Comparative cephalometric study of dentofacial patterns of individuals with normal occlusion and Angle malocclusions

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Abstract

Objective: To evaluate dentofacial patterns of patients with normal occlusion and Angle malocclusions, examining potential differences between specific cephalometric measures as they relate to gender, both intra- and intergroup. **Methods:** The sample consisted of 200 lateral cephalometric radiographs obtained from young Brazilians of both genders, aged between 11 years and 2 months and 19 years and 10 months, with permanent dentition. The material was divided according to the type of occlusion into five groups: One group consisted of patients with normal occlusion and four groups of patients with Angle malocclusions, and each group was also divided by gender. Angular and linear cephalometric measures were evaluated. **Results:** Genders did not differ in most measures. Position of the maxilla showed no significant differences between groups. Mandibular retrognathia was remarkable in groups with Class II, Divisions 1 and 2. Vertical imbalances were observed with some significant differences. The pattern was found to be hypodivergent for groups with normal occlusion and Class II, Division 2, and neutral for groups with Class I; Class II, Division 1 and Class III. Dentoalveolar compensation was evident in groups with Class III and Class II, Division 2. Finally, the normal occlusion group profile was more convex than the patterns found in the US population. **Conclusions:** In general, some features of facial morphology were associated with certain types of malocclusion. However, individual assessment of each face is still necessary as some of the features are shared across different types of occlusion.

Keywords: Cephalometry. Malocclusion. Growth.

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INTRODUCTION

Despite the widespread influence of US orthodontics, with its standards and references, it is known that these do not apply to the ethnically mixed Brazilian population.[23] Facial profiles have often been compromised due to little or no importance given to the analysis of soft tissues. In contemporary orthodontics, attention to the soft tissues of the face has prevailed over all other types of complementary exams. With the advent of facial pattern classification into Classes I, II and III[8,26] based on the facial characteristics of each patient, diagnostic data have become more meaningful when added to the numerous analyses[5,15,18,22,23,24,27,28] that serve as input for the understanding of dental and facial components and their relationship with malocclusions.

With this in mind, it is understandable that knowledge of facial growth pattern provided by certain cephalometric analyses[27,28] can also be very useful in establishing diagnosis, treatment plan and prognosis based on the outcomes of orthodontic treatment. Insight into how the variables of the craniofacial complex can contribute to the development of malocclusion, and that there are various manners in which parts of the skull and face (taken as normal in isolation) can form, in conjunction, an undesirable combination, can evidence the role and integration of each variable[9] in facial morphology. The aims of this study were to assess whether or not there are statistically significant differences among five groups in terms of gender of subjects with normal occlusion and Angle malocclusions; to identify the various facial growth patterns; to determine, in the sagittal direction, which skeletal components contributed most to the characterization of Class II, Division 1, Class II, Division 2 and Class III malocclusions; to detect potential vertical changes; to determine the role of dentoalveolar compensations; and to identify the features of facial profile.

MATERIAL AND METHODS

Sample

Two hundred cephalometric radiographs were obtained from young Brazilians with no previous orthodontic treatment and with permanent dentition. All were Caucasian students whose Brazilian-born parents were of Mediterranean descent. Subjects were from both genders and attending different schools in the city of São Paulo, ABC region, and in the city of Santos. The sample was divided into five groups according to the occlusion types, i.e., one group of individuals with normal occlusion and four groups of individuals with malocclusions according to the concepts advanced by Angle.[2] Furthermore, each group was divided according to gender. The Ethics Committee of the Federal University of São Paulo/São Paulo Hospital reviewed and approved this research project referenced under CEP 0094/08.

Subjects with normal occlusion were selected by a clinical examination conducted in 7500 schoolchildren from the São Paulo ABC region.

» Group 1 (normal occlusion): Forty subjects (20 male and 20 female) with mean age of 15 years and 9 months (standard deviation ±1 year and 7 months). ANB angle showed an overall mean of 2.01±1.90°. Sample selection comprised the clinical examination of the teeth in terms of healthiness, shape, size, position, presence of caries, adequate restorations and perioral tissue health. The anteroposterior relationship between dental arches was observed in the study models as well as the occlusal relationship between incisors, premolars and molars, the relationships between grooves and cusps, the axial inclination of teeth and appearance of the curve of Spee. Overjet and overbite were measured in the anterior region and any variation ranging from 0.5 to 4.0 mm was accepted as normal. In an occlusal view of the models, contact points, correct tooth positions, rotations and dental arch forms were observed. Facial soft tissues appeared well balanced and lips remained in contact when at rest.

