Original Article

Artigo Original

Proposal for facial type determination based on anthropometry

Proposta para determinação do tipo facial a partir da antropometria

Rossana Ribeiro Ramires[1]
Léslie Piccolotto Ferreira[2]
Irene Queiroz Marchesan[3]
Débora Martins Cattoni[3]
Marta Assumpção de Andrada e Silva[2]

Keywords

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ABSTRACT

Purpose: To describe orofacial indexes and proportions in adults, according to facial type and gender, and to verify the possibility to establish a way of classifying face based on anthropometry. **Methods:** Participants were 105 leukoderm adults, 34 male (32.4%) and 71 female (67.6%), with ages between 20 and 40 years old, patients in a private orthodontic clinic in Belo Horizonte, Minas Gerais, Brazil. The findings from the cephalometric analysis contained in their orthodontic records were used for determination of facial type. Subjects were divided according to gender and facial type, and were submitted to anthropometric facial measures obtained directly through a caliper rule. These measures were compared to six variables: facial index, lower face index, upper face index, chin-face height proportion, chin height proportion, and mandibular height proportion. **Results:** The average values obtained by the subjects divided into genders and facial types that presented significant differences were: facial index, lower face index, upper face index, and mandibular height proportion for males, and mandibular height proportion, for females. To predict facial types, the following parameters were considered significant: facial index, upper face index and mandibular height proportion for the dolichofacial type, for males; and mandibular height proportion for the dolichofacial and lower face index for the brachyfacial type, for females. **Conclusion:** Some indexes and orofacial proportions present variations according to facial types and genders. In general, the anthropometric variables in this study are not good predictors to determine facial types.

Descritores

Face/anatomia & histologia
Antropometria
Dimensão vertical
Avaliação
Diagnóstico
Adulto

RESUMO

Objetivo: Descrever índices e proporções orofaciais de adultos, segundo tipo facial e gênero, e verificar a possibilidade de estabelecer uma forma classificação da face, a partir da antropometria. **Métodos:** Participaram deste estudo prospectivo 105 adultos, leucodermas, 34 (32,4%) homens e 71 (67,6%) mulheres, de 20 a 40 anos, pacientes de uma clínica particular de ortodontia de Belo Horizonte, Minas Gerais, Brasil. Os achados da análise cefalométrica que constavam em suas documentações ortodônticas foram utilizados para determinação do tipo facial. Os indivíduos divididos em gêneros e tipos faciais foram submetidos à coleta de algumas medidas antropométricas faciais por meio de paquímetro. Essas medidas foram comparadas a seis variáveis: índice facial, índice facial inferior, índice facial superior, proporção queixo-face, proporção do queixo e proporção mandibular. **Resultados:** Os valores médios das variáveis obtidas dos indivíduos divididos em gêneros e tipos faciais que apresentaram diferenças foram: índice facial, índice facial inferior, índice facial superior e proporção mandibular, para o gênero masculino, e proporção mandibular, para o feminino. Para se predizer os tipos faciais, houve diferença entre índice facial, índice facial superior e proporção mandibular para o tipo dolicofacial, para o gênero masculino; e proporção mandibular para o tipo dolicofacial e índice facial inferior para o braquifacial, gênero feminino. **Conclusão:** Alguns índices e proporções orofaciais apresentam variações de acordo com os tipos faciais e gêneros. De maneira geral, as variáveis antropométricas desta pesquisa não apresentam boa habilidade preditiva para se determinar os tipos faciais.

Correspondence address:
Rossana Ribeiro Ramires
Av. Nove de Julho, 520, Sala 12, Vila Adyana, São José dos Campos (SP), Brasil, CEP: 12243-001.
E-mail: rossana_ramires@yahoo.com.br

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(1) Graduate Program (Masters degree) in Speech-Language Pathology and Audiology, concentration area Speech-Language Pathology Clinic, Pontifícia Universidade Católica de São Paulo – PUC-SP – São Paulo (SP), Brazil.
(2) Graduate Program in Speech-Language Pathology and Audiology, Pontifícia Universidade Católica de São Paulo – PUC-SP – São Paulo (SP), Brazil.
(3) CEFAC – Graduate Studies in Health and Education – São Paulo (SP), Brazil.

INTRODUCTION

The human face, with its bone and muscle structures, presents its own peculiar characteristics. It may be classified into basically three types, which relate to the growth and variation in format and craniofacial configuration, both in the vertical and horizontal directions. One form of classification, which takes into account the vertical plane of the face divides it into: long or dolichofacial, medium or mesofacial and short or brachyfacial[1-5].

