Determination of the structural characteristics in youngsters from Ceará with Class II, division 1 malocclusion

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Objective: To determine the structural characteristics of Caucasian youths from Ceará State, Northeastern Brazil, presenting with Class II, Division 1 malocclusion and to investigate whether there is gender dimorphism based on the cephalometric variables assessed.

Methods: By means of lateral cephalograms, it was possible to determine the cephalometric characteristics of Class II, Division 1 malocclusion in a sample of 50 Caucasian youths from Ceará State, Brazil, of both genders (25 male and 25 female), aged between 9 and 14 years, who had not received previous orthodontic treatment. Sixteen cephalometric measures were evaluated and a comparison was made between the experimental group (Class II) and the control group (Class I), a sample comprising 50 Caucasian children from the Brazilian State of Ceará, of both genders (22 male and 28 female), aged 9 to 13 years, obtained from research conducted at the Study Center of the Federal University of Ceará (UCCB), Department of Orthodontics.

Conclusions: Overall, the maxilla exhibited adequate positioning. The mandible showed a clear predominance of retrusion and dimensional changes in the sagittal direction. The facial vertical dimensions were increased. The maxillary incisors were well-positioned in their apical bases and with slight lingual inclination. The mandibular incisors were labially inclined and protruded. The study identified the presence of gender dimorphism in the following measures: P-Nperp, Co-A, Wits and ALFH.

Keywords: Angle Class II malocclusion. Cranial circumference. Orthodontics.

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INTRODUCTION

With the purpose of establishing scientific standards for different racial groups, dentofacial behavior studies have been conducted by researchers in various ethnic groups. Current cephalometric standards do not apply to all individuals given the wide range of racial and miscigenation characteristics.[2]

Comparative cephalometric evaluations showed indeed the existence of differences in craniofacial morphology between different racial groups.[15] The ethnic background of Ceará State`s population comprise a miscegenation of Portuguese and Indians (indigenous population), resulting in a facial pattern that differs from other populations. This population can be identified as a group with facial and skeletal features that represent a particular morphological pattern: the brachycephalic.[10]

In this context and in light of the proven variability, research was carried out to determine the skeletal and dental characteristics of Class II, Division 1 malocclusion, present in 22.3% of Ceará youths.[10] Knowledge of this population characteristics is of utmost importance, since, due to geographic and economic difficulties, a wide emigration process occurs from that region to more developed and therefore more attractive ones, not only inside Brazil but also to other countries. Evaluation of the cephalometric characteristics of Class II, Division 1 malocclusion was performed in a sample of 50 Caucasian Ceará youths, which ultimately provided further information about the dentoskeletal patterns of this racial group.

MATERIAL AND METHODS

The sample for the experimental group consisted of 50 lateral cephalograms of Caucasian Ceará youths of both genders (25 male and 25 female) aged between 9 and 14 years presenting with Class II, Division 1 malocclusion, originated from a private file comprising 5,000 orthodontic records.

The following selection criteria were used for inclusion of individuals in the experimental group: dental casts displaying increased overjet, ½ Class II, ¾ Class II and full Class II molar relationship, ANB angle of 4.5° or greater with no history of previous orthodontic treatment and radiographs taken using the same equipment.

The control group consisted of 50 lateral cephalograms of Ceará youths (22 male and 28 female) aged between 9 and 13 years, all with normal occlusion (molar and canine Class I), displaying facial harmony in frontal and lateral views, normal overbite, dental irregularities, if present, did not surpass 3 mm, overjet of 3 mm or lower, and no previous orthodontic treatment.

After selecting the lateral cephalometric radiographs the images were scanned. Thereafter, these images were imported into the Cef-X software (CDT software, version 2.1.24). The patients were registered and points of interest marked following the guidelines provided by the software.

The anatomical points (landmarks) were marked, resulting in the angular and linear cephalometric measures of interest, following the specifications of Downs,[5] Riedel,[15] Steiner and Riedel,[24] Jacobson[6] and McNamara Jr.[11] The lines and planes that compose the skeletal and dental cephalometric variables used in the study are shown in Figures 1 and 2. The linear and angular measures used for the control and experimental groups were: SNA, SNB, ANB, SNGoGn, 1.NA, 1-NA, 1.NB, 1-NB, Co-A, Co-Gn, ALFH, DMM, A-Nperp, P-Nperp, Wits and HF.PM. The values of the experimental group were compared to the control group's values and the statistical test applied.

