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Influence of maxillary first molar rotation on the severity of dental class II malocclusion: A cross-sectional study

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Abstract

AIM: The aim of the study was to evaluate and assess the influence of maxillary molar rotation on severity of dental class II malocclusion.

MATERIALS AND METHODS: The study comprised of 4 different groups namely, 1/4th class II malocclusion, 2/4th class II malocclusion, 3/4th class II malocclusion and full class II malocclusion involving sample size of 20,15,16 and 12. The samples were subjected to digital evaluation of maxillary 1st permanent molar rotation using 4 parameters namely angle of Friel, Ricketts E-Line, angle of Henry and Premolar angle.

RESULTS: The results were subjected to statistical analysis using one way ANOVA wherein group IV (Full class II malocclusion) exhibited a greater rotational value. On evaluation, angle of Friel exhibited a mean of 59.6±1.61 degrees, Ricketts E-Line was found to be 12.3±1.77mm while angle of Henry showed a mean of 19±3.19 degrees and premolar angle was 12.5±5.83 degrees.

CONCLUSION: On evaluating molar rotation using angle of Friel, Ricketts E-Line, angle of Henry and premolar angle, full cusp class II malocclusion presented higher degree of mesiopalatal rotation maxillary molar rotation. With increasing mesiopalatal rotation, the severity of molar relation also increased from 1/4th to full class II. Hence the maxillary molar spatial position along the long axis majorly influences the molar relation wherein a full cusp class II molar relation exhibits higher degree of molar rotation.

Keywords:

Molar rotation, Class II malocclusion, angle of Friel, Ricketts E-Line, angle of Henry and premolar angle

Introduction

The position of the first molar in the maxillary arch is of immense importance in the diagnosis of malocclusion and treatment planning. As stated by Edward H. Angle (1899), maxillary first permanent molar has been used to describe various occlusal malrelations and is the "key to occlusion."[1] Normal occlusion, as described by Angle, has the drawback of not considering the spatial axes of the molars. In general, as molars exhibit a rhomboidal shape, they occupy a large surface area.[2] Andrews (1972) has mentioned that lack of rotation is the key to normal occlusion. Correcting the axial deviation of the molar helps in achieving sufficient arch perimeter, proper sagittal positioning, and maximum intercuspation, thereby providing long-term stability.[3] Henry (1956) measured the angle created by the median raphe and the line drawn through the buccal cusp tips of the molar.[4] Furthermore, Friel (1959) proposed an angle made by the median raphe and the line drawn through the mesiobuccal and mesiopalatal cusps of the molar.[5] Orton (1966) used the

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angle made by two tangents, one drawn to the buccal surface of the premolar and the other through the molar.[6] According to Ricketts (1969), a molar is considered to be positioned normal along its long axis when the line joining the distobuccal and mesiopalatal cusps of the maxillary first permanent molar passes 4 mm distal to the canine cusp tip in the opposite side.[7] In addition, various other parameters in the form of linear and angular measurements were introduced to determine the spatial position of the molar. Cetlin and Tenhove (1993) postulated that a well-positioned maxillary first permanent molar exhibits parallelism of its buccal surfaces when viewed from the anterior aspect. Evaluation of the molar rotation is of prime importance in diagnosis and treatment planning as, when properly executed, it provides correction in the early phase of fixed orthodontic therapy. Thus, various problems, such as premature contacts and compromised inter-molar width, are minimized. A high prevalence of molar rotation in patients with class II malocclusion has been widely reported in the literature.[6,8-10] Hence, this study evaluated the rotation of maxillary first permanent molar in patients with Angles class II division 1 malocclusion to determine the correlation between molar rotation and the severity of class II malocclusion.

