Original Article

Skeletal, Dental and Soft-Tissue Changes Induced by the Jasper Jumper Appliance in Late Adolescence

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Abstract: The purpose of this study was to evaluate the skeletal, dental, and soft-tissue changes in late-adolescent patients treated with Jasper Jumpers applied with sectional arches. The study sample consisted of 30 subjects (15 treated, 15 untreated) with skeletal and dental Class II malocclusion. Our study was carried out on 75 lateral cephalometric films. Among these radiograms, 15 were taken before the leveling stage in the treatment group. Half of the remaining 60 were taken before placement and after removal of the Jasper Jumper appliance in the treatment group and the other half at the beginning and six months after in the control group. The patient selection criteria were Class II malocclusion caused by retrognathic mandible, normal or low-angle growth pattern, and postpeak growth period. The statistical assessment of the data suggests that the sagittal growth potential of the maxilla was inhibited. There were no significant changes in the vertical skeletal parameters. The mandibular incisors were protruded and intruded, whereas the maxillary incisors were retruded and extruded. The upper molars tipped distally as the lower molars tipped mesially. Because of these changes, the occlusal plane rotated in the clockwise direction. Overbite and overjet were reduced, and the soft-tissue profile improved significantly. The results revealed that, in late-adolescent patients, the Jasper Jumper corrected Class II discrepancies mostly through dentoalveolar changes. It is suggested that this treatment method could be an alternative to orthognathic surgery in borderline Class II cases. (*Angle Orthod* 2005;75:426–436.)

Key Words: Jasper Jumper; Functional therapy; Skeletal Class II malocclusion; Dentofacial orthopedics; Facial profile

INTRODUCTION

The Jasper Jumper™ (American Orthodontics, Sheboygan, Wis) is a fixed functional appliance which keeps the mandible in a protruded position by applying continuous, light forces. In correction of Class II malocclusions, it acts like headgear, activator or a combination of both according to how it is activated. In addition, it has the advantages of allowing the mandible lateral movements, good patient cooperation, and easy oral hygiene.[1,2]

Even though previous studies have revealed the clinical outcome of the appliance, there is still some debate about how much correction is achieved by skeletal changes vs dentoalveolar changes. In 1994, Cope et al[3] used a Jasper Jumper in 31 Class II patients and evaluated the craniofacial changes. They reported that the changes were mostly dentoalveolar rather than skeletal. According to their results, the maxilla underwent significant posterior displacement, the maxillary incisors retroclined, whereas the max-

TABLE 1. Age Range and Sex Distribution of Treatment and Control Groups[a]

	n	Age (X)	SD	Min	Max
Control group					
Girls	9	15.00	±0.68	14.00	16.00
Boys	6	15.25	±1.03	14.00	16.50
Total	15	15.13	±0.81	14.00	16.50
Treatment group					
Girls	8	15.00	±0.75	13.50	16.00
Boys	7	15.10	±1.21	13.50	17.00
Total	15	15.06	±0.96	13.50	17.00

[a] n indicates the number of patients; X, mean age before placement of Jasper Jumper (year); SD, standard deviation; min, minimum age before placement of Jasper Jumper (year); max, maximum age before placement of Jasper Jumper (year).

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Accepted: June 2004. Submitted: February 2004.

FIGURE 1. Lateral view of the sectional arch.

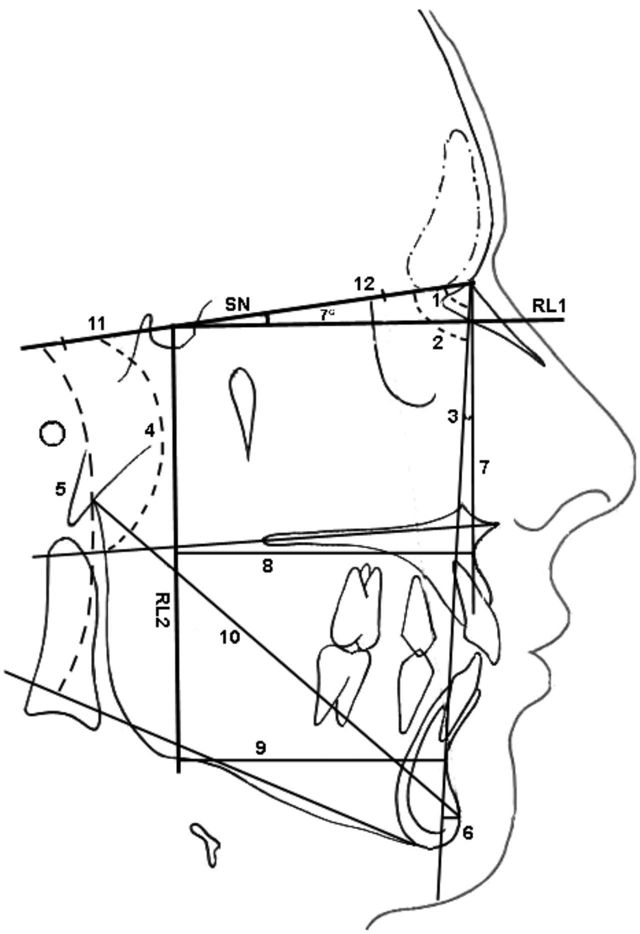


FIGURE 2. Angular and linear skeletal measures used in the study. SN indicates Sella-nasion plane; RL1, horizontal reference line; RL2, vertical reference line; 1, SNA angle; 2, SNB angle; 3, ANB angle; 4, SN/PP angle; 5, SN/MP angle; 6, Pg-NB distance; 7, A-RL1 distance; 8, A-RL2 distance; 9, B-RL2 distance; 10, Ar-Pg distance; 11, SE distance; and 12, SL distance.

