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## **A clinical comparative study of molar distalization using the bone anchored distalizer and the traditional tooth-supported distalizer**

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**Abstract**---Objective: The aim of this study was to Clinical Comparative evaluation of the maxillary 1<sup>st</sup> molars distalization by the Bone-Anchored Distalizer and the Traditional Tooth-Supported Distalizer. Patients and Methods: The sample was consisted of 20 patients (7 males and 13 females), 7 patients (3 Males and 4 females) for group A and 13 patients (4 males and 9 females) for group B. However, 2 of them discontinued the treatment due to different causes. As a result of this, the study was performed on 18 patients. The sample was selected from patients seeking orthodontic treatment in out- patient clinic, Orthodontic Department, Faculty of Dental Medicine, Al- Azhar University, Assiut , Egypt. Patients was divided into two groups; Group (A): In this group, upper molar distalization was done with bone anchored distalizer (advanced molar distalization appliance AMDA, Dentaurum, Ispringen, Germany) and Group (B): In this group, upper molar distalization was done with tooth supported distalizer (fast back appliance, leone, s.p.a, italy). Results: The results of the present study declared that the changes in the SNA, SNB, and ANB angles were significant ( $p > .05$ ), The maxillary first molars were distalized significantly ( $p < .05$ ) according to cephalometric measurements for both groups ( $6.6 \pm 1.06$  and  $7.37 \pm 0.47$  mm respectively) and dental cast measurements ( $19.85 \pm 1.46$  and  $28.64 \pm$

2.87 mm respectively). The mean duration of distalization was  $7.8 \pm 0.63$  months. In the present study the maxillary first molars were distalized with a significant distal tipping about ( $2.95^\circ \pm 0.76^\circ$  ( $p < .05$ ) for group A and ( $4.56^\circ \pm 0.75^\circ$  ( $p < .05$ ) for group B. The vertical positions of the upper first molars were significantly changed for both groups ( $p > .05$ ). The intermolar width was significantly increased by  $3.49 \pm 0.91$  mm for group A and  $3.50 \pm 1.29$  mm for group B indicating that upper first molars were moved buccally ( $p < .05$ ). Conclusion: The AMDA appliance and The Fast Back appliance is an effective distalizer with an easy way of activation. The skeletal changes sagittally and vertically are significant for each group, but insignificant for the intergroups comparison except for the palatal mandibular plane angle (PP-MP) which is significant.

**Keywords**---clinical comparative study, molar distalization, bone anchored distalizer, traditional tooth-supported distalizer.

## Introduction

Distalization is a common nonextraction strategy for treatment of moderate crowding malocclusion in which extraction is not indicated.<sup>1,2</sup> Various appliances have been routinely used for molar distalization and can be classified as compliance or non-compliance appliances.<sup>3</sup> Dependence on patients' cooperation is a cornerstone for the drawbacks of compliance modalities, such as, extraoral traction and removable appliances.<sup>4, 5, 6</sup> As a result of that, the creation and use of non-compliance, fixed, intramaxillary appliances for molar distalization, such as; Pendulum<sup>7</sup>, Distal Jet,<sup>8</sup> Jones Jig,<sup>9</sup> Keles Slider,<sup>10</sup> Fast Back<sup>11</sup> and First Class Appliance,<sup>3</sup> have been done through advancements of biomechanics, technology, and materials. However, they may have unfavorable side effects, including different degrees of anchorage loss, mesial tipping of premolars, maxillary first molar tipping, posterior rotation of the mandibular plane, proclination of the incisors, and lip protrusion.<sup>12</sup> These side effects can vary among different techniques and appliances.

Papadopoulos<sup>13</sup> in 2010 had developed the AMDA\ appliance for the distalization of upper molars. Few studies had investigated the treatment outcome of the AMDA appliance. Lanteri et al<sup>11</sup> in 2001 had developed the Fast Back appliance for the distalization of upper molars. They suggested that the appliance was fully programmable, with reduced bulk and causing minimal patient discomfort. As a result of that, this study was concerned about evaluating and clinical comparing the dental and skeletal effects of the AMDA appliance and fast back appliance used in distalization of maxillary first molars.

