A Study of Comparison and Correlation between Antegonial Notch Depth, Symphysis Morphology, and Ramus Morphology Among Different Growth Patterns in Angle’s Class II Division 1 Malocclusion

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Abstract

Introduction: In orthodontics and dentofacial orthopedics, a thorough knowledge of the skeletal and dental components that contribute to Angle’s Class II Division 1 malocclusion is essential because these elements may influence the approach to treatment. Orthodontic treatment planning is greatly influenced by prediction of mandibular growth pattern. The purpose of this study was to compare and correlate between antegonial notch depth, symphysis morphology, and ramus morphology in different growth patterns in Angle’s Class II Division 1 malocclusion. Objective: (1) To compare antegonial notch depth, symphysis morphology, and ramus morphology in different growth patterns in Angle’s Class II Division 1 malocclusion. (2) To find a correlation between these factors in different growth patterns in Angle’s Class II Division 1 malocclusion. Materials and Methods: In this study, lateral cephalograms of total 90 patients (43 males and 47 females) with Angle’s Class II Division 1 malocclusion patients were traced. The sample was divided into average, horizontal, and vertical growth pattern based on jarabak’s ratio. Antegonial notch depth, symphysis height, depth, ratio (height/depth) and symphysis angle, and ramus height and width were evaluated and analyzed statistically. Results: A significantly high proportion of subjects were having lesser ramus height and ramus width in vertical growth pattern than horizontal growth pattern in Angle’s Class II Division 1 malocclusion with sexual dichotomy in favor of males. The correlation coefficient within groups was calculated. In horizontal growth pattern, antegonial notch depth was correlated with anterior facial height, posterior facial height, and ramus height. In vertical growth pattern, antegonial notch depth was correlated with ramus height. In horizontal growth pattern, symphyseal height was found out to be correlated with anterior facial height, posterior facial height, ramus height and width. Symphyseal depth was also found to be correlated with ramus width, ramus height was correlated with symphyseal depth and symphyseal angle in horizontal growth pattern. Conclusion: The antegonial notch depth, symphysis morphology, and ramus morphology are significantly correlated with different growth patterns in Angle’s Class II Division 1 malocclusion but was highly significant in horizontal growth pattern.

Keywords: Angle’s Class II div 1, antegonial notch, growth patterns, ramus morphology, symphysis morphology

INTRODUCTION

Angle’s Class II Division 1 malocclusion is a frequently seen dento-skeletal disharmony which constitutes a marked percentage of patients treated worldwide by an orthodontist. A thorough knowledge of the skeletal and dental components that contribute to Angle’s Class II Division 1 malocclusion is essential because these elements may influence the approach to treatment.[1] The success of the treatment of Angle’s Class II or Class III malocclusion depends on the variations in the direction, timing, and duration of the development in the facial areas.[2] Hence, these variations in the craniofacial components need to be meticulously interpreted for a successful orthodontic diagnosis and to produce an appropriate treatment plan with a suitable retention regime.

Orthodontic treatment planning is greatly influenced by prediction of mandibular growth pattern.[3] Several investigators have extensively defined mandibular rotation...
types, and various parameters have been found useful in prediction of direction of mandibular rotations.[4] Jarabak’s cephalometric analysis predicted the direction of mandibular growth from a facial polygon and also from a ratio of posterior to anterior facial height which states below 60% vertical mandibular growth, 60%–65% considered as average growth, and above 65% indicated horizontal mandibular growth.[5]

In mandibles with backward and downward growth rotation, marked deposition under the mandibular angle with more resorption beneath the symphysis is witnessed.[3] The antegonial notch is result of upward curving of the lower border of the mandible anterior to the angular process.

The mandibular symphysis serves as the primary reference for esthetic considerations in lower one-third of the face, and in addition, it has been considered as one of the predictors for the direction of mandibular growth rotation.[5] Rickets in his study associated a thick symphysis with an anterior growth direction.[6]

Although various cephalometric parameters have been used to describe mandibular morphology, very few studies have reported comparison and correlation in different growth patterns.

Thus, the purpose of this study was to compare and correlate between antegonial notch depth, symphysis morphology, and ramus morphology in Angle’s Class II Division 1 malocclusion.

