

Evaluation of Mesiodistal Inclination of Permanent Maxillary and Mandibular First Molars in Different Angle's Molar Relation: A Cephalometric Study

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Abstract

Introduction: Angle's molar relationship is the most widely used classification in spite of the introduction of various other classifications. At the end of the treatment, the molars are finished in a Class I, II, or III molar relation. Thus, it is important to know the ideal inclinations of upper and lower 1st molars, thereby assisting in achieving a stable relationship. **Aims and Objectives:** The aim and objective of this study was to evaluate the mesiodistal inclination of permanent maxillary and mandibular first molars in Angle's Class I, II, and III molar relationships in relation to the occlusal plane. **Methodology:** Lateral cephalograms of 16–30-year-old individuals with Class I, II, and III molar relations were selected and traced in Dolphin imaging software, and the angle between the first molar and occlusal plane was calculated. **Results:** There was a statistically significant difference in the inclination of maxillary 1st molar in between Class I and Class III. No significant difference was noted in the inclination of maxillary first molar in case of Class I and Class II. In case of mandibular molars, there was a statistically significant difference in case of Class I and Class II and between Class I and Class III. **Conclusion:** When the end molar relationship of a case is planned to be Class I, the upper molar should be at an angle of 84.12° to the occlusal plane. When the end molar relationship of a case is planned to be Class II, the upper molar should be 84.15° to the occlusal plane. When the end molar relationship of a case is planned to be Class III, the upper molar should be inclined at an angle of 87.07° to the occlusal plane.

Keywords: Inclination, molar relation, molar tube, occlusal plane

INTRODUCTION

For orthodontists, incisors should not be the only concern. Molars, which are used as anchorage teeth, are also important, especially the first permanent molars (PMs), the compensatory differences of which have crucial roles in growth, development, and anchorage control.^[1]

In the specialty of orthodontics, the classification of malocclusion plays a very important role. It helps in the diagnosis and treatment planning of malocclusion and to determine the magnitude of the problem.^[2] Second, classification facilitates communication between specialists.

Jesuino *et al.*^[3] conducted a study to evaluate the mesiodistal root inclination of permanent incisors, canines, and first molar of Brazilian children with mixed dentition, using the horizontal reference line drawn on a panoramic radiograph.^[3]

Several tools^[4] have been used for assessing the inclination of teeth such as cephalometric angular measurements and conveyor and compass on dental casts. All teeth are arranged at an angle to the occlusal plane and each has an optimum inclination mesiodistally to best perform its individual and collective functions.^[5] Many clinicians have developed classification system for describing the malocclusion namely Dewey,^[6] Anderson,^[7] and Bennet.^[8] However, the most universally accepted classification system still in use today is Angle's^[9] method which was developed in 1889 and was based on the position of maxillary permanent first molar in the craniofacial anatomy.^[2]

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All teeth are essential; yet in function and influence, some are of greater importance than others, the most important of all being maxillary first molar which is often called “key to occlusion.”^[2] Angle^[9] in 1906 published his article where he proposed the virtues of this tooth. George Risse^[2] suggested that maxillary first molars were the key to occlusion because of the following virtues:^[2]

1. Largest teeth
2. Firmest in their attachment
3. Have a key location in the arch
4. Broadest spread of root and widest base
5. Occupy normal position in the arches far more often than teeth because they are the first permanent teeth to erupt.

Crown inclination had been defined by Andrews^[10] in “The six keys to normal occlusion” based on his study on 120 adults with normal occlusion. Several orthodontists have found that the inclination of dentition can change appreciably according to certain factors and can exhibit regularities. Teeth could change their direction of eruption to compensate for positional changes of the jaws because the amount and direction of jaw growth show considerable variability.^[1]

Changes in inclination of the first PMs are inextricably linked to changes in anchorage. Orthodontists have used various methods to make the correct changes in mesiodistal inclination of the first molars to influence anchorage preservation. Classic fixed appliances are used to put tip-backs on the posterior teeth for resisting the forward-tipping trend of the molars.

