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ORIGINAL ARTICLE

Cephalometric characteristics of Class II division 1 malocclusion in a Saudi population living in the western region

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KEYWORDS

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Abstract *Objective:* To describe and analyze the cephalometric dento-skeletal characteristics associated with Angle's Class II, division 1 malocclusion in Saudi population living in the western region.

Materials and methods: The material examined included 149 lateral head radiographs comprising two series: (1) 85 films of children with Class II, division 1 malocclusion and (2) 62 films of children with "normal" occlusion. Age range of the representing children was 10–13 years.

Results: In Class II division 1 subjects, the maxilla was prognathic in relation to anterior cranial base. The mandible was normally positioned in relation to anterior cranial base. Upper incisors were proclined and lower incisors were normally positioned. The cranial base angle was not different between the two groups.

Conclusions: In the western region of Saudi Arabia, Class II division 1 malocclusion has specific characteristics. The presence of prognathic maxilla, in this sample, indicates that the use of head gear therapy might be more appropriate than functional appliances when treating Class II division 1 malocclusion in Saudis living in the Western region.

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1. Introduction

A thorough knowledge of the skeletal and dental components that contribute to a malocclusion is essential as these elements may influence the treatment approach.

Angle defined Class II malocclusion as characterized by a distal relation of the lower to the upper permanent first molar to the extent of more than one-half the width of one cusp and the maxillary incisors being protrusive (Angle, 1899). The Class II malocclusion is a common malocclusion with a prevalence ranging between 5% and 29% (Massler and Frankel, 1951; Woodside, 1968). In a Saudi sample, Class II was

estimated at 12% of patients who seek treatment (Al-Balkhi and Al-Zahrani, 1994). Two thirds of the patients with Class II division 1 malocclusion were reported to have an associated significant skeletal discrepancy (Woodside, 1968). The dentoskeletal morphology of subjects exhibiting Class II malocclusion has been reported in several studies (Drelich, 1948; Craig, 1951; Riedel, 1952; Fisk et al., 1953; Rothstein, 1971; Harris et al., 1972; Hitchcock, 1973; Moyers et al., 1980; McNamara, 1981; Carter, 1987; Karlsen, 1994; Rosenblum, 1995; Pancherz et al., 1997).

Some reports have indicated that the maxilla in Class II division 1 patients was more protrusive and the mandible was normal in size and position (Rosenblum, 1995). Other studies found that the maxilla was in a normal position in relation to the cranial base while the mandible was retrusive (Craig, 1951; Hitchcock, 1973; McNamara, 1981). Others found that Class II skeletal pattern is due to both maxillary protrusion and mandibular retrusion (Gilmore, 1950; Henery, 1957; Rosenblum, 1995; Pancherz et al., 1997). It seems that ethnic backgrounds of the sample used in these studies have played a role in determining the craniofacial characteristics of the Class II pattern.

The objective of this study was to assess the dentofacial characteristics of a sample of Saudi children, living in the western region, having Class II division 1 malocclusion and to compare it with another sample of Saudi children having Class I ideal occlusion.

2. Materials and methods

A total of 85 lateral cephalograms of Saudi children (41 females and 44 males, aged 10–13 years) having full cusp Class II molar relationship, increased overjet (more than 5 mm), no history of orthodontic treatment and in the early permanent dentition stage were selected to be included in the study group (Class II group). A control group of 62 lateral cephalograms of Saudi children (33 females and 29 males, aged 9–12) having acceptable profiles, Class I molar relationship, minimum overbite and overjet, minimum or no crowding, and no previous orthodontic treatment was used for comparison (Class I group) (Table 1). The subjects in both groups were Saudi children living in the western region, selected through the public health program conducted at King Abdulaziz University for the primary and intermediate public school students in 2004–2005.

Table 1 Age and gender distribution of the samples.

