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Molar distalization with 2K appliance: One-year follow-up

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Abstract:

Correction of class II molars in growing patients with acceptable facial profile can be performed by distalization of maxillary first molars. However, in patients where compliance is difficult intraoral means of molar distalization is required. This case report describes the use and effectiveness of a novel 2K appliance in an 11-year-old female having an orthognathic profile, skeletal Class I relation, and Angle's Class II division 1 malocclusion with crowding of 8 mm and 3 mm in the maxillary and mandibular arches, respectively. Nonextraction treatment was planned with bilateral distalization of the maxillary first molars. The amount of distalization achieved by 2K appliance was 3.5 mm with only 1° distal tipping. The 2K appliance required minimal patient cooperation, produced bodily movement of molars with minimal tipping/rotation, and prevented anchorage loss of the anterior teeth. This 2K molar distalization appliance was found to be an effective technique to control molars in all three planes of space.

Keywords:

Class II, distalization, K loop, molar rotation

Introduction

Correction of class II malocclusion without extractions requires maxillary molar distalization by means of intraoral or extraoral forces. One of the major drawbacks of extraoral appliance is the dependability on patient cooperation. The intraoral molar distalization method has been an excellent option for patients who are unwilling to wear a headgear.

Among contemporary distalizing methods introduced, the K Loop appliance seems to best satisfy the requirements of an ideal distalization appliance. However, this device can produce unwanted tipping of the maxillary molars during distalization.^[1] Although miniscrew supported distalization appliances^[2-4] are being used, these are not well-accepted by patients due to high cost and invasive procedure involved in their placement. The following case is being presented using the 2K appliance for bilateral distalization of molars.

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Case Report

An 11-year-old female having an orthognathic profile [Figure 1] presented with the complaint of irregularity in her upper front teeth. She had Class II division 1 malocclusion with 8 mm crowding in the maxillary arch and 3 mm in the mandibular arch. The maxillary right and left canines were blocked-out. Overjet was 3 mm and overbite was 2.5 mm [Figure 2]. Cephalometric analysis revealed skeletal Class I maxillomandibular relation (ANB=4°) (ANB angle is the difference between SNA and SNB angles given by Steiner which indicates the sagittal skeletal relationship between the maxilla and mandible), average growth pattern (Frankfort Mandibular plane Angle = 25°) with upright upper incisors (upper incisor to SN plane = 102°) and a distance of 15 mm from pterygoid vertical [Figure 3].

Treatment objectives

To relieve the crowding in the maxillary and mandibular arches and achieve Class I molar relationship while maintaining a pleasing soft tissue profile, a nonextraction

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Figure 1: Pretreatment photographs



Figure 2: Pretreatment models

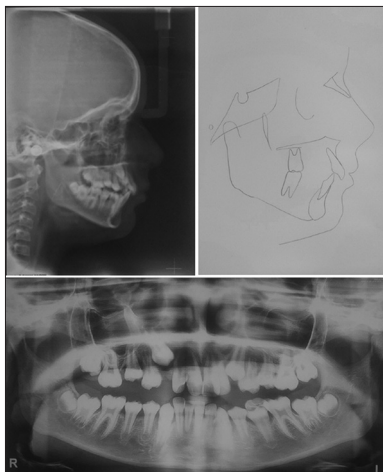


Figure 3: Pretreatment radiographs and cephalometric tracing

orthodontic treatment protocol was planned by molar distalization in the maxillary arch and interproximal reduction in the mandibular arch. To obtain bodily movement of the molars without any reciprocal flaring of maxillary incisor, a novel 2K appliance was designed for the distalization of molar.

Treatment alternatives

The extraction treatment option was ruled out because of the pleasing profile of the patient. Because the patient had an average growth pattern and was in a growing age, molar distalization was a better treatment option. Commonly used distalization appliances such as the K-loop or the Pendulum appliance were not used because of the fact that they apply forces only from either buccal or palatal aspect. On the other hand, the 2K appliance used in this case had a better control over distalization owing to force application from both buccal and palatal aspects.

