

**Analysis of Symphyseal Morphology and Correlation with Lower Incisor Position and Mandibular Growth Pattern – A Cross Sectional Study**

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**Citation This Article:** Anthony T S, Macari H J, Antoine L O, Elias Hanna A S, “Analysis of Symphyseal Morphology and Correlation with Lower Incisor Position and Mandibular Growth Pattern – A Cross Sectional Study”, IJHDC – May – June - 2023, Volume. – 2, Issue - 3, P. No. 01 – 08.

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**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

**Abstract**

**Introduction:** In this Article analysis and compared the symphyseal morphology and the lower incisor position in various growth patterns.

**Methods:** A total of 110 subjects were with age group of 20-35 years were divided into three groups based on the skeletal growth pattern i.e., horizontal growers, average growers and vertical growers. Comparisons of symphyseal morphology parameters were made in different groups and a correlation was drawn between

hold away ratio and the parameters of symphyseal morphology.

**Results** Parameters of symphyseal morphology showed variations with change in growth pattern. The mean values of H/A ratio and angle B-Pog-Me were found to be the highest in vertical growers with statistically significant differences. A moderate positive correlation was found between the symphyseal morphology parameters and the lower incisor position except for the angle Id-B-Pog.

**Conclusion:** Changes in the growth pattern of an individual affects both the symphyseal morphology and the lower incisor position. With the increase in the mandibular plane angle, long and narrow symphysis was observed with increased convexity, whereas a short and broad symphysis was seen in low mandibular plane angle subjects. Lower incisor position also varied accordingly as more proclination was seen in case of subjects with vertical growth pattern.

**Keywords:** Lwer, Morphology, Ratio.

### **Introduction**

With an increased realization of the great individuality in craniofacial growth and development, there is a need of predictive system and detailed knowledge regarding orthodontic treatment planning. Knowledge of the mandibular growth pattern is of great advantage for establishing an accurate diagnosis and treatment plan. In addition, it is also helpful for the balanced development of dentofacial structures. Jerabek's cephalometric analysis predicted the direction of mandibular growth from a facial polygon, including the saddle angle (N-S-Ar), articular angle (S-Ar-Go), and gonial angle (Ar-Go-Me). With sums of these three angles greater than 396 degrees, posterior mandibular growth patterns were predicted while less than 396 degrees was associated with anterior mandibular growth. Also, a ratio of posterior (S-Go) to anterior face height (N-Me) of 56% to 62% indicated a posterior growth pattern, whereas a ratio of 65% to 80% indicated an anterior growth tendency.

Symphysis is one of the most important regions of the craniofacial complex for the orthodontic treatment. It serves as a primary reference for esthetic considerations in lower third of the face. There has been found a close relation between the mandibular growth pattern and symphyseal morphology. It has been described that a

patient with a high symphyseal height/width (H/A) ratio usually presents with a vertical, dolichofacial growth pattern. In contrast, a low ratio is associated to a brachyfacial growth pattern. Ricketts stated that symphysis morphology may be used to predict the direction of mandibular growth. On a qualitative basis, he associated a thick symphysis with an anterior growth direction. The inclination of the mandibular incisors can indirectly affect the size and morphology of the symphysis and vice versa during the growth period through dentoalveolar compensation as a result of the sagittal discrepancy between the jaws and different growth patterns. As the lower incisor positioning is one of the most important factors for meeting the treatment objectives, it should keep a correct relationship with its underlying bony support, the mandibular symphysis. Sometimes extensive incisor movements are necessary to reach the individual treatment goal. If these limits are not respected, development of bone dehiscence and gingival retraction takes place, especially in patients with a narrow and high symphysis. So, it is important to draw the correlation between symphyseal morphology and inclination of lower incisors so as to maintain the limits of the incisor movements which will help in preventing any harm to the periodontium. Al-Khateeb et al in their study found that there is a weak but significant correlation between the inclination of the lower incisors and mandibular symphysis.