» Group 2 (Angle Class I): Forty subjects (20 male and 20 female) with mean age of 14 years and 5 months (standard deviation ±2 years). ANB angle exhibited an overall mean of 3.0±1.70°.

» Group 3 (Angle Class II, Division 1): Forty subjects (20 male and 20 female) with mean age of 14 years and 5 months (standard deviation ±1 year and 11 months). ANB angle exhibited an overall mean of 5.39±2.33°.

» Group 4 (Angle Class II, Division 2): Forty subjects (20 male and 20 female) with mean age of 15 years and 3 months (standard deviation ±2 years and 6 months). ANB angle displayed an overall mean of 4.56±1.80°.

» Group 5 (Angle Class III): Forty subjects (20 male and 20 female) with mean age of 15 years and 5 months (standard deviation ±3 years). ANB angle displayed an overall mean of –2.44±2.53°.

Methods

All cephalometric radiographs were obtained in right lateral view and centric occlusion. Cephalometric tracings were drawn over the radiographs using acetate paper and all anatomical details of interest to this study were highlighted. A pencil, protractor with 0.5° subdivisions, square and ruler with 0.5 mm subdivisions were used for cephalometric measurements.

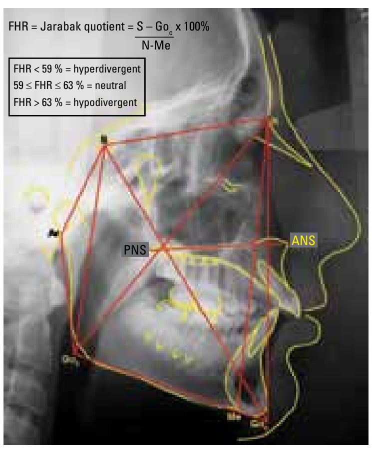

FIGURE 1 - S-N, S-Ar, Ar-Go_c, Go_c-Me, S-Go_c, N-Me, S-Gnc, N-Go_c, ANS-PNS and FHR.

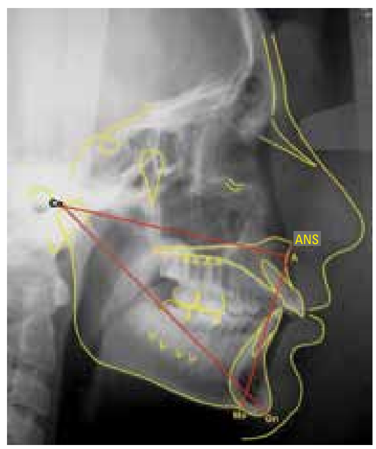

FIGURE 2 - Co-A, Co-Gn, ANS-Me.

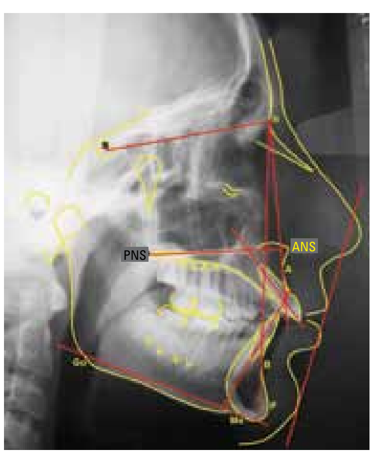

FIGURE 3 - SNA, SNB, ANB, H-Nose, N.NB, IMPA, 1.PP.

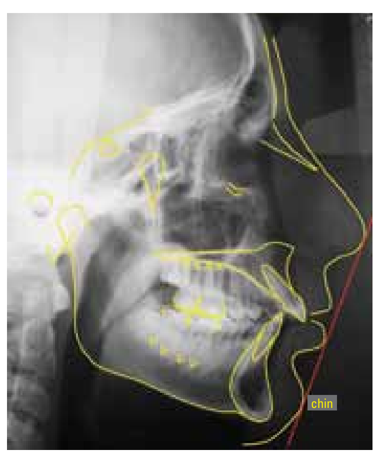

FIGURE 4 - E-LL line.

