Original Article

Comparative Evaluation of a New Removable Jasper Jumper Functional Appliance vs an Activator-Headgear Combination

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Abstract: The aim of this study was to comparatively evaluate the effects of an activator-headgear (HG) combination to a Jasper Jumper (JJ) plus occipital HG, which was incorporated into removable upper and lower plates. The study group consisted of 60 subjects with mandibular deficiency and a vertical growth pattern. Of these, 20 were treated with JJ appliance–HG incorporated to removable upper and lower plates, 20 were treated with an activator-HG combination. Another 20 subjects who refused orthodontic treatment served as controls. Pre- and postreatment lateral cephalograms and hand-wrist films were gathered for all 60 subjects. Lateral cephalograms were manually traced before being transferred to RMO JOE software by a digitizer. Measurements that are not included in the software were measured manually. Thirty-five dental and skeletal parameters were used in the study. The collected data were subjected to statistical analysis using SPSS packet software. Wilcoxon paired *t*-test was used for intragroup comparisons. Differences between groups were evaluated by analysis of variance and Bonferroni tests. Results suggest that ANB angle was decreased significantly in both treatment groups compared with the controls. Increase in total facial height was greater in the activator group than in the JJ group. Vertical growth inhibition of lower incisors was greater in the JJ group. The activator-HG appliance was more effective on the mandible, whereas the JJ appliance was mainly active on the maxilla. Thus, ideal cases for JJ–splinted appliance should be high-angle cases, particularly with maxillary excess and some mandibular deficiency. (*Angle Orthod* 2003;73:286–293.)

Key Words: Class II correction; Functional treatment; Jasper Jumper appliance; Activator; Extraoral force

INTRODUCTION

Angle Class II division 1 malocclusions have been studied extensively regarding their skeletal and dental characteristics and timing and method of treatment. The main reason for the extensive research on this particular type of malocclusion is its high frequency in the population. This malocclusion is reported to constitute 12% to 49% of all orthodontic disorders.[1,2] A successful treatment of this malocclusion requires that the skeletal and dental basis of the disorder be investigated carefully.[3,4] The method of treatment is usually performed using orthopedic and orthodontic applications.[5–8]

In cases of maxillary excess, orthopedic forces are directed on maxilla to inhibit further maxillary growth or to perform distalization. A functional appliance during the active growth period may solve a mandibular deficiency. Functional appliances may be combined with extraoral force to affect both jaws.[9–11]

Functional appliances that are an important part of orthodontic treatment demonstrate a significant diversity in design, which could easily affect their acceptance by the patients. Although Bionator or Twin block are more acceptable compared with activators, patients do not easily adapt to these appliances because of their large size and unfixed position in the mouth. Patients' adaptation may vary regarding different functional appliances.[12] An ideal functional appliance should be comfortable to the patient, allow jaw movements, leave room for the tongue, provide skeletal rather than dental effects, and should be such that it could be used in subjects with nasal obstruction.

The aim of this study was to comparatively evaluate the skeletal and dental effects of a new, possibly more comfortable functional appliance with those of an activator-occipital headgear (HG) combination and an untreated control group.

MATERIALS AND METHODS

The study group consisted of 40 Class II division 1 cases with mandibular deficiency (ANB $>$ 4°) and vertical

