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Characteristics of Craniofacial Complex For class II Division 1 Malocclusion in Saudi Subjects with Permanent Dentition

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The aims of this study were to evaluate the Cephalometric features of Class II division 1 in Saudi adult patients and to compare these values with those features of normal occlusion by referring to the effect of the gender on these values.

Ninety-four (94) Saudi patients were evaluated Cephalometrically and distributed into two groups where the first group comprised of (45) subjects with normal occlusion. The second group comprised of (49) subjects with Class II division 1.

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Keywords: class ii division1, cephalometric evaluation, dento skeletal morphology.

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Strictly as per the compliance and regulations of:

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Azzam Al – Jundi [α] & Hicham Riba [σ]

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Wide variations were observed for almost all measurements of Class II division 1.However, a posteriorly positioned mandible and shortness in its dimensions were noticed. Patients were found to have vertical growth pattern and posterior rotation of mandible, buccal inclination of upper and lower incisors and an increased cranial base angle were all main characteristics of Class II divisions 1 patients.

The comparison between the two genders revealed that the males have bigger facial dimensions than females, but the angular measurements were similar referring to the resemblance in the craniofacial morphology.

Keywords: class ii division1, cephalometric evaluation, dento skeletal morphology.

I. Introduction

Class II malocclusion is a frequently seen disharmony that has been studied in many different populations [1-4] because excessive overjet is easily recognized, class II division 1 malocclusion is of a greater concern for both patients and parents.

A review of literature shows that class II malocclusion has been evaluated in all three dimensions of space. In general, these studies have compared the craniofacial morphology of patients with class II malocclusion with class I control subjects.

Studies evaluating maxillary and mandibular skeletal and dental positions and vertical components of class II patients have reported conflicting results from both cross-sectional and longitudinal studies. No common results have been found regarding cranial base configuration.

The class II division 1 malocclusion is the most frequent in particular clinics, [5] caused in most times, by a retrognathic mandible [5, 6]

McNamara indicated that retrusion of the mandible is the most commonly occurring factor contributing to class II malocclusion, and the average position of the maxilla was found to be neutral in relation to cranial base structures. [7]

Although many studies have investigated class II malocclusion characteristics, [7, 8, 9, 10], few have studied the characteristic of skeletal II malocclusion in specific ethnic groups. [5, 11, 12].

Therefore, in order to provide more specific information regarding this type of malocclusion in Saudi subjects, this comparative Cephalometric study was undertaken.

The objectives of this comparative Cephalometric study were to:

1. Determine the specific Cephalometric features of class II division 1 malocclusion in adult Saudi subjects that had not been previously submitted to any orthodontic treatment.
2. Compare the changes in the dentofacial structure in untreated class II division 1 malocclusion and normal occlusion class I individuals.
3. Evaluation of the following features of the jaws was made: angular and linear sagittal relation between maxilla and mandible and related to the cranial base; geometric proportion between maxilla and mandible; craniofacial growth pattern and position of maxillary and mandibular incisors, presence of differences between genders.

II. Materials and Methods

Careful selection was made from the files of orthodontics clinics in King Abdul-Aziz Medical City, National Guard Health Affairs, Riyadh, Kingdom of Saudi Arabia, from January 2013 to June 2014.

Forty-nine (49) Saudi individuals having a class II division 1 (23 females and 26 males) aged 18-28 years were evaluated and compared with forty-five (45) Saudi

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individuals having normal occlusion class I pattern (21 females and 24 males) aged 18-28 years.

Selection criteria for class IIdivision1sample were:
ANB angle > 4˚;
Over jet > 4 mm;
Bilateral class II molar in centric occlusion;
Permanent dentition, no missing teeth, (except third molars);
Convex facial profile;
No previous orthodontic treatment;
No cleft lip/palate and/or other craniofacial syndromes
All selected subjects are Saudi descent.

Selection criteria for the class I sample were:
ANB angle ≤ 4˚;
Over jet ≤ 4 mm;
Normal over bite;
Bilateral class I molar and canine in centric occlusion;
Permanent dentition, no missing teeth (except third molars);
Well-aligned maxillary and mandibular arches with less than two mm crowding or spacing;
Class I soft tissue profile;
No previous orthodontics treatment.

a) Determination of sample size

A minimum sample size of 21 per group (total 42) will have 80% power to detect a difference in means of 1^0(Change in the skeletal ANB angle), (Cozza P et al, 2006) [13] assuming that the common standard deviation is 1.25^0 (Sayin & Turkkaharaman, 2005) [14], using a two group t-test with a 0.05 one sided significance.

