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ORIGINAL ARTICLE

Evaluation of Correlation between G-axis and the vertical Craniofacial Growth Vectors

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Abstract:

Background and aim: G-axis which is defined by the angle between line S-N and S-G would be of great use in evaluation of the mandibular growth relative to other craniofacial structures the aim of this study was to evaluate the correlation of G-axis with vertical parameters in adult patients of different malocclusions.

Materials and methods: Lateral cephalograms of 90 patients with different malocclusions, were traced for evaluation of some horizontal and vertical cephalometric facial parameters. The patients were classified into three groups of 30 on the basis of clinical examination, ANB angle and wits appraisal. Pearson correlation test were conducted to compare the correlation of G axis with vertical parameters in different malocclusions.

Results: Y-axis length showed significant and positive correlation with G-axis length. G-axis length and lower facial height had positive significant correlation in three categories. No significant correlation was found between G-axis length and ANB angle or wits. **Conclusion:** Application of the Y-axis and G-vector simultaneously seem to be more useful in cephalometric evaluation of mandibular growth pattern than emphasis on one.

Keywords: G-axis, cephalometry, correlation, growth vectors.

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INTRODUCTION

Cephalometric evaluation of craniofacial pattern is an important aspect of orthodontic treatment planning. ANB angle was the first sagittal indicator which was introduced by Riedel in 1952(1). Since ANB was influenced by upward or downward rotation of jaws and variability in Nasion point position (2), some other variables like wits (3) and Beta angle (4) were suggested to reduce the misinterpretation. Such parameters may have innate errors. A problem with wits may be related to difficulty in identification of the occlusal plan which may affect the analysis. Beta angle is identified by point A, point B, and the apparent axis of the condyle to assess the sagittal relations(5).

Different main parameters including Y-axis by Down (6), Jaraback index, FMA in Tweed analysis (7) and sum of Bjork were used for evaluation of vertical growth changes.

Y-axis is frequently used for interpretation of mandibular vertical rotation (6) Decreasing amounts may be related with mandibular upward and forward rotation, which may be interpreted as horizontal growth pattern. Increasing of Y-axis advocates the vertical growth of mandible that is a profound finding in Class II, openbite patients (8). but in an investigation by Hagg, it was shown that the change in Pogonion position during the mandibular growth and the bone apposition on the chin may be misleading in cephalometric measurement of vertical changes (8). C-axis which connects Nasion-Sella and M points (the center of the largest circle, that is tangent to the superior, anterior and palatal surfaces of the maxilla) has been used for determine the direction of vertical growth of maxilla (10).

In attempt to introducing a more accurate parameter, Braun claimed that G-axis would be of great use in evaluation of the mandibular growth relative to other craniofacial structures (11). G-axis is defined by the angle between line S-N and S-G. The G-point is the center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphyseal region on a lateral cephalogram. By using the stable G-point, this vector seems to overcome the limitations of Y-axis due to the remodeling of external symphyseal region. (11) Bhad W.A introduced the W-angle for evaluation of sagittal maxillary-mandibular relationship. It uses the angle formed between S, M and G-points and seems to be a combination of C-axis and G-axis. (12)

To our knowledge, no study has evaluated the correlation of the G-axis with Y-axis and the other growth vertical and horizontal indices so the aim of this study was to evaluate the correlation of G-axis with vertical parameters in adult patients of different malocclusions.

MATERIAL AND METHODS

In the present study, lateral cephalograms of 90 patients, 45 males and 45 females with age range of 16-20 were selected from the Orthodontics department, Tehran University of Medical Sciences, Iran. All the radiographs were ordered from the same radiology center to ensure the equal radiographic magnification.

The patients were selected according to following inclusion criteria:

1. No history of previous orthodontic treatment.
2. No history of craniofacial or developmental syndromes.
3. Mandibular plane angle (SN-Go Gn) between 32±5.

