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Comparison Between Antegonial Notch Depth, Symphysis Morphology and Ramus Morphology Among Different Growth Patterns In Skeletal Class I And Class II Subjects

Research Article

Navaneethan[1*], Abirami[2], Remmiya Varghese[3]

[1] Reader, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University.
[2] Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University.
[3] Senior lecturer, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University.

Abstract

In orthodontics and dentofacial orthopaedics, a thorough knowledge of growth and development is essential in order to understand various factors that contribute as to how particular type of growth takes place. When planning of orthodontic treatment for malocclusion, one has to take into account the growth pattern, because it would considerably affect success of the treatment.

Aim: The purpose of this study was to compare between antegonial notch depth, symphysis morphology, and ramus morphology in different growth patterns in skeletal class I and class II subjects.

Materials and Methods: In this study, a total of 60 cephalograms were taken which comprised 30 cephalograms in skeletal class I and 30 cephalograms of skeletal class II patients. The groups were further divided into 3 groups namely average, horizontal, and vertical growth patterns based on jarabak's ratio. Antegonial notch depth, symphysis width and symphysis angle, and ramus height were measured and compared between the growth patterns and between class I and class II skeletal patterns.

Statistical Analysis: An analysis of variance (ANOVA) test was performed to determine the comparison between groups for all these variables in both skeletal class I and class II. Independent 't' test was done to determine the comparison between skeletal class I and class II subjects for all variables. Mean and SD values for all variables were determined for all the groups.

Results: Depth of antegonial notch was found to be greater in vertical growth patterns compared to horizontal and average growth patterns. Large symphysis angle and symphysis width was noted in horizontal growth pattern. Increased ramus height was noted in horizontal and average growth patterns. There was no significant difference between skeletal class I and class II malocclusion for all parameters.

Conclusion: The morphology of the various parts of the mandible was found to vary significantly depending on the vertical growth pattern irrespective of the sagittal growth of the mandible.

Keywords: Antegonial Notch Depth; Ramus Height; Symphysis Morphology; Growth Patterns.

Introduction

Skeletal Malocclusions are a part of frequently seen dentoskeletal disharmony that occur due to a wide variety of etiology that includes genetics, environmental factors etc. Skeletal growth of the mandible varies widely in both the sagittal as well as vertical dimensions. Sagittally, the skeletal growth is classified in to Class I, Class II and Class III while vertically the growth pattern is divided into horizontal growth pattern, average growth pattern and vertical growth patterns. Knowledge of dental and skeletal characteristics together with different growth patterns is a necessity in determining treatment plans for successful treatment outcomes

***Corresponding Author**:
Navaneethan,
Reader, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, 162, Poonamallee High Road, Chennai-600077, Tamil Nadu, India.
Email Id: navaneethan@saveetha.com

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[19]. The success of the treatment of malocclusions may be improved or impaired depending on the variations in the direction, timing, and duration of the development in the facial areas[30, 4].

Prediction of the growth pattern of the mandible plays an important role in diagnosis and treatment planning [27]. Backward and downward rotation of mandibles occur during growth due to apposition beneath the gonial angle with excessive resorption under the symphysis. This results in upward curving of the inferior border of the mandible anterior to the angle of mandible is known as antegonial notching[6, 41, 43]. In adolescents with Deep antegonial notches, the mandible showed some characteristics such as retrusive mandible, short corpus length and ramus height and greater gonial angle when compared with shallow mandibular antegonial notches [40].

The mandibular symphysis also considered as one of the predictors for the direction of mandibular growth rotation and as the primary reference for esthetic considerations in lower one-third of the face [1]. Morphology and dimension of the symphysis may be indirectly affected by lower incisor inclination and dentoalveolar compensation occurred as a result of anteroposterior jaw discrepancy [3]. Thick symphysis is noted in horizontal growth patterns [34, 37]. Extraction and non extraction treatment plan depends on the symphysis morphology and movement of incisors in alveolar bone such as non extraction treatment plan is acceptable in thick symphysis and extraction treatment plan is indicated in small chin [28]. Mandibular ramus morphology is an important indicator for mandibular growth and mandibular ramus height is deficient in vertical growth pattern compared to horizontal growth pattern [29].