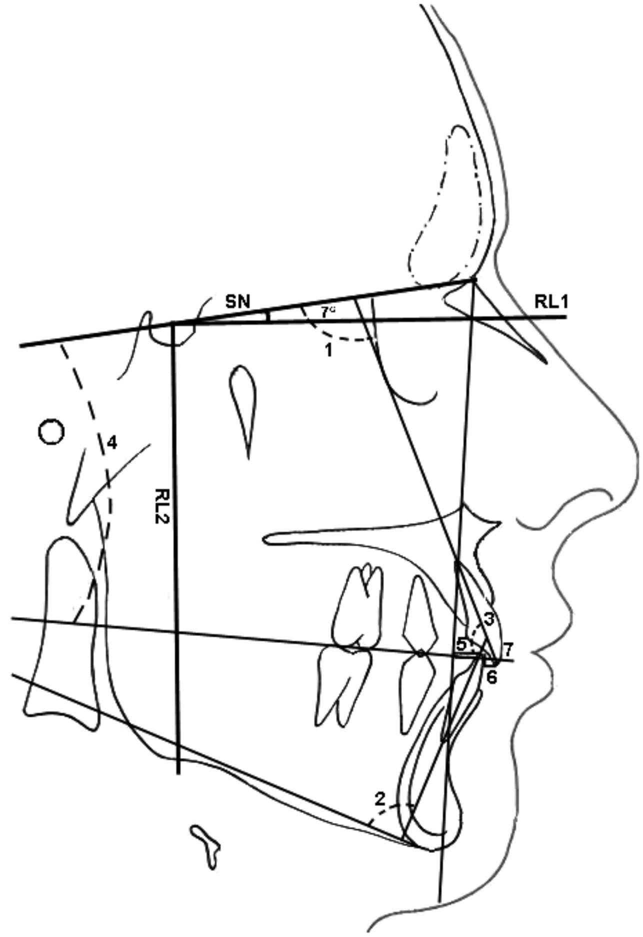


FIGURE 3. Angular and linear dental measures used in the study. SN indicates Sella-nasion plane; RL1, horizontal reference line; RL2, vertical reference line; 1, U1/SN angle; 2, IMPA; 3, interincisal angle; 4, SN/OP angle; 5, L1-NB distance; 6, overjet; and 7, overbite.

illary molars tipped distally. Also, a clockwise rotation of the mandible was evident and the mandibular incisors proclined significantly, whereas the mandibular molars tipped mesially.

Weiland and Bantleon[4] studied 17 consecutive growing patients with Class II, division 1 malocclusions treated with Jasper Jumper appliances and reported that the correction of the malocclusion was achieved both by skeletal (40%) and dental (60%) changes. As with these findings, Kucukkeles and Orgun[5] showed that the appliance produced mostly dentoalveolar changes.

In a case study by Mills and McCulloch,[2] the investigators used a modified Jasper Jumper on a mixed dentition Class II patient. They reported that the effects of the appliance were largely dentoalveolar.

Covell et al[6] investigated the effects of treatment with the Jasper Jumper in 36 growing Class II patients. They stated that the appliance corrected Class II discrepancies mostly through dentoalveolar changes and, to a limited extent, by restraint of forward maxillary growth.

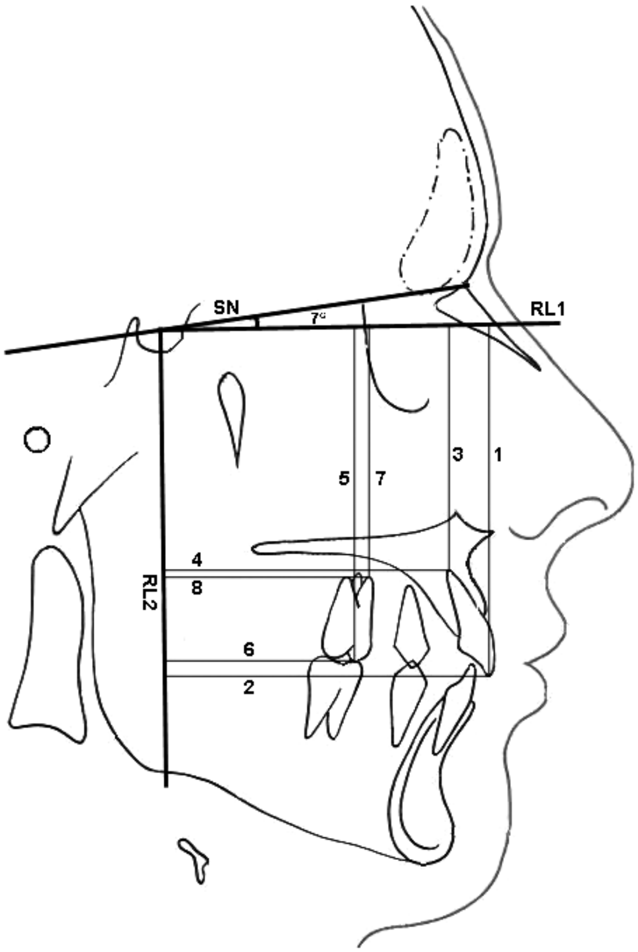


FIGURE 4. Horizontal and vertical measurements of upper incisor and first molar related to reference lines. SN indicates Sella-nasion plane; RL1, horizontal reference line; RL2, vertical reference line; 1, U1t-RL1 distance; 2, U1t-RL2 distance; 3, U1a-RL1 distance; 4, U1a-RL2 distance; 5, U6c-RL1 distance; 6, U6c-RL2 distance; 7, U6a-RL1 distance; and 8, U6a-RL2 distance.

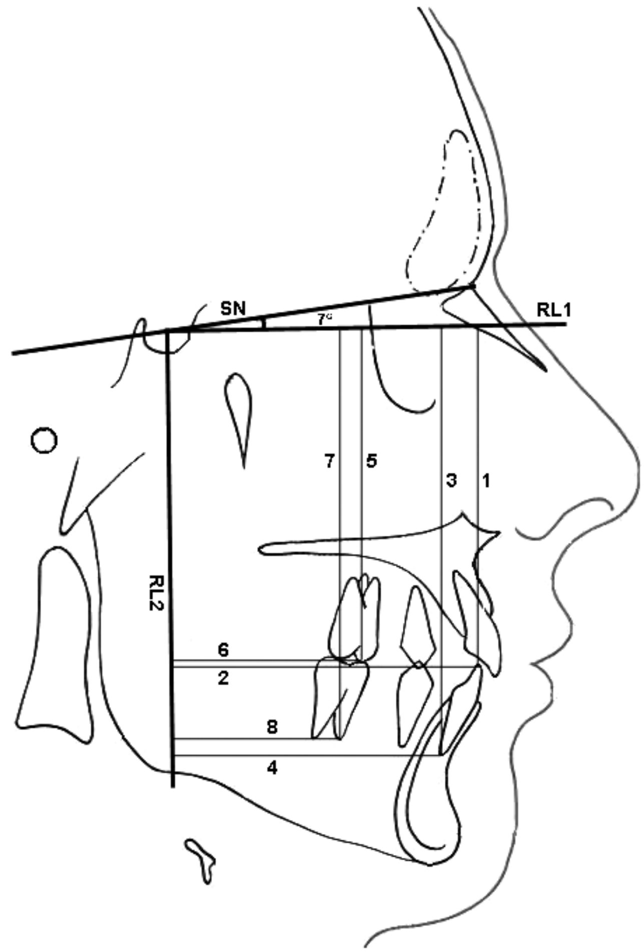


FIGURE 5. Horizontal and vertical measurements of lower incisor and first molar related to reference lines. SN indicates Sella-nasion plane; RL1, horizontal reference line; RL2, vertical reference line; 1, L1t-RL1 distance; 2, L1t-RL2 distance; 3, L1a-RL1 distance; 4, L1a-RL2 distance; 5, L6c-RL1 distance; 6, L6c-RL2 distance; 7, L6a-RL1 distance; and 8, L6a-RL2 distance.

