Original research

Aesthetic analysis of the face

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ABSTRACT

Objective: Using well-characterized sample of an european caucasian population, this study seeks to create lateral cephalometric information, based on the Natural Head Position within the assessed european population groups, to analyze sexual dimorphism and to study the comparison with similar work done in an american caucasian group.

Methods: Fifty-five subjects (20 men and 35 women) were selected with the following criteria: caucasian descent, over 18 years old and presenting good facial aesthetics; Angle class I occlusion with no crowding and without temporomandibular disfunction; no previous history of orthodontic treatment or surgical interventions in the maxillofacial area. The following records were collected: (1) clinical data; (2) alginate impressions to obtain the study models; (3) four pictures in the Natural Head Position (NHP); (4) lateral cephalometric radiographs in centric occlusion and in the NHP. The american caucasian sample, 20 men and 26 women, were selected on the basis of the same criteria.

Results: The thickness of the skin tissues that cover the face is larger in men than in women and there are no major ethnic differences. The total face height is significantly higher in men than in women, and is higher in european women compared to North-american women. The midface is further back sagittally in men than in women and is further back in the ideal european population versus the ideal american population.

Conclusion: In a cephalometric analysis, we must consider the gender, age and etnic background of the patient in order to obtain correct clinical information.

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Análise estética da face

R E S U M O

Palavras-chave:
Cefalometria
Estética
Grupos étnicos
Características sexuais

Objetivo: Este trabalho, recorrendo a amostras populacionais bem caracterizadas, procura criar informação cefalométrica lateral, baseada na Posição Natural da Cabeça e aferida a grupos de uma população caucasiana europeia. Também pretende analisar o dimorfismo sexual e estudar a comparação com trabalhos idênticos feitos numa população caucasiana norte-americana.

Métodos: Cinquenta e cinco indivíduos (20 homens e 35 mulheres) foram selecionados pelos seguintes critérios: caucasianos, maior de 18 anos, com boa estética facial; oclusão Classe I de Angle, sem apinhamento nem disfunção temporomandibular; sem história prévia de tratamento ortodôntico ou intervenções cirúrgicas na área maxilo-facial. Os seguintes registos foram recolhidos: (1) história clínica; (2) impressões em alginato para obter modelos de estudo; (3) quatro fotografias na posição natural da cabeça (PNC); (4) telerradiografias de perfil da face em oclusão cêntrica e em PNC. A amostra caucasiana americana, 20 homens e 26 mulheres, foi seleccionada com base nos mesmos critérios.

Resultados: A espessura dos tecidos cutâneos que recobrem a face é maior nos homens do que nas mulheres e não se verificam grandes diferenças étnicas. A altura total da face é significativamente maior nos homens do que nas mulheres, e é maior nas mulheres europeias em relação às mulheres norte-americanas. O andar médio da face está mais recuado sagitalmente nos homens do que nas mulheres e mais recuado na população europeia do que na população norte-americana.

Conclusão: Na interpretação da análise cefalométrica devem ser considerados o género, a idade e a etnia do indivíduo a estudar, para se obter uma correcta informação clínica.

Introduction

Facial aesthetics are currently one of the main objectives of orthodontic treatment, together with a normal occlusion, healthy periodontal tissues and the stability of the treatment.

Orthodontics, beyond seeking a functional balance between bones and teeth within a cephalometric correction, also seeks to develop facial harmony as part of the treatment objectives. Through cephalometrics, orthodontics acquires the capacity to detect abnormalities and measure the degree of dentoskeletal and soft tissue disharmony.

There are several published studies that fit cephalometric norms to various ethnic groups in an attempt to establish optimal standards of occlusion and facial aesthetics for these populations. Some authors[1-3] emphasize the importance of soft tissue analysis in their publications. However, these types of studies on the Portuguese-Caucasian population are rare.

Pereira[4] compared a sample population of 12 year old portuguese children with Caucasian groups of Norwegian origin. This study found that the Portuguese children had longer and more convex faces than the Norwegian children. Leitão[5] investigated and discussed the utility of natural head position–based cephalometric variables, evaluating the relationship between natural head position and craniofacial morphology.

Using a well-characterized sample of a Portuguese-Caucasian population, this study seeks to create lateral cephalometric information based on the Natural Head Position to analyze sexual dysmorphism and study the comparison with similar work done among other ethnic groups.

