ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

Evaluating the effect of Headgear on C axis - A Cephalometric Study

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Manuscript Info

Manuscript History:

Received: 15 April 2015
Final Accepted: 22 May 2015
Published Online: June 2015

Key words:

'C' axis, SM, Angle θ

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Abstract

Assessment of the growth and development of the maxilla, mandible and the craniofacial complex is an essential part of the diagnostic process in orthodontics. The main treatment goal in growing patients is the correction of abnormal maxillofacial relationships. Headgear appliances are frequently used to apply orthopedic forces to the maxilla. Use of orthopedic force for the control of excess maxillary growth is nothing new. But the exact effect of headgear force on altering the magnitude and direction of maxillary basal growth has not been quantitated. The effect of headgear on maxilla can be measured quantitatively by the use of the newly described maxillary growth vector, the 'C' axis. The samples comprised of 20 patients between 7–14 years of age, who had come as outpatients to the Department of Orthodontics and Dentofacial Orthopedics, Govt Dental College, Bangalore and were treated with headgear therapy, without any adjunctive orthodontic treatment. The mean treatment period was 6.4 months. Lateral cephalograms were taken of all the 20 patients both during the pretreatment and post treatment periods. This acted as the test group. These values were compared with the values of the control group, which were obtained by using the linear regression formulae, as given by Stanley Braun et al.

INTRODUCTION

When radiographic and clinical assessments show maxillary skeletal protrusion, the main treatment goal for growing patients is correction of the abnormal maxillofacial relationship. This is often done by applying orthopedic forces to the maxilla. Headgear appliances are frequently used to apply orthopedic forces to the maxilla. It has been demonstrated that headgear appliances produces important changes in growing and adult human beings.

The use of headgear therapy is very common in the treatment of class-II div 1 malocclusion. Extraoral maxillary retraction appliances are used to improve the dental relationship between maxilla and mandible and, as well as the skeletal relationship between the two jaws.

While investigators have described the manners in which the maxilla is altered during growth, no anatomic area viewed in the sagittal plane had been determined to be a suitable point of reference within the maxilla until Nanda and Merill proposed 'M' - point, a constructed point representing the center of the largest circle that is tangent to the superior, anterior, and palatal surface of the maxilla in the sagittal view. The magnitude of this vector is given by the length of 'SM' and the direction by the angle formed by the 'C'- axis to the SN-plane, denoted byθ.

The recently determined 'C'-axis, i.e. the growth vector of the dentomaxillary complex, suggested this study to evaluate any meaningful changes of the dentomaxillary complex's growth vector related to headgear therapy.

AIMS & OBJECTIVES

1. To evaluate the effect of headgear on restricting the growth of maxilla.
2. To determine the alteration in the direction of the maxillary growth vector by the use of headgear.

MATERIALS & METHODS

The study comprised of 20 patients aged between 7 – 14 years, who had come as outpatients to the Department of Orthodontics and Dentofacial Orthopedics, Govt Dental College, Bangalore. Lateral cephalograms were taken of all the 20 patients both during pretreatment and post treatment periods. This acted as the test group.

M-point was determined using a specially designed transparent template containing a number of circles whose diameter increase in 1 mm increments. Each of the centers was identified by a pinhole in the template. The best fit circle that was tangent to the superior, anterior and palatal surfaces of the maxilla in each sagittal cephalogram was selected. The selected circle center was then transferred to the tracing sheet. The line from the sella (S) to M- point is defined as the 'C'-axis (Fig 1).

The length ('SM' linear, T1 & T2) and direction (angle formed by the 'C'- axis to the SN-plane, denoted by 'θ', θ1 & θ2) of 'C'-axis were measured from the pretreatment and post treatment lateral cephalograms of all 20 patients, treated with headgear therapy, without any adjunctive orthodontic treatment.

The age criteria of the same 20 patients were used as the control group. The values were calculated using the linear regression formula for the specific age groups.

Students't'-test was performed to compare the means of pretest and post test values for both groups.

RESULTS

The mean rate of linear growth of the 'C' axis in treatment group was 0.56 mm/ year and the mean difference in the direction of growth, i.e. angle 'θ' was 0.310. The 'C' axis increased linearly at a mean rate of 1.2 mm per year and the mean difference in the direction of growth, i.e. θ was 0.550 for the control group (Table I, II & Graph 1, 2).

There was a statistically significant difference between the two groups for both the linear and angular measurements.

