Original Article

Skeletal Open Bite Correction with Rapid Molar Intruder Appliance in Growing Individuals

Alev Çinsar[a]; Amir Rahimi Alagha[b]; Sercan Akyalçın[c]

ABSTRACT

Objective: To determine the dentofacial effects of a fixed functional appliance, the rapid molar intruder (RMI).

Materials and Methods: One control group (n = 10) and two study groups (n = 10 each) were formed. The first experimental group consisted of growing children in the mixed dentition period who received RMI therapy alone. The second experimental group consisted of growing children in the early permanent dentition period who received both RMI and fixed appliance (edgewise) therapy together. Mean changes for the measurements for each group were evaluated by the Wilcoxon signed rank test. Comparisons of the mean changes between the groups were made by the Kruskal-Wallis test.

Results: Open bite correction was achieved by counterclockwise rotation of the mandible as a consequence of redirecting growth in both treatment groups. The ANB angle decreased significantly ($P < .05$). Significant decreases were also noted for vertical skeletal characteristics in both treatment groups ($P < .05$). Molar intrusion was statistically significant for both maxillary and mandibular first molars ($P < .05$) in both treatment groups.

Conclusions: The RMI appliance provided effective bite closure and favorable dentofacial changes for nonsurgical open bite treatment in growing patients. It was concluded that this method could be regarded as a safe and noncompliance alternative for early intervention of skeletal open bite correction.

KEY WORDS: Open bite; Growth modification; Molar intrusion

INTRODUCTION

Successful treatment of an individual characterized by an anterior open bite and a high-angle skeletal pattern might often turn into a challenge for the clinician. The problem in many patients may well be multifactorial, and subsequent problems that appear similar may have different causes.[1] Without a proper identification and elimination of the etiologic factors, treatment stability will have a poor prognosis. Therefore, planning treatment may require careful clinic and diagnostic examinations.[2,3]

Some of the cephalometric and morphologic features of skeletal open bite can be described as large anterior dentoalveolar height in both jaws, increased total and lower anterior facial height, decreased posterior facial height, backward rotation of the maxillomandibular skeleton, Class II tendency, downward rotation of the posterior portion of the palatal plane, increased gonial angle, high mandibular plane angle, divergent cephalometric planes, narrow maxillary arch, and marked antegonial notching.[4–12]

Individuals presenting with the above-mentioned morphologic characteristics usually have excessive eruption of posterior teeth accompanying their anterior open bite. Whenever a vertical jaw discrepancy of this type exists, the ideal solution is to apply growth modification by inhibiting subsequent growth or by intruding posterior teeth. High-pull headgear,[10,13,14] functional appliances,[10,15] bite blocks,[16,17] vertical-pull chin cups,[18–20] repelling magnets,[21–23] and more recently miniplates and screws[24–26] have been shown to be ef-

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Table 1. The Sample[a]

	Control Group (n = 10)		RMI Group (n = 10)		RMI + Fixed Appliance Group (n = 10)	
	Girls n = 7	Boys n = 3	Girls n = 7	Boys n = 3	Girls n = 6	Boys n = 4
Chronological age, y	10.8 ± 0.9	11 ± 1	10.3 ± 0.2	11 ± 0.4	12.2 ± 0.5	12.4 ± 0.4
Skeletal age, y	10.8 ± 0.7	10.8 ± 1.2	10.2 ± 0.4	10.8 ± 0.4	11.7 ± 0.8	11.8 ± 0.6

[a] RMI indicates rapid molar intruder.

fective for molar intrusion and to limit any increases in the vertical dimension. However, Sankey et al[27] argued that with the exception of posterior bite blocks, many of the treatment mechanics aimed to correct open bite were not effective in rotating the mandible forward and producing more condylar growth.

In light of our current knowledge on growth modification and open bite correction, this preliminary study aimed to document the treatment effects of a new fixed functional appliance, rapid molar intruder (RMI), in growing children. The effects of the appliance will be evaluated for both mixed and permanent dentition periods.

