Role of the horizontal activator in Class II i malocclusion treatment

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ABSTRACT

Background: The conflict in opinions about the dental and skeletal changes induced by class II malocclusion activator therapy is still present. The aim of this study was to assess the skeletal and/or dental outcomes of treating moderate-severe skeletal class II division 1 malocclusion by the activator.

Materials and Methods: The sample consisted of pre and post treatment records (cephalometric radiographs) of 11 Iraqi adolescent patients (7 females 10-11 years old, and 4 males 12-13 years old).

Results: The results showed significant skeletal and dental changes that reflected significant improvements in the cardinal features of class II (overjet, overbite, ANB angle, and lower anterior facial height).

Conclusion: Correction of the overjet, overbite, and ANB angle in moderate-severe skeletal class II i cases by the activator into normal range values may be at the expense of unfavorable lower incisors proclination and ii angle which are very important for stability of treatment result. The activator can induce skeletal changes that reflect improvements in the antero-posterior and vertical relationships of class II i malocclusion (downward and forward growth of the mandible, remodeling of glenoid fossa, in addition to the rotation of maxillary and mandibular bases). Acrylic loading and acrylic trimming done in the activator are responsible for the dramatic dental changes that can sometimes contribute to the skeletal improvements (extrusion of lower posterior teeth, relative intrusion of incisors, overjet and overbite correction, and changing positions of points A and B).

Keywords: Skeletal class II, horizontal activator, myofunctional appliance. **(J Bagh Coll Dentistry 2008; 20(1) 95-100)**

INTRODUCTION

Alteration of the patient’s facial profile has been a challenge for orthodontists over the years. Many investigations have been carried out to evaluate the possibilities of growth modification with orthopedic appliances. However, the results have generally been a subject of debate since there is little scientific evidence so far that an orthodontist is able to significantly alter the inherited complex craniofacial skeleton of the growing child on a permanent basis as compared to the dentoalveolar changes that have generally been found to be more stable.[1-3]

Orthopedic appliances provide a new muscular and functional environment for the facial bones that encourages growth changes of either the mandible or the maxilla.[4]

Headgears, activators, and Herbst appliances have proven to be valuable tools in their clinical results. Sagittal discrepancies between mandible and maxilla can be corrected adequately.

However, it remains questionable whether the results of this kind of therapy can be attributed to skeletal effects rather than to dentoalveolar compensation.[2,3]

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The aim of this study was to determine the sagittal and vertical skeletal and dental changes induced by the horizontal activator as an outcome of an Iraqi sample treatment.

MATERIALS AND METHODS

The sample consisted of 22 lateral cephalometric radiographs of 11 Iraqi adolescent patients [7 females 10-11 years old, and 4 males 12-13 years old]. Pre and post treatment cephalograms have been taken for every subject. The sample subjects have been selected from patients attending the orthodontic clinic in the hospital of the college of dentistry, Baghdad University according to the following criteria:

1- Patient’s age at least 1 year before the maximum growth spurt (which is 12 years for females and 14 years for males[5]).
2- Good general health status.
3- No history of previous orthodontic treatment.
4- Moderate-severe skeletal class II i malocclusion due to mandibular retrognathy (ANB>7 degrees).
5- Horizontal growth pattern (clinically reduced lower facial height).

All the steps of horizontal activator fabrication and clinical management were done according to the recommendations of Graber et al.[6] Upper

The cephalometric analysis included the following linear and angular measurements: (Figures 1 and 2 respectively)

Linear measurements:

1- Go-Me : Extent of mandibular base.(7)

2- Co-Gn : Mandibular length.(8)

3- Co-Go : Length of ascending ramus.(7)

4- ANS-PNS : Extent of maxillary base.(7)

5- N-Me : Anterior facial height.(7)

6- N-ANS : Upper anterior facial height.(9)

7- ANS-Me : Lower anterior facial height.(9)

8- S-Go : Posterior facial height.(7)

9- S-Ar : Lateral extent of cranial base.(7)

