(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 1, Page No: 868-876
January-February 2022

IJMSCR

Comparison of Mandibular Condylar Hypotenuse Growth in Class I and Class II Division 1 Skeletofacial Patterns: A Cross-Sectional Study

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Objective: Understanding of skeletofacial pattern of Class I and Class II is of utmost importance in delivering long stable results in these cases. Cross sectional studies done using growth pattern can provide accurate direction to treatment planning.

Materials and methods: Pre-treatment radiographs of 160 patients were selected. They were divided into two groups: Group I (80 subjects) - patients with Class I malocclusion and Group II (80 subjects) - patients with Class II division 1 malocclusion. These two groups were further sub divided into 4 age groups with equal number of males and females in each group. Various linear and angular parameters were measured and compared between the two groups.

Results: Condylion hypotenuse which reveals the condylar growth was statistically significant more in Class I subjects than in Class II division 1 subjects. Effective mandibular length was found to be more in Class I subjects. ANB was found to be more while SNB angle was reduced in subjects with Class II division 1 malocclusion.

Conclusion: There is considerable effect of environmental and epigenetic influence on mandibular height and body growth as it is least mature structure in craniofacial complex and hence considered primary cause of skeletofacial discrepancy.

Keywords: Condylion hypotenuse, Mandibular growth, Class II malocclusion, skeletofacial discrepancy

Introduction

An orthodontist intends to provide best possible, stable and pleasant occlusion to the patient. The various dental anomalies such as protrusion/retrusion, rotations, transverse malocclusion are most common, which patients seeks treatment for. However, skeletal malocclusion also has to be taken in consideration when treatment aims to achieve a pleasant profile. Understanding and treatment of skeletal malocclusion is necessary to avoid relapses and treatment failure; furthermore, can be done by studying the growth patterns of individuals. The analysing of differential growth pattern can be extremely useful tool for assessing skeletal anomalies.[1]

The pattern of growth for mandible can be either vertical or horizontal. The vertical pattern is observed when vertical growth of facial structure is more as compared to condylar growth. Horizontal growth pattern is observed when condylar growth is larger than that of facial structures and alveolar process at

the molar area.[2] Studies have shown that the craniofacial growth pattern is established in childhood and is present till adulthood; this growth trend is seen in both Class I and Class II.[3,4] This growth pattern has always been intriguing and studied frequently. There are various methods, which have been used in the orthodontic study for analysis of growth pattern. Longitudinal studies reports growth trajectory as they follow the growth of same individual but radiation exposure is an issue of concern.[4] Cross sectional studies compare various stages of growths in different individuals. This makes assessing larger sample size easy.[5]

Mandibular length is determined considering the various landmarks such as condylion, pogonion, gnathion or menton. The cross sectional studies use these landmarks to determine the length of the ramus thus establishing the growth patterns. Jacob and Buschang used various mandibular growth landmarks to determine the difference between growth patterns of Class I and Class II malocclusion.[6] They suggested that landmarks better quantify the changes that occur in overall growth thus delineating growth direction.

There have been numerous studies with similar as well as contradictory results and conclusions on mandibular growth patterns and size. The length of corpus, when compared amongst Class I and Class II malocclusion have been shown to be same[7,8] or different [3,5,9]. Class I have shown greater mandibular length and corpus length[7,8,9] as compared to Class II but conflicting studies are also present[3,5]. The ramus heights comparison has also shown similar results.[10.11] Since the literature had such conflicting results, the present study was undertaken to differentiate and assess the growth pattern of mandible in Class I and II malocclusion in different age groups.

Materials and Method

A total of 160 pre-treatment lateral cephalograms were selected from the archives of the Department of Orthodontics and Dentofacial Orthopedics of Rungta College of Dental Sciences and Research, Bhilai. The approval was obtained from the institutional ethical committee. To maintain uniformity amongst the cephalograms in regards to magnification (if, any) or exposure; they were recorded by the same radiographic technician with the same equipment (Sirona Orthophos XGS, Germany) in standardised conditions the natural head posture (NHP) using cephalostat. A tube voltage of 73 kV, a tube current of 15 mA and an exposure time of approximately 9.4 sec. was used for recording lateral cephalogram.