Appliance design

Maxillary first molars and premolars were banded and triple buccal tubes and brackets (0.018 × 0.025 McLaughlin, Bennett and Trevisi) were welded. Lingual sheaths were welded on the palatal aspect, keeping them parallel to the buccal tubes. The buccal K loop (0.017 × 0.025 Titanium molybdenum alloy (TMA)) was ligated on premolar and inserted in the molar tube. Another K-loop

(0.017 × 0.025 TMA) was placed on the palatal aspect. This palatally placed K-loop was embedded in the acrylic plate covering the anterior aspect of the palate, and its other end was inserted in the lingual sheath on the molar [Figure 4]. Anchorage for the molar distalization

was achieved from the acrylic plate covering the palate and from the bilateral first premolars made into one unit along with the acrylic button.

Treatment progress

The K-loops were activated to produce a combined force of 200 g. After insertion of the appliance, both the K-loops were activated by 1.5 mm every 6 weeks until a class I molar relation was obtained [Figure 5]. The total time period required for distalization was 3 months. The post-distalization intraoral photographs,



Figure 4: Intraoral photographs with activated 2K molar distalization appliance



Figure 5: Reactivation of the appliance after 6 weeks



Figure 6: Postdistalization photographs



Figure 7: Postdistalization models

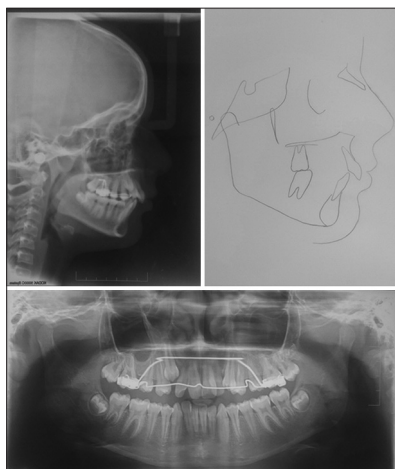


Figure 8: Postdistalization radiographs and cephalometric tracing



Figure 9: Maxillary occlusal view showing stabilization of molar distalization

models, and radiographs are shown in Figures 6–8. Post distalization, a stabilizing appliance was inserted comprising a combination of transpalatal arch along with nance button [Figure 9]. Following stabilization of the molars, both maxillary and mandibular arches were bonded. Alignment, levelling and finishing was completed in 12 months. At debonding, maxillary and mandibular fixed retainer were bonded.

Treatment results

Distalization results were evaluated on pretreatment (T1) and posttreatment (T2) lateral cephalograms by measurements, as described by Byloff et al.^[5] [Figure 10]. Rotations of the maxillary first molars and changes in intermolar distance were measured on dental casts obtained at T1 and T2. Photocopies of the models were obtained as described by Champagne.^[6] The measurements analyzed on the photocopies are shown in Figure 11.

The pre and postdistalization changes in sagittal, vertical, and transverse planes have been depicted in Tables 1 and 2.

Maxillary first molars

It was observed that the first molar was distalized by 3.5 mm (mx: distance between the center of the molar crown and y-axis). In addition, molars remained upright with only a slight distal tipping of 1° (α : angle between the molar long axis and x-axis, expressing inclination of the molar).

Vertical movement of the maxillary first molars, i.e., my_p and my_o , (distance between center of molar crown and x-axis and occlusal plane respectively) did not show any significant changes.

The intermolar width (measured between the mesiobuccal cusps of first molars) increased by 1 mm post distalization. However, no rotational changes were observed in the molars as depicted by angles UL6axis and UR6axis with midpalatine axis.

