ASSESSMENT OF MAXILLARY FIRST MOLAR ROTATION IN SKELETAL CLASS II, AND THEIR COMPARISON WITH CLASS I AND CLASS III SUBJECTS

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ABSTRACT

Mesial rotation of maxillary first molar around palatal root is a most common cause of class II molar relationship in class II subjects. Assessment of molar rotation is important because it utilizes 2-3mm of space in anteroposterior plane. There are different methods for assessment of its rotation which is very important in diagnosis and treatment planning of class II malocclusion.

Cephalometric radiographs and dental casts of 100 orthodontic patients (72 females and 28 males) with a mean age of 18.7 years (12-38 years) in the permanent dentition attending the orthodontic department of the University of Lahore, Lahore, Pakistan were randomly selected. The maxillary casts were photocopied 1/1 with maximum contrast. Maxillary first molar rotation was assessed on the photocopies of the upper dental casts. Skeletal class was assessed in Sagital plane through manual tracing of cephalometric radiographs by a single examiner.

Molar rotation was more on the right side as compared to the left side. In skeletal class I and II, maxillary first molar rotation was more on the right side as compared to the left side and in skeletal class III, molar rotation was more on the left side.

Key words: Mesial rotation, Maxillary first molar, Skeletal class II.

INTRODUCTION

The mildest form of maxillary space loss is mesiolingual rotation of maxillary first molars around the large lingual root. This can result from modest mesial drift into space formed because of proximal caries or after early extraction of maxillary second molars. This type of mesial drift can be recognized by the lack of molar buccal offset (the facial surface is normally more prominent than the primary molar or premolars) and an end-to-end permanent molar relationship.1

Lemons and Holmes have indicated that, in the majority of class II cases, the maxillary first molars are rotated mesially and utilize a space of 1-2mm.2

In the evaluation of an orthodontic patient prior to treatment, attention should be paid to the position of the upper first molars. In particular this is true in cases of class II malocclusion where molars are rotated mesially on their palatal roots and make a class II molar relation.3

Derotation of class II maxillary first molars is the first step in class II treatment of almost every type. This can be done with a transpalatal lingual arch, an axillary labial arch or the inner bow of a facebow.4

Assessment of maxillary first molar rotation is very important in diagnosis and treatment planning process. Different methods were used by different authors for their assessment. Rickett’s guideline for clinical evaluation of the position of maxillary first molars on the occlusal view has been proposed5 using a line traced through the tips of distobuccal and mesiopalatal cusps of the permanent maxillary first molar. It was observed that, in normal occlusion, this line should

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pass through the distal third of the canine on the opposite side, and that this was a good guideline to analyze the mesiopalatal rotations, characteristic of mesial displacement of first molars in malocclusions. Cetlin and Ten Hoeve described that, when the two maxillary first molars are well positioned, their buccal aspects are parallel to each other.

In this study, occlusal surface of maxillary cast was photocopied and mesial rotation of molar was assessed by using Ricketts method of molar rotation assessment with slight modification.

Therefore the aim of the present study was to determine maxillary first permanent molar rotation in skeletal class II including div 1 and div 2. Rotation of maxillary first molars was also measured in skeletal class I and class 3 and their values were compared.

**METHODOLOGY**

This cross sectional study was carried out at the orthodontic department, the University of Lahore. Maxillary casts and cephalometric radiographs of one hundred patients (having skeletal class I, II and III in sagittal plane), were randomly selected. Both male and females (72 females and 28 males) with a mean age of 18.7 years (12-38 years) in the permanent dentition were included in the study. All of them were Pakistani and lived in the city of Lahore. (Table 1)

Skeletal class was noted through manual tracing of cephalometric radiographs by a single examiner. ANB angle was used to classify malocclusion as skeletal class I, II and class III. fig 1

The inclusion criteria of the casts were permanent dentition from first molar to first molar. The casts with tooth agenesis, extractions and large restorations that could change the mesiodistal width of the tooth were excluded from the study.

**TABLE 1: DISTRIBUTION OF MALES AND FEMALES IN SKELETAL CLASS I, II AND CLASS III SUBJECTS**

<table>
<thead>
<tr>
<th>Sagital class</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>12</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>II</td>
<td>15</td>
<td>47</td>
<td>62</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

N = number of patients

Fig 1: Assessment of skeletal class in sagittal plane by angle ANB

Point A. The innermost point on the contour of premaxilla between anterior nasal spine and the incisor tooth.