Materials and Methods

This study was performed on 63 selected dental class II malocclusion models after receiving ethical clearance (registration no. IGIDSIEC2019NRP13PGSDODO) and informed consent from patients. Any model that deviated from class I molar relationship toward a class II condition on either side was collected and segregated into four groups based on molar relationships, as follows: 1/4th class II (group I), 2/4th class II (group II), 3/4th class II (group III), and full class II (group IV) malocclusion. The sample size was calculated using 5% alpha error and 80% power for a correlation coefficient of ≥0.20. The following were the inclusion criteria: 1) presence of all permanent teeth, 2) absence of any restoration or decay, attrition, worn or missing teeth, prosthetic replacement, and supernumerary teeth, 3) absence of previous orthodontic treatment, 4) absence of crossbite, and 5) toward a class II relationship from a class I relationship. This study aimed to evaluate the relationship between the magnitude of rotation and the severity of malocclusion. The anteroposterior discrepancy of the maxillary first molar was determined based on the position and distance of the distobuccal cusp tip of the maxillary molar in relation to the mesiobuccal groove of the mandibular molar, as follows: full class II group is 1.0–3.5 mm, 3/4th class II group is 3.5–7.0 mm, 2/4th class II group is 3.5 mm, and 1/4th class II group is >7 mm.[11]

The models were digitally photographed with the leveling bubble in place, and the molar rotation was assessed [Figures 1-3]. The digitally photographed models were standardized using a ruler and landmarks [Figure 4]. Parameters of angle of Friel, Ricketts E-line, angle of Henry, and premolar angle

Table 1: Mean and standard deviation

Angle of Friel						
Group	Mean (R)	Std dev (R)	Freq (R)	Mean (L)	Std dev (L)	Freq (R)
1	65.1	2.38	20	65	2.10	20
2	61.6	1.24	15	60.93	0.70	15
3	59.18	1.68	16	59.68	1.85	16
4	56.66	1.66	12	56.58	2.53	12
Total	61.15	3.63	63	61.07	3.57	63
Ricketts E-line						
Group	Mean (R)	Std dev (R)	Freq (R)	Mean (L)	Std dev (L)	Freq (R)
1	5.5	0.94	20	4.65	0.98	20
2	7.26	1.53	15	6.53	1.40	15
3	9.75	1.12	16	9.12	0.80	16
4	12.33	1.77	12	12	1.41	12
Total	8.301	2.854	63	7.634	2.94	63
Angle of Henry						
Group	Mean (R)	Std dev (R)	Freq (R)	Mean (L)	Std dev (L)	Freq (R)
1	11.7	1.59	20	12.25	1.91	20
2	16.93	3.36	15	16.26	2.46	15
3	19.5	1.59	16	18.62	2.09	16
4	19	3.19	12	19.66	4.77	12
Total	16.31	4.09	63	16.23	4.05	63
Premolar angle						
Group	Mean (R)	Std dev (R)	Freq (R)	Mean (L)	Std dev (L)	Freq (R)
1	4.7	1.80	20	6.05	2.96	20
2	5.86	2.23	15	6.26	2.25	15
3	6.93	3.29	16	8.5	3.32	16
4	12.5	5.83	12	10.66	4.16	12
Total	7.03	4.32	63	7.60	3.58	63

Table 2: Analysis of variance—right

Angle of Friel—Right					
Source	SS	df	MS	*F*	Prob > *F*
Between groups	617.908	3	205.969	60.01	0.0000
Within groups	202.504	59	3.432		
Total	820.412	62	13.23		
Ricketts E-line—Right					
Between groups	401.669	3	133.889	76.25	0.0000
Within groups	103.6	59	1.755		
Total	505.269	62	8.149		
Angle of Henry—Right					
Between groups	680.517	3	226.83	37.47	0.0000
Within groups	357.133	59	6.053		
Total	1037.65	62	16.736		
Premolar angle—Right					
Between groups	488.065	3	162.688	14.33	0.0000
Within groups	669.870	59	11.353		
Total	1157.936	62	18.676		

Figure 1: Digital camera with leveling bubble in place

Figure 3: Digital photograph of the maxillary model

Table 3: Analysis of variance—left

Source	SS	Df	MS	*F*	Prob > *F*
Angle of Friel—Left					
Between groups	581.315	3	193.771	53.60	0.0000
Within groups	213.287	59	3.615		
Total	794.603	62	12.816		
Ricketts E-line—Left					
Between groups	460.569	3	153.523	116.08	0.0000
Within groups	78.033	59	1.322		
Total	538.603	62	8.687		
Angle of Henry—Left					
Between groups	550.328	3	183.442	22.97	0.0000
Within groups	471.1	59	7.984		
Total	1021.42	62	16.474		
Premolar angle—Left					
Between groups	200.529	3	66.84	6.63	0.0006
Within groups	594.55	59	10.07		
Total	795.079	62	12.823		

were measured using a digital protractor and recorded [Figures 5–8].[12,13]