**MATERIALS AND METHODS**

In this study, pretreatment lateral cephalograms of total 90 patients (43 males and 47 females) with Angle’s Class II Division 1 malocclusion patients were taken from the records of the patients undergoing orthodontic treatment in the Department of Orthodontics and Dentofacial Orthopaedics. All the patients selected were aged between 12 and 25 years. Patients with orthodontic treatment history, congenital anomalies, and trauma were excluded from the study. All pretreatment lateral cephalograms were traced on acetate matte tracing paper manually by a single examiner with a 4H drawing pencil on a view box. The linear and angular measurements were taken with the help of a scale and protractor.

The sample was divided into average, horizontal, and vertical growth pattern based on jarabak’s ratio.

Various cephalometric parameters used for this study were as follows:

Cephalometric landmarks:[7] [Figure 1]:

1. S: Sella – the geometric center of the pituitary fossa
2. N: Nasion – the most anterior point of the frontonasal suture in the midsagittal plane
3. Point B: Supramentale – the most posterior midline point in the concavity of the mandible between the most superior point on the alveolar bone overlying the mandibular incisors (infradentale) and the most anterior point on the chin
4. Me: Menton – the lowest point on the symphyseal shadow of the mandible seen on a lateral cephalogram
5. Go: Gonion – A point on the curvature of the angle of the mandible located by bisecting the angle formed by lines tangent to the posterior ramus and the inferior border of the mandible
6. Ar: Articulare – A point at the junction of the posterior border of the ramus and the inferior border of the posterior cranial base (occipital bone).

Cephalometric planes:

1. Mandibular plane (Tweed’s) – the tangent drawn to the inferior border of the mandible[8]
2. Occlusal plane – the denture plane bisecting the posterior occlusion of the permanent molars and premolars and extends anteriorly bisecting the overbite.

Cephalometric linear and angular measurements [Figure 2]:

1. Anterior facial height – the linear distance measured between Nasion and Menton
2. Posterior facial height – the linear distance measured between Sella and Gonion
3. Jarabak’s ratio – measured as posterior facial height divided by Anterior facial height
4. Antegonial notch depth – the linear distance measured along a perpendicular drawn from deepest part of convexity to a tangent through two points on either side of the notch on the lower border of the mandible[9]
5. Symphyseal height – calculated as follows: A grid was constructed with the parallel and perpendicular lines to the tangent line drawn to point B which was taken as the long axis of the symphysis. The point B was taken as superior limit of the symphysis with inferior, anterior, and posterior limits were taken at the most inferior, anterior, and posterior borders of the symphysis outline, respectively. The symphyseal height is measured as linear...
distance measured from the superior to the inferior limit on the grid.

6. Symphysis depth – the linear distance measured from anterior to posterior limit on the grid

7. Symphysis ratio – measured as symphysis height divided by symphysis depth

8. Symphysis angle – the posterior-superior angle formed by the line through Menton and point B and the mandibular plane

9. Ramus height – the linear distance between Articulare and Gonion

10. Ramus width – the linear distance measured at the height of the osseous plane between anterior and posterior border of ramus of the mandible.

**Statistical analysis**

Gender sample size was evaluated using group cross-tabulation method, and Chi-square tests means and standard deviations for all variables were determined for all the groups. An analysis of variance (ANOVA) test was performed to determine the comparison between groups for all these variables.

Pearson’s correlation coefficient analysis was also calculated to evaluate the correlation between all variables within all groups.

**RESULTS**

Table 1 illustrates the male and female distribution along with their percentages within each group. The group cross-tabulation revealed nonsignificant difference within gender distribution.

Table 2 illustrates difference between gender and between three groups for each of the variables. To evaluate the statistically significant difference between cephalometric values within the three groups, ANOVA test was conducted. The results of ANOVA are shown in Table 3. A significantly high proportion of subjects were having lesser ramus height and ramus width in vertical growth patterns than horizontal growth pattern in Angle’s Class II Division 1 malocclusion.