The radiographic lateral cephalograms used were taken according to the conventional norms.

All cephalograms were taken by the same radiographic apparatus:
planmecapromax 3Ds/3D
Planmecaoy/Asentajankatu6/00800 Helsinki/Finland.

Cephalometric Landmarks were marked and digitized by one author to avoid interobserver variability angular and linear variables were established and measured by: Vistadent™At software (GAC int. Inc. Bohemia, NY)
No cleft lip/palate and/or
other craniofacial syndromes ;
All selected subjects are Saudi descent;
Cephalometric skeletal landmarks used in current study: Fig (1)
N- S - ANS – PNS -A -B -Pog- Me- Ar- Go- Bo -Ao.

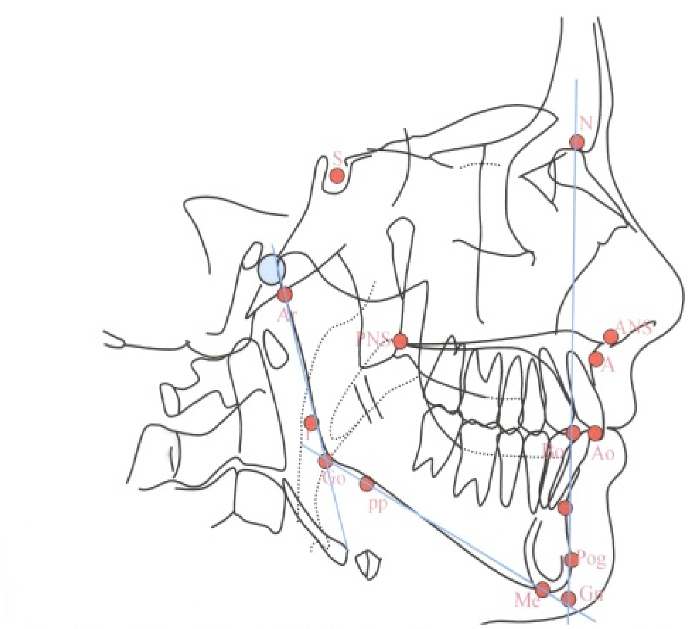

Fig.1 Cephalometric skeletal landmarks used in the current study

Figure 1 : Cephalometric Skeletal Landmarks used in the Current Study

Cephalometric dental and soft tissues landmarks used in the current study:Fig(2)
UI- APUI -LI - APLI- Pog'- Li- LS – Sn - Pn.

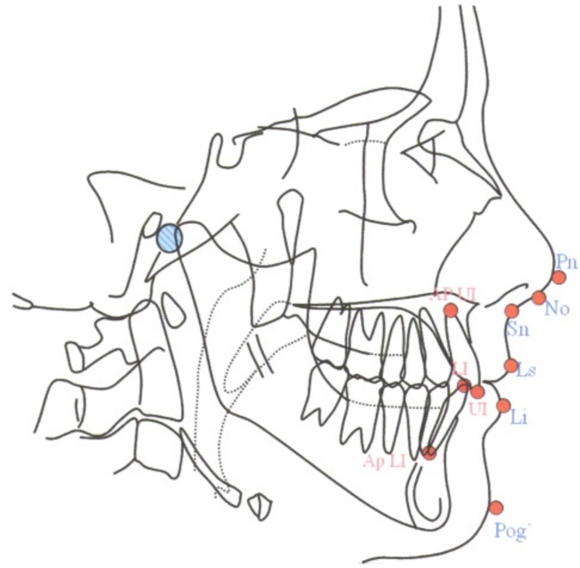

Fig. 2 Cephalometric dental and soft tissue landmarks used in the current study

Figure 2 : Cephalometric Dental and Soft Tissue Landmarks used in the Current Study

The linear measurements used in the current study: (Fig 3)

S-N, S-Ar, Ar-Go, Go-Me, S-Go, S-PNS, PNS-Go, N-Me, S-Gn, ANS-PNS, UI-NA, LINB, pog-NB LI-APog,Ls-ELine, Li-ELine , (B0 –A0) Wits Appraisal.

