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Comparison of dentofacial effects of Molar Mover and Drive Tube appliances

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ABSTRACT

The aim of this study was to compare the effects of Molar Mover and Drive Tube appliances. 20 patients with class II malocclusion were included to the study. 10 patients in Group 1 were treated with Molar Mover and 10 patients in Group 2 were treated with Drive Tube. Wilcoxon analysis was used to compare in-group differences and Mann Whitney U test was used for between-group differences. In both of the groups distal molar tipping and distopalatinal rotation were found. In Group 1, more distopalatinal rotation was observed and an increase in the intermolar distance was determined in this group. Extrusion, mesialization and mesial tipping of second premolars were found in Group 1, while extrusion, distalization and distal tipping of these teeth were found in Group 2. Anterior facial height increased in both of the groups due to the tipping of the first molars and extrusion of the second premolars. Protrusion of maxillary incisors and upper lip occurred depending on the anchorage loss and this protrusion caused reduction of nasolabial angle. Results of this study showed that Molar Mover and Drive Tube were both effective in molar distalization but undesirable side effects were more prominent in Molar Mover appliance.

Key words: *Intraoral molar distalization, Molar Mover, Drive Tube*

ÖZET

Molar Mover ve Drive Tube apereylerinin dentofasial yapılar üzerine etkilerinin karşılaştırılması

Bu çalışmanın amacı, Molar Mover ve Drive Tube apereylerinin etkilerini karşılaştırmaktır. Çalışmaya sınıf II maloklüzyonu olan 20 hasta dâhil edildi. Grup 1 deki 10 hasta Molar Mover ile ve Grup 2 deki 10 hasta Drive Tube ile tedavi edildi. Grup-içi farkları karşılaştırmak için Wilcoxon analizi ve gruplar-arası farklar için Mann Whitney U testi kullanıldı. Her iki grupta da distal molar tippingi ve distopalatinal rotasyon bulundu. Birinci grupta daha fazla distopalatinal rotasyon gözlendi ve bu grupta molarlar arası mesafede artış tespit edildi. Grup 1 de, ikinci premolarlarda ekstrüzyon, mesializasyon ve mesial tipping bulunurken, Grup 2 de bu dişlerde ekstrüzyon, distalizasyon ve distal tipping bulundu. Ankraj kaybına bağlı olarak maksiller kesicilerde ve üst dudakta protrüzyon oluştu ve bu protrüzyon nasolabial açıda azalmaya neden oldu. Çalışmanın sonuçları Molar Mover ve Drive Tube apereylerinin ikisinin de molar distalizasyonunda etkili olduğunu gösterdi ancak Molar Mover apereyinde istenmeyen yan etkiler daha belirgindi.

Anahtar kelimeler: *Intraoral molar distalizasyonu, Molar Mover, Drive Tube*

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Introduction

In the success of any course of orthodontic treatment, patient compliance is an important determinant factor. Fixed appliances that require minimal patient compliance have been developed for the treatment of Class II malocclusion, in the last decades. Lokar Molar Distalizer, Keles Slider, Jones Jig, Distal Jet, etc. have been introduced that have been successfully used in the molar distalization (1-4).

Molar Mover and Drive Tube are also intraoral fixed distalization appliances that may be used in the treatment of noncompliance patients. Molar Mover *(Dentsply GAC International, NewYork, USA)* was composed of a sentalloy (Japan Ni-Ti) open coil spring and a chrome nickel attachment unit. The diameter of the sentalloy open coil spring was 0.045 inch and the thickness of the wire was 0.010 inch. The appliance was constructed of 6 pieces of coils with 4 turns and the distance between each coil was 2.5 mm. The total length of the appliance, including the attachment unit, was 25 mm.