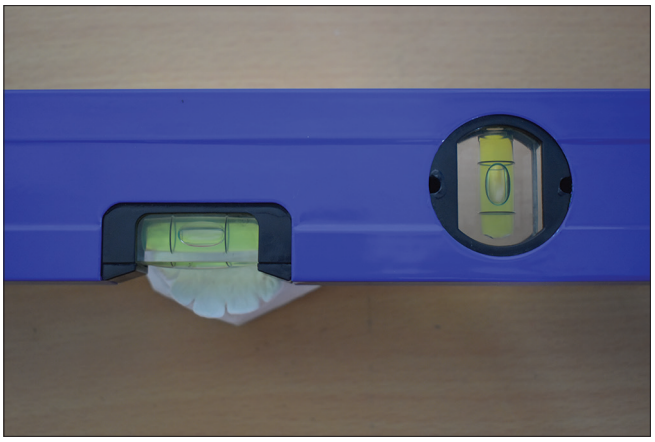

Figure 2: Maxillary model with leveling bubble in place

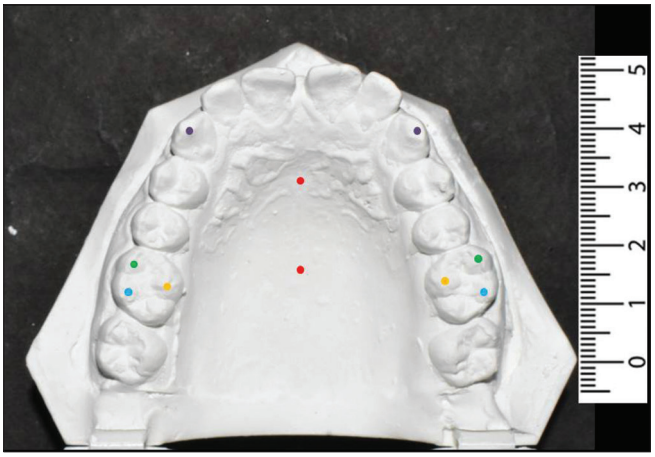

Figure 4: Landmarks plotted on the photographed model. ● RP1—Most anterior region of the palatine raphe, ● RP2—Most posterior region of the palatine raphe, ● MV—Tip of the mesiobuccal cusp of the maxillary first molar, ● DV—Tip of the distobuccal cusp of the maxillary first molar, ● MP—Tip of the mesiopalatal cusp of the maxillary first molar, ● C—Tip of the cusp of the maxillary canine

Results

The mean molar rotational values were statistically analyzed and tabulated for all four parameters on both sides [Table 1]. One-way analysis of variance was used to test the level of significance and was found to be statistically significant [Tables 2 and 3]. The groups were statistically compared using Bonferroni test. The comparison between group I and group IV showed a larger mean difference, which suggests a larger variation between 1/4th class II and full class II malocclusion, followed by group I (1/4th class II) and III (3/4th class II) and group II (2/4th class II) and group IV (full class II) [Table 4].

Discussion

The rotational position of the maxillary first molar is of great clinical importance in providing a well-aligned maxillary-to-mandibular arch and also fulfils Andrews

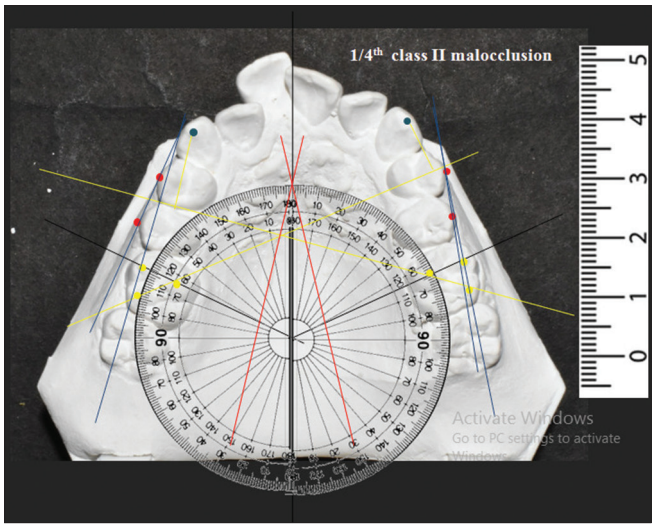

Figure 5: Plotted parameters (angle of Friel, Ricketts E-line, angle of Henry, and premolar angle) on 1/4th class II maxillary model

