International Journal of Oral Health Dentistry 2023;9(3):191–195

Content available at: https://www.ipinnovative.com/open-access-journals

International Journal of Oral Health Dentistry

Journal homepage: www.ijohd.org

Original Research Article

Assessment of vertical jaw relationship by R angle- A cephalometric analysis

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ARTICLE INFO

Article history:
Received 13-07-2023
Accepted 21-07-2023
Available online 16-10-2023

Keywords:
Cephalometric analysis
R angle
Vertical jaw relation

ABSTRACT

Background: The norms of the "R" value may not be extended for other regional populations because they are based on the South Indian population group. Therefore, the goal of the current study is to determine the mean value and standard deviation for R angle in a population of North Indian suburbs for subjects with horizontal, average, and vertical growth patterns, as well as to assess its correlation with other variables used to gauge vertical discrepancy.

Materials and Methods: The current cross-sectional study was carried out at the Swami Devi Dyal Dental College and Hospital, Barwala, Distt. Panchkula (Haryana), Department of Orthodontics and Dentofacial Orthopaedics, among 90 participants between the ages of 18 and 26 years having their pretreatment records. The parameters used in the study are R angle, Frankfort Mandibular Angle, Y- axis (Down's Analysis), Facial axis, SOP, SNO, SNPP, MMA. The ratios analyzed in the study are Jarabak Ratio, Facial index, LAFH ratio, skeletal, LAFH, Soft tissue.

Results: The results of the study showed that high correlation was found between R angle and LAFH (Skeletal), Y Axis, Facial Axis, FMA, SNMP, Sum of posterior triangles (SOP), Maxillomandibular plane angle (MMA), SN to palatal plane angle (SNPP). A strong negative correlation was found between R angle and Jarabak ratio and facial index.

Conclusion: There are many cephalometric parameters accessible, however not all of them point towards a certain pattern. In an effort to get around the difficulty of correctly and quickly identifying landmarks, the "R" angle was added.

1. Introduction

The physical appearance of a person is significantly influenced by the face. In order to achieve overall treatment goals, the esthetic result is crucial for patient satisfaction. There have been numerous attempts to measure beauty. Lombardi was the first to suggest using the golden ratio in dentistry.[1] Ricketts applied golden proportion to the human face both in the vertical and horizontal proportion.[2]

With greater emphasis on the role of soft tissue on diagnosis and treatment planning, Ackerman and Profit have further classified the relationship of teeth to the soft tissues that frame their display.[3] These relationships are classified according to Pitch, Roll, and Yaw, respectively. The antero-posterior axis can be thought of as the antero-posterior axes, and the pitch indicates the vertical relationship of the teeth to the lips and cheeks. Cephalometric radiography and clinical evaluation are used to assess this. The roll, which is viewed as up-down variations around the transverse axis, represents the vertical position of the teeth when this varies on the right and left sides. Both frontal and oblique views show it more

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https://doi.org/10.18231/j.ijohd.2023.035

clearly when the lips are relaxed.

A skeletal or dental midline disparity is produced when the jaw or dentition rotates to one side or the other, around vertical axis. This is referred to as yaw and is perceived as departures from the vertical axes that are to the left or right.[3] A harmonious relationship between the vertical proportions of the face is integral to facial esthetics. The vertical height of the midface, from the supraorbital ridges to the base of the nose, should equal the height of the lower face. Within the lower face, the mouth should be about one third of the way between the base of the nose and the chin.[4] A discrepancy in vertical jaw relationship is termed as vertical jaw dysplasia which may express as skeletal open bite or skeletal deep bite.[5]

Schudy was the first to give term hyper-divergent for skeletal open bite and hypo-divergent for skeletal deep bite.[6] Implant studies by Bjork in 1960s, appreciated the extent to which both maxilla and mandible rotate during growth.[7]

The severity of open bite and deep bite is ultimately determined by an increasing number of components (skeletal and dental) involved, and the amount of deviation (rotation) of each component. Accordingly, the difficulty of treating vertical malocclusions and the acceptability of treatment outcome is related to the corresponding severity.[8]

