ASSESSMENT OF THE CORRELATION BETWEEN CEPHALOMETRIC AND FACIAL ANALYSIS

ABSTRACT

PURPOSE: The objective of this study was to evaluate the correlation between angular and linear measurements obtained from cephalometric and facial analysis. **MATERIALS AND METHODS:** Eighteen patients with indication for orthodontic treatment were selected. Then a trained examiner assessed in lateral cephalographs the following linear measurements proposed by McNamara: Co-A; Co-Gn; A-NPerp; Pog-NPerp; maxillary-mandibular discrepancy. Moreover, angular nasolabial angle, N-A, A-Pog, and Frankfurt Mandibular Angle (FMA) were computed. Likewise, the corresponding facial measurements in lateral photographs were measured, as follows: Co'-A'; Co'-Gn'; A'-NPerp'; Pog'- NPerp'; Maxillary-mandibular discrepancy; nasolabial angle; N-A-Pog; FMA. **RESULTS:** Pearson's correlation test was applied to the results. All measurements were compared separately with their corresponding facial and cephalometric measurements. Results: The assessed linear measurements showed no statistical correlation. The nasolabial angle measurement showed a significant correlation, while FMA and NA-Pog measurements showed a low correlation. **CONCLUSION:** According to the methodology applied, the results of linear, facial and cephalometric measurements showed no correlation. Of the angular measurements, only the nasolabial showed a significant correlation.

OLIVEIRA, Marcelo Tomás*
CANDEMIL, Amanda**

KEYWORDS

Facial analysis. Cephalometric analysis. Orthodontic diagnosis.

DDS, MSc, PhD - Dental School, University of Southern Santa Catarina – UNISUL, Brazil*
Dental School student - University of Southern Santa Catarina - UNISUL, Brazil **
Correspondence: marcelo.oliveira@unisul.br (OLIVEIRA MT)

| **Received** 12 Dec 2012 **Received in revised form** 27 Jan 2013 **Accepted** 4 Mar 2013

INTRODUCTION

Cephalometric analysis has been used as a diagnostic element for ease of obtaining, measuring and comparing skeletal structures.[1] Based on the belief that following the cephalometric norms would result in a pretty face, for many years, ideal cephalometric measurements were reference to orthodontic treatment and a synonym for facial aesthetics.

The three-dimensional shape of facial structures was compacted in two-dimensional image of cephalographs and this was accepted in a simplistic way. [2,3] It is known for decades that the relationship between the apical bases and the skeletal profile convexity, the facial standard and position of anterior teeth have an important influence on facial aesthetics. [4]

Currently, the increasing demand for aesthetic standards, often rated by the media, created instability of the parameters pre-established by cephalometry. The effect of face treatment seeking the cephalometric ideal began to be questioned. Making an orthodontic diagnosis based only on dental casts, lateral cephalograms and cephalometry now seems to be a procedure often limited when a comprehensive face treatment is desired. [5,6]

Nowadays, it is observed that malocclusion should be treated under an aesthetic point of view, depending on the patient's face, and no face alteration should be made, in light of teeth, when it is in harmony. [7] This is paradoxical: on the one hand patients' demand increases for orthodontic treatment to promote improvements in their facial aesthetics. On the other hand, the orthodontist is worried about the success of the treatment, which is almost always tied to predetermined criteria in cephalometric analysis still considering primarily the hard tissue to establish the normal patterns.[8]

One of the most recent cephalometric analysis, available to the orthodontist, was proposed by McNamara. Among other things, this analysis evaluates three-dimensional relationships between the maxilla and mandible and between these and the face. Based on the Frankfurt plan, we propose a table of linear proportional ratios in an attempt to individualize the diagnosis.[1]

In this study, we tried to design the analysis on lateral photographs, to evaluate its correlation to the cephalometric analysis. Some angular measurements, classically defined in the population, were also evaluated and their correlation was also measured.

