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Reliability of Beta Angle for Analyzing Changes with Activator High Pull Headgear Using Linear and Angular Measurements by Cephalometric Analysis

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Abstract:
Background: An important objective of orthodontic treatment during adolescence is to take advantage of growth in patients with skeletal discrepancies. The reliability of beta angle in assessing the changes following activator high pull headgear as well as normal growth has received less attention. Therefore, the aim of this study was to assess the reliability of beta angle following activator high pull headgear therapy.
Materials and Methods: For this study, 20 subjects each were selected who had been treated by activator high pull headgear therapy. Lateral cephalograms were analyzed for skeletal changes during activator high pull headgear treatment. After cephalometric measurements were made, the changes between T_0 and T_1 were determined for each patient. The mean difference between T_0 and T_1 was compared to assess the effects of activator high pull headgear group. Results are expressed as mean ± standard deviation and are compared by paired *t*-test.
Results: Findings of this study demonstrated that, in general the maxilla did not move in downward and forward direction in the treated group, suggesting that maximum restraint of maxillary complex was achieved following activator high pull headgear therapy.
Conclusion: Activator high pull headgear appliance is an effective method in holding maxilla by preventing its downward and forward growth as well as effective in allowing the mandible to express its actual growth potential as compared to untreated subjects.

Key Words: Activator high pull headgear, beta angle, orthodontist

Introduction

In the 75 years history, since the development of cephalometric radiology, literally hundreds of methods of analysis have been proposed. Many of them have contributed to a better understanding of the complexity of changes associated with facial growth. Some analyses have been useful in identifying how individual patients vary from norms that have been derived from a large number of cohorts.[1] Some cephalometric analyses and methods of superimposition are useful in monitoring the changes that are due to growth or due to a combination of both growth and treatment. Few of the most popular measurements for assessing anteroposterior discrepancies in cephalometric analysis have always been the n ANB angle, the Downs A-B plane angle, and WITS appraisal. Studies have been conducted to evaluate skeletal, dentoalveolar, and soft tissue profile changes with activator and high-pull headgear combination therapy in patients with Class II malocclusions caused by maxillary prognathism and mandibular retrognathism.[2] Despite its widespread use, the limitations of the ANB angle have been amply described in the literature that there is often a difference between the interpretation of the angle and the actual discrepancy between the apical bases and also the position of the nasion is not fixed during growth and any displacement of nasion will directly affect the ANB angle as well. Furthermore, rotations the jaws by either growth or orthodontic treatment can also change the ANB reading.[3] The cephalometric analyses based on angular and linear measurements have obvious fallacies, which have been discussed in detail by various authors. However, the clinical application of such an analysis by the orthodontic profession in treatment planning is widely accepted.[4] Hence, the aims of this study are to evaluate the reliability of the beta angle using angular and linear measurement for assessing the skeletal discrepancy between the maxilla and the mandible in the sagittal plane and in assessing the changes following activator high pull headgear therapy to aid the orthodontist in better understanding of true skeletal changes.

Materials and Methods

Pre- and post-treatment lateral cephalograms of 20 patients with Class II skeletal malocclusion treated with activator high pull headgear therapy were traced.

Materials used in the study

- Standardized pre- and post-treatment lateral cephalograms
- 0.003 inch thick acetate tracing paper
- 0.3 mm HB lead pencil
- Geometry box (scale, protractor, set squares, eraser, sharpener)
- Scotch tapes

- Tracing board
- Scissors and calculator.

Analysis of lateral cephalograms

Profile cephalograms were taken in occlusion under standardized conditions with a cephalostat. Tracings were made on 0.003 inch thick acetate paper with 0.3 mm HB lead pencil and the landmarks were identified. Midpoints of right and left images were used for bilateral landmarks. Angular measurements were recorded with protractor to a nearest of 0.5° and linear measurements were made with a ruler to a nearest of 0.5 mm. All tracings were rechecked to verify the accuracy (Figure 1).