The objectives of this study are: to establish ideal cephalometric norms in lateral incidents of soft tissues that serve as a reference point for diagnostic, orthodontic or surgical-orthodontic treatment plan of an adult Portuguese-Caucasian population; to compare cephalometric norms obtained from men with those obtained from women and to compare cephalometric norms obtained from the studied Portuguese population with norms from North American caucasians obtained from the Arnett Soft Tissue Cephalometric Analysis (STCA) at the Center for Corrective Jaw Surgery, Santa Barbara, CA.[1-3]

The following null hypotheses will be tested: there are no morphological differences between men and women; and there are no morphological differences between ethnic groups.

Materials and Methods

The study was approved by the Ethics Committee from the Faculty of Medicine of the University of Coimbra.

The ideal population sample was obtained from 578 young Portuguese-Caucasian adults of both sexes, students from Faculty of Medicine of the University of Coimbra and other volunteers.

The following criteria were used to select the patients for data collection: A normal class I molar and canine occlusion; the absence of facial marks, such as scarring, as well as mandibular functional deviations; to be of Portuguese-Caucasian origin; absence of previous orthodontic treatment or surgery in the maxillofacial area.

The sample was reduced to 59 people, and the following data was collected: clinical data; study models obtained from alginate impressions of the dental arches; photographs in numbers of four: two frontal and two profile of the Natural Head Position (NHP).

The following criteria were used to select the patients for the final ideal population sample:

– Presence of all permanent teeth; molar and canine class I,[6] with overbite and overjet of 0.5 mm – 4 mm.
– Well-aligned teeth in the arches, without excess or missing space greater than 3mm per arch.
– The absence of: teeth with rotation or inclination more than 15°; ectopic eruption; supernumerary teeth; teeth in infra- or supra-occlusion; anterior or posterior crossbites; deviation of the dental midline relative to the facial midline greater than 0.5 mm; functional anterior or lateral deviations; forced bites, with deviations between the first tooth contact and maximum intercuspidation, greater than 1.5 mm;
– Without signs or symptoms of temporomandibular dysfunction;
– To have completed the period of bone growth. The chronological age must be over 18 years old;
– The presence of good overall facial harmony; clinical selection performed by two orthodontists and two postgraduate orthodontistry students from our school.

Fifty-five people (35 women and 20 men) constituted the final population. Their ages varied between 18 – 33 years with an average of 22.6 years of age. In addition to the aforementioned exams, this final population underwent lateral cephalometric radiography in the Natural Head Position.

The North-American sample[1-3] is constituted of 46 young Caucasian adults (20 men and 26 women), selected according to a dental and facial aesthetic criteria: the entire population contained a Class I dental occlusion, without prior orthodontic treatment, and good facial aesthetics. The methods of execution and study of the cephalometric analysis followed by the American author are similar to the steps described below.

A number of instruments were used in the execution of the teleradiography in the Natural Head Position. These included: a Siemens Orthophos CD Panoramic Dental X-ray, Kodak 24x30 cm cassettes and Kodak 8DS1 18x24 cm films, and a Gevamatic 60 automatic developing machine. In addition, the cephalostat of the Panoramic Dental X-ray was adapted with a metal chain to project the radiographic film. On the wall, two meters in front of the cephalostat, an adjustable mirror (120x40 cm) was placed.

The lateral cephalometric radiographs were taken in centric occlusion. The centric relation was obtained through a standard manual manipulation and recorded on a wax bite which was used as an occlusal guide when taking the cephalometric radiography. In preparation for the cephalometric radiography, metal markers were used to better identify parts of the soft tissue structures of the midface, specifically: the Cheek Bone CB, Orbital Rim OR, Alar Base AB and Subpupil SP.

To obtain the NHP a test was first made to ensure the patient found a comfortable position of the head. This was followed by the positioning of the cephalostat. The final position was achieved by rearranging the feet, body and head, adjusting its symmetry with the metal chain.

The relaxation movements of the body and head were repeated during the test, paying attention to the reflection on the mirror. With the midface cutaneous points marked, as well as with the positioned condyles and the lips relaxed, a teleradiography was a conducted on the Natural Head Position.