Method error

In order to determine the results` reliability a second measurement was performed on all cephalometric radiographs after a 30 days interval by the same subject. The systematic and random errors (Dahlberg and *t* test respectively) were applied to each cephalometric measure.

Statistical Analysis

After registering the cephalometric measurements a normality test (Shapiro-Wilk) was performed. Since variables ANB and ALFH had a *p* value lower than 0.05, they were analyzed by the nonparametric Wilcoxon test. To test compatibility between groups regarding age as well as the mean and standard deviation values of the cephalometric variables, Student's *t* test was applied. A significance level of $p < 0.05$ was adopted. To check for the existence of gender dimorphism Student's independent *t* test was applied.

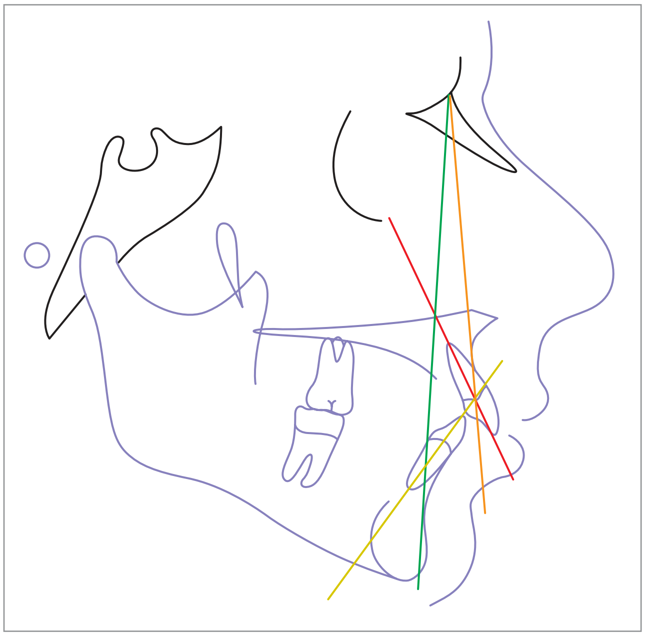

Figure 1 - Skeletal cephalometric variables, according to Dows, Riedel , Steiner and Riedel, Jacobson, McNamara Jr.

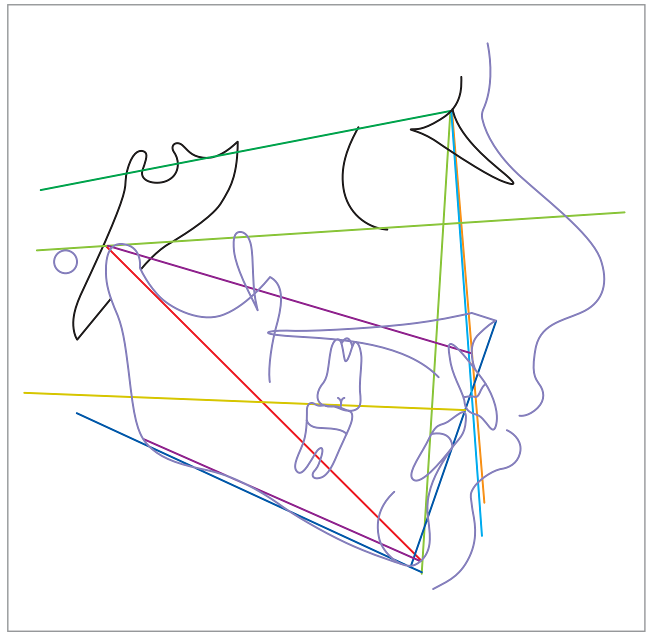

Figure 2 - Dental cephalometric variables according to Steiner and, also, Steiner and Riedel.

RESULTS

The data in Table 1 show normal distribution for 14 of the 16 measures assessed. According to the Wilcoxon data in Table 2, ANB showed no significant pre/post difference ($p > 0.05$). Variable ALFH showed significant pre/post difference ($p < 0.05$). The data presented in Table 3 show the two measurements taken with a 30 day interval, displaying the means and standard deviations of the paired *t* test and the random error. Among the 16 variables studied, only one exhibited systematic error (bias): ALFH.

Comparison between genders showed that four measures had statistically significant differences (Tab 4). Table 5 presents a comparison between the experimental and control groups.

