Original Article

Effects of the Activator and Twin Block on Facial Soft Tissue Thickness in Class II Division 1 Patients

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ABSTRACT

Objective: The purpose of this study was to evaluate and compare the effects of the activator and Twin Block appliances on soft tissue thickness in Class II division 1 patients.

Materials and Methods: Soft tissue thickness measurements were obtained from standardized lateral and posteroanterior cephalograms taken at the beginning and end of the time the appliances were used. The study patients consisted of 3 different groups: the control group (group I) comprised 30 patients (13 male, 17 female; mean age: 12.15 ± 0.61 years); the activator group (group II) comprised 30 patients (12 male, 18 female; mean age: 12.15 ± 0.68 years); and the Twin Block group (group III) comprised 30 patients (14 male, 16 female; mean age: 12.10 ± 0.62 years). In the present study, 12 linear anthropologic points were measured. Intragroup comparisons were analyzed using the paired samples *t* test; and for the intergroup comparisons, the ANOVA and Tukey tests were used at the $p < 0.05$ level.

Results: According to the intragroup comparisons, there were significant differences in groups II and III in the skeletal measurements (SNB, ANB, L1-NB, UL-E plane, and LL-E plane), and in the soft tissue thickness measurements (labrale superius, stomion, labiomental, pogonion, and gnathion) ($p<0.05$). When the treatment changes were compared between the groups, there were no significant differences between groups II and III. However, between groups I and II or III there were significant differences in the measurements of the SNB, ANB, L1-NB, UL-E plane, LL-E plane, and labiomental soft tissue thicknesses.

Conclusions: Both the activator and Twin Block therapies improved the mandibular advancement in Class II patients and affected the soft tissue thickness in a similar way; only the labiomental region was affected. (*Turkish J Orthod* 2014;27:128–135)

KEY WORDS: Activator, Class II, Soft tissue thickness, Twin Block

INTRODUCTION

Class II division 1 patient demands for orthodontic care are mostly due to their desire for facial esthetic improvement.[1] In these patients, the main problems are increased overjet and a convex profile. Therefore, the treatment approach, ideally, should be to gain sagittal dentoskeletal harmony.[2] Functional appliances have been used for many years to obtain this result in a growing number of Class II division 1 patients.[3–6]

In the literature, there has been widespread acceptance that removable functional appliance treatment could improve the facial esthetic appearance in these patients.[7–9] Therefore, many types of removable functional appliances have been introduced. The first removable functional appliance was the activator, which was introduced by Andresen and Haupl in 1945,[9] and it has been one of the most reliable functional appliances.[10,11] Many studies

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Table 1. Mean and standard deviations of chronologic ages for each group

		Age, Y		
Groups	**Gender**	**N**	**Mean**	**SD**
Control	Male	13	12.64	0.58
	Female	17	11.81	0.62
	Total	30	12.15	0.61
Twin Block	Male	14	12.48	0.68
	Female	16	11.74	0.57
	Total	30	12.10	0.62
Activator	Male	12	12.78	0.73
	Female	18	11.62	0.67
	Total	30	12.15	0.68

about the skeletal and dentoalveolar effects of the activator have been published from its introduction up until today. All removable functional appliances were inspired by the activator.

Another popular functional appliance is the Twin Block, which was first presented by Clark in 1988.[5] It has two separate removable plates, one for the maxilla and one for the mandible. Because of its simple design, usage, and less bulky appearance than the activator, the Twin Block has increased patient acceptance of functional appliances, and it has begun to supplant the activator.[12,13] It is one of the most popular removable functional appliances in Europe.[12,13]

The knowledge of the alterations of the soft tissue norms in patients undergoing different orthodontic treatments plays a crucial role in choosing treatment alternatives. Soft tissue changes after treatments with the activator or Twin Block appliances have been evaluated many times without a comparison of these 2 appliances.[6,13–15] To our knowledge, the soft tissue effects of these 2 removable functional appliances were compared in only one study, without a soft tissue thickness comparison.[11] Therefore, the aim of this clinical study was to compare the soft tissue thickness changes after using the activator and Twin Block, and the changes resulting from natural growth alone.

MATERIALS AND METHODS

This study was approved by the Ethical Committee on Research of Selçuk University, Faculty of Dentistry in Konya, Turkey. The sample size of the groups was calculated based on a significance of 0.05 and power of 80% to detect clinically meaningful differences between the 2 groups (Class II division 1 and Class I) in the distance of the E plane-lower lip according to the study by Varlik *et al*.[11] According to the power analysis, 28 patients were required for each group.

