Cant of occlusal plane and axial inclinations of teeth. Angle Orthod 1963;33:69-82.

5. Andrews FL. The six Keys to normal Occlusion. Am J Orthod. 1972;62: 296-309.
https://doi.org/10.1016/S0002-9416(72)90268-0

6. Marshall S, Dawson D, Southard KA, Lee AN, Casko JS, Southard TE.Transverse molar movements during growth. Am J Orthod Dentofacial Orthop. 2003;124:615-24.
https://doi.org/10.1016/S0889-5406(03)00630-9

7. Ito H, Okimoto K, Mizumori T, Terada Y, Maruyama T. A clini¬cal study of the Relationship Between Occlusal Curvature and Craniomandibular Disorders. Int J Prosthodont. 1997;10:78-82

8. Casko JS, Vaden JL, Kokich VG, Damone J, James RD, Cangialosi TJ et al. Objective grading system for dental casts and panoramic radiographs. American Board of Orthodontics. Am J Orthod Dentofacial Orthop 1998;114:589-99.
https://doi.org/10.1016/S0889-5406(98)70179-9

9. Ross VA, Issaacson RJ, Germane N, Rubenstein LK. Influence of vertical growth pattern on faciolingualinclinationsand treatment mechanics. Am J Orthod Dentofacial Orthop 1990;98:422-9. *https://doi.org/10.1016/S0889-5406(05)81651-8*

10. Tsunori M, Mashita M, Kasai K. Relationship between facial types and tooth and bone characteristics of the mandible obtained by CT scanning. Angle Orthod 1998;68:557-62.

11. Palomo JM, Kau CH, Bahl-Palomo L, Hans MG. Three dimensional cone beam computerized tomography in dentistry. Dent Today 2006;25:130-5.

12. Alkhatiba R, Chungb CH, Buccolingual inclination of first molars in untreated adults:A CBCT study. Angle Orthod. 2017;87:598-602 *https://doi.org/10.2319/110116-786.1*

13. Masumoto T, Hayashi I, Kawamura A, Tanaka K, Kasai K. Relationships among facial type, buccolingual molar inclination, and cortical bone thickness of the mandible. Eur J Orthod. 2001;23:15-23 *https://doi.org/10.1093/ejo/23.1.15*

14. Barrera JM, Llamas JM, Espinar E, Sa'enzRam'irez C, Paredes V, P'erez-Varela JC. Wilson maxillary curve analyzed by CBCT. A study on normocclusion and malocclusion individuals. Med Oral Patol Oral Cir Bucal. 2013;18:547-552.
https://doi.org/10.4317/medoral.18291

15. Shewinvanakitkul W, Hans MG, Narendran S, Martin Palomo J. Measuring buccolingual inclination of mandibular canines and first molars using CBCT. Orthod Craniofac Res. 2011;14:168-74. *https://doi.org/10.1111/j.1601-6343.2011.01518.x*

16. Mitra S, Ravi MS. Evaluation of buccolingual inclination of posterior teeth in different facial patterns using computed tomography. Ind J Dent Res. 2011;22:376-380.
https://doi.org/10.4103/0970-9290.87056

17. Kasai K, Kawamura A. Correlation between buccolingual inclination and wear of mandibular teeth in ancient and modern Japanese. Arch Oral Biol. 2001;46:269-73
https://doi.org/10.1016/S0003-9969(00)00106-0

18. Janson G, Bombonatti R, Cruz KS, Hassunuma CY, Santro MD. Buccolingual inclinations of posterior teeth in subjects with different facial patterns. Am J Orthod Dentofacial Orthop 125:316-22. *https://doi.org/10.1016/j.ajodo.2003.03.010*

19. Andrews LF. Straight Wire: The Concept and the Appliance. San Diego: L.A. Wells; 1989.

20. Sheridan J, Hasting J. Air-rotor stripping and lower incisor extraction treatment. J ClinOrthod 1992;36:18-22.

21. Peck S, Peck H. Crown dimension and mandibular incisor crowding. Angle Orthod 1972;42:148-53

22. Adkins M, Nanda R, Currier G. Arch perimeter changes on rapid palatal expansion. Am J Orthod Dentofacial Orthop 1990;97: 194-9. *https://doi.org/10.1016/S0889-5406(05)80051-4*