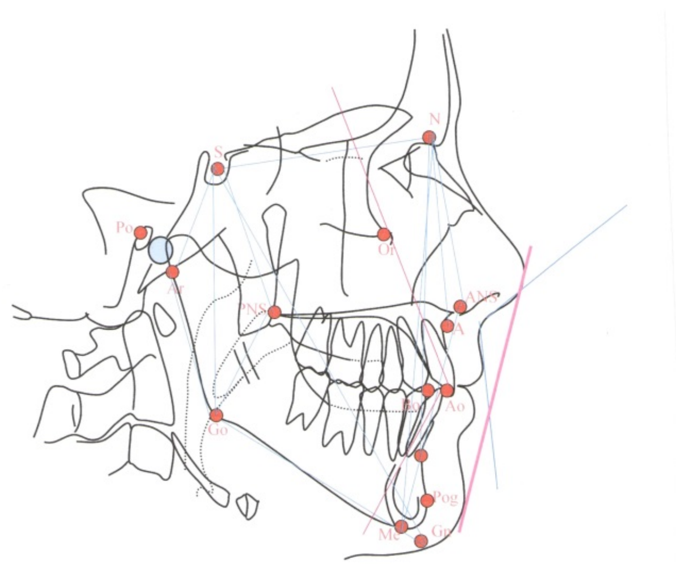

Fig.3 The linear and angular measurements used in the current study

Figure 3 : The Linear and Angular Measurements used in the Current Study

The angular measurement (degree) used in the study: Fig 3.
SNA – SNB – ANB – SNPog – MM – SN ^ GoMe – SN ^ PP – NSAr– SArGo –ArGoMe – Sum (Bjork) – NSPog (Y)– UI ^ SN – UI ^ SPP –LI ^ GoMe, LI ^ NB-UI ^ LI.

The reference points, planes and angles used in current study were defined according To Bjork, Riolo et al [15, 16]

b) Error Study

Within a two weeks interval from the first measurements, 20 randomly selected radiographs (10 from class II division 1 group and 10 from normal occlusion group) were retraced, redigitized and re-measured by the same author.

The causal error was calculated according to Dahlberg's formula [17]

$$ME = \sqrt{\frac{\Sigma d^2}{2n}}$$

Where **d** is the difference between two registration.

n is the number of duplicate registration and the systematic error with dependent tests, for $P<0.05$

The error of the method of cephalometric measurement ranged between 0.16mm and 0.41mm for linear measurements, and between 0.18 degree and 0.46 degree for angular measurements.

(Allowable inter-and intra-investigator error were 0.5 mm and 0.5 degree)

c) Statistical Analysis

Descriptive statistic was calculated for all measurements in both groups including the mean, standard deviation, and minimum and maximum values for each parameter. [18]

All the statistical analysis were performed by using SPSS-V15 (SPSS Inc., Chicago-ILL).

Anderson-Darling normally tests were performed to check the distribution of data, parametric (two-sample-t-test) or non parametric (Mann-Whitney U test), were used as appropriate to detect significant differences between the two groups with the level significance at 0.05, $p<0.05$

The comparison between genders in class II division 1 used the same statistical test.

Statistically significant values were considered if $p<0.05$

III. Results

Tables (1-4) show descriptive statistics and comparison of cephalometric measurements between two groups.

There was no difference in the mean position of the maxilla-(SNA) between the two groups,

and the class II appeared to be the result of more recessive (SNB) and shorter mandible

(Go-Me).

(These results were also supported by maxillary and mandibular skeletal measurements that were not sella-nasion based).

This was accompanied by an increased mandibular plane angle (Go-Gn/SN) but no increase in anterior facial height. The increased mandibular plane angle appeared to be the result of a reduced ramus height with a reduced posterior facial height in the class II division1 group.

In class II division I patients, the maxillary incisors were buccally inclined (upper incisor-NA) and the mandibular incisors were buccallyinclined and more protrusive (Lower incisor-NB), the overjet was significantly greater in class II division 1 group.

The cranial base angle (NS^Ar) was significantly greater in class II division 1 subjects, and the posterior cranial length (S-Ar) was significantly shorter in class II division 1 group.

The (ANB) angle was significantly greater in class II division 1 subjects.

The Bjork sum (angleNS^Ar, SAr^Go ,ArGo^me)was significantly greater in class II division 1 subjects.

Angle retuded chin is indicated by small (SN^Pog) angle in class II division 1 subjects.

