Unilateral maxillary molar distalization with zygoma-gear appliance

Dogan Kilkis, Mehmet Bayram, Mevlut Celikoglu, and Metin Nur
Trabzon, Turkey

The aim of this study was to present the orthodontic treatment of a 15-year-old boy with a unilateral maxillary molar distalization system, called the zygoma-gear appliance. It consisted of a zygomatic anchorage miniplate, an inner bow, and a Sentalloy closed coil spring (GAC International, Bohemia, NY). A distalizing force of 350 g was used during the distalization period. The unilateral Class II malocclusion was corrected in 5 months with the zygoma-gear appliance. The maxillary left first molar showed distalization of 4 mm with an inclination of $3^\circ$. The maxillary premolars moved distally with the help of the transseptal fibers. In addition, there were slight decreases in overjet ($-0.5$ mm) and maxillary incisor inclination ($-1^\circ$), indicating no anchorage loss from the zygoma-gear appliance. Preadjusted fixed appliances (0.022 $\times$ 0.028-in, MBT system; 3M Unitek, Monrovia, Calif) were placed in both arches to achieve leveling and alignment. After 14 months of unilateral distalization with the zygoma-gear appliance and fixed appliances, Class I molar and canine relationships were established with satisfactory interdigitation of the posterior teeth. Acceptable overjet and overbite were also achieved. This article shows that this new system, the zygoma-gear appliance, can be used for unilateral maxillary molar distalization without anchorage loss. (Am J Orthod Dentofacial Orthop 2012;142:e1-e7)
erupted canine and a maxillary left central incisor in crossbite (Fig 1). He had an Angle Class II molar relationship on the left side and a weak Class I molar relationship on the right side. Although they were measured from the most labially positioned tooth (right central incisor), overjet was 3 mm and overbite was 2 mm. The mandibular midline was 1.0 mm to the left of the facial midline because of the crowded mandibular left incisors. The maxillary and mandibular arch-length deficiencies were 6 and 2 mm, respectively. The Bolton tooth-ratio analysis (sum of incisors, 4:3.08; anterior ratio, 76.4%; overall ratio, 91.1%) indicated that the maxillary teeth were generally larger than the mandibular teeth. On the other hand, there was no transverse discrepancy. The patient had an SNA angle of 74°, an SNB angle of 72.5°, and an ANB angle of 1.5°. The mandibular plane was normal relative to the cranial base (SN-GoGn, 33°). The mandibular incisors had a 96° angle relative to the mandibular plane, and the maxillary incisors had a 117° angle relative to the palatal plane (Table). The temporomandibular joint evaluation showed no signs of clicks or crepitation, and the facial and masticatory muscles were asymptomatic.

The treatment objectives for this patient were to (1) relieve the crowding, which was his chief complaint; (2) establish Class I molar and canine relationships; (3) create ideal overbite and overjet; (4) correct the midline shift; and (5) establish a proper soft-tissue profile.

There were 3 treatment alternatives for this patient: (1) extraction of the maxillary left first premolar, (2) extraction of the maxillary left second premolar, and (3) distalization of the maxillary left first molar.

The patient and his family chose the nonextraction alternative, and distal movement of the maxillary left first molar was planned. There were 2 choices to achieve this movement: intraoral distalization mechanics and asymmetric headgear. The patient refused to wear headgear because of social and esthetic concerns. The maxillary left canine needed to be aligned; thus, preventing

---

**Fig 1.** Pretreatment intraoral photographs.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Before distalization</th>
<th>After distalization</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA (°)</td>
<td>74</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>72.5</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>ANB (°)</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wits (mm)</td>
<td>1</td>
<td>0</td>
<td>-0.5</td>
</tr>
<tr>
<td>SNP-GoGn (°)</td>
<td>22</td>
<td>34</td>
<td>25</td>
</tr>
<tr>
<td>ANS-PNS/GoGn (°)</td>
<td>25</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>FMA (°)</td>
<td>24.5</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>U1-NA (mm)</td>
<td>8</td>
<td>7.5</td>
<td>8</td>
</tr>
<tr>
<td>U1-NA (°)</td>
<td>28</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>U1-ANS-PNS (°)</td>
<td>117</td>
<td>116</td>
<td>114</td>
</tr>
<tr>
<td>L1-NB (mm)</td>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>L1-NB (°)</td>
<td>25</td>
<td>25</td>
<td>27.5</td>
</tr>
<tr>
<td>IMPA (°)</td>
<td>96</td>
<td>96</td>
<td>97</td>
</tr>
<tr>
<td>U1-PN (mm)</td>
<td>62.5</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>U6-PN (mm)</td>
<td>31</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>U6/ANS-PNS (°)</td>
<td>75</td>
<td>72</td>
<td>74</td>
</tr>
<tr>
<td>Overjet (mm)</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Overbite (mm)</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Lower lip–E-line (mm)</td>
<td>-3</td>
<td>-3.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Upper lip–E-line (mm)</td>
<td>-4</td>
<td>-5</td>
<td>6</td>
</tr>
<tr>
<td>Nasolabial angle (°)</td>
<td>117</td>
<td>115</td>
<td>114</td>
</tr>
</tbody>
</table>