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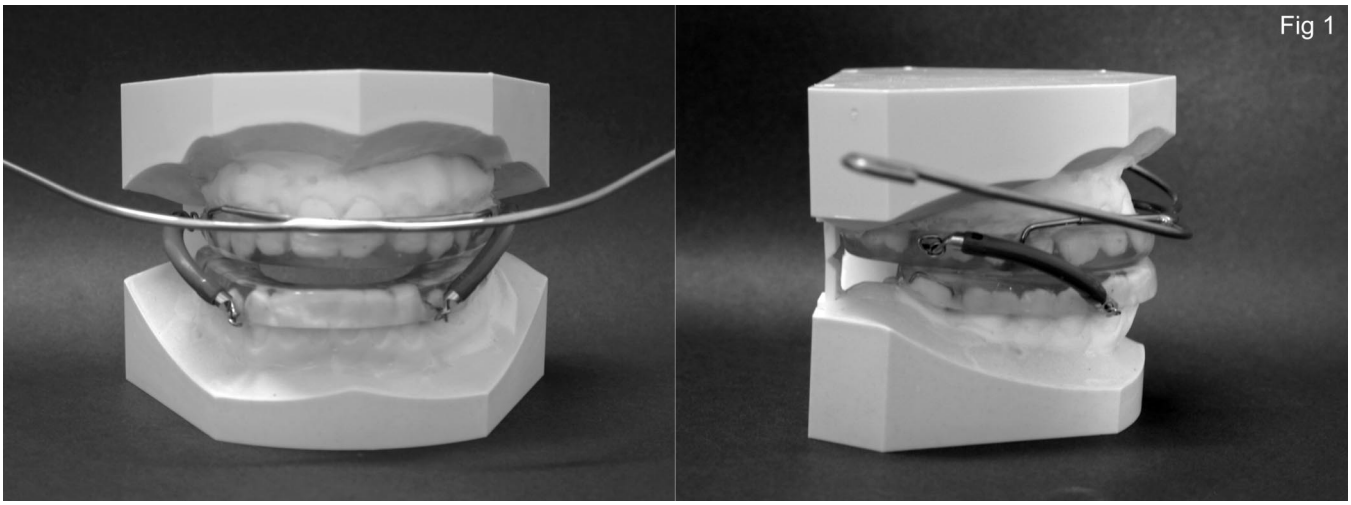

FIGURE 1. Removable JJ functional appliance on a dental model. Note that the photographs are taken with slightly open position to demonstrate the separate upper and lower splints.

growth pattern (SN-MP $>$ 34°). Subjects were randomly included into one of 2 treatment groups of 20 each (Groups A and B). The control group (Group C) consisted of 20 subjects with similar patterns who rejected orthodontic treatment. Skeletal ages of the subjects were determined on the basis of comparind hand wrist radiographs to the Greulich and Pyle standards.[13]

Jasper Jumper and occipital HG group (A)

This group consisted of 15 girls and five boys with an average skeletal age of 12 years and one month who were treated with a new removable Jasper Jumper (JJ) appliance and occipital HG. Duration of treatment ranged from five to 12 months with an average of 8.5 months.

Appliance

Intraoral anchorage system of this new appliance that uses JJs consisted of two separate acrylic plates that cover the whole occlusal and lingual aspects of teeth. Anchorage of the plates was reinforced by placement of clasps. JJs were placed diagonally on each side between upper and lower plates (Figure 1). Correct size of the Jumper was selected according to the measurement of upper molar distal to lower canine distal plus five mm. A facebow was attached to the upper plate to enable extraoral force application. After registration of the construction bite, models were carried to a fixator, (split post fixator 072-004-00 Dentarum, Ispring, Germany) and upper and lower splints were finished separately. It is very important to have the contact surface of two splints finished smooth and polished. One-millimeter thick wires were extended from distal of upper molar and lower canines to attach the Jumpers.

Inner bows of the facebow were attached to the upper splint from between the first and second premolars. Outer bows were adjusted so that the point of force application was in front of the center of resistance of maxilla. Extraoral force of 700 g was directed upward and backward.

Patients were instructed to wear the appliance 18 hours a day. After achievement of proper intermaxillary relationship, Jumpers were removed, and the two plates were splinted in the anterior part. The posterior parts of the plates were trimmed away so that the posterior teeth were free to extrude to get into contact with their antagonists. The appliance was worn only at nights from this point on until the lateral open bites were corrected.

Activator and occipital HG group (B)

This group consisted of 12 girls and eight boys with an average skeletal age of 13 years and one month who were treated with an activator–occipital HG combination. Mean duration of treatment was 8.5 months. The bite was constructed so that the sagittal activation was seven mm and the vertical activation was five mm. A 700-g extraoral force was applied with a facebow embedded in the activator so that it made a 35° angle with the occlusal plane.

Control group (C)

Control group consisted of 11 girls and nine boys with an average skeletal age of 12 years and six months. This sample consisted of patients who had refused orthodontic treatment. The observation period of the control group for this particular study was eight months. The subjects were informed that they would be offered orthodontic treatment on request at any time during their follow up.

Subjects of both treatment groups proceeded to fixed appliance therapy after completion of the functional appliance phase.