The success of a treatment plan in orthodontics is not only dependent on understanding where growth occurs, but also when it ends.[9] As the vertical component of growth is the last to end, failure to control it may lead to complex treatment, compromised results and relapse after treatment. This mandates a thorough assessment and an accurate diagnostic evaluation of such discrepancies in the vertical facial pattern to ensure treatment success.[10]

Cephalometric analysis attempts to define the pattern of craniofacial growth by examining angular and linear relationships of clearly defined skeletal landmarks on a cephalogram. The parameters used to describe vertical jaw dysplasia in various analyses are Growth Axis in Down's analysis (Y- Axis),[11] Mandibular plane angle in Reidel's analysis,[12] Facial Axis in Rickett's analysis,[13] Maxillary growth vector (C-Axis),[14] Mandibular growth vector (G-Axis),[15] Posterior facial height/ Anterior facial height (Jarabacks ratio).[16]

In an attempt to overcome the drawbacks, a new parameter R-Angle[17] was described by Dr. Mohammed Rizwan in 2013.[17] The angle is formed at center of the condyle (C) by the intersection of C-N axis and C-Me axis. Mean value of R angle ranges from 70.7°to 74.3°. If the angle is ≤ 70.7°, it represents horizontal growth pattern and if the angle is ≥ 74.3°, it represents vertical growth pattern.

The norms of the "R" value may not be extended for other regional populations because they are based on the South Indian population group. Therefore, the goal of the current study is to determine the mean value and standard deviation for R angle in a population of North Indian suburbs for subjects with horizontal, average, and vertical growth patterns, as well as to assess its correlation with other variables used to gauge vertical discrepancy.

2. Materials and Methods

The current cross-sectional study was carried out at the Swami Devi Dyal Dental College and Hospital, Barwala, Distt. Panchkula (Haryana), Department of Orthodontics and Dentofacial Orthopaedics, and the study material was obtained from the archives. 90 participants between the ages of 18 and 26 years having their pretreatment records were included in the study.

Adult patients with an age range between 18-26 years, with no oro-facial deformity, with full complement of teeth excluding third molars and having no previous history of orthodontic treatment were included in the study.

These cephalograms were drawn with an X-ray viewer and a sharp 3H pencil on acetate paper that was 0.003 inches thick, 8 inches wide, and 10 inches long. We employed lateral cephalometric head films of outstanding quality with clearly apparent cephalometric landmarks, linear measures traced to the nearest 0.5 mm, and angles to the nearest 0.5 degree.

These subjects were then classified into three groups namely:

1. Group I- Horizontal growth pattern group (SN-GoGn[12] angle ≤ 28°)
2. Group II- Average growth Pattern group (SN-GoGn[12] angle 32°±4°)
3. Group III- Vertical growth pattern group (SN-GoGn[12] angle ≥ 36°)

The parameters used in the study are R angle, Frankfort Mandibular Angle, Y- axis (Down's Analysis), Facial axis, SOP, SNO, SNPP, MMA. The ratios analyzed in the study are Jarabak Ratio, Facial index, LAFH ratio, skeletal, LAFH, Soft tissue. (Figures 1, 2 and 3)

The statistical analysis was done using IBM SPSS (Statistical Package for Social Sciences) Version 21.0 (SPSS Inc., Chicago, Illinois, USA) statistical analysis software and MS Excel was used to analyze the data. The values were represented in Number (%) and Mean ± SD.

3. Results

A total of 90 subjects were selected for the study and were equally distributed in horizontal, average, and vertical groups (Table 1). A lateral cepahlogram was obtained from each subject, traced and the landmarks were identified. To determine the intra and inter-observer error, the measurements were analyzed using paired t-test which revealed a statistically insignificant difference between two readings.