Consequently, a review of the literature shows that functional appliances including the Jasper Jumper have similar effects on dentoalveolar and skeletal structures. Among these changes, the increased inclination of the lower incisors is usually considered an unfavorable effect of functional therapy. In our study, to prevent or minimize this effect we applied the Jasper Jumpers using sectional arches.

Considering these findings, this study was done to evaluate the skeletal, dental, and soft-tissue changes in late-adolescent patients treated with Jasper Jumpers applied with sectional arches.

MATERIALS AND METHODS

Treatment sample

The study sample consisted of 30 subjects (15 treated, 15 untreated) with skeletal and dental Class II malocclusions. The patient inclusion criteria were (1) skeletal and dental Class II malocclusion caused by retrognathic mandible, (2) normal or low-angle growth pattern, and (3) post-peak growth period. The study method was approved by the Yeditepe University Ethical Committee.

Skeletal age was used for selecting the patients, and post-peak growth period was defined by hand-wrist radiographic stages. The mean pretreatment age for the treatment group was 15.06 ± 0.96 years and 15.13 ± 0.81 years for the control group. The age range and the sex distribution of treatment and control groups are shown in Table 1.

Treatment methods

In the treatment group, standard edgewise brackets and bands were placed with a transpalatal arch in the upper arch to increase stability. After leveling, 0.017 × 0.022–inch and 0.017 × 0.025–inch stainless steel continuous archwires were inserted and cinched back in the upper and lower arches, respectively. In the lower arch, 0.018 × 0.025/0.022 ×

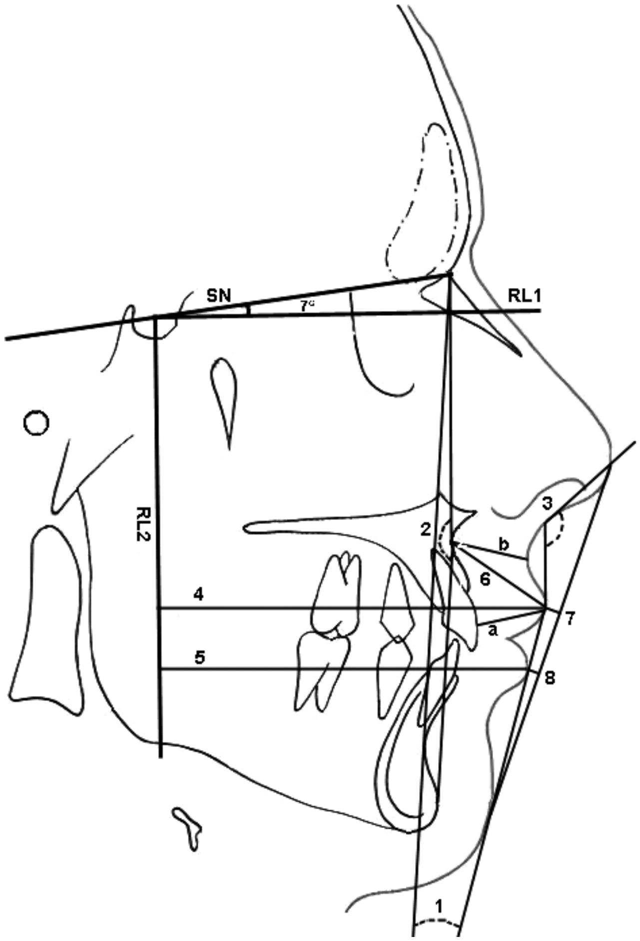


FIGURE 6. Angular and linear soft-tissue measures used in the study: SN indicates Sella-nasion plane; RL1, horizontal reference line; RL2, vertical reference line; 1, H angle; 2, N-A-Pg angle; 3, nasolabial angle; 4, labialis superior-RL2 distance; 5, labialis inferior-RL2 distance; 6, A-labialis superior distance; 7, E line-labialis superior distance; 8, E line-labialis inferior distance; and a-b, lip strength.

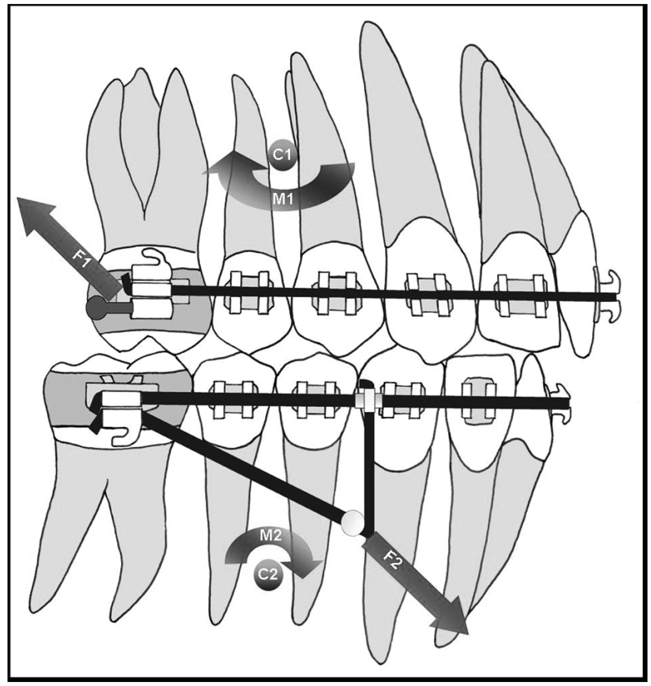


FIGURE 7. The sagittal, vertical, and oblique forces induced by the Jasper Jumper. C1 indicates the resistance center of the upper dentoalveolar arch; C2, the resistance center of the lower dentoalveolar arch; F1, the force applied by the Jasper Jumper to the upper arch; F2, the force applied by the Jasper Jumper to the lower arch; M1, the moment caused by F1; M2, the moment caused by F2; F1 = F2; and M1 > M2.