Lateral cephalograms were traced manually by two orthodontists on 8x10 inches acetate. The patients were classified into three groups of 30 on the basis of clinical examination , ANB angle and wits appraisal with regard to wits and Steiner's analysis. (13,14)

The following facial parameters were measured in 3 groups:

ANB: Difference of SNA and SNB angles.

Wits: Wits appraisal.

G-axis length: Distance between Sella and G-point.

Alpha angle: Angle formed between Sella-Nasion -G point.

Y-axis: Angle between Frankfurt and Sella-Gnathion.

FMA: Angle of Frankfurt to mandibular plane.

Anterior Facial Height (AFH): Distance between Nasion to Menton.

Posterior Facial Height (PFH): Distance between Sella to Gonion.

Lower Facial Height (LFH): Distance between anterior nasal spine to Menton.

Basal angle: Angle formed between palatal plan and Gonion-Menton.

Ramus height: Distance between Articular to Gonion.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, Version 18). After normality test, Pearson correlation test were conducted to compare the correlation of parameters in different malocclusion categories. P-value less than 0.05 was considered as significant level.

RESULTS

Descriptive data of cephalometric analysis is presented in Table 1.

In evaluating the correlation of vertical indices, Y-axis length showed significant and positive correlation with G-axis length. (P-value< 0.05, r=0.778) This correlation was seen in three malocclusion groups but the correlation was higher in class I (r=0.948) and class II categories (r=0.937).

Although significant correlation were found between Alpha angle and Y-axis angle in class II (p-value<0.05, r=0.506) and class III (r=0.597) categories, no significant correlation was detected in class I (p-value>0.05).

Alpha angle had negative correlation with ramus height. (P=0.01 r=-0.465) G-axis length did not show significant correlation with FMA. (P=0.852) Alpha angle correlates with FMA in class II (r=0.575) and class III(r=0.639).

Although G-axis length had positive significant correlation with posterior facial height in three categories, Alpha angle showed no significant correlation with posterior facial height. (P=0.132) Anterior facial height had significant correlation with Alpha angle and G-axis length only in class II.

G-axis length and lower facial height had positive significant correlation in three categories. The correlation between Alpha axis and lower facial height was significant only in class II(r=0.585).

In evaluation of correlation between G-axis and sagittal parameters, no significant correlation was found between G-axis length and ANB angle or wits. Alpha angle showed no correlation with wits or ANB in any of malocclusion categories.

Table1: Descriptive Data of Cephalometric Analysis

Variables	Class	Mean	Standard Deviation
G-axis length	1	120.06	6.6
	2	120.4	7.37
	3	122.05	12.6
Alpha angle	1	68.3	9.9
	2	71.8	4.69
	3	68	4.42
Y-axis	1	62.91	3.59
	2	65.18	3.97
	3	61.7	3.38
FMA	1	26.28	4.2
	2	30.55	5.4
	3	27.25	5.6
Basal angle	1	29.16	11.22
	2	30.53	6.71
	3	27.23	5.55
Posterior Facial Height	1	80.3	5.71
	2	78.93	6.95
	3	82.33	9.13
Anterior facial height	1	98.7	27.01
	2	127.3	9.09
	3	107.9	32.2
Ramus height	1	47.71	4.42
	2	46.45	5.1
	3	49.03	6.35
Wits	1	0.17	0.9
	2	3.2	1.3
	3	-4.2	1.8
ANB	1	2.6	0.56
	2	5.46	1.56
	3	-0.5	1.3

DISCUSSION

The present study has evaluated the correlation of different craniofacial parameters in adult patients with different malocclusions through cephalometric evaluation. According the findings of this investigation, G-axis length and Y-axis length had positive correlation but the correlation was higher in class I and class II. This findings may be due to different chin morphology in class III patients that is in agree with the finding of Shu Y and colleagues who found that different chin morphology are frequent finding in assessment of lateral

cephalogramsin adults with skeletal Class III malocclusion. (15) Hagg also claimed that bone apposition on the chin may be misleading in cephalometric measurement of vertical changes. (9) In the Bhad's study only in Cl III patients, a significant difference was seen in W-angle values between male and females (12).