## Patients and Methods

The study was approved by the research ethical committee of AlAzhar University Assuit Branch and informed consents were obtained from the patients. The sample of this study was obtained from the clinic of the Department of Orthodontics, Faculty of Dental Medicine, Al-Azhar University Assuit Branch.

Patients were selected according to the following criteria: mild Class II, space deficiency in the upper arch less than 8 mm, non-extraction lower arch, ages ranged from 13 to 20 years, good oral hygiene, no oral habits, and no previous orthodontic treatment. The sample was consisted of 20 patients (7 males and 13 females), 7 patients (3 Males and 4 females) for group A and 13 patients (4 males and 9 females) for group B. However, 2 of them discontinued the treatment due to different causes. As a result of this, the study was performed on 18 patients. Patients was divided into two groups; Group (A): In this group, upper molar distalization was done with bone anchored distalizer (advanced molar distalization appliance AMDA, Dentaaurum, Ispringen, Germany) and Group (B): In this group, upper molar distalization was done with tooth supported distalizer (fast back appliance, leone, s.p.a, italy).

The advanced molar distalization appliance (AMDA) and mini implant (MI) were inserted in a single appointment. Normal full infection control measures similar to those for extractions should be used, including sterilization of the MI kit (length 8mm, diameter 1.6mm. matt orthodontics, LLC, Chicago, USA). Fixing of the AMDA with the MIs through SS ligature wires (diameter, 0.012 inch) might be necessary, particularly when MIs with smaller head dimensions are used. A small portion of light-cure resin can be added to cover the top of each implant head plus the endings of the ligature wires and the loops of the palatal archwire to avoid plaque accumulation. Patients are given clear instructions on how to maintain oral hygiene. They are monitored every 4 weeks for hygiene, for the stability of the MIs, and for further adjustments and reactivation of the appliance.<sup>13,14</sup> Reactivation occurs by unscrewing the mesial stop screw, moving the anterior part of the tubing system more distally, thus squeezing the encased coil springs, and then rescrewing the stop screws in the new position.<sup>13,14</sup> The Fast back appliance was delivered with its coil springs were lightly activated (20%). Ligation of the molars bands to the respective first premolars bands was done to facilitate the positioning of the appliance in the mouth. The maxillary teeth were isolated with proper moisture control and the appliance was cemented with a chemically cured glass ionomer cement. Activation of the distalizer was done after 24 hours of cementation. According to the manufacturer, following these instructions, the distalizer was activated 4 activations by opening the screw, using a specific key, to deliver continuous, preset force (300 grams). Every activation generated 0,2 mm of spring compression. After distalization had begun, reactivation was carried out every 30 days.<sup>11</sup> Lateral cephalometric radiographs and dental casts were obtained before and immediately after distalization.

Pancherz's superimposition method was used to assess sagittal dental linear changes. Consequently, we could avoid errors due to possible variations in the inclination of the occlusal plane after molar distalization.<sup>15</sup> Regarding the measurements on the dental casts, landmarks were marked on the predistalization and postdistalization study casts. Angular and linear measurements on the photocopies of the cast were declared in Figure 4 All lateral cephalometric radiographs and cast photocopies were traced and analyzed by one investigator. Then, they were randomly retraced and analyzed again by the same.

### **Cephalometric landmarks**

1. is (incisor superior): the incisal tip of most prominent maxillary central incisor.
2. ia (incisor apex): the apex of most prominent maxillary central incisor.
3. ii (incisor inferior): the incisal tip of most prominent mandibular central incisor.
4. ms (molar superior): the mesial contact point of maxillary permanent first molar, determined by tangent perpendicular to occlusal line (OL).
5. ma (molar apex): the apex of mesio- buccal root of maxillary permanent first molar.
6. mmc (mesial molar cusp): the mesio-buccal cusp tip of maxillary first permanent molar.
7. dmc (distal molar cusp): the distobuccal cusp tip of maxillary first permanent molar.
8. ps (premolar superior): the mesial contact point of maxillary first premolar, determined by tangent perpendicular to occlusal line (OL).
9. pa (premolar apex): the apex of buccal root of maxillary first premolar.
10. pc (premolar cusp): the buccal cusp tip of maxillary first premolar. Where double image of molars or second premolars gave rise to two points, midpoint was used.
11. Or: orbitale. S: sella. N: nasion. Me: menton. Go: gonion. ANS: anterior nasal spine. PNS: posterior nasal spine. Po: porion.

