The effect of two types of functional appliance on soft tissue profile: a randomized clinical trial

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Abstract

Aim: The objective of this study was to compare and evaluate the effects of two functional appliances including modified activator and modified twin block appliances on the profiles of facial soft tissue.

Methods: This study included 30 patients suffering from skeletal class II abnormalities. Participants were randomly allocated into one of two treatment groups for functional appliances, the modified twin block group and the modified activator group (ten girls and five boys, with a mean age of 10.4± 0.82 years in the modified twin block group; nine girls and six boys, with a mean age of 9.8± 0.94 years in the modified activator group). The mean duration of treatment was 20.4± 6 months in the modified activator group, and 17.9 ± 5 months in the modified twin block group which included the eight months of after-treatment maintenance. Data were analyzed using a paired t-test and an independent samples t-test.

Results: In the modified activator treatment group, changes in the labiomental angle (p=0.02), the angle of facial convexity (p=0.004), the Ls-S vertical (p=0.034), the distance between the labial surface of the upper central incisor and the upper lip (p=0.012), the Li-E Line (p=0.029), the total anterior facial height (p=0.008) and the pog'-S vertical (p=0.013) were significant. The difference between two groups was significant only in Li-E line.

Conclusion: The effects of modified activators and modified twin block appliances on the soft tissue profile was almost the same, and both resulted in significant alterations to the soft tissue profile.

Key words: modified twin block appliance, modified activator appliance, soft tissue profile

The efficacy of functional appliances no longer needs to be proved, unless one is ignoring many thousands of case reports. Different removable functional appliances are being used for the treatment of patients with class II division 1 skeletal malocclusion in growing patients

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Improving facial esthetics is one of the aims of orthodontic treatment. However, changes in the facial profile may occur due to many factors, such as dental movement or growth[1]. Indeed, patients suffering from class II skeletal disharmony are a good example of orthodontic growth modification where the primary focus of treatment is to improve appearance.[2]Orthodontists recommend a two-phase treatment for patients who suffer from skeletal class II discrepancy. Initially, they begin treatment with growth modification treatment, and then, they continue on to fixed appliances .[3,4]

Obviously, the objective of treatment is skeletal adjustment and aesthetic

improvement of the patient's face. Graber5 reported that the modified activator, introduced by Andresen in 1935, is one of the most commonly used appliances to correct skeletal discrepancies in class II patients. The skeletal and dentoalveolar effects of functional appliances are almost always accepted by researchers6-9 however; with regard to aesthetic improvement, evaluation of soft tissue profile alterations after treatment with functional appliances is of great importance. Another well-known functional appliance is the modified twin block, which is characterized by its simple design, easy use, 24-hour wear, and improvements in speech. It can also be used simultaneously with fixed appliances.[10-12]

McDonagh13has also reported a change in pogonion position and improvements in lateral soft tissue profile after treating class II patients with the modified twin block. With regard to evaluating lateral cephalograms after treating class II division 1 patients using the mini block and the modified twin block, Ashvin14 noticed that the modified twin block had a greater effect on the facial soft tissue profile. Quintao15 has also reported total facial profile improvement, appropriate soft tissue pogonion and upper lip retreat after evaluating the results of treating class II division 1 patients. A clinical study by Varlik16 on class II division 1 patients using modified activator and modified twin block appliances revealed noticeable changes in soft tissue within both groups.

However to date, researchers still have different opinions concerning the extent to which these appliances improve the soft tissue beauty profile. The aim of this study was to evaluate and compare alterations in the facial soft tissue profile after using the modified activator and modified twin block appliances in class II division 1 patients.

Methods and material

In this randomized clinical trial, 30 patients suffering from class II division 1 skeletal discrepancies, who were between eight and eleven years of age, were randomly chosen from patients admitted in orthodontic department of the Babol university of medical sciences. The cases were randomly allocated to two treatment groups for functional appliances.

Fifteen patients (9 girls and 6 boys, with 9.8± 0.94 years old) were placed in the modified activator group, and fifteen patients (10 girls and 5 boys ,with10.4± 0.82years old) were placed in the modified twin block group. The aim of the first phase of treatment was described to the patients and their families, and written consent was obtained from the parents. All members of the two treatment groups were informed of a possible second phase of treatment. Ethical approval for the study was obtained from the ethical committee of the Babol university of medical sciences

The inclusion criteria were as follows:

1)Presences of a class II division 1 abnormality and over jet ≥ 5 mm

2)Appropriate age and growth for treatment prior to peak of growth(based on cervical vertebra age before CS4 stage)

3)Normal facial height with a mandibular growth deficiency

4)No prior orthodontic treatment.

