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Maxillary first molar rotation and its relationship with skeletal and occlusal discrepancies

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Abstract

Introduction: Permanent maxillary first molar rotation has important implications in static occlusion as far as the molar relationship is concerned. Hence the objective of present study was to determine permanent maxillary first molar rotation and its relationship with different skeletal and occlusal discrepancies.

Material and Methods: Cephalometric radiographs and maxillary casts of fifty patients (containing permanent maxillary first molar rotation) were randomly selected. Photographs of maxillary plaster casts were taken with Olympus e410 DSLR camera. Photos were imported into View box ™ version 4 software, where both maxillary first molar rotation angles were measured by buccal surface angulation with mid-sagittal plane. Arch length discrepancy, overjet, maxillo-mandibular plane and ANB angles were also measured.

Results: Molar rotation was more on the right side as compared to the left side. Insignificant correlations among most of the variables except for upper left and right molar rotations were observed. There was moderate negative correlation found between ANB and both the angles measured.

Conclusions: Molar rotation was more on the right side as compared to the left and in class III cases. No factors were found to be well correlated except for molar rotation on the opposing side.

Key words: Malocclusion; photography; casts

Introduction

Maxillary molar rotation is a common finding in orthodontic patients with arch length discrepancies.[1-3] This rotation on axis can result because of early extraction or proximal carries of primary second molar.[4] Difference in the tooth size and jaw size can also lead to such rotation. Lemons and Holmes indicated that about 1-2 mm space is utilized by maxillary first molar rotation in class II malocclusion cases.[4] Lack of buccal offset and end to end permanent molar relationship are the manifestations of such rotation and mesial drifting of upper first molar.[5] Therefore, it is very important to assess the maxillary first permanent molar rotation during orthodontic diagnosis and treatment planning.[6]

There are different ways for assessing molar rotation (Figure 1). Ricketts evaluated the occlusal surfaces of the maxillary casts and proposed that in normal occlusion, the line touching the tips of disto-buccal and mesio-palatal cusps of the maxillary first molar on one side should pass through the distal third of the canine on the opposite side.[7] Cetlin and Ten Hoeves described that maxillary first molars are consider to be well positioned, when the buccal surfaces of molars are parallel to each other.[8] Hansen and others used the line joining the mesio-buccal and disto-buccal cusps to calculate the molar rotations.[9]

How does molar rotation relate to other orthodontic diagnostic variables? A recent investigation from Pakistan reported frequencies and distribution of molar rotation in class I, II and III malocclusions.[10] However there are limited data available regarding the relationship of molar rotation with arch length, over jet and vertical skeletal

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discrepancies. Hence, the aim of this study was to determine permanent maxillary first molar rotation, its correlation with arch length, over-jet, sagittal and vertical skeletal discrepancies.

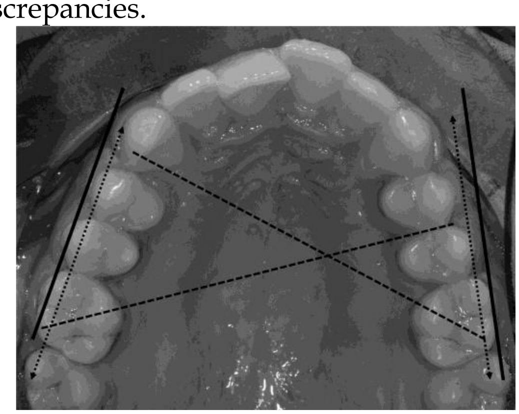

Figure 1: Methods of assessment of molar rotations

Material and Methods

This study was carried out at the Orthodontics Department, Sardar Begum Dental College, Peshawar from September to November 2013. Informed consent for the use of casts for research was taken at the beginning of the treatment. Ethical Committee approval was obtained from Institutional Review Board of Gandhara University Peshawar. Sample size was calculated online (www.StatsToDo.com) with 95% confidence level, 90% power and a minimum correlation coefficient of 0.4. Cephalometric radiographs and maxillary casts of fifty patients (containing permanent maxillary first molar rotation) were randomly selected. The inclusion criteria of this study were those patients who had all permanent dentition present from first molar to the contra lateral first molar in the same arch. Subjects with mixed dentition, missing/extracted/restored permanent molar teeth and those showing other dental anomalies were excluded from the study.