Measurements and statistical analysis

Pretreatment cephalometric measurements of the three groups were subjected to analysis of variance (ANOVA)

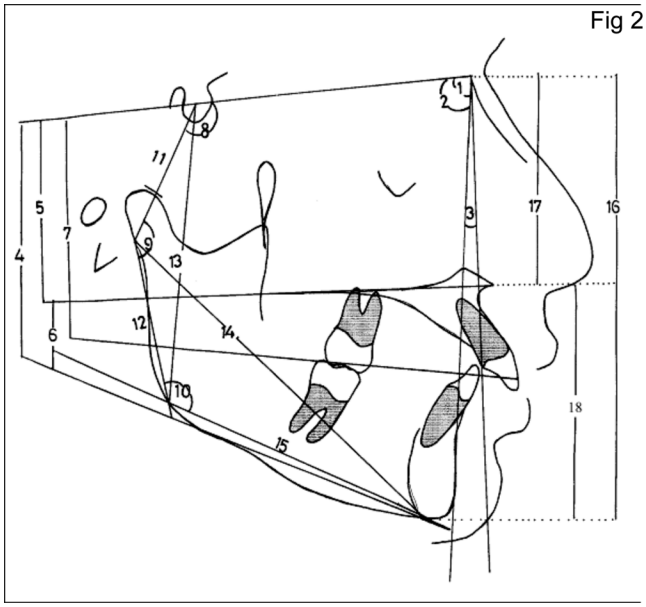

FIGURE 2. Measurements used in the study.

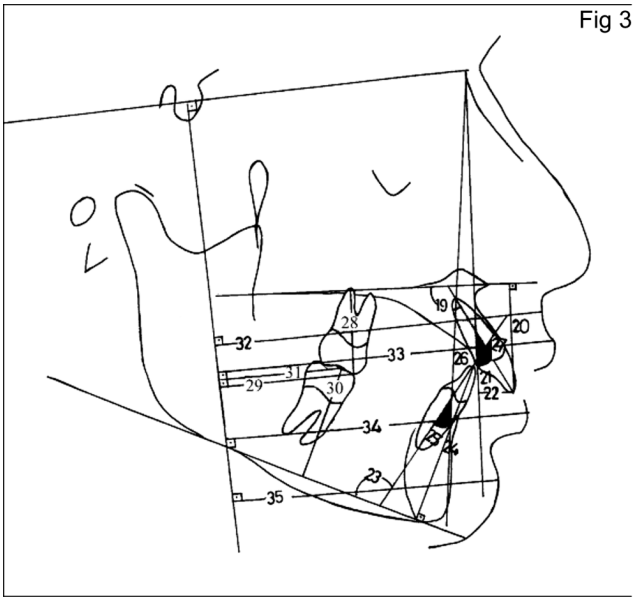

FIGURE 3. Measurements used in the study (continued).

and S-N-K tests to reveal any significant differences between them.

Pre- and postreatment lateral cephalograms and hand-wrist films were gathered for all 60 subjects. Lateral cephalograms were manually traced before being transferred to RMO JOE software (version 5.0, Denver, Colo) by a digitizer. Measurements that are not included in the software were measured manually. Thirty-five dental and skeletal parameters used in the study are demonstrated in Figures 2 and 3.

One week after the first measurements, 20 radiographs were selected at random and retraced, redigitized, and remeasured. A paired *t*-test was applied to the measured parameters. Differences between the first and second measurements were insignificant. The highest method error according to Dahlberg's formula for angular measurements was 0.96° for the Saddle angle and the lowest was 0.21° for SNB angle. Highest and lowest linear method errors were 0.90 and 0.24 mm for Ar-Go and S-Go measurements, respectively.

The collected data were subjected to statistical analysis using SPSS packet software (SPSS for Windows, Release 7.5.1, Chicago, Ill). Wilcoxon paired *t*-test was used for intragroup comparisons. Differences between groups were evaluated by ANOVA and Bonferroni tests.

TABLE 1. Significance of Pretreatment Skeletal Age Differences in Three Groups[a]

			P		
Groups	X	SD	A-B	A-C	B-C
Skeletal Age					
(A) Jasper Jumper	12.08	1.11	ns	ns	ns
(B) Activator	13.01	1.16	ns	ns	ns
(C) Control	12.26	1.18	ns	ns	ns

* $P < .05$.

[a] X indicates mean; SD, standard deviation; ns, not significant.