Before starting the treatment, it is better to evaluate: (i) molar inclination before treatment; (ii) the benefits of the compensatory condition of the molars themselves for anchorage preservation; and (iii) the natural pattern of differences in the axial inclination of the first molars in all types of malocclusions.^[1]

Su *et al.*^[1] evaluated the compensation trends of the inclination of first molar in Chinese population. Palatal and mandibular plane were used as reference planes. They concluded that the clinicians must avoid using a straight archwire in a 0° buccal tube on more distal-tipping first molars with regard to anchorage control.^[1]

During fixed orthodontic treatment, the buccal tube is placed in reference to the occlusal plane. Therefore, taking occlusal plane as reference instead of mandibular plane or palatal plane would be better so that the buccal tube can be tipped mesially or distally, depending on the planned end relationship of molar. Hence, it will be better to know the mesiodistal inclination of molars in relation to occlusal plane, which helps in accurate positioning of buccal tube.

Kannabiran *et al.*^[5] concluded that tip and torque modifications are suggested for the fine finishing and easy retention of occlusion in Dravidians while using straight-wire appliance.

Kamble *et al.*^[2] assessed 103 lateral cephalograms for positional variation of permanent maxillary first molar with infrazygomatic crest in skeletal Class I, II, and III cases.

Mesiodistal root angulation alterations of the maxillary and mandibular incisors may significantly change the molar relationship.^[3]

In Angle’s Class I molar relation, the mesiobuccal cusp of the upper first PM lies in the buccal groove of the lower first PM. Whereas in Class II molar relation, the mesiobuccal groove of the upper first molar lies in the interdental area between the 2nd PM and 1st molar.^[2] Thus, due to anatomic variations, there is change in the mesiodistal inclination of the upper first molar in Class I, II, and III cases.

Su *et al.*^[1] concluded that compensation of molar inclination varies among different classifications of sagittal malocclusion.

After searching the literature, databases such as PubMed, Medline, EBSCO, Scopus, and LILACS, till October 2017, with no restriction on language, very few studies^[1-3] are found which have evaluated the mesiodistal inclination of upper and lower first molars in Angles’ Class I, II, and III cases. No study has been found which evaluated the mesiodistal inclination of upper and lower first molars in relation to the occlusal plane. Therefore, this study has been taken up. The aim of this study was to evaluate difference in the mesiodistal inclination of permanent maxillary and mandibular first molars in Angle’s Class I, II, and III molar relationships in relation to the occlusal plane.

METHODOLOGY

The study was conducted at the Department of Orthodontics, K. M. Shah Dental College and Hospital, Piparia, Vadodara, Gujarat, India. Ethical approval was obtained from Sumandeep Vidyapeeth Institute of Ethical Clearance.

Based on values obtained from the study done by Kamble *et al.*,^[2] the sample size was calculated as follows:

A sample size of 150 achieves 80% power to detect an effect size (W) of 0.25 using 2 degrees of freedom by Chi-square test with a significance level (alpha) of 0.05.

Sample size $n = \text{Chi-square}/W^2$

Where $W = 0.25$

Chi-square = 9.4

df = 2.

Hence, the final sample size was 150 and sample per group was 50.

Good quality, undamaged lateral cephalograms of Angles Class I, Class II, and Class III molar relation were included in the study. The exclusion criteria were absence of permanent first molar or any tooth mesial or distal to it, lateral cephalograms showing bone loss around the first molar, any pathological

lesion on the radiograph, and lower anterior crowding and cephalograms showing open bite.

The study models were assessed from the archives of pretreatment orthodontic records of the patients. The study models with ideal posterior intercuspation were identified and their lateral cephalograms were included in the study. A total of fifty lateral cephalograms of Class I [Figures 1 and 2], fifty Class II [Figures 3 and 4], and fifty Class III [Figures 5 and 6] cases were recruited retrospectively based on the inclusion criteria.