Table 1 : Comparison angular measurements between class II and normal occlusion (in degree)

	Class II, 1			Class I			
Variable	Pts N	Mean	SD	Pts N	Mean	SD	P
NS ^ GoMe	49	33.63	2. 78	45	31.00	3.39	0.00
Ns ^ PP	49	8.01	1.15	45	7.93	1.99	0.18
NSAr	49	125.91	2.91	45	123.95	2.33	0.00
SArGO	49	142.91	2.58	45	141.11	1.70	0.00
ArGoMe	49	133.08	3.45	45	129.72	4.59	0.00
Sum(Bjork)	49	400.01	4.07	45	396.58	5.91	0.00
NSPog	49	69.98	3.22	45	66.20	4.13	0.00
SNA	49	81.66	2.51	45	80.96	3.02	0.22
SNB	49	75.42	3.14	45	78.53	2.81	0.00
ANB	49	6.21	1.94	45	2.57	1.01	0.00
SNPog	49	78.04	2.84	45	82.39	2.57	0.00
NAPog	49	184.93	3.90	45	179.10	4.40	0.00
MM	49	28.57	2.92	45	25.84	3.12	0.00
UI ^ SN	49	109.63	4.58	45	102.49	4.45	0.00
UI ^ Spp	49	67.69	4.23	45	70.10	3.25	0.00

UI ^ NA	49	24.15	2.24	45	22.30	2.60	0.00
LI ^ GoMe	49	97.20	5.60	45	91.60	4.27	0.00
LI ^NB	49	25.20	2.71	45	23.29	2.82	0.00
UI ^ LI	49	131.26	4.31	45	134.64	4.86	0.00

Use Mann-Whitney for comparison between non parametric and two sample student test for parametric distribution data.
Statistically significant values were considered if P<0.05

Table 2 : Comparison linear measurement between class II division 1 and normal occlusion (in mm)

	Class II, division 1			Normal Occlusion			
Variable	No	Mean	SD	No	Mean	SD	P
N-S	49	72.49	2.70	45	73.11	3.82	0.12
S-Ar	49	33.07	2.80	45	36.25	2.82	0.00
Ar-Go	49	50.88	2.69	45	52.34	3.18	0.01
Go-Me	49	73.43	3.00	45	76.83	4.73	0.00
S-Go	49	82.12	2.26	45	86.04	5.53	0.00
S-PNS	49	40.68	1.91	45	41.16	3.59	0.73
PNS-Go	49	41.33	2.05	45	44.15	3.76	0.00
N-Me	49	131.16	2.33	45	125.63	4.70	0.00
S-Gn	49	134.88	3.41	45	132.24	3.51	0.00
N-Go	49	126.62	3.36	45	127.67	4.24	0.18
ANS-PNS	49	53.50	2.49	45	52.89	3.17	0.29
UI-NA	49	5.66	.99	45	4.42	1.43	0.00
LI-NB	49	5.77	.99	45	4.15	1.02	0.00
Pog-NB	49	1.85	.84	45	1.71	.84	0.37
UI-APog	49	4.34	1.10	45	2.76	1.31	0.00
LI-APog	49	3.40	.86	45	1.08	1.26	0.00
Ls-E line	49	2.45	1.20	45	0.20	1.51	0.00
Li-E line	49	- 3.25	.93	45	1.05	1.46	0.00
Wits	49	4.14	1.79	45	1.11	1.48	0.00

Use Mann-Whitney for comparison between non parametric and two sample student test for parametric and two sample student test for parametric distribution data statistically significant values were considered if P<0.05

Table 3 : Study of linear measurements according to sex in class II group(in mm)

Variable	Sex	No	Min	Max	Mean	SD	P
N-S	M	26	67.16	77.25	72.88	2.68	0.04
	F	23	65.81	75.64	70.82	2.58	
S-Ar	M	26	28.68	39.82	33.76	2.93	0.08
	F	23	29.15	37.61	32.30	2.49	
Ar-Go	M	26	46.50	56.62	51.22	2.80	0.34
	F	23	45.83	55.15	50.48	2.57	
Go-Me	M	26	7.35	79.62	74.93	2.84	0.00
	F	23	68.82	76.42	71.74	2.18	
S-Go	M	26	79.56	87.31	83.00	2.44	0.00
	F	23	77.98	84.68	81.12	1.56	
S-PNS	M	26	38.45	45.19	41.15	2.10	0.11
	F	23	37.64	43.66	40.15	1.54	