The patients whose lateral cephalograms were considered include those a) patients in the age group of 10-18 years of both the genders, b) patients with Class I and Class II division 1 (Class II molar relation, Class II or end on canine relation) malocclusion who have not undergone orthodontic treatment, c) patients with no missing teeth except third molars, d) Good quality lateral cephalograms with landmarks identifiable on it. However cephalograms which were excluded are of a) Patients with severe crowding (more than 6 mm), open bite, multiple impactions, skeletal asymmetries, and Cranio-facial anomalies, b) Vertical growers, c) cephalograms showing any bone deformities or with history of medical condition affecting bone d) poor quality cephalograms.

The samples were divided using stratified sampling technique, in two groups, where Group I (80 subjects) consisted of patients with Class I malocclusion and Group II (80 subjects) had patients with Class II division 1 malocclusion. These groups were further subdivided into four classes: a, b, c and d; of different age interval which was chosen to be 10.1-12 years, 12.1-14 years, 14.1-16 years and 16.1-18 years respectively. Hence there were four subgroups under each group as follows:

Group Ia and IIa - 10.1-12 years

Group Ib and IIb - 12.1-14 years

Group Ic and IIc - 14.1-16 years

Group Id and IId - 16.1-18 years

The cephalographs were traced manually by the investigator on an x-ray illuminator box using 0.5 mm pencil. The cephalographs landmarks were traced by same investigator on acetate sheet and all reference points were marked. The radiographs were traced in random order to reduce bias. Six angular and five linear measurements were made to the nearest degree and nearest millimeter using protractor and scale. The following landmarks (figure 1) are used:

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Cephalometric Planes Used: 1. Sella Nasion plane (SN plane) 2. Mandibular plane (Go-Gn) 3. Tangent to the posterior border of mandibular symphysis (MS)

Cephalometric Measurements Undertaken (Fig.3-4):

A) Angular Measurements (In degree): 1. SNA expresses the sagittal relationship of the anterior limit of the maxillary apical base to the anterior cranial base. 2. SNB expresses the sagittal relationship between the anterior extent of the mandibular apical base and anterior cranial base. 3. ANB angle is formed by the intersection of lines joining N to point A & N to point B and denotes the relative position of maxilla to mandible. 4. MPA Mandibular plane angle formed between S.N plane and the mandibular plane. (Go- Gn) and indicates growth pattern of an individual. 5. Gonial angle (Ar-Go-Me) expresses the form of the mandible and also gives information on mandibular growth direction. 6. Saddle angle (N-Sn-Ar) – Assess the relationship between anterior and posterior cranial bases.

B) Linear Measurements (In millimetre) 6. Co-Gn measures the total mandibular length. 7. Co-Go measures the length of ascending ramus. 8. Go-Gn measures the mandibular body length. 9. Id-Me measures the total length of mandibular symphysis. 10. Pog-MS represents the total width of mandibular symphysis.

All the variables were measured and compared between the Class I and Class II division 1 to assess the mandibular growth. The amount of horizontal change of Codylion, Gonion, and Menton were measured parallel to the RL (Sella- nasion minus 7 degrees) and its vertical change were measured perpendicular to the RL

The hypotenuse $-\sqrt{}$ (horizontal change ^{2} + vertical change ^{2}) were calculated to define the total change in mandibular growth in different age groups.

Statistical Analysis

The data collected was analysed using Statistical Package for Social Sciences software for windows (SPSS, Version 20). Descriptive statistics were calculated for age, gender and different cephalometric variables. The student unpaired‘t’ test was used for comparison of cephalometric variables in Class I and Class II division 1 subjects for different age groups. Comparisons of cephalometric variables within the same malocclusion subjects were carried out using ANOVA test between different age groups. The results were regarded as statistically significant at $p< 0.05$ with confidence interval of 95%.

Results

The mean and standard deviation of each group and subgroup was calculated. The results showed no difference in the values for males and females with in the same malocclusion group, therefore the values were combined together for comparison of the cephalometric variables. Table 1 shows the comparison of cephalometric variables amongst between group I and II malocclusion. There was significant difference amongst parameters such as SNA, SNB, ANB and CoGn in various age groups. Graph 1 and 2 shows cephalometric parameters with significant results in intragroup comparison amongst various age groups.

