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Intraosseous Screw–Supported Upper Molar Distalization

İbrahim Erhan Gelgör, DDS, PhD;[a] Tamer Büyükyılmaz, DDS, PhD, MS;[b] Ali Ihya Ýhya Karaman, DDS, MS, PhD;[c] Doğan Dolanmaz, DDS, PhD;[d] Abdullah Kalaycı, DDS, PhD[e]

ABSTRACT

The aims of the present study were to investigate (1) the efficiency of intraosseous screws for anchorage in maxillary molar distalization and (2) the sagittal and vertical skeletal, dental, and soft tissue changes after maxillary molar distalization using intraosseous screw–supported anchorage. Twenty-five subjects (18 girls and seven boys; 11.3 to 16.5 years of age) with skeletal Class I, dental Class II malocclusion participated in the study. An anchorage unit was prepared for molar distalization by placing an intraosseous screw behind the incisive canal at a safe distance from the midpalatal suture following the palatal anatomy. The screws were placed and immediately loaded to distalize upper first molars or the second molars when they were present. The average distalization time to achieve an overcorrected Class I molar relationship was 4.6 months. The skeletal and dental changes were measured on cephalograms and dental casts obtained before and after the distalization. In the cephalograms, the upper first molars were tipped 8.8° and moved 3.9 mm distally on average. On the dental casts, the mean distalization was five mm. The upper molars were rotated distopalatally. Mild protrusion (mean 0.5 mm) of the upper central incisors was also recorded. However, there was no change in overjet, overbite, or mandibular plane angle measurements. In conclusion, immediately loaded intraosseous screw–supported anchorage unit was successful in achieving sufficient molar distalization without major anchorage loss.

KEY WORDS: Upper molar distalization, Anchorage, Intraosseous screw, Implants.

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INTRODUCTION Return to TOC

In the treatment of Angle Class II malocclusions, upper anterior crowding and excessive overjet can be treated with either distalization of upper posterior teeth or extraction of two upper premolars. Headgears are usually used for upper molar anchorage or distalization, but orthodontic mechanics requiring minimal patient cooperation are desirable.[1,2] Intraoral appliances for maxillary molar distalization, such as the pendulum,[3,4] push-coils,[5] magnets,[6,7] superelastic NiTi wires[8] distal jet,[9,10] and molar slider,[11] do not require extensive cooperation from the patient. All these techniques effectively distalize both first and second molars but may cause anchorage loss characterized by maxillary incisor protrusion and an increase in overjet and overbite.[5,6,12–16]

Improvements in implants have made their use possible as anchorage in orthodontic patients. Good implant stability was reported in animals[1,17–21] and in humans.[2,22–27] Although materials and surgical techniques have been improved, endosseous implant design, size, and alveolar ridge deficiencies remain as deterrents to their widespread use in orthodontic treatment. One group of workers have designed a titanium disc (onplant) as a subperiostal orthodontic anchor, biointegrated onto the surface of bone.[21] Intraosseous screws have been used as another orthodontic anchor.[2,28,29]

In the maxilla, implants and onplants or the screws can be used usually to move molars distally, mesially, or superiorly, as well as to retract, retrude, or intrude the canines and incisors. In the mandible, implants and onplants or the screws are used for molar anchorage because of the more dense bone structure compared with the maxilla.[29] The retromolar area[30] or the palate[31,32] are preferred as implant locations mainly because these regions do not interfere with orthodontic tooth movement. The histomorphology of the palatal bone shows that the median palatal region is the best location for an endosseous implant.[32,33]

The greatest obstacles in the use of implants are the size and the shape of the current implant design. Triaca et al[31] described an implant 7.5 mm wide and three mm deep. Wehrbein et al[26] used an endosseous palatal implant that was four to six mm long and 3.3 mm in diameter for anchorage reinforcement of posterior teeth. Small-diameter rods (0.7 and 0.85 mm) have been subjected to continuous force loads in animals,[1,34,35] and the implants were stable throughout the experimental period. They were reported to be potentially useful in humans and possibly small enough to insert between the roots of the teeth.