The patient and his family chose the nonextraction alternative, and distal movement of the maxillary left first molar was planned. There were 2 choices to achieve this movement: intraoral distalization mechanics and asymmetric headgear. The patient refused to wear headgear because of social and esthetic concerns. The maxillary left canine needed to be aligned; thus, preventing
anchorage loss of the first premolar was important. We planned to use intraoral distalizing mechanics combined with zygomatic miniplates for distalization of the maxillary left first molar.

A miniplate (left medium plate; Walter Lorenz Surgical, Jacksonville, Fla) was placed at the zygomatic buttress of the maxilla under local anesthesia. The miniplate was adjusted to fit the contour of the lower face of the zygomatic process and was fixed by 3 titanium bone screws (length, 5.0 mm; diameter, 2.0 mm). The inner bow was a modified version of the inner part of a conventional face-bow. Two hooks were soldered onto the inner bow at the lateral tooth regions, and U bends were bent bilaterally in front of the maxillary first molars. The inner bow was adjusted to the headgear tubes on the maxillary first molar bands because the anterior component of the inner bow was about 3 mm from the anterior teeth. To prevent a crossbite on the left side from the distalization force, the bend was made on the inner bow. On the right side not requiring distalization, the maxillary molar tube and the hook were ligated.

Three weeks after the surgery, a distalization force of 350 g was unilaterally applied to the maxillary left first molar with a Sentalloy closed coil spring (GAC International, Bohemia, NY) attached with 0.01-in stainless steel ligature (Figs 2 and 3). The force of the coil spring was calibrated with a gram-force gauge (Correx; Haag-Streit, Koeniz, Switzerland) during the initial activation and checked at 4 weekly intervals to ensure that the same force was maintained throughout the treatment. The appliance was adjusted by widening the U bends with a plier when the distance between the anterior teeth and the inner bow was near 1 mm during the distalization and distalization was still required, as described by Nur et al. The zygoma-gear appliance was removed at the end of distalization, and the maxillary first molars were stabilized by a transpalatal arch for 1 month before the fixed orthodontic treatment (Fig 4). The maxillary premolars drifted distally without any orthodontic force with the help of the transseptal fibers (Fig 5). Preadjusted fixed appliances (0.022 × 0.028-in, MBT system; 3M Unitek, Monrovia, Calif) were placed in both arches to achieve leveling and alignment. After leveling and alignment, a power chain was applied to move the canine and the premolars distally. At the end of active treatment, finishing procedures were used for final alignment of the teeth and detailing of the occlusion. The fixed appliances were removed after active treatment was completed, and a maxillary Hawley retainer and a 3-3 mandibular fixed lingual retainer were constructed for the patient and then placed. The miniplate was stable during the total treatment period and successfully removed with local anesthesia after the debonding.

The maxillary left first molar was successfully distalized into a super Class I relationship, and the needed space for the maxillary left canine was gained (Fig 6). After a treatment period of 5 months, the maxillary left first molar moved 4 mm distally without anterior movement of the anchor premolars, and the distal tipping of the maxillary left first molar was 3°. The zygoma-gear appliance caused slight changes in both skeletal and soft-tissue measurements. Furthermore, there were slight decreases in overjet (−0.5 mm), Ls-E (−1 mm), U1-PtV (−0.5 mm), U1-ANS-PNS (−1°), U1-NA (−0.5 mm), and U1-NA (−1°), indicating no anchorage loss with the zygoma-gear appliance (Table).

After 14 months of unilateral distalization with the zygoma-gear appliance and fixed appliances, Class I molar and canine relationships were established with satisfactory interdigitation of the posterior teeth. Acceptable overjet and overbite were also achieved (Fig 7). Figure 8 shows the superimpositions of the patient’s cephalometric films.

