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Original Article

Determination of vertical characteristics with different cephalometric measurements

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ABSTRACT

Objective: To analyze a possible correlation between different measures in the definition of vertical facial types. **Materials and Methods:** This is an analytical observational study about 95 lateral teleradiographs of Caucasian individuals with normal occlusion, of which 54 were male (56.84%) and 41 female (43.16%), aged between 15 years and 2 months old and 21 years and 4 months old. Facial types were divided into dolichofacial, mesofacial, and brachyfacial, according to the standards established by different authors. A relationship between these measurements was verified using total agreement analysis and the Kappa method, with the interpretation suggested by Landis and Koch. **Results:** Kappa was considered fair for Jarabak X VERT (0.22 and 60%) and slight for Jarabak X SN.GoGn (0.06 and 36.8%). **Conclusions:** Cephalometric studies often present different interpretations on the description of vertical facial types. In this study, the lowest agreement was between Jarabak and SN.GoGn. Such difference in interpretation may lead to distinct therapeutic approaches and thus different results.

Key words: Cephalometry, diagnosis, face

INTRODUCTION

Facial type is a determinant factor when selecting the most appropriate orthodontic treatment plan to follow. Facial type is also referred to as facial pattern or facial skeletal pattern. Normally, the clinician uses the patient's radiographs or photographs to obtain angular, linear or proportional measurements. Based on these, they are classified as: Dolichofacial (long and narrow face), brachyfacial (short and broad face), and an intermediate type named mesofacial.[1] Alternate measurements and classification of facial types have been developed to help defining vertical facial types. The classification of Siriwat and Jarabak,[2] for example, defines brachyfacials as hypodivergent, mesofacials as neutrals, and dolichofacials as hyperdivergent.

Some studies have reported correlations between measurements to define facial types and their prevalence. Some authors[3,4] compared facial types using the analyses of Ricketts (VERT index), finding an even distribution of the facial types for the Ricketts analysis. In the analysis of Siriwat and Jarabak, there was a predominance of the brachyfacial or hypodivergent type. These results showed a lack of correlation between the classifications of the facial types proposed by the applied analyses.[3,4] In 2004, others[5] also studied the correlation between those methods and found a slight agreement, reporting

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a higher prevalence for dolichofacial (Ricketts) and neutral (Siriwat and Jarabak). This disagreement among authors on the correlation between facial types remains unresolved.

The aim of this study was to evaluate a possible correlation between different cephalometric measurements in the definition of facial types to simplify the choice of treatment plan.

MATERIALS AND METHODS

Sample

The present study was approved by the Ethics Committee in Research of the Methodist University of São Paulo (Brazil), under protocol 281687-09, CAAE: 0062.0.214.000-09. The pool of subjects consisted of a population of 13,618 students from private, state, and municipal schools of São Bernardo do Campo, Sao Paulo, Brazil. They were selected according to an inclusion and exclusion criteria, with a final sample size of 95 subjects (n = 95).

For this analytical observational study, we used plaster casts, and posterior-anterior and lateral teleradiographs pertaining to the 95 subjects selected. They were classified according to gender and age groups. The mean age was 19.3 years, ranging from 15 to 21 years. Fifty-four patients (56.84%) were male and 41 (43.16%) female. Subjects were Brazilians and leukoderma. In order to include in the sample, we follow the criteria.

Inclusion criteria

Presence of normal natural occlusion falling at least into four of the six keys of Andrews[6] (not have mattered which key was present-the first key was considered essential for sample selection), individuals aged 15 years or older, and presence of all permanent teeth in occlusion except third molars.

Exclusion criteria

History of previous orthodontic treatment, presence of craniofacial malformations, presence of significant facial asymmetry, and presence of odontogenic abnormalities were excluded.

Digitalization of teleradiographs was performed using an AMD computer featuring a 4C Hewlett Packard Scanjet 6100/CT image scanner (Hewlett-Packard Development Company, USA), with a resolution of 150 dpi. Images were transferred to the CefX software (Computed Cephalometry, CDT IT LTDA, São Paulo, Brazil).