Implants are usually loaded after a period of approximately three to six months to allow healing and osseointegration.[19,20,24–26,31,32,36] The implants are troublesome for patients because of the severity of the surgery, the discomfort during initial healing, and the difficulty in oral hygiene.[19,20,24–27,36] In 1983, to shorten the loading time, Creekmore and Eklund[28] inserted a vitallium screw just below the anterior nasal spine in a patient with maxillary incisor elongation. After 10 days, they attached an elastic thread from the archwire to the head of the screw, which protruded into the vestibule. In one year, the upper incisors were intruded six mm and torqued lingually 25°. The bone screw remained stable and was painlessly retrieved at the end of treatment.

Byloff et al[2] designed a pendulum-type appliance consisting of an anchorage plate fixed to the palatal bone by four miniscrews and a removable part to distalize maxillary first and second molars in adults. They loaded the system two weeks after surgical placement of the screws. During the following eight months, both the first and second molars were distalized into an overcorrected Class I relationship.

This study was conceived to eliminate the side effects associated with the intraoral distalization appliances[3–10] and cope with difficulties seen in previous implant studies.[19,20,24–27,36] The aims of this study were (1) to evaluate the anchorage of the intraosseous screws in maxillary molar distalization and (2) to investigate the sagittal and vertical skeletal, dental, and soft tissue changes after molar distalization with intraosseous screw–supported anchorage.

MATERIALS AND METHODS Return to TOC

This study was approved by the Medical Scientific Ethics Committee of Selcuk University. All patients or their parents were apprised of the purpose of the study and possible complications. All patients or parents signed a consent form.

The criteria for subject selection included

- Skeletal Class I, bilateral Class II molar and canine relationship (as Steiner analysis and Angle classification).
- Minimal or no crowding in the mandibular arch.
- Existence of bilateral first or second premolar.
- Rejection of headgear wear.
- Good oral hygiene.

According to these criteria, 25 patients (18 girls and seven boys; 11.3 to 16.5 years of age) were included in this study (Table 1).

The intraosseous screw and insertion procedure

The intraosseous screw (IMF Stryker, Leibinger, Germany) is a pure titanium one-piece device with an endosseous body and intraoral neck section. The endosseous screw body has a self-tapping thread with a sandblasted surface. The diameter is 1.8 mm, and the available lengths are eight and 14 mm (Figure 1). The intraoral neck section is cylindrical.

In this study, 14-mm screws were used. Under local anesthesia, a syringe was placed in the incisive canal for reference, and a 1.5-mm-diameter hole was drilled five mm behind the syringe and three mm to the right or left of the raphe. The intraosseous screws were inserted, checked by cephalometric and occlusal radiographs (Figures 2 and 3). Implant mobility was assessed after insertion and at the end of the distalization period, using tweezers. Mobility was recorded on a two-grade scale in which score 0 denoted no mobility and score 1 mobility.

A visual analogue scale (VAS)[37,39] was used to quantify the pain levels and patients' discomfort during the insertion, one week after the insertion, and at the retrieval period. The subjects were instructed to mark an “x” on the scale corresponding to the pain that they were experiencing. The VAS scores were evaluated using scatter graphics.

Fabrication of the distalization appliance

After healing, an impression was obtained with the screw in place, and a plaster model was prepared.

Upper right and left first premolar and first molar bands that had 0.018-inch brackets and 0.030-inch tubes were fitted to the teeth on the dental cast.

A 0.036-inch (0.9 mm) stainless steel transpalatal arch (TPA) was prepared between the first premolars, with a “U” bend touching the screw. The TPA was soldered to the bands, the bands were cemented onto the premolars, and the U bend was bonded to the intraoral neck section of the screw using light-cured composite resin.