MATERIAL AND METHODS

In order to standardize the sample only eighteen white female patients aged 17 years old, with indication for orthodontic treatment were randomly selected. The patients were asked documentation about their standard orthodontic records, especially photographs and lateral cephalograms. After approval by the ethics committee, the patients signed an informed consent to participate in the study.

Digital radiographic images were taken using Dabi Atlante (Ribeirão Preto, Brazil) HF100 model. The radiographic technique used suggests that the results achieved represent the actual size measurements of the patient bone structure.[9,10] After that, with the aid of a light box (RHOS), ruler, protractor, pencil (0.5 mm) and drawing paper, calculations of the proposed measurements were performed.

All photographs were taken using Pentax camera (model K110 D) and 100mm macro lens (EX Sigma). Patient's head was in rest position with the Frankfurt plan parallel to the ground and for that we used a plumb line, mirror and distance standard separator.[11] On each photograph, a reference line placed perpendicular to the ground by using a small spirit level (true vertical) was drawn. All photographs that Frankfurt plan was not perpendicular to this line did not considered.

Moreover, prior to taking the photographs, two marks were made on the patient's face with a black eye pencil and the measurement between them was registered, with the purpose to calculate the real measurement during the analysis. After that, the digitalized images were transferred to the Image J software where the proposed measurements were performed.

In the schematic diagram in Figure 1, the cephalometric points used for cephalometric and facial analysis are shown. Tables 1 show the linear cephalometric measurements proposed by McNamara as well as the adjustments for the proposed facial analysis (notice the option to TR-Tragus in substitution to Co on facial analysis). Table 2 show the angular measurements added to this study, respectively. Pearson's statistical correlation was applied to each measurement, at a significance level of 5%.

Table 1. Assessed linear measurements.

Cephalometric analysis	A-Nperp	Pog-Nperp	Co-a	Co-Gn	ENA-Me	Max-mand. discrepancy
Facial analysis	A-Nperp'	Pog-Nperp'	Co-a'	Co-Gn'	ENA-Me'	Max-mand. discrepancy

Figure 1. Schematic drawing presenting the cephalometric points used for cephalometric and facial analysis.

