

Dentofacial characteristics of patients with Angle Class I and Class II malocclusions

Rogério Lacerda dos Santos¹, Antônio Carlos de Oliveira Ruellas²

Objective: The present study assessed some cephalometric measurements of the soft tissue profile in order to observe the behavior of facial convexity in patients with Class I, Class II division 1, and Class II division 2 malocclusions.

Methods: One hundred and thirty pre-treatment telerradiographs of Caucasian patients aged 10-16 years (mean age of 12.6 years) were selected for study and divided into 3 groups. The cephalometric measurements used in the present study were the following: H.SN, Cx, NLA, MLA, UL-SUL-S, LL-S, IMPA, and 1-SN. Analysis of variance and Tukey's test were applied for measurements H.SN, Cx, IMPA, 1-SN, MLA, and NLA, whereas Kruskal-Wallis and Dunn's tests were applied for UL-S and LL-S.

Results: The results showed statistically significant differences for the measurements H.SN, Cx, UL-S, and IMPA between Groups I, II-1 and II-2 ($p < 0.05$). Measurements LL-S and MLA showed statistically significant difference between Groups I and II-1 only ($p < 0.05$). On the other hand, no statistically significant differences were found for measurement NLA among the 3 groups ($p < 0.05$).

Conclusion: Regarding facial characteristics expressed by measurements H.SN, Cx, and UL-S, one could conclude that Class II division 1 and Class II division 2 malocclusions, both differed from Class I malocclusion. In addition, Class II division 1 malocclusion was found to have facial characteristics expressed by MLA, which differentiate it from the Class II division 2 and Class I malocclusions. Class I, Class II division 1 and Class II division 2 malocclusions showed no difference in facial characteristics expressed by the measurement NLA, and measurement LL-S was directly related to eversion of the lower lip.

Keywords: Malocclusion. Cephalometry. Angle's classification.

¹ Specialist in Orthodontics, Federal University of Alfenas - UNIFAL. MSc and PhD in Orthodontics, Federal University of Rio de Janeiro - UFRJ. Adjunct Professor of Orthodontics, Federal University of Campina Grande - UFCG.

² MSc and PhD in Orthodontics, Federal University of Rio de Janeiro - UFRJ. Associate Professor of Department of Pediatric Dentistry and Orthodontics, Federal University of Rio de Janeiro - UFRJ.

How to cite this article: Santos RL, Ruellas ACO. Dentofacial characteristics of patients with Angle Class I and Class II malocclusions. *Dental Press J Orthod*. 2012 Mar-Apr;17(2):46e.1-7.

Submitted: July 29, 2008 - **Revised and accepted:** November 24, 2011

» The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.

Contact address: Rogério Lacerda dos Santos
Av. dos Universitários, s/n, Rodovia Patos/Teixeira, Km1, Santa Cecília - 58700-970
Patos, PB - Brazil - E-mail: lacerdaorto@hotmail.com / lacerdaorto@bol.com.br

INTRODUCTION

The concept of beauty is philosophical, as the attribute refers to a supra-material dimension and is manifested by means of mediate realities that are perceptible to sight and sensitive to reason and emotion. The notion of “harmonious profile” differs from person to person and from one race or ethnic group to another. The harmonious profile may be considered a variant that depends on ethnic or racial factors and temporal factors of the individuals⁷ and it may not be analyzed exclusively by mean values or numbers.

The importance of identifying the facial types of each individual arises from the influence it has on the profile of the individual and dental arches.¹⁰ The relationship of the incisors with their respective bony bases and the facial growth pattern also have a significant influence on soft tissue profile assessment according to Riedel.²⁵ Examiners tend to prefer a more retrusive lip position for a reduced convexity and improve facial esthetics in both men and women.¹⁷

Several structures shape the complex called facial profile that undergoes changes throughout one's lifetime. Studies have found that during youth there is more extensive growth in the area of nose and lips whereas there is minimal growth in the menton area. Upper lip full length is established by the age of 7, but an increase in depth and length of the nose is observed in adult's facial profile for both genders. In men, the upper and lower lip thickness diminishes, whereas in women the profile becomes more convex because there are greater growth changes in the nose than in the menton.²⁰ Nevertheless, in terms of absolute and total area, the lips and menton were found to be larger in men; the male menton and female nose were significantly larger. The overall result was that the male profile was straighter and the female profile more convex.²⁸

Over the last one hundred years, especially in the past decade, the concept of facial beauty has undergone changes in esthetic agreement and the contemporary profile is shown to have more prominent lips in contrast with profiles of the early twentieth century with thin and less voluminous lips. One of the reasons could be that fuller lips tend to show a more youthful appearance. There are increasing endeavors to compare, relate and define standards and reliable measures for assessing facial esthetics with the purpose of defining reliability in the evaluation of these profiles.