0.028–inch cross tubes (order-no. 480-000-00 Dentaurum, Ispringen, Germany) were crimped distal to the canine brackets. Jasper Jumper mechanics were applied on 0.017 × 0.025–inch stainless steel sectional arches connected to the lower continuous archwire by means of 0.018 × 0.025/ 0.022 × 0.028–inch cross tubes. The anterior tip of the sectional arch was adjusted to pass close to the deepest part of the vestibular sulcus, which coincided with approximately one crown length of extension from the enamel-cement border of the canine tooth. Because it was impossible to pass through the center of resistance of the lower dentoalveolar arch, this way provided the most practical way to pass the force as near as possible to the center of resistance of the lower dentoalveolar arch without causing an excessive irritation on the mucosal surface of the vestibular sulcus (Figure 1).

Jasper Jumpers were selected according to the manufacturer's instructions and connected to the lower arch through sectional arches inserted between the auxiliary tubes of the lower molar bands and cross tubes.

The patients were seen every four weeks, and the appliances were activated every eight weeks. The appliance was removed when a Class I or overcorrected Class I canine and molar relationship was achieved.

Cephalometric methods

Our study was carried out on 75 lateral cephalometric films, 15 of which were taken off the treatment group before the leveling stage. These preleveling cephalometric films were used for comparison of IMPA values before leveling, at insertion, and removal of the Jasper Jumper. Half of the remaining 60 were taken before placement and after removal of the Jasper Jumper appliance in the treatment group and the other half at the beginning and six months later in the control group. The pretreatment and posttreatment radiograms of each patient were traced on acetate paper at the same time by one examiner to minimize any method error. Cephalometric landmarks and measurements can be seen in Figures 2–6. The reference lines used in this study were also used in previous investigations.[7–10]

Statistical methods

The nonparametric Wilcoxon signed rank test was used to assess the differences in each group. To evaluate the

TABLE 2. Changes and Comparisons of Pretreatment and Posttreatment Values Within the Control Group[a]

		Pretreatment		Posttreatment		Difference		Wilcoxon
		Mean	SD	Mean	SD	D	SD	*P*
1	SNA (°)	78.36	4.31	79.06	4.10	0.70	1.08	*
2	SNB (°)	73.76	3.86	74.40	3.72	0.63	1.04	*
3	ANB (°)	4.60	1.88	4.66	1.70	0.06	0.56	
4	SN/PP (°)	8.50	2.80	8.13	2.27	−0.36	1.56	
5	SN/MP (°)	36.56	3.91	36.26	3.91	−0.30	1.41	
6	SE (mm)	43.80	10.42	44.90	10.92	1.10	2.52	
7	SL (mm)	21.10	3.12	21.30	3.24	0.20	1.09	
8	Pg-NB (mm)	2.56	1.53	2.63	1.95	0.06	0.62	
9	Ar-Pg (mm)	102.23	10.06	104.60	10.75	2.36	1.14	***
10	A-RL2 (mm)	66.30	8.09	67.66	8.09	1.36	1.24	**
11	B-RL2 (mm)	55.93	9.93	57.66	10.11	1.73	1.34	**
12	A-RL1 (mm)	51.96	5.36	52.53	5.23	0.56	1.34	
13	ANS-Me/N-Me (%)	55.35	2.32	55.70	2.08	0.35	0.69	*
14	Jarabak ratio (%)	63.26	2.93	63.38	2.85	0.12	1.22	
15	Gonial ratio (%)	71.16	5.09	70.99	4.71	−0.17	2.26	
16	S-Ar/Ar-Go (%)	83.23	7.64	83.75	8.89	0.51	3.37	
17	U1/SN (°)	101.03	7.34	101.50	7.75	0.46	2.75	
18	IMPA (°)	94.06	9.06	92.80	8.99	−1.26	2.75	
19	Interincisal angle (°)	129.46	12.69	130.66	13.54	1.20	3.28	
20	SN/OP (°)	19.13	3.98	18.63	3.85	−0.46	2.33	
21	L1/NB (mm)	4.86	2.41	4.90	2.60	0.03	0.74	
22	Overjet (mm)	4.73	2.99	4.90	3.20	0.16	1.06	
23	Overbite (mm)	4.10	2.36	4.53	2.10	0.43	0.97	
24	H angle (°)	12.13	5.25	11.93	5.39	−0.20	2.52	
25	Nasolabial angle (°)	117.66	6.91	115.93	7.27	−1.73	3.55	
26	N-A-Pg (°)	173.13	5.54	173.40	5.50	0.26	1.45	
27	A-labialis superior (mm)	20.80	2.57	21.00	2.56	0.20	1.86	
28	E line-labialis superior (mm)	−2.83	2.89	−3.00	2.42	−0.16	1.43	
29	E line-labialis inferior (mm)	−1.96	3.10	−2.83	2.60	−0.86	1.57	
30	Labialis superior-RL2 (mm)	82.46	10.14	84.26	10.17	1.80	1.81	**
31	Labialis inferior-RL2 (mm)	77.66	10.33	79.20	10.48	1.53	1.79	**
32	Lip strength (mm)	2.83	2.15	3.20	2.31	0.36	1.10	

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.

differences between the groups the Mann-Whitney *U*-test was used. A confidence level greater than 5% was considered statistically not significant.

To assess the magnitude of the method error, 20 randomly selected cephalograms were traced and measured again by the same examiner after an interval of 20 days. Paired *t*-tests and correlation analysis were used to evaluate the findings. The method error did not exceed 0.10 mm and 0.75° for the linear and angular measurements, respectively.

RESULTS

Skeletal changes

Statistical comparisons of pretreatment and posttreatment values of the groups are shown in Tables 2–8. Comparisons of the cephalometric measurements revealed that the appliance had only limited skeletal effect on the maxilla. In the control group, SNA show a statistically significant increase (Table 2) whereas, no significant change was present in the treatment group (Table 3). When the two groups were compared, a significant decrease was found as seen in Table 4. As with this finding, a significant decrease was found in the A-RL2 line.

When measurements of the mandible were evaluated, no significant change between two groups was found (Table 4). However, the ANB angle demonstrated a significant decrease when the two groups were compared (Table 4).

When the skeletal vertical parameters were evaluated, the only significant change was found in the ANS-Me/N-Me ratio.