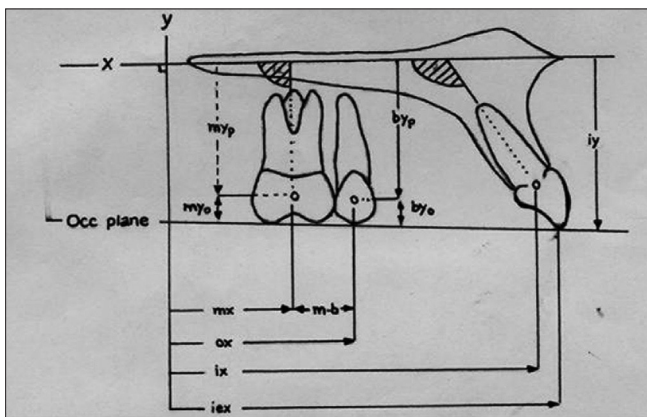


Figure 10: Byloff's Schematic illustration of sagittal (mm), Vertical (mm) and angular measurements

Maxillary second premolar

There was 1.5 mm of distalization of second premolar (bx: distance between center of premolar crown and y-axis). Second premolar did not show any change in the vertical plane, by_p and by_o (distance between center of premolar crown and x-axis/occlusal plane respectively).

Maxillary central incisor

Both incisal proclination and position (ix, iy, gamma, and iex) showed insignificant changes in the pre and postdistalization values where ix, distance between incisor reference point and y-axis, iy, distance between incisor reference point and x-axis, iex, distance between

Table 1: Pre and postdistalization changes in sagittal and vertical planes

Parameters	Pretreatment	Post distalization
Maxillary first molars		
mx	10.5 mm	7 mm
my_p	15 mm	15 mm
my_o	3 mm	2.5
alpha	81°	80°
Maxillary second premolars		
bx	19 mm	17.5 mm
by_p	17 mm	17 mm
by_o	4 mm	4 mm
Maxillary central incisors		
ix	41 mm	41.5 mm
iex	41 mm	41 mm
iy	28 mm	28.5 mm
gamma	103°	104°

Table 2: Pre and postdistalization changes in transverse plane

Parameters	Pretreatment	Postdistalization
Maxillary first molars		
Intermolar width	44 mm	45 mm
UL6axis	26°	26°
UR6axis	28°	28°

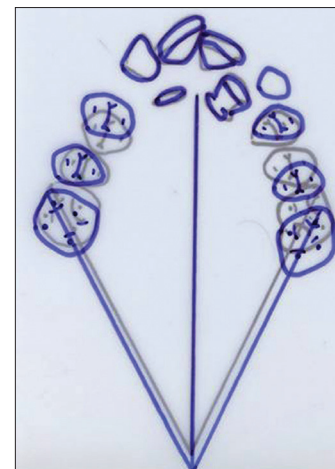


Figure 11: Superimposition of pre and postdistalization model tracing

incisor edge and y-axis, and γ , angle between incisor long axis and x-axis, expressing inclination of the incisor.

Thus, the treatment objectives were achieved with distalization of molars, resolution of crowding, and alignment of arches, maintaining a harmonious facial profile [Figure 12]. The teeth were well-aligned and good intercuspation with Class I occlusion and proper overjet and overbite [Figures 12 and 13]. The superimposition of pretreatment, postdistalization, and posttreatment showed bodily movement of molar with no reciprocal flaring of maxillary incisors [Figure 14]. Records obtained 1 year after completion of treatment showed maintained stable intercuspation [Figure 15]. The posttreatment and 1-year retention radiographs were examined, and comparative superimpositions of lateral cephalogram showed no change in treatment results [Figure 16].

Discussion

Because the patient had crowding of 8 mm in the maxillary arch with upright maxillary incisors (Upper Incisor to SN plane = 102°) and a distance of 15 mm from pterygoid vertical molar distalization was planned for space gaining and alignment of the arch. An efficient force system was delivered to move the molar distally

is a continuously acting force with little or no patient cooperation. Although there are many intraoral appliances available to move molars distally, controlling molar movement in all three directions is a difficult task.^[7-11] Therefore, a modified distalization appliance 2K loop system was used for this purpose. Distalization appliances usually cause unwanted tipping and rotation during the movement of molars. Ideally, a bodily movement is required in the distal direction without any tipping. It is almost impossible to apply orthodontic force directly to the center of resistance of a tooth. A simple and effective method for translation is to apply two forces at some distance from the center of resistance. If the resultant force passes through the center of resistance, bodily movement can be achieved.

