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Lip projection analysis in brachycephalic, dolichocephalic and mesocephalic individuals of a Mexican population.

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Key words: cephalometrics; lip projection; soft tissue.

Abstract. The aim of this study was to examine the lip projection of brachycephalic, dolichocephalic and mesocephalic Mexican patients and to analyze the relationship between dental protrusion and the lip position, to identify if a labial soft tissue projection exists and to determine what features predominated in this study. A total of 120 lateral radiographs of the skull were randomly selected from patients aged 16-25 years. The linear and angular data were measured, the values of the upper and lower lip projection relative to Ricketts E-line, Steiner S-line and Arnett TV-line were collected. The angles to be analyzed were the nasolabial, mandibular plane and interincisal, and the mentolabial groove depth. The statistical significance was determined by the Student t-test. A significant difference between mesocephalic and brachycephalic patients was observed measuring the angle between the Frankfurt plane and the mandibular plane ($P<0.001$). Between dolichocephalic and mesocephalic individuals significant differences were observed in the lower lip to E-line ($P<0.031$), lower lip to S-line ($P<0.010$), the interincisal angle ($P<0.032$) and the mandibular´s plane ($P<0.001$). A statistical significant difference was shown between brachycephalic and dolichocephalic individuals: lower lip to E-line ($P<0.001$), upper lip to S-line ($P<0.037$), lower lip to S-line ($P<0.001$), interincisal angle ($P<0.034$) and the angle between the mandibular´s plane ($P<0.001$). Lip soft tissue projection will depend on the population studied; we found some significant differences when compared with the cephalometric norms.

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Análisis de la proyección labial en pacientes braquiocefálicos, mesocefálicos y dolicocefálicos de una población mexicana.

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Palabras clave: cefalometría; proyección labial; tejidos blandos.

Resumen. El objetivo del presente estudio fue examinar la proyección labial en pacientes braquicéfalos, mesocéfalos y dolicocéfalos mexicanos al igual que analizar la relación entre la protrusión dental y la posición labial, identificar si existe proyección labial de los tejidos blandos y determinar las características predominantes en el estudio. Un total de 120 radiografías laterales de cráneo se seleccionaron de manera aleatoria de pacientes entre 16-25 años. Los datos angulares y lineales se identificaron, los valores de la proyección labial superior e inferior con respecto a línea línea-E de Ricketts, línea-S de Steiner y línea-VV de Arnett fueron recolectados, los valores angulares a analizar fueron el ángulo nasolabial, el plano mandibular y el ángulo interincisal al igual que el surco mentolabial. Se usó la prueba T de Student para obtener la significancia. Una diferencia significativa se observó entre pacientes mesocéfalos y braquicéfalos en el plano mandibular con Frankfort (P <0.001). Entre dolicocéfalos y mesocéfalos diferencias significativas se observaron en el labio inferior a línea-E (P <0.031), labio inferior a S (P <0.010), ángulo interincisal (P <0.032) y el plano mandibular (P <0.001). Diferencias significativas se observaron entre pacientes braquicéfalos y dolicocéfalos: labio inferior a línea-E (P <0.001), labio superior a línea-S (P <0.037), labio inferior a línea-S (P <0.001), ángulo interincisal (P < 0.034) y el plano mandibular (P <0.001). La proyección labial depende de la población y se pueden observar algunas diferencias significativas al ser comparadas con la norma cefalométrica.

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INTRODUCTION

The concept of beauty has changed over the centuries and differs from one population to another, but it has always been a topic of interest and importance to humankind. Throughout history different authors as Ricketts, Steiner, Altemus and Arnett have conducted cephalometric studies to determine which features determine facial beauty being one of them the lip projection. Over time, beauty parameters have been modified, however still had an important role in society. Cephalometrics is a study in which a number of records of points, lines and measurements are obtained from lateral radiographs of the skull in which certain anatomical structures are analyzed allowing the prediction of the patient´s growth pattern (1-7).

The importance of facial aesthetics and relationships of the soft tissues in orthodontic treatment was emphasized by Ricketts. He observed that the ideal for one patient might not be for another, for which the results of the cephalometric analysis vary by race or ethnic group, because they have different growth and physical characteristics due to genetic influences, there-

fore orthodontic treatment´s needs are different and must be adapted to the characteristics of each person (8-13).