At the same visit, active molar distalization was started for all patients. Bilateral sectional arches (0.016 × 0.022-inch stainless steel) and 0.036-inch nickel-titanium open-coil springs were inserted between the first premolar and molar with a continuous force of ~250 g per side (Figure 4).

The patients were examined every four weeks, and the force level of the coil springs was activated when necessary. When both first molars were moved into an approximately two-mm overcorrected Class I relationship, the premolar bands were removed, and the distalization appliance was converted into a modified Nance holding arch (Figure 5).

The analysis

Lateral cephalograms and impressions were taken before and after the molars were distalized. The anteroposterior movement of the maxillary first molars, premolar, and central incisors was evaluated from the cephalograms and dental casts.

Skeletal and soft tissue landmarks were selected on the cephalogram to measure changes in the position of the maxillary first molars (Figures 6 and 7). To form a vertical reference plane, a perpendicular line was drawn to the SN plane from the intersection of the anterior wall of sella turcica and the anterior clinoid processes, structures that do not move with growth changes[40] (Figure 8).

Dental casts permit three-dimensional studies of malocclusion for diagnosis and treatment planning and as a reference throughout treatment. In this study, a two-faced, transparent mesh chart with vertical and horizontal mesh lines and reference lines allowed three-dimensional analyses, and it was used to evaluate the dental casts by direct inspection.[29] During the inspection, it is important to fit the mesh lines of the chart snugly to each other. Vertical reference lines or raphe (Rp) and horizontal reference lines (R) were constructed on all study models, according to the description of Haas and Cisneros[41] and Hoggan and Sadowsky.[42] After these were made, the reference lines of the study models fit the mesh chart's, and the positional changes of the maxillary first molars and central incisors were evaluated in millimeters (Figure 9). Data were collected for 25 individuals and entered in tables. Means (x) and SD were calculated for the pre- and postdistalization measurements.

RESULTS Return to TOC

First molars were successfully distalized into an overcorrected Class I relationship in all patients. Distalization time ranged from three to 6.2 months (Table 1). A fixed, bonded and banded second-stage treatment lasted a mean of 14 months. An example of the distalization can be seen in Figures 10 through 20.

The insertion procedure of the screws was quick and simple, and no patients reported pain or required analgesic treatment after the insertion or during the distalization period. Depending on the level of hygiene around the screw, the adjacent tissues showed minimum or no inflammation. There were no speech perturbances, bleeding, or other complications (as to VAS scores, Figure 21a,b). All screws were stable right after the insertion and after the distalization period (score 0).

Method error study

The radiographs were retraced and remeasured for all 25 cases, a minimum of two weeks apart, to determine intraexaminer error. Using Dahlberg's formula,[43] the mean cephalogram measurement error was between 0.07 and 0.37, and the mean dental cast measurement error was between 0.14 and 0.20.

Cephalometric analysis

The mean maxillary molar distalization was 3.9 mm (SD 1.61) measured at the mesial buccal cusp tip. The maxillary molar crowns tipped distally an average of 8.7° (SD 4.8°), and the first premolars tipped mesially an average of 2.8° (SD 3.1°). Generally, tipping increased as movement increased (Table 2; Figure 22). The maxillary incisors proclined a mean 1° (SD 1.3°) and were advanced an average of 0.5 mm (SD 0.6) at the incisal edge. Vertical and sagittal dimensions remained virtually unchanged.

Dental cast analysis

During the molar distalization phase of treatment, the mean proclination of the right and left centrals was 0.3 mm (SD 0.8) and 0.5 mm (SD 0.9), respectively. The buccal and palatal cusps of the right and left maxillary first molars were distalized an average of 5.3 mm (SD 2.7) and 3.5 mm (SD 2.4) and 4.9 mm (SD 2.2) and 3.8 mm (SD 1.6), respectively. There was no change in the first premolars (Table 3; Figure 23).