Drive Tube *(Rocky Mountain Orthodontics, Denver, USA)* is an intraoral distalization appliance with a screw system which can be activated either by clinician or patient. It is produced as a kit containing a Drive Tube with a diameter of 0.018 inch, ball clasp wire, and L-shaped hex wrench. Inside the Drive Tube there is an activation screw. Ball clasp wire is a round wire with a diameter of 0.8 mm containing a small pushing ball at the end of one side. The screw is activated with the L-shaped hex wrench by turning it in the clockwise direction and 0.3 mm activation is provided by turning the screw180°.

The aim of this study was to compare the dentofacial effects of these two intraoral distalization appliances. To our knowledge there is no article reporting the effects of these two appliances.

Subjects and methods

The study was carried out after the approval of Ethics Committee of our academy. 20 patients with skeletal Class I and bilateral dental Class II malocclusion were included to the study. The selected patients were divided into two groups randomly. Group 1 was composed of 10 patients with a mean age of 11.8±0.92, treated by Molar Mover (Figure 1A), and Group 2 was composed of 10 patients with a mean age of 12.0±1.05, treated by Drive Tube (Figure 1B). Cephalometric and basilar radiographs were taken before the attachment of the distalization appliances (T1) and at the end of three months of distalization period (T2) to evaluate the effects of the appliances.

Molar Mover was performed between first molar and canine by passing the premolars. A Nance appliance was applied to the second premolars in order to increase the anchorage. Molar Mover was activated by ligaturing to the cleat that was soldered on the second premolar's band. The patients were controlled with 3 weeks intervals.

During the clinical application of Drive Tube "U" bend was performed to the clasp wire after the ball was adjusted to place between first and second premolars. The end of the clasp wire was passed through the headgear tube of the maxillary molar band. The wire was bended to the down side from the distal end of the headgear tube and the end of the wire was placed between the arms of the "U" bend. Drive Tube was positioned on the arch wire between the brackets of the first and second premolars. The brackets between the right and left first premolars were ligated to each other so as to increase the anchorage. The pushing ball of the clasp wire was in contact with the activation screw of Drive Tube. Patients activated the appliance with the L-shaped hex wrench by turning it 90° every day. They were controlled with 3 weeks intervals.

One investigator (E.Y.*) traced the radiographs and the landmarks were verified by other two investigators. Suspicious structures and landmarks were retraced to the mutual satisfaction of the investigators. A single average tracing was made in instances of bilateral structures. Measurements used in this study are shown in Figures 2,3 A,B.

The statistical analysis was performed by using SPSS (SPSS Inc, Chicago, III) statistical program. Descriptives were shown as mean ± SD. In-group differences were evaluated with Wilcoxon nonparametric test, and between-group differences were evaluated with Mann Whitney U test. Cephalograms and basilar radiographs of 12 patients were chosen randomly for examination of the measurement errors. These radiographs were remeasured after 1 month. The reliability of the single measurement was calculated by using Dahlberg's formula and was found to be 0.269.

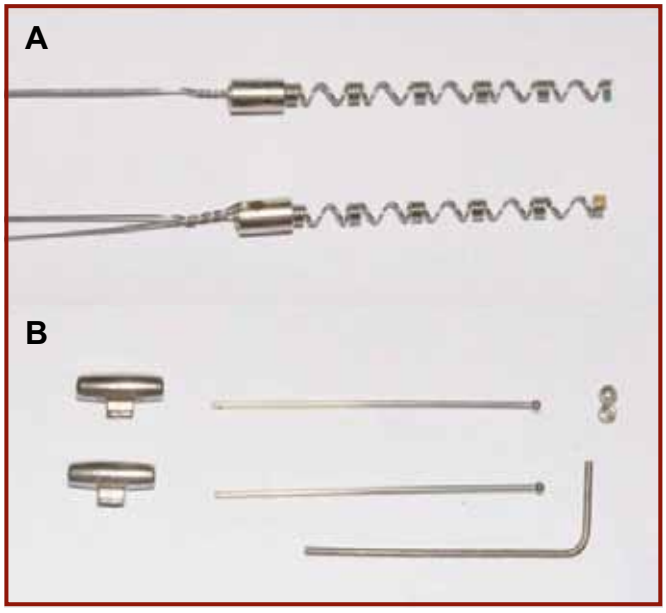

Figure 1. **(A)** Molar Mover and **(B)** Drive Tube.