The aim of the present study was to compare some measurements related to facial convexity among patients with Class I, Class II division 1 and Class II division 2 malocclusions, also comparing them with the standard measurements.

MATERIAL AND METHODS

This study was first sent to the Research Ethics Committee of the School of Pharmacy and Dentistry of Alfenas and received approval. For this study, 130 pre-treatment cephalometric radiographs obtained by the Broadbent⁶ technique were selected. They were of Caucasian patients, aged between 10 and 16, mean age of 12.6 years old, from the Orthodontics specialization program clinic at the School of Pharmacy and Dentistry of Alfenas.

The participants in the sample were randomly selected with regard to gender, and none of them had been submitted to orthodontic treatment of any kind. The exclusion criteria were presence of crossbite, open bite or indication for ortho-surgical treatments. The sample was divided into three groups. Group I was composed of 50 individuals with Class I malocclusion, being 26 boys and 24 girls. Group II-1 was composed of 50 individuals with Class II division 1 malocclusion, being 25 boys and 25 girls, and the third group, Group II-2, was composed of 30 individuals with Class II division 2 malocclusion, with 14 boys and 16 girls. The malocclusions were classified by the examination of dental casts (molar relationship according to Angle)¹ and angular cephalometric measurements (ANB, I,SN). All Angle Class I malocclusions were skeletal Class I (ANB between 0° and 4°) and all Class II malocclusions (division 1 and 2) were skeletal Class II (ANB greater or equal to 5°).

The method chosen was the comparison of cephalometric measurements. All the radiographs were obtained following the standardization norms of the first cephalometric workshop.²⁶ All tracings were performed with the objective of selecting the anatomical structures of interest. The measurements were performed by a single orthodontist, and were verified twice at different occasions.

The angular measurements used were as follows:

- **Angle of facial convexity (Cx)**, formed by the intersection of the line that passes through the glabella point (G') and the subnasale point (Sn)

and another line from the subnasale point to the soft pogonion point (Pog'). Ideally it should be $-11 \pm 4^\circ$ according to Downs⁹ (Fig 2).

- **Angle (H.SN)**, formed by the intersection of SN line with H-line. For Holdaway and Merrifield¹⁴ the value of this angle should be 73° (Fig 2).
- **Nasolabial angle (NLA)**, formed by the intersection of the line that passes through the columella (Cm) and subnasal (Sn) points and the line that passes through the labrale superior (Ls) and subnasale (Sn) points. According to Sheideman,²⁷ the nasolabial angle must be 110° with a clinical deviation from 90° to 110° (Fig 1).
- **Mentolabial angle (MLA)**, formed by the intersection of the line that passes through the lower lip vermilion point (LV) up to point B' and a line from point B' to the soft pogonion point (Pog') which, according to Nguyen and Turley,²² must be to 128.5° with a clinical deviation of $\pm 11^\circ$ (Fig 1).
- **Angle (I-SN)**, formed by the intersection of the long axis of the maxillary incisor and the SN line. The ideal value considered for this angle is 103° according to Steiner and Riedel²⁹ (Fig 1).
- **Angle (IMPA)**, formed by the intersection of the long axis of the mandibular incisor and mandibular plane. The normative value for this angle must be $90 \pm 5^\circ$ according to Tweed³⁰ (Fig 1).

The linear measurements used were as follows:

- **UL-S:** Distance from the most anterior point of the upper lip convexity to the S-line of Steiner. According to Steiner²⁹ the ideal distance would be 0 mm (Fig 2).
- **LL-S:** Distance from the most anterior point of the lower lip convexity to S-line of Steiner. According to Steiner²⁹ the ideal distance would also be 0 mm (Fig 2).