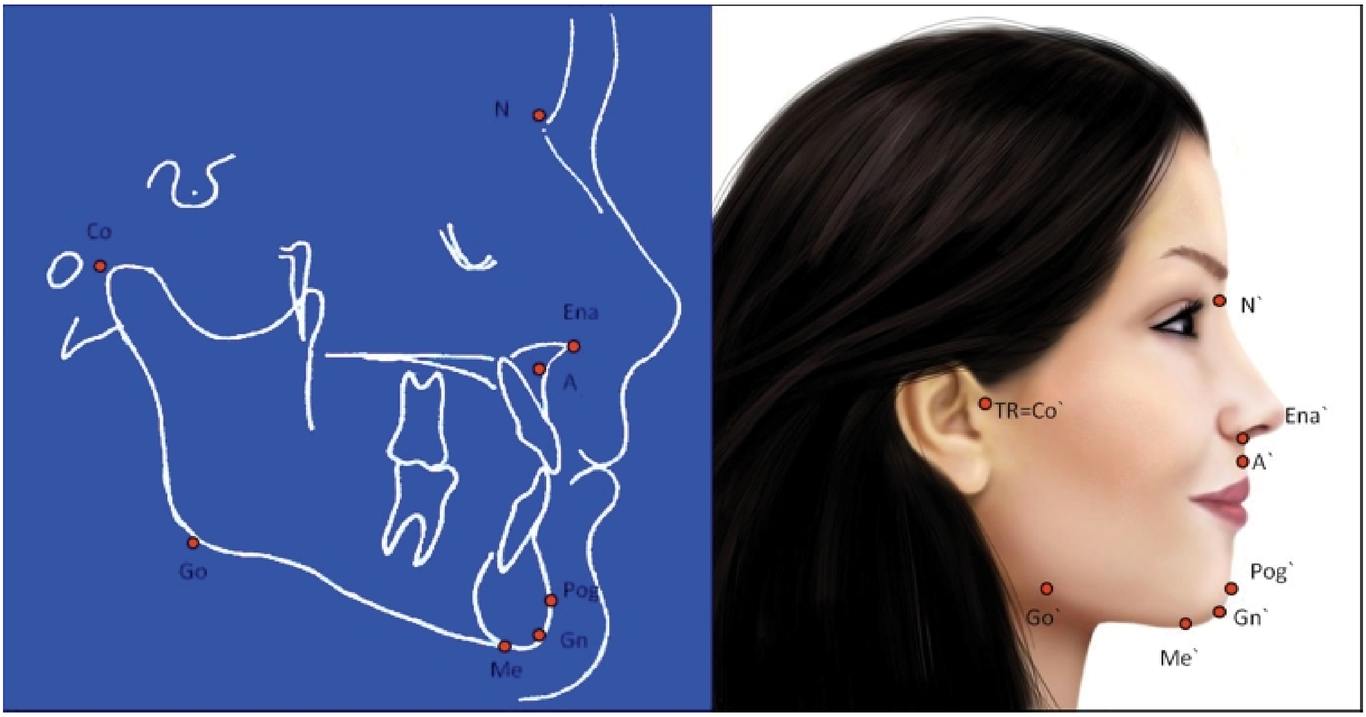

Table 2. Assessed angular measurements.

Cephalometric analysis	FMA	NA.Pog	Nasolabial
Facial analysis	FMA'	NA.Pog'	Nasolabial

RESULTS

The results shown in Table 3 present the average of the groups and the statistical correlation between the assessed linear measurements. None of the assessed linear measurements presented statistical correlation for Pearson's test.

Table 4 shows the results obtained for the correlation between the assessed angular measurements. It can be seen that, in this case, the nasolabial angle measurement, unlike the others, presented a significant correlation.

Table 3. Results of Pearson's correlation analysis between linear and facial measurements resulting from cephalometric analysis.

	A-NPerp	Pog-NPerp	Co-A	Co-Gn	Max.-Mand. Discrepancy
Cephalometry	-0.16 mm	-2.39 mm	88.5 mm	115.8 mm	-26.9 mm
Facial analysis	8.2 mm	2.38 mm	98.5 mm	110.2 mm	-11.64 mm
Correlation	0.299	0.55	0.38	0.47	0.49

Table 4. Results of Pearson's correlation analysis between angular and facial measurements resulting from cephalometric analysis.

	Ang. Nasolabial	N-A A-Pog	FMA
Cephalometric analysis	102.6	4.49	24.16
Facial analysis	100.3	16.45	26.8
Correlation	0.98	0.83	-0.23

DISCUSSION

Proper functional occlusion, health preservation of periodontal and supporting tissues, with the establishment of stable treatment within the boundaries of physiology and facial, dental and aesthetic harmony obtaining are currently accepted as a treatment goal. [7,8,12] It is known that not always these goals can be achieved; however, they cannot be neglected in the diagnosis and planning phase.

As said, nowadays it is believed that malocclusion should be treated from an aesthetic point of view, depending on the patient's face, and not alter the face in light of teeth when it is in harmony. [3,7,12]

Based on this, we tried to correlate linear and angular measurements that have cephalometric norms established in the literature on facial analysis in standardized digital photographs. As shown in Table 3, there was no correlation to any of the assessed linear measurements. Depending on the methodology applied, linear measurements represented the actual size, so the lack of data correlation should have occurred because of the great variability in the thickness of soft tissue on the face, which has different proportions depending on the area evaluated.

Although the results are not favorable, it is known that the measurements for the maxillary length, mandibular length and anterior facial height follow a standard of proportionality.[1] Therefore, further studies which seek this behavior in facial analysis are suggested, however respecting the variability of soft tissue. This way, proportionality norms as proposed by McNamara for measurements obtained from photographs will be established.