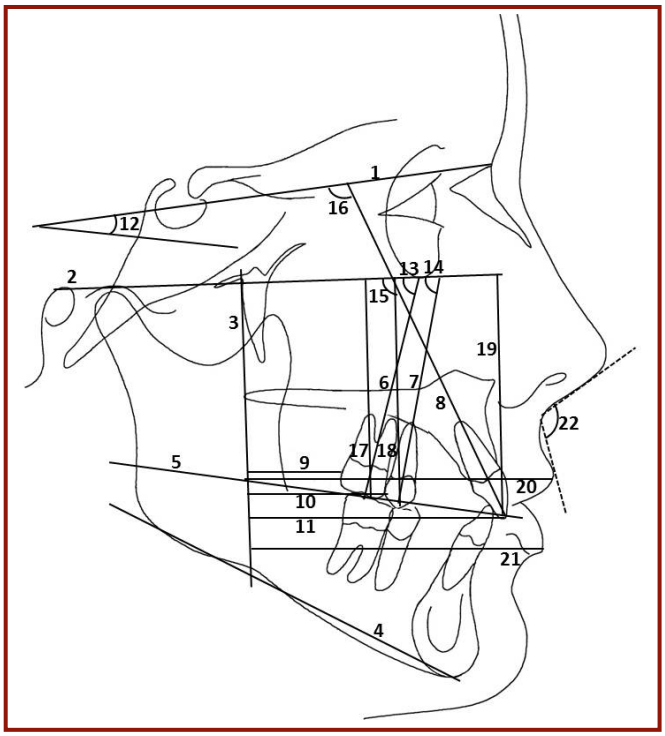

Figure 2. Dental and soft tissue measurements used in the cephalometric analysis: (1)SN (2)FH (3)PtV (4)Mandibular plane (5)Occlusal plane (6) U6a (7)U5a (8)U1a (9)U6d-PtV (10)U5d-PtV (11)U1i-PtV (12)SN/Occ (13) U6a/FH (14)U5a/FH (15)U1a/FH (16)U1a/SN (17)U6c-FH (18)U5c-FH (19) U1i-FH (20) Ls-Ptv (21)Li-PtV (22)Nasolabial angle.

Results

At the end of 3 months, Class I molar relationship was obtained for all patients in Group 1 but in Group 2, only 6 of the patients attained Class I molar relation. Other patients continue to the activation of the appliance for one more month after the cephalometric and basilar radiographs were taken.