Anatomical drawing, cephalometric landmarks, lines and planes were obtained and the following cephalometric measures evaluated: S-N, S-Ar, Ar-Go_c, Go_c-Me, S- Go_c, N-Me, S-Gn_c, N-Go_c, ANS-PNS, FHR, Co-A, Co-Gn, ANS-Me, SNA, SNB, ANB, H-Nose, H-NB, 1.PP, IMPA, E-LL line (Figs 1, 2, 3 and 4).

Statistical method

The Kolmogorov-Smirnov test was initially applied and results showed normal distribution. For this reason, analysis of variance parametric test (ANOVA) was applied. The hypothesis test was used to assess whether there was any statistically significant difference between genders. Tukey's test was subsequently applied. A $p \leq 0.05$ significance level was adopted.

Method error

To assess method accuracy, 40 radiographs were selected at random from patients in the study sample (n=200). All radiographs were traced and measured again by a single examiner one month after the initial tracing. Paired t-test was then applied to assess systematic error. Once the difference between the first and second measurements had been obtained for each radiograph, Dahlberg's formula was employed to estimate random error.

RESULTS

Systematic error and random error are presented in Table 3. There were no statistically significant differences between genders for most of the measures studied (except lines H-Nose and E-LL in Class II, Division 1 cases). No statistically significant difference was found after comparison between groups regarding to the variable SNA.

In evaluating the variables across the five groups significant differences were found in the following comparisons: S-N (G1xG2, G1xG5, G2xG5, G3xG5 and G4xG5); S-Ar (G1xG5 and G4xG5); Ar-Go_c (G1xG2, G1xG3, G1xG4, G3xG5); Go_c-Me (G1xG2, G1xG3, G1xG4, G2xG5, G3xG5, G4xG5); S-Go_c (G1xG3, G1xG5); N-Me (G1xG4, G2xG4, G3xG4, G4xG5); S-Gn_c (G1xG3, G1xG4, G2xG3, G2xG4, G2xG5, G3xG5, G4xG5); N-Go_c (G1xG3, G1xG5, G2xG5, G3xG5, G4xG5); ANS-PNS (G1xG5, G2xG5, G3xG5, G4xG5); FHR (G1xG2; G1xG3, G1xG5, G2xG4, G3xG4, G4xG5); Co-A (G1xG2, G1xG5, G3xG5, G4xG5); Co-Gn (G1xG3, G1xG4, G2xG3, G2xG4, G2xG5, G3xG5, G4xG5); ANS-Me (G1xG4, G2xG4, G3xG4, G3xG5, G4xG5); SNB (G1xG2, G1xG3, G1xG4, G1xG5, G2xG5, G3xG5, G4xG5); ANB (G1xG3, G1xG4, G1xG5, G2xG3, G2xG4, G2xG5, G3xG5, G4xG5); H-Nose (G1xG3, G1xG5, G2xG3, G2xG5, G3xG4, G3xG5, G4xG5); H.NB (G1xG3, G1xG5, G2xG5, G3xG4, G3xG5, G4xG5); 1.PP (G1xG4, G2xG4, G3xG4, G4xG5); IMPA (G1xG5, G2xG5, G3xG5, G4xG5); E-LL (G1xG3, G1xG4, G2xG4, G2xG5, G3xG4, G3xG5). The means of cephalometric measures (female, male and total) and the respective standard deviations for Groups 1, 2, 3, 4 and 5 are presented in Tables 1 and 2.

DISCUSSION

To facilitate reading, cephalometric measures will be discussed in topics. Due to the fact that no statistically significant differences were found between genders in most of the measures under study (except lines H-Nose and E-LL line in Class II, Division 1), the discussion was organized around the overall mean value of each measure in the five groups of the sample.

Sagittal evaluation of the basal bones

Among the factors that lend validity to cephalometric studies is their ability to quantify errors of discrepant samples by comparing them with normative values, which will

TABLE 1 - Means of cephalometric measures (female, male and total) and respective standard deviations for Groups 1 (normal occlusion) and 2 (Class I).