10- Ar-Go: Length of ramus representing lower posterior facial height.(9)

Angular measurements:

1- SNA: Anteroposterior position of maxilla.(7)

2- SNB: Anteroposterior position of mandible.(7)

3- ANB: Difference between SNA and SNB.(7)

4- N-S-Ar: Saddle angle.(7)

5- S-Ar-Go: Articular angle.(7)

6- Ar-Go-Me: Gonial angle.(7)

7- N-S-Gn : (Y-axis) Angle between SN line and S-Gn line, anteriorly.(7)

8- Inclination angle : Angle between the Pn line (perpendicular line on Se-n plane drown from soft tissue nasion) and the maxillary plane.(7)

9- MMP angle : Angle between maxillary and mandibular planes.(7)

10- 1 max : Angle between upper incisor axis and maxillary plane.(7)

11- 1 man : Angle between lower incisor axis and mandibular plane.(7)

12- ii angle : Interincisal angle between upper and lower central incisor axes.(7)

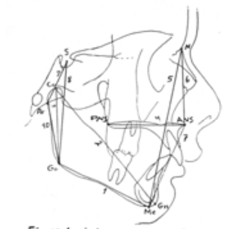

Figure 1 : Linear measurements

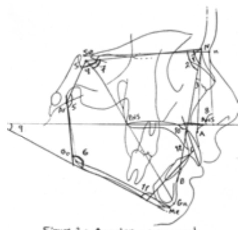

Figure 2 : Angular measurements

RESULTS

Table 1 shows the descriptive and inferential statistics for the pre and post treatment linear cephalometric measurements, in addition to the overjet and overbite. Paired t-test has been applied to examine the statistical significance of change between the pre and post treatment readings. All the linear variables that represent mandibular measurements showed an increase in the mean value after treatment (mandibular base, mandibular length, length of the ramus and ascending ramus). The increase in these measurements was statistically highly significant, excepting the mandibular base which showed a statistically non significant increase in mean value. Unlike the mandible, the maxillary base showed a slight decrease in its post treatment mean value which was statistically non significant.

The total anterior facial height showed a slight non significant increase, with a non significant decrease in the upper anterior facial height, while a significant increase of the lower anterior facial height mean value after treatment. All the posterior facial height measurements showed statistically significant changes after treatment by a significant increase of the total posterior facial height, significant decrease of the upper posterior facial height, and a highly significant increase of the lower posterior facial height. Both of the overjet and overbite showed a highly significant reduction from severe into normal range values.

Table 2 shows the descriptive and inferential statistics for the pre and post treatment angular cephalometric measurements.

All the angles showed highly significant changes after treatment, excepting 3 angles: the articular and interincisal angles reduced non significantly with a non significant increase in the Y-axis angle. The SNB, gonial, inclination, MMP, and 1 Man angles showed a highly significant increase in mean values after treatment, while a highly significant reduction has been demonstrated by the SNA, ANB, saddle, and 1 max angles.

DISCUSSION

It is well known that clinical studies that take long treatment time are somewhat difficult to be carried out due to the factor of patient cooperation (especially in case of children and adolescents). In this study, the planned sample number was 25-30 adolescent patients. Unfortunately, only 11 patients have been followed up successfully due to:

1- Lack of cooperation of many of the patients to continue the treatment and follow the instructions.

2- The hard unstable situations that our country passed through, which played a major role in small sample collection.

However, our sample number is comparable to many similar studies done in well stable and advanced countries.[10-13] In a previous Iraqi study, the skeletal and dental changes induced by the horizontal activator have been investigated by treating MILD skeletal class II cases.[14] A major shortcoming in studies that deal with mild skeletal malocclusion treatment is the confusion between treatment changes and natural individual growth changes.[1] For this reason, our study verified the clinical outcomes of horizontal activator therapy by treating Moderate-Severe cases in order to highlight the treatment changes over growth changes.