DISCUSSION Return to TOC

Headgears have inherent disadvantages related to compliance and duration of wear and are unacceptable to many adults. The intraoral molar distalization appliances such as the pendulum,[3,4] push-coils,[5] and magnets[6,7] effectively distalize the maxillary molar teeth to a Class I relationship without any cooperation on the part of the patients. Nevertheless, anchorage loss occurs with the use of these appliances, with a significant maxillary incisor proclination and an increase in overjet at the end of the distalization.[5,7,12–16,44,45]

Implants resist orthodontic forces for the duration of treatment. Both the absence of implant mobility and histologic findings suggest that a stable bone-implant bond is maintained during the treatment period.[26,46,47] The implants are loaded after a period of approximately three to six months[19,20,24–26,31,32,36] to allow healing and osseointegration. Moreover, implants are troublesome for patients because of the severity of the surgery, the discomfort during initial healing, and the difficulty in oral hygiene.[27]

Success of the screw

In the present study, we used the intramaxillary fixation screw to uni- or bilaterally distalize maxillary molars, allow immediate loading, and provide anchorage. The screw length of 14 to eight mm was selected based on a small pilot study, in which we observed that the length of the screw increases the stability.

The desired immobility of these screws relies on a mechanical locking between the screw and the surrounding bone. The insertion procedure took five to eight minutes and needed no mucoperiostal flap. All the screws showed primary stability and were loaded almost immediately. This is an advantage over implants that require a healing and osseointegration time of at least three months.[20,26,46] In the anterior part of the palatal vault, the screws must be placed precisely behind the incisive canal toward spina nasalis anterior to prevent possible perforation of the nasal floor or nasal mucosa (or both).

After the molars were distalized, screw removal was accomplished with a screwdriver. Local anesthesia was not required for some patients because the patients' discomfort was very slight, and primary wound healing was achieved in all patients (Figure 21c).

In this study, the IMF screws were very stable as in the intraosseous screw[2,35] and implant[22–27] studies for maintaining anchorage during molar distalization. After upper canine distalization or during the incisor consolidation, the screw must be removed because it may interfere with the roots of incisors.

An effective distalization

The distalization system efficiently distalized the maxillary molar teeth to a Class I relationship without any patient cooperation. Subsequent to the molar distalization period, the system was converted into a modified Nance appliance to increase upper molar anchorage. This design difference enabled first and second premolars to freely drift distally with the help of the transeptal fibers. These are the main advantages of the system when compared with other appliances requiring patient compliance such as headgear and Class II elastics.

Molar distalization usually can be achieved in a relatively short period (3.5 to four months) with repelling magnets,[12,13,48,49] superelastic coil springs,[13,50] pendulum appliance,[14–16] or the Wilson arch.[51] These appliances produce distal movement at the rate of 0.6 to 1.2 mm per month. In comparison, the distalization system displaced the maxillary molars at the rate of one to 1.3 mm for each month. According to the cephalometric and dental cast analyses, during a 4.6-month period, the system moved the maxillary first molars distally an average of 3.9 and 4.3 mm per side into an overcorrected Class I relationship (Tables 2 and 3).

Overcorrection need

The overcorrection is necessary because molar anchorage loss will invariably occur during retraction of the premolars, canines, and incisors, and the overcorrection serves to compensate for this anchorage loss. In a sense, the overcorrection is prepared anchorage.[52] In addition, distal tipping of the molars produces more crown than root movement, and overcorrection compensates for the subsequent forward movement of the molars into a Class I position because the crowns move mesially more than the roots.[4,12,41,52,53]

The molar distalization was increased by distal molar tipping (mean 8.76°). Many reports have found tipping occurring as a result of distalization, which ranges from 4° to 15.7°.[4,14,41,53] However, if more rigid mechanics were used for the distalization, there can be less molar tipping. KeleŞ and IŞguden[11] reported the use of a heavy rod for better control of the direction of the force and also achieved bodily distalization with sliding mechanics.

