Facial Analysis: Correlation Between Cephalometric Angles and Types of Facial Profile

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Abstract: *Objective:* to correlate the nasolabial angles (ANL) and mentholabial groove (ASML) with the straight, concave and convex facial profiles, determined through subjective analysis, for application in orthodontic facial analysis.

Method: a cross-sectional, retrospective and analytical study was carried out, with a sample of 184 documents from patients aged between 21 and 36 years old, being 107 woman and 77 man; belonging to the collection of the Specialization Course in Orthodontics, UNIFIP / PB, Brazil. The profile photographs were analyzed, through the subjective method, by visual analysis, under inter-examiner calibration, for classification of the profiles in: straight, concave and convex. For this, the projections of the upper and lower lips were considered, as well as their relationship with the projection of the chin and nose. In lateral radiographs, ANL and ASML angles were drawn for cephalometric analysis. The angles were transcribed through the construction of the facial profile of soft tissues from teleradiographies, in a negatoscope, outlined with ultrafan paper, through the contour of the anatomical soft tissue profile. The data were tabulated on a specific form for this purpose.

Results: the majority of the sample consisted of women (58.2%); by brown patients (63.6%); convex profiles (50.0%); and with woman ANL angles 103.53º (± 9.78) and man 103.27º (± 11.65); and ASML, within the normal range 132, 07º (± 9.54º) for both sexes, respectively. There was no significant correlation between facial profiles and ANL and ASML angles.

Conclusion: the ANL and ASML angles did not influence the facial profiles for the studied sample.

Keywords: Cephalometry, Face, Orthodontics.

INTRODUCTION

Facial aesthetics is one of the main reasons for seeking orthodontic treatment [1, 2]. Since antiquity, facial harmony and beauty have aroused interest in human beings, with beauty closely linked to proportionality [2-5]. Therefore, contemporary dentistry together with society, in the exaltation of the smile and facial symmetry, seeks to reestablish the masticatory function and restore facial harmony [1, 4].

Thus, due to the psychological and social effects involved, facial analysis is an indispensable and valid diagnostic method for the correct planning of ortho-surgical, purely orthodontic cases, or even those associated with functional orthopedics [6, 7]. This analysis identifies characteristics of the facial profile, using cephalometric data, and assesses the self-perception of individuals, as well as the perception of people in the results of treatments, emphasizing that the appreciation of beauty varies for each population at different historical moments [1, 8].

The study of the functional and aesthetic aspects of the tegumentary tissues of the face, in relation to the profiles, bone and dental, has aroused growing interest, in the sense of associating orthodontic treatment to changes involving facial aesthetics, thus suggesting that subjective patterns in facial analysis, they should be taken into consideration, distancing themselves from the fixed standards that cephalometry imposes [9]. Since they were described by Woolnoth, [7], straight, concave and convex facial profiles, influence the perception of beauty in different types of faces, as each individual has its particularities and can differ significantly in terms of their facial characteristics [9].

In addition to facial profiles, another important parameter in the integumentary evaluation of the face is the relationship between nose, chin and lips. Thus, the nasolabial (ANL) and mentolabial sulcus (ASML) angles assess the protrusion of the upper and lower lips in relation to the nasal base and chin, respectively [12], and are important in representing the profile of the maxillary soft tissues and mandible, as they describe the relationship between the nasal and chin bases, with the upper and lower lips, which may undergo changes, perceptibly, for laypersons and professionals, with orthodontic and surgical procedures, changing the anteroposterior position or inclination of the teeth [12 , 13].

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Cabral and Cruz [14] reported in their study that the perception of beauty is subjective and culturally influenced, however, facial analysis is essential for the success of orthodontic treatment. The knowledge obtained through this analysis guides the procedures to be carried out in the valorization and preservation of facial beauty and for this reason, the effects caused should be critically analyzed. In this literature review, it was concluded that the cephalometric data must be interpreted in association with the patient's facial pattern, therefore, the treatment must be individualized.

Queiroz and collaborators [10] evaluated the aesthetics of the lower third of the face, as well as the establishment of acceptable standards to facilitate the correct diagnosis and orthodontic treatment plan. They verified the measurements of the lower third of the cutaneous profile of Brazilian white blood cells, Pattern I; and compared to standard measurements through 19 photographs, showing from the tip of the nose to the soft pogonion. The profiles were evaluated by teachers, dental students and lay people, who qualified them as unpleasant, pleasant and very pleasant. It was concluded that Pattern I individuals do not always present a pleasant profile, and that Brazilians prefer the convex profile, while North American and European patterns, indicate the straight profile.