Our study consisted of 2 experimental groups and 1 control group. Each experimental group comprised 30 patients, and the control group comprised 30 study subjects. The demographic distribution of the patients is shown in Table 1. Inclusion and exclusion criteria of the experimental groups in this study are as follows.

Inclusion criteria were:

- skeletal Class II relationship (ANB $> 4°$),
- mandibular retrognathia (SNB $< 78°$),
- overjet ≥ 5 mm,
- SN-GoGn $= 32° \pm 6°$,
- minimal crowding in dental arches ($\leq$4 mm),
- bilateral Class II molar and canine relation (at least 4.0 mm), and
- patients with fourth (S and H2) or fifth (MP3cap, PP1cap ve Rcap) epiphyseal stages on hand wrist radiographs.

Exclusion criteria were:

- previous history of trauma or orthodontic treatment,
- congenitally missing or extracted permanent tooth (except third molars),
- posterior crossbites or severe maxillary transverse deficiency,
- severe facial asymmetry determined by clinical or radiographic examination,
- poor oral hygiene, and
- systemic diseases that may affect the orthodontic treatment results.

The patients who met the inclusionary criteria and agreed to participate in the study after receiving the study information were distributed into one of the

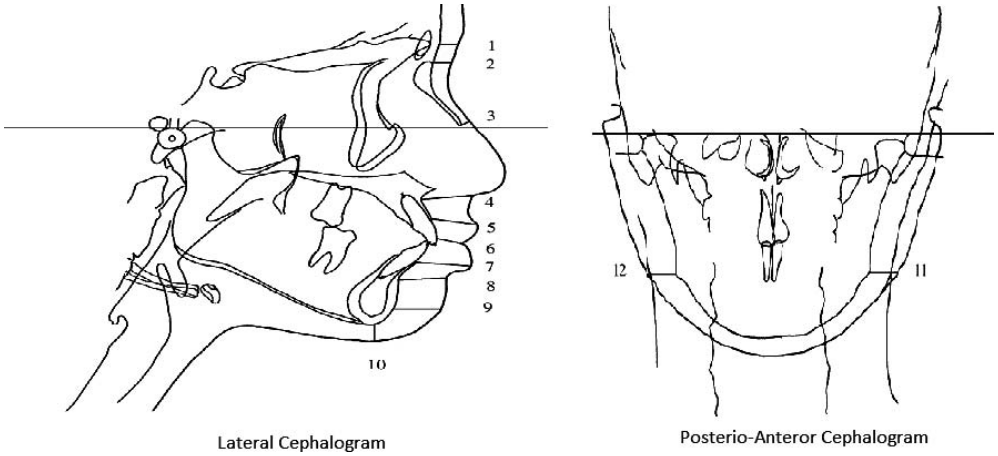

Figure 1. Location of measurement points for facial soft tissue thickness—lateral and posterior-anterior cephalograms: (l) glabella, (2) nasion, (3) rhinion, (4) subnasale, (5) labrale superius, (6) stomion, (7) labrale inferius, (8) labiomental, (9) pogonion, (10) gnathion, (11) gonion (right), and (12) gonion (left).

experimental groups randomly. A random number table was prepared at the beginning of the study to create randomization.

After a few months, 2 patients who used removable appliances, 2 patients in the Twin Block group, and 5 patients in the activator group were excluded and new patients were included in the study. The control group consisted of untreated Class I subjects who were waiting to begin fixed orthodontic treatment in our clinic. The body mass indices of all patients and control subjects were between 22.03 and 24.15 during the treatment and control periods.

In the activator group, the monoblock appliances were manufactured, consisting of a maxillary block of acrylic with an upper labial bow (0.8 mm) passively contacting the incisal third of the upper incisors, to avoid an extreme labial tipping movement. The acrylic extended down to the lower lingual sulcus and gingival margin to the mandibular tooth on the buccal side to provide stability and anchorage. In the Twin Block group, standard Twin Block appliances were manufactured, basically adhering to the original design of Clark.[5] In all treatment group patients, single step mandibular advancement (5–7 mm) was carried out during construction bite registration. The mandible protruded in an edge-to-edge incisal relationship with a 2–3 mm interocclusal space in the incisor region. The patients in the treatment groups were instructed to wear the removable functional appliances all day, except when brushing and at meal times. The active treatment was finished when the Class I molar relationship and ideal overjet were achieved. After active treatment, the functional appliances were removed and a modified Hawley appliance was manufactured, as described by Clark,[5] to achieve posterior interdigitation. Treatment was finished when the desired occlusal settling and posterior interdigitation were achieved.

