Research Article

Assessment of Maxillary First Molars Rotation in Class II malocclusion cases: A Cross-Sectional Study

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ABSTRACT

Introduction: Determination of malocclusion including individual tooth malposition is crucial during diagnosis and treatment planning. Along with anteroposterior mal-relation, there is often the rotation of upper first molars in Class II cases. Rotated molars not only occupy more space than normally positioned molars but also increase the challenge for orthodontic treatment.

Aims and objectives: This study aimed to determine the prevalence and extent of maxillary molar rotation in Class II division 1 and 2 malocclusion cases.

Material and Methods: A total of 142 pretreatment maxillary casts of Class II malocclusion (71 division 1 and 71 division 2) cases were collected from the Department of Orthodontics of People's Dental College and Hospital. All the casts were scanned at a 1200 dpi resolution with teeth touching the glass of the scanner (brother MFC-L2700DW model). Scanned pictures were then printed without any change in magnification. Measurement was made on those printed copies of casts. To determine the rotation and its severity a method developed by Ricketts (Line of Ricketts) was used. Descriptive analysis was carried out in Microsoft Excel 2013.

Result: In Class II division 1 cases, 45 (63.4%) had right molar rotation and 47 (66.2%) had left molar rotation. In Class II division 2 cases, 33 (46.5%) had right molar rotation while 34 (47.9%) had left molar rotation. Similarly, the mean rotations of the right and left molars in division 1 were 6.24 mm and 6.77 mm respectively and those in division 2 were 4.82 mm and 4.94 mm respectively.

Conclusion: The prevalence and extent of rotation of maxillary molars in Class II divisions 1 and 2 malocclusion cases were assessed in this study. Mesiopalatal rotation and left molar rotation were observed more commonly in both divisions.

KEYWORDS: Class II malocclusion, Line of Ricketts, Molar rotation

INTRODUCTION

The pioneers of Orthodontics, Angle and Andrews, introduced the concept of normal occlusion based on the relative position of the maxillary first permanent molar to the mandibular first permanent molar. To be in an ideal occlusion, the mesiobuccal cusp of the maxillary first permanent molar occludes in the buccal groove of the mandibular first permanent molar.[1,2] Any deviation in the anteroposterior position of molars result in Class II or Class III malocclusion where the line of occlusion may not be correct.[3]

Studies have shown that along with the difference in sagittal position, there is a higher chance of axial rotation of molars, especially of maxillary molars in Class II malocclusion cases.[4-6] Proper evaluation of rotation of these molars during diagnosis and treatment planning is essential as rotated molars not only occupy more space but also might be the cause of developing Class II condition.[7] Various methods have been developed by

researchers to assess maxillary molar rotation.[8] One of them is the 'Line of Ricketts' developed by Robert M. Ricketts. According to Ricketts, for an upper molar to be in an ideal position, a line drawn through the tips of the distobuccal and the mesiolingual cusps of the molars should pass through the distal third of the canine of the contralateral side.[9] The smaller the distance between the line and tip of the canine better the position of the molar. Molars are considered non-rotated and well positioned if the perpendicular distance between the tip of the canine and the line of Ricketts is within 4 mm.[6,10]

Many studies have been conducted assessing the correlation between the rotation of molars and the severity of malocclusion[6,10] but very few have researched the prevalence and extent of molar rotation in Class II malocclusion. Thus the aim of this study was to determine the prevalence of rotation of maxillary molars and the extent of their rotation in Class II division 1 and division 2 cases.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Orthodontics, People's Dental College and Hospital, Kathmandu from 5th November 2021 to 30th January 2022. Ethical clearance (Reference No. 1, CH No. 19, 2078/2079) was obtained from the Institutional Review Committee of People's Dental College and Hospital, Kathmandu, Nepal. A convenience sampling technique was used to collect a total of 142 Class II cases (71 cases for each division 1 and division 2).

The cases were selected from the individuals who visited the Department of Orthodontics of People's Dental College and Hospital for orthodontic treatment. Written informed consent was taken prior to making an impression of the upper arch. The inclusion criteria of the study were individuals above 18 years of age with all permanent dentition at least from the first molar to first molar, cases with Angle's Class II malocclusion and individuals without a history of orthodontic treatment. The exclusion criteria were the individuals with tooth agenesis, extractions, large proximal restorations that could change the mesiodistal width of the tooth, occlusal wear in first maxillary molars, any changes in shape, size and position of teeth especially of maxillary canines and post orthodontic treatment cases.

The sample size was calculated by using the following formula:

$n = z^2 x \sigma^2 / e^2$ where z=1.96, σ = 6.06 from reference article[7], e = 1

$= (1.96)^2 \times (6.06)^2 / 1^2$

$= 141.07$

$= 142$

Impression was made of the upper arch and a study model was prepared. All the study models were scanned at a 1200 dpi resolution with teeth touching the glass of the scanner (brother MFC-L2700DW model). Scanned pictures were printed without any change in magnification. Measurements were made on those printed copies of casts.

To determine the rotation and its severity a Line of Ricketts was used where a line was drawn along the tips of the distobuccal cusp and mesiopalatal cusp of molar passing through the distal third of the canine of the opposite side.[9] When a perpendicular line was drawn from the tip of canine to the line of Ricketts, a distance of up to 4mm was considered as well positioned molar and if the distance was more than 4mm, the molar was considered as rotated (Fig 1). The more distal position of Ricketts line indicates more mesiopalatal rotation while the more mesial line indicates more distopalatal rotation of the molar.