DISCUSSION

In assessing gender dimorphism in the experimental group only four measures displayed statistically significant differences. All differences between variables were found in linear measures: Co-A, P-Nperp, Wits and ALFH. These results are consistent with a study which found that only linear measurements show significant differences between genders in Class II, Division 1 malocclusions.[5] Silva Filho et al[23] found that the behavior of angular cephalometric measures in Class II, Division 1, Pattern II malocclusion is independent of the gender variable.

The sagittal position of the maxilla (SNA) displayed similarity between the experimental and the control groups, revealing to be well positioned in relation to the skull base. This finding is confirmed by most published works.[1,4,9,13,16,20,22] Some researchers support the idea that changes in the respiratory function may lead the soft tissues of the face to increase in length. These tissues can inhibit the forward development of the nasomaxillary complex, maintaining the maxilla in a good position.[24] Measured linearly, the maxilla was found to be in a protruded position. This mismatch between the SNA angle and A-Nperp values can be explained by the difficulty in locating some landmarks related to the Frankfurt plane, such as Condylion and Orbitale. Potential changes in the inclination of the aforesaid plane, resulting from the above mentioned difficulties would imply changes in the A-Nperp measurement.[22]

Analysis of mandiblar position assessed by SNB angle showed that the mandibular retrusion in

Table 1 - Shapiro–Wilk test.

VARIABLES	W	P
Age 1	0.96	0.24
Age 2	0.96	0.24
CEPHALOMETRICS		
SNA 1	0.98	0.72
SNA 2	0.98	0.77
SNB 1	0.98	0.90
SNB 2	0.98	0.86
ANB 1	0.88	0.00
ANB2	0.88	0.00
A-Nperp 1	0.98	0.77
A-Nperp 2	0.97	0.63
P-Nperp 1	0.95	0.10
P-Nperp 2	0.94	0.05
Co-A 1	0.98	0.91
Co-A 2	0.98	0.92
Co-Gn 1	0.97	0.65
Co-Gn 2	0.97	0.49
DMM 1	0.97	0.70
DMM 2	0.97	0.61
SNGoGn 1	0.97	0.50
SNGoGn 2	0.95	0.19
AFAI 1	0.94	0.04
AFAI 2	0.96	0.02
1-NA 1	0.97	0.44
1-NA 2	0.97	0.44
1.NA 1	0.98	0.84
1.NA 2	0.98	0.92
1-NB 1	0.94	0.06
1-NB 2	0.95	0.07
1.NB 1	0.97	0.46
1.NB 2	0.96	0.39
HF.PM 1	0.97	0.62
HF.PM 2	0.97	0.67

Table 2 - Wilcoxon test.

	ANB Pre	ANB Post	AFAI Pre	AFAI Post
Median	6.40	6.55	70.87	70.64
Z	0.71		2.33	
p	0.47		0.01	

relation to the skull base. This is a frequent finding in other studies.[1,4,9,13,16,22,26] Some researchers have suggested that this is partly due to the skull base architecture, specifically the Basion-Sella-Nasion angle, which under genetic influence appears more obtuse, favoring a more posterior positioning of the mandible and thereby generating a poor relationship between the basal bones.[15] Evaluation by means of linear measurements showed that the mandible was in a retruded position. This result was found by most studies in the literature.[1,11,16,22]

To verify the maxillo-mandibular relationship the angular measure ANB and the linear measure Wits were employed. The degree of sagittal discrepancy observed by means of the angular measure suggests a spacial disharmony between the apical bases. An increase in this angle was also observed in studies by Santos.[22] The discrepancy observed by means of the linear measure AO-BO (Wits) also points to a basal disharmony. Canuto[3] observed that the higher the ANB, the greater the AO-BO distance, i.e., he found a positive correlation between ANB and Wits.