TABLE 2. Variables that were Found to be Significantly Different Between Three Groups Before Treatment[a]

	Jasper Jumper (A)		Activator (B)		Control (C)		*P*		
	X	SD	X	SD	X	SD	A-B	A-C	B-C
S angle	124.2	5.0	125.9	5.2	128.2	4.5	*	*	ns
L6-MP(V)	28.8	2.8	29.2	2.0	30.4	2.3	ns	*	*

* $P < .05$.

[a] X indicates mean; SD, standard deviation; ns, not significant.

RESULTS

At the end of functional appliance treatment, a skeletal Class I intermaxillary relationship was achieved in all treated cases. The overjet was significantly reduced with a marked correction of the profile.

No statistically significant differences were found between the pretreatment skeletal ages of three groups (Table 1). Pretreatment comparison of the three groups showed significant differences only in two of the 35 variables (Table 2). Saddle angle was significantly smaller in the JJ group than in the activator and control groups. Vertical distance of lower molar to the mandibular plane was significantly higher in the control group compared with both treatment groups (Table 2).

Changes in the two treatment groups and the control group and significances of these changes are presented in Table 3.

When groups A and C were compared, increases in the

TABLE 3. Pre-and Posttreatment Values and Tests of Their Changes

		Jasper Jumper (A)					Activator Group (B)	
		Pre Tx		Post Tx			Pre Tx	
		$\bar{X}$	SD	$\bar{X}$	SD	*P* Value	$\bar{X}$	SD
Skeletal measurements	1 SNA	80.5	4.0	79.4	3.6	0.006**	80.2	3.5
	2 SNB	74.7	3.9	75.5	4.0	0.000***	74.2	3.8
	3 ANB	5.8	1.4	3.9	1.4	0.000***	6.0	1.6
	4 SN-MP	34.3	5.5	35.3	5.7	0.046*	35.6	7.3
	5 SN-PP	7.9	3.4	8.3	2.8	0.198	8.0	4.1
	6 MP-PP	26.2	4.8	27.6	4.3	0.005**	28.1	5.9
	7 SN-Occ	18.9	4.3	20.1	4.8	0.263	15.7	6.4
	8 S angle	124.2	5.0	124.1	4.9	0.247	125.9	5.2
	9 Ar angle	142.0	6.8	145.0	7.4	0.002**	143.2	5.1
	10 Go angle	125.1	5.4	124.7	6.0	0.751	124.5	6.9
	11 S-Ar	33.7	3.0	32.8	3.2	0.015*	33.8	3.5
	12 Ar-Go	43.0	3.3	45.9	3.6	0.006**	45.2	4.3
	13 S-Go	72.2	4.9	74.0	4.7	0.000***	75.4	5.5
	14 Ar-Me	99.9	4.4	101.8	4.9	0.001***	99.3	4.9
	15 Go-Me	65.5	3.4	67.0	5.1	0.021*	67.6	5.7
	16 N-Me	114.2	6.8	117.1	6.9	0.000***	115.7	6.6
	17 N-ANS	51.5	3.5	51.9	3.5	0.352	52.9	4.1
	18 ANS-Me	63.9	5.6	67.4	5.5	0.002**	66.6	5.1
Dental measurements	19 U1P-PP	114.1	7.7	105.8	6.7	0.000***	115.3	4.7
	20 U1-PP(V)	128.6	2.6	28.5	2.9	0.856	29.2	2.5
	21 U1P-NA	25.1	7.5	18.2	7.0	0.000***	26.7	5.6
	22 U1-NA	5.4	2.0	3.7	1.6	0.001***	6.2	2.0
	23 L1P-MP	96.5	7.0	97.4	5.0	0.332	95.9	6.1
	24 L1-MP(V)	39.2	2.6	39.3	2.7	0.807	39.6	3.2
	25 L1P-NB	25.5	5.5	28.0	5.0	0.008**	25.6	5.9
	26 L1-NB	4.8	1.7	6.1	1.7	0.002**	5.3	2.1
	27 U1P-L1P	123.6	7.7	129.8	7.0	0.001***	121.7	7.8
	28 U6-PP(V)	21.3	1.4	20.8	1.9	0.286	21.9	2.5
	29 U6-SV	27.0	4.8	25.3	4.8	0.015*	27.9	5.9
	30 L6-MP(V)	28.8	2.8	30.7	2.9	0.000***	29.2	2.0
	31 L6-SV	26.3	5.4	30.8	5.2	0.000***	27.8	6.0
Soft tissue measurements	32 A′-SV	72.7	4.6	72.4	5.0	0.587	74.4	5.8
	33 UL-SV	73.9	5.6	72.9	5.5	0.099	75.0	6.4
	34 LL-SV	65.8	5.5	68.0	5.9	0.002**	67.5	6.7
	35 B′-SV	54.2	5.5	57.9	7.0	0.001***	55.9	7.6

* $P < .05$, ** $P < .01$, *** $P < .001$, $\bar{X}$ = mean, SD = Standard Deviation.

