Evaluation of a new design of the maxillary molar distalizer using palatally anchorage

Pakshir H.R. DDS, DMD, MSc1, Fattahi H.R. DDS, DMD, MSc2

1Associate Prof.; 2Assistant Prof., Dept. of Orthodontic, Dental School, Shiraz University of Medical Sciences, Shiraz-Iran.

ABSTRACT

Purpose: Different intraoral methods are introduced to facilitate the movement of molars distally, which in most cases their major disadvantage is the undesirable movement of the anchorage unit. This study was undertaken to evaluate the effect of a new design of the maxillary molar distalizer using palatally anchorage to assess the anchorage loss.

Materials & Methods: The survey was carried out on 10 patients with the mean age of 14.5 years old. A new fixed intraoral appliance was developed in order to achieve maxillary molar distalization. The appliance was consisted of two parts: The anchorage unit having of a wide Nance button with two Adams clasps on the first premolars and the active unit was composed of a NiTi open Coil spring on the 0.018” stainless steel wire. The patients were followed for total period of 6 weeks in 2 weeks interval time. Lateral cephalograms, study models and copies of the maxillary casts were provided and analyzed prior and after molar distalization by superimposition of the cephalograms and copies respectively. T-test was used to evaluate the changes after distal movement of the molar.

Results: The results showed that maxillary first molars were distalized with an average of 1.75mm without any extrusion. Distal tipping of the first molars was found to be 4.35°. Maxillary first premolars and incisors moved forward by 0.7mm and 0.67mm respectively. The first premolars with an average of 0.58mm extrusion were tipped by 6.17°. Distal out-rotation of the first molars were showed to be 3.4° while mesial out-rotation of the first premolars were not significant. Intermolar width was increased by 2.26mm and interpemolar width was decreased by 1.58mm.

Conclusion: This study showed that the designed appliance could be considered as one of the non-compliant appliances for maxillary molar distalization. No extraoral appearance, patient cooperation and acceptability and applying a light-continuous force could be considered as the other advantages of the appliance.

Keywords: Non-Compliant appliance, Palatal anchorage, Molar distalization.

INTRODUCTION

Headgear, as the most commonly used extraoral appliance for distal movement of maxillary molars, is rejected by many patients because of esthetic and social concerns. (1) The difficulties problems with headgear wear and poor patient cooperation resulted in the development of new intraoral devices and techniques for distal movement of molars using non extraction treatment and non compliance therapy for correction of Cl II malocclusion.

Different intraoral methods were introduced to facilitate the distal movement of molars, which in most cases their major disadvantage was the undesirable movement of the anchorage unit. Mesial tipping of
premolars and labial tipping of incisors were also frequently observed in most of these intraoral methods.

Magnets were used for maxillary molar distalization by Gianelly et al (1989) and Bondemark and Kurol (1992-1994). In 1991, Gianelly et al used Supra-Elastic Ni-Ti Coil Spring for distal movement of maxillary molars. Hilgers (1992) developed the pendulum appliance for the same purpose. Meanwhile, an open coil jig was developed by Jones for rapid Cl II molar correction.

K-Loop and Nance appliance with coil spring were the methods for molar distalization used by Kalra (1995) and Pieringer (1997) respectively. In 1996, Carano et al developed the Distal Jet method for bodily molar distalization.

This study with introduction of a new design of maxillary molar distalizer was preformed to evaluate its effect on the anchorage loss by applying a light continuous force.

**MATERIALS & METHODS**

Ten patients with class II Div2 skeletal malocclusion in permanent dentition and class II molar relation were included in this longitudinal descriptive study. All patients (mean age of 14.5 years old) had well developed maxillary third molars with horizontal growth patterns. Extraction of second molars was obtained due to mild to moderate crowding in upper jaw.

After extraction of both maxillary second molars, the first molars were banded with a palatally welded, 0.025×0.027 inch size brackets and maxillary impression were obtained. The constructed appliance composed of a wide acrylic Nance button, retained to the first premolars with Adam’s clasps.

A 0.018 inch size stainless steel wire was bent and oriented from the acrylic to the distal end of the palatally welded bracket on the band (Fig1). For molar distalization a 0.030inch Ni-Ti open coil spring was used with a 150 grams distal force induced by 7mm activation of the coil spring. Activation was accomplished by pushing and seating the spring into the slot of the palatally welded bracket and then was tied by an elastic ring.