Alpha angle and Y-axis showed positive correlation. In three malocclusion classes, the interpretation of these angles do not show the similar findings of mandibular growth and this may be another reason for the effect of symphyseal morphology on these parameters. A study of rickets demonstrates that mandibular growth is accompanied with change in morphology of the symphyseal region (16).

Alpha angle showed negative correlation with ramus height, this fact may be due counterclockwise rotation of mandible which may be a frequent finding in patients with decreased ramus height.

In this study no exact correlation was found between G-axis with vertical or sagittal indices though there were higher correlations with vertical parameters. This is in agreeing with Rizwan's opinion that G- axis is not proficient enough to assess the overall skeletal pattern of the face (17).

Braun claimed that G-axis and Alpha angle can be used to evaluate mandibular anterior and forward migration (11) but in present study sagittal indices did not show any correlation with G-axis length or Alpha angle.

CONCLUSIONS

According to the findings of this study, each of growth vectors of Y-axis and G-axis may be representative of some specific growth changes, so the application of both indices simultaneously seem to be more useful in cephalometric evaluation of mandibular growth pattern than emphasis on one. In addition sagittal indices did not show any correlation with G-axis length.

References

1. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. Angle Orthodontist, 1952; 22: 142–145.
2. Oktay H. A comparison of ANB, WITS, AF-BF, and APDImeasurements. Am J OrthodDentofacialOrthop, 1991;99:122-8
3. Jacobson A.The "Wits" appraisal of jaw disharmony. American Journal of Orthodontics, 1975; 67: 125–138
4. Baik CY, Ververidou M.A new approach of assessing sagittal discrepancies: the Beta angle. American Journal of Orthodontics and Dentofacial Orthopedics, 2004; 126:100–105.
5. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: the Beta angle. American Journal of Orthodontics and Dentofacial Orthopedics, 2004; 126(1): 100-5.
6. Downs WB.Variations in facial relationships, their significance in analysis and treatment planning. Americam Journal of orthodontics, 1948; 34:812–823.
7. Tweed C.H: The Frankfort Mandibular Plane Angle in orthodontic diagnosis, classification, treatment planning and prognosis. Am J Orthod Oral Surgery, 1946; 32:175-230.
8. Joong-GYU AHN. Cephalometric appraisal of posttreatment vertical changes in adult orthodontic patients. Am J Orthod, 2000; 118:378-84.
9. Ha¨gg U, Attstro¨m K. Mandibular growth estimated by four cephalometric measurements. American Journal of Orthodontics and Dentofacial Orthopedics, 1992; 102:146–152.
10. Braun S, Kittleson R, Kim K. The G-Axis: A Growth Vector for the Mandible. Angle Orthodontist, 2004; 74:328-331.
11. Braun S. C axis: A growth vector for the maxilla. Angle Orthodotics, 1999; 69:539-542.
12. Bhad W.A, Nayak S, Doshi U.H. A new approach of assessing sagittal dysplasia: the W angle. European Journal of Orthodontics, 2013; 35(1): 66-70.
13. Steiner C.C: Cephalometrics for you and me. Am J Orthod, 1953; 39:729 -755.
14. Jacobson A.The "Wits" appraisal of jaw disharmony.Am J OrthodDentofacialOrthop, 2003;124(5):470-9
15. Shu Y, Liu J, Chen J, Fang CH. Comparison of mandibular and chinmorphology in adults with skeletal Class III malocclusion in different vertical facial types. Shanghai Kou Qiang Yi Xue, 2011: 20(2): 191-5.
16. Ricketts Rm. The evolution of diagnosis to computerized cephalometries. Am JOrthod, 1969; 55:795-803
17. Available from: http://www.ortodoncia.ws/publicaciones/2013/art14.asp. (accessed April 27, 2014)