Measurements performed to determine facial type

To classify individual facial types, the measurements presented in Figure 1 and described below were used:

- SN.GoGn - Angle between the SN planes and the mandibular plane (GoGn). This angle elucidates the behavior of the mandibular base with the cranium base, indicating the facial growth type, whether horizontal, vertical, or balanced. Preestablished standard of 32°, with a variation of ± 5°, according to Riedel.[7]

To obtain the Quotient of Jarabak, the following were used:

- Posterior facial height (S-Goc)/anterior facial height (N-Me) × 100 - The authors associate these standards with changes in rotational growth that tend to accentuate the characteristic pattern of growth, so even static evaluations are identified in terms of growth.[2]

To obtain the VERT index, the five-factors of Ricketts[1] were used, as follows:

- Facial axis angle - The angle formed by the facial axis (Pt-Gn) and the Basion-Nasion plan indicates the chin's direction of growth and expresses the ratio of facial height to facial depth. An angle >90° indicates a horizontal direction of the mandible growth and the reverse would indicate a vertical growth. It presents a consistent pattern during the growth process, or may undergo slight changes, reaching up to 6° in mixed dentition
- Mandibular plane angle (Tweed fort-mandibular angle) - It is the angle formed by the mandibular plane and the Frankfurt horizontal plane. High values indicate a skeletal open bite due to the jaw, and low values indicate a skeletal deep overbite due to the jaw

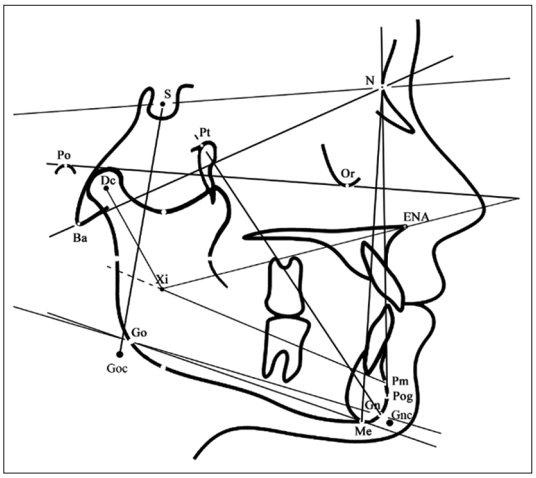

Figure 1: Cephalometric measurements used to define the facial type

- Height of the lower face-angle - formed by the plans Xi-ENA and Xi-Pm. Describes the oral cavity's divergence. Skeletal open bites have high values and skeletal deep bites have low values
- Mandibular arch - Angle formed between the axis of the mandible's body and the condylar axis. Describes the jaw, showing whether the jaw is growing in a square or obtuse way
- Facial angle or facial-depth - The angle formed by the facial plane (N-Pog) and the Frankfurt plane (Downs facial angle). It meets the chin horizontally in the face. It is an indicator of facial depth and determines whether a skeletal Class II or Class III is due to the lower jaw.

For the values of Riedel,[7] the simple measurement and acquisition of values within the norms and standard deviations already determine the mesofacial facial type. For higher values, the individual is considered dolichofacial, and below these values is brachyfacial. Ricketts's VERT[1] is obtained from an average measurement of five factors, found by the difference between the measured value and the individual standard, which will be divided by the standard deviation (which varies with the angle). A positive sign is assigned when the value indicates a trend of brachyfacial growth, and a negative sign when the value found indicates a dolichofacial trend. In Jarabak's case, the facial type is obtained by a mathematical calculation that relates posterior facial height, divided by anterior facial height, and the result is multiplied by 100. The range of percentages recommended determines neutral, hypo- and hyper-divergent individuals,[2] respectively, related to mesofacial, brachyfacial, and dolichofacial.

Statistical analysis

Method error was determined by conducting the measurements once again in 19 randomly selected films, with a 2-week break between the first and second measurements. Systematic error was determined using paired *t*-test, with a 5% level of significance. The casual error was calculated using the suggested formula: $\text{Error} = \sqrt{\sum \frac{d^2}{2n}}$ by Dahlberg.[8] No random errors were found, as the error analysis showed no significant differences while the systematic bias was tested ($P < 0.05$) and correlations were >0.95. Total agreement analysis and the Kappa[9] method were applied, and results interpreted as suggested by Landis and Koch.[10]

RESULTS

Results are presented on Tables 1 and 2, with values of total of agreement and Kappa[9] in each comparison. The Table 1 shows the low association between Jarabak measures and SN.GoGn angle (36.8%, Kappa = 0.6). However, it is possible to notice in Table 2 a higher relation between SN.GoGn angle and VERT index (60%, Kappa = 0.22)

DISCUSSION

The use of cephalometric parameters in the comprehension of face characteristics is still an important instrument in the orthodontic treatment planning.[11,12]

Undesired deviations from a designed treatment plan may occur when the facial type of the patient is not taken in consideration during the diagnosis phase. The present study shows different results in the definition of facial types. This is in accordance with a previous study[13] that concluded that a simple variable is not enough to understand the differences between facial types.