PNS-GO	M	26	37.46	45.15	41.87	2.15	0.04
	F	23	36.85	44.67	40.71	1.79	
N-Me	M	26	128.68	135.65	132.16	2.01	0.00
	F	23	126.32	135.64	130.02	2.17	
S-Gn	M	26	129.45	141.25	137.04	2.62	0.00
	F	23	128.67	137.25	132.44	2.41	
N-Go	M	26	123.64	137.46	128.68	2.73	0.00
	F	23	119.68	128.69	124.30	2.36	
ANS-PNS	M	26	50.64	60.94	54.51	2.33	0.00
	F	23	48.64	56.16	52.36	2.18	
UI-NA	M	26	2.04	6.84	5.51	1.13	0.25
	F	23	3.65	6.15	5.83	.79	
LI-NB	M	26	2.58	6.64	5.90	1.07	0.62
	F	23	2.98	6.64	5.54	.90	
Pog-NB	M	26	.54	3.61	1.71	.85	0.23
	F	23	.64	3.64	2.00	.83	
UI-A Pog	M	26	2.43	6.68	4.40	1.12	0.67
	F	23	2.64	6.82	4.27	1.11	
LI-A Pog	M	26	1.85	5.05	3.35	.95	0.65
	F	23	2.21	5.06	3.46	.75	
Ls-E line	M	26	2.05	7.15	2.37	1.30	0.63
	F	23	2.65	6.85	2.54	1.10	
Li-E line	M	26	-4.15	2.15	-3.15	1.03	0.78
	F	23	-4.51	1.36	-3.40	.81	

Table 4 : Study of angular measurements according to sex in class II group (in degree)

Variable	Sex	No	Min	Max	Mean	SD	P
NS ^ GoMe	M	26	27.68	38.65	33.73	2.99	0.70
	F	23	26.94	37.16	33.53	2.58	
Ns ^ PP	M	26	6.35	10.05	8.21	1.14	0.29
	F	23	5.65	9.26	7.79	1.15	
NSAr	M	26	120.95	131.61	125.99	2.65	0.85
	F	23	119.95	131.46	125.83	3.24	
SArGO	M	26	138.26	147.16	143.30	2.48	0.92
	F	23	136.26	145.03	142.46	2.68	
ArGoMe	M	26	125.54	138.74	132.92	3.70	0.93
	F	23	128.15	139.25	133.25	3.23	
Bjork Sum	M	26	392.94	411.37	399.97	4.51	0.88
	F	23	396.12	408.06	400.05	3.60	
NSPog	M	26	61.58	75.16	69.25	3.58	0.09
	F	23	66.22	76.13	70.81	2.61	
SNA	M	26	77.82	86.94	81.81	2.50	0.66
	F	23	76.65	87.61	81.49	2.58	
SNB	M	26	71.42	80.90	75.37	2.83	0.77
	F	23	68.35	83.31	75.48	3.53	
ANB	M	26	4.21	10.01	6.43	1.37	0.33
	F	23	.70	11.10	5.97	2.45	

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SNPog	M	26	72.46	82.64	77.51	2.72	0.16
	F	23	73.46	85.62	78.64	2.91	
MM	M	26	20.15	33.64	28.09	3.11	0.22
	F	23	23.57	34.76	29.12	2.65	
UI ^ SN	M	26	99.54	115.64	110.89	4.61	0.68
	F	23	100.64	113.64	109.34	4.63	
UI ^ Spp	M	26	60.15	75.16	68.33	4.47	0.26
	F	23	61.35	73.45	66.96	3.90	
UI ^ NA	M	26	19.21	27.24	23.94	2.41	0.20
	F	23	20.40	28.64	24.39	2.07	
LI ^ GoMe	M	26	86.54	106.32	98.18	5.58	0.19
	F	23	84.35	106.35	96.09	5.53	
LI ^ NB	M	26	19.86	29.81	25.36	2.54	0.65
	F	23	18.95	30.61	25.01	2.94	
UI ^ LI	M	26	124.30	140.13	131.18	4.15	0.88
	F	23	122.10	139.52	131.36	4.57	

IV. Discussion

Class II malocclusion has been evaluated in numerous studies. [19, 20, 21]. These studies have reported conflicting results about the features of class II malocclusion both in the anteroposterior and vertical dimensions.