It is important to diagnose facial type, for each one presents singular characteristics according to dental occlusion, facial harmony and orofacial muscles[1]. It is known that these aspects have a direct influence in mastication, swallowing, voice, breathing and speech, which consequently affects the practice of Speech-Language Pathologists. The most commonly used test to determine facial type is cephalometry, which is not requested by the Speech-Language Pathologist.

Quantitative measurements of the face have been increasingly used by Speech-Language Pathologists, for assessment and establishment of diagnosis, prognosis and therapeutic planning[6], especially in the orofacial motricity field[7,8]. The measurement of the human body, object of study of the science named anthropometry, basically involves locating points and conducting measurements in a non-invasive, low-cost[9], direct or indirect[8,10] procedure. These measurements are important for clinical documentation, scientific studies and craniofacial diagnosis[6,11].

The purpose of this study was to describe several orofacial indexes and proportions of adults, according to face type and gender, and to verify the possibility of establishing a form of facial classification based on anthropometry.

METHODS

The participants in this study were 105 leukoderm adults, 43 (32.4%) men and 71 (67.6%) women, in between 20 and 40 years of age. Sample collection was conducted with patients of a private dental clinic in the city of Belo Horizonte (MG). The adopted inclusion criteria was to have a full set of orthodontic documents, and the exclusion criteria were having had orthognatic surgery in the past, or belonging to black, oriental or indigenous races.

Using the Ricketts cephalometric analysis in the participants orthodontic documents, the subjects were classified according to their facial type: dolichofacial (VERT index lower than -0.5), mesofacial (values in between -0.5 and +0.5) and brachyfacial (VERT greater than +0.5). The VERT index or vertical face coefficient represents a value calculated from five cephalometric measures (inferior facial height, facial facial depth, facial axis angle, mandibular plane angle and mandibular arch) measured by traces along x-rays in lateral norm[12].

To collect the orofacial anthropometric measurements, eight facial points were marked as reference in each patient's face with a black projector marker. These points were: nasion (n) – located in the greatest depression in between the frontal region and the nose; menton (me) – most inferior point in the contour of the chin; zygomatic (zi) – most lateral point in each zygomatic arch; subnasal (sn) – located at the intersection of the inferior margin of the base of the nose with the upper lip; supramenton (b) – point of greatest concavity of the sulcus of the soft profile of the mandibule; stomion (sto) – located at the junction of the upper and lower lips; condylion (cd) – higher point at the head of the mandible condyle; and gonion (go) – point at the mandible angle, in between the posterior margin of the superior branch and mandibular base[9].

Subsequently, with the aid of a metal digital Digimess 100.174BL/Pró-fono® caliper, with accuracy of ±0.02 millimeters (mm) and a reproducibility of 0.01 mm, seven anthropometric facial measures were collected: anterior face height (n-me), bizygomatic left to right distance (zi-zi), lower face height (sn-me), middle face height (n-sto), chin height (b-me), inferior face height (sto-me) and posterior face height (cd-go). In order to measure the bizygomatic distance (zi-zi), a ten-centimeter extension was adapted to the caliper. All measurements were conducted by the same Speech-Language Pathologist and measured three times. The average for the obtained values was calculated. Six variables were calculated from the obtained measurements: facial index (n-me/zi-zi); inferior facial index (sn-me/zi-zi); superior facial index (n-sto/zi-zi); chin-face proportion (b-me/n-me); chin proportion (b-me/zi-zi); and mandibular proportion (sto-me/cd-go).

The subjects remained with their teeth occluded in habitual position, sitting down, with their backs gently against a chair with no arms, feet flat on the ground, arms hanging alongside the body and head in natural position. After each complete set of measurements was collected, the caliper was washed with water and detergent, and disinfected by rubbing cotton soaked in ethylic alcohol.

Results were crossed and analyzed according to: gender, facial type obtained through cephalometric analysis; orofacial proportions and indexes. For the purpose of statistical analysis, ANOVA (variance analysis) and the Kruskal-Wallis tests were used, both of them with significance level (p) of 5%. Furthermore, an analysis of the area under the ROC curve was performed, in order to verify the possibility of establishing a way to predict facial type only from orofacial indexes and proportions. In this case, the area under the ROC curve considered significant was greater than 0.5 and with p-value lower than 0.05.

All subjects read and signed a Free and Informed Consent term. This study was approved by the ethics committee at the Pontifícia Universidade Católica de São Paulo, under protocol number 0021/2006.