Very few studies have been reported about mandibular morphology in different growth patterns, thus the purpose of this study was to evaluate the mandibular morphology in different growth patterns of skeletal class I and class II subjects.

Materials and Methods

The sample size for this retrospective cross sectional study consists of 60 pretreatment lateral cephalograms of individuals. They were divided in to two groups consisting of 30 skeletal class I and 30 Class II cases which were further grouped based on the growth pattern as described below. Simple random sampling methods have been used to avoid sampling bias.

Inclusion Criteria:

Patients with skeletal class I and class II malocclusion.

High quality radiographs with adequate sharpness were taken by using standard techniques and exposure conditions in natural head position.

Patients with full permanent dentition.

Patients with the age group of 18 to 30 years.

Skeletal class I and class II subjects were selected based on ANB angle between (0-4 degrees) and ANB angle of more than 4 degrees respectively.

Exclusion Criteria:

Patients with previous history of orthodontic treatment and other mandibular surgery.

Patients with any other congenital anomalies or syndromes and hypodontia.

Patients with facial asymmetry and congenital malformations.

All cephalograms were traced digitally by using FACAD software. Based on Jarabak's ratio sample was divided into average, horizontal, and vertical growth patterns in both control group and case group.

Group 1: skeletal class I
Average growth pattern - 10
Horizontal growth pattern - 10
Vertical growth pattern - 10

Group 2: skeletal class II
Average growth pattern - 10
Horizontal growth pattern - 10
Vertical growth pattern - 10

Cephalometric linear and angular measurements as follows,

Anterior facial height - the linear distance measured between Nasion and Menton.

Posterior facial height - the linear distance measured between Sella and Gonion.

Jarabak's ratio - posterior facial height divided by Anterior facial height.

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 [28].(figure 1).

Symphysis angle - the posterior-superior angle formed by the line through Menton and point B and the mandibular plane [1](figure 2).

Symphysis width: The perpendicular distance from the pogonion to the most convex point of the lingual curvature of the symphysis.(figure 3).

Ramus height - the linear distance between Articulare and Gonion [28].(figure 4).

Statistical Analysis:

An analysis of variance (ANOVA) test was performed to determine the comparison between groups for all these variables in both skeletal class I and class II. Independent t test was done to determine the comparison between skeletal class I and class II subjects for all variables. Mean and SD values for all variables were determined for all the groups.

Figure 1. Measurements of Antegonial notch.

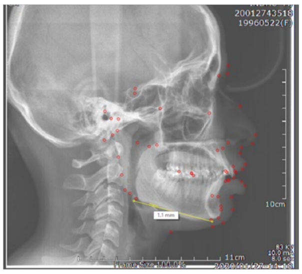


Figure 2. Measurements of symphysis angle.

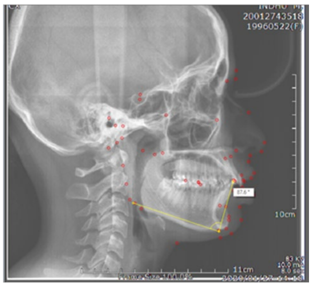


Figure 3. Measurements of symphysis width.

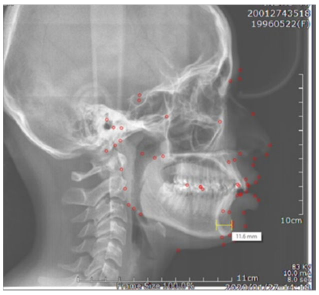
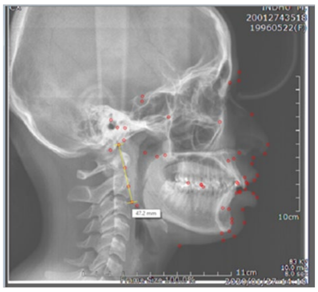


Figure 4. Measurements of ramus height.