The soft tissue thickness changes were evaluated in all groups on standardized lateral and posteroanterior cephalometric radiographs, which were taken with a same cephalometer (PM 2002 CC, Planmeca, Helsinki, Finland) by the same technician. All radiographs were taken while the subjects were positioned in the cephalostat with their sagittal plane at a right angle to the path of the x-rays, the Frankfort plane parallel to the floor, their teeth in centric occlusion, and their lips lightly closed. All radiographs were traced by Quick Ceph Studio (Quick Ceph Systems, San Diego, CA, USA) and recorded by a single author (O.P.). Twenty-four measurements, 8 angular and 16 linear, were measured on each radiograph. In soft tissue thickness determinant the distance between bony and soft tissue was measured for each of the following anthropologic landmarks as defined by Utsuno *et al*.[16] Soft tissue thickness linear measurements are shown in Figure 1. To evaluate the method error or intraobserver reliability, 15 pretreatment and 15 posttreatment randomly selected cephalograms for every group were retraced and remeasured with each tracing program by the same operator with a 15-day interval from the first tracings.

Statistical Analysis

All statistical analyses were performed by using the Statistical Package for the Social Sciences, and

Table 2. Comparison of mean differences of pretreatment values of treatment groups

	Twin Block Group		Activator Group		
	Mean	**SD**	**Mean**	**SD**	***p* Value***
Skeletal measurements					
SNA, degrees	81.25	2.12	80.24	2.96	NS
SNB, degrees	76.24	2.32	75.33	2.28	NS
ANB, degrees	5.01	1.64	4.91	1.86	NS
Y-axis, degrees	61.64	3.02	62.12	2.78	NS
SN-GoGn, degrees	33.21	3.45	33.84	3.12	NS
Dental measurements					
U1-NA, mm	4.98	2.63	5.67	2.17	NS
U1-NA, degrees	25.41	3.99	26.04	4.34	NS
L1-NB, mm	5.28	2.34	5.14	2.25	NS
L1-NB, degrees	28.86	4.22	26.89	4.07	NS
IMPA, degrees	96.34	4.75	98.23	5.02	NS
Soft tissue measurements					
UL-E plane, mm	0.21	1.86	0.02	2.08	NS
LL-E plane, mm	0.86	2.04	1.06	1.85	NS

* NS indicates not significant.

a p value of < 0.05 was considered to be statistically significant. Four weeks after the first measurements, 15 randomly selected radiographs were remeasured, and a paired samples t test was applied to these measurements. The differences between the first and second measurements of the 15 radiographs were insignificant. Intraclass correlation coefficients were performed to assess the reliability of the measurements as described by Houston[17] in the same radiographs, and the coefficients of reliability for the measurements were above 0.909. The mean method error was calculated using the Dahlberg formula. The values changed from 0.512 to 0.971 and were within acceptable limits.

The Shapiro-Wilk normality test and the Levene variance homogeneity were applied to the data. The data were distributed normally, and there was homogeneity of variance in the intergroup comparison of the pretreatment values. Therefore, the pretreatment measurement comparisons were evaluated by using the independent sample t test, intragroup comparisons were evaluated by using the paired sample t test, and intergroup changes were analyzed using ANOVA. Post-hoc comparisons were done using the Tukey test.

RESULTS

Descriptive pretreatment values of the activator and Twin Block groups of measurements and the statistical comparisons are presented in Table 2. The results of this evaluation show that these 2 groups were equally matched because the measurements were not significantly different.

The results of the descriptive statistics and intragroup comparisons of the measurements are presented in Table 3. The skeletal Class II relationship was corrected by mandibular forward improvement in both treatment groups ($p<0.01$). The labrale superius and stomion measurements were increased; and the labiomental, pogonion, and gnathion measurements were decreased in both treatment groups, significantly. The labrale superius and labrale inferius were significantly increased in the control group ($p<0.05$).