The cephalometric analysis was performed with the direct digital method by Dolphin Imaging Software/32 (High Quality Digital Imaging Software for Orthodontics, Orthographic Surgery, Cosmetics and Medical Imaging), using the 8.0.6.12 version from the Dolphin Imaging Systems Inc, USA. The conversion of teleradiographies to digital images was done using the Astra 2400S HAL0 scanner with a transparency adapter (UMAX Technologies, Inc., Fremont, USA) and Photoshop 5.01® (Abode Systems Incorporated, San Jose, USA). To ensure exact measurements, the scan was obtained on a 100% scale with a resolution of 300 DPI without image enhancement filters. This method was chosen because it is the most popular choice by respected authors.[7]

Once scanned, the radiographic images were saved in JPEG format on a personal computer. The cephalometric values were subsequently exported to a spreadsheet.

Table 1 describes and Figure 1 shows the location of all points used in this study.

The repetition of the cephalometric tracing was carried out by a direct digital method of 20 randomly selected lateral teleradiographies, three weeks following the initial cephalometric tracing by the same investigator. To detect any systematic errors, a t-test with a significance level of 5% was used for each pair of records[8] (Table 2). The random error was studied using a formula proposed by Dahlberg.[9] The Pearson correlation coefficient (r) was determined for each pair of records.

To study sexual dysmorphism and the morphological differences between the two ethnic groups, the two-tailed t-test was used. A significance level of 5% was adopted. The t-test assumes values that come from populations with the same variance. A multiple comparison correction method (Benjamini-Hochberg[10]) was adopted with a FDR (False Discovery Rate) of 0.05.

Results

Table 3 and 4 present the results of variables that establish the cephalometric norms of the *ideal* Portuguese-Caucasian population, sexual dysmorphism and ethnic dysmorphism.

The thickness of the upper lip (LS-LSI) and lower lip (LL-Lli) is significantly different between both sexes and there is no dif-

Table 1. Dentoskeletal points		
S	Sela	The midpoint of sella turcica
Ba	Basion	The posterior inferior point on the occipital bone at the anterior margin of the foramen magnum
Ar	Articulare	Midpoint – formed by the intersection of the posterior contour of the mandibular articular process and the temporal bone
Co	Condilion	Midpoint – the most posterior and superior point on the outline of the mandibular condyle
Cl	Clinoidale	The most superior point of the contour of the anterior clinoid, or most posterior point of the orbit root
OR	Orbitale	Midpoint – the most inferior point on the infraorbital margin
N	Nasion	The most anterior limit of suture nasofrontalis
Go	Gonion	Midpoint – the most posterior and inferior point of the angle of the mandible
Me	Menton	The lowermost point on the shadow of the mandibular symphysis
Pg	Pogonion	The most anterior point on the mandibular symphysis
B	B point	The most posterior point in the concavity of the anterior mandible between the alveolar crest and Pogonion
A	A point	the most posterior point on the concave anterior border of the maxillary alveolar process, between the anterior nasal spine and the alveolar crest
ANS	Anterior Nasal Spine	Tip of the anterior nasal spine
PNS	Posterior Nasal Spine	Tip of posterior nasal spine
Mx1	Maxillary incisor	Tip of the crown of the upper central incisor
Md1	Mandibular incisor	Tip of the crown of the lower central incisor
Soft tissue points		
CB	Cheek Bone	The most convex point of the malar cutaneous region, transferred to the radiographic through the radiopacity of a metallic marker placed directly on the individual.
OR'	Orbital Rim	Marked point on the skin surface of the infraorbital rim, transferred to the radiographic through the radiopacity of a metallic marker placed directly on the individual.
SP	Subpupil	Point located midway between the Orbital Rim point and the Alar Base point, transferred to the radiographic through the radiopacity of a metallic marker placed directly on the individual.
AB	Alar Base	Point located in the deepest depression at the alar base of the nose, transferred to the radiographic through the radiopacity of a metallic marker placed directly on the individual.
Gl'	Soft tissue glabela	The most prominent or anterior point in mid-sagital plane of the forehead.
N'	Soft tissue nasion	The most concave point in the tissue overlying the area of the frontonasal suture.
Prn	Pronasale	The most prominent point of the nose
Sn	Subnasale	The point at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane
A'	Soft tissue A point	The point of greatest concavity located between the subnasale and the most anterior point of the upper lip
LS	Labrale Superior	The most anterior point on the upper lip
ULS	Stomion Superius	Lower most point on vermillion of upper lip
LLS	Stomion Inferius	Upper most point on vermillion of lower lip
LL	Labrale Inferius	The most anterior point on the lower lip
B'	Soft tissue B point	The point of greatest concavity in the midline of the lower lip between the labrale inferius and the soft tissue pogonion
PG'	Soft tissue Pogonion	The most anterior point on the soft tissue chin
GN'	Soft tissue Gnathion	The most anterior and inferior point on the soft tissue chin
ME'	Soft tissue Menton	The most inferior point on the soft tissue chin.
LSi	Internal Upper Lip	The most inferior point of the upper lip internal curvature that touch the labial surface of the maxillary central incisor crown
LLi	Internal Lower Lip	The most superior point of the lower lip internal curvature that touch the labial surface of the maxndibular central incisor crown
Cm	Columella	The most anterior and inferior point of the nose
The vertical reference line (VRL) is a straight line, drawn from P1 and P2:		
P1	Superior Point	Point located on a link at the top end of the metal chain radiographic image.
P2	Inferior Point	Point located on a link of the metal chain radiographic image, 10 cm bellow P1.
Cephalometric Plans:		
TVL	True Vertical Line	Straight line, parallel to the vertical reference line (P1-P2), placed through subnasale.
NSL	Linha Sela-Nasion	Straight line between the Sela point and Nasion point.