### **Skeletal and dental angular measurements**

- Skeletal sagittal measurements:  $SNA^{\circ}$ ,  $SNB^{\circ}$ ,  $ANB^{\circ}$ .
- Dental angular measurements:  $isia/SN^{\circ}$ ,  $pc-pa/SN^{\circ}$ ,  $mmc-ma/SN^{\circ}$ .
- Skeletal vertical measurements:  $SN-MP^{\circ}$ ,  $FMA^{\circ}$ ,  $PP-MP^{\circ}$ .

### **Sagittal and vertical dental linear measurements.**

- Sagittal dental linear measurements (Pancherz's superimposition method):  $ms \perp Olp$ ,  $ps \perp Olp$ ,  $is \perp Olp$ , Overjet.
- Vertical dental linear measurements: 5. Overbite ( $ii \perp OL$ ), 6.  $mmc \perp SN$ , 7.  $pc \perp SN$ , 8.  $Is \perp SN$ .

### **Angular and linear cast measurements.**

- Angular measurements
  1. MV- 6: the mean of right and left anterior angles formed by (mb-dp) lines of right and left maxillary first molars and (MV) line.
  2. MV- 4: the mean of right and left anterior angles formed by (bc-pc) lines of right and left maxillary first premolars and (MV) line.
- Linear measurements:
  1.  $MH \perp 6$ : the mean of the perpendicular distances between (CMR) and (CML) to (MH) line.
  2.  $MH \perp 4$ : the mean of the perpendicular distances between (CPR) and

(CPL) to (MH) line.

3. Interpremolar distance: the distance between (CPR) and (CPL). Those two points represented the geometric centers of the maxillary first premolars.
4. Intermolar distance: the distance between (CMR) and (CML).
5. Overbite: The vertical overlap of the lower incisors by the upper incisors. It was determined by measuring the vertical distance between the incisal tips of the most prominent maxillary and mandibular incisors.
6. Overjet: The horizontal distance from the incisal edge of the most protruded maxillary incisor to the labial surface of the opposing mandibular incisor.

### Statistical analysis

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests and showed parametric (normal) distribution. Independent sample t-test was used to compare between two groups in nonrelated samples. Paired sample t-test was used to compare between two groups in related samples. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

### Results

The means, standard deviations (SD) and results of paired t-test for pre and post distalization measurements are listed in Tables I and II. The results of the present study declared that the changes in the SNA, SNB, and ANB angles were significant ( $p > .05$ ). The maxillary first molars were distalized significantly ( $p < .05$ ) according to cephalometric measurements for both groups ( $6.6 \pm 1.06$  and  $7.37 \pm 0.47$  mm respectively) and dental cast measurements ( $19.85 \pm 1.46$  and  $28.64 \pm 2.87$  mm respectively).

The mean duration of distalization was  $7.8 \pm 0.63$  months. In the present study the maxillary first molars were distalized with a significant distal tipping about ( $2.95^\circ \pm 0.76^\circ$  ( $p < .05$ ) for group A and ( $4.56^\circ \pm 0.75^\circ$  ( $p < .05$ ) for group B. The vertical positions of the upper first molars were significantly changed for both groups ( $p > .05$ ). The intermolar width was significantly increased by  $3.49 \pm 0.91$  mm for group A and  $3.50 \pm 1.29$  mm for group B indicating that upper first molars were moved buccally ( $p < .05$ ). Rotations of molars were significantly increased by  $18.84 \pm 2.70$  for group A and  $10.78 \pm 1.46$  for group B ( $p > .05$ ).