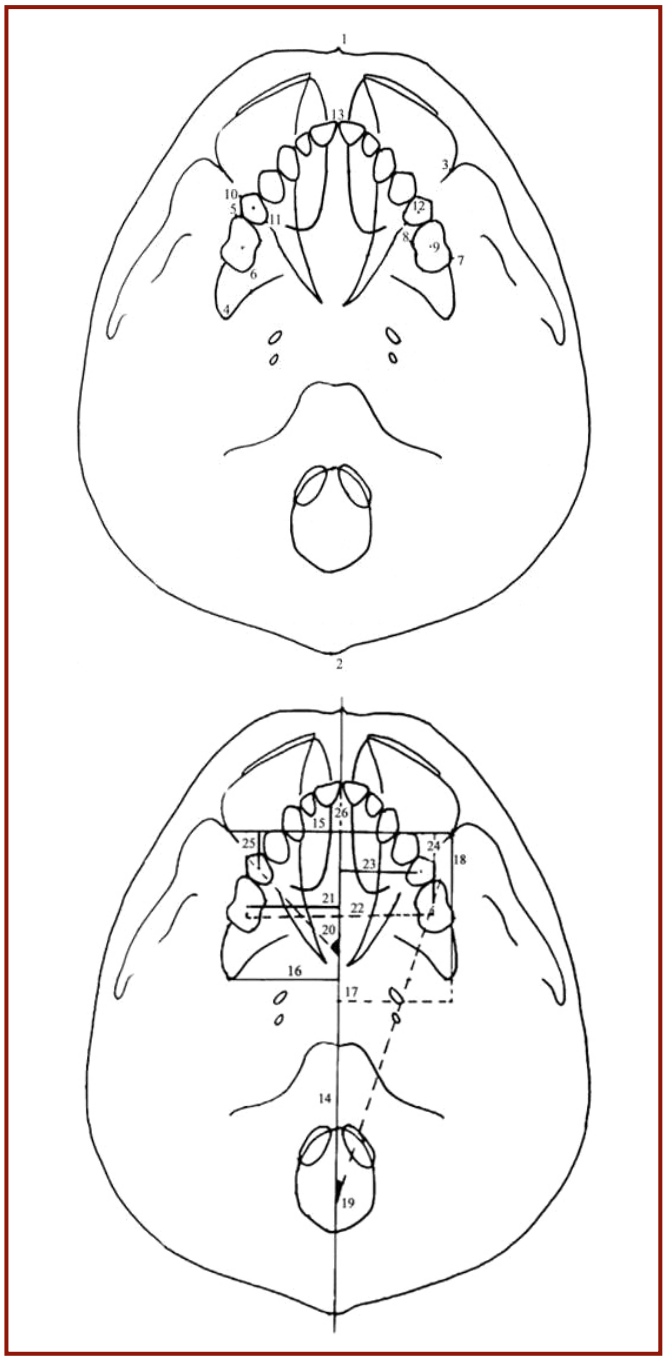

Figure 3. "R" is the symbol of right and "L" is the symbol of left. Point and measurement of one side is shown on the figures; **(A)** Points used in the basilar analysis: (1)GI (2)PPCB (3)SOL (4)MADR (5)MBR (6)DPR (7)DBL (8)MPL (9)MLC (10)PVR (11)PPR (12) PLC (13)I; **(B)** Measurements used in the basilar analysis: (14)midsagittal plane (MSR) (15)transversal plane(TP) (16)MADR-MSR (17)MADL-MSR (18)MADL-TP (19)MBL-DPL/MSR (20)PVR-PVR/MSR (21)MRC-MSR (22)MRC-MLC (23)PLC-MSR (24)MLC-TP (25)PRC-TP (26)I-TP.

In the cephalometric evaluation it was determined that FMA ($p<0.05$ for both groups), SN/GoGn ($p<0.01$ for both groups), ANS-Me ($p<0.01$ for Group 1, and $p<0.05$ for Group 2), and N-Me increased ($p<0.05$ for both groups) (Tables I, II).

Cephalometric findings revealed distalization and distal tipping of the molar teeth by decreases in the variables U6d-Ptv ($p<0.01$ for both groups) and U6a/FH ($p<0.05$ for both groups), respectively (Tables I, II). Increases in basilar variables MRC–TP ($p<0.01$ for both groups), and MLC-TP ($p<0.01$ for both groups) also showed the distalization of molars. Distopalatal rotation of the first molars was determined by increases in basilar variables MBR-DPR/MSR ($p<0.01$ for Group 1 and $p<0.05$ for Group 2), and MBL-DPL/MSR ($p<0.05$ for Group 1, $p<0.01$ for Group 2)

Table I. Comparison of pre-treatment (T1) and post-treatment (T2) cephalometric measurements of Group 1 (Molar Mover group)