Table 2. Systematic error analysis of cephalometric variables				
Variable	Se	r	P	n
Soft tissues: structure				
LS-Lsi (mm)	0.18	0.98	0.335 ns	20
LL-Lli (mm)	0.08	0.97	0.403 ns	20
Pg-PG` (mm)	0.18	0.96	0.493 ns	20
Me-ME` (mm)	0.21	0.98	0.352 ns	20
LS-Sn-Cm (°)	1.30	0.95	0.288 ns	20
TVL-Sn-LS (°)	1.20	0.96	0.211 ns	20
Vertical relations				
N`-ME` (mm)	0.34	1.00	0.488 ns	20
Sn-ULS (mm)	0.26	0.98	0.349 ns	20
ULS-LLS (mm)	0.23	0.93	0.420 ns	20
LLS-ME` (mm)	0.25	0.96	0.485 ns	20
Sn-ME` (mm)	0.29	0.99	0.453 ns	20
Mx1-ULS (mm)	0.20	0.96	0.350 ns	20
Sn-Mx1 (mm)	0.22	0.98	0.427 ns	20
Md1-ME` (mm)	0.25	0.98	0.486 ns	20
Soft tissue: projection to TVL (True Vertical Line)				
TVL:Gl` (mm)	0.30	0.99	0.483 ns	20
TVL:OR` (mm)	0.36	0.97	0.320 ns	20
TVL:CB (mm)	0.90	0.97	0.238 ns	20
TVL:SP (mm)	0.31	0.97	0.376 ns	20
TVL:AB (mm)	0.39	0.99	0.454 ns	20
TVL:Prn (mm)	0.35	0.91	0.260 ns	20
TVL:A` (mm)	0.39	0.92	0.399 ns	20
TVL:LS (mm)	0.40	0.98	0.366 ns	20
TVL:Mx1 (mm)	0.29	0.99	0.445 ns	20
TVL:Md1 (mm)	0.31	0.99	0.495 ns	20
TVL:LL (mm)	0.34	1.00	0.485 ns	20
TVL:B` (mm)	0.38	1.00	0.493 ns	20
TVL:PG` (mm)	0.38	1.00	0.443 ns	20
Facial harmony				
LL: LS (mm)	0.37	0.98	0.483 ns	20
A`:B` (mm)	0.24	0.99	0.443 ns	20
OR`:A` (mm)	0.35	0.98	0.387 ns	20
OR`:PG` (mm)	0.30	0.98	0.478 ns	20
Gl`-Sn-PG` (°)	0.37	1.00	0.493 ns	20
Gl`:A` (mm)	0.30	0.99	0.454 ns	20
Gl`:PG` (mm)	0.38	0.99	0.383 ns	20
Dentoskeletal variables				
OJ (mm)	0.09	0.96	0.381 ns	20
OB (mm)	0.10	0.95	0.479 ns	20
S-N-A (°)	0.22	0.98	0.360 ns	20
S-N-B (°)	0.14	0.98	0.289 ns	20
A-N-B (°)	0.17	0.98	0.460 ns	20
S-N-Pg (°)	0.20	0.98	0.418 ns	20
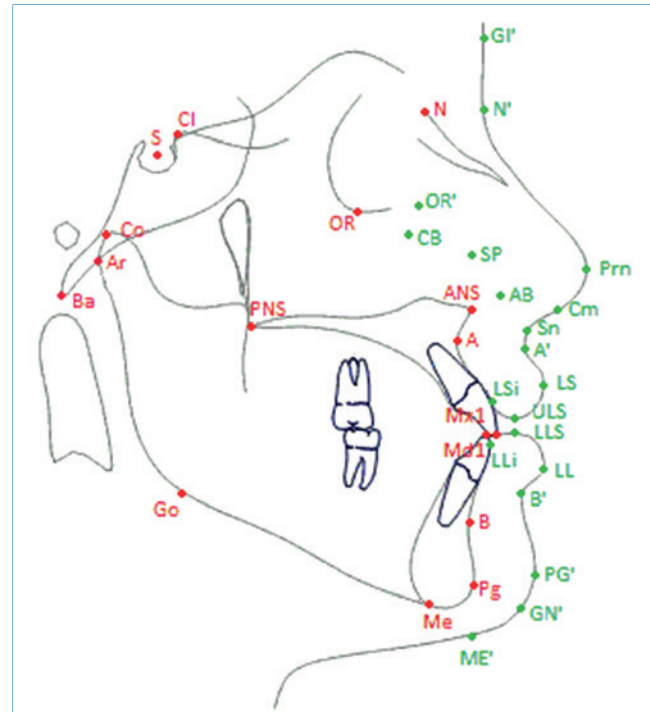
(**Dentoskeletal points** – S: Sela; B: Basion; Ar: Articulare; Co: Condilion; Cl: Clinoidale; OR: Orbitale; N: Nasion; Go: Gonion; Me: Menton; Pg: Pogonion; B: B point; A: A point; ANS: Anterior Nasal Spine; PNS: Posterior Nasal Spine; Mx1: Maxillary incisor; Md1: Mandibular incisor; **Soft tissue points** – CB: Cheek Bone; OR': Orbital Rim; SP: Subpupil; AB: Alar Base; Gl': Soft tissue glabella; N': Soft tissue nasion; Prn: Pronasale; Sn: Subnasale; A': Soft tissue A point; LS: Labrale Superior; ULS: Stomion Superius; LLS: Stomion Inferius; LL: Labrale Inferius; B': Soft tissue B point; PG': Soft tissue Pogonion; GN': Soft tissue Gnathion; ME': Soft tissue Menton; LSi: Internal Upper Lip; LLi: Internal Lower Lip; Cm: Columella).

