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ORIGINAL RESEARCH

A Retrospective Cephalometric Evaluation of Dental Changes with Activator and Activator Headgear Combination in the Treatment of Skeletal Class II Malocclusion

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ABSTRACT

Aim: The aims of this study were to evaluate the dental changes brought about by activator and activator headgear combination (ACHG) and to determine whether we can achieve control over the lower incisor proclination which is a side effect of using functional appliances; or not, while treating cases of skeletal class II malocclusions.

Methods: Lateral cephalograms of 45 skeletal class II division 1 patients were selected for the study. Fifteen of them were successfully treated with an Andresen activator and the other 15 with an activator headgear combination. Fifteen class II subjects who had declined treatment served as the control group. Cephalometric landmarks were marked by one author to avoid interobserver variability.

Results: The results revealed that both the activator and the activator headgear combination significantly ($p < 0.001$) affected dental variables measured. The mandibular incisor proclination was effectively controlled in the activator headgear combination group.

Conclusion: An activator headgear combination would offer itself as a better option compared with activator alone in the treatment of skeletal class II malocclusions especially in cases with proclined mandibular incisors.

Clinical significance: When one of the treatment goals is to achieve a greater control over mandibular incisor proclination in the treatment of Skeletal Class II malocclusions, employing a combination of activator and headgear may substantially improve clinical outcomes.

Keywords: Activator, Headgear, Orthopedic appliance, Proclination, Cephalograms, Dentoalveolar.

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INTRODUCTION

A major reason for the development of functional appliances was the recognition that function affects the ultimate morphological status of the dentofacial complex. Functional appliances are considered to be the primarily orthopedic tools to influence the facial skeleton of the growing child in the condylar and sutural areas.

However, the appliances also exert orthodontic effects on dentoalveolar areas. The goal of functional dental orthopedic is to use this functional stimulus, channeling it to the greatest extent—the tissues, jaws, condyles and teeth can allow. The influence of natural forces and functional stimulation on form was first reported by Roux (1883) as results of studies he performed on the tail fins of dolphin.[1,2] His working hypothesis became the background of both general orthopedic and functional dental orthopedic procedures. Various appliances were subsequently developed, but Andresen's activator is an appliance which has been invented over a century back and is still in use because of many indications to its advantage.[3,4]

Several types of functional appliances are currently in use for class II treatment aimed at improving existing skeletal imbalances, arch form and orofacial function.[5] These functional appliances demonstrate a significant diversity in design, which could affect their acceptance by patients. Although bionator or twin blocks are more acceptable compared with activators, patients do not easily adapt to these appliances because of their large size and unfixed position in the mouth.

There have been several studies which have compared the effects of activator and activator headgear combinations.[6-11] However, only some studies have included data from untreated class II as control group.[6-8]

AIMS AND OBJECTIVES

The aims of the present study were to study the dental changes brought about by activator and activator headgear combination (ACHG) and to determine whether we can achieve control over the lower incisor proclination which is a side effect of using functional appliances; or not, while treating cases of skeletal class II malocclusions.

MATERIALS AND METHODS

Two different fixed functional appliances used for this study were as follows:

1. The activator appliance (Andresen's).
2. Activator headgear combination (ACHG).

Data from 15 patients served as the control group and 15 patients each for both appliance groups. The control group consisted of those individuals who were skeletally and dentally similar to other two groups and had not undergone any kind of orthodontic treatment in the past.

The age group was in the range of 8.2 to 13.3 years with a mean age of 10.5 years. All the cases were randomly selected for this study irrespective of sex. Pretreatment and postfunctional lateral cephalograms of 15 patients who had been treated successfully by activator alone and 15 patients who had been treated successfully by activator along with headgear orthopedic appliance for class II skeletal correction were obtained fulfilling the following criteria:

Skeletal and dental Angle's class-2 div-1 malocclusion with:

- Horizontal growth pattern
- Increased overjet
- A positive overbite.