MATERIALS AND METHODS

Pre- and posttreatment lateral cephalograms of 20 girls and 10 boys with Class I malocclusions and skeletal and dental open bites were evaluated. The first group consisted of growing children in the mixed dentition period who received RMI therapy alone. The second group consisted of growing children in the early permanent dentition period who received both RMI and fixed appliance therapy together. A skeletally equivalent group of individuals who did not receive any means of orthodontic treatment during 10 to 11 months was evaluated for control purposes (Table 1). Only patients presenting with 2° to 4° of ANB and with GoGnSN greater than 37° were included. The patients exhibited no transverse anomalies or bad habits. Before treatment, all the patients were referred to an ear, nose, and throat specialist to detect any possible nasal airway obstructions. None of the patients exhibited clinically significant respiratory problems.

The RMI uses flexible springs to deliver intrusion forces to the maxillary and mandibular first molars. The appliance consists of one spring module and two ball connectors per side (Figure 1a,b). The terminal ends of the flexible spring modules are designed to attach the ball connectors, which will insert into headgear or lip bumper tubes welded on molar bands. There are two different end caps on each elastic module. The straight terminal ends attach to upper headgear tubes, and the angulated terminal ends attach to lower lip bumper tubes (Figure 1c,d).

The mechanism of the appliance is quite simple. When the patient tends to close his or her jaws, the intrusion force created by the flexion of the elastic spring modules is transferred to the maxillary and mandibular first molars (Figure 2). Because the force is applied buccal to the center of resistance of the molar teeth, buccal tipping of the molar crowns will be inevitable. To prevent this side effect, a transpalatal arch in the maxillary arch and a lingual arch in the mandibular arch should also be utilized (Figure 3a,b).

Before the appliance was installed, working models were obtained from the patients with maxillary and mandibular molar bands seated on the first molars. Lingual and transpalatal 1-mm stainless steel arches were bent for each patient on the plaster models. Care was taken not to place the transpalatal arches too far from the palate to eliminate the intrusion force that might be exerted by the relative pressure of tongue (Figure 3c). The lingual and palatal arches were then soldered to the molar bands. For those patients with fully erupted second molars in the RMI plus fixed appliance group, a 1-mm stainless steel wire occlusal rest was added that extended from the transpalatal and lingual arches to the occlusal surface of the sec-

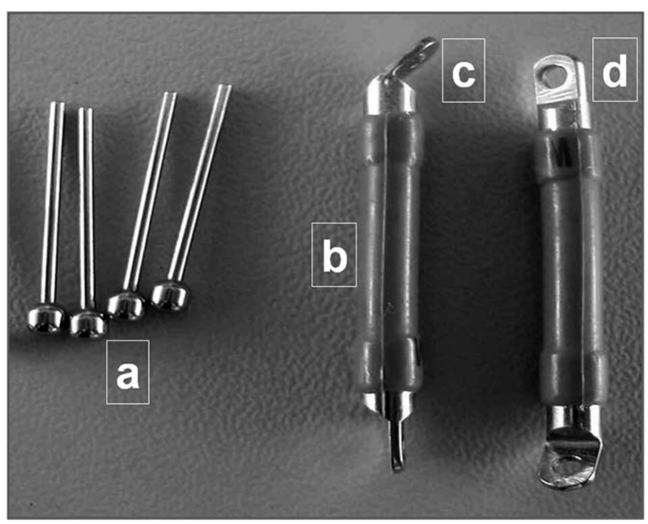

Figure 1. Components of the appliance. (a) Ball connectors. (b) Spring modules. (c) Angulated terminal end. (d) Straight terminal end.

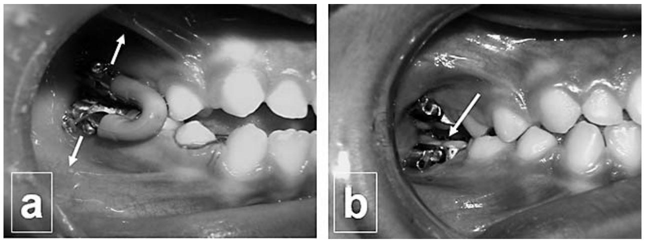

Figure 2. (a) The intrusion force is directly transferred to the maxillary and mandibular first molars. (b) Significant molar intrusion soon after removal of the appliance

ond molar to avoid elongation of these teeth (Figure 3d). The appliances were installed according to the instructions provided by American Orthodontics (Sheboygan, Wis). The ball pin connectors were inserted mesially into both maxillary and mandibular molar tubes (Figure 2a).