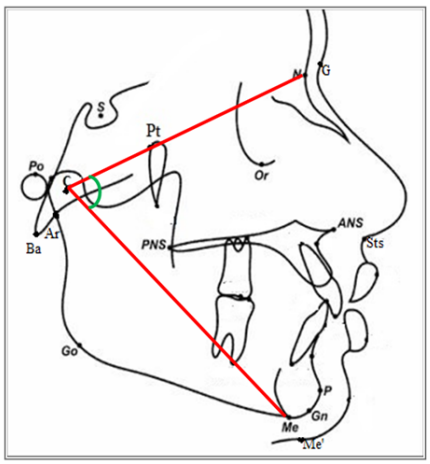

Fig. 1: R angle

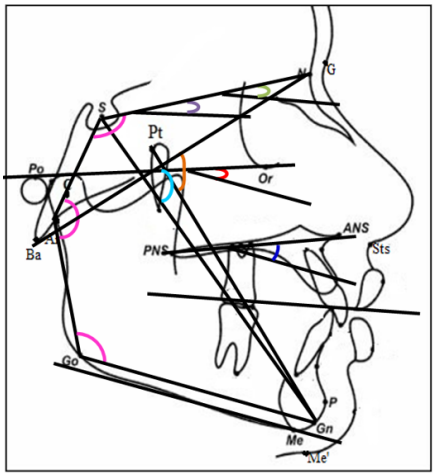

Fig. 2: Various parameters (FMA, Y axis, Facial axis, SOP, SNO, SNPP, MMA) used in the study

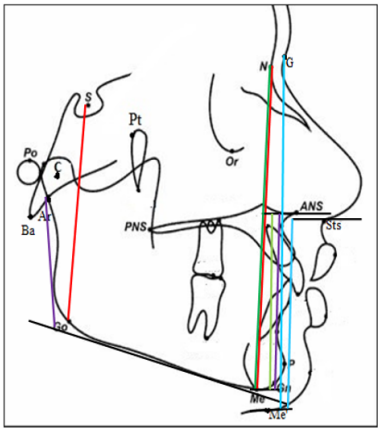

Fig. 3: Ratios (Jarabak Ratio, Facial index, LAFH ratio, skeletal, LAFH, Soft tissue) used in the study

Table 1: Distribution of subjects in three skeletal groups

Group	Horizontal	Average	Vertical
No. of subjects	30	30	30
Males	11	13	13
Females	19	17	17

The mean value and standard deviation for R angle in skeletal horizontal, average and vertical growth pattern in males and female subjects are depicted in Table 2.

Table 2: Mean and standard deviation of R angle in skeletal horizontal, average and vertical group

Groups	Mean	Standard deviation
Horizontal	69.03	4.19
Average	74.3	2.58
Vertical	78.8	3.95

Difference in R angle values between males and females**.** There was no sexual dimorphism observed in values in each of the three skeletal groups i.e. Average, Vertical, Horizontal (Table 3).

Table 3: Comparison of R angle values between males and females in each group

Group	Males	SD	Females	SD	Mean difference	P value
Horizontal	68.41	4.488	69.39	4.098	-.986	.545
Average	74.96	2.904	73.82	2.270	1.138	.238
Vertical	78.54	2.989	79.06	4.683	-.524	.730

Level of significance
*Correlation is significant at the 0.05 (2-tailed)
**correlationis significant at the 0.01 (2-tailed)

Comparison of 'R' angle values between South Indian and Barwala (North Indian) population in three skeletal groups –Horizontal, Average, Vertical. There was statistically significant difference in R angle values only in the average skeletal group while comparing South Indian and Barwala population. Horizontal (Table 4).

Table 4: Comparison of 'R' angle values between South Indian and Barwala (North Indian) population in three skeletal groups–Horizontal, average, vertical

Group	South Indian	Barwala (North Indian)	Mean difference	P value
Horizontal	68.86	69.03	.173	.823
Average	72.5	74.3	1.817	.001**
Vertical	78.5	78.83	.328	.659

Level of significance
*Correlation is significant at the 0.05 (2- tailed)
**Correlation is significant at the 0.01 (2- tailed)

Correlation of 'R' angle with other vertical parameters. Correlation between various parameters used to assess the vertical parameters was also calculated shown in Table 5.