Figure 1. Location of cephalometric points used in this study

ference between the two ethnic groups for the upper lip. Males presented a thicker upper lip and lower lip in comparison to females. The thickness of the Pogonion Cutaneous (Pg-PG`) is not significantly different between both sexes and neither between the two ethnic groups. The thickness of the Soft Tissue Menton (Me-ME`) shows no significant differences between both male and female, but is higher in the Portuguese sample in comparison to the North American sample. The naso-labial angle (LS-Sn-Cm) is significantly more open in females than in males in the Portuguese sample and also more open than in females of the North American sample. The upper lip angle (TVL-Sn-LS) is not significantly different between the two sexes in the Portuguese sample. However, it is significantly lower in Portuguese females in comparison to the North-american sample.

The total face height (N`-ME`) is significantly higher in males than in females, and higher among the females of the Portuguese sample versus North American females. The length of the upper lip (Sn-ULS) is significantly higher in males versus females in the Portuguese sample without any ethnic dysmorphism. The length of the lower lip (LLS-ME`) and the height of the lower face (Sn-ME`) are significantly higher in males than

Table 3. Cephalometric analysis of the soft tissues and sexual dysmorphism

	Portuguese sample				Sexual dysmorphism	
	♀	35	♂	20		
	mean	SD	mean	SD	p	
Soft tissues: structure						
LS-Lsi (mm)	13.01	2.13	15.67	1.76	0.0000	*
LL-Lli (mm)	10.13	1.56	11.24	1.69	0.0171	*
Pg-PG' (mm)	12.83	2.2	14.1	2.34	0.0492	ns
Me-ME' (mm)	11.1	2.52	11.78	3.23	0.3894	ns
LS-Sn-Cm (°)	111.2	6.17	105.53	10.88	0.0166	*
TVL-Sn-LS (°)	0.98	6.25	2.39	9.68	0.5141	ns
Vertical relations						
N`-ME` (mm)	129.3	5.88	137.45	7.65	0.0000	*
Sn-ULS (mm)	21.88	2.67	24.49	3.29	0.0023	*
ULS-LLS (mm)	1	0.75	0.99	0.59	0.9594	ns
LLS-ME` (mm)	48.87	3.38	51.85	4.77	0.0092	*
Sn-ME` (mm)	71.71	5.37	77.27	6.99	0.0017	*
Mx1-ULS (mm)	4.21	2.92	1.43	1.97	0.0004	*