In this study, analyzing angular measurements and comparing them with linear measurements served to draw a parallel between the behavior of linear and angular relationships. As it might be expected, the angular measurements showed a more favorable behavior. This is because it should be considered that the angular measurements, provided they have their points of measurement correlated, should have at least similar angle. This can be corroborated by the significant correlation obtained in the nasolabial angle.

For the FMA measurement in particular, it is believed that the low correlation was due to the difficulty in locating the gonial point in the mandibular angle region. It is suggested that, for future studies, the gonial point should be demarcated in the patient's face by palpation, in lateral cephalograms. This could make the mandibular plan drawing less susceptible to variations imposed by soft tissue.

The low correlation for the N-A-Pog facial angle was also due to the thickness variability of the soft tissue. In this case, it should be noted that the observed thickness in the soft tissue tracing of radiographs showed great discrepancy between the regions of point N, A and Pog, implying, therefore, mistaken measurements when projected onto the photographs (N', A' and Pog').[1]

Finally, although that the present sample is small, it should be noted that these low correlations cast doubt on what is set as cephalometric diagnosis and orthodontic treatment goal. There is only one diagnosis for each patient, and the method that can identify it seems that still needs to be better determined.[12] Therefore, we reiterate that cephalometric assessments of patients should be analyzed from a critical point of view. Patient's facial harmony and orthodontist's clinical sensitivity should not be overlooked.

CONCLUSION

According to the methodology, we can conclude that:

1. The correlation results of linear, facial and cephalometric measurements showed no statistical correlation.
2. The correlation results of angle, facial and cephalometric measurements had a statistically significant correlation only in the nasolabial angle.

REFERENCES

1. McNamara JA. A method of cephalometric evaluation. Ortodontia, v. 23, n. 3, p. 79-92, 1990. Am J Orthod Dentofacial Orthop. 1984;86:449-469.

2. Auger TA, Turley PK. The female soft tissue profile as presented in fashion magazines during the 1900s: a photographic analysis. Int J Adult Orthodon Orthognath Surg. 1999; 14:7-18.

3. Virgilio FF, Chlarella S, Alessandro M, Gianluca T. Head posture and cephalometric analyses: Na integrated photographic radiographic technique. Am J Orthod Dentofacial Orthop. 1994;106:257-66.

4. Riedel RA. Esthetics and its relation to orthodontic therapy. Angle Orthod. 1950; 20:168-178.

5. Jacobson A. Planning for orthognathic surgery: Art or science? Int J Adult Orthod Orthogth Surg. 1990, 5:217-224.

6. Lee MS, Chung DH, Lee J, Cha K. Assessing soft-tissue characteristics of facial asymmetry with photographs. Am J Orthod Dentofacial Orthop. 2010;138:23-31.

7. Arnett GW, Bergman RT. Facial keys orthodontic diagnosis and treatment planning. Part I. Am J Orthod Dentofacial Orthop. 1993;103:299-312.

8. Arnett GW, Bergman RT. Facial keys orthodontic diagnosis and treatment planning. Part II. Am J Orthod Dentofacial Orthop. 1993;103:395-411.

9. Solow B, Tallgren A. Natural head position in standing subjects. Acta Odont. Scand., Stockholm. 1971; 29:591-607.

10. Siersbaek-Nielsen SB, Solow B. Intra- and interexaminer variability in head posture recorded by dental auxiliaries. Am. J. Orthod. 1982;82:50-57.

11. Ferrario VF, Sforza C, Miani A, Tartaglla G. Cranio facial morphometry by photographic evaluations. Am J Orthod Dentofacial Orthop. 1993;103:327-37.

12. Arnett GW. Soft tissue cephalometric analysis: diagnosis and treatment planning of dentofacial deformity. Am J Orthod Dentofacial Orthop. 1999;116:239-253.