An Effective and Precise Method for Rapid Molar Derotation: Keles TPA

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Most of the time, Class II molar relationships occur due to the mesiopalatal rotation of the molars. Transpalatal arches have been used routinely to derotate and stabilize the molars. In this article, an easy, effective, and precise method is introduced. Hinge cup attachments, instead of palatal sheaths, and square beta-titanium alloy wires, instead of round stainless steel wires, have been used. A new biomechanical approach is introduced. The results show that molars were derotated effectively in a short period of time with the application of this method. World J Orthod 2003;4:xx–xx

Distal molar relationships can arise due to the mesiopalatal rotation of maxillary molars. In some cases, an ideal Class I intercuspation can be achieved with the opposing molar and a Class II relationship can be corrected by molar derotation. Maxillary molars consist of three roots and, due to the early loss of the deciduous second molars, the palatal root acts as a hinge for mesial rotation of molars. Lemons and Holmes[1] reported that a gain of 1 to 2 mm of arch length per side may be achieved following derotations. The transpalatal arch (TPA) for molar derotation was introduced to the orthodontic literature by Goshgarian[2] in 1972. Cetlin and Ten Hoeve[3] showed that the TPA is an effective device to stabilize, rotate, and distalize the molars. According to Ricketts,[4] a line drawn from the distobuccal and mesiopalatal cusp tips of the first molars should pass through the cusp tip of the canines on the opposite side. Investigators have assessed the shape of maxillary first molars and examined the arch length gain with derotation.[5–7] According to Braun et al,[8] 2.1 mm of arch length can be gained with the application of a TPA and a distal force equivalent at the level of the maxillary first molar center of resistance.

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The TPA can be removable or fixed, depending on the clinician's preference.

The aim of this study was to develop an easy method to rapidly and precisely rotate the maxillary molars.

TPA CONSTRUCTION

Maxillary first molars were banded with Precision (Ormco, Orange, CA, USA) lingual hinge cap attachments, welded on their palatal aspect (Fig 1). The hinge cap attachment is designed to accommodate 0.032-inch × 0.032-inch wires. The TPA was constructed from the Burstone lingual arch system (Ormco), which was introduced to the orthodontic literature in 1988 by Dr Burstone[9–11] (Fig 2). The wire consists of 0.032-inch × 0.032-inch beta-titanium alloy (TMA; Ormco). After the passive construction of the TPA, molar bands were cemented to the first molars (Figs 3a and 3b) and the TPA was removed for activation (Fig 3c).

The method for activation is simple and precise. The TPA is placed on a piece of white paper and two lines are drawn along the terminal ends (rotating component) of the TPA with a black pen (Fig 4a). Additional lines are drawn with a red pen, with a 20-degree angle passing through the distal end of the helix of the wire. The TPA is activated on both sides with the help of a bird peak pliers (Fig 4b). The biomechanics of the force-moment system is presented in Fig 5. Two equal and opposite moments are generated on both molars. Two equal and opposite forces are generated on both sides, which would also help

Fig 1 *(Left)* Maxillary first molars were banded with a Precision lingual hinge cap attachment, welded on the palatal sides.

Fig 2 *(Right)* A transpalatal arch was constructed, using the Burstone lingual arch system.

Fig 3 **(a)** After the passive construction of the TPA, molar bands were cemented to the first molars with the TPA. **(b)** Palatal view of the TPA design. **(c)** TPA was removed for activation.

Fig 4 **(a)** Passive stage. **(b)** Active stage.

Fig 5 Biomechanics of the force-moment system.

Fig 6 The activation of the TPA is checked on both sides.

to increase the intermolar width between the mesial cusp tips of the first molars. The activation of the TPA is checked on both sides and then placed in the mouth (Fig 6).

Unilateral activation of a TPA, as described by Cetlin and Ten Hoeve,[3] would generate distal force on one side and rotation on the other side. After the correction of rotation of the molar on one side, Cetlin and Ten Hoeve recommend subsequent activation to rotate the molar on the other side a few months later. This would extend the treatment duration and generate unwanted distal forces. McNamara and Brudon[9] have also indicated that the subsequent activation would generate a distal force on one side and rotation on the other side.