Measures	Group 1						Group 2					
	Male		Female		Total		Male		Female		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
S-N	77.10	3.06	74.00	2.90	75.55	3.34	73.08	3.87	72.48	3.74	72.78	3.77
S-Ar	38.50	3.59	34.48	2.44	36.49	3.65	36.13	2.27	33.73	3.25	34.93	3.02
Ar-Go_c	50.88	5.36	47.50	3.30	49.19	4.71	47.15	4.82	44.00	3.80	45.58	4.57
Go_c-Me	80.75	5.57	77.45	3.60	79.10	4.92	75.90	5.14	72.83	4.59	74.36	5.06
S-Go_c	85.48	6.81	78.50	3.81	81.99	6.49	80.55	6.28	75.03	4.24	77.79	5.98
N-Me	126.75	5.21	120.98	5.35	123.86	5.98	128.15	7.97	123.30	7.07	125.73	7.83
S-Gn_c	139.98	6.88	134.18	4.91	137.08	6.59	136.18	7.55	131.65	5.95	133.91	7.09
N-Go_c	129.03	6.64	120.88	4.24	124.95	6.88	123.55	7.50	117.83	5.16	120.69	6.98
ANS-PNS	57.78	3.03	55.73	2.00	56.75	2.74	55.85	3.07	54.98	2.91	55.41	2.99
FHR %	67.45	4.85	64.99	3.56	66.22	4.38	62.90	3.92	61.00	4.55	61.95	4.30
Co-A	98.80	4.30	94.05	2.86	96.43	4.33	93.05	5.13	91.68	6.03	92.36	5.57
Co-Gn	128.00	5.72	122.50	3.62	125.25	5.49	122.55	7.27	119.70	5.59	121.13	6.56
ANS-Me	69.63	4.72	67.55	4.43	68.59	4.64	70.13	6.07	67.20	6.09	68.66	6.18
SNA	81.35	2.56	81.98	1.85	81.66	2.23	79.85	3.15	79.65	5.09	79.75	4.18
SNB	79.45	2.77	79.85	2.60	79.65	2.66	76.95	3.06	76.55	4.75	76.75	3.95
ANB	1.90	2.04	2.13	1.79	2.01	1.90	2.90	1.77	3.10	1.67	3.00	1.70
H-Nose	5.53	4.82	5.93	4.59	5.73	4.65	3.33	5.09	5.03	4.49	4.18	4.81
H.NB	12.23	4.80	12.30	4.56	12.26	4.62	14.73	5.45	11.55	4.03	13.14	4.99
1.PP	108.40	6.18	112.60	6.18	113.33	6.15	115.85	6.77	113.48	7.16	114.66	6.98
IMPA	94.67	6.98	92.05	5.63	93.58	6.32	91.05	6.07	91.15	6.24	91.10	6.08
E-LL line	1.18	3.07	1.63	2.74	1.40	2.88	-1.00	3.54	0.75	3.39	-0.13	3.53

be determined in this study.[26] It is noteworthy, however, that in the same manner that balanced faces, defined as Pattern I, can present with any type of malocclusion, normal occlusion can be seen in facial Patterns II, III, Long and Short Faces with moderate discrepancies, susceptible to natural or orthodontic dental compensations.[8] In this study, the occlusal characteristics employed to characterize the normal occlusion group (Group 1) were in accordance with the concepts advanced by Angle.[2] The average values of the ANB angle for females were 2.13° and for males 1.90°. In a qualitative facial analysis, all individuals in this group showed balanced facial soft tissues with lips sealed at rest, although the pattern type was not taken into consideration.[8] In assessing the composite values – McNamara's Regular Patterns – an adequate ratio was found in five female patients (n=20) and 5 male patients (n=20) for measures Co-A, Co-Gn and ANS-Me (25% of the sample), although, on average, cephalometric measures showed a good anteroposterior relationship between basal bones. No statistically significant difference was found in the sagittal position of the maxilla among the five groups under study. Other investigations[7,30]

TABLE 2 - Means of cephalometric measures (female, male and total) and respective standard deviations for Groups 3 (Class II, Division 1), 4 (Class II, Division 2) and 5 (Class III).