Linear measurements analysis:

Among the mandibular measurements, an exclusive behavior was demonstrated by the mandibular base (Go-Me) which showed a non significant increase after treatment. This slight increase may be attributed to the non significant activator influence on mandibular base and/or the horizontally directed growth pattern. On the other hand, the highly significant increase demonstrated by the mandibular length (Co-Gn), Co-Go, and Ar-Go reflects the significant effect imposed by the activator on these variables. The increase in mandibular length, ramus length, and length of ascending ramus results in downward and forward movements of the mandible demonstrating the skeletal influence of the activator. These findings come in agreement with those of other researchers.[1,15-17] The muscular elastic properties play a positive important role in a favorable neuromuscular response to the forward positioning of the mandible induced by the activator by straining the soft tissues and muscles attached to the condyles stimulating the growth centers there.[18-20]

On the contrary, the restraining effect of the activator on maxillary base growth explains the non significant decrease in its post treatment mean value, a finding which is supported by many authors.[1,2,6,21] Other researchers found a slight increase in maxillary base after treatment and they attributed that to posterior growth of maxillary base, however, this increase was also statistically non significant.[14,22] A non significant decrease was shown by the upper anterior facial height (N-ANS) which may be due to the non significant effect of activator on midface structure as reported by other researchers.[8,14,23] Whereas a significant increase was shown by the lower anterior facial height (ANS-Me) which is attributed to the highly significant increase in the gonial and MMP angles and this will be discussed later on. These changes resulted in an increase of the total anterior facial height (N-Me), however, it was statistically non significant.

The upper posterior facial height (S-Ar) was reduced significantly after treatment due to the anterior displacement of the condyle in the glenoid fossa (a marked skeletal effect exhibited by the highly significant reduction of the saddle angle), while the lower posterior facial height (Ar-Go) showed a highly significant increase after treatment (which has been discussed previously). These changes resulted in a significant increase of the total posterior facial height (S-Go). These findings come in agreement with those reported by other researchers.[15,24,25]

The overjet demonstrated a dramatic improvement from severe class II into normal range value. Overjet reduction can be attributed to: (1) A highly significant retroclination of upper incisors, (2) A highly significant proclination of lower incisors (induced by the acrylic of the activator) with anterior positioning of lower incisors (induced by the downward forward movement of the mandible with the highly significant increase of SNB angle). So, major dentoalveolar and less skeletal changes contributed to the overjet reduction. The same explanation has been mentioned by other researchers.[1,2,26]

Table 1: Descriptive and inferential statistics for pre and post treatment linear data, overjet, and overbite.*

	Pre treatmen		Post treatment		Mean differenc		Paired t-tes			
Variabl	Mean	SD	Mean	SD	Mean	S.error	t	d	p	Si
Go-Me	70.818	1.80	71.22	1.5	-0.41	0.631	-0.6	1	0.5	N
Co-Gn	106.48	1.65	109.52	0.7	-3.045	0.638	-4.7	1	.00	H
Co-Go	50.491	2.32	53.855	2.6	-3.364	0.746	-4.5	1	.00	H
ANS-PN	54.327	1.798	54.036	1.5	0.291	0.555	0.5	1	.61	N
N-Me	117.20	3.578	118.67	4.6	-1.464	1.065	-1.3	1	.19	N
N-ANS	54.091	1.70	53.255	2.0	0.836	0.439	1.9	1	.08	N
ANS-M	65.491	2.45	68.082	3.7	-2.591	0.878	-2.9	1	.01	S
S-Go	74.155	4.13	76.727	4.9	-2.573	0.957	-2.6	1	.02	S
S-Ar	37.636	2.26	36.845	1.3	0.791	0.338	2.3	1	.04	S
Ar-Go	40.5	1.48	44.736	2.4	-4.236	0.562	-7.5	1	.00	H
Overjet	12.073	1.509	3.118	0.7	8.955	0.378	23.	1	.00	H
Overbit	5.982	0.70	2.145	0.5	3.836	0.219	17.	1	.00	H