Group	*N*	Mean (year)	SD
Class II, division 1			
Female	41	10.53	1.23
Male	44	10.67	1.12
Total	85	10.75	1.17
Class I			
Female	33	10.44	1.18
Male	29	10.32	1.20
Total	62	10.38	1.29

2.1. Cephalometric tracings

The radiographs were traced and analyzed manually by a single examiner. Magnification was recorded for each cephalometric head film and the readings were adjusted accordingly. Eighteen linear and angular measurements were calculated for each group (Fig. 1 and Table 2).

2.2. Statistical analysis

The mean and standard deviation for each measurement were calculated using the Statistical Package for Social Sciences (SPSS, Version 15.0 Inc., Chicago, IL) for Windows. The variables in the two groups were compared using the independent *t*-test ($p < .05$ and $p < .001$).

2.3. Method error

To asses tracing errors, 20 films were retraced after 1 month. The method error was calculated using Dahlberg's double determination formula (Dahlberg, 1940). Results are summarized in Table 3. The error ranged from 0.14° to 1°.

3. The results

Table 4 presents the mean and standard deviation values for the angular and linear measurements for the Class II group. Table 5 presents a comparison between the Class II group and Class I group.

Compared to the subjects in the control group, those in the Class II group have significantly increased ANB and N–A–Pog angles ($p < 0.001$). Maxilla was significantly more prognathic in Class II group as indicated by the increased SNA angle

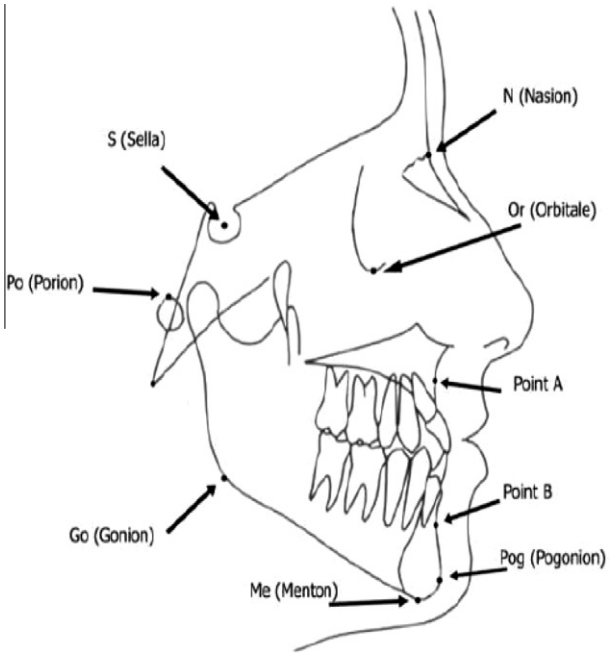

Figure 1 Cephalometric reference points. Different reference points used in the present study and their abbreviations.

Table 2 Different cephalometric measurements used in the study.

Measurement	Interpretation
N–Pog–FH (°)	Intersection between N–Pog plane and Frankfort horizontal plane
N–Pog to SN (°)	Intersection between N–Pog plane and SN plane
SNA (°)	Maxillary apical base relationship to anterior cranial base
SNB (°)	Mandibular apical base relationship to anterior cranial base
ANB (°)	Apical base relationship
NA–A–Pog (°)	Angle of convexity
MP–FH (°)	Inclination of mandibular plane to FH
MP–SN (°)	Inclination of mandibular plane angle to anterior cranial base
OP–SN (°)	Inclination of occlusal plane to anterior cranial base
Y-axis (°)	Angle made between SN and N-Gn line
LAFH%	Lower face height (Anterior nasal spine-Menton)
U1–SN (°)	Inclination of maxillary incisors to anterior cranial base
U1–NA (°)	Inclination of maxillary incisors to NA
U1–NA (mm)	Protrusion of maxillary incisors to NA
U1–L1 (°)	Inclination of maxillary incisors to mandibular incisors
L1–MP (°)	Inclination of mandibular incisors to mandibular plane
L1–NB (°)	Inclination of mandibular incisors to NB
L1–NB (mm)	Position of maxillary incisors relative to NB
L1–A–Pog (°)	Inclination of mandibular incisors to A–Pog plane
L1–A–Pog (mm)	Position of mandibular incisors relative A–Pog plane

Table 3 The results of the tracing errors as calculated using Dahlberg's double determination formula.