Facial patterns no longer present changes after the end of primary dentition.[14,15] This is the rationale behind the age range of the sample used in this study. We have identified several studies[2-4,16-20] in the literature that researched the identification of the prevalence of facial types using different references. To be more comprehensive with the methods for determining facial types, this study's main purpose was to determine if a correlation between the Ricketts analysis of facial

Table 1: Agreement between Jarabak and SN.GoGn

Jarabak × SN.GoGn	SN.GoGn (%)			
	Mesofacial	Brachyfacial	Dolichofacial	Total
Jarabak				
Mesofacial	12 (12.6)	1 (1.1)	6 (6.3)	19 (20.0)
Brachyfacial	53 (55.8)	22 (23.2)	0 (0.0)	75 (78.9)
Dolichofacial	0 (0.0)	0 (0.0)	1 (1.1)	1 (1.1)
Total	65 (68.4)	23 (24.2)	7 (7.4)	95 (100.0)
Total agreement (%)	36.8			
Kappa	0.06			

Table 2: Agreement between Jarabak and VERT

Jarabak × VERT	VERT (%)			
	Mesofacial	Brachyfacial	Dolichofacial	Total
Jarabak				
Mesofacial	9 (9.5)	3 (3.2)	7 (7.4)	19 (20.0)
Brachyfacial	25 (26.3)	47 (49.5)	3 (3.2)	75 (78.9)
Dolichofacial	0 (0.0)	0 (0.0)	1 (1.1)	1 (1.1)
Total	34 (35.8)	50 (52.6)	11 (11.6)	95 (100.0)
Total agreement (%)	60.0			
Kappa	0.22			

types[1] and other measurements, such as Riedel[7] and Siriwat and Jarabak,[2] could be demonstrated. The division of facial types was based on the classification of Ricketts,[1] which divides it in dolichofacial (vertical growth), brachyfacial (horizontal growth), and mesofacial, an intermediate of the previous two.

To some authors, the results from the agreement analyses of Ricketts[1] and Siriwat and Jarabak[2] showed a predominance of brachyfacial type, followed by mesofacial.[4,16,21] Together, they comprised nearly all patients (91.6% and 98.3%).[21] These results contradict studies of facial types by Ricketts,[17] Björk and Skieller,[18] Christie,[19] Siriwat and Jarabak,[2] and Santos and Ghershel.[20] In these studies, the brachyfacial type is not the most prevalent. Taking into account the different ethnicity of the individuals, which for Ricketts[1] and Siriwat and Jarabak[2] is defined as mesofacial, it can be considered dolichofacial in another methodology. The different results may stem from the different methodologies used in relation to the type of method for determining the type of face.

The facial type of an individual can be determined through various analyses among them is the growth pattern of Ricketts (VERT index). This pattern consists of an average of five factors, and seeks to determine the type of face of an individual. It is composed of facial axis, facial depth, mandibular plane, anterior facial height, and mandibular arch.[1]

Christie[19] describes that the facial axis of the Ricketts VERT index is a variable that, when its value is increased, tends to deviate from the index to the right, indicating positive values that determine the brachyfacial pattern.

Another way to obtain the facial type is with the SN.GoGn angle, which, according to Riedel,[7] shows the relation of the mandibular base to the cranium base. The higher values indicate a trend of vertical growth, and lower values indicate horizontal growth.

Jarabak's quotient and Ricketts' VERT are not obtained by means of an angle directly. This method of determining the facial type establishes a relationship between posterior facial height, divided by anterior facial height, multiplied by 100. Values are expressed in percentages. Below 59% are considered hyperdivergent, between 59% and 63% are neutral, and above of 63 are hypodivergent. For the authors, these standards are commonly associated with changes in horizontal growth that tend to accentuate the features of normal growth, then, even the statistical evaluations are identified in terms of growth,[2] as described above.

The interpretation of Landis and Koch[10] indicated a relation between Jarabak and VERT as Fair. The Kappa value between those is due to the predominance of vertical measurements in the five factors of Ricketts and in Jarabak's measurements that, as described previously, seeks to establish patterns associated with the horizontal growth changes which would accentuate the normal characteristics with growth.[2]

A minor value was found in the relation of Jarabak and SN.GoGn, which was considered slight by Landis and Koch.[10] The difference between Jarabak and SN.GoGn is due to the use of vertical measurements in the evaluation of the face's horizontal growth of an individual.

CONCLUSION

The results of the present study help to understand the different values in studies involving the prevalence of facial types. Due to the use of different measurements, these studies often present different interpretations on the description of vertical facial types. In addition, it is possible to conclude that the lowest correlation was between Jarabak and SN.GoGn. Such difference in interpretation may lead to distinct therapeutic approaches and thus different results.

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Conflicts of interest
There are no conflicts of interest.

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