Figure -1: The relationship of C-axis (S-M- point) to SN, and to the palatal plane (ANS-PNS)

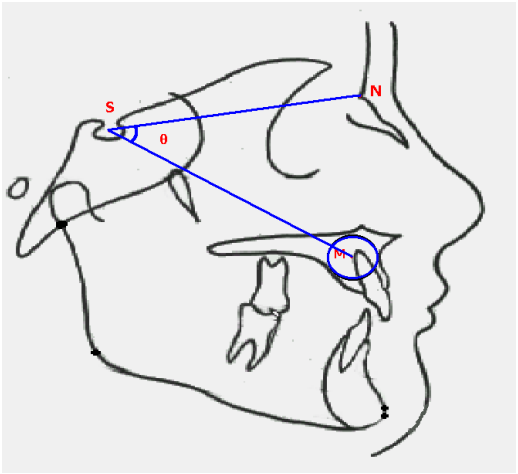


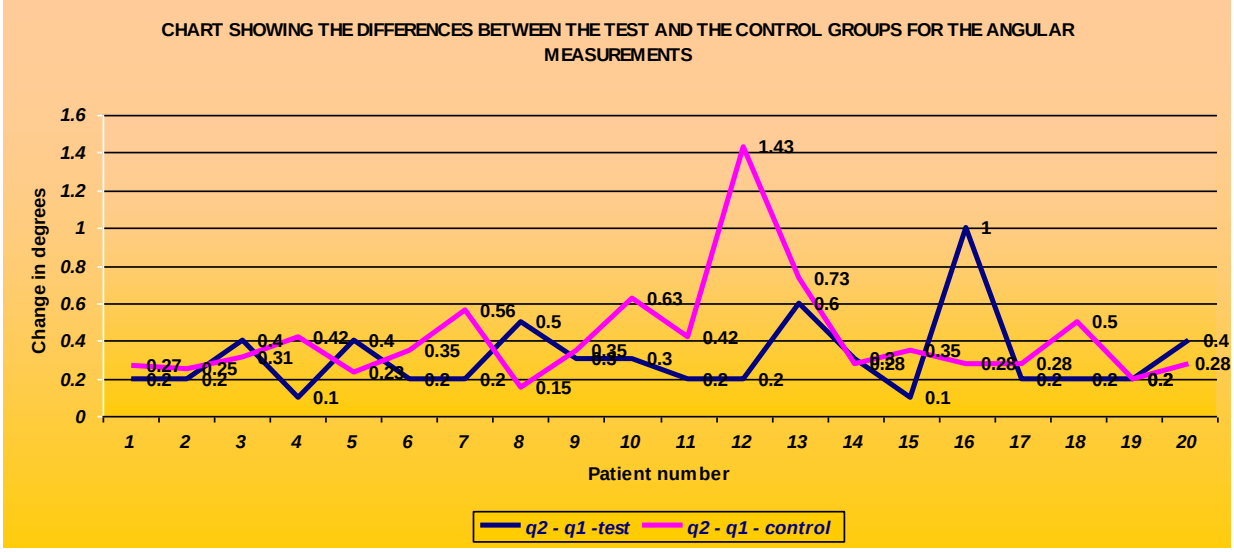
TABLE I: Table showing the difference between the test groups & the control group for angular measurements

Patient No	AGE-PRE	AGE-POST	SM1- Test group	SM2 - Test group	SM1 - Control group	SM2 - Control group	SM2-SM1 (Test)	SM2 - SM1 (Control)
1	8.6	10	77.9	78.3	70.9	73.15	0.4	2.25
2	8.7	10	78	78.5	71.07	73.15	0.5	2.08
3	9.3	10.2	77.2	77.7	73.77	74.8	0.4	1.02
4	9.3	10.5	79.5	80.6	73.77	75.14	0.9	1.37
5	9.4	10.6	75.4	76	72.23	74	0.6	1.7
6	10	11	79.5	80	74.57	75.71	0.5	1.14
7	10.1	11.7	78.6	79	75.37	76.51	0.4	1.14
8	10.2	11	79.2	79.8	73.44	74.53	0.6	1.08
9	10.3	11.3	79.3	80.1	74.91	76.06	0.8	1.14
10	11.2	13	79.8	80.6	75.94	78	0.8	2.05
11	11.5	12.7	80.3	80.9	76.29	77.66	0.6	1.37
12	11.7	13.5	80	81	76.51	78.57	1	2.05
13	12.3	14.4	82.1	82.3	77.2	79.6	0.2	2.39
14	12.4	13.2	82.3	83	77.31	78.23	0.7	0.91
15	13	13.8	81	81.2	78	79.14	0.2	1.14
16	13	14	83	84	78	78.91	1	0.91
17	13.2	14.1	82.3	82.8	78.23	79.25	0.5	1.02
18	13.2	14.9	80.3	80.5	78.23	80.17	0.2	1.94
19	13.3	14	82.4	82.9	78.34	79.14	0.5	0.8
20	13.9	14.7	82.4	82.6	79.03	79.94	0.2	0.9