Results and Discussion

For skeletal class II, as can be seen from Tables 1&2, the antegonial notch depth was found to be greater in vertical growth pattern than horizontal and average growth pattern($p<0.05$). Large symphysis width and symphysis angle is noted in horizontal growth patterns compared to vertical and average growth patterns($p<0.05$). Ramus height is significantly increased in horizontal and average groups compared to vertical growth patterns($p<0.05$). While Table 3 &4 show that in skeletal class I, antegonial notch depth was found to be greater in vertical growth pattern than horizontal and average growth pattern($p<0.05$). Large symphysis width and symphysis angle is noted in horizontal growth patterns compared to vertical and average growth patterns($p<0.05$). Ramus height is significantly increased in horizontal and average groups compared to vertical growth patterns($p<0.05$). Table 5 showed that there was no significant difference between skeletal class I and class II malocclusion for all parameters($p>0.05$). Figures 4&5 show the mean plots of skeletal class I and class II for all the variables respectively.

Previously our team had conducted numerous clinical trials[12, 21, 25, 37, 42, 45, 46, 42] lab animal studies [14, 15, 20, 32, 33, 36] and in vitro studies [13, 9] over the past 5 years. Now this research study focused on prediction of growth pattern of mandible by analyzing the different anatomical structures of mandible.

Depth Of Antegonial Notch:

Depth of antegonial notch was found to be greater in vertical growth pattern compared to horizontal and average growth pattern. Similar findings have been reported by Singer et al [40],

Table 1. One way ANOVA test with descriptives was done to determine the values of the mean and standard deviation in skeletal class II.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		
					Lower Bound	Upper Bound	
Antegonial notch	average	10	1.18	0.15	0.049	1.069	1.291
	horizontal	10	1.33	0.29	0.094	1.117	1.543
	vertical	10	2.97	0.32	0.103	2.736	3.204
Symphysis	average	10	11.27	2.27	0.7194	9.643	12.897
width	horizontal	10	17.16	1.16	0.369	16.324	17.996
	vertical	10	10.05	0.519	0.1641	9.679	10.421
Ramus length	Average	10	41.01	1.50	0.4764	39.932	42.088
	Horizontal	10	48.94	3.06	0.9690	46.748	51.132
	Vertical	10	46.12	1.85	0.5869	44.792	47.448
Symphysis angle	Average	10	74.90	3.24	1.0269	72.577	77.223
	Horizontal	10	93.30	2.83	0.8950	91.275	95.325
	Vertical	10	70.1	2.31	0.7325	68.493	71.807

Table 2. One way ANOVA Post Hoc test was done to determine the significant difference among different growth pattern in skeletal class II.

variable	Growth pattern			Mean Difference (I-J)	Std. Error	Sig.
Antegonial notch	Tukey HSD	Average	Horizontal	-0.15	0.1210	0.441
			Vertical	-1.7900*	0.1210	0.000
		Horizontal	Average	0.1500	0.1210	0.441
			Vertical	-1.6400*	0.1210	0.000
		Vertical	Average	1.7900*	0.1210	0.000
			Horizontal	1.6400*	0.1210	0.000
Symphysis width	Tukey HSD	Average	Horizontal	-5.8900*	0.6738	0.000
			Vertical	1.2200	0.6738	0.185
		Horizontal	Average	5.8900*	0.6738	0.000
			Vertical	7.1100*	0.6738	0.000
		Vertical	Average	-1.2200	0.6738	0.185
			Horizontal	-7.1100*	0.6738	0.000
Ramus length	Tukey HSD	Average	Horizontal	-7.9300*	1.0034	0.000
			Vertical	-5.1100*	1.0034	0.000
		Horizontal	Average	7.9300*	1.0034	0.000
			Vertical	2.8200*	1.0034	0.024
		Vertical	Average	5.1100*	1.0034	0.000
			Horizontal	-2.8200*	1.0034	0.024
Symphysis angle	Tukey HSD	Average	Horizontal	-18.4000*	1.2628	0.000
			Vertical	4.7500*	1.2628	0.002
		Horizontal	Average	18.4000*	1.2628	0.000
			Vertical	23.1500*	1.2628	0.000
		Vertical	Average	-4.7500*	1.2628	0.002
			Horizontal	-23.1500*	1.2628	0.000