Results

Lateral cephalograms of pretreatment (T_0) and posttreatment (T_1) were taken. Descriptive data that included means and standard deviations were calculated for the linear and angular parameters. Paired *t*-test was used to compare between pretreatment and post treatment changes within activator high pull headgear. A total of six parameters were used in this study. They included both angular and linear parameters.

Angular parameters

Angle SNA

The maxillary prognathism reduced significantly with a pretreatment value of 81.8° ± 3.9° and a mean post-treatment value of 81.0° ± 3.1°. The activator high pull headgear group showed a mean difference of 0.75 and a *P* = 0.01, which is significant (Table 1).

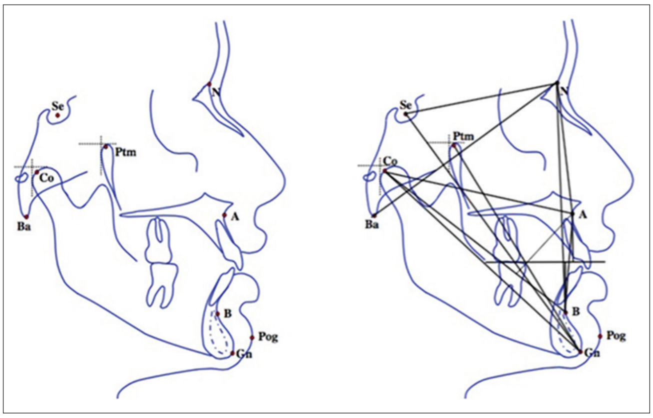

Figure 1: Cephalometric landmarks for tracing angular and linear measurements.

Angle SNB

The mandibular retrognathism reduced significantly with a pretreatment value of 74.4° ± 2.9° and a mean post-treatment value of 77° ± 2.4°. The activator high pull headgear group showed a mean difference of 2.55 and a *P* < 0.001, which is highly significant (Table 1).

Angle ANB

Angle ANB showed a pretreatment mean value of 7.4° ± 1.8° which reduced to a post-treatment value with a mean value of 4.2° ± 1.5°. The activator high pull headgear group showed a mean difference of 3.15 and a *P* < 0.001, which is statistically highly significant (Table 1).

Beta angle

The beta angle in the activator high pull headgear group showed a pretreatment mean value of 22.0° ± 2.6° to a posttreatment mean value of 26.9° ± 2.70°. The activator high pull headgear group showed a mean difference of 4.9 and a *P* < 0.001, which is highly significant (Table 1).

Linear parameters

Effective maxillary length

The effective maxillary length in the activator high pull-headgear group showed a pretreatment mean value of 90.3 ± 3.8 mm and a posttreatment mean value of 90.5 ± 1.5 mm. The activator high pull headgear group showed a mean difference of 0.05 and a *P* = 0.82 which is not significant (Table 2).

Effective mandibular length

The effective mandibular length in the activator high pull-headgear group showed a pretreatment mean value of 105.4 ± 3.8 mm and a posttreatment mean value of 110.8 ± 3.9 mm. The activator high pull headgear group showed a mean difference of 5.45 and a *P* < 0.001, which is highly significant (Table 2).

Discussion

Class II Division 1 malocclusion in children is commonly treated with various removable or fixed functional appliances. Activator and headgear have been combined in a variety of designs in attempts to create a more efficient appliance. Van Beek presented a simple, robust type of activator headgear with high construction bite and claimed that it could maintain sagittal and vertical control of the maxilla and stimulate mandibular growth. The beta angle does not depend on cranial landmarks or the functional occlusal plane. It uses three points

Table 1: Angular measurements of 20 patients treated with activator high pull headgear.