Stage 4 in vertebral maturation evaluation is the stage which that is less than one year prior to peak of growth.[17]

Once lateral cephalograms were obtained, alginate and construction bite impressions were made for constructing modified twin block (that has Adams clasps on maxillary and mandibular first molars and premolars, ball claps on the lower labial segment and torquing springs) and modified activator appliances (with Adams clasps on maxillary molars , torquing springs, labial bow in lower arch and acrylic caps on the lower incisors). To obtain the construction bite for both groups, the incisors were placed in an end-to-end position; the bite opening was 3-4 mm.

All appliances were built by the same technician. On average, all patients used the appliances for 17 hours a day. This treatment was continued until an appropriate molar relationship, nearly class I occlusion, was obtained, and acceptable overjet and overbite were noticed. The mean duration of treatment was 20.4 ± 6 months in the modified activator group, and 17.9± 5 months in the modified twin block group which included the eight months of after-treatment maintenance. After the first phase of treatment was completed, the patients were put in the maintenance and retainer phase until the end of their growth peak and then referred for continued treatment with fixed appliances. Soft tissue profile alterations in both groups were compared and evaluated using pre-treatment (T1) and post-treatment (T2) lateral cephalograms , which were obtained using natural head position (NHP) method by the same maxillofacial radiologist. The lateral cephalograms were traced by the same orthodontist on 0.3 diameter tracing paper using pencil. The landmarks detect as follows. (Figure 1)



Figure 1:S:sella (1), Na: Nasion(2),Ls: Labi superior (3), Li:Labi inferior (4), Prn :tip of nose (5),A point: most deep point in anterior border of maxilla (6), B point : most deep point of anterior border of mandible(7), Ss: sulcus superior(8), Sn:subnasal (9), Me':soft tissue menton (10), :soft tissue pogonion,(11),Si:sulcus inferior(12), N':soft tissue nasion(13)

The lines and angles that were used in this study are illustrated in Figures 2 and 3. To sketch the lines, the S-N plane was drawn, and from the N point, a line with a 7-degree angle related to SN was drawn that named cHP16 (customized horizontal plan), which seems to be nearer to the true horizontal line. A line was then drawn from the S point perpendicular to this line and named the S-vertical (SV). All anterior-posterior soft tissue alterations in the horizontal dimension were evaluated with respect to the SV line in millimeters. The lateral profile in the vertical dimension was calculated by measuring the Sn- Me' and N'-Me'. The E-line was provided to evaluate the position of the lips with respect to the chin and nose. The lines were measured in millimeters (Figure 2), and the nasolabial, labiomental

and facial convexity angles were measured in degrees. (Figure 3)

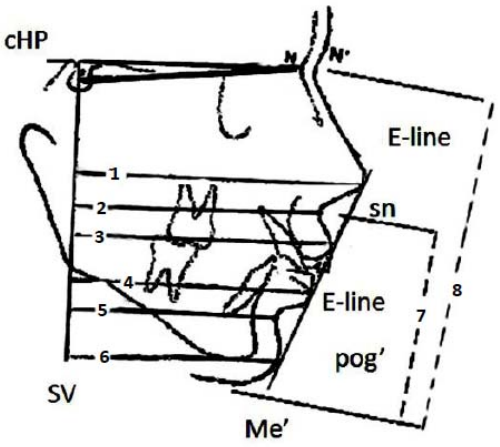


Figure 2: Prn-Sv(1):distance between the most anterior point of the nose and Sv ,Ss-SV(2):distance between the most posterior point of the upper lip border and SV, Ls-SV (3):distance between the most anterior point in vermilion border of upper lip and SV , Li–SV (4) distance between the most anterior point in vermilion border of lower lip and SV:, Si-SV(5): distance between the most posterior point of the lower lip border and SV, pog'-SV(6),distance of soft tissue pogonion to SV:, Sn-Me(7):distance between the most inferior point of nose border and soft tissue menton, N'-Me'(8):distance between soft tissue nasion and soft tissue menton ,Ls-E line(9):distance between the most anterior point of vermilion and E line ,Li-E Line(10):distance between the most anterior point of lower lip vermilion and E line, Ls-U1(11):distance between the line perpendicular from point of labi superior to incisal edge , Li-L1(12):distance between the line perpendicular from point of labi inferior to incisal edge.

To determine the measurement error, ten lateral cephalograms were randomly chosen and, once again, were traced and measured. The tracing error was found to be 0.78 mm - 0.11 mm in line measurements and 0.21-0.83 degrees in angle measurements.

Data was analyzed by using SPSS(16.0 version). The paired t-test was used to compare alterations pre- and post-treatment, and the two groups were compared using an independent samples t-test.