An 800- to 1000-g intrusive force was applied to the molars on each side in the study groups. The patients were scheduled at 4-week intervals. The transpalatal and lingual arches were adjusted every 2 months to prevent them from impinging on the soft tissues. During the use of the RMI appliance, occlusal contacts were avoided by grinding the deciduous teeth in the RMI group and leveling the occlusal plane with fixed appliances in the RMI plus fixed appliance group.

Open bite correction was achieved in a mean of 5.1 months for the RMI group and 6.7 months for the RMI plus fixed appliance group. The appliance was left in place for an additional 4 months for overcorrection purposes in both treatment groups. Thus, the evaluation period for the study groups was 9 to 11 months. During the use of the RMI appliance in the RMI plus fixed appliance group, no attempts were made (eg, with box elastics) to extrude the incisors.

Both pre- and posttreatment radiographs were retraced and remeasured by the same investigator to ensure measurement accuracy. Paired *t*-tests showed

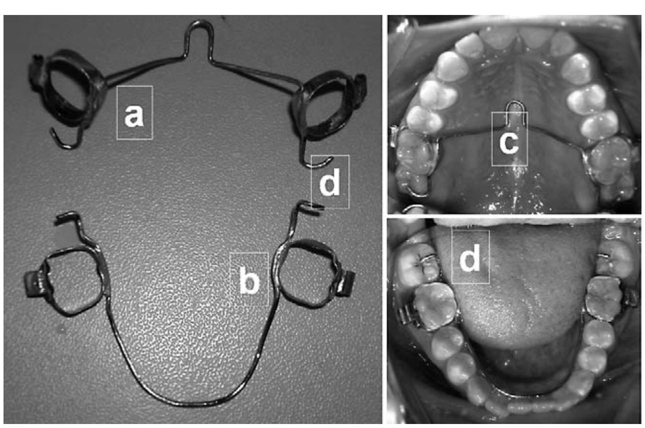

Figure 3. (a) Transpalatal arch. (b) Lingual arch. (c) Adjustment of the transpalatal arch. (d) Occlusal rests.

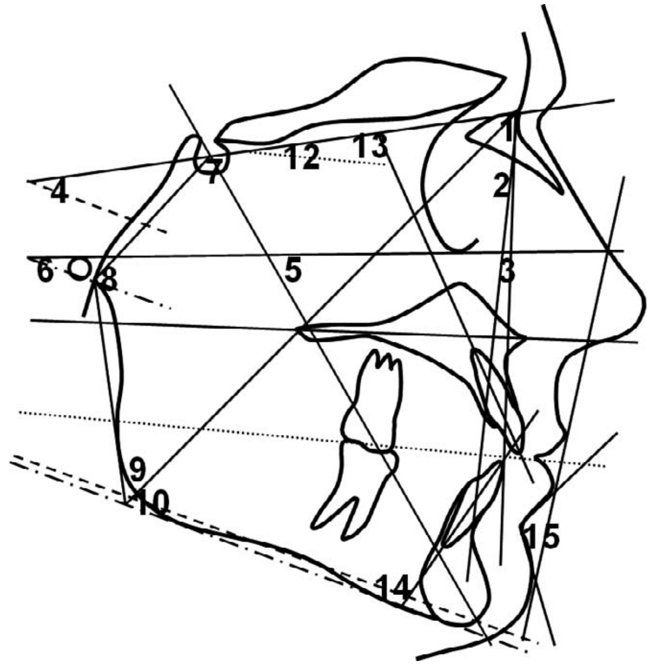

Figure 4. Angular measurements. 1: SNA; 2: SNB; 3: ANB; 4: GoGnSN; 5: Y-axis; 6: FMA; 7: NSAr; 8: SArGo; 9: NGoAr; 10: NGoGn; 11: Post Σ; 12: OP-SN; 13; U1-SN; 14: L1-MP; 15: LMA.

no differences in the first and second measurements ($P > .05$) and the mean values of the first and second measurements for each parameter were used in later analysis (Figures 4, 5). Treatment changes in each