The anchorage unit was unable to completely resist the reciprocal mesial force of group B. The upper first premolars were significantly moved mesially about  $3.92 \pm 0.38$  mm according to cephalometric measurements, and about  $67.29 \pm 6.58$  mm according to dental cast measurements ( $p < .05$ ), and for group A, about  $6.55 \pm 4.90$  mm according to cephalometric measurements, and about  $55.62 \pm 25.16$  mm according to dental cast measurements ( $p < .05$ ). In addition to this, the upper first premolars were significantly tipped mesially about  $1.60^\circ \pm 0.51^\circ$  for group A and  $2.66^\circ \pm 1.15^\circ$  for group B ( $p < .05$ ). Furthermore, they were significantly rotated about  $4.99^\circ \pm 1.39^\circ$  for group A and  $5.34^\circ \pm 0.51^\circ$  for group B. Regarding

the vertical position, the upper first premolars were extruded significantly about  $4.01 \pm 0.18$  mm for group A and  $3.99 \pm 0.37$  mm.

The interpremolar distance was insignificantly changed (group A,  $2.20 \pm 1.51$  and group B,  $1.68 \pm 1.99$ ). The maxillary incisors were significantly moved labially about  $2.57 \pm 1.25$  mm for group A and  $2.14 \pm 0.47$  for group B ( $p < .05$ ). In addition, upper incisors were significantly tipped labially about  $1.77^\circ \pm 0.28^\circ$  for group A and  $2.91^\circ \pm 0.48^\circ$  for group B ( $p < .05$ ) and significantly lower in group A .



Figure (1): a case presenting group (A) initial, during and after distalization.



Figure (2): a case presenting group (B) initial, during and after distalization.

Table I: The mean, standard deviation (SD) values of Cephalometric measurements (percentage of change) of the two groups

Variables	Cephalometric measurements Percentage of change					
	Group A		Group B		p-value	
	Mean	SD	Mean	SD		
Skeletal angular measurement (sagittal)	SNA°	0.71	0.08	0.67	0.18	0.668ns
	SNB°	0.59	0.19	0.56	0.28	0.839ns
	ANB°	18.40	6.39	23.09	8.89	0.366ns
Skeletal angular measurement (vertical)	FMA°	4.89	1.89	5.95	2.62	0.485ns
	SN-MP°	3.40	1.01	2.47	1.85	0.352ns
	PP-MP°	3.77	0.52	1.98	0.77	0.003*
Skeletal linear measurement	A-PTV, mm	2.35	1.16	2.65	0.60	0.622ns
	B-PTV, mm	1.00	0.36	0.94	0.54	0.847ns
	6-SN°	-2.95	0.76	-4.56	0.75	0.010*

Dental angular measurements	4-SN°	1.60	0.51	2.66	1.15	0.095ns
	1-SN°	1.77	0.28	2.91	0.48	0.002*
Dental linear measurements (sagittal)	1-PTV, mm	2.90	2.53	6.51	0.38	0.013*
	4-PTV, mm	9.72	1.20	7.75	1.09	0.026*
	6-PTV, mm	22.75	3.80	34.40	4.04	0.002*
	ms <sup>⊥</sup> OLp	-6.60	1.06	-7.37	0.47	0.175ns
	ps <sup>⊥</sup> OLp	6.55	4.90	3.92	0.38	0.265ns
	is <sup>⊥</sup> OLp	2.57	1.25	2.14	0.47	0.497ns
	Overjet	6.85	2.98	5.40	2.91	0.054ns
Dental linear measurements (vertical)	mmc <sup>⊥</sup> SN	-1.97	0.29	-1.05	0.58	0.013*
	spc <sup>⊥</sup> SN	4.01	0.18	3.99	0.37	0.913ns
	is <sup>⊥</sup> SN	1.34	0.50	2.79	0.54	0.002*
	Overbite	-3.44	2.32	-3.69	1.94	0.475ns

\*; significant (p<0.05) ns; non-significant (p>0.05)