Discussion

The developmental pattern of mandible determines the change of profile from childhood into adulthood. This pattern of differential mandibular growth results in straight profile in Class I. However, convexity in childhood may persists or worsen in Class II Division I cases.[12] The reason of convex has been blamed on two factors in the literature; they are maxillary protrusion or mandibular retrusion.[6,7,13] Since the maxilla matures before mandible, therefore mandibular growth is more susceptible to environmental influences. There are certain studies in the literature which suggests increased gonial angle causes vertical growth tendency in Class II div I individuals[14,15] while some other studies denote that obtuse cranial base angle position mandible more retrognathic resulting in a convex profile.[16,17]

The rationale for having four different age groups was to assess different individuals at one particular stage so as to compare growth by using averages. Literature shows that this methodology makes evaluating larger sample size convenient. Cross-sectional studies confines interpretation to inferences between growth changes and detect only significant changes.[1] Hence the present study was done to analyse the craniofacial growth changes in untreated subjects with Class II div I malocclusion with those

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in subjects with Class I occlusion from the prepubertal through post pubertal stages with the cervical vertebral maturation (CVM) method.[8] The method is useful for the anticipation of the pubertal peak in mandibular growth. A reliable growth prediction can be done, by assessing lateral profiles of vertebral bodies of C2, C3, and C4 vertebraes'. Based on that the four groups was chosen signifies following: 1) Group Ia and IIa (10-12 yrs) – Initiation 2) Group Ib and IIb (12-14 yrs) – Acceleration to transition 3) Group Ic and IIc (14-16 yrs) – Deceleration to maturation 4) Group Id and IId (16-18 yrs) – Completion.[8]

In the present study, ANB angle values were found to be statistically highly significant as expected between Class I and Class II division 1 subjects in all the age groups. Differences in the ANB angle were mainly due to mandibular retrusion. SNB angle was found to be significantly less in all the age groups in Class II division 1 subjects except Group Id and IId. SNA angle value was higher in Class II division 1 subjects in all the age groups but the difference was not statistically significant. However, SNB values significantly improved over a period of time, in Class II division 1 subjects which could be attributed to late mandibular growth or 'catch up' growth in Class II malocclusion. Effective mandibular length (Codylion to Gnathion) was found to be statistically highly significant between Class I and Class II division 1 subjects in all the age groups except group Ic and IIc (14 – 16 years) where the growth spurts are expected or just completed. Class I subjects show a higher value of mandibular body length expressed by Go-Gn compared to Class II subjects. This difference was found to be statistically highly significant in group Ib and IIb (12-14 years). The results were similar to that of Jacob & Buschang[6], Ngan et al.[7] and were contradicted by Elsasser & Wylie[18], Riesmeijer et al.[19] The changes in dimension of mandible body suggests of hereditary shorter and retrusive mandible.[6,7]

In a study done by Buschang and Martin[20] stated that the antero-posterior relationships tend to worsen during adolescence. They accounted differences in horizontal growth of mandible for this tendency. In this study, the hypotenuse was taken in to account to measure the condylar growth in both the groups of malocclusion. Value of condylion hypotenuse was statistically significant more in Class I subjects for all age groups suggestive of greater condylar growth in Class I subjects. This result coincides with the studies by Gomes[21] and Jacob & Buschang[6]. They reported significantly more condylar growth in Class Is than Class IIs. Thus, it can be stated that greater condylion growth in Class I subjects compared to Class II subjects could be reason for the positive mandibular positional changes in relation to maxilla and cranial base. Gonion hypotenuse (Go hypo) shows no statistically difference in between two groups of malocclusion. The growth of condylion will cause simultaneous resorption at gonion. However, the literature shows no differences in ramus height between Class I and Class II malocclusions, which can be attributed to the fact that ramus height misjudges the growth that occurs at condylion.[6,21,22]

Limitation of the study includes it is of cross sectional design; hence do not follow the environmental and epigenetic influence on mandibular growth of a single subject over a period of time.