Most patients with a Class II malocclusion exhibit maxillary first molars that are rotated mesially around the palatal root.[54] In the present investigation, the first molars developed a mild distal rotation of the buccal cusps during the distalization (Figure 23). This can be useful in the correction of mesially rotated molars.

Insufficient overbite

In the correction of Class II malocclusions, distal and intrusive movement of the maxillary molars usually is desirable, especially in those patients with hyperdivergent growth patterns.[55] In this study, the force vector passed occlusally to the center resistance, and this force system produced backward and upward movements of maxillary molars in conjunction with distal crown tipping. Because of the intrusive effect, distal movement of maxillary molars did not tend to open the mandible (Table 2). These effects are similar to those produced by a high-pull headgear.[56–61] In contrast, most rapid molar distalization appliances tend to cause the mandible to rotate downward and backward, opening the mandibular plane angle. Of seven studies[12–16,50,62] that evaluated the mandibular plane changes during distalization, five reported that the mandible rotated downward and backward approximately 1°.[13,14,16,50,62]

The second molars

Second molars have been considered a hindrance to traditional means of distalization. However, this was not the case with the intraosseous screw–supported molar distalization. Distalization was successfully achieved regardless of the status of the second molar or patient age (Table 1). The three patients who had not yet erupted second molars achieved a correction as quickly as those who had second molars present. Joseph and Butchart[4] also did not find second molars a hindrance to distalization. It was reported that presence of second molar did not interfere with distalization of molar when using the pendulum. The latter is contrary to the findings of Gianelly et al,[6] who found that second molars impeded the distalization of the first molars when using magnets.

Anchorage loss

The present sample demonstrated a slight anchorage loss as defined by maxillary incisor proclination (mean 1°) and increased overjet at the end of movement (mean 0.5 mm). These can be attributed to mesial tipping of the first premolars (mean 2.8°) during the molar distalization. If the screw is stable during the distalization and retention period, mesial tipping of the premolars may be due to flexibility of the TPA and an insufficient connection between the TPA and the screw. There is a one-point contact between the TPA and the screw, which results in minimal mesial rotational movement of the premolars during the molar distalization. Wehrbein et al[33] also reported mesial tipping of the anchoring premolars of 0.5 mm due to flexibility of the palatal bar using Strauman implants and the Orthosystem.

Anchorage loss was also noted with many intraoral distalizing mechanics. Ghosh and Nanda[14] and Joseph and Butchard[4] observed overjet increases of 1.3 and 3.7 mm, respectively. Dietz and Gianelly[52] reported four-mm molar distalization vs two-mm overjet increase.

Inaccuracies in obtaining both cephalometric and dental cast data may result in measuring errors. Cephalometric errors may be due to positioning of the patient in the cephalostat, magnification, and the difficulty in determining right from left molars with absolute certainty in all films. The dental cast data could be considered more accurate because positioning of the models was subject to less variability and landmarks were more easily identifiable and reproducible.[41,42]

This study has shown the action of intraosseous screw– supported upper molar distalization. The esthetic and compliance-free nature of the distalization system appears superior to the alternative of headgear and Class II elastics. In addition to the relative ease of placement and removal, other aspects of system also make this procedure more acceptable to the patients.

CONCLUSIONS Return to TOC

The conclusions to be drawn from the results of the present prospective study using the IMF screw inserted in the midsagittal palate for distalization and anchorage reinforcement of posterior teeth in 25 patients are:

- The screw insertion and retrieval procedures were quick, simple, and painless. They retained their stability during treatment. There was no inflammation, bleeding, or excessive pain in the tissues adjacent to the screw.
- Class II molar relationships were corrected to Class I in about 4.6 months. The orientation of the force vector resulted in a tipping and rotation in the first molars.
- The distalizing force on the maxillary molar resulted in 88% molar distalization and 12% reciprocal anchorage loss measured at the maxillary central teeth.
- No significant vertical changes were observed during distalization.
- The advantages of this treatment approach were elimination of compliance-dependent intraoral and extraoral anchorage aids, relatively predictable outcomes, favorable esthetics, reduction of orthodontic appliances, the possibility of immediate force application, different activations on each side, and active bi- or unilateral molar distalization.
- Subsequent to the distalization period, the system can be converted into a modified Nance appliance to increase upper molar anchorage. This design difference enabled first and second premolars to drift distally freely with the help of the transeptal fibers.
- This distalization system can be used safely in patients of all age groups, who have bilateral first or second premolar.
- The more rigid systems are required to prevent the side effects on first molar and premolar.