The 2K molar distalization appliance was an effective means for controlled molar distalization in all three dimensions. The molars were distalized by 3.5 mm with distal tipping of 1° . This was accomplished by introducing a palatal component along with buccal distalization system. This provided the advantage of force application more close to the centre of resistance of the molars, and hence, bodily movement was achieved.

The incisal proclination and position showed insignificant changes after molar distalization. The additional palatal



Figure 12: Posttreatment photographs

K-loop of this appliance seemed to reduce anchorage loss and provided more effective distalization by better

control of the moment to force ratio. The palatal K-loop could be positioned closer to the center of resistance of the first molar compared to the buccal K-loop, which has anatomic limitations. Palatal K-loop complimented the buccal K-loop, thus providing an efficient biomechanical system.

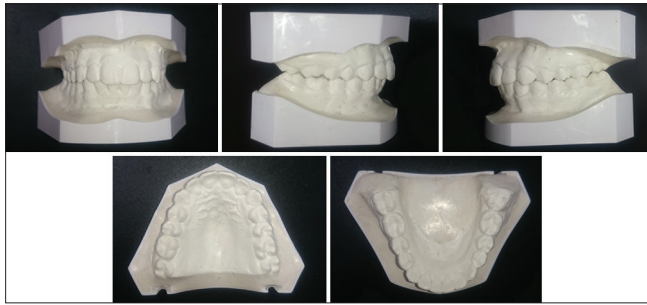


Figure 13: Posttreatment models

Study model photocopy analysis did not show significant expansion in the intermolar region or mesiobuccal rotation of the maxillary first molars during distalization. This is in variance to studies reported by Ghosh and Nanda^[12] and Kinzinger *et al.*^[13] A good control in the transverse plane could be attributed to a vector-controlled rail mechanics. This was provided by the palatal K-loop acting in tandem with the buccal K-loop.

In the vertical direction, the distalized molar showed insignificant intrusion. This finding is in agreement with Acar *et al.*^[14] who had distalized the maxillary molars using a pendulum K-loop combination. Hence, the design of this appliance satisfied the biomechanical needs of the patients.

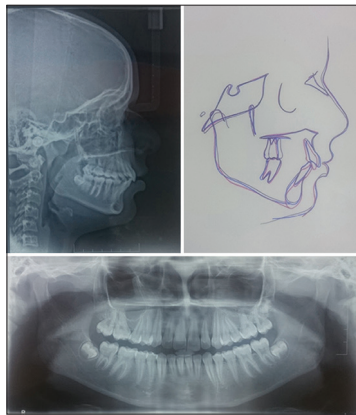


Figure 14: Posttreatment radiographs and superimposition of pretreatment, postdistalization and posttreatment cephalometric tracing (SN plane at Sella)

Conclusion

This case report describes the designing, fabrication, and successful use of 2K appliance in a case with moderate crowding, bilateral Class II molar, with good facial profile. The amount of distalization achieved by this



Figure 15: Postretention photographs after 1 year

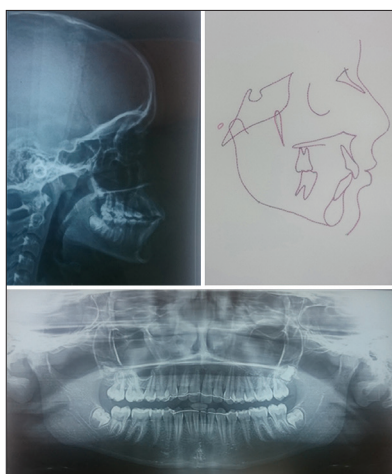


Figure 16: Post retention radiographs and superimposition of post treatment and 1-year postretention cephalometric tracing (SN plane at Sella)

appliance was 3.5 mm with only 1° distal tipping. 2K molar distalization appliance requires minimal patient cooperation, produces bodily movement of molars with minimal tipping/rotation, and prevents anchorage loss of the anterior teeth. Hence, this 2K distalization appliance is an effective modality to control molar in all three planes of space. These results were stable after a follow-up of 1 year.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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