Conclusion

The present focused on condylar growth so as to estimate the growth pattern of mandible in Class I subjects compared to Class II division 1 subjects. The findings showed the small increase in condylar growth in all the age groups in Class II dentoskeletal disharmony does not have a tendency to self-correct with growth.

Conflicts of Interest: Authors declare no conflicts of interest

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Tables

Table 1. Comparison of cephalometric variables between group I and II malocclusion

Variable	Malocclusion	Mean ± SD	Malocclusion	Mean±SD	Malocclusion	Mean±SD	Malocclusion	Mean±SD
SNA	Class Ia	81.0±3.3	Class Ib	82.8±3.6	Class Ic	83.8±3.5	Class Id	82.5±4.1

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								*
	Class IIa	81.4±3.3	Class IIb	83.0±5.3	Class IIc	82.1±4.8	Class IId	85.0±3.1 *
SNB	Class Ia	78.3±3.1 *	Class Ib	80.1±3.1 *	Class Ic	80.9±3.2 *	Class Id	80.0±4.0
	Class IIa	75.4±3.1 *	Class IIb	74.6±4.2 *	Class IIc	76.6±4.4 *	Class IId	79.0±3.5
ANB	Class Ia	2.6±1.2	Class Ib	2.7±1.1*	Class Ic	2.9±1.0*	Class Id	2.7±1.0*
	Class IIa	6.1±1.3	Class IIb	7.2±1.8*	Class IIc	5.4±0.9*	Class IId	6.9±1.97 *
MPA	Class Ia	33.2±7.9	Class Ib	34.1±13. 6	Class Ic	29.8±5.4	Class Id	28.6±5.5
	Class IIa	29.4±7.5	Class IIb	33.3±5.4	Class IIc	30.1±5.4	Class IId	27.0±6.0
Ar Go Me	Class Ia	126.6±6. 4	Class Ib	128.6±6. 3	Class Ic	125.8±6. 2	Class Id	125.7±5. 0
	Class IIa	125.3±8. 7	Class IIb	127.3±14 .5	Class IIc	126.8±7. 9	Class IId	125.5±5. 5
Co Gn	Class Ia	106.2±7. 1*	Class Ib	106.3±6. 6*	Class Ic	111.3±6. 1	Class Id	111.9±6. 9*
	Class IIa	100.5±6. 7*	Class IIb	99.4±6.3 *	Class IIc	110.4±5. 8	Class IId	107.3±4. 9*
Co Go	Class Ia	51.6±7.5	Class Ib	49.2±10. 0	Class Ic	53.4±4.8	Class Id	55.9±12. 4
	Class IIa	50.0±7.4	Class IIb	49.0±4.1	Class IIc	53.95±5. 7	Class IId	51.1±2.6
Go Gn	Class Ia	69.6±5.5 *	Class Ib	70.8±4.9 *	Class Ic	73.3±4.6	Class Id	72.4±6.1 *
	Class IIa	62.7±5.8 *	Class IIb	66.3±5.4 *	Class IIc	69.6±11. 8	Class IId	69.1±2.5 *
Id Me	Class Ia	32.1±16. 5	Class Ib	26.8±2.8	Class Ic	27.7±3.0	Class Id	29.0±3.8
	Class IIa	25.3±3.3	Class IIb	25.5±2.6	Class IIc	28.0±2.6	Class IId	29.9±10. 9
Pog MS	Class Ia	13.6±2.1	Class Ib	14.0±1.8	Class Ic	14.5±1.8	Class Id	14.4±1.7
	Class IIa	13.7±2.2	Class IIb	13.9±4.3	Class IIc	14.2±2.2	Class IId	14.2±2.7
S N Ar	Class Ia	123.5±4. 8	Class Ib	125.6±4. 6	Class Ic	124.1±4. 7	Class Id	124.6±6. 6
	Class IIa	125.5±4.	Class IIb	124.5±5.	Class IIc	126.8±3.	Class IId	124.4±6.