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TABLES Return to TOC

TABLE 1. Patient Characteristics

Patient	Treatment Time (Mo)	Second Molars Present	Pretreatment Age
1	Four	Yes	12 y four mo
2	Three	No	11 y three mo
3	Five	Yes	14 y two mo
4	5.5	Yes	13 y one mo
5	Five	Yes	14 y four mo
6	Five	Yes	15 y one mo
7	5.5	Yes	15 y six mo
8	Four	Yes	12 y six mo
9	Five	Yes	14 y six mo
10	Four	No	12 y one mo
11	Five	Yes	14 y nine mo
12	Six	Yes	11 y nine mo
13	4.4	Yes	12 y eight mo
14	5.4	Yes	13 y nine mo
15	6.2	Yes	16 y five mo
16	Four	Yes	14 y three mo
17	4.2	Yes	14 y six mo
18	3.8	Yes	12 y four mo
19	3.5	Yes	16 y three mo
20	Four	Yes	15 y six mo
21	4.3	Yes	14 y seven mo
22	Six	Yes	13 y three mo
23	4.2	Yes	14 y three mo
24	3.7	No	12 y zero mo
25	5.2	Yes	14 y two mo
Mean	4.6		13 y nine mo

TABLE 2. Cephalometric Evaluation of Changes Before and After Distalization

	n	Before				After				Change			
		Mean (x)	SD	Minimum	Maxi-mum	Mean (x)	SD	Minimum	Maxi-mum	Mean (x)	SD	Minimum	Maxi-mum
Vertical parameters													
SNGoMe	25	34.56	5.01	26.00	45.00	34.66	4.99	26.00	45.00	0.10	0.02	−1.00	1.00
FMA	25	26.00	4.99	16.00	37.00	26.08	4.90	16.00	37.00	0.08	0.09	−1.00	1.00
Y axis angle	25	68.50	4.56	62.00	77.00	68.58	4.54	62.00	77.00	0.08	0.02	−2.00	2.00
ANSPNS-GoMe	25	26.08	5.33	14.00	35.00	26.00	5.23	14.00	35.00	−0.08	0.10	−1.00	1.00
Sagittal parameters													
SNA	25	80.10	4.43	70.00	86.00	80.06	4.43	70.00	86.00	−0.04	−0.01	−1.00	0.00
SNB	25	77.00	4.47	68.00	85.00	76.92	4.46	68.00	85.00	−0.08	0.00	−2.00	0.00
ANB	25	3.10	1.98	0.00	8.00	3.14	1.97	0.00	8.00	0.04	0.02	0.00	1.00
N ⊥ A (mm)	25	0.88	2.91	−4.50	9.00	0.94	2.83	−4.00	9.00	0.06	0.08	−0.50	1.00
N ⊥ B (mm)	25	7.42	4.62	1.00	19.00	7.52	4.71	1.00	20.00	0.10	−0.09	−0.50	1.00
Dental angular parameters													
U1 SN	25	100.24	6.99	89.00	115.00	100.90	6.70	90.00	115.00	0.66	0.29	−2.00	4.00
U1 NA	25	19.32	5.88	7.00	30.00	19.75	5.73	7.00	30.00	0.43	0.15	−2.00	4.00
U1 PP	25	108.30	6.79	95.00	122.00	109.26	6.39	95.00	123.00	1.00	1.34	0.00	5.00
U4-PP	25	80.36	3.55	73.00	88.00	83.20	4.67	74.00	92.00	2.84	3.11	0.00	3.00
U6 PP	25	75.56	6.67	64.00	94.00	66.80	7.46	44.00	77.00	−8.76	4.79	−20.00	0.00
L1 MP	25	93.64	7.88	79.00	107.00	93.64	7.88	79.00	107.00	0.00	0.00	0.00	1.00
L1 NB	25	26.08	17.22	1.00	99.00	26.12	17.13	1.00	99.00	0.04	0.09	−2.00	3.00
interincisal angle	25	127.24	22.14	35.00	151.00	126.78	21.79	35.00	146.00	−0.46	0.35	−5.00	2.00
Dental linear parameters (mm)													
S ⊥ U1u	25	54.36	6.34	40.00	62.50	54.84	6.16	40.00	62.50	0.48	0.62	0.00	1.50
U1-NA	25	2.76	1.68	0.00	6.00	3.13	1.56	0.00	6.00	0.37	0.11	−0.50	3.50
S ⊥ U6b	25	23.68	8.46	8.00	36.00	19.78	8.50	4.50	34.50	−3.90	1.61	−8.00	−1.50
overjet	25	3.62	1.74	1.00	6.00	3.78	1.75	0.00	6.50	0.16	−0.01	−1.00	2.50
overbite	25	3.58	1.77	0.00	6.50	3.48	1.70	0.00	6.00	−0.10	0.07	−2.50	2.50
Soft tissue (mm)													
UL-E	25	0.02	3.47	−5.00	7.00	0.06	3.50	−5.50	7.00	0.04	−0.03	−0.50	1.00
LL-E	25	−0.81	2.72	−5.50	4.50	−0.77	2.64	−5.50	5.00	0.04	0.08	−1.50	1.50