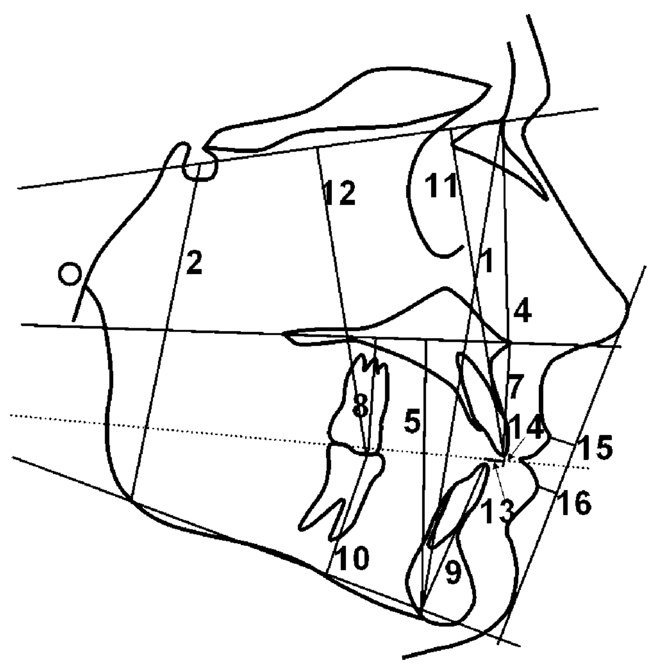

Figure 5. Linear measurements. 1: Na-Me; 2: Se-Go; 3: Se-Go/Na-Me; 4: N-ANS; 5: ANS-Me; 6: N-ANS/ANS-Me; 7: U1 to ANS-PNS; 8: U6 to ANS-PNS; 9: L1-GoGn; 10: L6-GoGn; 11: U1-SN; 12: U6-SN; 13: overjet; 14: overbite; 15: E-line to UL; 16: E-line to LL.

Table 2. Comparison of Treatment Changes in Each Group Evaluated by the Wilcoxon Signed Rank Test[a]