Melo *et al*. [15] studied facial pleasantness and classified 30 black individuals as aesthetically unpleasant, acceptable or pleasant through frontal and profile photographs. The results indicated that the most aesthetically unpleasant structures were: mouth, lips and face, in the frontal photograph; and nose and chin, in profile photography. The bursts identified as aesthetically pleasing were: facial harmony, face and mouth, in the frontal photograph; and facial and nose harmony, in profile. It was concluded that facial pleasantness, according to the criteria of subjective facial analysis, is applicable, valid and important in planning orthodontic treatment.

For Gonzatti and collaborators [16], facial analysis is an important method in orthodontic diagnosis. However, it has also been a major clinical challenge for orthodontists in seeking standards of normality due to ethnic miscegenation for each population. Therefore, in their study, they aimed to compare the values of the cephalometric analysis of soft tissues (ACTM), in a sample of young Brazilians; with averages of North American individuals, as well as other Brazilian surveys. Teleradiographic shots and extra-oral profile pictures were taken in a natural position of the head in 30 individuals, 15 women and 15 men. It was concluded that the cutaneous profile was convex, suggesting that future research is necessary due to the Brazilian ethnic mix.

Considering the points previously discussed, the present study aims to correlate the subjective facial analysis of the facial profiles (straight, concave and convex), with the ANL and ASML angles, in determining the orthodontic diagnosis and treatment, young northeasterners people.

METHOD

A cross-sectional, retrospective, descriptive-analytical study was carried out, through the evaluation of 184 standardized lateral teleradiographies in natural head position (PNC) and profile photographs, of orthodontic documentation belonging to the collection of the Specialization Course in Orthodontics at UNIFIP / PB; all performed by the same radiology center.

Documentations of patients with completed facial skull growth and aged between 21 and 36 years were included; and incomplete, poorly executed, patients who underwent orthognathic surgery, patients with syndromes and fissures, as well as those that did not contain the signatures of the parents and / or guardians in this document, were excluded.

The data collection was performed by a single examiner, guided and duly trained by the responsible researcher, who classified, subjectively, by the visual method, in the profile photographs; facial profiles in: straight, convex and concave; considering the projections of the upper and lower lips, as well as their relationship with the projection of the chin and nose. For intra-examiner agreement, the Kappa coefficient of agreement was applied (degree of substantial agreement (0.06 to 0.80) - Landis and Koch scale) [17].

For the cephalometric analysis, nasolabial angles and mentolabial groove were traced, in projections of the soft profile of the lateral teleradiographies, through megatoscope contrast and anatomical profile contour on ultrafan paper, whose marked points were the following: nasolabial angle (Prm. Sn.Ls) - formed by the base of the nose and the upper lip [18, 19].

Scheidemann and collaborators [19] proposed a normative value of 111.9º (± 8.4º) for man, and 111, 4th (± 11.7º) for woman. For the angle of the mentholabial groove (Li. Lm. Pg ') - formed between the lower lip and the anterior projection of the chin, Worfod and Hilliard [20], proposed its normative value of 124º (± 10º), for both sexes (Figure **1**).

Figure 1: Graphical representation of the Nasolabial (ANL) and Mentolabial Groove (ASML) angles.
Source: Author's Data, Patos, PB, Brazil, 2020.

The data were tabulated in a specific form for this purpose, and distributed in descriptive and analytical tables. Statistical analysis was performed using the IBM SPSS Statistic software (Version 25.0, IBM SPPS Inc., Armonk, NY, USA), considering a 95% confidence interval, in absolute and percentage frequencies, to characterize the sample. Then, bivariate analysis was performed using Pearson's chi-square test ($p < 0.05$).

This study followed the precepts of Bioethics (Resolutions 466/12 and 566/16 - Brazil), and was submitted for approval by the Ethics Committee on Research with Human Beings of UNIFIP / PB, being approved under protocol number: 2,713,971.

RESULTS

Table **1** describes the distribution of the sample according to the variables sex, age and skin color. The average age was 25.64 years; the majority of the sample was woman and brown.

Tables **2** and **3** show the variables related to subjective and cephalometric facial analysis; as well as the ANL and ASML angles. It was observed, according to the subjective analysis, that the majority of the sample presented the convex profile. As for the cephalometric analysis of the soft profile, it was found that in most of the sample, the ANL and ASML angles corresponded to the pattern proposed by the literature.