Proportionality between the skeletal components was evaluated according to the principles advocated by McNamara.[12] The effective length of the maxilla (Co-A) showed a statistically significant difference when compared to the control group sample, revealing an increased maxilla, and corroborating with a previous study.[19] The mandiblar length (Co-Gn) showed a reduced size, which does not differ from the findings of most researchers.[8,13,22] The variable DMM exhibited an unfavorable maxillomandibular relationship, although it did not show statistically significant difference when compared to the control group sample. This can be explained by the fact that DMM is part of a set of measures involving proportionality and this aspect must therefore be taken into account. The anterior lower facial height (ALFH) displayed increased vertical dimension. McNamara[11] posited that excessive vertical development in these individuals is a frequent feature and can be a manifestation of changes in respiratory function. Maia[9] argued that this increase in ALFH occurs due to a more vertical facial growth pattern. Most patients in the experimental group had no lip competence, possibly due to a discrepancy between the jaws (retruded and smaller mandibles). One cannot assert in this study that the patients had a

Table 3 - Means and standard deviations of Student's paired *t* test and random error for the two measurements taken.

VARIABLES	1st MEASUREMENT		2nd MEASUREMENT		N	DAHLBERG	*t*	P
	Mean	SD	Mean	SD				
MAXILLARY COMPONENT								
SNA (°)	83.82	3.11	83.86	3.10	50	1.16	-0.18	0.858
Co-A (mm)	99.35	5.32	99.26	5.34	50	2.88	-0.27	0.782
A-Nperp (mm)	3.61	2.99	3.67	3.02	50	1.52	-0.24	0.810
MANDIBULAR COMPONENT								
SNB (°)	76.73	2.89	77.6	3.14	50	0.84	-0.12	0.898
Co-Gn (mm)	120.86	6.69	117.9	12.02	50	9.18	0.35	0.722
P-Nperp (mm)	-6.4	5.59	0.98	24.9	50	3.18	-0.42	0.670
MAXILLO-MANDIBULAR RELATIONSHIP								
ANB (°)	6.59	1.79	6.75	1.73	50	0.45	-0.18	0.852
Wits (mm)	6.41	2.84	6.43	2.73	50	0.02	-0.34	0.576
DMM (mm)	21.85	3.82	21.73	3.81	50	4.20	0.29	0.766
VERTICAL COMPONENT								
SN.GoGn (°)	33.34	4.54	33.46	4.67	50	1.35	-0.51	0.605
HF. PM (°)	25.75	4.10	25.84	4.04	50	3.61	0.43	0.664
AFAI (mm)	71.02	4.75	70.38	4.60	50	1.56	0.00	0.009*
DENTOALVEOLAR COMPONENT								
1.NA(°)	22.68	8.6	21.90	8.62	50	11.80	-0.32	0.747
1-NA(mm)	4.47	2.85	3.63	2.77	50	0.83	-0.00	0.996
1.NB (°)	32.52	5.61	34.43	5.38	50	6.03	-0.25	0.803
1-NB (mm)	7.81	2.63	7.73	2.29	50	1.02	0.04	0.961

* Statistically significant for $p < 0.05$.

Table 4 - Student's independent *t* test by gender .Experimental group.

VARIABLES	MALE (n=25)		FEMALE (n=25)		P
	Mean	SD	Mean	SD	
Age	138.69	17.77	140.92	16.60	0.650
MAXILLARY COMPONENT					
SNA (°)	84.00	3.42	83.63	2.8	0.684
Co-A(mm)	101.42	5.32	97.12	4.43	0.003*
A-Nperp (mm)	3.36	3.38	3.88	2.57	0.541
MANDIBULAR COMPONENT					
SNB (°)	76.82	2.87	77.40	2.56	0.459
Co-Gn(mm)	122.32	6.07	120.02	5.98	0.182
P-Nperp (mm)	-8.17	6.01	-4.44	3.95	0.012*
MAXILLO-MANDIBULAR RELATIONSHIP					
ANB (°)	7.17	1.94	6.24	1.35	0.054
Wits (mm)	7.37	3.02	5.49	2.06	0.013*
DMM (mm)	20.91	3.31	27.04	2.11	0.171
VERTICAL COMPONENT					
SN.GoGn (°)	33.32	4.76	33.37	4.40	0.965
HF. PM (°)	26.30	4.50	25.71	3.90	0.628
AFAI (mm)	72.34	3.90	69.59	5.24	0.039*
DENTOALVEOLAR COMPONENT					
1.NA(°)	21.28	9.14	22.11	7.93	0.733
1-NA(mm) (°)	3.30	3.15	3.99	2.31	0.387
1.NB (°)	34.51	5.68	34.09	5.13	0.786
1-NB (mm)	8.08	2.41	7.37	2.17	0.279

* Statistically significant for $p < 0.05$.