Table 1 and 2 showed that in skeletal class II, antegonial notch depth was found to be greater in vertical growth pattern than horizontal and average growth pattern($p<0.05$). Large symphysis width and symphysis angle is noted in horizontal growth patterns compared to vertical and average growth patterns($p<0.05$). Ramus height is significantly increased in horizontal and average groups compared to vertical growth patterns($p<0.05$).

Bjork and Skieller [8] and Bjork [7, 9] in their implant studies. Lambrechts et al stated that the deep antegonial notch group found more in vertical mandibular growth patterns that result in a increase in the anterior facial height than the shallow notch group, hence antegonial notch depth may be considered as possible predictor for the direction of facial growth (Lambrechts et al., 1996) [26]. Kolodziej et al [24]. suggested that a statistically significant negative relationship was found between mandibular antegonial notch depth and horizontal growth pattern and (Kolodziej et al., 2002)[24]. Condylar bone change is not only related to retrognathic mandible but also to antegonial notch depth and ramus notch depth [2].

Table 3. One way ANOVA test with descriptives was done to determine the values of the mean and standard deviation in skeletal class I.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		
					Lower Bound	Upper Bound	
Antegonial notch	Average	10	1.73	0.69	0.218	1.235	2.225
	Horizontal	10	1.20	0.29	0.093	0.989	1.411
	Vertical	10	3.22	0.28	0.091	3.013	3.427
Symphysis angle	Average	10	78.30	1.70	0.538	77.082	79.518
	Horizontal	10	87.76	1.84	0.584	86.437	89.083
	Vertical	10	77.2	0.79	0.251	76.631	77.769
Symphysis width	Average	10	9.12	0.62	0.197	8.674	9.566
	Horizontal	10	12.60	0.45	0.145	12.271	12.929
	Vertical	10	9.65	1.02	0.3394	8.882	10.418
Ramus length	Average	10	41.01	1.50	0.476	39.932	42.088
	Horizontal	10	53.26	1.42	0.452	52.238	54.282
	Vertical	10	47.99	4.23	1.34	44.958	51.022

Table 4. One way ANOVA Post Hoc test was done to determine the significant difference among different growth patterns in skeletal class I.

Variable	Growth pattern			Mean Difference (I-J)	Std. Error	Sig.
Antegonial notch depth	Tukey HSD	Average	Horizontal	.5300*	0.2079	0.043
			Vertical	-1.4900*	0.2079	0.000
		Horizontal	Average	-.5300*	0.2079	0.043
			Vertical	-2.0200*	0.2079	0.000
		Vertical	Average	1.4900*	0.2079	0.000
			Horizontal	2.0200*	0.2079	0.000
Symphysis angle	Tukey HSD	Average	Horizontal	-9.4600*	0.6809	0.000
			Vertical	1.1000	0.6809	0.256
		Horizontal	Average	9.4600*	0.6809	0.000
			Vertical	10.5600*	0.6809	0.000
		Vertical	Average	-1.1000	0.6809	0.256
			Horizontal	-10.5600*	0.6809	0.000
Symphysis width	Tukey HSD	Average	Horizontal	-3.4800*	0.3417	0.000
			Vertical	-0.5300	0.3417	0.284
		Horizontal	Average	3.4800*	0.3417	0.000
			Vertical	2.9500*	0.3417	0.000
		Vertical	Average	0.53	0.3417	0.284
			Horizontal	-2.9500*	0.3417	0.000
Ramus length	Tukey HSD	Average	Horizontal	-12.2500*	1.2186	0.000
			Vertical	-6.9800*	1.2186	0.000
		Horizontal	Average	12.2500*	1.2186	0.000
			Vertical	5.2700*	1.2186	0.001
		Vertical	Average	6.9800*	1.2186	0.000
			Horizontal	-5.2700*	1.2186	0.001