STATISTICAL ANALYSIS

Method error

In order to assess the method error and increase its reliability, 30 cephalometric radiographs were randomly selected from the 3 groups studied. The radiographs were traced again by a single operator after a 1 month interval from the initial tracing, according to Midtgard, Bjork and Linder-Aronson.¹⁹

The error was calculated in accordance with the

formula proposed by Dahlberg⁸ and defended by Houston,¹⁵ and the paired *t*-test (for the variables with normal distribution) and Wilcoxon paired test (for the variables UL-S and LL-S) were performed comparing the two tracings at a level of significance of 5%. The deviation values were below the acceptable limits to the method error assessment which is 1.5 degrees for the angular measurements and 1.0 mm for the linear measurements, in accordance with Houston's recommendations.¹⁵

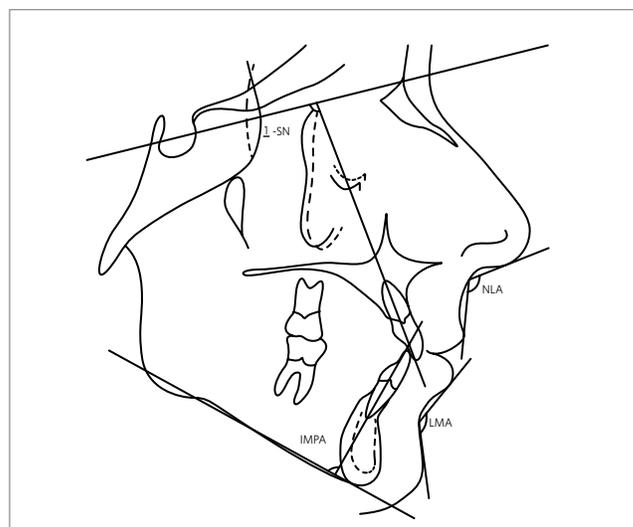


Figure 1 - Representation of the angular measurements of dental positioning and lip posture.

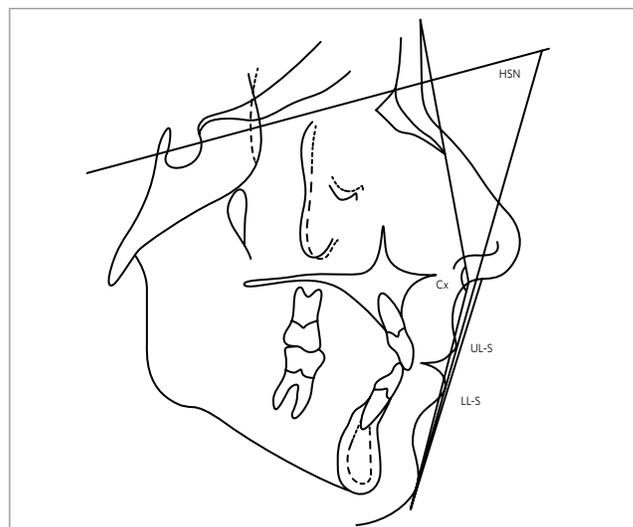


Figure 2 - Representation of the angular measurements of facial convexity and linear measurements of lip positioning.

Data analysis

Initially, an exploratory analysis of the data was performed using the Proc Lab of the SAS* statistical software (SAS Institute Inc., Cary, NC, USA, Release 8.2, 2001). The analysis of variance and the Tukey test were used for the data that met the presuppositions of parametric analysis (Cx, IMPA, \perp -SN, MLA and NLA). For the variable H.SN, the logarithmic transformation was used followed by the Analysis of Variance and the Tukey test. Since the other variables (LL-S and UL-S) did not meet the presuppositions of parametric analysis, Kruskal-Wallis and Dunn tests were used. For some variables the median was used instead of the mean because some measurements were shown to be discrepant and were not indicated for obtaining the mean. However, this did not harm the objectives of this study, as the test applied to one variable was the

same for the three types of malocclusions and these were compared to each other, to find the similarity among them. In all the analyses, a level of significance of 5% was considered.

RESULTS AND DISCUSSION

The measurement \perp -SN showed (Fig 3) statistically significant difference between the three groups ($p < 0.05$) corroborating the findings of Riedel²⁵. This measurement was revealed to be capable of differentiating these malocclusions. However, when considering the SD, expressive values were observed for all malocclusions (6.02 Class I; 6.39 Class II-1; 5.18 Class II-2), which suggests variations in the inclination of the cranial base and axial inclination of the maxillary incisor. This incisor could undergo variations resulting from factors inherent to anterior-posterior^{13,21}

Table 1 - Dentofacial angular measurements.