Pearson’s correlation coefficient analysis results illustrated the individual comparisons between different groups. In horizontal growth pattern, antegonial notch depth was correlated with anterior facial height (r = 0.559), posterior facial height (r = 0.514), and ramus height (r = 0.624). In vertical growth pattern, antegonial notch depth was correlated with ramus height (r = 0.659). In horizontal growth pattern, symphyseal height was found to be correlated with anterior facial height (r = 0.661), posterior facial height (r = 0.734), ramus height (r = 0.617), and width (r = 0.599). Symphyseal depth was also found to be correlated with ramus width (r = 0.555), ramus height was correlated with anterior facial height (r = 0.724), symphyseal depth (r = 0.588) and symphyseal angle (r = 0.537) in horizontal growth pattern.

**DISCUSSION**

The present study was conducted to compare and correlate antegonial notch depth, symphysis morphology, and ramus...
morphology in different growth patterns in Angle’s Class II Division 1 malocclusion. In our study, the depth of the antegonial notch was found to be highest in vertical growth pattern group. The results were statistically significant among males than females. Similar findings have been reported by Singer et al., Björk and Skjellér, and Björk in their implant studies. Lambrechts et al. investigated the nature of mandibular growth into two groups with deep and shallow notch depth and noted significant difference in the various cephalometric measurements. He stated that the deep antegonial notch group showed more vertical mandibular growth patterns that result in a longer anterior facial height than the shallow notch group. A statistically significant negative relationship was found between mandibular antegonial notch depth and horizontal growth pattern individuals in the study conducted by Kolodziej et al.

The anatomy of the mandibular symphysis is an important consideration in evaluating patients seeking orthodontic treatment. In our study, the symphysis morphology in horizontal growth pattern group was found to be associated with short height, large depth, small ratio (height/depth), and larger angle. In contrast, a symphysis with a larger height, smaller depth, larger ratio, and a smaller angle found in vertical growers. These results are consistent with the findings of Aki et al. and Mangla et al. that attributed smaller symphyseal height and width in females as observed in our study. Roy et al. also found in his study that the amount of external symphysis increases in size as the facial form differ from vertical to horizontal growth pattern. An anterior growth direction of the mandible has been associated with thick symphysis as reported by Ricketts. Sassouni and Nanda and Björk have found pronounced apophysis at the symphysis with excessive concavity of the lower mandibular border associated with the tendency toward backward mandibular jaw rotation. A greater protrusion of the incisors which is esthetically acceptable is attributed to pronounced symphysis, and therefore, a greater chance of nonextraction approach to treatment can be considered. On the contrary, in patients with larger symphyseal height and small chin, an extraction approach is adopted for compensation of arch length discrepancies. These findings are significant with our results as deepest symphyseal depth is found in horizontal growth pattern group among males and thus nonextraction approach can be used in such patients whereas in vertical growers, it is better to prefer extraction approach as the symphyseal depth is less in these patients. Sympysis ratio, in particular, showed sexual dichotomy in favor of females among all groups but was highest among average group. This result was consistent with the findings of Moshfeghi et al. and Aki et al. also found symphysis ratio to be strongly related to the direction of mandibular growth. Noh et al. found that a high symphysis ratio was seen significantly correlated in patients with vertical growth pattern. This finding is however in contrast to that of Kim and Son who stated that no statistically significant difference was found in symphysis ratio to mandibular plane between forward and backward mandibular rotational growth patterns.

Ramus width was found to be higher in horizontal growth pattern as compared with average and vertical growth pattern group and showed statistically significant sexual dichotomy among males. A significant increase in ramus height was noted in horizontal and average groups whereas significant sexual dichotomy was observed in horizontal group among males. These findings were consistent with observations by Muller, Schudy, and Sassouni, who all reported a considerable deficiency in dimension in vertical growers. Thus, mandibular ramus morphology is an important indicator of how mandibular growth will respond to Class II treatment mechanics.

**Limitations**

In the present study, random samples were taken across the city of Amritsar. Further studies are required to validate the results among various ethnic and racial groups of Indian population. Therefore, the authors suggest similar studies to be conducted with greater sample size and different malocclusions which would further validate our results.

**Conclusion**

From clinical perspective, in an individual-seeking orthodontic treatment, the decision to extract, anchorage preparation, biomechanics applied, and period of retention are dependent on different growth patterns which is influenced by anatomy of mandibular symphysis, antegonial notch depth, and ramus height and width as observed from the present study.
Symphyseal depth and ramus height are the main characteristic in the differential diagnosis of Angle’s Class II Division 1 malocclusion as concluded from our study.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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