The soft copy of the lateral cephalograms was digitized using Dolphin cephalometric software (Vadodara, Gujarat, India). Occlusal plane was traced by drawing a line passing through the intercuspation of the upper and lower teeth. The long axis of the upper first molar was constructed from the apex of the mesiobuccal root of the first molar and its mesiobuccal cusp using the software [Figure 1]. The line was extended until it intersected the occlusal plane. Then, the superior inside angle was measured

was measured. Similarly, long axis of the lower first molar was constructed by joining the apex of the mesiobuccal root with the mesiobuccal cusp [Figure 2]. The lines were extended until they intersected the occlusal plane. Then, the inferior inside angle was measured. The data obtained were subjected to statistical analysis.

RESULTS

In patients with Class I molar relation, the mean inclination of maxillary molar is 84.12° and mean inclination of mandibular molar is 85.23 [Table 1].

In patients with Class II molar relation, the mean inclination of maxillary molar is 84.15 and mean inclination of mandibular molar is 81.71 [Table 1].

In patients with Class III molar relation, the mean inclination of maxillary molar is 87.07 and mean inclination of mandibular molar is 81.25 [Table 1].

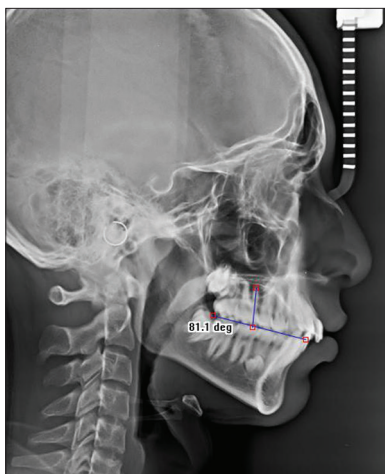


Figure 1: The long axis of the upper first molar was constructed from the apex of mesiobuccal root of the first molar and its mesiobuccal cusp using the software. The line was extended until it intersected the occlusal plane. Then, the superior inside angle was measured

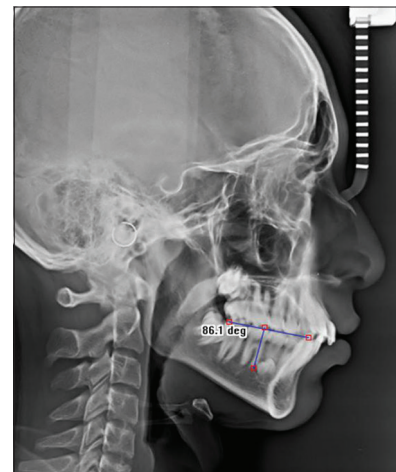


Figure 2: The long axis of the lower first molar was constructed by joining the apex of the mesiobuccal root with mesiobuccal cusp. The lines were extended until they intersected the occlusal plane. Then, the inferior inside angle was measured. A case of Class I molar relation

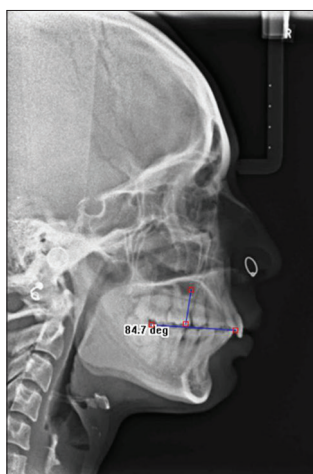


Figure 3: Inclination of the upper molar measured in a case of Class II molar relation