Angular Measurements						
Groups	1-SN	IMPA	MLA	NLA	CX	H.SN
I	105.34(6.02) ^b	90.22(5.39) ^b	120.3(13.26) ^a	108.55(9.92) ^a	166.58(4.47) ^a	67.58(5.73) ^a
II-1	110.19(6.39) ^a	98.15(7.35) ^a	110.56(16.80) ^b	105.18(12.21) ^a	161.19(4.83) ^b	59.65(4.51) ^b
II-2	96.62(5.18) ^c	97.82(8.45) ^a	115.18(15.44) ^{ab}	109.73(9.46) ^a	158.95(4.08) ^b	57.58(4.39) ^b

N=50 (Groups I and II-1) and N=30 (Group II-2), Mean (Standard deviation). *Equal letters: No statistically significant difference ($p < 0.05$), observed for the same measurement.

Table 2 - Linear measurements of lip positioning.

Linear measurements	UL-S			LL-S		
	I	II-1	II-2	I	II-1	II-2
Minimum value	-4.5	-3.5	-3.5	-3.5	-3.0	-2.5
Median*	1.0 ^b	3.75 ^a	2.25 ^a	2.0 ^b	3.0 ^a	2.5 ^{ab}
Maximum value	9.5	12.0	9.0	10.0	11.0	9.0

N=50 (Groups I and II-1) and N=30 (Group II-2), *equal letters: No statistically significant difference ($p < 0.05$), observed for the same measurement.

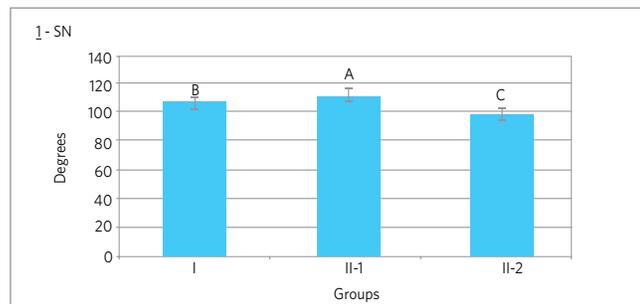


Figure 3 - Means for 1-SN angular measurement.

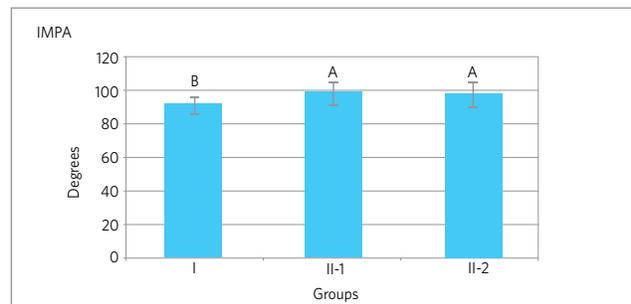


Figure 4 - Means for IMPA angular measurement.

skeletal growth, perioral muscles, tongue and position of the antagonist teeth.²⁴

The measurement IMPA showed (Fig 4) a statistically significant difference between Groups Class I and Class II-1, and between Groups Class I and Class II-2 ($p < 0,05$). The expressive SD (5.39 Class I; 7.35 Class II-1; 8.45 Class II-2), particularly in Class II malocclusions, showed that the axial behavior of mandibular incisors on their bony base (IMPA) was highly variable, similarly to findings of Tweed³⁰ for Group Class I and higher than the value found by Tweed for Class II malocclusions. Furthermore, the IMPA also depends on other factors such as the perioral muscles, tongue, overjet, overbite, presence of habits, growth and each individual's own characteristics. It is worth

emphasizing the similarity found for the measurements of the Groups Class II-1 and Class II-2, which showed the same proclination of the mandibular incisors for compensation of Class II,^{16,18} irrespective of the type of malocclusion.

The MLA angle showed (Fig 5) a statistically significant difference only between Groups Class I and Class II-1 ($p < 0,05$), similar to the findings of Nguyen and Turley²² for Group Class I but lower for Class II malocclusion and expressive SD for all groups (13.26 Class I; 16.80 Class II-1; 15.44 Class II-2), which is a reflection of the variations in lip position. A more significant degree of eversion of the lower lip was found for Group Class II-1 due to greater protrusion and proclination (\perp -SN) of the maxillary incisor in this group.