RESULTS

According to the cephalometric findings, the most frequent facial type was brachyfacial (n=41; 39.1%) and the least frequent, dolichofacial (n=27; 25.7%). Seven orofacial athropometric measurements were conducted, which led to a total of 735 collected measurements. Three indexes and three proportions were also calculated, which generated a total of 630 results (Tables 1, 2, 3 and 4).

The values obtained from the anthropometric indexes and

proportions calculated for males were described. This data was compared to the facial type classification obtained through cephalometric analysis (Table 1). The data show that three indexes and one facial proportion present differences between the averages in the groups: facial index, inferior face index, superior face index and mandibular proportion.

The values of anthropometric indexes and proportions calculated for females were compared to facial type classification obtained by cephalometric analysis (Table 2). The data show that only one out of the six variables, mandibular proportion, had a significant difference between the averages in the groups.

The predictive ability of the indexes and facial proportions for defining facial type was calculated. Sensitivity and positive predictive value refer to the chance of one person presenting a certain facial type. On the other hand, specificity and negative predictive value are related to the chance of a person not having a specific facial type (Tables 3 and 4).

For males, the variables considered good predictors of determining dolichofacial type were: facial index (area under the ROC curve=0.886, p=0.002); superior facial index (ROC=0.894, p=0.002); and mandibular proportion (ROC=0.825, p=0.009) (Table 3).

Table 1. Indexes and anthropometric proportions, according to facial types, in males

Variable	Facial type	n	Mean	SD	p-value
Face index (n-me/zi-zi)	Dolichofacial	7	1.09	0.05	0.002*
	Mesofacial	11	1.01	0.05	
	Brachyfacial	16	0.98	0.06	
Inferior face index (sn-me/zi-zi)	Dolichofacial	7	1.58	0.09	0.008*
	Mesofacial	11	1.74	0.14	
	Brachyfacial	16	1.78	0.14	
Superior face index (n-sto/zi-zi)	Dolichofacial	7	0.67	0.03	0.002*
	Mesofacial	11	0.62	0.04	
	Brachyfacial	16	0.60	0.04	
Chin-face proportion (b-me/n-me)	Dolichofacial	7	0.24	0.03	0.552
	Mesofacial	11	0.23	0.03	
	Brachyfacial	16	0.25	0.02	
Chin proportion (b-me/zi-zi)	Dolichofacial	7	0.26	0.03	0.180
	Mesofacial	11	0.24	0.03	
	Brachyfacial	16	0.24	0.03	
Mandibular proporion (sto-me/cd-go)	Dolichofacial	7	1.03	0.13	0.011*
	Mesofacial	11	0.89	0.12	
	Brachyfacial	16	0.85	0.11	

* Significant values (p≤0.05) – ANOVA (variance analysis)
Note: SD = standard deviation

Table 2. Indexes and anthropometric proportions, according to facial type, in females

Variable	Facial type	n	Mean	SD	p-value
Facial index (n-me/zi-zi) [A]	Dolichofacial	20	1.01	0.07	0.227
	Mesofacial	26	1.01	0.05	
	Brachyfacial	25	0.98	0.07	
Inferior facial index (sn-me/zi-zi) [B]	Dolichofacial	20	1.74	0.14	0.412
	Mesofacial	26	1.76	0.10	
	Brachyfacial	25	1.86	0.17	
Superior facial index (n-sto/zi-zi) [A]	Dolichofacial	20	0.64	0.05	0.123
	Mesofacial	26	0.63	0.04	
	Brachyfacial	25	0.61	0.04	
Chin-face proportion (b-me/n-me) [A]	Dolichofacial	20	0.23	0.02	0.732
	Mesofacial	26	0.23	0.01	
	Brachyfacial	25	0.23	0.02	
Chin proportion (b-me/zi-zi) [A]	Dolichofacial	20	0.23	0.02	0.615
	Mesofacial	26	0.23	0.02	
	Brachyfacial	25	0.23	0.03	
Mandibular proportion (sto-me/cd-go) [A]	Dolichofacial	20	0.99	0.12	<0.001*
	Mesofacial	26	0.91	0.07	
	Brachyfacial	25	0.85	0.08	

* Significant values (p≤0.05) - ANOVA (variance analysis)[A] and Kruskal-Wallis Test[B]
Note: SD = standard deviation

In regards to females, mandibular proportion (ROC=0.761, p=0.001) was considered a good predictor for dolichofacial type, and inferior facial index (ROC=0.683, p=0.011) for the brachyfacial type (Table 4).