Dental changes

In the treatment group, the dental changes caused by Jasper Jumper were evident. The upper incisors were significantly retroclined as compared with the control group (Table 4). The maxillary incisal tip moved distally 2.17 mm, whereas the incisor apex moved mesially 0.30 mm. Likewise, significant vertical movements of the upper incisors occurred (Table 7).

On the other hand, in the treatment group, the lower incisors showed significant proclination (Tables 3 and 7). The

TABLE 3. Changes and Comparisons of Pretreatment and Postreatment Values Within the Treatment Group[a]

		Pretreatment		Posttreatment		Difference		Wilcoxon
		Mean	SD	Mean	SD	D	SD	*P*
1	SNA (°)	79.83	2.26	79.63	2.37	−0.20	0.64	
2	SNB (°)	74.93	2.55	75.30	2.51	0.36	0.66	
3	ANB (°)	4.90	2.45	4.33	2.06	−0.56	0.82	*
4	SN/PP (°)	8.63	4.29	8.83	4.48	0.20	1.06	
5	SN/MP (°)	33.43	4.31	33.20	4.25	−0.23	0.67	
6	SE (mm)	47.13	5.47	47.50	5.52	0.36	1.97	
7	SL (mm)	21.93	2.21	22.30	2.81	0.36	1.00	
8	Pg-NB (mm)	3.46	2.19	3.20	1.99	−0.26	0.77	
9	Ar-Pg (mm)	107.00	5.17	107.63	5.83	0.63	1.28	
10	A-RL2 (mm)	69.83	3.26	69.76	3.81	−0.06	0.94	
11	B-RL2 (mm)	58.93	3.95	59.70	4.40	0.76	1.30	*
12	A-RL1 (mm)	53.56	4.60	54.53	4.59	0.96	1.89	
13	ANS-Me/N-Me (%)	56.25	1.41	55.82	1.71	−0.43	0.52	*
14	Jarabak ratio (%)	66.09	4.00	66.12	3.90	0.03	0.57	
15	Gonial ratio (%)	70.44	6.40	70.81	7.05	0.36	1.26	
16	S-Ar/Ar-Go (%)	81.31	9.90	82.15	10.40	0.84	2.66	
17	U1/SN (°)	105.76	4.74	99.60	5.29	−6.16	3.13	***
18	IMPA (°)	97.63	4.85	104.96	4.28	7.33	3.65	***
19	Interincisal angle (°)	122.86	6.93	121.73	6.64	−1.13	5.00	
20	SN/OP (°)	15.96	4.52	20.60	4.03	4.63	2.03	***
21	L1/NB (mm)	5.80	2.06	7.76	2.32	1.96	0.89	***
22	Overjet (mm)	6.03	1.74	1.33	1.09	−4.70	1.57	***
23	Overbite (mm)	3.36	0.99	1.73	1.33	−1.63	1.17	***
24	H angle (°)	12.33	5.61	10.93	5.53	−1.40	2.02	*
25	Nasolabial angle (°)	113.93	9.74	115.70	9.36	1.76	2.69	*
26	N-A-Pg (°)	172.36	7.21	173.46	6.28	1.10	1.57	*
27	A-labialis superior (mm)	23.56	2.87	22.63	2.94	0.93	1.98	
28	E line-labialis superior (mm)	−3.40	3.00	−4.46	3.26	−1.06	1.25	**
29	E line-labialis inferior (mm)	−2.40	3.74	−2.06	3.17	0.33	0.99	
30	Labialis superior-RL2 (mm)	88.00	4.75	86.86	5.26	−1.13	1.77	*
31	Labialis inferior-RL2 (mm)	81.96	4.89	83.16	5.36	1.20	1.75	*
32	Lip strength (mm)	2.93	1.88	2.06	1.90	−0.86	1.27	*

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.

IMPA increased 7.33°, whereas L1-NB distance increased 1.96 mm (Table 3). The changes relative to reference lines also support these findings. The mandibular incisal tip moved forward 2.67 mm, whereas the incisor apex moved backward insignificantly. The vertical changes of the lower incisors displayed a greater movement in the opposite direction to the maxillary incisors (Table 7).

The upper molar showed significant backward movement with distal tipping and intrusion, whereas the lower molar displayed a significant mesial tipping movement (Table 7).

The dentoalveolar effects that occurred both in the upper and lower jaws produced a clockwise rotation of the occlusal plane (Table 4).

The decrease in overbite and overjet supports the incisor inclination variations caused by the appliance (Table 4).

Soft-tissue changes

Soft-tissue profiles improved significantly, reflecting the changes that took place in the dentoskeletal structures. When the two groups were compared, a significant increase was seen in the nasolabial angle. Likewise, the statistically significant decrease in the labialis superior-RL2 distance and lip strength also showed the retrusion of the upper lip (Table 4).

When the parameters related to the lower lip were evaluated, the decrease in the E line-labialis inferior distance showed that the lower lip moved forward as the lower incisors protruded.

DISCUSSION

This study evaluated the skeletal, dental, and soft-tissue changes in late-adolescent patients treated with Jasper Jumpers, applied with sectional arches. The study sample was composed of late-adolescent patients who were at the end of their postpubertal growth period. This group was chosen because it would benefit from the minimal residual growth and have minimal relapse due to growth and posttreatment dentoskeletal changes.

In the treatment group, the Jasper Jumper was applied using sectional arches to prevent or minimize the lower

TABLE 4. Comparison of Skeletal, Dental, and Soft-Tissue Changes of the Control and Treatment Groups Related to Treatment[a]