SN-Occ, ANS-Me, L1-NB, U1P-L1P, and L6-SV and decreases in the SNA, ANB, S-Ar, U1P-PP, U1P-NA, L1P-MP(V), U6-PP(V), U6-SV, A′SV, and UL-SV measurements of group A were significant (Table 4).

ANB, U1PP, U1P-NA, U1L-NA, U6-SV, and UL-SV measurements of group B showed significant decreases when compared with group C. On the other hand, increases of SN-Occ, Ar-Go, S-Go, Ar-Me, N-Me, U1P-L1P, L6-MP(V), and L6-SV measurements were significantly higher than those of group C (Table 4).

Comparison of two treatment groups revealed a significant increase of the Ar angle in group A in contrast to group B and a significant increase of S-Ar measurement in group B in contrast to group A. Increases in the S-Go, Ar-Me, N-Me, and L1-MP(V) were also more prominent in group B (Table 4).

DISCUSSION

Functional appliances are widely used to reposition the mandible in the growing subject. The activator is a common choice of appliance for this treatment, however, it inhibits speech and lateral jaw movements, and it cannot be used in subjects with nasal obstruction. These factors may lead to a decrease of patient compliance.

Failure of removable functional appliances in noncompliant subjects led to the development of fixed appliances such as Herbst and Mars appliances. However, these appliances are reported to cause hygiene problems when bonded[14] and to inhibit lateral jaw movements.[15] JJ appliance used in combination with fixed mechanics may also lead to some problems. Before the insertion of this appliance, upper and lower arch should be leveled and full-size rigid,

TABLE 3. Extended

Activator Group (B)			Control Group (C)				
Post TX			Pre Control		Post Control		
$\bar{X}$	SD	*P* Value	$\bar{X}$	SD	$\bar{X}$	SD	*P* Value
79.7	3.5	0.314	80.3	3	80.4	3.2	0.809
75.7	3.8	0.002**	74.5	3	75	3.4	0.220
4.0	2.1	0.000***	5.8	1.4	5.4	1.5	0.159
35.8	6.8	0.808	35.6	5.8	35.1	6.1	0.396
7.8	4.3	0.755	7.3	2.8	7.4	2.5	0.888
28.5	6	0.326	28.6	5.8	28.4	5.4	0.469
16.9	5.8	0.286	17.6	5.1	16	4.6	0.048*
125.6	4.3	0.538	128.2	4.5	127.7	4.8	0.614
142.5	5.5	0.275	140.9	5.7	140.9	6.9	0.965
125.9	6.2	0.027*	124.4	5.8	125.3	6.5	0.412
34.9	3.3	0.067	33.9	3.8	34.8	4	0.032*
48.7	5.1	0.001***	45.4	3.1	46.7	3.5	0.007**
79.8	6.1	0.000***	75.1	5.2	77.3	5.4	0.001***
105.7	5.4	0.000***	100.3	5.6	101.9	5.6	0.000***
70.4	5.2	0.004**	67.9	4.1	69.2	3.9	0.050*
121.9	5.6	0.000***	115.7	7.9	118.9	8.4	0.000***
54.5	3.4	0.042*	51.9	3.6	52.7	3.3	0.035*
70.5	5.9	0.000***	68.4	6.1	69.6	6.9	0.050*
108.8	5.4	0.000***	111.2	8.5	111.8	8.3	0.485
30.0	2.8	0.073	29.9	3.7	30.1	3.8	0.984
20.5	6.7	0.001***	23	7.5	23.9	7.6	0.627
4.8	1.5	0.021*	5.3	2.4	6.2	2.9	0.502
95.4	8	0.940	94.3	5.7	94.5	6.5	0.717
41.1	3.3	0.003**	40.5	2.4	42.1	2.7	0.000***
26.8	7.8	0.240	24.4	5.5	24.7	5.5	0.780
6.0	2.1	0.005**	4.8	1.7	4.8	2	0.445
128.7	7.8	0.001***	126.9	9	126.1	8.3	0.478
22.6	2.2	0.130	21.8	2.6	23	2.5	0.007**
26.8	6.4	0.347	27.7	4.7	29	4.4	0.008**
31.0	2.8	0.002**	30.4	2.3	31.4	2.4	0.001***
31.4	6.6	0.001***	28.1	5.5	29.5	5.2	0.003**
75.0	5.4	0.192	73.3	5.5	75.4	5.3	0.003**
75.2	6	0.446	74.6	5.7	77.1	5.8	0.003**
70.1	6.5	0.006**	66.3	6	67.8	6	0.098
59.4	7.8	0.003**	54.2	6.9	55.8	6.4	0.040*