### **Materials and Methodology**

The total of 110 subjects were selected for the study. Considering minimum correlation for sample i.e., 0.25 in our present study, a sample size of 118 was calculated with 80% power and 5% level of significance when it was compared with null hypothesis correlation. A few of them were undergoing treatment in the department while a few subjects were selected from the OPD of the

department of orthodontics. Adults between the age group of 20-35 years were included in the present study. This age group was taken because skeletal maturity is attained by this age (with minimum impending growth if at all) and age changes of elderly population have not yet begun. Therefore, the morphology of the symphysis is most stable in this age group. Individuals with cranio-facial abnormalities, prior orthodontic or orthognathic treatments, asymmetries or less visibly identifiable anatomical landmarks on lateral cephalogram (especially the symphyseal region contours, point B) and patients who presented a severe alteration of the growth pattern were excluded from the study. lateral cephalograms of participants were taken in centric occlusion with lips in repose and Frankfort Plane Horizontal according to natural head position. All the radiographs were taken by the same operator using the same equipment and technique. During exposure to the X- rays, subjects were guided to stand still with the mandible in the relaxed position to ensure that no strain or change in the head posture occurred while the head is fixed in the cephalostat. All the cephalograms were obtained with KODAK 8000C Digital Panoramic and cephalometric system. Standardized 8” × 10” radiographic head films were used for each subject. All the cephalograms were obtained with exposure at 64 KVp, 16 Ma, and 0.64 seconds, as recommended by the manufacturer. The cephalograms were carefully traced for each patient on acetate paper with a sharp 0.5 mm lead pencil on an X-ray view box. Precautions were taken to eliminate stray light for clarity of cephalometric landmarks. All the linear and angular measurements were obtained nearest to 0.5 mm and 0.5<sup>0</sup> by a ruler and a protractor respectively. Table 1 summarizes the cephalometric points used for the tracing. In order to check the reliability of calibration and to eliminate the risk of

measurement error, 25% of the total cephalograms were retraced and recalibrated after the interval of 1 week. Intra class correlation coefficient test was done between two sets of measurements to check the reliability of assessment. High similarity between the two sets of values in relation to all the parameters at 95% confidence interval was observed thus satisfying the criteria of reliability of assessment for all the variables.

- It is calculated by: posterior facial height x 100
- anterior facial height
- The average range is 59%-63%. A ratio of less than 59% expresses a vertical growth pattern whereas more than 63% expresses a horizontal growth pattern.

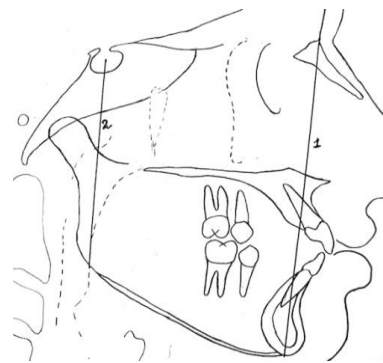


Fig 1: Anterior facial height and Posterior facial height  
The subjects were divided into three groups according to their growth pattern.

Table 1: Sample distribution according to their Jaraback ratio

Groups	Range	No. Of subjects
Horizontal	>63%	40
Average	59%-63%	39
Vertical	<59%	39

Parameters Used to Assess Symphyseal Morphology  
**H/A ratio :** To determine the morphology of the symphysis, it is essential to assess its width and height and a ratio is calculated between height and width known as H/A ratio. A tangent is drawn from point B of

the mandibular symphysis. Two parallel lines are drawn to this tangent one on the most anterior surface of the symphysis and other on the most posterior surface. Then the perpendicular is drawn on these tangents passing through the point B on the superior surface and from lower border of symphysis on the inferior surface. This will form a rectangle and the height of the rectangle will denote the height of the symphysis whereas the width of the rectangle will form the width of the symphysis.