Table 5: Correlation of R angle with other parameters

	R angle	JR percent	FI Ratio	LAFH/ TAFH (skeletal %)	LAFH/ TAFH soft %	Y Axis	Facial axis	FMA	SNMP	SOP	MMA	SNPP	SNO
Pearson Correlation	1	-.690(**)	-.695(**)	.281(**)	0.058	.612(**)	.780(**)	.737(**)	.383(**)	.372(**)	.805(**)	.295(**)	0.172
P value		0	0	0.008	0.592	0	0	0	0	0	0	0.005	0.11

Level of significance
*Correlation is significant at the 0.05 (2-tailed)
**correlation is significant at the 0.01 (2-tailed)

The results of the study showed that high correlation was found between R angle and LAFH (Skeletal), Y Axis, Facial Axis, FMA, SNMP, Sum of posterior triangles (SOP), Maxillomandibular plane angle (MMA), SN to palatal plane angle (SNPP). A strong negative correlation was found between R angle and Jarabak ratio and facial index.

4. Discussion

The sagittal, vertical, and horizontal planes of space must be used to evaluate the jaw relationship while making an orthodontic diagnosis. An essential component of an orthodontic diagnostic is the evaluation of vertical face form. As with macro-esthetics, extraction versus non-extraction, anchorage consideration, surgery versus non-surgical decision, etc., it is crucial in the planning of orthodontic therapy.[18] There is a large variation found in the vertical dimension, which directly impacts the clinician's approach to successful diagnosis, treatment planning and biomechanics.

Rotation of the mandibular and maxillary bases, as well as dento-alveolar compensation, have an impact on the vertical jaw relation. If consistent facial proportions are to be preserved, Lavergne and Gasson,[19] Isaacson and associates[20] as well as Schudy, have proposed that a harmony in growth amount, direction, and degree of rotation between the maxilla and the mandible must exist. Depending on whether dento-alveolar compensation has been placed, distinct malocclusions may manifest with comparable skeletal issues.

The R angle values in this investigation were 69.3+4.19, 74.3+2.58, and 78.8+3.95 for the horizontal, average, and vertical, respectively. These numbers differ from those of the average skeleton group in the south Indian population. The racial disparity is responsible for the variations in these values. As opposed to south Indian males and females (Facial index Males- 100.28 1.77 and Females- (85.39 6.33)), north Indian males and females have lengthy faces (Facial index Males-101.04 1.95 and Females- 107.7 7.69). This was discovered by Prasanna L et al.[21]

In both sexes, there are clear differences in the "R" angle values among the three skeletal groupings. These variations were quite important. So, it is safe to assume that the "R" angle can be used as a therapeutically useful parameter to evaluate the vertical jaw relation in cephalometrics. Some of the constraints of the aforementioned cephalometric metrics may be overcome using the "R" angle. The 'R' angle does not differ between men and women.

The Jarabak ratio provides information regarding the growth pattern. The explanation for its greater value producing a short face and vice versa was an increase in posterior facial height. Because the lower facial height ratio only considers the anterior face heights (upper and lower) and ignores the posterior facial height, the Jarabak ratio is more representative. Male and female distributions in the

Barwala population did not differ significantly according to the Jarabak ratio or the facial index ratios. In contrast, Drs. Saad Asad and Saqib Naeam[18] discovered that men in the Baghdad community had greater men values than women. The varying ethnic population may be the cause of their disparities.

In an effort to determine the predictability of various variables and determine whether or not they can be substituted for one another, correlation between various variables used to evaluate the patient's vertical pattern was also analysed.

Using the two-dimensional imaging approach (lateral cephalogram) to assess skeletal jaw connection may be a potential drawback of this study given advancements in digital imaging and tri-dimensional (3D) imaging technique. A review of recent literature revealed that manual and digital lateral cephalograms are still trustworthy and relevant for scientific study with the added benefit of a reduced radiation dosage, even if CBCT generated images are better at evaluating skeletal jaw disparity.[22,23]

5. Conclusion

The secret to effective treatment planning is making an accurate diagnosis and identifying the morphologic imbalance in the three spatial planes. All treatment facets, including anchoring, biomechanics, and retention, are impacted by a thorough understanding of vertical jaw growth. There are many cephalometric parameters accessible, however not all of them point towards a certain pattern. In an effort to get around the difficulty of correctly and quickly identifying landmarks, the "R" angle was added.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Cite this article: Singh G, Teja PH, Mittal S, Nayar R, Sharma R, Rafiq M. Assessment of vertical jaw relationship by R angle- A cephalometric analysis. *Int J Oral Health Dent* 2023;9(3):191-195.