rectangular archwires should be placed before the insertion of force modules.[16]

Consequently, achievement of these preparations is time consuming, and this may be a problem for those who are in the late pubertal growth period.

Another disadvantage of JJ appliance used with fixed mechanics is the need to remove the arches completely in the case of a single bracket failure unless an auxiliary arch is used. This requires extra chair time, and if the patient does not visit the office shortly, undesired tooth movements might occur as a result of force modules. Most JJ studies report rapid correction of Class II, Division 1 with a dentoalveolar mechanism rather than a skeletal one.[17–19] JJ, together with fixed appliances, causes intrusion and distalization of upper molars. This intrusive force is a result of diagonal placement of the appliance. This intrusion, in turn, leads to incisor extrusion as a result of continuous archwire in the upper arch. This is the main disadvantage of the appliance.[14]

Many studies may be found in the literature on the use of the activator-HG combination.[20–23] Fixed mechanics plus JJ[14,17,18,24,25] or with the addition of occipital HG have also been studied.[26] However, a review of the literature revealed no studies about the use of JJ with removable plates, which overcomes many disadvantages of conventional functional appliances. In this study, results of treatment with this type of an appliance are comparatively evaluated together with results of activator plus occipital HG combination and a control group.

In the present study, the JJ treatment group was younger; however, there were no statistically significant differences between the pretreatment skeletal ages of the three groups studied. Moreover, pretreatment comparison of the three groups showed statistical differences only in two of the 35