Photographs of maxillary plaster casts were taken with hand-held Olympus e410 DSLR camera with 35mm macro lens. Photos were imported into Viewbox ™ version 4, software (Dhal Orthodontic Software, Athens, Greece) where both maxillary first molar angles were measured by bisecting the casts in the center and then measuring the angulation of the buccal surfaces with the mid sagittal plane (Figure 2).

Figure 2: Molar Rotation Angle Measurement in View Box Software

The mesio-distal widths of all permanent maxillary teeth from first molar onwards were measured by using a vernier caliper (Fig 3a)

Figure 3(a): Measurement of mesiodistal width of teeth
Figure 3(b): Measurement of arch length

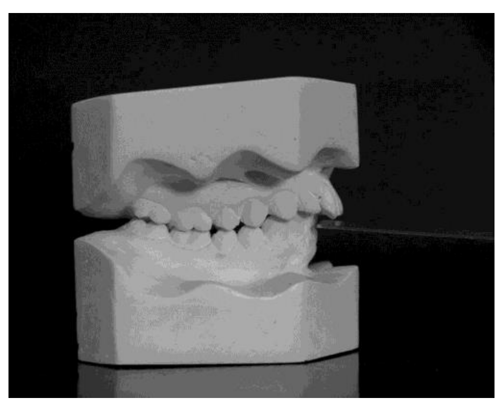

Figure 4: Measurement of overjet

Arch length was measured by using divider from the mesial contact surface of first permanent molar of one side to the same surface on the opposite side. (Fig 3b) Overjet was measured from lower incisal edge to the upper incisal edge on the casts with the help of a ruler (Fig 4). Two cephalometric angles i.e. ANB & Maxillo-Mandibular plane angle (MMPA) were measured on the cephalometric tracings of the radiographs.

Means, standard deviations, minimum and maximum values were calculated for all numeric variables i.e. age, overjet, ANB, rotation angles and MMPA. To test the method error, molar rotation angles were re-evaluated on the software with ten randomly selected models from the sample. Associations among the variables and the method error were calculated with Pearson's correlation coefficients. An r value of 0.60 or more was considered strong correlation. All calculations and statistical tests were carried out by using the Statistical Package for Social Sciences (SPSS™) version 16.

Results

A total of 50 dental casts and cephalometric radiographs were analyzed. Out of these 50 subjects 17 (34%) were males and 33 (66%) were females with a mean age of 17.8 ± 3.8 years. The descriptive statistics of subjects according to the variables i.e.

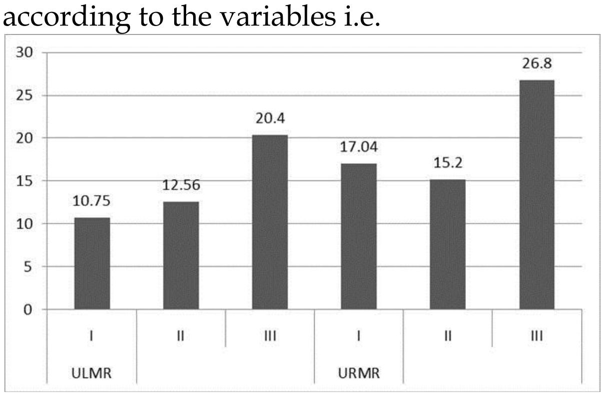

Figure 5: Mean molar rotations in class I, II and III cases

Arch length discrepancy (ALD), upper left molar rotation (ULMR), upper right molar rotation (URMR), ANB angle, Overjet and Maxillo-Mandibular plane angle were measured (table 1).

Table I: Descriptive statistics of subjects according to variables

	Mean	*Std. Deviation*	*Minimum*	*Maximum*
Age (yrs)	17.88	3.89	11	26
ALD (mm)	-0.70	4.86	-10	10
ULMR (deg)	12.55	11.17	-11	31
URMR (deg)	17.33	11.68	-14	42
ANB (deg)	4.13	3.65	-6	15
OJ (mm)	4.45	3.32	-4	12
MMPA (deg)	25.60	7.35	10	43

ALD: Arch Length Discrepancy
ULMR: Upper Left Molar Rotation Angle
URMR: Upper Right Molar Rotation Angle
ANB: Angle between NA and NB cephalometric lines
OJ: Overjet
MMPA: Angle between maxillary and mandibular cephalometric planes.