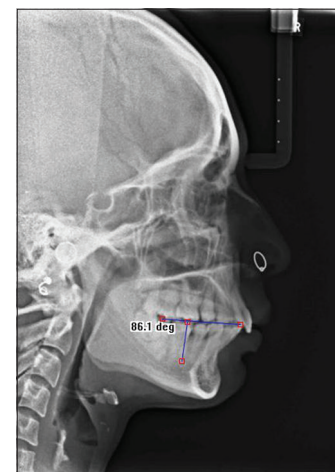


Figure 4: Inclination of the lower molar measured in a Class II molar relation

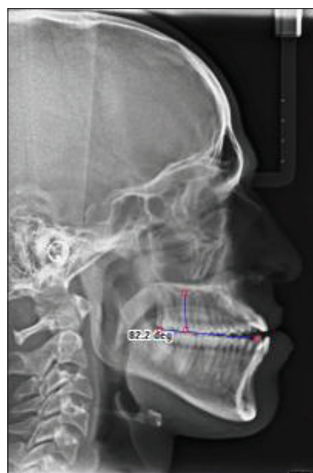
Table 1: One-way ANOVA

	<i>n</i>	Mean	SD	SE	95% CI for mean		Minimum	Maximum
					Lower bound	Upper bound		
Upper								
I molar	50	84.12	3.62	0.51	83.09	85.15	75.90	90.00
II molar	50	84.15	4.82	0.68	82.78	85.52	72.00	92.40
III molar	50	87.07	4.24	0.60	85.86	88.27	71.40	92.40
Total	150	85.11	4.45	0.36	84.39	85.83	71.40	92.40
Lower								
I molar	50	85.23	4.80	0.68	83.86	86.59	65.50	95.00
II molar	50	81.71	5.05	0.71	80.27	83.14	64.90	92.00
III molar	50	81.25	5.68	0.80	79.64	82.86	65.50	90.50
Total	150	82.73	5.45	0.45	81.85	83.61	64.90	95.00

ANOVA

	Sum of squares	df	Mean square	<i>F</i>	ANOVA (<i>P</i>)
Upper					
Between groups	286.376	2	143.188	7.905	0.001
Within groups	2662.803	147	18.114		
Total	2949.178	149			
Lower					
Between groups	472.949	2	236.474	8.786	0.0002
Within groups	3956.438	147	26.915		
Total	4429.387	149			

SD: Standard deviation, SE: Standard error, CI: Confidence interval

**Figure 5:** Inclination of the upper molar measured in case of Class III molar relation

Post hoc test was used and multiple comparisons were done [Table 2]. When the inclination of maxillary molar was compared between Class I and Class II, the *P* value obtained was 0.999, showing that the data obtained were not statistically significant. This indicates that there is no difference in the inclination of maxillary molar in cases of Class I and Class II molar relation [Table 3].

When the inclination of maxillary molar was compared between Class I and Class III, the *P* value obtained was 0.002 [Table 2], showing that the data obtained were statistically significant. This indicates that there is a significant difference in the inclination of maxillary molar in cases of Class I and Class III molar relation.

**Figure 6:** Inclination of the lower molar measured in a Class III molar relation

When the inclination of mandibular molar was compared between Class I and Class II, the *P* value obtained was 0.003 [Table 2], showing that the data obtained were statistically significant. This indicates that there is a significant difference in the inclination of mandibular molar in cases of Class I and Class II molar relation.

When the inclination of mandibular molar was compared between Class I and Class III, the *P* value obtained was 0.001 [Table 2], showing that the data obtained were statistically significant. This indicates that there is a significant difference in the inclination of mandibular molar in cases of Class I and Class III molar relation.

Table 2: Tukey's *post hoc* multiple comparison tests

Dependent variable	Mean difference (I-J)	SE	P	95% CI	
				Lower bound	Upper bound
Upper					
I molar					
II molar	-0.026	0.851	0.999	-2.04	1.99
III molar	-2.944	0.851	0.002	-4.96	-0.93
II molar					
I molar	0.026	0.851	0.999	-1.99	2.04
III molar	-2.918	0.851	0.002	-4.93	-0.90
III molar					
I molar	2.944	0.851	0.002	0.93	4.96
II molar	2.918	0.851	0.002	0.90	4.93
Lower					
I molar					
II molar	3.518	1.038	0.003	1.06	5.97
III molar	3.974	1.038	0.001	1.52	6.43
II molar					
I molar	-3.518	1.038	0.003	-5.97	-1.06
III molar	0.456	1.038	0.899	-2.00	2.91
III molar					
I molar	-3.974	1.038	0.001	-6.43	-1.52
II molar	-0.456	1.038	0.899	-2.91	2.00