CASE REPORTS

Case 1

D.K. was a female patient, 11 years 3 months of age, diagnosed with an edge-to-edge molar relationship. She was in the mixed dentition period and had crowding of 5.6 mm in the maxilla and 4.2 mm in the mandible. There was not adequate space for the eruption of the canines in her maxillary arch. Her maxillary first molars were severely rotated mesiopalatally. She had an 80% anterior deep bite. Her pretreatment extraoral and intraoral photographs are shown in Figs 7 and 8.

The treatment goals were to derotate the maxillary molars, correct the deep bite, align the maxillary and mandibular arches, and achieve a Class I molar and canine relationship.

The treatment was started with the engagement of the TPA and derotation of the maxillary first molars (Fig 9). Twenty-degree anti-rotation bends were constructed on the TPA, and 2 months later the rotations were corrected (Fig 10). After the placement of fixed appliances, the maxillary and mandibular arches were aligned and the deep bite was eliminated. At the end of the orthodontic treatment, a Class I molar and canine relationship was achieved and the patient's smile was significantly improved. Posttreatment extraoral and intraoral views, cephalometric superimposition, and measurements are shown in Figs 11 to 13, and in Table 1.

Case 2

S.Y. was a male patient, 16 years 2 months of age, when diagnosed with a Class II molar relationship, an impacted maxillary second premolar on the right side, and a palatally malposed second premolar on the left side. He had 10 mm of maxillary crowding. His maxillary molars were severely rotated mesiopalatally and he had an anterior crossbite with retroclined maxillary incisors. He had a pseudo Class III malocclusion, since he could bring the incisors in an edge-to-edge relationship in centric relation. The mandibular left first molar had been extracted earlier, due to a deep caries lesion. His extraoral and intraoral views at the beginning of the treatment are shown in Figs 14 and 15.

The treatment goals were to *(1)* derotate the maxillary first molars and open up space for the eruption and alignment of the second premolars, *(2)* correct the anterior crossbite, and *(3)* achieve a Class I molar and canine relationship, and ideal overbite and overjet relationships.

Table 1 Cephalometric measurements of the patients

		Case 1		Case 2	
Measurements	Normal	Initial	Final	Initial	Final
Go-Me-SN (degrees)	32 ± 8	40	36	34	35.5
Saddle angle (degrees)	123 ± 5	121	122	124	124
Articular angle (degrees)	143 ± 6	148	145	138	139
Gonial angle (degrees)	130 ± 7	132	129	132.5	133
S (degrees)	396 ± 3	401	396	394.5	396
Jarabak (mm)	59–62	60	63.5	66	65.4
ANSMe/NMe (mm)	55	57	57	54.5	56.1
Max height (mm)	60	65	64	64	64
Facial axis angle (degrees)	90	79	380	85	86.5
FMA (degrees)	25	35	30	27	29.5
Y-axis (degrees)	59.4	67	64	58	60
SNA (degrees)	82 ± 2	81	81	82	82
SNB (degrees)	80 ± 2	76	78	84.5	84
ANB (degrees)	2	5	3	−2.5	−2
Witt's appraisal (mm)	−1.0	−2	−3	−8	−6.5
SL (mm)	51	41	47	64.5	63
SE (mm)	22	18	21	20	20.5
Nper-PA (mm)	−1	−4	3	−2.5	−3
Max depth (mm)	90	86	87	88	88.5
⊥-SN (degrees)	103	105	111	106	111
⊥-NA (degrees)	22	25	20	24	29
⊥-NA (mm)	4	1	6	4	7.5
⊥-FH (degrees)	112	110	118	112	117
IMPA (degrees)	90	91	102	79	76
I-NB (degrees)	25	27	35	17	15
I-NB (mm)	4	5	7	3	2
Pog-NB (mm)	4	1	3	2	3
Holdaway ratio	1/1	5/1	7/3	3/2	2/3
⊥-I (degrees)	131	124	110	142	137