	Control Group (n = 10)					RMI Group (n = 10)					RMI + Fixed Appliance Group (n = 10)				
	T1		T2			T1		T2			T1		T2		
	Mean	SD	Mean	SD	*P*	Mean	SD	Mean	SD	*P*	Mean	SD	Mean	SD	*P*
SNA, °	79.65	4.49	79.90	4.30	.28	78.90	2.72	79.00	2.62	.31	77.65	2.78	78.05	2.94	.03*
SNB, °	76.20	4.54	76.50	4.30	.18	75.20	2.78	76.95	2.54	.00*	74.25	2.86	76.15	3.05	.00*
ANB, °	3.45	0.49	3.40	0.84	.78	3.70	0.48	2.05	0.15	.00*	3.50	0.57	1.90	0.31	.00*
GoGnSN, °	42.00	4.54	42.00	4.18	.75	42.45	3.53	37.60	2.67	.00*	41.10	3.65	36.40	4.59	.00*
Y-axis, °	67.80	3.32	68.10	1.85	.63	70.35	2.72	66.95	1.73	.01*	70.60	3.30	66.60	3.92	.00*
FMA, °	37.20	4.44	36.90	3.14	.67	37.80	4.15	32.95	3.00	.00*	37.70	5.88	33.70	5.47	.00*
NSAr, °	125.30	6.41	125.30	6.20	1.00	124.10	4.86	123.90	3.69	.57	125.00	4.29	122.80	4.36	.02*
SArGo, °	149.20	8.37	147.20	6.86	.10	146.50	7.29	145.80	6.71	.79	146.70	5.43	146.30	4.05	.77
NGoAr, °	47.50	14.85	51.30	4.34	.77	50.00	3.05	50.35	3.24	.21	51.40	1.64	51.70	1.15	.31
NGoGn, °	82.40	8.55	86.00	8.43	.00*	80.00	6.42	76.20	5.75	.00*	76.20	8.17	73.70	6.94	.00*
Post Σ, °	412.20	6.17	413.00	8.48	.90	400.70	3.68	396.15	4.61	.01*	399.40	2.75	395.00	4.44	.00*
Na-Me, mm	125.20	4.49	128.80	4.84	.00*	124.60	5.37	121.30	4.66	.00*	125.00	6.34	123.30	6.46	.00*
Se-Go, mm	69.30	3.05	70.10	3.21	.14	71.30	3.86	73.70	2.75	.01*	70.50	4.03	74.40	4.62	.00*
Se-Go/Na-Me, ratio	0.55	0.01	0.54	0.01	.07	0.57	0.01	0.60	0.01	.00*	0.56	0.01	0.60	0.01	.00*
N-ANS, mm	49.90	2.07	50.20	3.08	.77	49.60	1.83	51.20	1.98	.00*	50.00	2.58	50.90	2.51	.01*
ANS-Me, mm	75.30	2.66	78.60	2.95	.01	75.00	3.68	70.10	2.92	.00*	76.00	3.33	72.40	4.64	.00*
N-ANS/ANS-Me, ratio	0.65	0.01	0.63	0.04	.17	0.65	0.01	0.73	0.02	.00*	0.65	0.01	0.70	0.03	.00*
OP-SN, °	24.00	4.18	23.90	4.09	.78	23.90	2.02	19.50	3.89	.00*	22.40	2.67	17.50	2.22	.00*
U1-SN, °	102.70	6.94	103.80	8.43	.25	101.50	7.05	101.10	4.84	.83	97.80	30.74	104.30	3.43	.10
L1-MP, °	97.40	3.83	96.70	4.27	.41	90.45	6.98	93.50	4.40	.06	91.20	2.34	94.00	2.40	.00*
U1_ANS-PNS, mm	28.20	3.11	28.95	3.21	.01*	29.20	2.93	30.15	2.96	0.00*	27.00	2.24	28.30	2.39	.00*
U6_ANS-PNS, (mm)	21.40	3.16	21.70	3.09	.18	24.22	1.54	21.68	1.44	0.00*	24.35	141	21.40	1.61	.00*
L1-GoGn, mm	40.75	2.09	41.50	2.06	.04*	41.50	2.71	42.50	2.54	0.00*	41.75	2.22	42.85	1.91	.00*
L6-GoGn, mm	31.40	2.01	32.40	1.77	.02*	33.00	2.70	31.10	2.07	0.00*	33.05	1.03	30.00	0.78	.00*
U1-SN, mm	80.40	4.64	81.40	4.42	.05*	81.80	5.78	83.70	4.32	0.04*	79.90	3.34	81.45	3.45	.00*
U6-SN, mm	68.70	2.79	69.25	2.97	.06	74.00	3.85	72.25	4.18	.01*	73.45	3.30	71.10	3.72	.00*
Overjet, mm	4.10	2.23	3.90	2.68	.48	2.75	2.15	1.75	0.63	.04*	4.00	1.88	2.15	0.74	.01*
Overbite, mm	−3.40	1.04	−2.45	1.78	.02*	−2.95	0.68	1.60	0.51	.00*	−3.10	0.87	1.50	0.52	.00*
LMA, °	31.05	2.96	31.40	4.14	.67	32.30	3.09	30.90	3.24	.06	31.00	10.21	32.70	4.24	.06
E-UL, mm	−0.35	1.37	−0.25	1.84	1.00	−2.05	1.30	−1.20	0.91	.06	−1.25	1.27	−0.70	0.82	.20
E-LL, mm	1.10	2.51	0.90	2.46	.59	−0.65	1.63	0.20	0.75	.04*	−1.20	1.31	0.30	0.67	.00*

[a] RMI indicates rapid molar intruder; SD, standard deviation.
[b] $P < .05$.

group were evaluated by the Wilcoxon signed rank test. A comparison of the mean changes between the groups was made by the Kruskal-Wallis test. The level of significance was established as $P < .05$ for all statistical tests.

RESULTS

Descriptive data of the cephalometric analysis and the results of the Wilcoxon signed rank test and Kruskal-Wallis test are presented in Tables 2 and 3. Both the lower gonial angle (NGoGn) and lower and total facial height measurements increased significantly in the control group during the control period ($P < .05$). Dental variables in the control group showed significant increases as a result of incisor eruption. Overbite increased accordingly ($P < .05$).

The results showed that the anterior open bite was successfully corrected (Figures 6 and 7) in both treatment groups by forward mandibular rotation as evidenced by the changes in SNB and ANB angles. The SNB increased whereas the ANB decreased in both treatment groups ($P < .05$). The mean changes for these angles in both treatment groups were also statistically significant when compared with the mean changes recorded for the control group. GoGnSN, Y-axis, FMA, NGoGn and Post Σ angles, and total and lower facial height measurements all showed statistically significant decreases in both treatment groups. Relatively statistically significant increases were recorded for Se-Go/Na-Me and N-ANS/ANS-Me ratios in both treatment groups. The Kruskal-Wallis test revealed statistical significance between the treatment groups and the control group in comparison of mean changes for the above-mentioned variables.