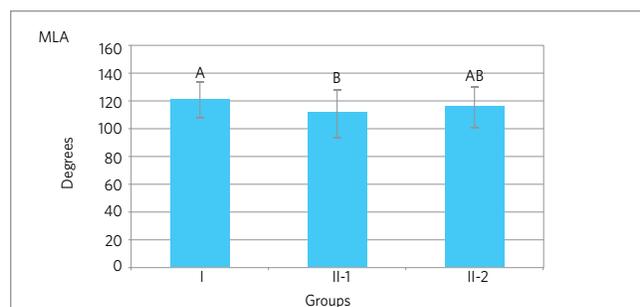


Figure 5 - Means for MLA angular measurement.

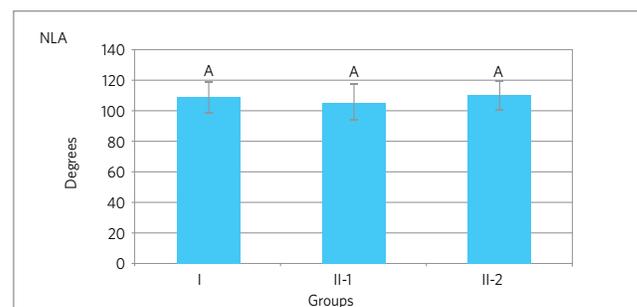


Figure 6 - Means for NLA angular measurements.

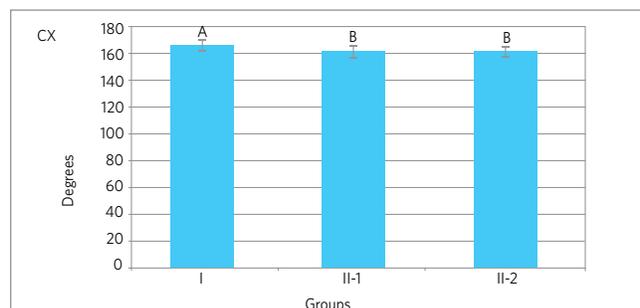


Figure 7 - Means for CX angular measurement.

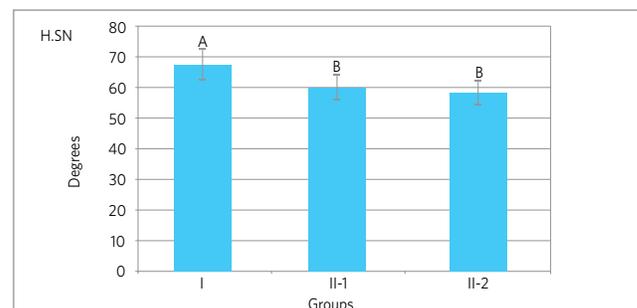


Figure 8 - Means for H.SN angular measurement.

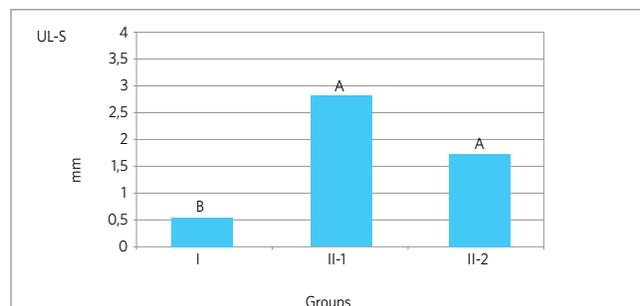


Figure 9 - Medians for UL-S linear measurements.

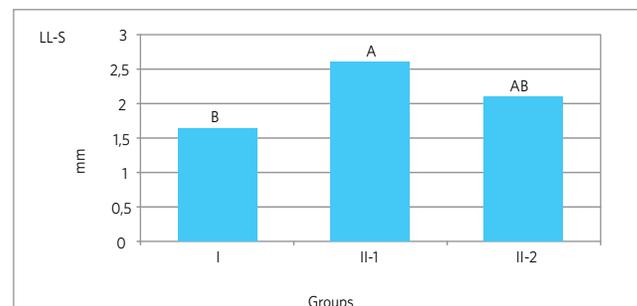


Figure 10 - Medians for LL-S linear magnitude.