Dentofacial features of many ethnic groups have been reviewed by several researchers for orthodontic purposes. Some of these show similarities, but others showed significant differences regarding the projection of the lips. Given that every population has different dentoskeletal characteristics, it is difficult to apply a general cephalometric standard.

The aim of this study was to examine the lip projection of brachycephalic, dolichocephalic and mesocephalic Mexican patients and to analyze the relationship between dental protrusion and the lip position, to identify if a labial soft tissue projection exists and to determine what features predominated in this study.

MATERIALS AND METHODS

A sample of 120 digital lateral skull cephalometric radiographs, that showed good definition of the hard and soft tissues, were randomly selected from Mexican patients with Mexican grandparents, aged 16-25 years, who attended the Clinic of Orthodontics and Dentomaxilofacial Orthopedics of the Autonomous University of San Luis Potosi. Permits for the use of the material were given, and the H. Research Ethics Committee of the Faculty of Dentistry revised informed and approved consents.

Each individual´s lateral cephalometric radiographs of the skull where taken without any previous orthodontic treatment, using a Digital Panoramic and Cephalometric System (Kodak 8000c, Germany) at 68.0 kV, 5.0 mA for 17 s at 18.5 mGy/cm2, at the Faculty of Dentistry of the Autonomous University of San Luis Potosi. Inclusion criteria were healthy individuals, with no facial anomalies and lack of skeletal abnormalities. These radiographs were manually traced on 0.003-mm matte acetate sheets. All radiographs were traced by the third author (DAS) and then reviewed by the second author (RAH), for accurate landmark identification.

Ten measurements (seven linear and three angular) were traced according to Steiner, Ricketts and Arnett´s soft tissue analysis.

The lines used in this study to determine the lip projection where the S-line described by Steiner, ranging from soft tissue pogonion to half of columnela´s nose, which should touch both lips. Ricketts´ E-line goes from pogonion soft tissue to the tip of the nose; the lips should pass behind or nearly touching the line.

Arnett´s True Vertical Line (TV-line) passing through the subnasale and perpendicular to the ground, both upper and lower lips must pass ahead of the line. The angles to be analyzed were: the nasolabial angle, formed by the nose columnela and the nasolabial projection; the interincisal angle conformed by the upper and lower incisors; the mentolabial groove depth, that gave the length of depth between the lower lip and the chin; and the mandibular plane angle, which divide the sample, due to its degree of divergence with Frankfort´s plane, into brachycephalic ($\geq 25°$), mesocephalic ($\geq 30°$) and dolichocephalic ($\geq 35°$) (Fig. 1) individuals.

A single operator with blinding measured the linear and angular data. Statistical analysis was performed using the Minitab´s 17 version software by a specialist with data blinding, to analyze the normality of variables. The Shapiro Wilk test was applied and Student t-test statistical significance was determined. Confidence intervals were determined at 95 % and the statistical significance of $p< 0.05$ value were determined.

RESULTS

The mean, mean error, standard deviation, minimum and maximum values were determined (Table I). Significant differences between

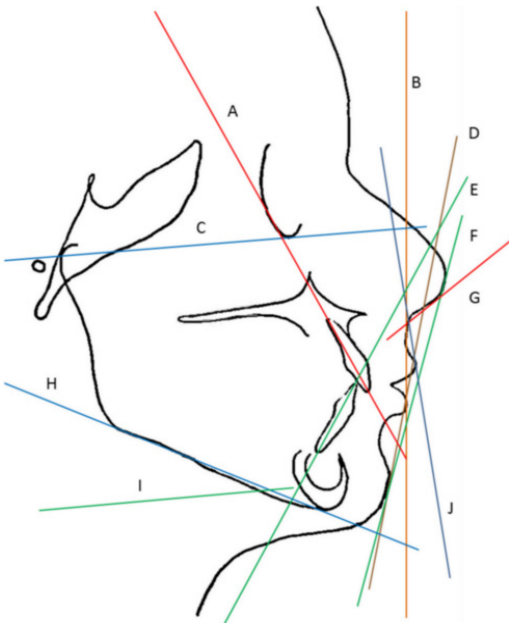

Fig. 1. Cephalometrics traces. A. Upper incisor, B. TV-line, C. Frankfort plane, D. S-line, E. Lower incisor, F. E-line, G. Columnela, H. Mandibular plane, I. Projected Frankfort plane, J. Nasolabial projection.