For consistency of the procedure, thirty printed pictures were remeasured after a week and intraobserver variability was calculated. Cronbach Alpha was used for intra-observer variation and the value was found to be 0.9 which indicated an excellent agreement.

The data were collected and Microsoft Excel 2013 was used for descriptive analysis.

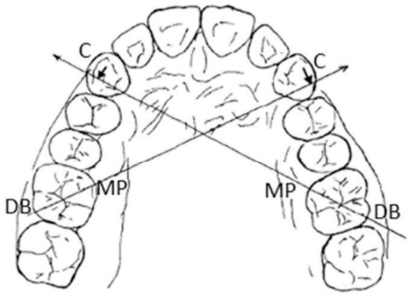

Fig. 1: Line of Ricketts: A line connecting the tips of the distobuccal cusp (DB) and mesiopalatal cusp (MP) of a first permanent maxillary molar and passing through the distal third of the canine (C) of the opposite side

RESULT

In total 142 study models of individuals, an equal number of cases from Class II divisions 1 and 2 (71 in each division) were included in the study. Out of 71, 58 (81.7%) in division 1 and 43 (60.57%) in division 2 were females (Table 1).

The majority of cases in Class II division 1, had molar rotations while in division 2 majority had a normal orientation of molars (Table 2).

It was found that in division 1, the mean rotation of right molars was 6.24mm and that of left molars was 6.77mm whereas, in division 2, the mean rotations of right and left molars were 4.82mm and 4.94mm respectively (Table 3).

Table 1: Demographic data of Class II division 1 and 2 individuals

Class II	Male	Female
Division 1	13 (18.30%)	58 (81.70%)
Division 2	28 (39.43%)	43 (60.57%)

Table 2: Distribution of molar rotation in Class II divisions 1 and 2

	Class II division 1		Class II division 2	
	Right molar	Left molar	Right molar	Left molar
Normal	26 (36.6%)	24 (33.8%)	38 (53.5%)	37 (52.1%)
Rotation	45 (63.4%)	47 (66.2%)	33 (46.5%)	34 (47.9%)

Table 3: Descriptive statistic of right and left side molar rotation (in mm)

Class II	Rotation side	Mean	Standard deviation	Standard error	Minimum	Maximum
Division 1	Right molar	6.24	4.24	0.49	0	16.5
	Left molar	6.77	4.36	0.50	0	19
Division 2	Right molar	4.82	3.65	0.43	0	16.5
	Left molar	4.94	3.48	0.41	0	14

DISCUSSION

Determination of malocclusion is crucial during diagnosis and treatment planning. Most of the cases are classified as Class I, II or III malocclusion based on the relative positions of upper and lower first molars. A previous study has shown that abnormal anteroposterior positioning of upper and lower molars is associated with the rotation of molars in malocclusion cases.7 Use of 'Line of Ricketts' is one of the methods devised to measure the rotation of molars which is simple and easy to use.

In this study, it was observed that in both Class II divisions 1 and 2, there were more females than males. It may be due to higher esthetic concerns of females than that of males. A study done by Shrestha et. al. also showed that females had higher expectations for a better smile and straight teeth.[11]

Regarding the rotation of both molars, it was observed that Class II division 1 cases had more number of rotated molars (63.4% right molar and 66.2% left molar) compared to Class II division 2 (46.5% right molar and 47.9% left molar). Interestingly it was noticed that in division 1 only 7 (9.8%) right molars and 6 (8.4%) left molars were distopalatally rotated while in division 2 both right and left molars, 8 (11.2%) each had distopalatal rotation. The remaining molars had mesiopalatal rotation. The literature also states that mesiopalatal rotation is more common.[12-14] Also our result showed that a greater number of left molars were rotated than the right molars, this finding is contrary to that of Amin where a greater number of right molars were rotated.[7]

The linear measurement of rotation in this study exhibited an almost similar amount of rotation between the right and left molars in division 1 and division 2. The mean value of rotation was 6.24 mm for the right molars and 6.77 mm for the left molars of division 1 while in division 2 the values were 4.82 mm and 4.94 mm for the right and left molars respectively. This result showed less rotation of molar in comparison to the study done by Marisa et. al where the mean rotation was 11.38 mm.[8] However the value of rotation in our study was up to 19 mm in certain cases. This wide range of variation may be due the factors like the shape of the dental arch, variation in the shape and size of the molar crown and differences in the size and location of canines. A study done by Cremonini et.al. also indicated that there exists

a strong correlation between the arch shape and size of the teeth.[15]

Assessment of the maxillary first molar rotation with reference to the Ricketts line is a simple, easy to perform and economic method. However, the method depends upon the eruption, position and size of the canine. This method cannot be applied in cases with missing canines and is less reliable if canines are rotated. Further, if premolars and incisors are missing or ectopically erupted, the position of the canine is affected which limits the application of this method in such conditions.

During the study, it was observed that the narrower the arch greater the rotation of molars. Also in most instances, both molars rotated in the same direction and in very few cases one molar rotated in mesiopalatal direction and the molar on the other side rotated in distopalatal direction. These conditions were not evaluated in this research, hence, future studies with these considerations are suggested.

CONCLUSION

The study concluded that the maxillary first permanent molar rotation was more prevalent in class II division 1 malocclusion cases than in division 2 malocclusion and the mesiopalatal rotation was more prevalent than the distopalatal rotation. Also, the left molar rotation was more common than the right.

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