The results of the descriptive statistics and intragroup comparisons of the measurements are presented in Table 4. In both the activator and Twin Block groups, the mandibular forward movements in the sagittal plane mean value measurements were more excessive than in the control group ($p<0.05$). The activator group showed significant changes in the labiomental measurements ($p<0.05$), and the Twin Block group showed significant changes in the labrale inferius and labiomental measurements ($p<0.05$) when compared with the control group. When both treatment groups were compared, no statistically significant differences were found in any of the measurements ($p>0.05$).

DISCUSSION

Esthetic improvement is the main goal of orthodontic treatment. In Class II mandibular retrognathic

Table 3. Comparison of pretreatment and posttreatment/observation mean values of each group

	Twin Block Group					Activator Group					Control Group				
	Pretreatment		Posttreatment		*p*	Pretreatment		Posttreatment		*p*	Pretreatment		Posttreatment		*p*
Measurement	Mean	SD	Mean	SD	Value*	Mean	SD	Mean	SD	Value*	Mean	SD	Mean	SD	Value*
Skeletal measurements															
SNA, degrees	81.25	2.12	81.13	2.24	NS	80.24	2.96	80.12	2.86	NS	80.24	3.12	80.41	3.61	NS
SNB, degrees	75.24	2.32	78.34	3.01	*	74.33	2.28	77.75	2.69	*	77.34	3.04	78.12	2.91	NS
ANB, degrees	6.01	1.64	2.79	1.83	**	5.91	1.86	2.37	1.58	**	2.90	2.12	2.29	2.08	NS
Y-axis, degrees	61.64	3.02	61.36	3.42	NS	62.12	2.78	62.44	3.37	NS	59.23	3.21	59.08	4.01	NS
SN-GoGn, degrees	33.21	3.45	32.84	3.06	NS	33.84	3.12	34.53	3.52	NS	32.45	2.85	32.41	3.02	NS
Dental measurements															
U1-NA, mm	4.98	2.63	4.88	2.08	NS	5.67	2.17	5.08	2.53	NS	4.12	2.09	4.23	2.62	NS
U1-NA, degrees	25.41	3.99	23.96	3.83	NS	26.04	4.34	24.97	3.95	NS	22.45	3.56	23.08	3.81	NS
L1-NB, mm	5.28	2.34	6.11	1.95	NS	5.14	2.25	6.93	1.83	*	4.84	2.85	4.62	2.45	NS
L1-NB, degrees	28.86	4.22	32.08	3.49	*	26.89	4.07	30.37	3.79	*	25.08	3.04	24.67	3.43	NS
IMPA, degrees	96.34	4.75	95.74	4.47	NS	98.23	5.02	98.64	5.24	NS	92.34	4.67	92.12	4.27	NS
Soft tissue measurements															
UL-E plane, mm	0.21	1.86	−2.34	1.84	**	0.02	2.08	−2.06	1.82	**	−2.85	1.93	−3.03	2.08	NS
LL-E plane, mm	0.86	2.04	−0.14	1.97	*	1.06	1.85	−0.08	2.06	*	−1.67	2.07	−1.62	2.17	NS
Soft tissue thickness															
Glabella (g), mm	5.27	0.89	5.57	0.83	NS	6.03	1.10	6.31	1.03	NS	6.52	1.20	6.36	0.89	NS
Nasion (n), mm	5.60	0.75	5.64	0.86	NS	6.12	1.08	6.15	1.58	NS	5.88	1.91	5.23	1.00	NS
Rhinion (rhi), mm	2.64	0.43	2.61	0.66	NS	2.76	0.69	2.74	0.65	NS	2.59	0.42	2.54	0.53	NS
Subnasale (sn), mm	15.10	1.81	15.42	1.66	NS	15.75	3.30	16.16	2.97	NS	14.83	1.67	15.05	1.84	NS
Labrale superius (ls), mm	14.42	2.01	15.54	2.06	*	15.37	2.97	16.44	3.22	*	14.96	1.75	15.63	1.64	*
Stomion (sto), mm	11.68	1.75	12.74	1.71	*	12.73	2.81	13.76	3.16	*	14.18	1.76	14.47	1.70	NS
Labrale inferius (li), mm	16.63	1.78	16.30	1.87	NS	17.48	2.18	17.57	3.07	NS	15.48	1.52	15.86	1.72	NS
Labiomental (lbm), mm	11.09	1.72	10.34	1.44	*	11.45	2.19	10.81	1.86	*	11.26	1.46	11.64	1.54	NS
Pogonion (pog), mm	10.70	1.41	10.18	1.52	*	11.31	2.63	10.80	2.69	*	11.52	1.93	11.62	1.80	NS
Gnathion (gn), mm	7.41	1.34	6.58	1.19	*	8.63	1.93	7.88	1.59	*	8.72	2.33	8.72	2.22	NS
Gonion right (gor), mm	9.32	2.56	9.35	2.50	NS	11.45	3.18	11.03	3.17	NS	10.53	1.85	10.47	2.75	NS
Gonion left (gol), mm	9.03	2.64	8.93	2.75	NS	11.15	3.07	10.87	3.06	NS	9.99	2.16	10.22	2.67	NS