Point B. The innermost point on the contour of mandible between the incisor tooth and the bony chin.

Na (nasion). The anterior point of intersection between the nasel and frontal bones.

ANB 0-4 skeletal class I

ANB > 4 skeletal class II

ANB < 0 skeletal class III

Measurements were made on the photocopies of study models. The models were photocopied 1/1 with maximum contrast and teeth touching the glass (Mita DC-1435). The following reference points were marked with thin and soft pencil. Fig 2

- T: cusp tip of the maxillary permanent canine crown.
- DB: distobuccal cusp tip of maxillary first permanent molar.
- ML: mesiolingual cusp tip of maxillary first molar.

The following linear measurements were performed on the photocopies of the upper models. Fig 3

1. A line drawn through distobuccal cusp tip and mesiolingual cusp tip of right sided maxillary first permanent molars and extended up to the opposite side of arch (left side). line a, fig 3
Assessment of maxillary first molar rotation

2. A perpendicular is drawn from cusp tip of left canine to line a . line a1, fig 3

3. A line drawn through distobuccal cusp tip and mesiolingual cusp tip of left sided maxillary first permanent molars and extended upto the opposite side of arch (right side). line b, fig 3

4. A perpendicular is drawn from cusp tip of left canine to line b . line b1, fig 3

5. Length of line a1 and b1 is measured in millimeters.

6. line a1 demonstrate right sided first molar rotation.

7. line b1 demonstrate left sided first molar rotation.

STATISTICAL ANALYSIS

The statistical package for social sciences (SPSS 16) was used to assess mean, median and standard deviations of right and left side molar rotation. Table 2. Descriptive statistics of right and left side molar rotation in sagital class I, II and III. Table 4

The reproducibility of the method was analysed by determining intraexaminer measurement error. For this purpose, twenty dental casts from the present study were randomly selected. The measurements were again determined by the same examiner after six weeks in order to obtain the intra examiner error, which in turn , calculated by the coefficients of variation (CVs). These CVs (CV = standard deviation X 100/ mean) are expressed as a percentage. The CV was very low.

RESULTS

The mean maxillary first molar rotation on right side was 7.89mm and on left side was 6.41mm. Table 2

In sagital class I, molar rotation was 7.62mm on right side and 5.9mm on left side. Table 4

In sagital class II, molar rotation was 8.00mm on right side and 6.27mm on left side. Table 4

In sagital class III, molar rotation was 8.3mm on right side and 10.16mm on left side.

DISCUSSION

Orientation and position of maxillary permanent first molar in the maxillary arch is very important in establishing molar relationship into angle’s class I position. Maxillary first molars are rhomboidal in shape which easily rotate mesially on their palatal roots when so ever there is a space mesial to it, because of any reason. It mostly happens when there is a carious tooth and mesiodistal width has been reduced because of caries or carious tooth has been restored preiously but mesiodistal width of the tooth was not maintained. Maxillary first molars also rotate mesially because of mesial drifting of teeth due to attrition at interproximal contacts of teeth due to aging process.

Mesial rotation of molar utilizes a space of 2-3mm and changes its relation from class I to class II. There-
Assessment of maxillary first molar rotation

It was observed that maxillary arch dimension and arch form especially anterior arch form greatly influence the assessment of molar rotation. So canine position would be different in tapering, ovoid and squarios anterior arch forms. Secondly, ectopic eruption of the canine into the buccal sulcus and its rotation also affect and vary the assessment of molar rotation. Like wise, crowding and spacing are also very important variable which influence on the position of canine as well as molar. So these variable should be discussed and addressed when you plan and choose a specific method for assessment of molar rotation.