The patients were visited at every two weeks interval. After six weeks of molar distalization, the new situations were stabilized by conventional Nance appliances. Usually, it is difficult to identify the inclination of the right and left molars on cephalometric radiographs due to the superimposition of the right and left side structures. To avoid such situation, molar bands were cemented on the left side while pretreatment cephalometric radiographs were taken. Then the right side molar bands were cemented. The appliances were inserted and the treatment commenced. After six weeks, the right side molar bands were removed and the final cephalometric radiographs were obtained. The cephalometric parameters used in this study are shown in Fig 2.

To determine the degree of the maxillary first molar and premolar rotation and evaluation of the changes in the intermolar and interpremolar width, a model analysis was carried out. Model copies were provided and the palatal sutures, cusp tips and midmesial and middistal points of the first molars and premolars were defined both before and after molar distalization.

On each model copy, a midline along the median palatal suture was traced. Also, two mesiodistal lines were constructed by connecting the determined mesial and distal points of first molars and premolars. The
measurements were analyzed on the model occlusal copies as follows:

**Fig 2.** Cephalometric points, angles and distances used in the study Molar Distalization (M.D); Premolar Mesial movement (P.M); Incisor Protrusion (I.P); Molar Extrusion (M.E); Premolar Extrusion (P.E); Incisor Extrusion (I.E); Molar Angulation (M.A); Premolar Angulation (P.A); Incisor Inclination (I.I); Incisor Vertical (I.V); Anterior Facial Height (A.F.H).

**Fig 3.** Maxillary model photocopy measurements.
- a. Rotation of the maxillary first molar and premolar.
- b. Intermolar and interpremolar width (MW; PW).

Rotation of the maxillary first molar and premolar (Fig. 3a): The angle between the midline and mesiodistal lines passing through the midmesial and middistal points of the maxillary first molar and premolar.

Intermolar width (M.W.): The distance between palatal grooves of the first molars (Fig 3b).

Interpreamolar width (P.W.): The distance between central points of the mesiodistal line of the first premolars (Fig 3b).

T-test was used to compare the changes after distal movement of molars.

**RESULTS**

During the 6 weeks of treatment, maxillary first molars were distalized with an average of $1.75\pm0.82$ mm without any extrusion (Fig4). Distal tipping of the first molars were recorded to be $4.35\pm2.56$ degree (Fig5).

The forward movement of maxillary first premolars and incisors were measured to be $0.7mm\pm0.35$ and $0.67mm\pm0.62$ respectively (Fig4). The maxillary first premolars were tipped by $6.17^\circ\pm4.53$ and the amount of extrusion was $0.58mm\pm0.57$. Overbite and anterior facial height did not change significantly, and the overjet increased as much as $0.76\pm0.81$. 

**Fig 4.** Mean and standard deviation for linear measurements.
The distal out-rotation of the first molars were recorded to be $3.4^\circ\pm1.98$ while the mesial out-rotation of the first premolars were not prominent.

The intermolar and interpremolar width showed an increase by $2.26\text{mm}\pm0.93$ and a decrease of $1.58\text{mm}\pm1.1$ respectively.

The results of cephalometric and model analysis method are presented in Table 1.

Figure 6 shows the pre and post treatment photos and model of the upper arch of one patient, after 6 weeks of molar distalization with the designed appliance.

### DISCUSSION

Distal movement of the upper first molars not only will correct the molar relationship, but will also provide space for alignment of other teeth and may create sufficient space to gain class I canines. Molar distal crown tipping for space regaining is difficult and would be more difficult if bodily movement of molars are desired.