Parameters	Mean±SD		Mean difference	*P* value*, significant
	Pre-treatment	Post-treatment		
SNA	81.8±3.9	81.0±3.1	0.75	0.01 S
SNB	74.4±2.9	77.0±2.4	2.55	<0.001 HS
ANB	7.4±1.8	4.2±1.5	3.15	<0.001 HS
b	22.0±2.6	26.9±2.7	4.9	<0.001 HS

SD: Standard deviation

Table 2: Linear measurements of 20 patients treated with activator high-pull headgear.

Effective maxillary length	90.3	3.8	90.5	1.5	0.05	0.82 NS
Effective mandibular length	105.4	3.8	110.8	3.9	5.45	<0.001 HS

located on jaws Point A, Point B, and the apparent axis of the condyle Point C, so changes in this angle reflect only changes within the jaws. Hence, this study intends to evaluate the reliability of the beta angle to assess the changes following activator high pull headgear treatment and also assess the normal growth changes. The results of the present study are discussed under following headings.

Changes in the maxilla

When the sagittal measurements were compared from pretreatment (T_0) to postorthopedic (T_1), it revealed that there was a statistically significant reduction of maxillary prognathism in the activator high pull headgear group which was due to the skeletal effect of the activator-high pull headgear which primarily restrained the forward growth of the maxilla which was in accordance with the findings of Bendeus *et al.*[5]

Changes in the mandible

The mandibular retrognathism reduced significantly from pretreatment (T_0) to postorthopedic (T_1), it indicated that there was enhancement of mandibular growth during the phase of growth modulation in the activator high pull headgear group. Findings by Bjork who showed that the direction of the condylar growth can vary in the same subject; thus growth can possibly vary from favorable to unfavorable due to not only the growth but to the translation and rotation of the mandible.[6-8]

Changes in the maxillo-mandibular relationship

When angle ANB was compared from pretreatment (T_0) to post-orthopedic (T_1) in the activator high pull headgear group, it revealed that there was a significant reduction of the relative prognathism (ANB) was due to a significant increase in SNB by forward growth of mandible which was freed from occlusal interferences to grow normally and reduction of SNA by restriction of forward growth of the maxilla. These changes were in accordance with previous studies.[9]

Changes in the beta angle

When angle beta was compared from pre-treatment (T_0) to postorthopedic (T_1) in the activator high-pull headgear, it revealed that there was a significant reduction of the relative prognathism (beta angle), which was more significant in the activator high-pull headgear group, which resulted from reduction in the maxillary prognathism due to the restraining effect of the activator high pull headgear which prevented the downward and forward translation of the maxilla.[10]

Changes in the effective maxillary length

The effective maxillary length did not show any significant changes from pretreatment (T_0) to post orthopedic (T_1) in the activator high pull headgear group, which can be attributed to the restraining effect of the activator high pull headgear.[11]

Changes in the effective mandibular length

When the linear mandibular measurements were compared from pre-treatment (T_0) to post-orthopedic (T_1), significant changes in both activator high pull headgear. Major movements in the horizontal plane occurred at the Point B and Gnathion point. The mandible moved in forward direction. This finding is in accordance with the findings of Bishara who reported that mandiblar length was significantly shorter in skeletal Class II subjects than in normal subjects only in the earlier stages of development.[12]

By the time the permanent dentition had completely erupted, the differences in mandibular length were not significant. This finding suggests the possibility of late "Catch-Up" growth in mandibular length in the untreated skeletal Class II subjects 43 which is in accordance to findings of Hansson *et al.*, Levin.[13,14]

Conclusion

When the activator high-pull headgear patients were assessed by the application of various cephalometric parameters including the beta angle the following conclusions were made. In the sagittal dimension, the findings of the beta angle corelated with angle ANB, which showed a significant reduction in facial convexity which resulted due to the restraining effect of the activator high pull headgear on the maxilla which in turn prevented the downward and forward translation of the maxilla and in turn allowed the growth potential of the mandible to express itself hence aiding in correction of the skeletal Class II malocclusion.

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