Noncontributory medical and dental history and no history of previous orthodontic treatment.

After the cephalograms were obtained of all the three study groups, they were traced on lead acetate tracing paper of 50 microns thickness. The tracings were done using 0.5 mm colored lead pencils. The landmarks were recorded to the nearest 0.5 mm in both vertical and horizontal plane (Table 1). A X/Y coordinate system was used to quantify the changes between the pretreatment and post-treatment cephalograms. FH plane served as the X-axis and a vertical line perpendicular to the FH plane passing through the sella served as the Y-axis.

Table 1: Cephalometric landmarks, lines and planes

ANS	Anterior nasal spine
Ba	Basion
Co	Condylion
Gn	Gnathion
Go	Gonion
Me	Menton
N	Nasion
Or	Orbitale
Po	Porion
Pog	Pogonion
Point A	Subspinale
Point B	Supramentale
Ptm	Pterygomaxillary fissure
S	Sella
S-N plane	Sella nasion plane
F-H plane	Frankfort horizontal plane
Occ plane	Occlusal plane
Go-Me plane	Mandibular plane
A-Pog plane	A-Pogonion line
N⊥	Nasion perpendicular
PtV	Pterygoid vertical
Pog⊥	Pogonion perpendicular

STATISTICAL ANALYSIS

Prior to recording of the measurements, the reliability of the measurement was determined. The cephalograms were traced on two separate occasions by one operator after a period of three months. The two readings were then averaged for the final data.

The mean net changes and the standard deviation for each group were calculated using paired t-test.

$$\text{Paired } t = \left| \frac{d}{SE_d} \right|$$

d = changes in values after treatment

$\bar{d}$ = mean of change

$$SE_d = \sqrt{\frac{\bar{d} - d^2}{n\,(n-1)}}$$

The mean changes in the two groups were compared using unpaired t-test.

$$t = \left| \frac{X_1 - X_2}{SE} \right| \qquad (\bar{X}_1,\ \bar{X}_2 = \text{mean of two groups})$$

$$SE = \sqrt{\frac{1}{n_1} \quad \frac{1}{n_2}} \sqrt{\frac{(n_1 - 1)\, S_1^2 + (n_2 - 1)\, S_2^2}{n_1 \quad n_2 - 2}}$$

RESULTS

For the purpose of comparison of cephalometric analysis, linear and angular measurements were done to record both skeletal and dental changes; however, only dental changes were considered for this article and their significance was compared using the standardized Student's t-test in order to obtain the difference. The results obtained are discussed as maxillary dental changes, mandibular dental changes, maxilla to mandible (dental) changes and intergroup comparisons.

Maxillary Dental Changes (Tables 2 to 4)

Both treatment groups demonstrated significant changes in comparison with the control group in almost all measured variables. The upper incisors were more retracted in the activator headgear group. The mean ∠ U1-NA (degree) was 32.40 ± 8.46 SD pretreatment and reduced to 24.00 ± 3.68 SD post-treatment in the activator headgear group. While the mean ∠ U1-NA (degree) was 33.80 ± 5.63 SD pretreatment and reduced to 29.57 ± 6.89 SD posttreatment in the activator group.

Mandibular Dental Changes (Tables 2 to 4)

A greater protrusion of the lower incisors occurred in the activator group than in the activator headgear group. The mean ∠ L1-NB (degree) was 27.50 ± 6.38 SD pretreatment and increased to 31.80 ± 6.00 SD post-treatment in the