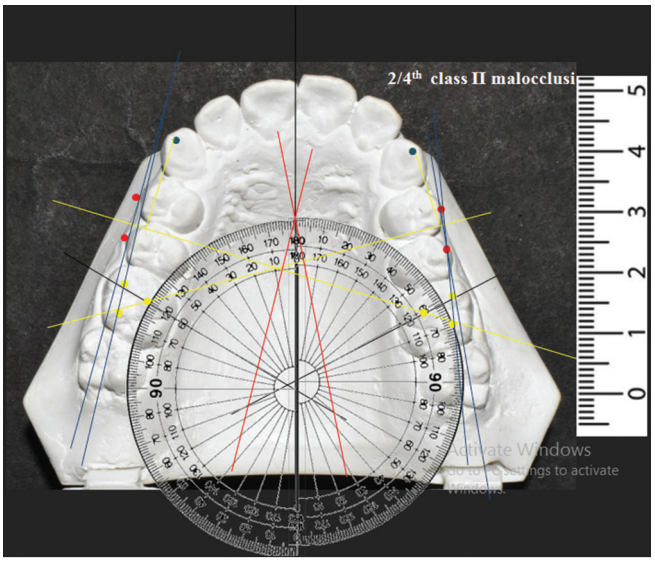

Figure 6: Plotted parameters (angle of Friel, Ricketts E-line, angle of Henry, premolar angle) on 2/4th class II maxillary model

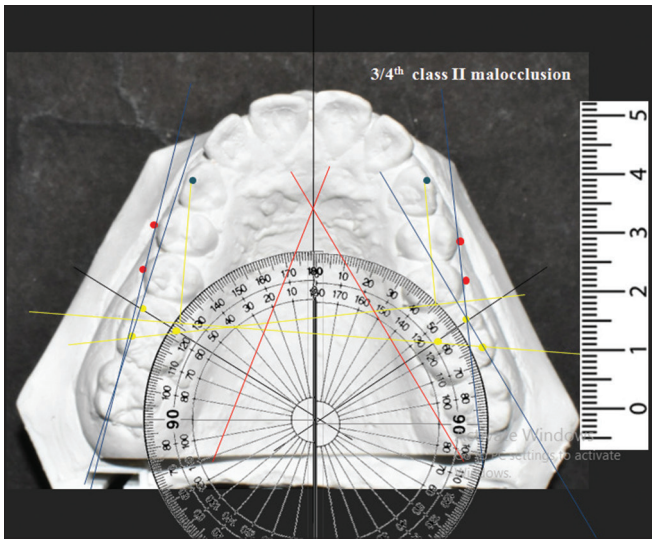

Figure 7: Plotted parameters (angle of Friel, Ricketts E-line, angle of Henry, and premolar angle) on 3/4th class II maxillary model

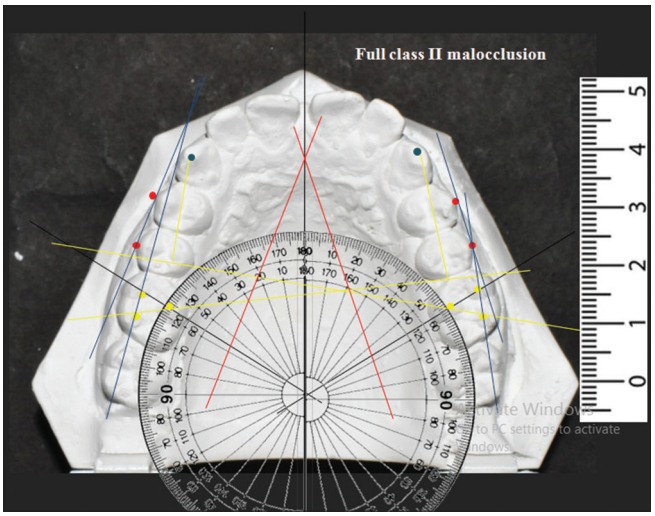

Figure 8: Plotted parameters (angle of Friel, Ricketts E-line, angle of Henry, and premolar angle) on full class II maxillary model