SD: Standard deviation, SE: Standard error, CI: Confidence interval

Table 3: Paired sample *t*-test

	Mean	<i>n</i>	SD	SEM	Mean difference	<i>P</i>
Class I molar						
Upper	84.12	50	3.62	0.512	1.10	0.225
Lower	85.23	50	4.80	0.678		
Class II molar						
Upper	84.15	50	4.82	0.682	−2.44	0.008
Lower	81.71	50	5.05	0.715		
Class III molar						
Upper	87.07	50	4.24	0.600	−5.81	<0.001
Lower	81.25	50	5.68	0.803		

SEM: Standard error of mean, SD: Standard deviation

In Class I molar relation, the mean difference in the inclination of maxillary and mandibular first molar was 1.10, with $P = 0.225$ [Table 3]. This shows that there is no significant difference in the inclination of upper and lower molars in Class I cases.

In Class II molar relation, the mean difference in the inclination of maxillary and mandibular first molar was -2.44, with $P = 0.008$ [Table 3]. This shows that there is a statistically significant difference in the inclination of upper and lower first molars in Class II cases.

In Class III molar relation, the mean difference in the inclination of maxillary and mandibular first molar was -5.81, with $P < 0.001$ [Table 3]. The value obtained is. This shows that there is a statistically significant difference in the inclination of upper and lower first molars in Class III cases.

DISCUSSION

This study was carried out with the aim of evaluating the difference in the mesiodistal inclination of permanent maxillary and mandibular first molars in Angle's Class I, II, and III molar relationships in relation to the occlusal plane. The molar tube is placed in reference to the occlusal plane. Till now, no study had measured the inclination of molars in relation to the occlusal plane. Therefore, this study was taken up.

Lateral cephalograms of 16–30-year-old individuals with Class I, II, and III molar relations were taken and were digitized using Dolphin cephalometric software. 4-point angle was taken. Only angular values were noted. No calibration was required.

All the values obtained were subjected to statistical analysis. Thus, the ideal inclination of upper and lower molar was identified. Hence, while ending a case in Class I, II, or III molar relationship, the inclination of maxillary and mandibular molar should be calculated in relation to the occlusal plane. If it is not in the range of being ideal, then the molar tube can be tipped as per requirement to obtain the required inclination.

In Angle's Class I molar relation, the mesiobuccal cusp of the upper first PM lies in the buccal groove of the lower first PM. Whereas in Class II molar relation, the mesiobuccal groove of the upper first molar lies in the interdental area between the 2nd PM and 1st molar. Thus, due to anatomic variations, there is change in the mesiodistal inclination of the upper first molar in Class I, II, and III cases.

This will help in achieving proper inclination of molar at the end of the treatment. Thus, due to anatomical variations in the molar relations, its inclination varies in Class I, II, and III molar relationships. To achieve ideal inclination of first molar after the treatment, proper positioning of molar tube is a necessity. Thus, by knowing the variations which need to be done while bonding the first molar, it is possible to achieve good cusp-to-fossa relation, thereby stabilizing the occlusion. Hence, once we decide the molar relation in which we plan to end the case, the molar tube should be positioned accurately.

CONCLUSION

After appraising the inclination of molars, it can be concluded that:

1. When the end molar relationship of a case is planned to be Class I, the upper molar should be at an angle of 84.12° to the occlusal plane
2. When the end molar relationship of a case is planned to be Class II, the upper molar should be 84.15° to the occlusal plane
3. When the end molar relationship of a case is planned to be Class III, the upper molar should be inclined at an angle of 87.07° to the occlusal plane
4. This helps in achieving an ideal cusp-to-fossa relationship, thereby stabilizing the occlusion.

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Conflicts of interest

There are no conflicts of interest.

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