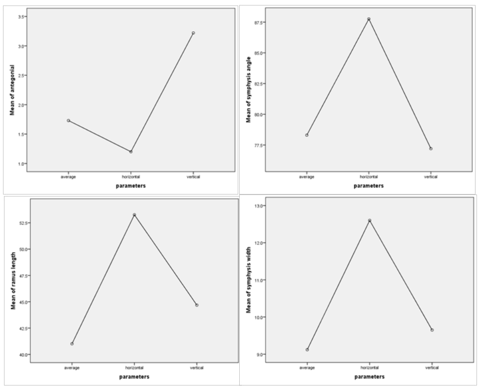
Table 3 &4 showed that in skeletal class I ,antegonial notch depth was found to be greater in vertical growth pattern than horizontal and average growth pattern($p<0.05$). Large symphysis width and symphysis angle is noted in horizontal growth patterns compared to vertical and average growth patterns($p<0.05$).Ramus height is significantly increased in horizontal and average groups compared to vertical growth patterns($p<0.05$).

For Bone-formation mechanism of the antegonial notch, Enlow demonstrated that the size of the antegonial notch is determined mainly by ramus-corpus angle and extent of bone deposition on the inferior margin of the corpus on either side of the notch and concluded that less prominent antegonial notch is noted if ramus-corpus angle is closed and a much more prominent antegonial notch is observed if it becomes opened [10]. Hovell showed that,

Table 5. Independent t test was done to determine the comparison between skeletal class I and class II subjects for all variables and showed that there was no significant difference between skeletal class I and class II malocclusion for all parameters(p>0.05).

variables		N	Mean	Std. Deviation	p values
Antegonial average	Skeletal class I	10	1.000	0.153	0.92
	Skeletal class II	10	1.180	0.1549	
Antegonial horizontal	Skeletal class I	10	3.610	1.2706	0.087
	Skeletal class II	10	1.330	0.2983	
Antegonial vertical	Skeletal class I	10	3.160	0.4502	0.143
	Skeletal class II	10	2.970	0.3268	
Symphysis angle average	Skeletal class I	10	86.540	1.3850	0.045
	Skeletal class II	10	81.430	2.3353	
Symphysis angle horizontal	Skeletal class I	10	82.830	1.2019	0.317
	Skeletal class II	10	80.990	1.6100	
Symphysis angle vertical	Skeletal class I	10	70.33	22.1718	0.057
	Skeletal class II	10	72.780	0.8025	
Symphysis width average	Skeletal class I	10	11.160	0.5758	0.399
	Skeletal class II	10	12.990	0.7578	
Symphysis width horizontal	Skeletal class I	10	11.820	0.8574	0.207
	Skeletal class II	10	16.610	0.6027	
Symphysis width vertical	Skeletal class I	10	13.430	1.1451	0.084
	Skeletal class II	10	10.170	0.3653	
Ramus length average	Skeletal class I	10	46.450	0.8606	0.098
	Skeletal class II	10	41.010	1.5066	
Ramus length horizontal	Skeletal class I	10	52.040	1.6153	0.07
	Skeletal class II	10	48.940	3.0642	
Ramus length vertical	Skeletal class I	10	44.950	3.2654	0.748
	Skeletal class II	10	46.120	1.8558	

Figure 5. Mean plots of skeletal class I for all variables.