Both treatment groups had significant intrusion of the molars, resulting in a significant decrease for the OP-SN angle. Molar intrusion, as determined by U6_ANS-PNS and L6_GoGN distances, revealed more significant molar intrusion for the RMI plus fixed appliance group. Overbite also increased significantly in

Table 3. Mean Changes for the Study Groups and Comparison of the Changes by the Kruskal-Wallis Test[a]

	Control Group (n = 10) (I)		RMI Group (n = 10) (II)		RMI + Fixed Appliance Group (n = 10) (III)				
	Mean	SD	Mean	SD	Mean	SD	I–II	I–III	II–III
SNA, °	−0.25	0.71	−0.10	0.31	−0.40	0.45	.91	.19	.07
SNB, °	−0.30	0.67	−1.75	0.63	−1.90	0.61	.00*	.00*	.54
ANB, °	0.05	0.49	1.65	0.47	1.60	0.45	.00*	.00*	.76
GoGnSn, °	0.00	2.53	4.85	1.73	4.70	1.51	.00*	.00*	.87
Y-axis	−0.30	2.66	3.40	2.76	4.00	1.94	.00*	.00*	.46
FMA, °	0.30	2.98	4.85	2.45	4.00	1.56	.00*	.00*	.21
NSAr, °	0.00	1.05	0.20	4.80	2.20	2.82	.45	.14	.51
SArGo, °	2.00	5.73	0.70	4.29	0.40	2.54	.18	.14	.97
NGoAr, °	1.20	3.42	−0.35	0.94	−0.30	0.94	.18	.31	.86
NGoGn, °	−3.60	1.34	3.80	3.85	2.50	2.27	.00*	.00*	.90
Post Σ, °	−0.80	4.54	4.55	4.45	4.40	2.75	.02*	.01*	.84
Na-Me, mm	−3.60	1.57	3.30	1.25	1.70	0.82	.00*	.00*	.00*
Se-Go, mm	−0.80	1.61	−2.40	2.79	−3.90	1.96	.10	.01*	.14
Se-Go/Na-Me, ratio	0.01	0.01	−0.03	0.01	−0.04	0.01	.00*	.00*	.34
N-ANS, mm	−0.30	2.26	−1.60	0.84	−0.90	0.73	.07	.08	.08
ANS-Me, mm	−3.30	2.62	4.90	1.44	3.60	3.68	.00*	.00*	.00*
N-ANS/ANS-Me, ratio	0.02	0.04	−0.07	0.02	−0.05	0.04	.00*	.00*	.03*
OP-SN, °	0.10	1.10	4.40	3.23	4.90	2.99	.00*	.00*	.50
U1-SN, °	−1.10	2.68	0.40	5.12	−6.50	31.86	.62	.09	.34
L1-MP, °	0.70	2.00	−2.60	5.23	−2.80	1.22	.09	.00*	.93
U1_ANS-PNS, mm	−0.75	0.54	−0.95	0.49	−1.30	0.42	.56	.03*	.07
U6_ANS-PNS, mm	−0.30	0.67	2.54	0.45	2.95	0.28	.00*	.00*	.03*
L1-GoGn, mm	−0.75	0.85	−1.00	0.66	−1.10	0.39	.47	.28	.72
L6-GoGn, mm	−1.00	0.94	1.90	1.19	3.05	0.49	.00*	.00*	.01*
U1-SN, mm	−1.00	1.41	−1.90	3.10	−1.55	0.59	.56	.28	.71
U6-SN, mm	−0.55	0.83	1.75	1.08	2.35	0.66	.00*	.00*	.20
Overjet, mm	0.20	0.91	1.00	1.58	1.85	1.41	.24	.02*	.15
Overbite, mm	−0.95	1.11	−4.55	0.49	−4.60	0.96	.00*	.00*	.96
LMA, °	−0.35	2.98	1.40	1.64	−1.70	11.36	.07	.12	.96
E-UL, mm	−0.10	1.07	−0.85	1.10	−0.55	1.25	.10	.22	.58
E-LL, mm	0.20	1.22	−0.85	1.08	−1.50	0.84	.02*	.00*	.16

[a] RMI indicates rapid molar intruder; SD, standard deviation.
[b] $P < .05$.

both treatment groups. Mean increases in overbite for both treatment groups were more pronounced than in the control group ($P < .05$). This might be due to the bite closure in both treatment groups.