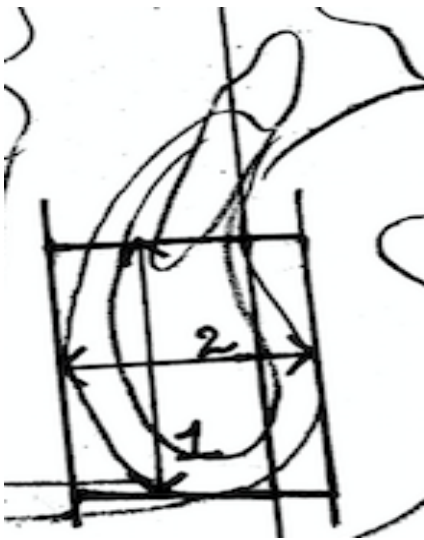


Fig 2: Height of symphysis and Width of symphysis

**Symphyseal angle:** The intersection of the point B - Menton line and mandibular plane.

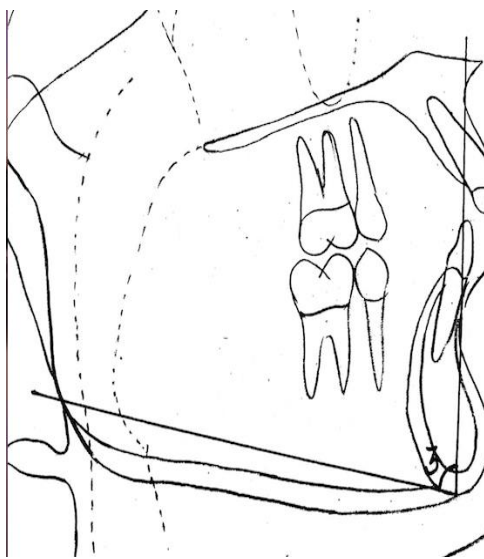


Fig 3: Symphyseal angle

**Id-B-Pog:** The angle between point Id, point B, and pogonion. It reflects the concavity of the mandibular symphysis.

**B-Pog-Me:** The angle formed between point B, Pogonion, and Menton. It reflects the convexity of the mandibular symphysis.

Parameters Used for Assessing the Position of Lower Incisor in Relation to the symphysis.

**Hold away Ratio :** It was given by R.A. Hold away to evaluate the relative prominence of the mandibular incisors as compared to the size of the bony chin.

- It is calculated as the ratio of the linear distance from the labial surface of the mandibular central incisor to the NB line, over the linear distance of the chin to the same line.
- There should be 1:1 ratio between chin and lower incisor with NB line.

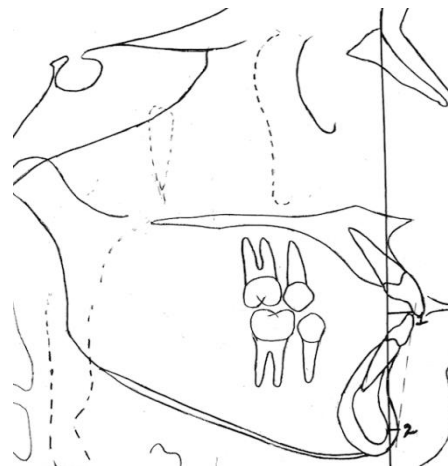


Fig 4: Li-NB and Pog-NB

### Statistical Analysis

The SPSS version 22 statistical package (IBM SPSS Statistics, IBM Corporation, Chicago, IL) was used to analyze the results. The Shapiro-Wilk test was used to assess the normality distribution of the sample. Statistical comparisons were made based on variance and descriptive analysis of the data. In addition, analysis of variance was used to study the differences among the

group means w.r.t symphyseal morphology in three growth patterns followed by Post hoc analysis (tukeys test). Regression analysis was done to check the sensitivity of correlation of parameters of symphyseal morphology and those depicting lower incisor position in relation to growth pattern. Correlation (Karl Pearson Correlation) tests were performed to find out the relation between the lower incisor position (Hold ways ratio) and the various parameters of symphyseal morphology and the results were represented with the help of scatter plot. The results of the test were considered to be significant at  $P < .05$ .

Table 1 : Descriptive Statistics

Groups		Mean	Std. Deviation
Horizontal Grower	H/A ratio	1.434	0.258
	Symphyseal angle (°)	78.525	6.271
	Id-B-Pog (°)	145.6	7.516
	B-Pog-Me (°)	126.6	7.894
	Li-NB (mm)	4.425	2.731
	Pog-NB (mm)	3.4	1.795
Average Grower	H/A ratio	1.591	0.176
	Symphyseal angle (°)	79	6.42
	Id-B-Pog (°)	145.013	6.845
	B-Pog-Me (°)	128.795	9.648
	Li-NB (mm)	7.321	2.944
	Pog-NB (mm)	1.449	2.331
Vertical Grower	H/A ratio	1.646	0.253
	Symphyseal angle (°)	76.282	5.37
	Id-B-Pog (°)	146.385	6.526
	B-Pog-Me (°)	133.231	6.8
	Li-NB (mm)	8.462	2.287
	Pog-NB (mm)	0.526	1.912