	T1		*T2*		*p*
	MEAN	*SD*	*MEAN*	*SD*	
SNA	79.10	3.34	78.50	3.77	NS
SNB	75.40	2.75	74.80	3.48	NS
ANB	3.50	1.64	3.70	2.47	NS
FMA	24.30	5.39	26.20	4.26	*
SN/GoGn	33.30	5.65	36.50	6.02	**
Y-Axis	62.50	4.06	63.40	3.43	NS
N-ANS	54.30	3.16	54.70	2.49	NS
ANS-Me	66.00	4.64	67.50	4.76	**
N-Me	119.30	6.96	122.20	6.39	*
S-Go	77.40	4.22	78.40	4.74	NS
Co-A	90.00	3.36	89.90	3.44	NS
NV-A	3.20	3.64	4.30	3.40	NS
U6d-PtV	13.85	3.26	9.90	3.13	**
U5d-PtV	23.70	3.23	26.10	2.96	*
U1i-PtV	52.40	4.69	55.10	4.74	**
SN / Occ	18.60	5.25	18.20	5.07	NS
U6a / FH	77.80	6.26	71.30	5.55	*
U5a / FH	80.80	5.71	85.20	4.91	*
U1a / FH	104.20	7.92	110.40	8.15	**
U1a / SN	95.70	8.39	101.90	8.27	**
U6c-FH	45.20	3.39	46.30	3.94	NS
U5c-FH	47.60	3.09	49.60	2.27	*
U1i-FH	52.90	3.68	51.30	3.53	**
PtV-Ls	68.00	3.18	69.00	2.58	**
PtV-Li	64.50	3.37	64.40	2.87	NS
Nasolab.	116.70	7.64	114.40	8.50	**

SD; standard deviation and ***NS;*** not significant,
*p< 0.05, **p< 0.01, ***p< 0.001

Table II. Comparison of pre-treatment (T1) and post-treatment (T2) cephalometric measurements of Group 2 (Drive Tube group).

	T1		T2		p
	MEAN	SD	MEAN	SD	
SNA	79.40	2.45	78.90	2.60	NS
SNB	75.60	1.89	75.00	1.56	NS
ANB	3.80	1.68	3.90	2.18	NS
FMA	26.00	5.41	27.20	5.49	*
SN/GoGn	34.40	4.27	35.90	4.22	**
Y-Axis	62.70	2.75	63.40	3.02	NS
N-ANS	53.40	1.89	54.00	2.05	NS
ANS-Me	63.80	4.41	65.20	4.63	*
N-Me	117.30	5.07	119.30	5.81	*
S-Go	75.80	3.67	76.50	3.97	NS
Co-A	86.70	5.85	87.10	5.95	NS
NV-A	2.90	2.23	3.40	1.89	NS
U6d-PtV	13.80	3.67	10.40	3.89	**
U5d-PtV	25.10	4.20	23.90	3.98	*
U1i-PtV	53.00	4.59	54.50	3.50	**
SN / Occ	20.60	3.20	20.00	3.36	NS
U6a / FH	77.00	3.59	73.90	3.92	*
U5a / FH	83.20	5.00	82.50	4.69	*
U1a / FH	104.70	6.30	107.80	5.90	**
U1a / SN	96.60	5.16	99.60	6.05	**
U6c-FH	44.10	4.17	44.80	3.99	NS
U5c-FH	45.60	3.41	46.90	4.28	*
U1i-FH	53.60	3.14	52.50	3.49	*
PtV-Ls	68.60	4.24	69.30	4.27	*
PtV-Li	64.70	5.20	64.60	5.33	NS
Nasolab.	119.80	6.05	118.20	5.99	**

SD; standard deviation and *NS;* not significant,
*p< 0.05, **p< 0.01, ***p< 0.001

Table III. Comparison of pre-treatment (T1) and post-treatment (T2) basilar measurements of Group 1 (Molar Mover group).