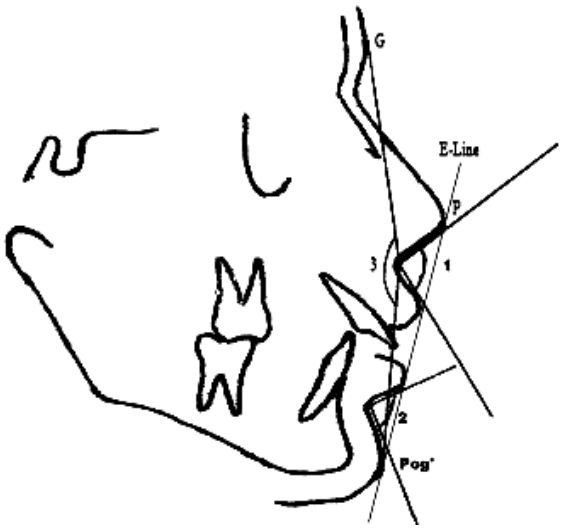


Figure 3: Nasolabial angle (1), Labiomental angle (2), Angle of facial convexity (3), E-line

Results

This study included 30 children suffering from skeletal class II abnormalities, who were between eight and eleven years old and had been admitted in the orthodontics department of the Babol university of medical sciences. They were randomly allocated into two groups, each including 15 patients. The mean age was 10.4 years old in the modified twin block group and 9.8 years old in the modified activator group. After statistical analysis using a t-test, soft tissue alterations pre-treatment and post-treatment were evaluated in the groups (Tables 1 and 2)The soft tissue pogonion, lower lip, overjet and facial convexity alterations were outstanding and showed a significant difference between pre and post treatment ($p<0.05$).

Table 1: Soft tissue profile alterations in the modified activator group.

Mean	SD	Mean	SD			
Parameter		**T1stage**		**T2stage**		
		Mean	**SD**	**Mean**	**SD**	**p-value**
Nasolabial angle		105.2	9.63	110.87	9.92	0.16
Labiomental angle		108.8	17.632	116.13	20.113	0.02
Facial convexity angle		21.8	5.068	19.53	5.514	0.004
Upper lip to S-Vertical		85.6	6.833	86.53	6.576	0.034
Lower lip to S-Vertical		71.537	7.999	75.6	7.851	0.000
Upper lip to U 1		12	2.449	12.67	2.35	0.012
Lower lip to L 1		14.87	1.598	14.73	1.751	0.719
Upper lip to E-line		-0.6	1.92	1.33	2.41	0.000
Lower lip to E-line		-1.87	2.774	-0.73	2.154	0.029
Pronasal to SV		91.7	3.46	93.09	3.76	0.071
Lower anterior facial height		73.33	5.602	73.47	6.621	0.898
Total anterior facial height		122.8	6.742	126.87	6.833	0.008
Soft tissue pogonion to S-Vertical		63.67	7.771	86.87	8.959	0.013

Table 2: Soft tissue profile alterations in the modified twin block group.

	T1 stage		**T2 stage**		
Parameter	**Mean**	**SD**	**Mean**	**SD**	**P- value**
Nasolabial angle	100.73	10.69	104.8	11.27	0.15
Labiomental angle	100.4	15.212	105.6	16.45	0.07
Facial convexity angle	19.73	2.65	17.47	2.66	0.001
Upper lip to S-Vertical	81.2	6.54	82.13	6.83	0.005
Lower lip to S-Vertical	76.67	6.91	79.93	7.85	0.001
Upper lip to U 1	11.53	1.55	12.07	2.05	0.16
Lower lip to L 1	14.47	1.68	13.73	2.01	0.08
Upper lip to E-line	0.6	2.09	2.53	1.76	0.003
Lower lip to E-line	1.27	3.21	1.2	2.11	0.89
Pronasal to SV	92.07	4.6	93.45	3.25	0.06
Lower anterior facial height	72.47	7.51	74.07	8.22	0.049
Total anterior facial height	121.8	6.27	126.67	8.22	0.003
Soft tissue pog to S-Vertical	60.93	8.46	66.93	9.21	0.04

Table 3: Comparison of the soft tissue profile in the two groups, the modified activator and modified twin block.

	Modified activator		Modified twin block		
Parameter	**Mean**	**SD**	**Mean**	**SD**	**P- value**
Nasolabial angle	5.67	7.98	4.07	10.87	0.63
Labiomental angle	7.33	10.87	5.20	10.29	0.58
Facial convexity angle	2.27	2.31	2.26	0.96	0.75
Upper lip to S-Vertical	0.93	1.53	0.93	1.09	1
Lower lip to S-Vertical	-3.26	2.81	-4.06	2.76	0.43
Upper lip to U 1	-0.66	0.89	-0.53	1.40	0.76
Upper lip to L 1	0.13	1.40	0.73	1.53	0.27
Upper lip to E-line	1.93	1.38	1.93	1.16	1
Lower lip to E-line	1.13	1.80	-0.07	1.86	0.08
Pronasal to SV	1.39	1.21	1.38	1.09	0.000
Lower anterior facial height	0.06	3.96	1.6	2.87	0.25
Total Anterior facial height	4.07	5.06	3.86	4.17	0.90
Soft tissue pogonion to S-Vertical	5.2	3.29	6.00	3.17	0.22

Comparison of the two groups using the t-test showed that, although there were differences between the two groups with respect to the soft tissue facial profile, these differences were not statistically significant (Table 3).