Therefore, trustworthy data was obtained to determine certain facial types: dolichofacial in men; dolichofacial and brachyfacial in women. The data obtained in this study show that a man in dolichofacial if he presents a facial index value (n-me/zi-zi) greater than or equal to 1.01 (cut-point value), superior face index (n-sto/zi-zi) greater than or equal to 0.5 and mandibular proportion e (sto-me/cd-go) greater than or equal to 0.95. On the other hand, a woman is probably dolichofacial if she has a mandibular proportion (sto-me/cd-go) greater than or equal to 0.96 and is brachyfacial if the inferior facial index (sn-me/zi-zi) is lower than 0.5.

According to the data, both the chin-face proportion (b-me/n-me) and chin proportion (b-me/zi-zi) were not considered good predictors for any facial types, in both genders.

Table 3. Predictive ability of orofacial indexes and proportions, according to facial type, in males

Index/ orofacial proportion	Facial type (cephalometry)	Cut point	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predicitve value (%)	ROC	
							Area undercurve	p-value
Face index (n-me/zi-zi)	Dolicofacial	1.01	100.0	51.8	35.0	100.0	0.886*	0.002*
	Mesofacial	1.03	63.6	47.8	42.3	37.5	0.458	0.699
	Braquifacial	0.95	68.7	16.7	42.3	37.5	0.283	0.027*
Inferior facial index (sn-me/zi-zi)	Dolicofacial	1.68	28.6	37.0	10.5	66.7	0.138	0.004*
	Mesofacial	1.64	81.8	39.1	39.1	81.8	0.569*	0.519
	Braquifacial	1.72	62.5	77.8	71.4	70.0	0.677*	0.067
Superior facial index (n-sto/zi-zi)	Dolicofacial	0.65	85.7	85.2	60.0	95.8	0.894*	0.002*
	Mesofacial	0.62	63.6	43.5	35.0	71.4	0.484	0.883
	Braquifacial	0.59	75.0	11.1	47.1	33.3	0.255	0.016*
Chin-face proportion (b-me/n-me)	Dolicofacial	0.24	71.4	33.3	21.7	81.8	0.548*	0.701
	Mesofacial	0.23	27.3	73.9	50.0	75.0	0.421	0.462
	Braquifacial	0.21	100.0	16.7	50.0	75.0	0.538*	0.535
Chin proportion (b-me/zi-zi)	Dolicofacial	0.25	85.7	55.6	33.3	93.7	0.714*	0.085
	Mesofacial	0.24	36.4	60.9	50.0	66.7	0.425	0.484
	Braquifacial	0.22	87.5	22.2	50.0	66.7	0.425	0.535
Mandibular proportion (sto-me/cd-go)	Dolicofacial	0.95	85.7	74.1	46.1	95.2	0.825*	0.009*
	Mesofacial	0.86	36.4	69.6	42.3	46.1	0.478	0.840
	Braquifacial	0.81	75.0	22.2	42.3	46.1	0.306	0.045

* Significant values (area under the curve>0.5 and p≤0.05) – Analysis under the ROC curve

Table 4. Predictive ability of orofacial indexes and proportions, according to facial type, in females

Index/ orofacial proportion	Facial type (cephalometry)	Cut point	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predicitve value (%)	ROC	
							Area undercurve	p-value
Face index (n-me/zi-zi)	Dolichofacial	0.99	65.0	43.1	31.0	75.9	0.566*	0.388
	Mesofacial	0.98	80.8	40.0	42.3	37.5	0.545	0.527
	Brachyfacial	0.95	68.0	13.0	29.8	42.9	0.395	0.147
Inferior face index (sn-me/zi-zi)	Dolichofacial	1.90	60.0	23.5	16.7	67.9	0.365	0.079
	Mesofacial	1.87	73.1	35.6	71.4	70.0	0.438	0.384
	Brachyfacial	1.69	88.0	28.3	40.0	81.2	0.683*	0.011*
Superior face index (n-sto/zi-zi)	Dolichofacial	0.63	60.0	56.9	35.3	78.4	0.602*	0.182
	Mesofacial	0.62	65.4	44.4	47.1	33.3	0.529*	0.685
	Brachyfacial	0.60	64.0	23.9	31.4	55.0	0.380	0.095
Chin-face proportion (b-me/n-me)	Dolichofacial	0.25	45.0	43.1	50.0	75.0	0.432	0.374
	Mesofacial	0.25	23.1	80.0	50.0	75.0	0.536*	0.616
	Brachyfacial	0.22	76.0	19.6	33.9	60.0	0.524*	0.741
Chin proportion (b-me/zi-zi)	Dolichofacial	0.23	45.0	45.1	24.3	67.6	0.497	0.964
	Mesofacial	0.23	65.4	55.6	50.0	66.7	0.591*	0.206
	Brachyfacial	0.22	64.0	21.7	30.8	52.6	0.411	0.217
Mandibular proportion (sto-me/cd-go)	Dolichofacial	0.96	65.0	80.4	56.5	85.4	0.761*	0.001*
	Mesofacial	0.94	53.8	60.0	42.3	46.1	0.522*	0.756
	Brachyfacial	0.84	60.0	8.7	26.3	28.6	0.246	<0.001*