TABLE 3. Dental Cast Evaluation of the Changes Before and After Distalization

	Before				After				Change			
	Mean (x)	SD	Minimum	Maximum	Mean (x)	SD	Minimum	Maximum	Mean (x)	SD	Minimum	Maximum
11-R (mm)	18.10	2.90	12.50	25.00	18.50	2.50	15.00	22.50	0.30	0.80	0.00	2.50
21-R (mm)	18.40	3.10	12.00	22.50	18.80	2.50	15.00	22.50	0.50	0.90	0.00	3.00
16b-R (mm)	7.80	3.90	3.50	14.50	13.10	4.20	6.00	19.00	5.30	2.70	1.00	11.50
16p-R (mm)	11.50	3.90	6.00	17.00	15.00	4.40	8.00	21.00	3.50	2.40	0.50	9.00
26b-R (mm)	7.70	4.30	0.00	14.50	12.60	4.10	6.50	19.00	4.90	2.20	1.50	9.00
26p-R (mm)	11.70	4.40	5.00	18.50	15.50	3.80	9.50	21.00	3.80	1.60	2.00	7.00

FIGURES Return to TOC

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FIGURE 1. The intraosseous screw

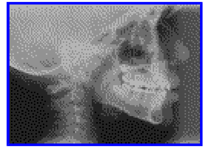

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FIGURE 2. After insertion, the screw position on cephalometric radiograph

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FIGURE 3. After insertion, the screw position on occlusal radiograph

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FIGURE 4. The distalization appliance

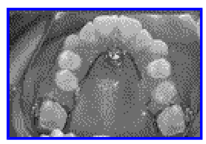

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FIGURE 5. The removable modified Nance holding arch

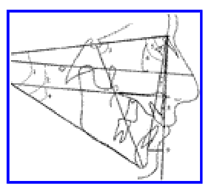

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FIGURE 6. Skeletal measurements. 1: SNGoMe; 2: FMA; 3: Y axis angle; 4: ANSPNS-GoMe; 5: SNA; 6: SNB; 7: ANB; 8: N ⊥ A (mm), 9: N ⊥ B (mm)