In spite of the more anterior positioning of the maxillary incisor in Group Class II-2, this group showed no significant eversion and presented similar values to those of Group Class I as a result of compensation between the existing retroclination of the maxillary incisors (I-SN) and the proclination of the mandibular incisors (IMPA).⁵

The NLA measurement showed (Fig 6) no statistically significant difference for the 3 groups ($p > 0.05$), corroborating the findings of Scheidemann,²⁷ Epker, Stella and Fish.¹¹ The high SD values (9.92 Class I; 12.21 Class II-1; 9.46 Class II-2) showed that this angle can undergo significant variations, and still remain within the esthetic values. It is worth pointing out that there seems to be a compensation of point Cm (Columella) and/or the position of the upper lip in these malocclusions,²⁷ resting on the professional the responsibility of evaluating the harmony existent between the lip and nose and make a decision in each case, since the measurement of this angle was not capable of differentiating the three types of malocclusion. This corroborates the findings of Reche,²³ but is contrary to the findings of Fitzgerald, Nanda and Currier,¹² who reported that this angle is reliable.

The CX measurement showed a statistically significant difference between Groups Class I and Class II-1, and between Class I and Class II-2 ($p < 0.05$) similarly to the findings of Arnett, Bergman,² but differing from those of Downs,⁹ the SD was not very significant. The values found for Groups Class II-1 and Class II-2 suggest greater lip protrusion. The individuals with Class II-1 showed a greater angle of convexity⁴ and the opposite for the Group Class II-2, but without statistically significant difference.

The H.SN measurement showed a statistically significant difference between Groups Class I and Class II-1 and between Groups Class I and Class II-2 ($p < 0.05$) according to Holdaway,¹³ but with lower values and a less significant SD. The results corroborate the findings of the CX measurement. The higher values shown by the Group Class II-1, in comparison with Group Class II-2, even though there is not a statistically significant difference between these two groups, suggest a smaller inclination of the cranial base, as there seems to be a trend towards positive correlation

between Group Class II-1 and the presence of a spatial change of the mandible in the clockwise direction.

The linear measurement of UL-S showed a statistically significant difference between Groups Class I and Class II-1 and between Class I and Class II-2 ($p < 0.05$). The values found for three groups were higher than those recommended by Steiner,²⁹ but are in agreement with those found by Auger and Turley.³ The values show that the Groups with Class II malocclusion showed no statistically significant difference among them, however it suggests a direct relationship with the nose size.^{13,14} showing an anterior-posterior growth of the nose, inferior for Group Class II-1 when compared with Group Class II-2.

The linear measurement of LL-S showed a statistically significant difference only between Groups Class I and Class II-1 ($p < 0.05$). The values for the three groups were higher than those recommended by Steiner,²⁹ but are in agreement with those found by Auger and Turley.³ These results show that the values found for Group Class II-1 reflect the greater eversion of the lower lip found in this group due to the position of the maxillary incisor, since the values of the Li-NPog measurement are very similar for Groups Class II-1 and Class II-2, on the contrary from the angular values of MLA and IMPA, in spite of showing no statistically significant difference among the groups.

CONCLUSIONS

- » The Class II-1, Class II-2 and Class I malocclusions showed different facial characteristics for the I-SN measurement.
- » The Class II-1 malocclusion showed facial characteristics that differentiate it from Class II-2 and Class I as regards the MLA measurement.
- » Class II-1, Class II-2 and Class I malocclusions did not show different facial characteristics for the NLA measurement and showed a direct relationship with lower lip eversion for the LL-S measurement.
- » The Class II-1 and Class II-2 malocclusions differ from Class I by the facial characteristics expressed by the measurements H.SN, Cx, UL-S and IMPA.