Measures	Group 3						Group 4						Grupo 5					
	Male		Female		Total		Male		Female		Total		Male		Female		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
S-N	75.05	2.73	71.60	2.97	73.33	3.31	74.63	3.95	71.87	3.94	73.25	4.13	72.70	4.62	64.80	3.17	70.51	4.54
S-Ar	35.70	3.57	34.28	3.24	34.99	3.44	37.50	2.81	34.60	2.18	36.05	2.88	34.88	4.34	32.40	2.26	33.64	3.64
Ar-Go_c	43.65	4.14	45.05	5.32	44.35	4.76	46.20	5.10	45.07	3.56	45.64	4.38	49.23	7.47	42.93	5.43	47.26	6.79
Go_c-Me	71.10	5.80	71.78	3.67	71.44	4.80	73.50	4.67	72.10	5.84	72.80	5.27	80.45	7.21	76.30	5.15	78.38	6.53
S-Go_c	75.98	6.35	76.30	5.40	76.14	5.82	80.20	6.01	76.40	3.75	78.30	5.30	80.80	9.59	73.88	6.05	77.34	8.66
N-Me	123.70	5.89	119.53	6.55	121.61	6.50	119.38	5.62	112.57	4.80	115.98	6.20	126.25	9.58	119.53	7.42	122.89	9.12
S-Gn_c	129.48	7.06	126.60	4.90	128.04	6.17	127.08	5.71	120.57	5.36	123.83	6.38	143.40	11.09	135.73	9.20	139.56	10.79
N-Go_c	121.68	6.94	119.00	4.61	120.34	5.97	124.88	7.20	119.55	4.72	122.21	6.59	118.15	8.52	109.95	6.33	114.05	8.49
ANS-PNS	56.90	3.23	55.08	3.25	55.99	3.33	56.63	3.10	54.47	2.97	55.55	3.19	53.30	3.45	51.25	2.69	52.28	3.23
FHR %	61.43	4.44	64.04	5.82	62.73	5.28	67.24	5.01	67.90	3.04	67.57	4.10	64.05	6.31	52.43	4.43	62.96	5.58
Co-A	95.10	6.06	93.05	3.14	94.08	4.87	95.55	4.82	92.85	4.07	94.20	4.61	90.43	5.58	88.55	4.42	89.49	5.06
Co-Gn	116.65	7.13	116.80	5.37	116.73	6.23	118.50	4.64	113.05	4.77	115.78	5.40	129.90	9.46	124.05	8.86	126.98	9.52
ANS-Me	65.30	4.14	65.23	6.04	65.26	5.11	61.90	2.78	59.25	3.24	60.58	3.27	71.93	9.11	66.05	6.40	68.99	8.32
SNA	79.43	5.28	80.90	2.83	80.16	4.25	79.13	3.19	80.20	3.09	79.66	3.15	80.38	4.29	81.65	3.30	81.01	3.83
SNB	73.85	4.23	75.75	3.02	74.80	3.75	74.93	3.06	75.27	2.60	75.10	2.81	83.38	4.16	83.58	3.10	83.48	3.62
ANB	5.63	2.61	5.15	2.05	5.39	2.33	4.20	1.85	4.92	1.73	4.56	1.80	-3.00	2.83	-1.88	2.11	-2.44	2.53
H-Nose	-2.28	3.83	3.20	4.31	0.46	4.89	4.25	4.12	6.35	2.50	5.30	3.53	11.25	5.51	9.98	4.23	10.61	4.89
H.NB	18.03	5.25	14.23	3.85	16.13	4.93	13.00	6.92	12.57	3.29	12.76	5.36	3.75	6.17	4.48	4.98	4.11	5.55
1.PP	113.85	6.74	117.80	6.45	115.83	6.81	102.15	8.63	102.20	8.00	102.18	8.21	116.83	7.66	117.75	6.46	117.29	7.01
IMPA	94.67	5.46	93.95	4.50	94.31	4.95	96.95	7.51	95.15	6.18	96.05	6.85	81.47	6.69	79.50	6.72	80.51	6.69
E-LL line	-1.80	3.25	0.20	2.23	-0.80	2.93	2.95	2.47	4.22	2.57	3.59	2.57	2.23	3.95	2.38	2.96	2.30	3.45

have confirmed these findings in patients with Class II, Divisions 1 and 2.

In Group 5 (Class III), the maxilla was assessed by the palatal plane and Co-A distance, and showed the lowest means in relation to all groups. A study[29] involving Asian youths with Class III malocclusion showed significant differences in ANB values and in the effective length of the maxilla (Co-A) between the Class III and Class I groups, determining a skeletal maxillary retrusion in the Class III group. Although the sample used in this study comprises Caucasians, the results of the aforementioned study[29] are in agreement with the results of this study.

As regards craniofacial growth, coinciding with the growth of the anterior cranial base, the maxilla migrates forward to a very similar extent, thereby keeping the SNA angle relatively constant.[15] As described in the literature[12] and in agreement with it, there was a progressive and significant increase in all dimensions of the cranial base in the Class III group, going through the Class I group and proceeding through the Class II groups. Likewise, the anterior cranial base is reduced in Class III patients when

TABLE 3 - Method error (systematic and random).