The treatment started with the engagement of a modified TPA and derotation of the first molars. Twenty-degree anti-rotation bends were constructed on the TPA. Three months later, molar derotation had been achieved (Fig 16). Additional arch length gain was achieved in the maxilla by incisor protrusion with the application of coil springs between the first premolars and first molars on a 0.016-inch stainless steel archwire. At the end of the fixed orthodontic treatment, a Class I molar and canine relationship, molar derotation, eruption and alignment of permanent premolars, and ideal overbite and overjet relationships were achieved. The patient's smile and profile were significantly improved with the protrusion of the maxillary incisors (Fig 17). Intraoral photographs of the patient at the end of the fixed orthodontic treatment are shown in Fig 18. The cephalometric superimposition and measurements are shown in Fig 19 and Table 1.

Fig 7 Patient 1. Pretreatment extraoral photographs of D.K.

Fig 8 Patient 1. Pretreatment intraoral photographs of D.K.

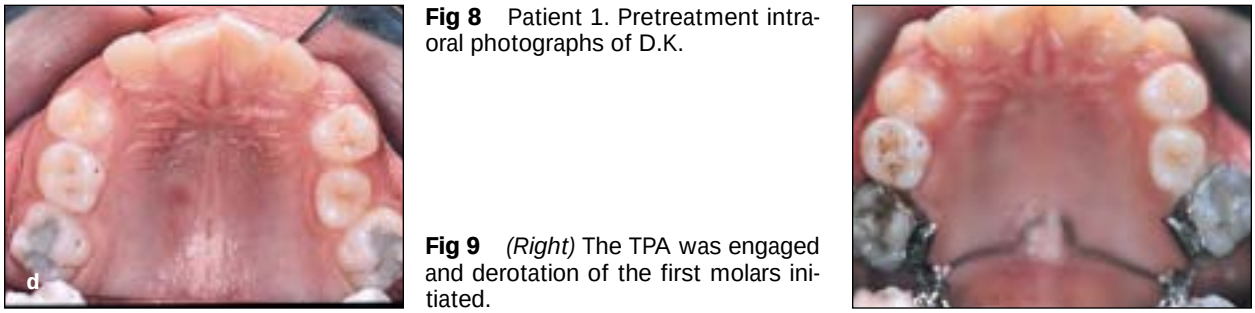

Fig 9 *(Right)* The TPA was engaged and derotation of the first molars initiated.

Fig 10 Patient 1. Intraoral photographs of D.K after the rotation of molars.