Discussion

The aim of this study was to evaluate and compare the effects of modified activator and modified Twin block appliances on facial soft tissue profile. The study results reveal that both functional appliances had a profound impact on the soft tissue profile.

Nanda and colleagues[18] have studied long-term growth changes on the lateral soft tissue profile in patients between seven and eighteen years of age and found that, during the sexually dimorphic period, the most soft tissue growth alterations in the nose, lips and chin occur.They have reported that by approximately seven years of age that upper lip growth in 93% of girls and 82% of boys and lower lip growth in 89% of the girls and 85% of the boys is complete

In the present study, changes resulting from growth were not considered. To decrease the probable effect of growth on the results, only short-term treatment was studied. The most noticeable changes under the influence of the modified activator and modified twin-block appliances occurred in the forward movement of the mandible landmarks with respect to the vertical reference line. This effect, along with the forward movement of mandibular incisors, which was confirmed

by different studies, probably led to the forward movement of the lower lip.15

The nasolabial angle in both groups has increased (Table 1, 2). This increase was more noticeable in the modified activator group than the modified Twin block group, which may be due to an increased retraction in maxillary incisors. On the other hand, on comparing the two groups, the findings of this study showed a similar difference in both groups (p= 0.639, Table 3). The labiomental angle in the modified activator group was significantly greater than that in the Modified Twin block group (p=0.02, Tables 1 and 2), but the two groups did not show much difference when compared to each other (p=0.586, Table 3).

The facial convexity angle was significantly decreased in both treatment groups (Table 1, 2), but the comparison of the results pre-treatment and post-treatment within the two groups was not significantly different (p=0.75, table 3). These results indicate that forward repositioning of the mandible and maxillary incisors retraction in both groups finally would lead facial soft tissue profile improvement. Studies by Ashvin and Quintao confirm these findings .14,15

The results showed that the distance between upper lip to S-vertical line (LS-SV) in both groups showed a large increase; however, the difference between the groups was not significant (p=1, Table 3). The increase in this linear measurement may be due to the continuous maxillary forward growth during treatment. The distance between lower lip to S-vertical line (LI-SV) was also increased in both groups, which may be due to alterations in the mandible position, protrusion of mandibular incisors and, to some extent, the growth process during treatment. Our results are in accordance with those of studied by Ashvin et al.14

The distance of upper incisors labial surface to the foremost point of the upper lip (LS-U1) was significantly increased (Tables 1 and 2) but was similar in both groups (p=0.76, table 3). As for the lower incisors labial surface to the foremost point of the lower lip (LI-U1), the measurement was decreased in both groups, but this difference was significant (Tables 1 and 2). These results were in agreement with those of studied by Ashvin and Clark.11,14

In patients treated with modified activator, upper and lower lip showed forward movement related to E-line, but displacement was significant only in lower lip. In modified twin block group there was no significant change in lips position related to E-line .There in no significant difference in lips positions to E-line between two groups. There was an increase in Sv-Prn, due to nasal growth alone. The mean increase (1.3 mm/year) was greater than was reported by Subtelny (2.5 mm/year).19

The lower anterior facial height showed significant increase in modified twin block group and non significant increase in modified activator group(Table1,2).There is no significant different between two groups.(Table3)

Both modified activator and modified Twin block groups had an increase in anterior facial complete height (Table1,2); however, height increase difference within two groups was not significant (p= 0.90, Table 3). Previous studies confirm these results12. The distance between soft tissue pogonion to the S.vertical line showed a noticeable increase in both groups (Tables 1 and 2).There is no significant different between two group. In this study the treatment interval in the modified Twin block group was less than that in the modified activator group, but both appliances had a large effect on soft tissue profile. However, it is still unclear what role and to what extent the growth process plays in our findings. Therefore, we recommend that future studies include a control group with similar skeletal

discrepancy and growth patterns to determine the extent to how growth affects soft tissue profile alterations when using functional appliances.

Conclusion

1)The soft tissue pogonion had a forward movement that was greater in the modified twin block group.
2)The facial convexity angle was decreased with both appliances but was greater in the modified Twin block group.
Facial height increased by a greater amount in the modified activator than the modified twin block group.
3)The nasolabial and labiomental angles increased by slightly more in modified activator than the modified twin block group.
4)The treatment period was decreased in the modified twin block as compared to the modified activator group.

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