Table 2: Activator group: Comparison of pre- and post-treatment mean values

	Pretreatment		*Post-treatment*		*Difference*		*Paired-t*	*p-value*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*			
Maxillary dental									
∠U1-NA (degree)	33.80	5.63	29.57	6.89	–4.23	6.77	2.56	<0.025	S
U1-APog (mm)	11.20	1.66	7.97	1.36	–3.23	1.83	6.83	<0.001	S
∠U1-SN (degree)	113.40	6.10	107.87	7.41	–5.53	7.76	2.66	<0.025	S
Mandibular dental									
∠L1-NB (degree)	27.50	6.38	31.80	6.00	4.3	4.34	3.82	<0.005	S
L1-APog (mm)	1.30	2.20	4.03	1.81	2.73	1.7	6.19	<0.001	S
∠IMPA (degree)	99.40	4.41	103.13	4.95	3.79	3.17	4.55	<0.001	S
Maxilla to mandible (dental)									
∠U1-L1 (degree)	112.60	5.19	114.07	4.32	1.47	4.89	4.32	<0.001	S
Overjet (mm)	9.63	2.62	3.80	1.37	–5.83	2.65	8.5	<0.001	S
Overbite (mm)	5.00	1.31	3.30	1.28	–1.7	1.53	4.29	<0.001	S

S—significant, NS—nonsignificant

Table 3: Activator headgear group: Comparison of pre- and post-treatment mean values

	Pretreatment		*Post-treatment*		*Difference*		*Paired-t*	*p-value*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*			
Maxillary dental									
∠U1-NA (degree)	32.40	8.46	24.00	3.68	–8.40	10.04	2.65	<0.05	S
U1-APog (mm)	11.60	2.88	8.20	1.75	–3.40	3.31	3.25	<0.001	S
∠U1-SN (degree)	112.60	10.52	104.80	5.29	–7.80	10.85	2.27	<0.05	S
Mandibular dental									
∠L-NB (degree)	29.80	4.85	30.80	5.56	1.00	7.88	2.65	<0.05	S
L1-APog (mm)	1.60	1.40	5.10	1.97	3.30	2.45	4.26	<0.001	S
∠IMPA (degree)	103.70	6.93	109.50	2.76	5.80	8.54	2.12	<0.05	S
Maxilla to mandible (dental)									
∠U1-L1 (degree)	112.00	6.51	120.60	6.26	8.60	6.54	3.72	<0.001	S
Overjet (mm)	9.20	3.08	3.30	2.00	–5.90	4.38	4.26	<0.001	S
Overjet (mm)	5.10	.79	2.70	1.25	–2.40	1.90	4.00	<0.001	S

S—significant, NS—nonsignificant

Table 4: Control group: Comparison of pre- and post-treatment mean values

	Pretreatment		*Post-treatment*		*Difference*		*Paired-t*	*p-value*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*			
Maxillary dental									
∠U1-NA (degree)	33.73	5.04	33.67	4.45	–0.07	2.34	0.11	>0.5	NS
U1-APog (mm)	11.57	2.03	10.97	1.56	–0.60	1.07	2.16	<0.05	S
∠U1-SN (degree)	114.73	4.93	115.13	4.85	0.40	3.13	0.49	>0.5	NS
Mandibular dental									
∠L-NB (degree)	30.60	3.44	32.47	2.70	1.87	2.74	2.63	<0.25	S
L1-APog (mm)	3.10	1.26	3.77	1.16	0.67	1.20	2.14	>0.05	NS
∠IMPA (degree)	101.00	5.03	102.60	4.72	1.60	2.38	2.59	<0.05	S
Maxilla to mandible (dental)									
∠U1-L1 (degree)	110.47	5.67	110.10	4.35	–0.37	4.73	0.29	>0.5	NS
Overjet (mm)	7.43	1.61	7.07	1.87	–0.37	1.17	1.21	>0.2	NS
Overjet (mm)	4.27	1.22	4.03	1.26	–0.23	0.56	1.60	>0.1	NS

S—significant, NS—nonsignificant

activator group. While the mean ∠ L1-NB (degree) was 29.80 ± 4.85 SD pretreatment and only slightly increased to 30.80 ± 5.56 SD post-treatment in the activator headgear group.