The lower lip to E-line distance increased significantly in both treatment groups by a counterclockwise rotation of the mandible. In contrast, the LL to E-line distance decreased over time in the control group as a result of hyperdivergent growth model. Mean changes in the LL to E-line distance for both treatment groups were statistically significant when compared with the mean change in the control group.

DISCUSSION

Anterior open bite malocclusion is considered to be one of the most demanding challenges for the orthodontist. Occlusal correction is difficult, facial esthetics may be unsatisfactory, and the incidence of relapse is high.[28] The logical treatment strategy for a growing individual characterized by a skeletal open bite is the inhibition of the vertical development or intrusion of the buccal segments, which will produce an upward and forward mandibular rotation rather than vertical growth.[17] The advantages of this early orthopedic treatment philosophy are the elimination of the risks associated with a late orthognathic intervention and improvement of a child's self-esteem by enhancement of facial esthetics.[29] Although various appliances are proposed for molar intrusion and vertical growth restriction purposes, Sherwood et al[30] argued that only relative intrusion of the molars might be achieved with the use of bite blocks and headgear while molars are held in place and the remainder of the dentoalveolus grows downward.

Perhaps the biggest problem with conventional mechanotherapies is their dependence on patient cooperation. A patient-independent mechanism that can be installed with fixed appliance therapy might be beneficial because fixed appliance therapy alone has no power for skeletal open bite correction.

Kim[31] advocated the use of multiloop arches and an-

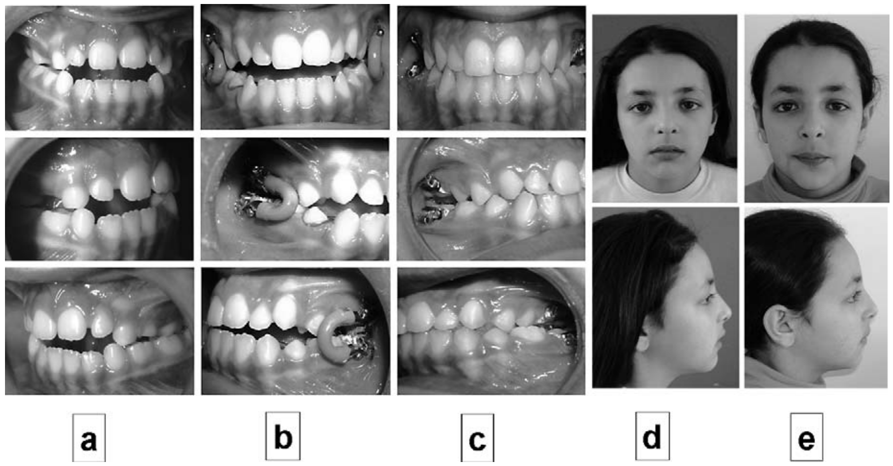

Figure 6. A sample case from the rapid molar intruder (RMI) group. (a) Patient initially presented for treatment. (b) Pre-RMI therapy intraoral photographs. (c) Post-RMI therapy intraoral photographs. (d) Pre-RMI therapy extraoral photographs. (e) Post-RMI therapy extraoral photographs.

terior elastics. However, the entire mechanics provide only uprighting of the maxillary molars but not their intrusion. Enacar et al[32] modified this technique by using 0.016- × 0.022-inch mesially accentuated-curved and mandibular reverse-curved archwires with intermaxillary elastics in the canines region. Although bite closure was successfully achieved and the mechanic had a hygienic superiority, Küçükkeleş et al[33] reported that the underlying hyperdivergent growth model continued, which later became an issue of facial esthetics.

The RMI[34–36] is a noncompliance appliance that can deliver continuous intrusion forces to the maxillary and mandibular molars. Besides the high patient acceptance and hygienic advantages, the appliance is easy to use with fixed appliances. The initial clinical experiences with the RMI device are promising.[34] A combination of these positive properties of the appliance makes it worthwhile to investigate and to document its treatment effects, making the RMI an apparently unique fixed functional appliance for skeletal open bite correction.