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		6		5		7		8
COh	Class Ia	14.2±2.3	Class Ib	14.9±3.1 *	Class Ic	16.0±2.7	Class Id	16.2±3.0
	Class IIa	13.8±3.6	Class IIb	12.7±2.9 *	Class IIc	16.4±3.0	Class IId	15.3±4.8
COv	Class Ia	21.3±14.3	Class Ib	24.5±22.9	Class Ic	22.1±3.7	Class Id	20.1±3.0
	Class IIa	19.9±2.8	Class IIb	19.0±3.4	Class IIc	20.7±2.9	Class IId	20.5±4.5
GOh	Class Ia	6.9±3.1	Class Ib	8.5±2.8	Class Ic	10.6±3.0	Class Id	11.8±3.6
	Class IIa	6.7±4.0	Class IIb	7.0±3.8	Class IIc	9.4±2.9	Class IId	10.6±12.3
GOv	Class Ia	70.3±6.9	Class Ib	70.6±6.3	Class Ic	72.6±6.2	Class Id	75.2±6.0
	Class IIa	69.5±8.6	Class IIb	65.8±11.3	Class IIc	73.9±13.2	Class IId	73.4±10.3
Meh	Class Ia	54.3±5.2	Class Ib	54.4±10.5	Class Ic	54.3±4.7 *	Class Id	50.2±6.3
	Class IIa	50.7±11.8	Class IIb	49.3±5.9	Class IIc	51.8±4.7 *	Class IId	49.5±7.1
Mev	Class Ia	96.1±20.7	Class Ib	100.4±6.4	Class Ic	106.9±7.3	Class Id	105.7±7.9
	Class IIa	95.8±5.5	Class IIb	97.8±7.0	Class IIc	104.1±6.3	Class IId	102.0±9.5
COhypo	Class Ia	33.6±25.4*	Class Ib	30.3±20.0*	Class Ic	30.7±3.9 *	Class Id	26.4±2.8 *
	Class IIa	24.3±3.8 *	Class IIb	26.5±16.0*	Class IIc	26.1±12.8*	Class IId	27.0±6.4 *
GOhypo	Class Ia	71.1±7.1	Class Ib	70.8±6.6	Class Ic	76.4±6.6	Class Id	76.0±5.9
	Class IIa	69.6±9.1	Class IIb	68.7±5.9	Class IIc	74.3±6.1	Class IId	72.1±14.5
Mehypo	Class Ia	109.7±15.1	Class Ib	113.9±8.7	Class Ic	119.7±7.5	Class Id	116.8±8.0
	Class IIa	109.6±9.1	Class IIb	109.5±7.0	Class IIc	116.5±5.7	Class IId	114.0±8.4

*Denotes significant differences amongst the groups, COhypo shows significant difference amongst Class I and Class II in all age groups.

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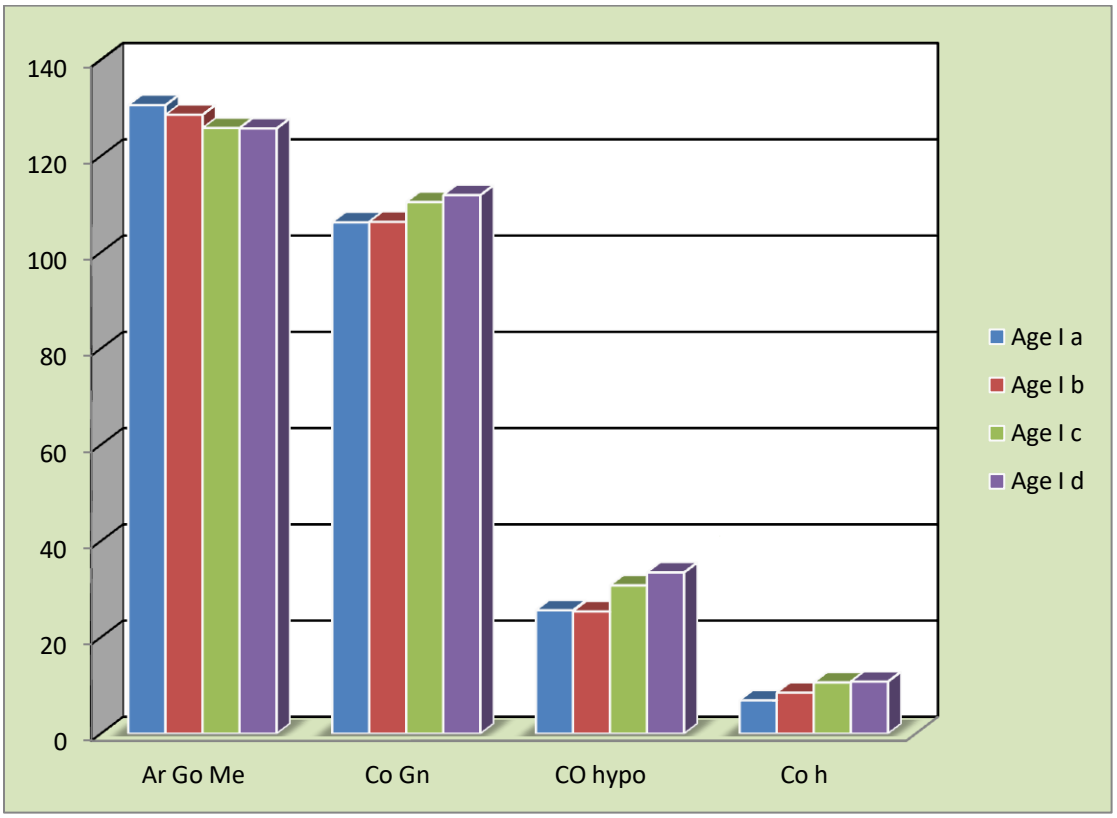
Graph 1. Intra group comparisons of significant cephalometric variables between different age groups for Class I malocclusion