Variable	Method error
N–Pog–FH (°)	0.95
N–Pog–SN (°)	0.44
SNA (°)	0.60
SNB (°)	0.33
ANB (°)	0.45
N–A to A–Pog (°)	0.57
MP/FH (°)	0.91
MP/SN (°)	0.45
OP/SN (°)	0.27
Y-axis (°)	0.85
U1–SN (°)	0.71
U1–L1 (°)	1
L1–MP (°)	0.35
L1–NB (°)	0.21
L1–NB mm	0.33
L1–A–Pog (°)	0.14
LAFH%	0.83
N–S–BA (°)	0.59

($p < 0.001$). There was no significant difference in the mean position of the mandible (SNB, SN–Pog) between the two groups ($p > 0.05$). Mandibular plane angle was also similar in both groups. Dentally, upper incisors were significantly more proclined in the Class II group ($p < 0.001$). No statistically significant difference was found between the two groups in mandibular plane angle ($p > 0.05$).

Table 4 Different cephalometric measurements of patients with Class II division1 malocclusion.

Measurement	Mean	Std. deviation
N–Pog to FH (°)	85.07	3.14
N–Pog to SN (°)	75.20	7.90
SNA (°)	81.32	3.12
SNB (°)	75.25	2.99
ANB (°)	6.00	2.33
N–A to A–Pog (°)	9.55	4.65
MP to FH (°)	27.84	3.82
MP to SN (°)	36.35	3.71
OP to SN (°)	19.94	3.10
Y-axis (°)	70.00	3.09
U1–SN (°)	109.66	5.78
U1–L1 (°)	120.15	8.52
L1–MP (°)	96.67	6.16
L1–NB (°)	28.12	4.78
L1–NB (mm)	6.02	1.67
L1–A–Pog (°)	25.34	4.71
LAFH%	54.54	3.04
N–S–BA (°)	131.04	2.45

4. Discussion

The Class II group sample in this study included Saudi children taken form a larger randomly collected sample from school children. In addition, comparison group consisted of subjects taken from the records used previously to establish Saudi norms in the western region of Saudi Arabia (Hassan, 2006). These randomly selected samples represent the Saudi population in the western region of Saudi Arabia. Class II division 2 was not addressed in this study due to the limited number of children with this type of malocclusion seen in the specified school sample.

The Class II malocclusion may result from several combinations of skeletal and dental components (Wylie, 1947; Drelich, 1948; Craig, 1951; Moyers et al., 1980; McNamara, 1981). In the present study, the subjects in the Class II groups had skeletal Class II relationship, due to prognathic maxilla in the presence of normal mandible in most of the cases. This is in agreement with several studies (Renfroe, 1948; Pancherz et al., 1997) and in contrary to Karlsen and Krogstad (1999) and Sayin and Turkkahraman (2005) who found the maxilla to be normally positioned in Class II division 1 malocclusion. The mean angle of SNB was similar in both groups and this is in contrast to several studies (Gilmore, 1950; Craig, 1951; Hitchcock, 1973; McNamara, 1981; Pancherz et al., 1997) that indicated mandibular retrusion as a common characteristic of Class II malocclusion.

Treatment modalities for Class II division 1 children aim at modifying maxillo-mandibular growth using either functional appliance or headgear. The results of the present study support the need to harness maxillary growth or at least distalize upper dentition, in most of the Saudi patients. Therefore, headgear appliance could be a major alternative in the majority of growing Class II division 1 patients. In addition, camouflage treatment via extraction of maxillary premolars could be another good alternative for the treatment of those patients. Lower incisor inclination was also similar in both groups and this is in agreement with Henery (1957) and in contrast to Al-Khateeb and Al-Khateeb (2009) who found the lower incisors to be more proclined in Class II division 1.