Because the timing of orthodontic treatment in growth modification cases is an important issue, both mixed and permanent dentition periods were evaluated and compared. However, care was taken to include only individuals with considerable remaining growth for both the treatment and control groups. Perhaps the greatest advantage of starting treatment in the permanent dentition is to combine the RMI with fixed appliances so that both maxillary and mandibular arches will be aligned simultaneously.

The results of this study showed that overbite correction was successfully obtained in all treated subjects. The amount of molar intrusion was less than the

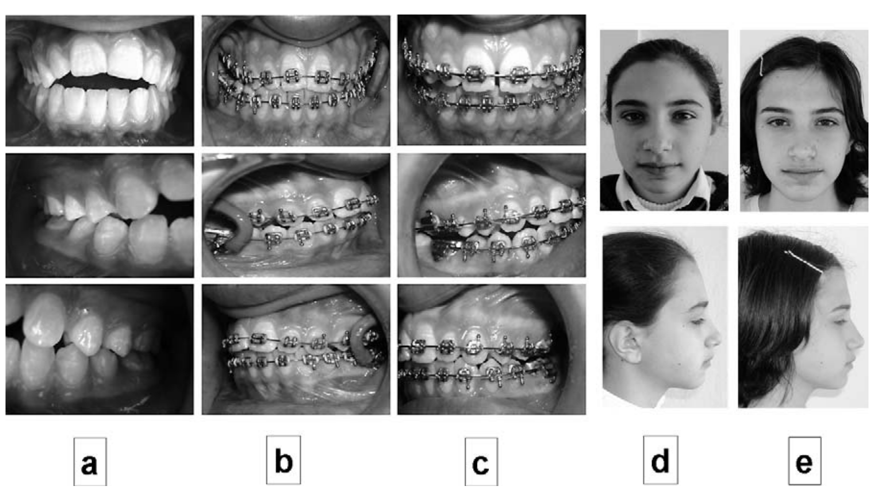

Figure 7. A sample case from the rapid molar intruder (RMI) plus fixed appliance group. (a) Pre-RMI therapy intraoral photographs. (b) Post-RMI therapy intraoral photographs. (c) Intraoral photographs soon after appliance removal. (d) Pre-RMI therapy extraoral photographs. (e) Post-RMI therapy extraoral photographs.

results of some skeletal anchorage reports[26–30] but slightly more than the recent results by Gürton et al.[37] Additionally, the RMI plus fixed appliance group experienced significantly more molar intrusion than did the RMI group, which might be attributed to the difference between the total treatment times of the two groups.

Although we did not incorporate a mesiodistal vector when installing the appliances, according to statistical analysis the SNB angle increased whereas the ANB decreased. The ANB approached the ideal value, 2°, in both treatment groups. This effect might be due to anterior mandibular rotation and bite closure. Similar findings were previously reported for skeletal open bite treatment with various appliances.[23,37–39] Mandibular autorotation also brought about significant vertical plane changes. Angular vertical measurements significantly decreased in both treatment groups. Anterior total and lower facial height measurements decreased, whereas posterior facial height increased in both treatment groups. These findings demonstrated that control of the vertical dimension was successfully achieved with the RMI appliance. These findings agreed with previous studies that reported significant mandibular autorotation signs.[16,18,25,30,34,37] The RMI seems to limit normal eruption of the molars during growth and to induce a change in the cant of the mandibular plane resulting from anterior rotation.[34]

The L1-MP angle increased in both treatment groups, but this increase was significant only in the RMI plus fixed appliance group. The increase in the RMI plus fixed appliance group was more than the change in the control group but did not differ statistically when compared with the change in the RMI group.

The occurrence of no significant difference between the two study groups might be explained by the inevitable mesial pressure of the RMI mechanics against the dental arch. A pronounced increase in the RMI plus fixed appliance group might be attributed to the side effects of the fixed appliance therapy. We studied the effects of RMI appliances in growing patients with open bite for a short period in a small sample. Although no signs of root resorption were detected for either the maxillary or mandibular first molars in both study groups by routine periapical radiographic investigations, further monitoring should be undertaken. Additional studies are needed to confirm the current findings. Posttreatment and long-term changes should also be determined to evaluate the stability of the results.

CONCLUSIONS

a. The RMI appliance provided effective bite closure and favorable dentofacial changes for nonsurgical open bite treatment in growing patients.
b. This method could be regarded as a safe and noncompliance alternative for early intervention of skeletal open bite correction.

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