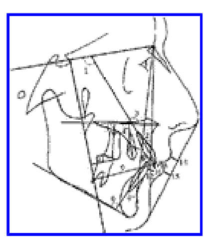

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FIGURE 7. Dental and soft tissue measurements. 1: U1 SN; 2: U1 NA; 3: U1 PP; 4: U4-PP; 5: U6 PP; 6: L1 MP; 7: L1 NB; 8: interincisal angle; 9: S (⊥) U1u; 10: U1-NA; 11: S (⊥) U6b; 12: overjet; 13: overbite; 14: UL-E; 15: LL-E

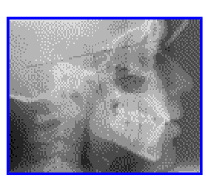

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FIGURE 8. Vertical reference plane

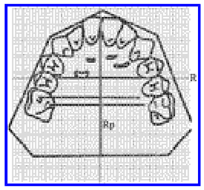

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FIGURE 9. Millimetric evaluation of positional changes of maxillary first molars and central incisors

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FIGURES 10–12. Pretreatment photographs of a 16.5-year-old female patient

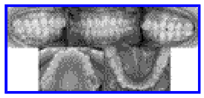

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FIGURE 11

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FIGURE 12

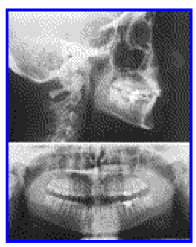

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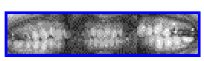
FIGURE 13. Pretreatment panoramic and cephalometric radiographs



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FIGURES 14–16. Intraoral photographs after 6.2 months of molar distalization

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FIGURE 15

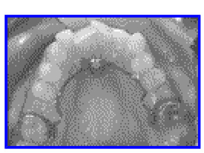

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FIGURE 16

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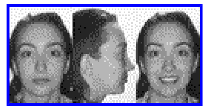
FIGURE 17. After the distalization, panoramic and cephalometric radiographs



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FIGURES 18 and 19. Posttreatment photographs

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FIGURE 19

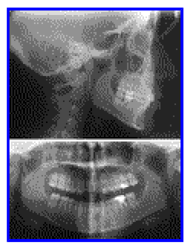

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FIGURE 20. Posttreatment panoramic and cephalometric radiographs

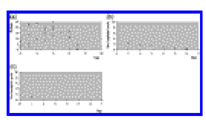

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FIGURE 21. (a) The patient's pain levels during the screw application. (b) During one week period, the patient's discomfort after the screw application. (c) During one week period, the patient's discomforts during and after the screw removal

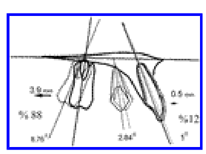

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FIGURE 22. After the distalization. Schematic diagram of the treatment effects on the teeth shown by cephalometric analysis

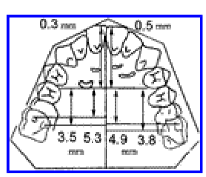

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FIGURE 23. After the distalization. Schematic diagram of the treatment effects on the teeth shown by dental cast analysis

[a]Postdoctoral Fellow, Department of Orthodontics, Faculty of Dentistry, Selcuk University, Konya, Turkey

[b]Associate Professor, Department of Orthodontics, Faculty of Dentistry, Selcuk University, Konya, Turkey

[c]Associate Professor, Department Chief, Department of Orthodontics, Faculty of Dentistry, Selcuk University, Konya, Turkey

[d]Associate Professor, Department of Maxillofacial Surgery, Faculty of Dentistry, Selcuk University, Konya, Turkey

[e]Postdoctoral Fellow, Department of Maxillofacial Surgery, Faculty of Dentistry, Selcuk University, Konya, Turkey

Corresponding author: İbrahim Erhan Gelgör, DDS, PhD, Department of Orthodontics, Selcuk University, Dishekimligi, Konya, Selcuklu 42080, Turkey (E-mail: egelgor@yahoo.com)