REFERENCES

1. Angle EH. Classification of malocclusion. *Dent Cosmos*. 1899;41:255-64.
2. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning - Part I. *Am J Orthod Dentofacial Orthop*. 1993;103(4):299-312.
3. Auger TA, Turley PK. The female soft tissue profile as presented in fashion magazines during the 1900s: a photographic analysis. *Int J Adult Orthod Orthognath Surg*. 1999;14(11):7-18.
4. Bishara SE, Cummins DM, Zaher AR. Treatment and post treatment changes in patients with class II, division 1 malocclusion after extraction and nonextraction treatment. *Am J Orthod Dentofacial Orthop*. 1997;111(1):18-27.
5. Brandão AMB, Vigorito JW, Capelozza Filho L. Avaliação das características do perfil tegumentar em pacientes com maloclusão classe II, divisão 1 por meio da análise facial numérica. *Ortodontia*. 2001;34(2):59-85.
6. Broadbent BH. A new x-ray technique and its application to orthodontia. *Angle Orthod*. 1931;1(2):45-66.
7. Burstone CJ. The integumental profile. *Am J Orthod*. 1958;44(1):1-25.
8. Dahlberg G. *Statistical methods for medical and biological students*. New York: Interscience; 1940.
9. Downs WB. Análises do perfil dentofacial. *Angle Orthod*. 1956;26(12):191-212.
10. Enlow DH. *Crescimento Facial*. Rio de Janeiro: Artes Médicas; 1984.
11. Epker BN, Stella JP, Fish LC. *Dentofacial deformities: integrated Orthodontic and surgical correction*. 2a ed. St. Louis: Mosby; 1995.
12. Fitzgerald JP, Nanda R, Currier GF. Na evaluation of the nasolabial angle and the relative inclinations of the nose and upper lip. *Am J Orthod Dentofacial Orthop*. 1992;102(9):328-34.
13. Holdaway RA, Merrifield LL. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. *Am J Orthod*. 1983;84(1):1-28.
14. Holdaway RA, Merrifield LL. The profile line as an aid in critically evaluating facial esthetic. *Am J Orthod*. 1966;52(11):804-22.
15. Houston WJB. The analysis of errors in orthodontic measurements. *Am J Orthod Dentofacial Orthop*. 1983;83(5):382-90.
16. Lindquist JT. The lower incisor: its influence on treatment and esthetics. *Am J Orthod*. 1958;44(2):112-40.
17. Loi H, Nakata S, Nakasima A, Counts A. Effect of facial convexity on antero-posterior lip positions of the most favored Japanese facial profiles. *Angle Orthod*. 2005;75(3):326-32.
18. Merrifield LL. Differential diagnosis. *Semin Orthod*. 1996;2(4):241-53.
19. Midtgard J, Bjork G, Linder-Aronson S. Reproducibility of cephalometric landmarks and errors of measurements of cephalometric cranial distances. *Angle Orthod*. 1974;44(1):56-61.
20. Czarnecki ST, Nanda RS, Currier GF. Perceptions of a balanced facial profile. *Am J Orthod Dentofacial Orthop*. 1993;104(2):180-7.
21. Nanda RS, Ghosh J. Harmonia entre os tecidos moles da face e crescimento no tratamento ortodôntico. In: Sadowsky PL, Zachrisson BU, Nanda R, Vlachos CC, Vaden JL, editores. *Atualidades em Ortodontia*. Porto Alegre: Premier; 1997. p. 65-78.
22. Nguyen DDE, Turley PK. Changes in the caucasian male facial profile as depicted in fashion magazines during the twentieth century. *Am J Orthod Dentofacial Orthop*. 1998;114(2):208-17.
23. Reche R. Análise do perfil facial em fotografias padronizadas. *Rev Dental Press Ortod Ortop Facial*. 2002;7(8):37-45.
24. Ricketts RM. Esthetics, environment and the law of lip relation. *Am J Orthod*. 1968;54(4):272-89.
25. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. *Angle Orthod*. 1952;22(3):142-5.
26. Salzmann JA. First roentgenographic cephalometric workshop. *Am J Orthod*. 1958;44(12):899-900.
27. Scheideman GB. Cephalometric analysis of dentofacial normals. *Am J Orthod*. 1980;78(9):404-20.
28. Skinazi GLS, Lindauer SJ, Isaacson RJ. Chin, nose and lips. Normal ratios in young men and women. *Am J Orthod Dentofacial Orthop*. 1994;106(5):518-23.
29. Steiner CC. Cephalometric as a clinical tool. In: Kraus BS, Riedel RA, editors. *Vistas in Orthodontics*. Philadelphia: Lea & Febiger; 1962. p. 131-61.
30. Tweed CH. Indications for the extraction of teeth in orthodontic procedure. *Am J Orthod*. 1944;30(8):405-28.