		Control Group			Treatment Group			Mann-Whitney *U*
		D	SD	Test	D	SD	Test	*P*
1	SNA (°)	0.70	1.08	*	−0.20	0.64		**
2	SNB (°)	0.63	1.04	*	0.36	0.66		
3	ANB (°)	0.06	0.56		−0.56	0.82	*	*
4	SN/PP (°)	−0.36	1.56		0.20	1.06		
5	SN/MP (°)	−0.30	1.41		−0.23	0.67		
6	SE (mm)	1.10	2.52		0.36	1.97		
7	SL (mm)	0.20	1.09		0.36	1.00		
8	Pg-NB (mm)	0.06	0.62		−0.26	0.77		
9	Ar-Pg (mm)	2.36	1.14	***	0.63	1.28		***
10	A-RL2 (mm)	1.36	1.24	**	−0.06	0.94		***
11	B-RL2 (mm)	1.73	1.34	**	0.76	1.30	*	
12	A-RL1 (mm)	0.56	1.34		0.96	1.89		
13	ANS-Me/N-Me (%)	0.35	0.69	*	−0.43	0.52	*	**
14	Jarabak ratio (%)	0.12	1.22		0.03	0.57		
15	Gonial ratio (%)	−0.17	2.26		0.36	1.26		
16	S-Ar/Ar-Go (%)	0.51	3.37		0.84	2.66		
17	U1/SN (°)	0.46	2.75		−6.16	3.13	***	***
18	IMPA (°)	−1.26	2.75		7.33	3.65	***	***
19	Interincisal angle (°)	1.20	3.28		−1.13	5.00		
20	SN/OP (°)	−0.46	2.33		4.63	2.03	***	***
21	L1/NB (mm)	0.03	0.74		1.96	0.89	***	***
22	Overjet (mm)	0.16	1.06		−4.70	1.57	***	***
23	Overbite (mm)	0.43	0.97		−1.63	1.17	***	***
24	H angle (°)	−0.20	2.52		−1.40	2.02	*	
25	Nasolabial angle (°)	−1.73	3.55		1.76	2.69	*	*
26	N-A-Pg (°)	0.26	1.45		1.10	1.57	*	
27	A-labialis superior (mm)	0.20	1.86		0.93	1.98		
28	E line-labialis superior (mm)	−0.16	1.43		−1.06	1.25	**	
29	E line-labialis inferior (mm)	−0.86	1.57		0.33	0.99		*
30	Labialis superior-RL2 (mm)	1.80	1.81	**	−1.33	1.77	*	***
31	Labialis inferior-RL2 (mm)	1.53	1.79	**	1.20	1.75	*	
32	Lip strength (mm)	0.36	1.10		−0.86	1.27	*	*

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.

TABLE 5. Mean Values of IMPA Before Levelling (T1), at Insertion (T2), and Removal (T3) of Jasper Jumper

	T1 (Mean)	SD	T2 (Mean)	SD	T3 (Mean)	SD
IMPA (°)	94.66	±4.14	97.63	±4.85	104.96	±4.28

incisor protrusion.[1,11] Because the lower arch was stabilized by cinching the archwire behind the molar tubes, the center of resistance of the lower dentoalveolar arch was located between the roots of the premolars. Sectional arches were used to decrease the distance to the center of resistance to reduce the moment produced by this force. This way, the force vector produced passed as near as possible to the center of resistance of the mandibular arch (Figure 7).

The results showed that Class II correction was achieved mostly through dentoalveolar changes and skeletal changes played a minor role (Figures 8 and 9). The results revealed that the appliance had a limited skeletal effect on the maxilla. This restraint of forward maxillary growth was the only skeletal change caused by the appliance. This finding is in accordance with the results of other investigators who showed that the appliance had a high-pull headgear effect on the maxilla.[2,3,6,11,12] Weiland and Bantleon,[4] on the other hand, found that the Jasper Jumper had limited effects on the maxilla and stated that the change at point A is the result of the retrusion of the upper incisors.

Unlike the maxilla, we did not find any significant effect on mandibular growth. Our results support the findings of Cope et al,[3] Kucukkeles and Orgun,[5] and Covell et al[6] but contradict Weiland and Bantleon.[4] This contradiction may be related to several factors such as age, variance of the sample groups, and different treatment mechanics.

The ANS-Me/N-Me ratio was the only vertical skeletal parameter found to be significant in our study. This decrease in the lower facial height may be related to the sample having a normal or low-angle growth pattern.

TABLE 6. Cephalometric Measurements and Statistical Comparisons of Dental Values Relative to Reference Lines Within the Control Group[a]

		Pretreatment		Posttreatment		Difference		Wilcoxon
		Mean	SD	Mean	SD	D	SD	*P*
1	U1t-RL1 (mm)	74.13	6.19	74.80	6.58	0.67	1.28	
2	U1t-RL2 (mm)	68.37	9.09	70.07	9.07	1.70	1.22	***
3	U1a-RL1 (mm)	50.57	5.78	51.37	6.08	0.80	1.21	*
4	U1a-RL2 (mm)	60.57	8.32	61.87	8.43	1.30	0.98	***
5	L1t-RL1 (mm)	70.37	5.74	70.80	6.19	0.43	1.79	
6	L1t-RL2 (mm)	63.17	8.89	64.07	9.18	0.90	0.81	**
7	L1a-RL1 (mm)	88.67	7.41	89.30	7.67	0.63	1.34	
8	L1a-RL2 (mm)	51.30	10.43	52.93	10.09	1.63	1.25	***
9	U6c-RL1 (mm)	66.37	6.59	67.60	6.61	1.23	0.88	**
10	U6c-RL2 (mm)	35.03	7.43	36.30	7.57	1.27	1.08	**
11	U6a-RL1 (mm)	48.00	5.27	49.13	5.49	1.13	0.83	***
12	U6a-RL2 (mm)	39.33	6.61	40.23	6.37	0.90	1.20	*
13	L6c-RL1 (mm)	66.10	6.37	67.30	6.55	1.20	0.98	***
14	L6c-RL2 (mm)	35.40	8.08	36.43	7.62	1.03	1.19	**
15	L6a-RL1 (mm)	84.53	8.52	85.70	8.51	1.17	1.05	**
16	L6a-RL2 (mm)	27.83	9.84	28.77	9.49	0.93	1.02	**

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.

TABLE 7. Cephalometric Measurements and Statistical Comparisons of Dental Values Relative to Reference Lines Within the Treatment Group[a]

		Pretreatment		Posttreatment		Difference		Wilcoxon
		Mean	SD	Mean	SD	D	SD	*P*
1	U1t-RL1 (mm)	76.60	5.11	78.30	5.08	1.70	0.59	***
2	U1t-RL2 (mm)	73.40	3.43	71.23	4.12	−2.17	1.08	***
3	U1a-RL1 (mm)	53.60	4.14	54.47	4.31	0.87	0.64	**
4	U1a-RL2 (mm)	63.80	3.39	64.10	4.08	0.30	1.24	
5	L1t-RL1 (mm)	73.43	4.81	76.73	4.67	3.30	1.40	***
6	L1t-RL2 (mm)	66.67	3.01	69.33	4.06	2.67	1.64	***
7	L1a-RL1 (mm)	91.47	5.55	93.17	5.08	1.70	1.21	***
8	L1a-RL2 (mm)	54.57	3.98	54.90	4.52	0.33	1.85	
9	U6c-RL1 (mm)	70.77	5.15	69.60	4.91	−1.17	1.23	**
10	U6c-RL2 (mm)	41.00	4.17	39.07	4.31	−1.93	1.21	***
11	U6a-RL1 (mm)	49.97	3.86	49.00	3.70	−0.97	1.03	**
12	U6a-RL2 (mm)	43.40	3.76	43.53	4.36	0.13	2.02	
13	L6c-RL1 (mm)	70.13	4.84	70.33	4.76	0.20	1.16	
14	L6c-RL2 (mm)	38.90	2.90	41.80	3.90	2.90	1.72	***
15	L6a-RL1 (mm)	90.77	5.90	90.87	6.17	0.10	0.95	
16	L6a-RL2 (mm)	33.07	4.51	34.10	4.58	1.03	1.72	*

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.