* $p < 0.05$; ** $p < 0.01$. NS indicates not significant.

patients with an increased overjet, an unfavorable convex profile may lead to negative feelings.[1] Therefore, the main goal of treatment in these patients, ideally, should be directed toward solving this disharmony. This study was performed to determine the soft tissue thickness effect of activator and Twin Block appliances, which are used in the treatment of skeletal Class II malocclusion in mandibular retrognathic patients.

Patients should be in a relaxed lip position while taking the lateral cephalogram and evaluating the soft tissue profile.[18] Uysal *et al.*[19] described and used standardized relaxed lip positions in their method, while taking the lateral cephalogram, to assess the soft tissues. The lateral cephalograms were taken in a relaxed lip position in the present study, in agreement with other studies[18,19]; however, it was difficult to obtain relaxed lip positions after the functional appliance treatments, due to lip tension.[6]

To achieve final interdigitation and occlusal settling, a fixed orthodontic treatment phase was performed after the activator and Twin Block treatments. Therefore, the final mandibular position was achieved after fixed orthodontic treatment, which also affected the soft tissue thickness. In order to determine the pure soft tissue effects of these functional appliances, the records obtained immediately following functional therapy were used.

The main treatment goal and philosophy of the activator and Twin Block appliances are the same. The most prominent effect of both appliances is the significant forward movement of the mandible; temporomandibular joint adaptation escorts this forward movement.[11] The most significant side effect of these appliances is that mandibular incisor proclination may contribute to the forward movement of the lower lip.[20] Additionally, in Class II patients, the mandibular incisors bend forward spontaneously due to compensation. This side effect and compen-

Table 4. Comparison of mean differences between treated and control groups

	Twin Block Group		Activator Group		Control Group		Post-Hoc Test		
Measurement	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Twin Block-Activator**	**Twin Block-Control**	**Activator-Control**
Skeletal measurements									
SNA, degrees	−0.12	1.12	−0.12	1.19	0.17	0.83	NS	NS	NS
SNB, degrees	3.10	1.21	3.42	1.29	0.78	0.68	NS	*	*
ANB, degrees	−3.22	1.07	−3.54	1.27	−0.61	0.72	NS	*	*
Y-axis, degrees	−0.28	2.02	0.32	1.97	−0.15	1.26	NS	NS	NS
SN-GoGn, degrees	−0.37	1.42	0.69	1.54	−0.04	1.17	NS	NS	NS
Dental measurements									
U1-NA, mm	−0.10	1.08	−0.59	1.21	0.11	0.87	NS	NS	NS
U1-NA, degrees	−1.45	2.23	−1.07	2.17	0.63	1.14	NS	NS	NS
L1-NB, mm	0.83	1.17	1.79	1.23	−0.22	0.79	NS	NS	*
L1-NB, degrees	3.22	1.93	3.48	2.03	−0.41	1.20	NS	*	*
IMPA, degrees	−0.60	2.41	0.41	2.29	−0.22	2.03	NS	NS	NS
Soft tissue measurements									
UL-E plane, mm	−2.55	1.31	−2.08	1.41	−0.18	1.03	NS	*	*
LL-E plane, mm	−1.00	1.29	−1.14	1.22	0.05	1.11	NS	*	*
Soft tissue thickness									
Glabella (g), mm	0.30	0.37	0.28	0.63	−0.16	1.23	NS	NS	NS
Nasion (n), mm	0.04	0.96	0.09	1.22	−0.66	1.79	NS	NS	NS
Rhinion (rhi), mm	−0.03	0.38	−0.03	0.43	−0.06	0.57	NS	NS	NS
Subnasale (sn), mm	0.32	0.98	0.41	1.18	0.22	1.10	NS	NS	NS
Labrale superius (ls), mm	1.12	1.13	1.07	1.49	0.67	1.24	NS	NS	NS
Stomion (sto), mm	1.07	0.63	0.99	1.60	0.29	1.25	NS	NS	NS
Labrale inferius (li), mm	−0.33	1.50	0.09	1.62	0.38	1.28	NS	NS	NS
Labiomental (lbm), mm	−0.76	0.84	−0.54	0.84	0.39	1.44	NS	*	*
Pogonion (pog), mm	−0.52	0.71	−0.51	0.45	0.10	1.45	NS	NS	NS
Gnathion (gn), mm	−0.82	0.59	−0.75	0.74	−0.01	1.92	NS	NS	NS
Gonion right (gor), mm	0.03	1.68	−0.42	1.87	−0.06	1.44	NS	NS	NS
Gonion left (gol), mm	−0.10	1.79	−0.27	1.92	0.22	1.97	NS	NS	NS