## Results

A. Comparison Of Symphyseal Morphology Parameters Among Three Groups Based on Different Facial Growth Patterns:

B. The cumulative comparison of symphyseal morphology parameters in different facial growth pattern groups were assessed by ANOVA. The measures of H/A ratio ( $p=0.0003$ ) and angle B-Pog-Me ( $p=0.0018$ ) varied significantly in different growth pattern. The Post hoc tests inferred that the value of H/A ratio was more in average growers as compared to horizontal growers ( $p=0.009$ ). Similarly vertical growers demonstrated increased value of H/A ratio than horizontal ( $p=0.000$ ). The vertical growers demonstrated increased value of B-Pog-Me than horizontal growers and the difference was statistically significant ( $p=0.001$ ). In case of average growers and vertical growers, the mean value in vertical growers was more than the value in average grower and the difference was statistically significant ( $p=0.048$ ). Therefore, long and narrow symphysis was found as growth pattern shifted towards verticality. Similarly, the convexity increased with verticality. Correlation Between the Symphyseal Morphology and The Lower Incisor Position. Karl Pearson Correlation tests were performed to find out the relation between the lower incisor position and the various parameters of symphyseal morphology. A moderate positive correlation was found between H/A ratio and Hold ways ratio (0.327089036), symphyseal angle and hold ways ratio (0.39171589). The Hold away ratio and angle Id-B-Pog showed least correlation (0.0189184). The Hold away ratio and angle B-Pog-Me depicted maximum positive correlation (0.489829331).

Table 2: Correlation Table

	H/A ratio	Symphys- eal angle	Id-B- Pog	B-Pog- Me
HOLDA	0.327089	0.391715	0.018	0.489829
WAY	036	89	9184	331

The regression analysis (Table: 7) depicts the sensitivity of correlation of different variables to the jarabak ratio. The decreasing order of sensitivity was Li-NB>Pog-NB>B-Pog-Me>H/A ratio>symphyseal angle>Id-B-Pog. Therefore, the most sensitive variable w.r.t jarabak ratio was Li-NB and the least sensitive variable was Id-B-Pog.

Table 3: Regression Analysis

Independent Variable	R Square
H/A Ratio	0.142
Symphyseal angle	0.016
Id-B-Pog	0.0087
B-Pog-Me	0.112
Li-NB	0.304
Pog-NB	0.294

**Discussion**

The symphysis also determines the distance available for tooth movement, which is one of the factors when orthodontists decide between a surgical or non- surgical orthodontic treatment plan. A thick symphysis allows for more tooth movement and is a good candidate for camouflage treatment compared to a thin symphysis which limits the range of tooth movement and can possibly lead to development of dehiscence during tooth movement.

In the present study, the correlation between symphyseal morphology and the mandibular growth pattern was assessed by H/A ratio, symphyseal angle, Id-B-Pog angle and B-Pog-Me angle. The H/A ratio showed a linear pattern of increase from horizontal growers to

average growers to vertical growers. It demonstrated that a long and narrow symphysis was found in vertical growers whereas short and broad symphyseal morphology was found in horizontal growers. The finding was in agreement with the results reported by Aki et al the vertical growth pattern i.e. the increased anterior facial height was associated with increased height and decreased width of the symphysis; whereas the horizontal growth pattern of mandible was associated with wide symphysis i.e decreased H/A ratio. In contrast a SEM study conducted by Ahn et al implied that the width of the external cortical bone of the mandibular symphysis could be wider in patients with a strong vertical pattern. So the change in the H/A ratio based on growth pattern could not be determined as both the height and the width increased with the increase in the verticality.

Correlation of symphyseal morphology parameters with lower incisor position signified the increase in proclination of lower incisors in long and narrow symphysis associated with vertical growth pattern. Similar results were seen in a study by Manea et al depicting a positive correlation between the hold ways ratio and the symphyseal H/A ratio. An increased hold away ratio implied an increased lower incisor proclination with narrow symphysis, whereas decreased Holloway ratio indicated more upright lower incisor position usually found in a wide symphysis.

Although, it was a chance finding that lower incisors were found to be Proclaimed in vertical growers, the wider symphysis usually can accommodate the incisors and can tolerate the proclination of incisors.

The correlation of symphyseal morphology with lower incisor position depicted by the angle B-Pog-Me signified the increased proclination of lower incisors in

long and narrow symphysis. Further studies are required to analyse this fact.

### **Clinical perspective**

- Extraction decision, type of anchorage preparation, mechanics, and retention period are influenced by the growth pattern on an individual.
- With a larger symphysis, more protrusion of the incisors is esthetically acceptable and therefore there are greater chances of no extraction approach to treatment and vice versa. Therefore, the size and shape of mandibular symphysis is an important consideration in formulating of the treatment plan.

### **Conclusion**

Symphyseal morphology is correlated to the facial growth pattern and lower incisal inclination. With the change in growth pattern various parameters of symphyseal morphology had different behavior that are as follows:

An increase in height of the symphysis and decrease in the width of the symphysis, increasing the overall H/A ratio was seen in individuals with increasing verticality in growth pattern. Similar increase with verticality was seen in B-Pog-Me angle. All the parameters of symphyseal morphology had a positive correlation with lower incisor position with maximum correlation with B-Pog-Me angle and no correlation seen with Id-B-Pog angle.

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