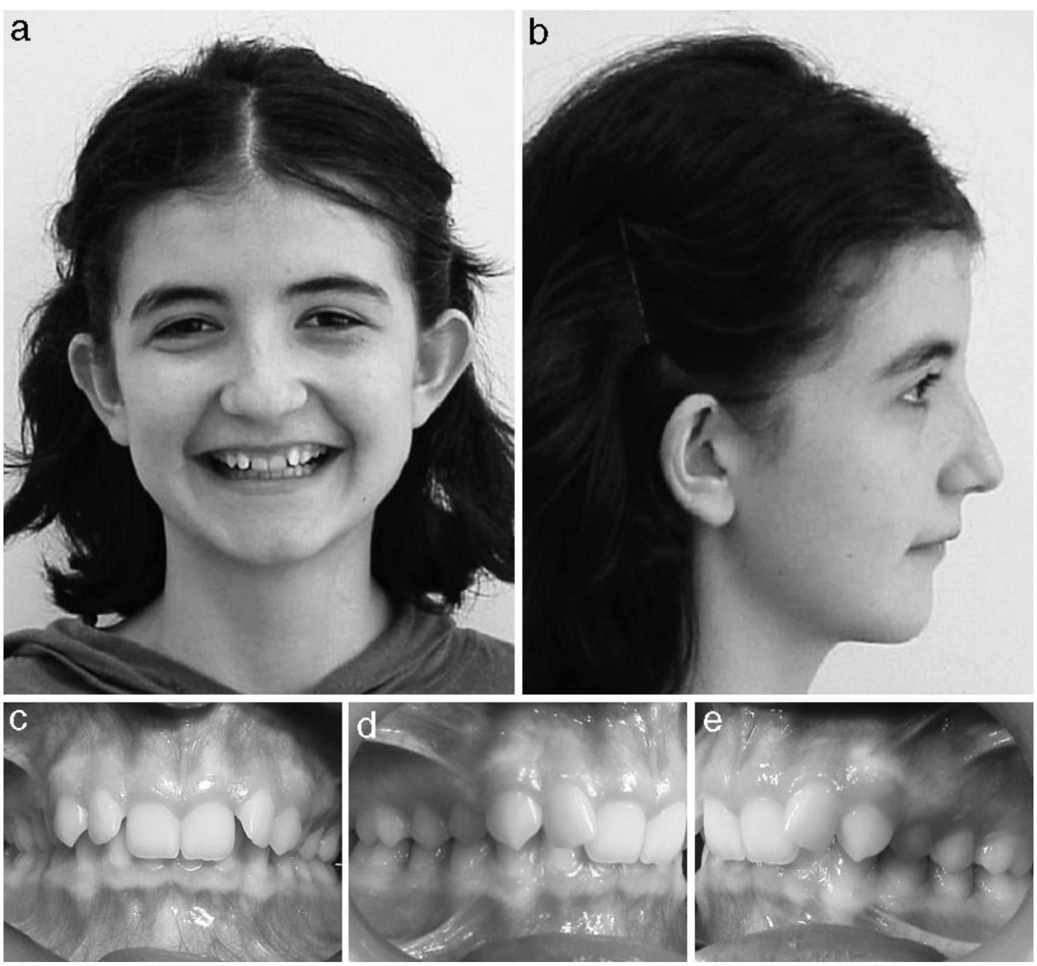
The findings related to the dentoalveolar structures showed significant treatment effects. Because the upper molars and incisors were blocked together, the upper incisors retroclined and the molars distalized considerably as a result of the high-pull effect of the appliance. This is in accordance with the findings of Mills and McCulloch,[2] Cope et al,[3] Weiland and Bantleon,[4] Kucukkeles and Orgun,[5] and Covell et al.[6] In our study, the use of the segmental arches allowed the force vector to be shifted to a more vertical direction. Consequently, this vertical force vector tipped and intruded the upper molars significantly. Therefore, we think that Jasper Jumpers used with the segmental arches can be used in high-angle cases.

The increased lower incisor inclination is usually considered an unfavorable functional therapy effect. To prevent or minimize this effect, we applied the Jasper Jumpers using sectional arches, but a statistically significant protrusion still occurred at the lower incisors. This may be the result