six keys to occlusion. Dahlquist has previously observed that sex distribution is unnecessary for this type of study; hence, equal sex distribution was not considered in the present investigation. On evaluating the right and left sides of the models, no significant difference was evident in the indicators included in the study, which agrees with the findings of a study by Junqueira *et al*. published in 2011. Several authors have described various indicators to evaluate the position of the molar around the spatial axis. Henry, in the year 1956, proposed an angle to quantify the rotational position of the maxillary molar by constructing the angle formed by the two planes, namely the median raphe and buccal cusp tips of molars.[14,15] Similarly, in 1959, Friel considered the median raphe as the reference plane and presented an angle with the line joining the mesiobuccal and mesiopalatal cusp tips. Orton, in 1966, put forth an angle created by the tangent drawn from the buccal surfaces of the premolars to the molars. In 1969, Ricketts suggested a line (joining the distobuccal and mesiopalatal cusps of the maxillary molar), which on bisecting the distal aspect of the contralateral canine, is aptly positioned around its axis in the maxillary dental arch.[16] According to Van der Linden, the raphe line and median palatal rugae points are stable anatomic landmarks for evaluating the rotational position.[12-14]

Some studies have evaluated the positioning of the molar in the occlusal aspect of the arch; however, no association has been reported in the literature between molar rotation and its influence on molar relation. In this study, mesiopalatal molar rotation was highly prevalent in all four groups. The individual mean values for the

Table 4: Comparison (right and left)—(Bonferroni)

Comparison		Angle of Friel		Ricketts E-Line		Angle of Henry		Premolar angle	
Group	Group	Right	Left	Right	Left	Right	Left	Right	Left
1	2	-3.5	-4.06	1.76	1.88	5.23	-4.01	1.16	-0.216
		0.000	0.000	0.001	0.000	0.000	0.001	1.000	1.000
1	3	-5.9	-5.31	4.25	4.47	7.8	-6.37	2.23	2.45
		0.000	0.000	0.000	0.000	0.000	0.000	0.314	0.000
1	4	-8.4 0.000	-8.41	6.83	7.35	7.3	7.41	7.8	4.61
			0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	3	-2.4	-1.24	2.48	2.59	2.56	2.35	1.07	2.23
		0.004	0.440	0.000	0.000	0.031	0.142	1.000	0.330
2	4	-4. 9	4.35	5.06	5.46	2.06	3.4	-6.63	4.4
		0.000	0.000	0.000	0.000	0.205	0.017	0.000	0.004
3	4	-2.52	-3.10	2.58	2.87	-0.5	1.041	5.56	2.16
		0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.474

four groups were evaluated for the tested parameters, namely angle of Henry, angle of Friel, Ricketts E-line, and premolar angle [Table 1]. The findings were in accordance with the study performed by Lima.[11,17] In this study, the mean value for the angle of Friel decreased from group I (1/4th class II) to group IV (full class II), which indicates an increase in molar rotation on both sides. The other three parameters, that is, Ricketts E-line, angle of Henry, and premolar angle, increased from group I to group IV, which signifies that the molar rotation increases with the increase in molar class II relations from 1/4th class II to full class II malocclusion. Hence, molar rotation influences the severity of class II malocclusion. On evaluating individual parameters, the mean and standard deviation for the angle of Friel were found to be 56.66 ± 1.66 degrees on the right side and 56.58 ± 2.53 degrees on the left side for group 4 and 65.1 ± 2.38 degrees on the right side and 65 ± 2.10 degrees on the left side for group 1, which shows increased mesiopalatal rotation. Similarly, the mean and standard deviation for Ricketts E-line were found to be 5.5 ± 0.94 mm on the right side and 4.65 ± 0.98 mm on the left side for group I and 12.33 ± 1.77 mm on the right side and 12 ± 1.41 mm on the left side for group IV. Angle of Henry was found to be 11.7 ± 1.59 degrees on the right side and 12.25 ± 1.91 degrees on the left side for group I and 19 ± 3.19 degrees on the right side and 19.66 ± 4.77 degrees on the left side for group IV. Premolar angle was found to be 4.7 ± 1.8 degrees on the right side and 6 ± 2.16 degrees on the left side for group I and 12.5 ± 5.83 degrees on the right side and 10.6 ± 4.16 degrees on the left side for group IV. In this study, on an average, not much difference was noted between the right and left sides, which is in line with the results of Scanavini *et al*., and Lamons FF, Holmes, who stated that there is no statistical difference between the right and left molar positioning.[9,18] Further studies with a larger sample size that consider the arch form and other related parameters affecting the positioning of maxillary molars are needed. Inter-examiner reliability check is required on a larger scale to standardize the method of assessing and quantifying the molar rotation.