Different methods were used to assess molar rotation. The first of these studies, and the one which somewhat set the pattern for method of approach was by Friel in 1959. In this study the degree of rotation of the maxillary first permanent molar was determined by the angle formed by a line passing through the points of the mesiobuccal and mesiolingual cusps and the midpalatal raphe. A simple but well designed instrument was made for the purpose of quite accurately measuring this angle for both the right and left maxillary first permanent molars. The investigation consisted of 34 cases of normal occlusions in the premo-lar-molar area. The second group consisted of 30 cases of post-normal (class II) occlusion with labioclination of upper incisors. The results of this investigation showed that in the first group (the normals) the mean angle on the right side was 60 degrees and on the left side 57 degrees. In the second group (postnormals) the mean angle on the right side was 52 degrees and on the left side 51 degrees. This gave a mean difference between the normals and the postnormal of 7 degrees.

TABLE 2: DESCRIPTIVE STATISTICS OF RIGHT AND LEFT SIDE MOLAR ROTATION

<table>
<thead>
<tr>
<th>Molar rotation</th>
<th>Minimum (mm)</th>
<th>Maximum (mm)</th>
<th>Mean (mm)</th>
<th>Median (mm)</th>
<th>SD* (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right side</td>
<td>-5</td>
<td>21</td>
<td>7.89</td>
<td>8</td>
<td>5.54</td>
</tr>
<tr>
<td>Left side</td>
<td>-6</td>
<td>26</td>
<td>6.41</td>
<td>5.75</td>
<td>6.06</td>
</tr>
</tbody>
</table>

* = standard deviation
Mm = millimeter
- = denotes extension of line a1 and b1 across the canine tip mesially, towards midline.

TABLE 3: DESCRIPTIVE STATISTICS OF RIGHT AND LEFT SIDE MOLAR ROTATION IN SKELETAL CLASS I, II AND III

<table>
<thead>
<tr>
<th>Molar rotation</th>
<th>Sagittal class I</th>
<th>Sagittal class II</th>
<th>Sagittal class III</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right side</td>
<td>Sagittal class I</td>
<td>62</td>
<td>8.00</td>
<td>5.59</td>
<td>0.71</td>
<td>-5.00</td>
<td>0.71</td>
<td>21.00</td>
<td>21.00</td>
</tr>
<tr>
<td></td>
<td>Sagittal class II</td>
<td>6</td>
<td>8.33</td>
<td>5.08</td>
<td>0.27</td>
<td>-5.00</td>
<td>0.27</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
<td>7.89</td>
<td>5.54</td>
<td>0.55</td>
<td>-5.00</td>
<td>0.32</td>
<td>21.00</td>
<td>21.00</td>
</tr>
<tr>
<td>Left side</td>
<td>Sagittal class I</td>
<td>32</td>
<td>5.96</td>
<td>5.24</td>
<td>0.91</td>
<td>-2.00</td>
<td>1.38</td>
<td>24.00</td>
<td>24.00</td>
</tr>
<tr>
<td></td>
<td>Sagittal class II</td>
<td>6</td>
<td>6.27</td>
<td>6.39</td>
<td>0.81</td>
<td>-6.00</td>
<td>0.81</td>
<td>26.00</td>
<td>26.00</td>
</tr>
<tr>
<td></td>
<td>Sagittal class III</td>
<td>6</td>
<td>10.16</td>
<td>6.49</td>
<td>2.65</td>
<td>0.00</td>
<td>2.65</td>
<td>19.00</td>
<td>19.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
<td>6.41</td>
<td>6.06</td>
<td>0.60</td>
<td>-6.00</td>
<td>0.60</td>
<td>26.00</td>
<td>26.00</td>
</tr>
</tbody>
</table>

N= total number of patients
Mm= millimeter

TABLE 4: ROTATIONAL POSITION OF MAXILLARY FIRST MOLARS IN SKELETAL CLASS I, II AND CLASS III SUBJECTS

<table>
<thead>
<tr>
<th>Molar rotation</th>
<th>Sagittal</th>
<th>Sagittal</th>
<th>Sagittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right side</td>
<td>7.62mm</td>
<td>8.00mm</td>
<td>8.3mm</td>
</tr>
<tr>
<td>Left side</td>
<td>5.9mm</td>
<td>6.27mm</td>
<td>10.16mm</td>
</tr>
</tbody>
</table>
side (12.76 degrees), in patients with acceptable occlusion.

Two years later, two groups of normal occlusion were selected and measured using assessment method of Friel. It was concluded that the angles of normally positioned molars are 61 degrees, plus or minus 4 degrees and there was not as much difference between the angle of rotation of the right and left sides.