	T1		T2		p
	MEAN	SD	MEAN	SD	
MADR-MSR	28.50	1.90	28.90	1.79	NS
MADL-MSR	28.00	2.49	28.00	2.16	NS
MADR-MADL	56.50	4.27	56.90	3.72	NS
MADR- TP	27.75	1.90	28.00	2.16	NS
MADL- TP	28.05	2.02	28.10	1.91	NS
MBR-DPR/ MSR	27.00	7.05	32.20	7.42	**
MBL-DPL/ MSR	27.40	5.29	31.10	5.46	*
MRC-TP	12.10	1.10	15.60	1.55	**
MLC- TP	12.70	1.29	16.10	1.44	**
MRC-MLC	51.40	3.62	52.10	3.66	*
MRC-MSR	25.20	2.14	26.00	2.22	**
MLC-MSR	25.10	2.23	25.70	2.21	NS
PVR-PPR/ MSR	77.10	7.63	76.50	7.07	NS
PVL-PPL/ MSR	78.70	11.30	75.30	11.91	NS
PRC- TP	4.65	1.29	2.50	1.43	**
PLC- TP	4.90	0.90	2.80	1.51	**
PRC-PLC	45.50	4.06	45.30	4.16	NS
PRC-MSR	22.40	2.11	22.10	2.33	NS
PLC-MSR	23.10	2.28	23.20	2.25	NS
I – TP	24.40	1.71	27.40	2.95	**

SD; standard deviation and *NS;* not significant,
*p< 0.05, **p< 0.01, ***p< 0.001

whereas the expansion of these teeth was shown by increase in MRC-MLC (p<0.05 for Group 1) (Tables III, IV).

Mesialization of the second premolars was denoted by increase in U5d-PtV (p<0.05), and decreases in PRC-TP (p<0.01) and PLC-TP (p<0.01) for Group 1 (Table I, III). In this group U5a/FH (p<0.05) also increased due to mesial tipping of the premolars (Table I). However, U5d-PtV (p<0.05) decreased, PRC-TP (p<0.05) and PLC-TP (p<0.05) increased in Group 2 revealing distal movement of the second premolars (Tables II, IV). U5a/FH (p<0.05) also decreased and denoted distal tipping of these teeth (Table II). In both of the groups, U5c-FH increased (p<0.05) due to the extrusion of the second premolars (Tables I, II).

Increase of U1i-Ptv, U1a/FH, 1/SN, and I-TP (p<0.01 for both groups), and decrease of U1i-FH (p<0.01 for Group 1, p<0.05 for Group 2) revealed that maxillary incisors were protruded, labially tipped and intruded (Tables I-IV). In the evaluation of the profile alterations, it was determined that PtV-Ls increased (p<0.01 for Group 1, p<0.05 for Group 2) and nasolabial angle decreased (p<0.01 for both groups) showing the protrusion of the upper lip (Tables I, II).

In the comparison of two groups, significant differences were found in cephalometric variables of U6a/FH (p<0.05), U5c-PtV (p<0.001), U5a/FH (p<0.001), U1a/FH (p<0.05), U1a/SN (p<0.05) and basilar variables of MBR-DPR/MSR (p<0.05), PRC-TP (p<0.001), PLC-TP (p<0.001), MRC-MLC (p<0.05), and MRC-MSR (p<0.05) (Table V).

Discussion

In our study, the distalization period was restricted as 3 months in order to standardize the groups. Class I molar relation was obtained for all patients in Molar Mover group but in the Drive Tube group,

Table IV. Comparison of pre-treatment (T1) and post-treatment (T2) basilar measurements of Group 2 (Drive Tube group).