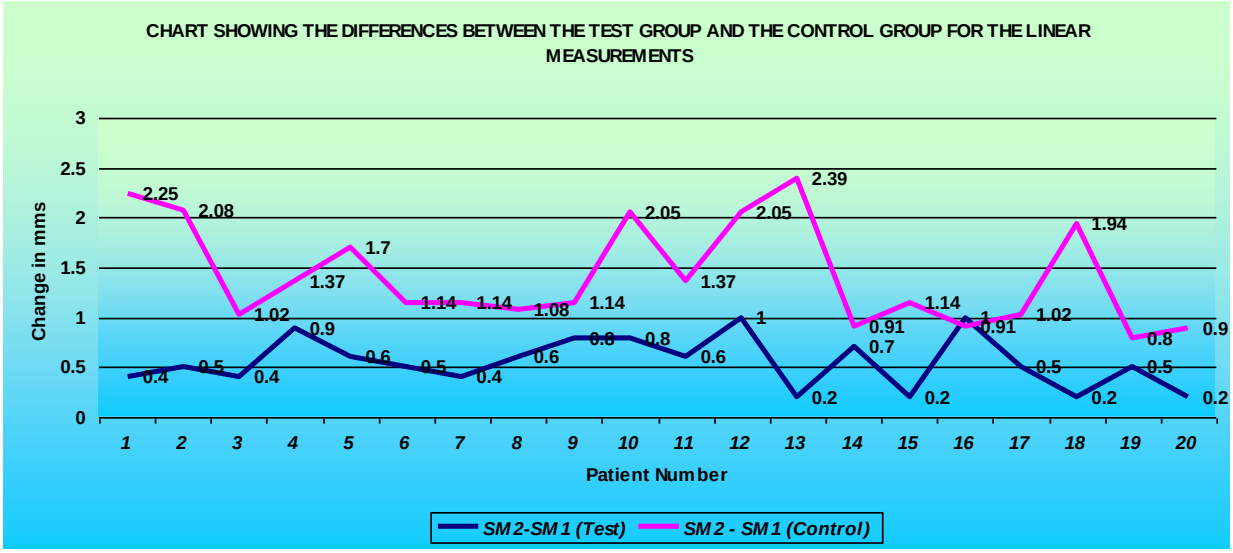
TABLE II: Table showing the difference between the test groups & the control group for linear measurements

Patient	AGE-PRE	AGE-POS	q1- Test group	q2 - Test group	q1 - Control group	q2 - control group	q2 - q1 – test	q2 - q1 - control
1	8.6	10	43.2	43.4	42.44	42.72	0.2	0.27
2	8.7	10	43.7	43.9	42.46	42.72	0.2	0.25
3	9.3	10.2	41.3	41.7	42.28	42.6	0.4	0.31
4	9.3	10.5	44.2	44.3	42.28	42.7	0.1	0.42
5	9.4	10.6	41.3	41.7	42.6	42.84	0.4	0.23
6	10	11	45	45.2	42.53	42.88	0.2	0.35
7	10.1	11.7	42	42.4	42.56	43.12	0.2	0.56
8	10.2	11	40	40.5	42.76	42.92	0.5	0.15
9	10.3	11.3	37.8	40.1	42.63	42.98	0.3	0.35
10	11.2	13	39.7	40	42.95	43.33	0.3	0.63
11	11.5	12.7	44.7	44.9	43.05	43.77	0.2	0.42
12	11.7	13.5	38.7	38.9	43.12	45.12	0.2	1.43
13	12.3	14.4	41	41.6	43.33	44.07	0.6	0.73
14	12.4	13.2	40.6	40.9	43.37	43.65	0.3	0.28
15	13	13.8	38	38.1	43.58	43.93	0.1	0.35
16	13	14	36	37	43.58	43.86	1	0.28
17	13.2	14.1	36	36.2	43.65	43.93	0.2	0.28
18	13.2	14.9	39	39.2	43.65	44.25	0.2	0.5
19	13.3	14	41.4	41.6	43.68	43.93	0.2	0.2
20	13.9	14.7	40.3	40.7	43.89	44.18	0.4	0.28

Graph-1: Chart showing the difference between the test groups & the control group for angular measurements



Graph-2: Chart showing the difference between the test groups & the control group for linear measurements



DISCUSSION

The C – axis increased linearly continually at a mean rate of 1.2 mm per year from ages 7-14 years for control groups. This is based on the slope of a linear regression formula where

- C-axis length in millimeters for males = 1.142 (age in years) + 63.157, with a correlation coefficient (R) of 0.669.
- C-axis length in millimeters for females = -0.099 (age in years)2 +3.454 (age in years) + 48.519, with a correlation coefficient (R) of 0.618

The mean difference in the direction of growth i.e. θ was 0.550 for the control group. The regression formula for,

- Growth axis angle for males, θ = 0.351 (age in years) +39.021, with a correlation coefficient (R) of 0.355
- Growth axis angle for females, θ = 0.199 (age in years) + 40.733, with a correlation coefficient (R) of 0.169

The results of the present study showed that the mean rate of growth in treatment group was 0.56 mm compared to 1.2mm increase in the control group. The mean difference in the direction θ was 0.310 for treatment group and 0.550 for the control group. There was a statistically significant difference between the two groups for both the linear and angular measurements.

The results of the present study were in accordance with the study conducted by Stanley Braun et al in 1999.

CONCLUSION

The growth axis ('C'-axis), which describes the growth vector of dentomaxillary complex is altered in clinically meaningful manner through the use of Headgear appliance. Hence, the following conclusions can be derived from this study,

- ✓ There is a clinically significant alteration in the 'C' axis, the growth vector for the maxilla, after the use of headgear.
- ✓ Use of a headgear orthopedic force decreases not only the magnitude of the growth vector, i.e. C axis, but also causes a decrease in the angulations of the vector.
- ✓ The downward and forward growth of maxilla is restricted by the use of headgear.

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