Table II. Correlations among the variables

		AGE	*ALD*	*ULMR*	*URMR*	*ANB*	*OJ*	*MMPA*
ULMR	*R value*	-.037	.008	1	.663**	-.278*	-.095	.008
	p value	.798	.956		.000	.048	.508	.953
URMR	*R value*	-.180	-.047	.663**	1	-.388**	-.100	.048
	p Value	.211	.747	.000		.005	.487	.737

* Significant Correlations
** Highly significant Correlations
ALD: Arch Length Discrepancy
ULMR: Upper Left Molar Rotation Angle
URMR: Upper Right Molar Rotation Angle
ANB: Angle between NA and NB cephalometric lines
OJ: Overjet

MMPA: Angle between maxillary and mandibular cephalometric planes.

Insignificant correlations were found for most of the measurements (Table 2). Only 2 out of 7 variables that showed significant correlation, were molar rotation (left with right and vice versa) and ANB. There were moderate correlations found between ANB and both the angles measured. Molar rotations in Class III cases were more than in Class I and II cases and in all groups, right side rotations were more pronounced. (Fig 5) Excellent correlations were found between the measurements when analyzed for intra-observer error, indicating consistency in readings. (Table 3)

Table III: Method error correlations.

	N	*Correlation*	*Sig.*
ULMR	10	.940	.000
URMR	10	.968	.000

ULMR: Upper Left Molar Rotation Angle
URMR: Upper Right Molar Rotation Angle

Discussion

Careful analysis of dental casts and assessment of molar rotation is very important prior to the Orthodontic treatment. The occlusal arch length and width is affected by molar rotation. It is estimated that due to mesiolingual rotation, 2mm of mesiodistal arch space occupied by upper first molar increases and for 3 degrees of derotation, there is a net gain of 0.25mm arch width.[11]

Maxillary molar rotation assessment and its correlation with different variables were evaluated in this study. Strong correlations were found between maxillary molar angles of rotation on left and right sides, moderate correlation was found between ANB and both the angles whereas weak correlation existed between the rest of the variables.

In this study we took the photographs of the casts for measuring the angles. Other methods used previously included manual measurements and digital measurements with scanned images.[1, 8, 9] However it is unlikely that a major difference exists in the measurements of each of these methods.[3]

An interesting observation was the negative correlation of ANB with molar rotation. While the common perception would indicate that prevalence of molar rotations should be more in class II cases, our results indicate otherwise. More degree of molar rotation was observed in class III cases and negative correlation indicated that the rotation increased as the ANB decreased. Lifschiz, concluded with caution that one must be careful when ascribing molar rotation to mesial drift only, as the problem seems to be multifactorial.[12]

In this study, the mean angle on the right side was 17.3 degrees while that on the left side was 12.5 degrees. This gives a mean difference of 5 degrees. This is in accordance with Friel et al who found 3 degrees more rotation on the right side as compared to the left side.[13] Lifschiz found no difference in class I cases while 3 degrees difference in class II cases when comparing left with right side rotation.[12] Our study found 7 degrees difference in class I and three degrees difference in class II. Right side had more molar rotation in all these studies including ours. However none of the measurements were statistically significant.

While the methods of assessing the rotations in these studies differed, similar findings suggest that the difference did not have any major impact on assessment of rotations. Junqueira et al also found that the line of Cetlin and Ten Hoove which represents buccal surface is nearly the same as line joining mesiobuccal and distobuccal cusp tips.[3]

It would be worthwhile to identify associated factors related to molar rotations, however no other factors were found to be well correlated except for molar rotation on the opposing side. This simply means that the likelihood of finding the molar rotation on the other side increases if any first maxillary molar is rotated. Future studies with larger samples, more extensive variables pool and robust statistical methods may be able to identify more risk factors associated with molar rotations.

Conclusion

Molar rotation was more on the right side and in class III cases. No other factors were found to be well correlated except for molar rotation on the opposing side.

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