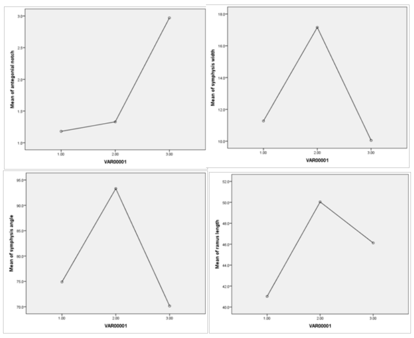
the antegonial notch is produced by role of muscles such as masseter and the medial pterygoid especially when condylar growth fails to contribute to the lowering of the mandible [18]. Becker demonstrated that impaired mandibular growth and muscular imbalance will occur if the condylar area, an important growth site injured by inflammatory reactions, results in growth changes that produce antegonial notching [5]. On the contrary no reports have been found against a positive relationship between vertical growth pattern and antegonial notch depth. Overall consensus of previous studies are favourable to our present study as the present study is in agreement with the findings of previous studies.

Symphysis Width and Symphysis Angle:

The anatomy of the mandibular symphysis is an important consideration in evaluating patients seeking orthodontic treatment [7, 1]. According to the size and shape of the symphysis many clinicians classify the growth pattern of the mandible anteriorly or posteriorly [23].

In our study large symphysis width and symphysis angle is noted in horizontal growth patterns compared to vertical and average growth patterns. Similar findings have been reported in some literature such as aki et al, mangla et al, gupta et al attributed that large symphyseal angle, symphysis width and small symphysis ratio was observed in horizontal growth patterns compared to

Figure 6. Mean plots of skeletal class II for all variables.



vertical growth patterns [1, 17, 28]. Roy et al also found in his study that external symphysis increases its size from vertical to horizontal growth pattern [35]. Thick symphysis is noted in horizontal growth pattern [34]. Gracco et al showed that symphysis thickness was greater in short-faced subjects than in long-faced subjects [16]. In patients with horizontal growth pattern,short symphysis height, large symphyseal depth, and small symphyseal ratio is noted as compared with the hyperdivergent group the results were statistically significant but larger symphysis angle showed not statistically significant difference compared to hyperdivergent group [22]. Sassouni and Nanda and Bjork have found pronounced apposition beneath the symphysis with concavity in the inferior border of mandible associated with the tendency toward backward jaw rotation of mandible [7, 38]. Symphysis width was wider in the hypodivergent Class II group but symphysis height was similar among all the groups [11]. No findings have been found against the positive relationship between horizontal growth pattern and symphysis morphology, hence overall consensus is in agreement with the findings of the study.

Ramus Height:

Ramus height is significantly increased in horizontal and average groups compared to vertical growth patterns. Similar findings have been reported in some literature such as muller et al, schudy et al, sassouni et al, Nanda who all reported a considerable deficiency in vertical growth patterns [17, 29, 31, 38, 39]. Ramus height is significantly smaller in vertical growth patterns and larger in hypodivergent groups [28]. No a findings have been found against a positive relationship between horizontal growth pattern and ramus height, hence overall consensus is in agreement with the findings of this study.

There was no significant difference between skeletal class I and class II malocclusion for all parameters ($p>0.05$), hence concluded that sagittal relationship does not alter the vertical measured variables between skeletal class I and class II malocclusion.

Future Scope:

From clinical perspective, in an individual-seeking orthodontic treatment, the decision to extract, anchorage preparation and biomechanics and period of retention are dependent on different growth patterns which is greatly influenced by anatomy of mandible, hence thorough knowledge about various growth patterns should be considered as important because it will greatly helpful in diagnosis and treatment planning.

Conclusion

Depth of antegonial notch was found to be greater in vertical growth pattern compared to horizontal and average growth pattern.

Large symphysis width and symphysis angle was noted in horizontal growth patterns compared to vertical and average growth patterns.

Ramus height was significantly increased in horizontal and average groups compared to vertical growth patterns in both skeletal class I and class II malocclusion.

The study shows that the vertical pattern of growth is independent of the type of sagittal pattern of growth.

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