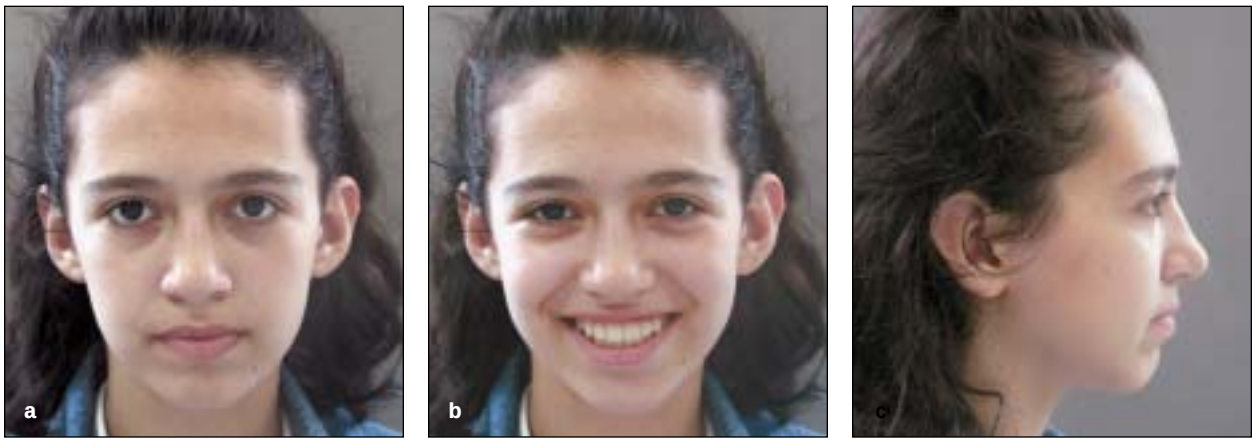

Fig 11 Patient 1. Extraoral photographs of D.K. at the end of fixed orthodontic treatment.

Fig 12 Patient 1. Intraoral photographs of D.K. at the end of orthodontic treatment.

Fig 13 *(Below)* Patient 1. Cephalometric superimposition of D.K. tracings. Black line is initial visit and red line is final result.

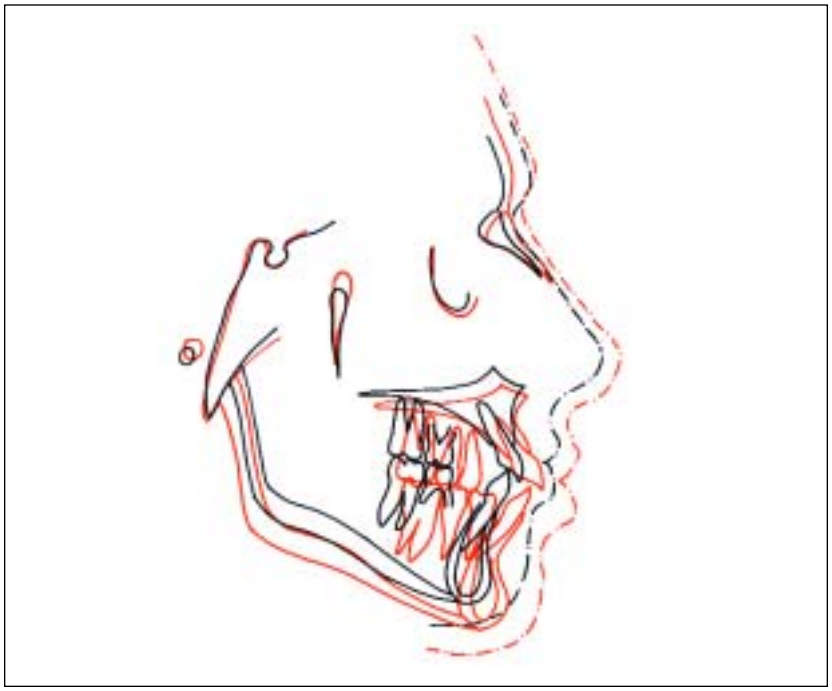

Fig 14 Patient 2. Pretreatment extraoral photographs of S.Y.