* Statistical significance at $p < 0.05$ * Measurements in millimeters

Table 2: Descriptive and inferential statistics for pre and post treatment angular data.*

	Pre treatmen		Post treatment		Mean differenc		Paired t-tes			
Variable	Mean	SD	Mean	SD	Mean	S.error	t	d	p	Si
SNA	81.309	1.34	79.3	2.25	2.009	0.315	6.3	1	0.00	H
SNB	71.236	1.35	75.627	1.55	-4.39	0.543	-8.	1	0.00	H
ANB	9.636	1.96	3.318	0.68	6.318	0.593	10.	1	0.00	H
N-S-Ar	128.7	0.92	127.47	1.00	1.227	0.256	4.	1	0.00	H
S-Ar-Go	141.45	2.05	141.16	3.59	0.291	0.558	0.5	1	0.61	N
Ar-Go-M	125.18	1.53	127.2	3.26	-2.03	0.558	-3.	1	0.00	H
N-S-Gn	71.382	1.26	71.9	1.67	-0.51	0.362	-1.	1	0.18	N
Inc. angl	86.127	1.51	87.864	1.74	-1.73	0.534	-3.	1	0.00	H
MMP ang	25.882	1.21	28.455	0.98	-2.57	0.562	-4.	1	0.00	H
1 Max	119.36	2.51	110.58	3.66	8.782	0.907	9.6	1	0.00	H
1 Man	92.973	4.26	100.52	4.71	-7.55	0.563	-1	1	0.00	H
ii angle	114.52	1.03	113.92	4.16	0.600	1.389	0.4	1	0.67	N

* Statistical significance at $p < 0.05$ * Measurements in millimeters

The overbite has also been changed from deep bite into normal range value. This can be attributed to: (1) Over eruption of lower posterior teeth leading to opening of the bite anteriorly,[6,27] (2) Relative intrusion of incisors by acrylic loading of their incisal edges,[6] and (3) Anterior translation of the mandible (discussed previously).

Angular measurements analysis:

Highly significant reduction was shown by the SNA angle. It has been reported that point A position is influenced by upper incisors retroclination induced by the activator leading to a decrease in SNA angle.[1,2] The SNB angle showed a highly significant increase which can be explained by the downward and forward stimulation of mandibular growth, in addition to the proclination and anterior positioning of lower incisors.[1,2,28] These changes in the SNA and SNB angles resulted in a highly significant reduction of the ANB angle from severe class II value into normal class I value. However, it must be kept in mind that this ANB reduction was not a pure skeletal improvement due to the significant dentoalveolar contribution.

A highly significant decrease was shown by the saddle angle, while the articular angle showed non significant decrease. The reduction in these angles is related to S-Ar decrease (mentioned previously) which has been explained by the anterior displacement of the condyle with remodeling of the glenoid fossa.[15,24,25]

The gonial angle showed a highly significant increase, while there was a non significant increase in the Y-axis angle. The increase in these angles reflects the clockwise rotation of the mandible which may be attributed to the forward and downward growth of the mandible, in addition to the extrusion of lower posterior teeth (as discussed previously).

The clockwise rotation of the mandible played an important role in the highly significant increase of the MMP angle due to the clockwise canting of the mandibular plane. The second important role came from the anticlockwise canting of the maxillary plane, as it has been reported that the restraining effect imposed by the activator on the anterior growth of the maxilla may enhance the posterior growth of the maxillary base leading to anticlockwise canting of the maxillary plane.[22] This phenomenon will clearly explain the highly significant increase of the inclination angle.

Before treatment, the ii angle was of low value due to the severe proclination of upper incisors rather than the lower incisors which were nearly in normal relation to the mandibular plane. After treatment, in spite of the highly significant upper incisors retroclination, the ii angle remained of low value which is due to the highly significant proclination of lower incisors in spite of their acrylic capping. So, we agree with the opinion that acrylic capping can restrict but not prevent proclination of lower incisors.[1-3]

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