	T1		T2		p
	MEAN	SD	MEAN	SD	
MADR-MSR	28.10	1.79	28.50	2.01	NS
MADL-MSR	28.50	1.95	28.50	2.27	NS
MADR-MADL	56.60	3.33	57.00	3.82	NS
MADR- TP	30.10	2.76	30.40	2.94	NS
MADL- TP	30.40	2.87	30.70	2.82	NS
MBR-DPR/ MSR	24.30	5.92	26.10	6.52	*
MBL-DPL/ MSR	28.80	5.24	31.10	4.97	**
MRC-TP	13.65	3.08	16.85	3.01	**
MLC- TP	13.60	2.17	16.70	2.40	**
MRC-MLC	51.70	2.00	52.30	2.17	NS
MRC-MSR	25.60	1.55	26.10	1.85	NS
MLC-MSR	26.30	1.56	26.40	1.98	NS
PVR-PPR/ MSR	72.50	8.83	72.10	8.74	NS
PVL-PPL/ MSR	73.80	9.88	73.00	9.39	NS
PRC- TP	6.90	1.66	7.90	1.37	*
PLC- TP	6.20	1.68	7.20	1.47	*
PRC-PLC	44.40	3.06	44.55	2.96	NS
PRC-MSR	21.60	1.71	21.65	1.76	NS
PLC-MSR	22.80	1.61	22.90	1.79	NS
I – TP	28.20	2.44	30.00	2.40	**

SD; standard deviation and *NS;* not significant,
*p< 0.05, **p< 0.01, ***p< 0.001

Table V. Comparison of differences between Group I and Group II (only the measurements with statistically significant differences are presented).

	GROUP I		GROUP II		p
	MEAN	SD	MEAN	SD	
U5d-PtV	2.40	0.96	-1.20	0.94	***
U6a / FH	-6.50	3.10	-3.10	1.03	*
U5a / FH	4.40	2.36	-0.70	0.67	***
U1a / FH	6.20	4.02	3.10	1.70	*
U1a / SN	6.20	4.80	3.00	2.25	*
MBR-DPR/ MSR	5.20	4.10	1.80	1.80	*
MRC-MLC	0.70	0.52	0.60	0.84	*
MRC-MSR	0.80	0.42	0.50	0.65	*
PRC- TP	-2.15	1.33	1.00	0.66	***
PLC- TP	-2.10	1.41	1.00	0.81	***

SD; standard deviation and *p< 0.05, **p< 0.01, ***p< 0.001

only 6 of the patients attained Class I molar relation. Lateral cephalometric evaluation revealed that molar distalization was 3.95 mm in Molar Mover group and 3.40 mm in Drive Tube group. However, in the comparison of the two groups; no statistically significant differences were found. The tipping of the molars was also more in the Molar Mover group. Molar Mover provided more molar distalization but in fact, this difference depended on the higher distal tipping observed in this group.

Disto-palatinal rotation of the molars was statistically significant in both groups. Rotation was more in the Molar Mover group, and this situation increased the intermolar width in this group. This finding was in accordance with Ghosh and Nanda (2), Keleş and Sayınsu (3). In the Drive Tube group no statistically significant increase was observed.

Evaluation of the second premolars showed mesial tipping in Molar Mover group and distal tipping in Drive Tube group. Since Drive Tube was inserted between first and second premolars, second premolars followed the distalization of the molars and the force applied through periodontal fibers caused distal tipping of these teeth. This finding was in accordance with some previous researchers (4-6). Molar Mover appliance was inserted between first molar and canine teeth bypassing the premolars. In this group, mesial tipping of second premolars was observed although Nance appliance was attached on these teeth. Similar to our findings, Haydar and Ünal (7), and Gulati et al. (8) also reported mesial tipping of the premolars. Extrusion of second premolars was also observed in both groups. This finding was in accordance with Altug et al. (5), Ghosh and Nanda (2), and Keles and Sayınsu (3) but conflicted with Üçem et al. (6), and Runge, Martin and Bukai (9).