Class II malocclusion may results from numerous combination of skeletal and dental components [22]

This was also true for our sample because wide variations were observed for almost all measurements of the class II division 1 patients (Table 1, 2).

Fushima et al [21]reported aretruded and smaller mandible in adult females with class II division 1 malocclusion. In another study of adult patients, Gilmore[23]reported that the mandible was shorter in dental class II division 1 patients. Because our results are consistent with previous studies on adults, we suggest that the majority of class II division 1 patients have a normally positioned maxilla but a smaller and more retruded mandible when compared with class I patients.

Conflicting results of studies regarding anteroposterior positions of maxilla and mandible in growing class II patients may be attributed to the individual differences in skeletal growth rates of these patients.

The sagittal position of the maxilla (SNA) in class II division 1 patients was normally positioned similar to the normal class I group, with a well-positioned maxilla in relation to the cranial base, corroborating previous studies [6, 7, 18, 24, 25]

The sagittal position of the mandible (SNB) presented that it was retracted in relation to the cranial base. The effective length (Go-Me) showed a small sized mandible. These results are in agreement with other studies in the literature.[6, 7, 24, 25, 26, 27] demonstrating that the mandible presents great participation in this type of malocclusion.

These cephalometric results justify the mandibular advancement for correction of the class II malocclusion in great part of the cases [28, 29]

Our results indicated that the class II division 1 patients show an increased mandibular plan angle (NS^Go Me) but no increase in anterior facial height (ANS-Me).

The increased mandibular plan appeared to be the result of reduced ramus height. In accordance with our results. Fushima et al[21] also reported backward rotation of the mandible in class II division 1 patients. Bjork and Skieller[30]reported that the intensity of the Condylar growth was strongly correlated with the rotation of the mandible.

Sinclair and Little [31] reported that the degree of vertical mandibular growth was closely correlated with the total amount of condylar growth.

Discrepancy in the posterior face height especially in ramus height may indicate decreased condylar growth in class II division 1 patients. Histological and implant studies [32, 33, 34]have demonstrated that growth in mandibular length occurs primarily at the condyle, the decreased mandibular length found in class II division 1 patient also supports our findings.

The maxillary incisors presented buccal inclination (UI.NA) in class II division 1 subjects. That findings are in consonance with the results of previous studies [6, 7, 18, 35].

The position of maxillary incisors presented protrusion in relation to the cranial base (UI^SN) in

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class II subjects.This results diverges from studies in the literature [14 ,36,]

The angular measurement for the mandibular incisors (LI-NB) presented statistically significant differences, showing mandibular incisors strongly bucally inclined.

The results for the linear position of mandibular incisors (LI-NB) showed protrusion in relation to their apical base, indicating dento- alveolar compensation for the skeletal discrepancy.

The craniofacial growth pattern presented a vertical tendency in class II division 1 subjects,(Bjork-sum). These finding are uniform to those mentioned in most studies [7, 8, 12], however some authors found contrasting results [9,37]

The cranial base angle (NS^Ar) was significantly greater in class II division 1 subjects. The larger cranial base angle in class II subjects might explain the distal positioning of the mandible.

The sagittal discrepancy of the skeletal base angle (ANB) presented an increase in this angle in class II division 1 subjects when compared to the normal occlusion subjects corresponding with other studies [5,11] Hopkin et al [38] stated that the cranial base configuration was an etiological factor in determining anteroposterior male relationships of the jaws. However a review of the literarure indicated no common results concerning cranial base configurations of class II patients.

Dhopatkar et al [39] has suggested that cranial base morphology was more important in establishment of mal occlusion when there was a significant skeletal discrepancy. This is also acceptable for our study because our class II patient have significantly greater over jet and ANB angle than class I subjects.

V. Conclusion

According to the methodology used, the cephalometric characterizations of Saudi subjects presenting class II division 1 malocclusion were the following:

The maxilla was well positioned in relation to the cranial base and in normal size.

The mandible was smaller in size, posteriorly positioned ((retracted)) and rotated posteriorly when compared with class I subjects.

The geometric proportion between the apical base presented a small mandible and a normal size maxilla.

The craniofacial growth pattern showed a vertical tendency.

The maxillary and mandibular incisors were bucally inclined and protrusively positioned in relation to skeletal base.

Gender comparison revealed that there was statistical difference in linear measurements.

However, there was no difference in angular measurements. This may indicate that males have bigger facial dimensions than females with the resemblance in the geometric proportions and craniofacial morphology.

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