Table 1: Distribution of the Sample according to the Variables: Age, Sex and Skin Color

Variables	N	%
Age		
≤ 24 years	102	55,4
> 24 years	82	44,6
Sex		
Woman	107	58,2
Man	77	41,8
Skin color		
Black	11	6,0
White	56	30,4
Brown	117	63,6

Source: Author Data, Patos, PB, Brazil, 2020 (n = 184).

Table 2: Description of Variables Related to Facial, Subjective and Cephalometric Analysis

Variables	N	%
Facial Profile		
Straight	64	34,8
Convex	92	50,0
Concave	28	15,2
Nasolabial Angle - Womam		
Reference Value	50	46,7
Smaller	55	51,4
Bigger	2	1,9
Nasolabial Angle - Man		
Reference Value	40	51,9
Smaller	35	45,5
Bigger	2	2,6
Mentolabial Groove Angle		
Reference Value	121	65,8
Smaller	4	2,2
Bigger	59	32,1

Source: Author's Data, Patos, PB, Brazil, 2020 (n = 184).

Table **4** shows the measurements of the facial profile in relation to the ANL and ASML angles. The ANL average did not vary between profiles. The ASML varied approximately by one degree per profile, corresponding to 133.13º (± 9.92) straight profile, 131.09 (± 8.74) convex profile and 132.86 (± 11.10) concave profile.

Table **5** describes the association between the facial profile and the variations of the ANL and ASML angles. It was found, with no significant association ($p > 0.05$), that increased ASML was more prevalent in patients with a convex profile.

DISCUSSION

Subjective facial analysis, used as a diagnostic resource, has become indispensable in orthodontic planning, because in addition to identifying characteristics of the individual's soft profile, it is an instrument by which patients and people around them will evaluate the results of treatment, being important associate it with cephalometry and other existing complementary exams, such as frontal and profile photographs [10].

As for the characterization of the studied sample, considering the findings in this research and the rescue of the literature [12, 21-23], young woman individuals are more concerned with aesthetics and are, therefore, most in demand for treatments related to facial changes. This data corroborates the values described in the present study, since the majority of individuals were woman, and young patients, with a mean age of 24 years.

In addition, there was a high prevalence of brown patients, demonstrating that the relationship between racial miscegenation and facial changes is true, as described in the current literature [12]. This miscegenation is an important variable when considering the analysis of soft tissue and, therefore,

Table 3: Distribution of Cephalometric Quantities: ANL and ASML Angles

Variables	Average (SD)	Minimum	Maximum
Nasolabial Angle - Womam	103,53º (±9,78)	65º	126º
Nasolabial Angle - Man	103,27 (±11,65)	80º	135º
Mentolabial Groove Angle	132,07º (±9,54º)	96º	165º

Source: Author's Data, Patos, PB, Brazil, 2020 (n = 184). Note. SD = standard deviation.

Table 4: Distribution of Facial Profiles in Relation to ANL and ASML

Variables	ANL			ASM		
	Average (SD)	Minimum	Maximum	Average (SD)	Minimum	Maximum
Straight	103,45º (±11,12)	65º	135º	133,13º (±9,92)	107	160
Convex	103,40 (±10,42)	78º	128º	131,09 (±8,74)	113	165
Concave	103,43º (±10,13º)	83º	126º	132,86 (±11,10)	96	149

Source: Author's Data, Patos, PB, Brazil, 2019 (n = 184).

Table 5: Association between the Facial Profile and the Variations of the ANL and ASML Angles

Variables	Facial Profile				
	Straight N (%)	Convex N (%)	Concave N (%)	Total N (%)	Value P
Nasolabial Angle - Womam					
Reference Value	18 (36,0)	26 (52,0)	6 (12,0)	50 (100)	0,59
Smaller	19 (34,5)	26 (47,3)	10 (18,2)	55 (100)	
Bigger	0 (0,0)	2 (100,0)	0 (0,0)	2 (100)	
Nasolabial Angle - Man					
Reference Value	14 (35,0)	19 (47,5)	7 (17,5)	40 (100)	0,38
Smaller	11 (31,4)	19 (54,3)	5 (14,3)	35 (100)	
Bigger	2 (100)	0 (0,0)	0 (0,0)	2 (100)	
Mentolabial Groove Angle (Womam / Man)					
Reference Value	39 (32,2)	67 (55,4)	15 (12,4)	121 (100)	0,29
Smaller	2 (50,0)	1 (25,0)	1 (25,0)	4 (100)	
Bigger	23 (39,0)	24 (40,7)	12 (20,3)	59 (100)	

Source: Author's Data, Patos, PB, Brazil, 2020 (n = 184). Not significant: p> 0.05.

indispensable for subjective facial analysis, since individuals with different racial profiles can generate descendants with intermediate characteristics, being thus able to, increase the chance of facial discrepancies, whether bone, dental or soft tissue [12, 16, 23, 24]. For Gonzatti *et al*. [16], facial analysis has been an important method in orthodontic diagnosis, however, it is a great clinical challenge for orthodontists in the search for normality patterns due to ethnic miscegenation for each population.