* $p < 0.05$; NS indicates not significant.

sation have been reported in several studies.[14,21,22] In the present study, the mandibular incisors proclinated significantly in both treatment groups when compared with the control group.

In both treatment groups, the maxillary segment pieces, labrale superius and stomion thicknesses, were increased significantly; and the mandibular segment pieces, labiomental, pogonion, and gnathion thicknesses, were decreased significantly during the treatment period. On the other hand, in the control group, the maxillary segment piece, labrale superius, was increased significantly during the control period. When comparing the treatment groups with the control group, there were no significant differences in upper lip soft tissue thickness. This finding might be due to a little insignificant prevention of maxillary growth and forward movement of the mandible. It is known from the literature that functional appliances prevent maxillary growth and activate mandibular growth, while the maxillary incisors are tipped lingually and mandibular incisors are tipped buccally during the treatment period. Similar results were reported after the Twin Block and Herbst therapies by Baysal and Uysal.[6]

In the soft tissue effects of functional appliances, upper lip affects are still controversial. Varlik *et al*.[11] and Ramos *et al*.[23] reported that functional appliances retracted the maxillary incisors, and soft tissue was affected in this situation, in varying degrees. Sharma and Lee[24] found that the maxillary incisors retracted and the upper lip advanced after using the Twin Block and mini-block functional appliances. However, Morris *et al*.[14] reported no changes in the upper lip position after using the Bass, Twin Block, and Bionator functional appliances. Similarly, Lange *et al*.[25] found no significant changes in the upper lip position following Bionator

treatments. In the present study, the labrale superius thickness was increased in the treatment groups, more than in the control group, but the differences were not significant. Therefore, we could suggest no significant upper lip soft tissue thickness changes following activator and Twin Block use, compared with the control group.

No significant differences were found in the position of the soft tissue thickness of the lower lip, except in the labiomental thickness, in the treatment groups when compared with the control group. Kamak and Celikoglu[26] reported that the soft tissue labiomental thickness in Class II was greater than in Class I; therefore, the change of Class II to Class I could explain the decrease in the soft tissue thickness. The protrusion of soft tissue may not reach the hard tissue, only in the labiomental region, in both treatment groups. Baysal and Uysal[6] reported soft tissue lower lip, lower lip sulcus, and soft tissue pogonion movement anteriorly, which was the same as the hard tissue in the Twin Block group. Morris *et al*.[14] reported significant differences in the lower region when evaluating three different functional appliances (Twin Block, Bionator, Bass) with a laser scanning system. They found that the chin moved anteriorly and inferiorly, the lower lip moved forward, and the lower lip curvature was reduced. However, there were no significant differences in the right and left gonion soft tissue thicknesses.

According to the results of this clinical study, it may be concluded that the Twin Block and activator could have the same result in the growing number of Class II division 1 patients. Both removable functional appliances can advance mandibular hard and soft tissue. The soft tissue differences could reveal the treatment effects of hard tissue in Class II division 1 patients.

CONCLUSIONS

- Both Twin Block and activator therapy could treat Class II division 1 patients successfully by forward movement of the mandibular region.
- The effects of Twin Block and activator therapies on soft tissue thicknesses were similar. They only significantly influenced the labiomental region.
- To evaluate the stability of the observed soft tissue thickness changes in both the Twin Block and activator therapies, longitudinal studies are required.

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