DISCUSSION

Several methods have been used for molar distalization, including headgear, distal jet, and Keles slider. The effects of the different mechanics for molar distalization on the craniofacial complex have been evaluated in several experimental and clinical studies. Previous studies have shown that extraoral cervical traction requires considerable patient compliance to obtain
successful results.\textsuperscript{1,2} On the other hand, the need for minimum patient cooperation and ease of use are among the advantages of the distal jet. But distal molar movement occurs mainly by tipping and rotation of the crowns, and anchorage loss does occur in the premolars and the incisors.\textsuperscript{7} The main problem with the pendulum appliance is its side effects on the anchorage unit, especially on the premolars and incisors. In addition, relapse of molar distalization is commonly seen because the molars are used as anchorage during distalization and retraction of the premolars and incisors.

To remedy those problems, various intraoral distalizing mechanics combined with palatal implants have been used, because it is possible to distalize the maxillary molars without anchorage loss by using absolute

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{zygoma_gear_appliance.png}
\caption{Schematic illustration of the components of the zygoma-gear appliance.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{intraoral_photos.png}
\caption{Intraoral occlusal photographs.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{distalization_photos.png}
\caption{Photographs showing the spontaneous distalization of the maxillary premolars with the help of the transseptal fibers.}
\end{figure}
anchorage more efficiently than ever.\textsuperscript{9,11-16} Although anchorage loss has been eliminated in this way, retraction of the anterior teeth is limited because of the proximity of the palatal implant to the roots of the anterior teeth.\textsuperscript{15} Thus, the zygomatic process of the maxilla was used as an anchorage unit.\textsuperscript{17,18} Suguwara et al\textsuperscript{17} and Kaya et al\textsuperscript{18} showed the use of zygomatic anchorage miniplates for bilateral maxillary molar distalization. In addition to maxillary molar distalization, these systems can be used for en-masse distalization of maxillary buccal segments. In our study, we used the zygoma-gear appliance for unilateral maxillary molar distalization in a 15-year-old boy. No previous study has shown the use of the zygoma-gear appliance with zygomatic anchorage miniplates for unilateral maxillary molar distalization. In this respect, this case report is the first study.

In the case report of Nur et al,\textsuperscript{15} the authors used elastics from the hooks to the miniplates, and they advised the usage of nickel-titanium closed coils instead of elastics. Thus, we used a closed-coil spring to obtain a continuous force of 350 g, and the force was checked.

![Fig 6. Intraoral photographs after distalization.](image1)

![Fig 7. Intraoral photographs after debonding.](image2)
at every appointment. Furthermore, the force can be increased by activating the ligature if needed.

Nur et al.\textsuperscript{15} stated that the design of the zygoma-gear appliance enables the first and second premolars to drift distally with the help of transseptal fibers. In agreement with this, Figure 7 shows the movement of the premolars distally with the help of the transseptal fibers.

The maxillary left first molar moved 4 mm distally by means of the unilateral distalizing zygoma-gear appliance. The amount of molar inclination was 3°. These findings are close to the findings of the previous studies that used different bone-supported distalizing appliances. Oncag et al.\textsuperscript{19} who compared the osseous-supported pendulum with a tooth-supported one, found distalization of 3.4 to 4.5 mm in 6 months in the bone-supported appliance group. Escobar et al.\textsuperscript{12} found 6 mm in 7.8 months; Kircelli et al.\textsuperscript{13} showed an average of 6.4 mm in 7 months. However, the amounts of molar inclination in those studies were 14°, 11.3°, and 10.9°, respectively. One advantage of this new system is that the molar inclination is less than with the previous appliances. The low inclination might be due to the direction of the force vector of the zygoma-gear appliance. As stated by Nur et al.\textsuperscript{15} the distalizing force vector passes close to the center of resistance of the first molar.

The distalization amounts vary according to the eruption of the second molars and the presence of the third molars. According to Karlsson and Bondemark,\textsuperscript{20} it is more effective to distalize the maxillary first molars before the second molars have erupted. In most patients, the third molars are extracted to facilitate the distalization of the maxillary first molars.\textsuperscript{21} In our patient, the second molars had erupted, and the maxillary third molars were present but in a high position. Despite those factors, we obtained 4 mm of distalization in 5 months.

However, the minor surgical procedure to place the zygomatic miniplate and the necessity of a second operation to remove the miniplate are the disadvantages of this system.

**CONCLUSIONS**

This article reports the use of the zygoma-gear appliance for unilateral maxillary molar distalization without anchorage loss in a short time in a 15-year-old boy despite the presence of his second and third molars.

**REFERENCES**