Table 5 Comparisons between means of the measured variables in Class II group and their corresponding variables in Class I.

Measurement	Class	*N*	Mean	Std. deviation	Std. error mean	*P*	*t*
N–Pog–FH (°)	I	62	86.52	3.16	.395	.006	2.779
	II	85	85.07	3.14	.341		
N–Pog–SN (°)	I	62	75.95	3.21	.401	.432	.789
	II	85	75.20	7.90	.857		
SNA (°)	I	62	79.75	2.59	.324	.001*	−3.352
	II	85	81.32	3.12	.338		
SNB (°)	I	62	75.64	2.60	.326	.401	.843
	II	85	75.25	2.99	.324		
ANB (°)	I	62	4.10	1.97	.246	.000**	−5.393
	II	85	6.00	2.33	.252		
N–A to A–Pog (°)	I	62	6.18	3.11	.388	.000**	−5.280
	II	85	9.55	4.65	.505		
MP/FH (°)	I	62	26.84	4.34	.543	.145	−1.468
	II	85	27.84	3.82	.414		
MP/SN (°)	I	62	36.32	4.13	.516	.963	−.047
	II	85	36.35	3.71	.403		
OP/SN (°)	I	62	19.91	7.30	.912	.978	−.028
	II	85	19.94	3.10	.336		
Y-axis (°)	I	62	70.16	3.25	.406	.756	.311
	II	85	70.00	3.09	.335		
U1–SN (°)	I	62	105.27	8.16	1.020	.000**	−3.668
	II	85	109.66	5.78	.627		
U1–L1 (°)	I	62	121.52	9.33	1.166	.362	.915
	II	85	120.15	8.52	.924		
L1–MP (°)	I	62	94.96	7.81	.977	.153	−1.438
	II	85	96.67	6.16	.668		
L1–NB (°)	I	62	27.62	6.17	.771	.589	−.542
	II	85	28.12	4.78	.519		
L1–NB mm	I	62	5.87	2.39	.299	.673	−.424
	II	85	6.02	1.67	.181		
L1–A–Pog (°)	I	62	26.32	4.82	.603	.221	1.231
	II	85	25.34	4.71	.511		
LAFH%	I	62	55.04	3.12	.391	.332	.974
	II	85	54.54	3.04	.330		
N–S–BA (°)	I	62	131.04	2.45	.265	.114	2.509
	II	85	132.62	4.60	.575		

* Significant difference between the two groups; $p < 0.05$.
** Significant difference between the two groups; $p < 0.001$.

The relationship between the cranial base angle and malocclusion is controversial in the literature. In the present study, cranial base angle was similar in both groups and this is in agreement with several reports (Bacon et al., 1992; Renfroe, 1948; Menezes, 1974; Guyer et al., 1986) and disagrees with several other reports that indicated a correlation between cranial base angulation and malocclusion (Anderson and Popovich, 1983; Bjork, 1955; Kasai et al., 1995).

Future studies are required to evaluate the skeletal and dental features of Saudis living in the other regions of Saudi Arabia and to compare the results with the present data. In addition, three dimensional skeletal and dental evaluations of the different types of malocclusion in Saudis are also required. Finally the characteristics of Class II division 2 malocclusion are also needed to be evaluated in the Saudi population.

5. Conclusion

Class II division 1 malocclusion in Saudi children living in the western region is characterized by the following: significantly increased ANB angle, more prognathic maxilla, normal mandibular position and proclined upper incisors. These features may favor specific treatment concepts, such as harnessing maxillary growth, or camouflage dental treatment when treating Saudi children living in the western region with Class II division 1 malocclusion.

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