In another study, groups of 77 untreated class II, division 1 cases and one hundred class I cases were studied. Photographs of the plaster casts were used instead of the casts themselves and the same landmarks and relationship was used as by Friel. It was charged that a class II division 1 malocclusion is characterized in part by a forward drift in maxillary denture and that a diagnostic sign of such drift is the rotation linguually of the mesial portion of the upper first molars. Moreover it was assumed that failure to restore this tooth to its proper position decreases arch length and develops faulty occlusion in the cuspid area.

A study was conducted to determine how much loss of arch length (increase in occlusal arch length) can occur from molar rotation. It was noted that the mesiodistal arch space of the upper first molar may be increased as much as 2mm due to mesiolingual rotation. There will be an increase in width of 0.25mm for each 3 degree of rotation.

Later on, maxillary first molar rotation was assessed using a line traced through the tips of the distobuccal and mesiopalatal cusps and this line should pass through the distal third of the canine of the opposite side in class I cases (rickets methods). This method was accepted and widely used at that time even uptill now. The author considered that the first molar was well positioned when a line passing through the tips of the distobuccal and mesiopalatal cusps intersected the distal third of the canine on the opposite side. Therefore considering that a maxillary canine presents an average mesiodistal dimension of 8mm, this line should fall within a range between the distal aspect of the canine and a point up to 2.6mm mesially to this tooth. When this line crosses the distal contact point of canine and moves towards the first premolar and second premolar, it represents the severity of molar mesial rotation.

In the present study, occlusal surface of the maxillary dental cast was photocopied and ricketts method of molar rotation assessment was used with slight modification. A line which passes through the distobuccal and mesiopalatal cusps of the first molar and crosses the opposite side of arch. A perpendicular is drawn from the tip of the canine to this line and its length was measured in millimeters. This linear measurement was noted in sagital class I, II (division 1 and 2) and class III on both right and left sides. Table 4

Molar rotation in class I was (7.62mm), class II (8mm) and in class III (8.3mm) on right side. On left side, it was 5.9mm (class I), 6.27mm (class II) and 10.16mm in class III subjects. So molar rotation was greater in class II and III subjects as compared to class I. It was also noted that molar rotation was greater on right side in class I and class II subjects but in class III, it was greater on left side. Almost all humans use their right side more commonly and more frequently during mastication, so more mesial drifting of teeth on right side and ultimately more rotation on that side.

In skeletal class III, molar rotation was more on left side (10.16mm) as compared to right side (8.3mm). In the present sample size (100 patients), only six patients had class III pattern with variable expressivity so the values of mean and SD are greater. As the sample size decreases, chances of bias increases. Therefore accurate assessment of molar rotation (for right and left sides) in class III demands a larger sample size on a larger scale.

In an other study, casts of 60 subjects with normal occlusion (group 1, mean age 15.5 years) and 120 with untreated class II, division 1 malocclusion (group 2, mean age 15.5 years) were evaluated. The maxillary dental casts were scanned and the position of the maxillary molars was analysed using three angular measurements and one linear measurement (ricketts method). It was concluded that statistically significant differences (greater mesiopalatal rotation in class II division 1) were found between group 11 and 1 for all measurements, on both right and left sides. The linear measurement which represent molar rotation exhibited a mean value of 5.75mm. This is in comparable but less than the present study (mean value was 7.3mm). This is probably, due to the fact that cast was photocopied in the present study as
compared to scanning and the method of assessment was slightly modified.

Molar rotation was also assessed in class II division 1 and class I subjects at mixed dentition stage in an other study\textsuperscript{14}. Dental cast measurements (ricketts method) were performed in a sample of 120 Class II Division 1 subjects (CL2 group, 67 females and 53 males, mean age $9.4\pm1.1$ years), and in a sample of 58 Class I subjects (CL1 group, 34 females and 24 males, mean age $9.7\pm1.2$ years). Subjects with Class II malocclusion in the mixed dentition present with mesial upper molar rotation in about 84\% of the cases.

**CONCLUSION**

Molar rotation was more on the right side as compared to the left side. In sagittal class I and II, maxillary first molar rotation was more on the right side as compared to the left side and in sagittal class III, molar rotation was more on the left side.

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