mesocephalic and brachycephalic patients were observed measuring the angle between the Frankfurt plane and the mandibular plane (P<0.001) but no other significant measurements differences were identified. When comparing between dolichocephalic and mesocephalic, significant differences were observed in the lower lip to E-line (P<0.031), lower lip to S-line (P<0.010), the interincisal angle (P<0.032) and the mandibular´s plane (P<0.001). Statistical significant differences were shown between brachycephalic and dolichocephalic: lower lip to E-line (P<0.001), upper lip to S-line (P<0.037), lower lip to S-line (P<0.001), interincisal angle (P<0.034) and the angle between the mandibular´s plane (P<0.001). These findings show no significant differences between upper lip to E-line in all the groups as well as upper lip to TV-line, lower lip to TV-line, the mentolabial groove, the nasolabial angle. Comparing together brachycephalic-mesocephalic and mesocephalic-dolichocephalic groups no significant difference was present from the upper lip to S. (Table II).

DISCUSSION

All facial features vary from one population to another, and within the same population. This is due to miscegenation, as it allows an infinite combination of characteristics causing difficulties to establish a standard to help achieve facial harmony in all of them. However, investigations based on the cephalometric norms, show that there are similarities in some data and a greater or lesser degree depending on the population.

Sinojiya *et al.* (14) compared a population of Mahabubnagar in the south of India, and found some differences with the standard of Arnett, thicker soft tissue, acute nasolabial angle, increased facial length, increased deficiency midface, a more convex profile and less vertical lower incisors, this show that some people have more similarity than others regarding the standard, upper lip thickness (P<0.000), lower lip thickness (P<0.000), Pog- Pog' (P<0.0459) nasolabial angle (P<0.0090) and upper lip angle (P<0.0011). We agree with the authors, as our studies showed differences in most of the data obtained; the facial growth and their characteristics directly influence on the proportions of the head, as seen in the results showed between brachycephalic and dolichocephalic, as well as mesocephalic and dolichocephalic, in measures of the interincisal angle, lower lip to E-line (p<0.001) and lower lip to S-line (p<0.001), which shows that the incisal inclination has a direct effect on the lip position, allowing us to observe lip protrusion.

All factors relating to Arnett´s norms were similar in the study of Uysal *et al.* (15), which

analyzed a population of Turkey and found features like thin upper and lower lips and retruded incisors, resulting that the majority of Turks have harmony and the values obtained are within the norm of Arnett. In the present study, the results show significant differences, and when we compared mesocephalic with dolichocephalic and brachycephalic with dolichocephalic, statistical significant differences were identified in lower lip to S-line and E-line, which may be

TABLE I
DESCRIPTIVE STATISTICS OF THE CEPHALOMETRIC TRACERS

	Variables	Media	Standard error	Standard deviation	Minimum value	Máximum value
Upper lip to E-line	Mesocephalic	-0.280	0.549	2.747	-5.000	4.000
	Brachycephalic	-1.280	0.599	2.993	-7.000	4.000
	Dolichocephalic	0.160	0.399	1.993	-4.000	3.000
Lower lip to E-line	Mesocephalic	1.400	0.473	2.363	-3.000	6.000
	Brachycephalic	0.040	0.626	3.129	-7.000	8.000
	Dolichocephalic	2.920	0.538	2.691	-2.000	7.000
Upper lip to S-line	Mesocephalic	2.480	0.462	2.312	-2.000	6.000
	Brachycephalic	1.800	0.490	2.449	-2.000	7.000
	Dolichocephalic	3.200	0.374	1.871	-1.000	6.000
Lower lip to S-line	Mesocephalic	3.080	0.454	2.272	-2.000	7.000
	Brachycephalic	2.000	0.574	2.872	-5.000	9.000
	Dolichocephalic	4.920	0.503	2.515	0.000	9.000
Upper lip to TV-line	Mesocephalic	3.240	0.508	2.538	-4.000	6.000
	Brachycephalic	3.400	0.440	2.198	0.000	8.000
	Dolichocephalic	3.720	0.274	1.370	1.000	6.000
Lower lip to TV-line	Mesocephalic	1.440	0.595	2.973	-6.000	5.000
	Brachycephalic	2.320	0.553	2.765	-6.000	7.000
	Dolichocephalic	1.680	0.399	1.994	-2.000	6.000
Mentolabial groove	Mesocephalic	5.120	0.380	1.900	2.000	10.000
	Brachycephalic	4.560	0.306	1.530	2.000	8.000
	Dolichocephalic	4.480	0.301	1.503	2.000	7.000
Nasolabial angle	Mesocephalic	103.60	2.08	10.39	90.00	127.00
	Brachycephalic	103.12	2.33	11.65	81.00	125.00
	Dolichocephalic	106.32	2.16	10.79	85.00	124.00
Interincisal angle	Mesocephalic	118.60	2.14	10.69	103.00	149.00
	Brachycephalic	118.96	2.00	10.01	95.00	135.00
	Dolichocephalic	112.96	1.89	9.46	86.00	135.00
Mandibular plane angle	Mesocephalic	27.320	0.335	1.676	25.000	30.000
	Brachycephalic	20.160	0.496	2.478	13.000	24.000
	Dolichocephalic	32.480	0.880	4.398	19.000	43.000