Graph 2: Intra group comparisons of significant cephalometric variables between different age groups for Class II malocclusion

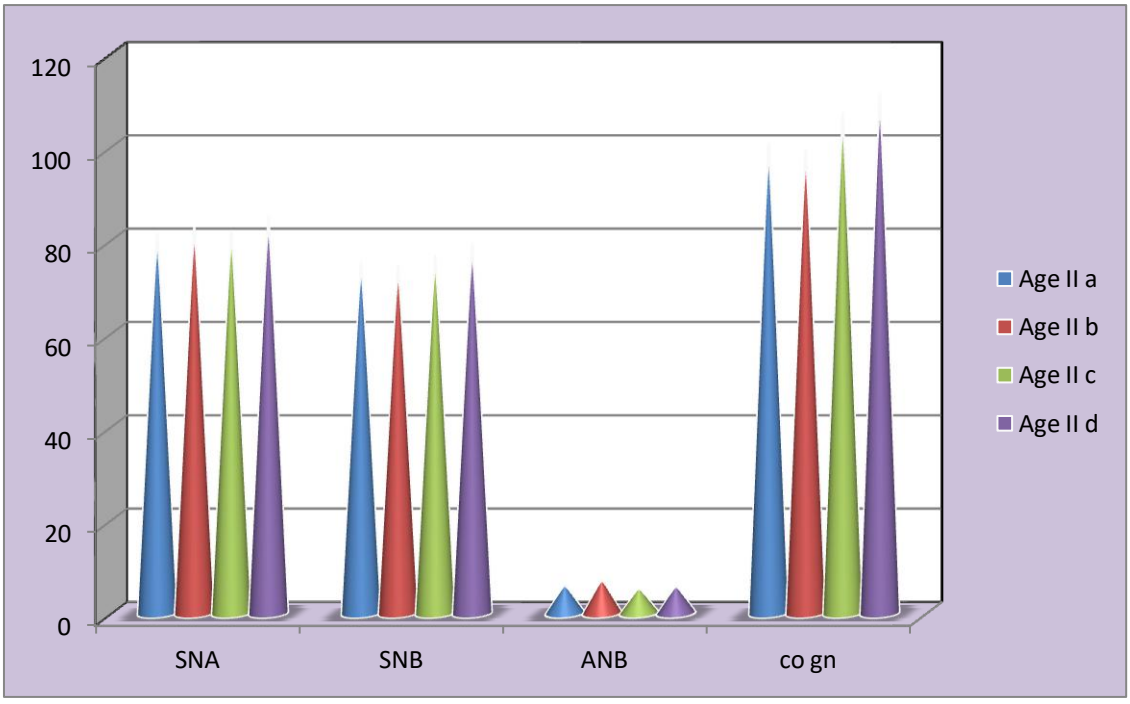


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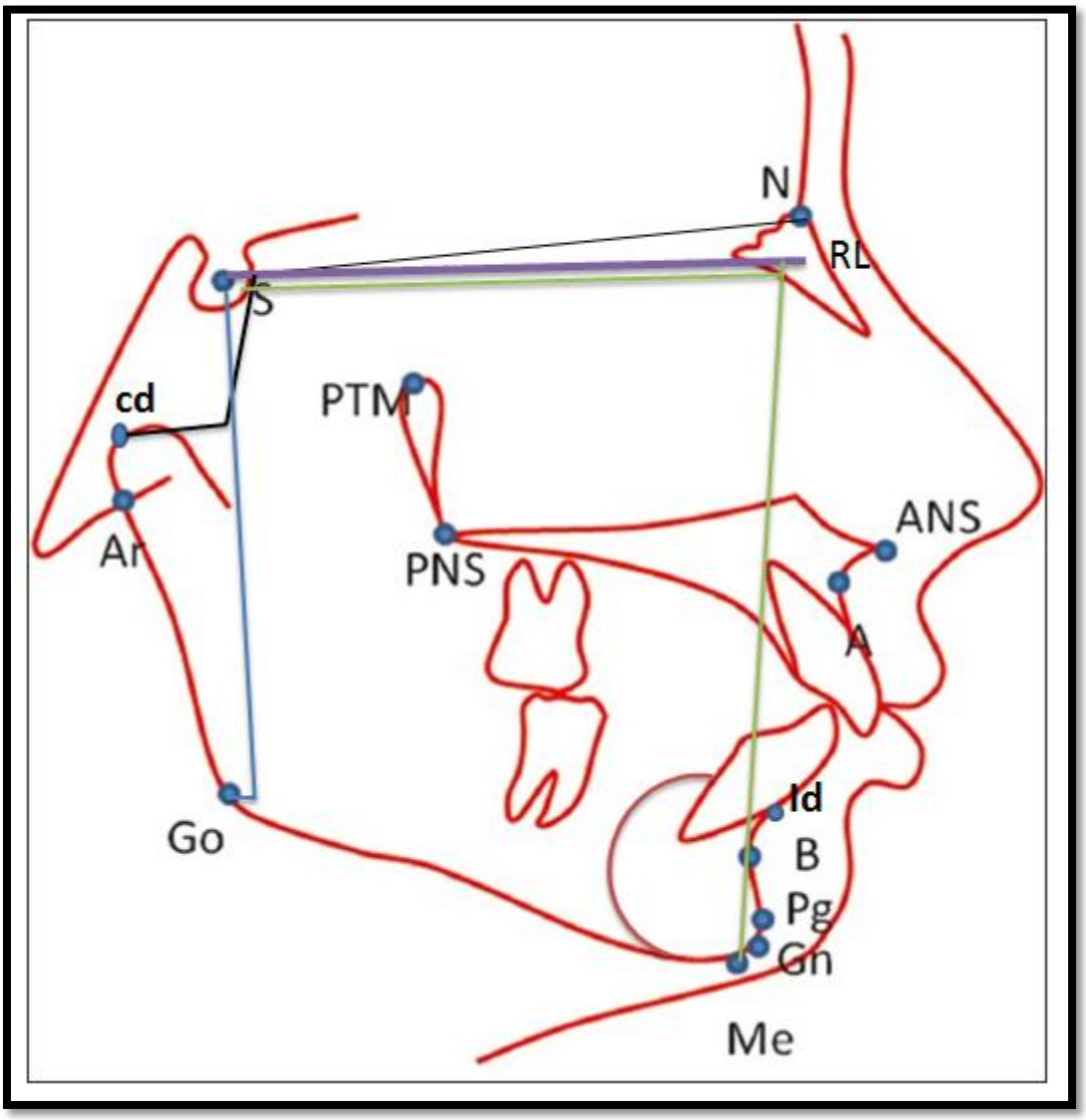
Figure 1. Amount of horizontal change of Codylion, Gonion, and Menton measured parallel to the Reference Line (RL) and its vertical change measured perpendicular to the Reference Line (RL)



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