Maxilla to Mandible (Dental) Changes (Tables 2 to 4)

Both treatment groups demonstrated significant changes in comparison with the control group in reducing the overjet. A similar magnitude of correction of the overjet was observed in the activator headgear group and the activator group. Also, the interincisal angle was more significantly increased in the ACHG group. The mean ∠ U1-L1 (degree) was 112.00 ± 6.51 SD pretreatment and increased to 114.07 ± 4.32 SD post-treatment in the activator group. While the mean ∠ U1-L1 (degree) was 112.00 ± 6.51 SD pretreatment and increased to 120.60 ± 6.26 SD post-treatment in the activator headgear group.

Intergroup Comparisons (Table 5)

Both treatment groups demonstrated significant changes in comparison with the control group in almost all measured variables. However, a significant difference was observed in ∠ U1-NA, ∠ L1-NB, and interincisal angle was observed between the treatment groups.

DISCUSSION

The untreated skeletal class II patient presents with a discrepancy in jaw size or position between the maxilla and the mandible. Commonly, the teeth are partially compensating for the discrepancy. In these types of patients, their prepubertal status can be made use of by functional appliances; however, the difficulty arises in selecting the right kind of appliance for the right patient.[12-14]

In case of conventional activator being used, the retractor group of muscles will force the mandible backwards, whereas the construction bite taken will prevent the dentoalveolar segment to react to the muscular forces; hence, the lower incisors tend to procline which is a normal compensation for a class II skeletal pattern.[15]

Many activator and activator headgear studies[6,8-10,16-18] have reported a retroclination of upper incisors. A more pronounced retrusion of the upper incisors with the activator compared with the activator headgear has been reported.[6,10] In our study, we observed a greater retrusion in the activator headgear group. This may be explained due to the effect of additional occipital headgear forces acting posteriorly on the apical base of the maxilla and associated alveolar structures.

Improved control of the axial inclination of the lower incisors has been reported with an activator headgear combination than with an activator alone.[6-11] Our results are in concurrence with the findings of the studies.

In case of activator with headgear, initially, the lower incisors may procline under the effect of retractor group of muscles but once the pterygoid response develops and the mandible attains its position the retracting force of the headgear comes into action causing the lower incisors to retrude, hence, allowing for greater compensation for class II skeletal pattern. The lower incisors instead of showing proclination showed retroclination which is a desirable effect for overjet correction to a greater extent, which in turn corrects the sagittal skeletal relationship.

SUMMARY AND CONCLUSION

The dental changes brought about by both activator and activator headgear combination were comparable and effective in the treatment of skeletal class II malocclusions. Control over the lower incisor proclination was greater in the activator headgear combination group. Although the superiority of one appliance over the other could not be established, it is however reasonable to conclude that activator headgear combination would offer itself as a better

Table 5: Activator to activator headgear: Comparison of the mean changes at the end of treatment

	Mean	*SD*	*Mean*	*SD*	*Diff.*	*t-value*	*p-value*	
Maxillary dental								
∠U1-NA (degree)	–4.23	6.77	–8.40	10.04	4.17	2.6479	<0.001	S
U1-APog (mm)	–3.23	1.83	–3.40	3.31	0.17	0.1657	>0.05	NS
∠U1-SN (degree)	–5.53	7.76	–7.80	10.85	2.27	0.6113	>0.05	NS
Mandibular dental								
∠L1-NB (degree)	4.3	4.34	1.00	7.88	–3.30	1.0652	<0.05	S
L1-APog (mm)	2.73	1.7	3.30	2.45	–0.57	0.6886	>0.05	NS
∠IMPA (degree)	3.73	3.17	5.80	8.64	–2.07	0.8532	>0.05	NS
Maxilla to mandible (dental)								
∠U1-L1 (degree)	1.47	4.89	8.60	6.64	7.13	3.8124	<0.001	S
Ovejet (mm)	–5.83	2.65	–5.90	4.38	0.07	0.0499	>0.05	NS
Overbite (mm)	–1.7	1.53	–2.40	1.90	0.70	1.0186	>0.05	NS

S—significant, NS—nonsignificant

option in the treatment of skeletal class II malocclusions especially in cases with proclined mandibular incisors.

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