Measures		1st reading	2nd Reading	Student's t-test (systematic error)	Dahlberg's formula (random error)
S-N	Mean	73.28	73.34	0.536	0.44
	SD	4.23	4.35		
S-Ar	Mean	35.24	35.19	0.421	0.27
	SD	4.09	4.04		
Ar-Go_c	Mean	47.30	47.24	0.342	0.29
	SD	5.29	5.32		
Go_c-Me	Mean	75.43	75.34	0.147	0.42
	SD	6.01	6.02		
S-Go_c	Mean	79.24	79.29	0.694	0.56
	SD	7.41	7.44		
N-Me	Mean	122.74	122.84	0.273	0.40
	SD	9.26	9.34		
S-Gn_c	Mean	134.36	134.43	0.453	0.37
	SD	9.98	9.90		
N-Go_c	Mean	120.16	120.11	0.512	0.34
	SD	8.57	8.52		
ANS-PNS	Mean	55.11	55.19	0.492	0.48
	SD	3.49	3.35		
FHR %	Mean	64.69	64.68	0.936	0.50
	SD	5.56	5.56		
Co-A	Mean	93.68	93.61	0.161	0.52
	SD	5.55	5.59		
Co-Gn	Mean	122.70	122.53	0.538	1.25
	SD	7.27	7.56		
ANS-Me	Mean	67.51	67.45	0.724	0.40
	SD	8.30	8.42		
SNA	Mean	81.18	81.28	0.390	0.51
	SD	3.03	2.96		
SNB	Mean	78.69	78.63	0.767	0.56
	SD	4.04	4.13		
ANB	Mean	2.50	2.65	0.343	0.70
	SD	3.09	3.22		
H-Nose	Mean	4.74	4.65	0.484	0.22
	SD	5.45	5.50		
H.NB	Mean	12.10	12.06	0.637	0.35
	SD	5.33	5.40		
1.PP	Mean	113.90	113.99	0.360	0.42
	SD	8.69	8.72		
IMPA	Mean	91.50	91.34	0.085	1.68
	SD	7.82	7.71		
E-LL line	Mean	0.71	0.71	0.928	0.70
	SD	3.53	3.56		

compared with normal occlusion.[13] Thus, using the anterior cranial base as a reference is unreliable since it can alter the reading of angles SNA, SNB and ANB.

The position of the mandible (SNB) in Group 2 (Class I) showed a slight retrusion with the ANB angle showing statistical differences relative to Groups 3 and 4 (Class II, Divisions 1 and 2) and Group 5 (Class III). Effective mandibular length (Co-Gn) and Go_c-Me distance in Group 3 (Class II, Division 1) were decreased as well, with statistical differences found in comparison with Group 1 (normal occlusion), a result also found in other studies.[19,20] The mandible showed marked retrusion, very similar to the patients in group 4 (Class II, Division 2). As a result, a sagittal discrepancy was found between the basal bones, which increased angle ANB.[3,4] These findings corroborate the results of investigations[14,22] that studied a clinical population suffering from Class II malocclusion and found that, on average, the maxilla was in a neutral position and, whenever that was not the case, it was positioned more retrusively than protrusively. Investigators further argued that mandibular skeletal retrusion was the most common feature in the Class II sample. Results from another study[6] also revealed that mandibular length was greater in the normal occlusion group compared with the Class II, Division 1 group. Facial length (S-Gn_c) was reduced due to the small size of the mandible in Groups 3 and 4 (Class II), unlike the other groups. Facial depth (N-Go_c) showed in Group 4 (Class II, Division 2) values that were similar to those in Group 1 (normal occlusion) probably owing to the fact that these two groups had hypodivergent facial growth.

In Group 5 (Class III) patients, distances Co-Gn and Go_c-Me showed significant differences relative to all groups except Group 1 (normal occlusion). In the sagittal direction, the mandible was found to protrude (SNB) and, again, it should be noted that anterior cranial base shortening, often present in Class III patients, can affect SNB angle reading. Facial length (S-Gn_c) was also higher in Group 5 (Class III) when compared with other groups while facial depth (N-Go_c) produced the lowest mean, probably due to the possible retraction of point nasion.