Conclusion

Based on the methodology adapted in this study, the following conclusions could be drawn:

1. All class II malocclusions generally exhibit mesiopalatal rotation of maxillary first permanent molars.
2. The mean values for the parameter angle of Friel decline in terms of rotational values from group I to group IV, which indicates a drop in molar rotation toward group IV. This finding suggests a positive correlation between the magnitude of molar rotation and the severity of class II malocclusion.
3. The mean values for the parameters Ricketts E-line, angle of Henry, and premolar angle were observed to increase from group I to group IV, which demonstrates an increase in molar rotation with an increase in the severity of class II malocclusion.

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Conflicts of interest

There are no conflicts of interest.

References

1. Andrews LF. The six keys to normal occlusion. Am J Orthod 1972;62:296-309.
2. Foresman RR. The maxillary first permanent molar as a causative factor in arch length deficiency. Angle Orthod 1964;34:174-9.
3. Cetlin NM, Ten Hoeve A. Nonextraction treatment. J Clin Orthod 1983;17:396-413.
4. Henry RG. Relationship of the maxilary first molar in normal occlusion and malocclusion. Am J Orthod 1956;42:288-306.
5. Friel S. Determination of the angle of rotation of the upper first molar to the median raphe of the palate in different types of malocclusion. Dent Pract 1959;9:72-8.
6. Orton HS. An evaluation of five methods of de-rotating upper

molar teeth. Dent Pract Dent Rec 1966;16:279-86.
7. Ricketts RM. Occlusion-the medium of dentistry. J Prosthet Dent 1969;21:39-60.
8. de Oliveira Viganó C, da Rocha VE, Junior LR, Paranhos LR, Ramos AL. Rotation of the upper first molar in Class I, II, and III patients. Eur J Dent 2016;10:59-63.
9. Scanavini PE, Jóias RP, Vasconcelos MH, Scanavini MA, Paranhos LR. Assessment of first molars sagittal and rotational position in Class II, division 1 malocclusion. Dental Press J Orthod 2013;18:106-11.
10. Braun S, Kunsnoto B, Evans CA. The effect of maxillary first molar rotation on arch length. Am J Orthod Dentofacial Orthop 1997;112:538-44.
11. Lima BP, Pinzan-Vercelino CRM, Dias LS, Bramante FS, De Jesus Tavarez RR. Correlation between the rotation of the first molars and the severity of class II division 1 malocclusion. ScientificWorldJournal 2015;2015:261485.
12. Bailey DR. Rotated maxillary molars and their contribution to crowding and malocclusion. J Gen Orthod 1991;2:26-7.
13. van der Linden FP. Changes in the position of posterior teeth in relation to ruga points. Am J Orthod 1978;74:142-61.
14. Almeida MA, Phillips C, Kula K, Tulloch C. Stability of the palatal rugae as landmarks for analysis of dental casts. Angle Orthod 1995;65:43-8.
15. Junqueira MHZ, Valle-Corotti KM, Garib DG, Vieira RB, Ferreira FV. Analysis of the rotational position of the maxillary first permanent molar in normal occlusion and Class II, division 1 malocclusion. Dental Press J Orthod 2011;16:90-8.
16. Dahlquist A, Gebauer U, Ingervall B. The effect of a transpalatal arch for the correction of first molar rotation. Eur J Orthod 1996;18:257-67.
17. Corbett MC. Molar rotation and beyond. J Clin Orthod 1996;30:272-5.
18. Lamons FF, Holmes CW. The problem of the rotated maxillary first permanent molar. Am J Orthod 1961;47:246-72.