TABLA II
STATISTICAL SIGNIFICANCE OF THE CEPHALOMETRIC TRACERS OBTAINED BY THE STUDENT t TEST

	Mesocephalic vs Brachycephalic	Mesocephalic vs Dolichocephalic	Brachycephalic vs Dolichocephalic
	P value	P value	P value
Upper lip to E-line	0.239	0.475	0.077
Lower lip to E-line	0.090	0.031*	0.001**
Upper lip to S-line	0.332	0.228	0.037*
Lower lip to S-line	0.127	0.010**	0.001**
Upper lip to TV-line	0.775	0.478	0.606
Lower lip to TV-line	0.330	0.708	0.388
Mentolabial groove	0.303	0.191	0.866
Nasolabial angle	0.862	0.321	0.337
Interincisal angle	0.900	0.032*	0.034*
Mandibular plane angle	0.001**	0.001**	0.001**

* Significance level ($p<0.05$).
** Significance level ($p<0.001$).

due to the difference in labial thickness and incisal protrusion causing a more pronounced lip projection in our population.

In various studies based on the Steiner´s standard such as the case of Ikenna *et al.* (16), a Nigerian population was analyzed against the standards established by Ricketts and Steiner, differences were shown in most of the recorded measurements, obtained as a greater lip protrusion against the standard. Our study agrees with this. No significant differences in both upper lip and lower lip were found, mainly on the comparison between the Mexican brachycephalic and dolichocephalic populations, so it may be assumed that both lips are protruded, but the lower lip which is greater and it may be due to the position of the chin, the nose´s projection or excessive protrusion of the lower incisors to compensate for the lack of growth in the jaw.

Gupta *et al.*(17) showed that similarity between the soft tissue of a northern Indian population and the norm, except for nasal prominence and the thickness of the upper lip, the results that are shown to be significant were: thickness of the upper lip ($P<0.000$), increased lower lip thickness ($P<0.000$), lower lip to E-line ($P<0.009$) and thickness of the chin ($P<0.27$). They concluded that individuals with a relatively minor nose, lip protrusion and slightly convex profile are more aesthetic. The present results show significant differences: lower lip to S-line ($P<0.001$), lower lip to E-line ($P<0.001$) between brachycephalic and dolichocephalic, as well as significant differences with the E-line, a more pronounced projection of the lower lip this, may be due, to the difference in genetic characteristics.

Both, Lahlou *et al.*(18) and Erbay *et al.* (19,20) found that soft tissue analyses differ according to the population. Every race has its

own nose and chin characteristics. We observe major facial features differences of the Mexican population against the standard, identifying greater projection of the lower lips, perhaps caused by the interincisal position, being the incisors in a protruding position and making the lips look more protruded, also features of the chin will have a direct effect on the aesthetic characteristics.

Cephalometric standards aim to maintain harmony and balance in the facial features applied despite the obvious variations that exist depending on the population. Due to this, implementation of various cephalometric studies are recommended considering the characteristics of each population in order to develop an appropriate treatment plan. The results show both similarities and differences compared to different standards, this may be due to the racial mix through the history generating variables; however, the standards are only general guidelines to achieve better orthodontic results and always taking into account the particular facial features of each population

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