* Significant values (area under the curve>0.5 and p≤0.05) – Analysis of the area under the ROC curve

DISCUSSION

The participants in this study were exclusively leukoderms, as in various other studies[4,11,13-19]. This is due to the variation in craniofacial structures according to race, observed in different reports[20-24].

Some studies base themselves on anthropometry to determine facial type using: morphological face index (reason between anterior face height and bizygomatic distance)[25,26]; cephalic index (reason between length and total width of the head)[20,27]; and facial index (reason between maximum vertical facial height and maximum horizontal face width)[24]. However, most of these studies did not specify how data was collected or the values used as references.

In a different study[28], three indexes and three anthropometric proportions, obtained indirectly in Caucasian North-American individuals, were used in order to verify the tendency of a person presenting a certain facial type. The variables used then were adapted and used in the present study since they were based in various indexes, and also to provide means for posterior comparison.

The mean values for facial index were similar among both genders, yet lower than the results report in another study[28]. This index was obtained from the reason between one vertical facial measure and one horizontal measure. According to literature reports[1,27], dolichofacial individuals are characterized by a long, narrow face, while brachyfacials have a short, wide face. Therefore, it was expected that the values would follow the dolichofacial>mesofacial>brachyifacial order, as observed in the men participating in this study.

In regards to the inferior face index (sn-me/zi-zi), the mean values calculated in this study were lower for males. For both genders, the values, greater than the ones observed in a different study[28], followed the brachyfacial>mesofacial>dolichofacial order. The order should be inverse, as the dolichofacial type is characterized by a longer inferior facial third and a narrow face, opposite to brachyfacial, short inferior facial third and wide face[1,2,27].

As far as the superior facial index (n-sto/zi-zi), the mean values were greater for dolichofacial men and lower for mesofacial and brachyfacial men. The mean values, greater than those in other studies[20,28], followed the dolichofacial>mesofacial>brachyfacial order, which is in accordance to literature reports, as the middle facial third is longer and narrower for dolichofacials, and short and wide for brachyfacials[1,27,29].

In regards to chin-face (b-me/n-me) and chin (b-me/zi-zi) proportions, the mean values did not follow the expected dolichofacial>mesofacial>brachyifacial order. The mean chin-face proportions, lower for males, presented values that were similar to those of another study[28]. The chin proportion mean values, greater in men, were greater than those found in another report[28].

For mandibular proportion (sto-me/cd-go), the averages were greater for dolichofacial men, lower in mesofacial men, ande qual for brachyfacial women. The values, relatively larger than reported in another research[28], followed the expected dolichofacial>mesofacial>brachyifacial order, for the dolichofacial individual is characterized by lower mandibular branch height than the brachyfacial's[27].

Regarding the possibility of using only indexes and facial proportions to determine facial types, it was generally observed that the anthropometric variables used in this study did not have a good predictive ability for this purpose. Suggestions for a subsequent study include collecting data from a larger sample, and that the morphological face index[25-26], facial height index[20,27] and cephalic index[24] also be included in the data, comparing the findings with cephalometric facial type classification.

It must be made clear that the purpose of this study was not to propose a standardized way of determining facial type, since each kind of analysis, cephalometric or anthropometric, carries within distinct concepts, aims and results. In addition, the findings concern one specific population and race. However, the study of the face and its proportions is vital in verifying and obtaining facial balance[2,30]. For this reason, the use of indexes and facial proportions is important, not only when performing facial type classification, but also for the assessment and therapeutic planning of each case in the Speech-Language Pathology field.

CONCLUSION

Some indexes and orofacial proportions vary according to different facial types. These differences may be noticed in a greater number of variables in males, when compared to females.

Generally, the anthropometric variables in this study did not show good predictive ability to determine facial types.

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