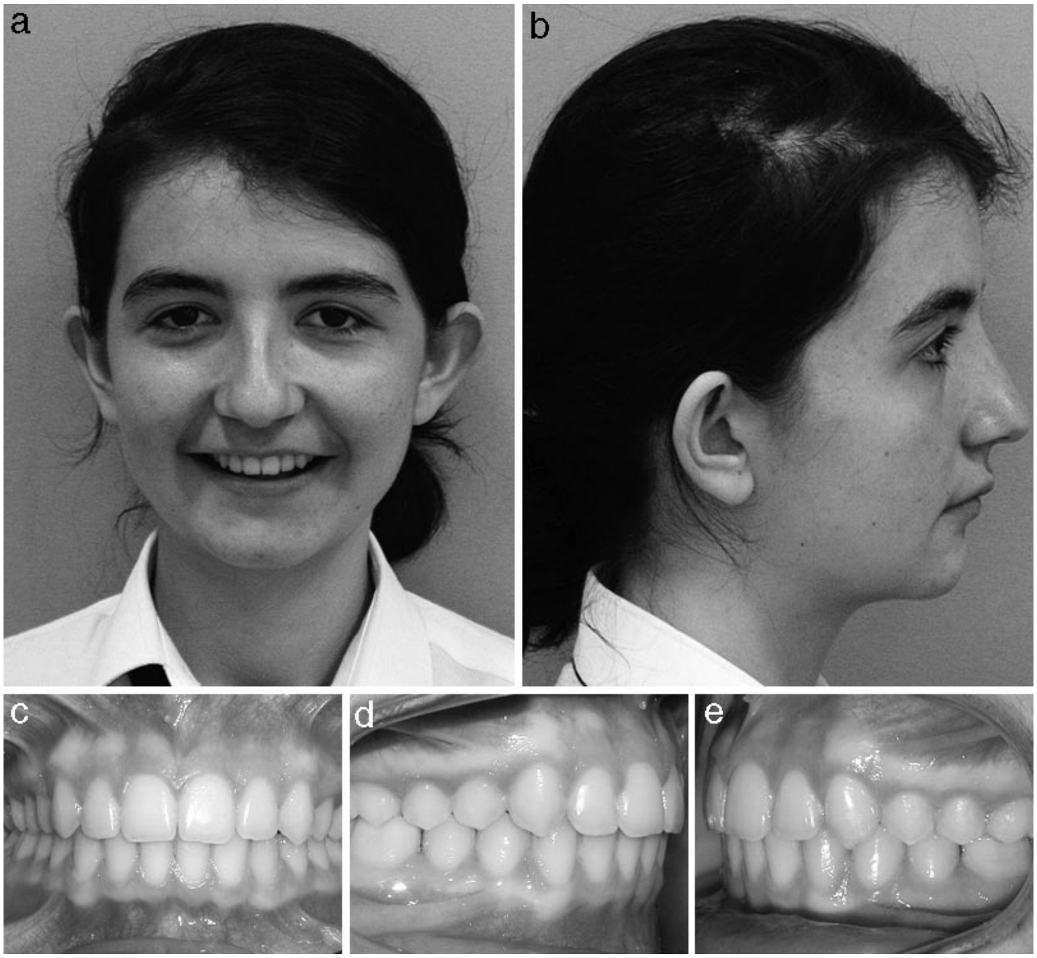
TABLE 8. Comparison of Changes in Dental Values Relative to Reference Lines of Control and Treatment Groups[a]

		Control Group			Treatment Group			Mann-Whitney *U*
		D	SD	Test	D	SD	Test	*P*
1	U1t-RL1 (mm)	0.67	1.28		1.70	0.59	***	**
2	U1t-RL2 (mm)	1.70	1.22	***	−2.17	1.08	***	***
3	U1a-RL1 (mm)	0.80	1.21	*	0.87	0.64	**	
4	U1a-RL2 (mm)	1.30	0.98	***	0.30	1.24		*
5	L1t-RL1 (mm)	0.43	1.79		3.30	1.40	***	***
6	L1t-RL2 (mm)	0.90	0.81	**	2.67	1.64	***	**
7	L1a-RL1 (mm)	0.63	1.34		1.70	1.21	***	*
8	L1a-RL2 (mm)	1.63	1.25	***	0.33	1.85		*
9	U6c-RL1 (mm)	1.23	0.88	**	−1.17	1.23	**	***
10	U6c-RL2 (mm)	1.27	1.08	**	−1.93	1.21	***	***
11	U6a-RL1 (mm)	1.13	0.83	***	−0.97	1.03	**	***
12	U6a-RL2 (mm)	0.90	1.20	*	0.13	2.02		
13	L6c-RL1 (mm)	1.20	0.98	***	0.20	1.16		*
14	L6c-RL2 (mm)	1.03	1.19	**	2.90	1.72	***	**
15	L6a-RL1 (mm)	1.17	1.05	**	0.10	0.95		**
16	L6a-RL2 (mm)	0.93	1.02	**	1.03	1.72	*	

[a] D indicates the difference between pretreatment and posttreatment.
* $P < .05$, ** $P < .01$, *** $P < .001$.



FIGURES 8. (a)–(e) Facial and intraoral photographs before treatment.



FIGURES 9. (a)–(e) Facial and intraoral photographs after treatment.

of the fact that it was impossible to pass through the center of resistance of the lower dentoalveolar arch without causing an excessive irritation in the vestibular sulcus of the patients. Our results are similar to those in the literature.[2,3,5,6,13] The use of lower incisor brackets with negative torque values or having lingual crown torque at the lower anterior segment of the archwire may be further options to prevent the protrusion of the lower incisors.

Retrusion and extrusion of the upper incisors and distal tipping of upper molars, and protrusion and intrusion of the lower incisors and mesial tipping of the lower molars all point to a clockwise rotation of the occlusal plane. Cope et al,[3] Weiland and Bantleon,[4] Kucukkeles and Orgun,[5] and Covell et al,[6] all reported similar effects on the occlusal plane in their studies. In addition, the changes in overbite and overjet are consistent with our previous dentoalveolar findings. The correction of the overjet was achieved by combination of the retrusion of the upper incisors and protrusion of the lower incisors. These tipping movements were also effective at correcting the excessive overbite. Previous Jasper Jumper[3–6] and Herbst[14–18] studies also have shown significant decreases in overbite and overjet.

The change of the angulation of the incisors probably is due to the anchorage loss during treatment. Because this tipping movement occurs around their apices, extrusion and intrusion were observed at the upper and lower incisors, respectively. These findings reveal that the changes were mostly dentoalveolar rather than skeletal.

The soft-tissue parameters show that the Jasper Jumper favorably improved the profile. As the upper incisors retruded, the upper lip moved back and the lower lip was no longer captured behind the upper incisors. Moreover, the proclined lower incisors supported the lower lip. Lip strength decreased favorably because of the upper incisor retrusion. Previous studies show similar soft-tissue changes.[5,13]

Most of the time, Class II surgery is indicated for the patients who have very little growth left similar to the patients in our study. De Clerck and Timmerman[19] reported that there were no significant differences between patients treated with headgear-activator and the ones who had undergone mandibular advancement osteotomy. Likewise, Ruf and Pancherz[14] suggested the use of functional therapy in some of the borderline cases instead of orthognathic surgery. Also, Weiland and Droschl[13] used a Jasper Jumper in one of their cases who did not want surgery and received very satisfactory results. Taking these into consideration this treatment method could be an alternative to orthognathic surgery in some borderline Class II cases.

CONCLUSIONS

This study demonstrated the skeletal, dental, and soft-tissue effects of the Jasper Jumper used in late adolescence. The results revealed that, the appliance corrected Class II discrepancies mostly through dentoalveolar changes. Because the Jasper Jumper can successfully correct the soft-tissue profile in late-adolescent patients, it is suggested that this treatment method could be an alternative to orthognathic surgery in borderline Class II cases. However, further studies will be needed to evaluate the long-term effects and stability of the appliance used in young adults.

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