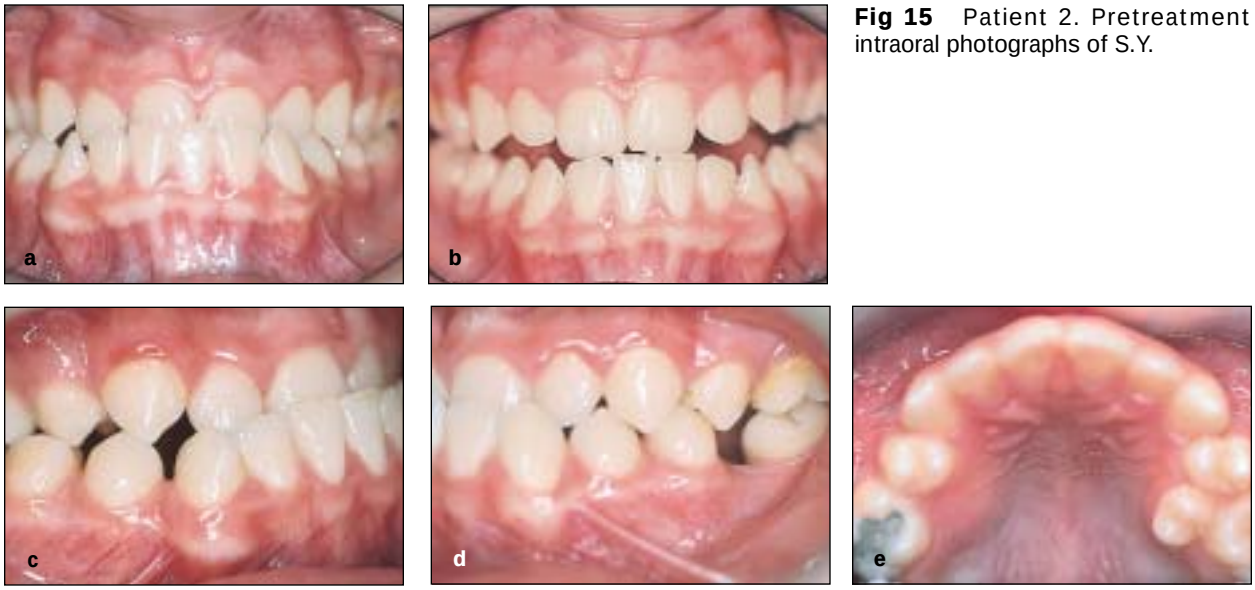

Fig 15 Patient 2. Pretreatment intraoral photographs of S.Y.

Fig 16 Patient 2. Intraoral maxillary occlusal photographs of S.Y. after the rotation of molars.

Fig 17 Patient 2. Extraoral photographs of S.Y. at the end of fixed orthodontic treatment.

Fig 18 Patient 2. Intraoral photographs of S.Y. at the end of orthodontic treatment.

Fig 19 *(Below)* Patient 2. Cephalometric superimposition of S.Y. tracings. Black line is initial visit and red line is final result.

DISCUSSION

The results show that the maxillary molars can be derotated effectively in 2 to 3 months. From a biomechanic point of view, the method described above has several advantages. With most techniques, due to the mesiopalatal rotation of molars, the molar width between the mesial cusp tips is decreased. The method described here increased the intermolar width between the mesial cusp tips of the molars and maintained the intermolar width on the distal (see Figs 10c and 16). In fact, the final outcome after the subsequent use of a conventional TPA, which is described in the literature, would tend to decrease the intermolar width on the distal[9] rather than increase the intermolar width on the mesial.

With this approach, palatal hinge cup attachments were used instead of TPA sheaths. The hinge cup attachment opens and shuts easily, which makes the clinical application practical and dramatically enhances TPA mechanics. In addition, this technique minimizes the difficulty of lingual wire insertion and removal. A secure lock over the wire eliminates the double-back bend and ligature ligation that is required with many traditional TPAs. The hinge cup attachment has a 12-degree built-in torque in its base, which makes it an equally appropriate choice for both passive and active TPA application. Some investigators prefer a soldered rather than removable type of TPA.[12] For bilateral molar rotation correction, however, subsequent activation and repeated cementation are required to obtain the desired bilateral rotational result.

Square-sectioned beta-titanium alloy wire enables 3-dimensional control of the molar movement. In contrast, the traditional TPA uses a round stainless steel wire. The other advantage of beta-titanium alloy wire is that it allows constant and long-lasting light force, without any plastic deformation.

In addition to rotating the molars effectively after rapid palatal expansion, this TPA can be used to maintain and stabilize intermolar width and to correct buccal crown tipping of molars by bilateral activation of the square-sectioned beta-titanium alloy wire for buccal root movement.

CONCLUSION

Molar derotation was successfully accomplished in both cases, in a short period of time. Arch length was significantly increased and an ideal Class I molar relationship was achieved in both cases. From a biomechanic point of view, this method eliminated the subsequent activation process and also increased the reduced intermolar width between the mesial cusp tips of the molars.

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