In our study, maxillary incisors revealed labial movements in both groups. Tipping in Molar Mover group was statistically more than Drive Tube group. The proclination of anterior teeth was reported by several authors who used intraoral molar distalization appliances (3,4,7). On the other hand, conflicting with our finding Runge, Martin and Bukai (9) didn't observe incisor proclination and Üçem (6) reported retrusion of the incisors at the end of molar distalization. The findings of our study also showed 1.60 mm intrusion in Molar Mover group while it was 1.10 mm in Drive Tube group. This intrusion was relative and it depended on the labial tipping of the incisors. Our result was in accordance with Haydar and Üner (7) but it conflicted with Muse et al. (10) who reported extrusion of the incisors. Alterations of the variables related with the incisors affected the soft tissue profile and caused protruded upper lip and

decreased nasolabial angle in both groups. Similar findings were reported by Üçem et al. (6).

In our study, dentoalveolar alterations caused skeletal changes and created increases in the measurements FMA, SN/GoGn, N-Me, and ANS-Me in both groups. Extrusion of the molars and premolars caused posterior rotation of mandible. Therefore anterior facial height increased. Similar results were reported by many authors studied with intraoral distalization appliances (3,6,8-10).

Conclusion

Our findings can be summarized as follows:

- Class I molar relation was obtained in a shorter period by Molar Mover but distal tipping of first molars was more in this group.
- In Molar Mover group, more distopalatinal rotation was observed at the molars and this rotation caused an increase in the intermolar width.
- Extrusion, mesialization and mesial tipping of second premolars were found in Molar Mover group, while extrusion, distalization and distal tipping of second premolars were found in Drive Tube group. Distal drift of these teeth during molar distalization is an advantage for the subsequent treatment of the increased overjet and shortens the total orthodontic treatment period.
- Labial tipping of the maxillary incisors was more in Molar Mover group.
- Both of the appliances increased protrusion of the upper lip and decreased nasolabial angle.
- Anterior facial height increased in both of the groups due to the posterior rotation of mandible caused by tipping of first molars and extrusion of second premolars.
- Molar Mover and Drive Tube are both effective in molar distalization but undesirable side effects are more prominent in Molar Mover group.

References

1. DeVincenzo JP. Treatment options for sagittal corrections in noncompliant patients. In: Grabber TM, Vanarsdall RL, Vig KWL (eds). Orthodontics: Current Principles and Techniques. 4th ed. Missouri: Elsevier Co, 2005: 879-900.
2. Ghosh J, Nanda RS. Evaluation of intraoral maxillary molar distalization techniques. Am J Orthod Dentofacial Orthop 1996; 110: 639-646.
3. Keleş A, Sayinsu KA. New approach in maxillary molar distalization: Intraoral bodily molar distalizer. Am J Orthod Dentofacial Orthop 2000; 117: 39-48.
4. Jones RD, White JM. Rapid class II molar correction with an open-coil jig. J Clin Orthod 1992; 26: 661-664.
5. Altug H, Bengi AO, Akin E, Karacay S. Dentofacial effects of asymmetric headgear and cervical headgear with removable plate on unilateral molar distalization. Angle Orthod 2005; 75: 584-592.
6. Üçem TT, Yüksel S, Okay C, Gülşen A. Effects of a three-dimensional bimetric maxillary distalizing arch. Eur J Orthod 2000; 22: 293-298.
7. Haydar S, Üner O. Comparison of jones jig molar distalization appliance with extraoral traction. Am J Orthod Dentofacial Orthop 2000; 117: 49-53.
8. Gulati S, Kharbanda OP, Parkash H. Dental and skeletal changes after intraoral molar distalization with sectional jig assembly. Am J Orthod Dentofacial Orthop 1998; 114: 319-327.
9. Runge ME, Martin JT, Bukai F. Analysis of rapid maxillary molar distal movement without patient cooperation. Am J Orthod Dentofacial Orthop 1999; 115: 153-157.
10. Muse DS, Fillman MJ, Emmerson WJ, Mitchell, RD. Molar and incisor changes with Wilson rapid molar distalization. Am J Orthod Dentofacial Orthop 1993; 104: 556-565.