Vertical evaluation of the basal bones

Group 1 (normal occlusion) showed, on average, hypodivergent facial growth with counterclockwise rotation.[28] Fourteen female patients displayed a hypodivergent pattern and 6 were neutral (n=20), with a mean of 64.99% (59.44% minimum and 73.5% maximum) and 16 males were hypodivergent, 3 were neutral and 1 hyperdivergent (n=20), with a mean equal to 67.45% (58.8% minimum and 76.89% maximum). Distances S-Ar and Ar-Go_c achieved the highest overall means. Each time the ratio between posterior cranial base and mandibular ramus height approaches 1:1, this will point to the existence of a short branch.[15] The ratio between distances S-Ar and Ar-Go_c in this group was 1:1.34, which is indicative of increased ramus height and greater counterclockwise rotation of the mandible, a pattern that favors a hypodivergent pattern.

Assessment of Jarabak analysis disclosed that patients in Group 2 (Class I) had a neutral facial growth pattern, according to prior studies.[1,5,28] Concerning anterior facial height (N-Me), some investigations[9,16] have shown that in male subjects this dimension is typically larger than in females, which is confirmed by the findings of this study. When changes occur in anterior facial proportions, lower facial height (ANS-Me) contributes most to these changes[11,17] while upper facial height remains virtually unaltered.

In Group 3 (Class II, Division 1), posterior facial height (S-Go_c) displayed the lowest mean of all groups under study. Assessment of Jarabak analysis indicated that Group 3 (Class II, Division 1) had a neutral facial growth, corroborating the findings of Siriwat and Jarabak.[28]

In Group 4 (Class II, Division 2) both maxilla and mandible showed anteroposterior discrepancy of apical bases, which was masked not only by a marked decrease in anteroinferior facial height (ALFH) but also by reduced anterior facial height (N-Me). These two measures showed statistical differences, with Group 4 (Class II, Division 2) exhibiting the lowest means in relation to the groups under study.

Posterior cranial base length, represented by measure S-Ar, was increased similarly to the values of Group 1 (normal occlusion), and ramus height (Ar-Go_c) showed a statistically significant difference compared to the same group. The combination of posterior and anterior facial heights resulted in a hypodivergent[28] facial growth pattern in this malocclusion group. Judging from the results, it appears that anticlockwise rotation of the mandible is more associated with reduced anterior facial height than with excessive posterior facial height. Group 4 (Class II, Division 2) was characterized by a short anterior facial height accompanied by excessive overbite.[18] The results of this study are consistent with other investigations[1,7,25,28] which also found hypodivergence in this malocclusion group. On the other hand, a research[24] has shown that in individuals with Class II, Division 1 and Class II, Division 2, both hypo- and hyperdivergent patterns can be found. The authors[24] concluded that, except for the position of maxillary incisors, there is no basic difference in dentoskeletal morphology between Class II, Division 1 and Class II Division 2 malocclusions. In this sample, 33 out of 40 subjects (82.5%) in Group 4 (Class II, Division 2) were found to display a hypodivergent growth pattern and only seven (17.5%) had a neutral pattern. Group 3 (Class II, Division 1) showed that 19 of 40 subjects (47.5%) had a hypodivergent pattern, 13 (32.5%) had a neutral patterns and 8 (20%) were hyperdivergent. Current results do not confirm the findings of Pancherz et al[24] since in this sample no hyperdivergent cases were found in Group 4 (Class II, Division 2). Another important aspect to consider in the above study is its sample size[24] of 347 subjects with Class II, Division 1 malocclusion and 156 with Class II, Division 2. This study comprised 40 Class II, Division 1 and 40 Class II, Division 2 cases. Some authors[18] define two different types of Class II, Division 2 malocclusion: The "easy" type, with a long mandibular ramus, also called mandibular brachyfacial typology, and the "difficult" type, with a short mandibular ramus or mandibular dolichofacial typology.

In Group 5 (Class III), anterior facial height (N-Me) showed a statistically significant difference compared to Group 4 (Class II, Division 2). Posterior cranial base length (S-Ar) showed reduced values for all groups. The combination of posterior (S-Go_c) and anterior (N-Me) facial heights resulted in a neutral facial growth pattern. In contrast to the results of this research, Siriwat and Jarabak[28] found a hypodivergent growth pattern in Class III patients.

Dentoalveolar position

In assessing maxillary incisors position in Group 1 (normal occlusion) in light of measure 1.PP, a mean of 112.60º (minimum 103º and maximum 127º) was found for the female gender and 113.90º for males (minimum 100º and maximum 128º).