Table II: The mean, standard deviation (SD) values of Cast measurements (Percentage of change)

Variables		Cast measurements Percentage of change				
		Group A		Group B		p-value
		Mean	SD	Mean	SD	
Angular measurements	MV-6	18.84	2.70	10.78	1.46	<0.001*
	MV-4	4.99	1.39	5.34	0.51	0.609ns
Linear measurements	MH-6	19.85	1.46	28.64	2.87	<0.001*
	MH-4	55.62	25.16	67.29	6.58	0.345ns
	Interpremolar distance	2.20	1.51	1.68	1.99	0.656ns
	Intermolar distance	3.49	0.91	3.50	1.29	0.988ns
	Overbite	-25.71	6.25	-22.39	6.86	0.447ns
	Overjet	7.45	3.54	14.16	7.50	0.108ns

\*; significant (p<0.05)ns; non-significant (p>0.05) minimize the distal tipping.

## Discussion

The results of the study showed less molar tipping than other studies.<sup>3, 7,11,13,16, 17, 18, 19, 20, 21</sup> However, it was more than that reported by Caprioglio et al.<sup>22</sup> The AMDA is provided with a rigid guiding system which was positioned parallel to the center of resistance to minimize the distal tipping. Despite the heavy distalizing force, the appliance was able to minimize the amount of molars tipping. The Fast Back Also is provided with a rigid guiding system (the posterior arm sliding inside the palatal tube) which was positioned parallel to the occlusal plane to minimize the distal tipping. Additionally, the 10 screws of the appliance were placed as close as possible to the center of resistance of the first molars inducing them to distalize bodily. Despite the heavy

distalizing force, the appliance was able to minimize the amount of molars tipping.

According to the results of the study, the vertical position of the upper first molars was insignificantly changed. The rigid guiding system was positioned parallel to the center of resistance to minimize the vertical changes of molars in AMDA and parallel to the occlusal plane in fast back but the screw parallel to the center of resistance. The intermolar width was significantly increased indicating that first molars were moved buccally. The result was matched with those of Ghosh and Nanda.<sup>17</sup> However, Fuziy et al<sup>23</sup> demonstrated a decrease in intermolar width, while Keles and Sayinsu<sup>24</sup> reported no change. In the present study, rotation of molars was insignificant. The increase in intermolar width and the lack of molar rotation after distalization can be attributed to the rigid guiding system of the AMDA and fast back appliances which helped to distalize the molars toward the posterior wider part of the dental arch and guarded the molars against the rotation.

The upper first premolars were minimally tipped mesially and rotated. However, The interpremolar distance was insignificantly changed. Some researches reported more anchorage loss regarding the mesial movement, tipping, and extrusion of the first premolars.<sup>7,10,11,13,18,22</sup> Regarding the maxillary incisors, they were moved and tipped labially. The findings were in agreement with several studies.<sup>3,10,21,23</sup> On the other hand, our results were less than other studies.<sup>8, 10, 22, 23, 24</sup> It was evidenced that the upper incisors were insignificantly extruded.

Proclination of the maxillary central incisors was associated with an increase in overjet. The results were in harmony with those of Keles.<sup>10</sup> Meanwhile, the decrease in overbite was less than those declared by other studies.<sup>7, 8, 10, 22, 23, 24</sup> In our study, the increase in mandibular plane angle (FMA angle) indicated that the lower vertical dimension was increased leading to reduction in overbite. Furthermore, proclination of the maxillary central incisors would decrease groups due to high force the overbite. system in the two appliances but less in AMDA group due The changes in sagittal and to it,s bony anchorage. vertical skeletal measurements<sup>5</sup>. The AMDA appliance more were significant, The skeletal effective in molar distalization measurements were affected than fast back appliance and significantly due to a relatively also less in anchorage loss. long period of distalization time.

## **Conclusion**

The AMDA appliance and The Fast Back appliance is an effective distalizer with an easy way of activation. The skeletal changes sagittally and vertically are ignificant for each group,but insignificant for the inter groups comparison except for the palatal mandibular plane angle (PP-MP) which is significant.

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