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**Table 1:** Mean, Standard Deviation and P.Value for sagittal, vertical and transverse changes during 6 weeks use of the designed intraoral distalizer appliance.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean (mm)</th>
<th>SD</th>
<th>P.Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molar Distalization (M.D)</td>
<td>1.75</td>
<td>0.82</td>
<td>0.000 (***)</td>
</tr>
<tr>
<td>Molar Extrusion (M.E)</td>
<td>0.12</td>
<td>0.66</td>
<td>NS</td>
</tr>
<tr>
<td>Molar Angulation (M.A)</td>
<td>4.35</td>
<td>2.56</td>
<td>0.000 (***)</td>
</tr>
<tr>
<td>Premolar Mesia movement (P.M)</td>
<td>0.7</td>
<td>0.35</td>
<td>0.000 (***)</td>
</tr>
<tr>
<td>Premolar Extrusion (P.E)</td>
<td>0.58</td>
<td>0.57</td>
<td>0.016 (*)</td>
</tr>
<tr>
<td>Premolar Angulation (P.A)</td>
<td>6.17</td>
<td>4.53</td>
<td>0.003 (**)</td>
</tr>
<tr>
<td>Incisor Protrusion (I.P)</td>
<td>0.67</td>
<td>0.62</td>
<td>0.007 (**)</td>
</tr>
<tr>
<td>Incisor Extrusion (I.E)</td>
<td>0.19</td>
<td>0.41</td>
<td>NS</td>
</tr>
<tr>
<td>Incisor Inclination (I.I)</td>
<td>3.1</td>
<td>2.42</td>
<td>0.002 (**)</td>
</tr>
<tr>
<td>Intermolar Width (M.W)</td>
<td>2.26</td>
<td>0.93</td>
<td>0.000 (***)</td>
</tr>
<tr>
<td>Interpremolar Width (P.W)</td>
<td>-1.58</td>
<td>1.1</td>
<td>0.000 (***)</td>
</tr>
</tbody>
</table>

NS: Not significant $P>0.05$  
$P < 0.05$ (*)  
$P < 0.01$ (**)  
$P < 0.001$ (***)

In the presence of second molars, it is even more difficult to distalize the maxillary first molars. So in adolescents with limited growth, extraction of the maxillary second molars and distalizing the other teeth would correct moderate class II malocclusion. Therefore, the ideal patient would be the one with less than full cusp Cl II molar relationship. This is due to the fact that, even one would not expect more than 4 mm distal movement of first molar with second molar extraction (according to Proffit).(11)

Extraoral forces and class II elastics, with the ability of causing tooth movement have their own advantages and disadvantages. Headgear, instead of applying light-continuous forces would apply heavy intermittent force and would have its maximum effect if used full time. Although full time application of Cl II elastics would be more comfortable for the patients compared with headgears, it would certainly provide a tendency for mandibular rotation and arch protraction.
The present design of the maxillary molar distalizer would give the possibility of getting benefit of the palatal anchorage by splinting the premolars and the palatal acrylic part of the appliance. For this purpose an extended Nance acrylic button splinted by Adam’s claps on the first premolars was used.

Fig 6a.

Fig 6b.

Fig6. (a and b) Photos of patient’s pre and post treatment by designed appliance.

C. Model of the same patient after 6 weeks molar distalization. The space created following molar distalization was significant.

Using a 0.018SS wire which was extended from acrylic button, followed by inserting it in the slot of the palatally welded bracket of maxillary first molar band, not only guides the molar teeth during distalization but also considerably reduces the rotational tendency of the teeth. In this study, a force of 150gr which was considered as a light continuous force was applied by Ni-Ti open coil springs.

The amount of distal movement of the first molars in this study was shown to be 1.75±0.82mm. This is almost the same as previous studies done by other researchers such as Gianelly et al (1991)\(^5\) and Puente (1997)\(^12\) with 1-1.5mm and 0.75-1mm in one month treatment time respectively. Hilgers noted that if the pendulum appliance is used before the eruption of the second molar teeth, 2/3 of the space created is due to molars distalization and 1/3 is due to the forward movement of premolars.\(^6\) The present study resulted in the same situation whereby the ratio of 2/3 and 1/3 was also observed. Therefore, for every one milimeter of distal molar movement, premolar was moved forward by an average of 0.4 mm.

Byloff and Darendeliler’s (1997)\(^13\) study showed a distal tipping of 4.2° for every 1mm of molar distal movement. Our study proved the benefit of the designed appliance since after 1.75±0.82mm of molar distal movement, the recorded distal tipping was 3.4±1.98 degree. Additionally, our appliance was superior to the result shown by Ghosh and Nanda (1996)\(^14\). They reported 8.4 degree of distal tipping after moving the molars for 3.4mm.

CONCLUSION

This study showed that the designed appliance could be considered as one of the non-compliant appliances for maxillary molar distalization. Our appliance showed to have the following advantages:

- Absence of extraoral appearance
- Reduced need for patient’s cooperation
- High level of patient’s acceptability
- Presence of a light continuous force
- Absence of palatal mucosal inflammation in patients

It should also be noted that the molar distalization is achieved at the cost of some anchorage loss. Using the Adam’s clasp on premolar and ring elastic for the wire engagement offers a simple insertion/removal method of the appliance. This is most suited for the clinicians.

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REFERENCES