In evaluating mandibular incisors position, IMPA showed a mean of 92.5º (minimum 86º and maximum 99º) for females and 94.67º (minimum 79º and maximum 107º) for males. Incisor position is best evaluated in relation to their basal bones by means of the angles formed between maxillary incisors and the palatal plane, and between mandibular incisors and the mandibular plane. These measures prevent sagittal errors in the basal bones from undermining the evaluation of dental positions.[26] This research yielded an overall mean for 1.PP (113.25°) that was greater than the one advocated by Schwartz (110°), but in agreement with the findings of Reis et al[26] (115.2°), although these authors examined a sample of Pattern I individuals, i.e. normal individuals with malocclusion, but without skeletal discrepancy.[8] The results of the study sample showed mandibular incisor inclination (overall mean= 93.58°) in agreement with other results found in the literature.[21,26] The overall mean for angle ANB was 2.01° (ranging from -2° to 5.5°) and the skeletal discrepancies found in some cases were offset by the position of maxillary and mandibular incisors, in attempting to reach facial balance.

As regards the groups with malocclusion, the dental compensations in Groups 4 and 5 (Class II, Division 2 and Class III) are worthy of note. The results of Group 4 (Class II, Division 2) confirm previous investigations,[7,24] which also found retroclination in maxillary incisors. In Group 5 (Class III), dentoalveolar compensation took place, especially when maxillary incisors were evaluated relative to the palatal plane (increased 1.PP), although statistically significant differences were only found in comparison with Group 4 (Class II, Division 2). Moreover, the lower incisors, in relation to mandibular plane (IMPA), had their values decreased and statistically different from all other groups. As can be observed, dental compensation was more a result of the relationship between mandibular and maxillary incisors. Group 3 (Class II, Division 1) exhibited a higher dental protrusion than all other groups.

Facial profile

Group 1 (normal occlusion), after evaluation of H-Nose (mean = 5.73 mm) and H.NB (mean = 12.26°), showed a tendency toward a more convex profile due to a greater protrusion. Regarding the distance from lower lip to Ricketts esthetic plane, a mean 1.4 mm was found (15 years and 9 months). This distance increased at a rate of 0.2 mm per year, and at 8 years and 6 months should be equal to 2 mm.[27] According to Ricketts, at 12 years it should measure -2.8 mm, at 13 years, -3 mm, and at age 14, -3.2 mm. Corroborating the results of this study, Nobuyasu et al[23] also found that the lower lip was positioned more anteriorly compared to the standard recommended by Ricketts. This is due to a greater protrusion found in the samples under study, probably owing to a greater ethnical miscegenation of Brazilian Caucasians.[23]

Groups 3 and 4 (Class II, Divisions 1 and 2) exhibited mandibular retrusion, as mentioned earlier. Group 3 (Class II, Division 1) displayed a more convex profile than all other groups. In Group 4 (Class II, Division 2), the facial profile was similar to values found for Group 1 (normal occlusion) due to reduced anterior facial height, which caused mandibular rotation in a counterclockwise direction and masked the mandibular deficiency. Assessment of the influence of mandibular position on facial esthetics has determined that Class I malocclusion patients with normal vertical pattern[10] exhibited the most pleasant profile. Group 5 (Class III) had the most concave profile owing to sagittal discrepancy of the apical bases (mandibular excess, maxillary deficiency or a combination of both factors).

CONCLUSIONS

1) Normal occlusion and Class II, Division 2 malocclusion groups presented a hypodivergent growth pattern, while Class I; Class II, Division 1, and Class III malocclusion groups showed a neutral growth pattern, according to Siriwat and Jarabak.

2) Sagittal mandibular retrognathism was the most common feature found in the Class II, Divisions 1 and 2 malocclusion groups. In the group of Class III malocclusion, due to the shortening of the anterior cranial base, sagittal assessment through angles SNA and SNB was compromised, though the size of the maxilla was decreased in light of the measures under study (Co-A and ANS-PNS).

3) The greatest dental compensations occurred in response to Class III and Class II, Division 2 malocclusions.

4) The facial profile in the Class II, Division 1 malocclusion group exhibited greater convexity while the lower lip crossed Ricketts E line. The normal occlusion group showed a profile more convex than the patterns found in the US population.

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