TABLE 4. Comparisons of Pre- and Posttreatment Differences Between Groups

		Jasper Jumper (A)		Activator Group (B)		Control Group (C)		*P* Value		
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	A-B	A-C	B-C
Skeletal measurements	1 SNA	−1.1	1.1	−0.5	2.3	0.1	1.7	0.878	0.048*	0.927
	2 SNB	0.8	0.6	1.5	2.1	0.5	1.6	0.401	1.000	0.102
	3 ANB	−1.9	1.1	−2.1	1.5	−0.4	1.2	1.000	0.001***	0.000***
	4 SN-MP	1.0	1.7	0.2	2.8	−0.5	1.8	0.813	0.106	0.901
	5 SN-PP	0.4	1.3	−0.3	2.3	0.1	1.8	0.826	1.000	1.000
	6 MP-PP	1.4	1.8	0.4	1.8	−0.2	2.5	0.439	0.060	1.000
	7 SN-Occ	1.3	3.5	1.1	3.7	−1.6	2.9	1.000	0.031*	0.043*
	8 S angle	−0.2	2.8	−0.4	3.0	−0.5	2.6	1.000	1.000	1.000
	9 Ar angle	3.0	5.9	−0.7	3.4	−0.1	2.6	0.020*	0.075	1.000
	10 Go angle	−0.5	2.5	1.5	2.5	0.8	3.2	0.093	0.411	1.000
	11 S-Ar	−0.9	1.6	1.1	2.6	0.9	1.9	0.007**	0.016*	1.000
	12 Ar-Go	2.9	3.1	3.5	3.0	1.4	1.9	1.000	0.234	0.046*
	13 S-Go	1.8	1.3	4.4	3.0	2.2	1.8	0.001***	1.000	0.006**
	14 Ar-Me	1.9	1.8	6.4	2.8	1.6	1.2	0.000***	1.000	0.000***
	15 Go-Me	1.5	3.4	2.8	3.6	1.4	2.6	0.656	1.000	0.492
	16 N-Me	2.9	1.9	6.2	4.3	3.2	2.6	0.003	1.000	0.008**
	17 N-ANS	0.4	1.3	1.6	3.1	0.9	1.8	0.211	1.000	0.853
	18 ANS-Me	3.4	2.6	3.9	2.7	1.3	2.6	1.000	0.037*	0.008**
Dental measurements	19 U1P-PP	−8.4	5.2	−6.6	6.1	0.6	3.1	0.752	0.000***	0.000***
	20 U1-PP(V)	−0.1	1.4	0.8	1.9	0.2	1.9	0.359	1.000	0.733
	21 U1P-NA	−6.8	5.1	−6.2	6.1	0.9	3.9	1.000	0.000***	0.000***
	22 U1-NA	−1.7	1.6	−1.5	2.4	0.9	2.7	1.000	0.003**	0.007**
	23 L1P-MP	0.8	4.7	−0.5	5.2	0.3	3.6	1.000	1.000	1.000
	24 L1-MP(V)	0.1	0.8	1.5	2.0	1.6	1.1	0.005**	0.003**	1.000
	25 L1P-NB	2.5	3.8	1.2	4.6	0.3	3.6	0.974	0.283	1.000
	26 L1-NB	1.2	0.8	0.7	1.0	0.0	1.3	0.246	0.001***	0.146
	27 U1P-L1P	6.2	5.5	7.0	7.4	−0.7	4.9	1.000	0.002**	0.000***
	28 U6-PP(V)	−0.5	1.7	0.8	1.9	1.2	1.9	0.125	0.017*	1.000***
	29 U6-SV	−1.7	2.5	−1.2	3.8	1.4	1.9	1.000	0.004**	0.023*
	30 L6-MP(V)	1.9	1.4	1.8	2.2	0.9	1.0	1.000	0.181	0.026*
	31 L6-SV	4.5	2.0	3.6	3.3	1.4	1.5	0.848	0.000***	0.012*
Soft tissue measurements	32 A′-SV	−0.3	1.7	0.5	2.9	2.1	2.5	0.853	0.010**	0.151
	33 UL-SV	−0.9	2.2	0.2	3.1	2.6	3.0	0.648	0.001***	0.027*
	34 LL-SV	2.2	2.3	2.7	3.9	1.5	3.6	1.000	1.000	0.807
	35 B′-SV	3.6	3.6	3.5	3.8	1.6	3.0	1.000	0.247	0.276

* $P < .05$ ** $P < .01$, *** $P < .001$, $\bar{X}$ = Mean SD = Standard Deviation

variables—Saddle angle and vertical distance of lower molar to the mandibular plane. Although significant, the differences in the Saddle angle were small (1.7° to 4°) and averages were in the normal deviation of the mean value reported for this angle (123 ± 5°).[27] Thus, we concluded that the three groups were comparable.

Appliance used in this study gets anchorage not only from dental units but also from the alveolar processes and palate. The upper and lower plates cover the occlusal and middle thirds of the crowns. This, in turn, may again increase the skeletal effect of the appliance. Occipital HG was added to the JJ appliance to control the maxillary growth and development and to overcome the clockwise rotational effect of Jumper on the palatal plane.

One of the most important observations with the JJ appliance was that the patients rapidly got used to the appliance and showed a high level of compliance. This high acceptance by the patients was related to the comfort of the appliance compared with the conventional functional orthopedic appliances. The appliance leaves more room for the tongue, lateral jaw movements and speech are not affected, and oral respiration is possible when needed. However, these parameters were not studied methodologically in this study and, thus, should be evaluated with caution.

Sagittal changes

At the end of treatment, ANB angle was decreased significantly in both treatment groups. This decrease was mainly related to decrease of SNA in group A. In group B, decrease of ANB angle also was related to inhibition of maxillary growth and forward positioning of the mandible. A more prominent effect on ANB angle in group A should be related to the distal force application of Jumpers to maxilla together with occipital HG. Most of the researchers who studied activator-HG also reported a decrease in the ANB

angle.[22,23,28,29] Dermaut et al[29] stated that this was the result of an increase in the SNB angle rather than a decrease in the SNA angle.

Growth pattern

Some studies of activator HG combination did not report a significant change in the SN-MP angle[21,22] and the palatal plane angle.[23,30] Lehman and Hulsink[31] state that most of the cases did not demonstrate a mandibular rotation, and correction was a result of changes in the dentoalveolar structure. Our results are in accordance with these findings. None of treatment groups in this study showed significantly different changes in the measurements of SN-MP, SN-PP, and MP-PP, and, therefore, treatment did not cause a significant rotation of the maxilla or mandible.