Table 5 - Means and standard deviations of the experimental and control groups for the assessed measures.

VARIABLES	EXPERIMENTAL GROUP		CONTROL GROUP		P
	Mean	SD	Mean	SD	
MAXILLARY COMPONENT					
SNA (°)	83.82	3.11	82.95	2.96	0.155
Co-A (mm)	99.36	5.33	92.78	4.19	0.000*
A-Nperp (mm)	3.61	2.99	0.03	2.35	0.000*
MANDIBULAR COMPONENT					
SNB (°)	77.10	2.72	80.25	2.67	0.000*
Co-Gn (mm)	121.22	6.08	116.57	5.68	0.000*
P-Nperp (mm)	-6.38	5.41	-3.55	4.4	0.005*
MAXILLO-MANDIBULAR RELATIONSHIP					
ANB (°)	6.72	1.73	2.7	1.94	0.000*
Wits (mm)	6.38	2.86	-0.16	2.47	0.000*
DMM (mm)	23.85	14.97	23.79	3.27	0.978
VERTICAL COMPONENT					
SN.GoGn (°)	33.34	4.55	31.16	4.4	0.012*
HF. PM (°)	26.02	4.19	23.63	4.05	0.004*
AFAI (mm)	71.02	4.75	64.3	4.22	0.000*
DENTOALVEOLAR COMPONENT					
1.NA (°)	21.68	8.51	25.49	1.69	0.003*
1-NA (mm)	3.63	2.77	4.5	3.95	0.204
1.NB (°)	34.31	5.37	28.41	5.14	0.000*
1-NB (mm)	7.74	2.30	5	1.8	0.000*

* Statistically significant for $p < 0.05$.

history of respiratory disorders. Other parameters are involved, which can be investigated in future studies. In addition, ALFH suffered the greatest variation as indicated by the method error.

The cephalometric measures for the facial pattern (SN.GoGn and HF.PM) exhibited increased values. When the facial pattern was evaluated by the SN.GoGn measure it was found to be in agreement with other investigations.[9,22] Contrary to the results mentioned by some authors,[21] a reduction was observed in the vertical relationship between the jaws and the skull base in the Class II, Division 1 pattern. The mean value found for HF.PM was relatively high, although consistent with results found by Karlsen[8] and Ngan et al.[13] The prevalence of a vertical facial growth pattern is an unfavorable factor in the correction of Class II malocclusion, rendering such treatment a most daunting task. It can be inferred based on these results that the key to a successful treatment should include control of the vertical growth of the maxilla and mandible, or the use of a mechanics that does not produce excessive increments, such as extrusion of the posterior segments.

Among the dentoalveolar component values, all measures showed statistically significant differences, except for variable 1-NA. Changes observed from the evaluation of 1.NA revealed that the upper incisors were lingually inclined. Riedel[16] found no significant differences between patients with Class II malocclusion and normal patients when examining the axial inclination of the incisors. The upper incisors were shown to be well positioned when assessed by 1-NA. Similar findings were reported in other studies.[4,22] The reduced values found for measure 1.NA when compared to the control group reveals lingual inclination, compensating or masking the discrepancy between the skeletal bone bases. Measure 1-NA, which checks for a possible incisor protrusion, corroborates the maxillary measurements, which indicates that the maxilla was usually well positioned anteroposteriorly and that the teeth supported by this structure were also in a good position. The buccal inclination of mandibular incisors (1.NB) found in this study was also reported by most studies in the literature.[9,21,22] Protruded lower incisors (1-NB), as found in this study, were also the most common feature observed by most researchers,[9,22] although some authors have argued that the lower incisors are usually well positioned.[11,20]

The study revealed dental compensation in the lower incisors, with all relevant measures indicating higher values in the experimental group.

CONCLUSIONS

Based on the methods employed and the results achieved, the following conclusions could be drawn regarding the structural characteristics of Class II, Division 1 malocclusion in Ceará youths:

» Overall, the maxilla exhibited good positioning, with a few protrusive cases.
» The mandible showed a clear predominance of retrusion and sagittal dimensional changes.
» The vertical dimensions of the face were increased.
» The maxillary incisors were well-positioned in their apical bases and slightly lingually inclined.
» The lower incisors were labially inclined and protrusive in relation to their apical bases.
» The existence of gender dimorphism was identified in the following measures: P-Nperp, Co-A, Wits and ALFH.

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