Thus, Arnet and collaborators [9], reported that the individuality of the patient must be taken into account, as individuals of the same race who would supposedly have the same facial characteristics, present peculiarities in their facial patterns due to the fact that they belong to different geographic regions. It was also found that people of different genders of the same race and region, differ significantly in terms of facial characteristics [22].

As for the analysis of facial profiles, some authors [16, 23] compared the facial profile of Brazilians to North Americans, emphasizing that the convex profile was the most prevalent facial constitution among Brazilians, corroborating the present study; and differing from the study carried out by Boeck *et al*. [25] where the highest prevalence was for the straight profile (84.2%). In addition, the results of a recent systematic review [12], concluded that the biprotuse profile was the most attractive among all, indicating that beauty is subjective and individual for each population. These data disagree with the findings of some studies [23, 26], which highlighted the straight profile as more attractive.

In the evaluation between the measurements of the ANL and ASML angles, and the three profiles studied straight, convex and concave, no statistically significant differences were found. The ANL average did not vary between profiles. The angulation for the rectum was 103.45º (± 11.12), corroborating the studies by Khan and collaborators [27], which found an average value of 101.6º (+ - 14.5º); and disagreeing with another study [10], which evaluated the lower third of the face of Pattern I individuals and observed a value lower than that considered standard (97.6°); demonstrating that this more acute angle is more accepted by Brazilians, who consider more voluminous lips aesthetically more pleasant.

It is also worth noting that, among the sample of the present study, some convex profiles presented considerable inclination from the base of the nose upwards, resulting in a more open ANL, demonstrating a factor that can influence the values presented by this angle. For the convex and concave profiles, the measurements were, respectively, 103.40º (± 10.42) and 103.43º (± 10.13º); result that corroborates with the study of Reis and collaborators [28], and disagrees with the findings of Ferreira and collaborators [29], which presents a lower value, with an average of 91.95º.

For ASML, the present research found a variation between the profiles, with the rectum presenting an angle of 133.13º (± 9.92); the convex, 131.09 (± 8.74), and the concave 132.86 (± 11.10); corroborating with several studies [28, 29, 30], where the values maintained very similar averages numerically. The variations of AMSL in the different profiles did not show statistical significance, demonstrating that this angle did not influence facial profiles.

ANL is generally found to be higher in woman than in man. In this study, the woman mean was 103.53º (± 9.78) corroborating with some findings in the literature [6], which verified a value of 101.1º (± 12.5º). This difference was not statically significant when comparing women and men. These data corroborate the results of Ferreira *et al*. [29], who evaluated the integumentary characteristics of patients with class III malocclusion; and disagree with Feres and Vasconcelos [6], who found, for the male gender, a value of 97º (± 19.89º). It is relevant to emphasize the importance of tilting the base of the nose when measuring the nasolabial angle, as it is possible to analyze individuals with very different measurements for the angle, but without major changes in lip protrusion.

For ASML, the literature [7] proposed a normative value of 124º (± 10º), disagreeing with the findings of the present study, with an average of 132.07º (± 9.54º) for both sexes. This result corroborates with some studies [28, 31], where the averages remained numerically similar to the present study.

In view of all the points listed and discussed previously, it is clear the need for further research that focuses on the specific correlation between the ANL and ASML angles, and the facial profiles, as well as it is suggested to compare them, in isolation, to the Facial Patterns I, II and III. More studies are needed in this sense, as well as, focusing on the Northeastern population, which has its own and peculiar characteristics, in relation to other samples described in the literature.

CONCLUSIONS

According to the literature consulted and the methodology used in this research, it was concluded that:

- Facial profiles showed the following prevalences, from highest to lowest, respectively: convex, straight and concave;
- The ANL and ASML angles showed variations for, increased or decreased, however the majority of the sample showed to be very close to the standard values proposed by the literature;
- No statistically significant differences were found between the correlations of the straight, convex and concave facial profiles; and the ANL and ASML angles.

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