SN-Occ measurement increased significantly in both treatment groups, whereas it was decreased in the control group. This is a result of dentoalveolar changes in treatment groups rather than a skeletal effect. For example, the change with the occlusal plane in group A is a result of upper molar region intrusion and inhibition of vertical growth of lower anterior region. Some studies of HG-activator combination on the other hand did not report significant changes in the SN-Occ plane angle.[22,32]

Vertical changes

N-Me measurement in group A and N-Me and N-ANS measurements in group B were significantly increased. It is clear that activator-HG combination significantly increased lower and total facial heights, whereas this increase was limited to lower facial height with JJ appliance. Researchers report significant in-group differences in these parameters in treatment and control groups. However, there were no significant differences between the treatment and control groups.[20,23] That is, the increase in the vertical dimension should be related to growth rather than to treatment.

Incisor position

Both treatment groups in this study demonstrated upper incisor retrusion similar to that observed in acrylic splinted MARS[33] and HG-activator studies.[21–23,28,29,32,34] Vertical positions of the incisors were not affected by the treatment. This is in accordance with the findings of Altuğ et al.[20] The L1P-NB and L1-NB measurements showed significant changes in group A; however, only the L1-NB measurement was different from that of the control group. Slight lower incisor protrusion was present in group A. On the other hand, no significant lower incisor changes were observed in group B, and this was in accordance with the findings of some previous studies.[22,23,34] When L1-MP(V) measurement was evaluated, vertical development of lower incisor region was inhibited in group A. In group B, however, no significant changes were present when compared with the control group. Both treatment groups demonstrated significant increase in the interincisal angle, which was mainly related to upper incisor retrusion. This is in accordance with the results of previous studies.[26,35]

Molar changes

U6-PP(V) measurement was significantly increased in the control group, whereas it was decreased in group A and insignificantly increased in group B. This implies that JJs inhibited the vertical growth vector of the molar region. Effect of occipital HG used in group B was not this much. Molar distalization was reported in activator-HG studies.[22,23,36] Accordingly, significant distalization of molars was observed in both treatment groups. L6-SV measurement was significantly increased in all groups; however, increases were more prominent in treatment groups. Literature reports similar results with use of activator–occipital HG.[22,23]

Vertical dimension

Comparison of two treatment groups revealed that in group B, total and posterior facial height and Ar-Me dimensions were increased more than in group A.

Soft tissue

Decreases in the A′-SV and UL-SV measurements in group A imply that forward movement of upper lip was inhibited as a result of A point development inhibition and upper incisor retrusion. This must be a result of diagonally placed JJs in addition to occipital HG. These measurements were increased in group B, however, changes were insignificant when compared with the control group. Some authors[21,34,36] reported retrusion of the upper lip with an activator-HG combination, whereas Ülgen stated that this retrusion was insignificant. No significant changes were observed in the lower lip position in accordance with the findings of previous activator-HG studies.[21,26,34]

When the results of this study are considered clinically, an important number of ‘‘changes during treatment,’’ although statistically significant, are so small that the clinical significance might be limited.

Functional appliances are not usually recommended for the treatment of high-angle Class II cases. The JJ occipital HG appliance may contribute to the treatment of these difficult cases.

CONCLUSIONS

Dentofacial changes in growing Class II, Division 1 subjects as a result of JJ occipital HG splinted appliance or activator-HG combination were as follows:

- In the JJ group, maxillary growth was inhibited and slight maxillary retrusion was realized. No significant rotations of maxilla or mandible were present.

- In the JJ and activator groups, upper facial height was not significantly changed, however, lower facial height was significantly increased. Total facial height and posterior facial height were significantly increased only in activator group.
- In both groups, obvious upper incisor retrusion, upper molar distalization, and mesial movement of lower molars were observed. Splinted JJ appliance plus HG group demonstrated slight lower incisor protrusion and significant inhibition of vertical molar and lower incisor growth.
- The activator-HG appliance is more effective on the mandible, whereas the JJ appliance is mainly active on the maxilla. Thus, ideal cases for a JJ splinted appliance should be high-angle cases, particularly with maxillary excess and mandibular deficiency.
- Treatment results in favorable changes in the profile.
- Although not methodologically tested, treatment comfort and cooperation were observed to be higher in the JJ group.

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