Sn-Mx1 (mm)	26.09	2.92	27.38	3.73	0.1606	ns
Md1-ME` (mm)	48.25	3.1	51.87	3.92	0.0004	*
Soft tissue: projection to TVL (True Vertical Line)						
TVL:Gl` (mm)	-9.09	4.99	-13.2	7.18	0.0156	*
TVL:OR` (mm)	-20.23	3.53	-23.59	4.95	0.0050	*
TVL:CB (mm)	-23.04	5.19	-26.38	6.9	0.0471	ns
TVL:SP (mm)	-16.13	3.16	-19.04	3.7	0.0032	*
TVL:AB (mm)	-12.85	1.95	-15.62	2.82	0.0000	*
TVL:Prn (mm)	16.35	2.36	16.78	2.36	0.5185	ns
TVL:A` (mm)	-1.26	0.77	-1.02	1.16	0.3608	ns
TVL:LS (mm)	2.11	1.49	3.58	2.2	0.0047	*
TVL:Mx1 (mm)	-10.79	2.86	-12.42	2.74	0.0439	ns
TVL:Md1 (mm)	-13.71	2.89	-15.53	2.75	0.0263	ns
TVL:LL (mm)	0.64	2.48	1.45	2.69	0.2636	ns
TVL:B` (mm)	-7	3.61	-8.62	3.32	0.1055	ns
TVL:PG` (mm)	-4.01	5.08	-5.29	4.16	0.3428	ns
Facial harmony						
LL: LS (mm)	1.46	1.63	2.14	1.95	0.1718	ns
A`:B` (mm)	5.73	3.61	7.6	3.41	0.0650	ns
OR`:A` (mm)	23.97	3.22	29.58	4.73	0.0000	*
OR`:PG` (mm)	21.23	6.55	25.32	6.39	0.0288	ns
Gl`-Sn-PG` (°)	168.64	4.79	165.11	5.47	0.0157	*
Gl`:A` (mm)	7.83	4.82	12.18	7.07	0.0091	*
Gl`:PG` (mm)	5.09	8.23	8.24	8.69	0.1866	ns
Dentoskeletal variables						
OJ (mm)	2.92	0.7	3.1	0.6	0.3392	ns
OB (mm)	2.63	1.52	1.98	1.25	0.1106	ns
S-N-A (°)	82.69	3.7	83.29	3.42	0.5549	ns
S-N-B (°)	80.02	3.27	80.62	2.84	0.4960	ns
A-N-B (°)	2.66	1.78	2.68	1.84	0.9686	ns
S-N-Pg (°)	80.99	3.46	81.08	2.84	0.9217	ns

Table 4. Cephalometric analysis of the soft tissues and etnic dysmorphism

	EUA sample				Ethnic Dysmorphism			
	♀		♂		♀		♂	
	mean	SD	mean	SD	p		p	
Soft tissues: structure								
LS-Lsi (mm)	12.60	1.80	14.80	1.40	0.4309	ns	0.0917	ns
LL-Lli (mm)	13.60	1.40	15.10	1.20	0.0000	*	0.0000	*
Pg-PG' (mm)	11.80	1.50	13.50	2.30	0.0442	ns	0.4186	ns
Me-ME' (mm)	7.40	1.60	8.80	1.30	0.0000	*	0.0005	*
LS-Sn-Cm (°)	103.50	6.80	106.40	7.70	0.0000	*	0.7720	ns
TVL-Sn-LS (°)	12.10	5.10	8.30	5.40	0.0000	*	0.0222	Ns
Vertical relations								
N`-ME` (mm)	124.60	4.70	137.70	6.50	0.0014	*	0.9119	ns
Sn-ULS (mm)	21.00	1.90	24.40	2.50	0.1576	ns	0.9229	ns
ULS-LLS (mm)	3.30	1.30	2.40	1.10	0.0000	*	0.0000	*
LLS-ME` (mm)	46.90	2.30	54.30	2.40	0.0130	ns	0.0471	ns
Sn-ME` (mm)	71.10	3.50	81.10	4.70	0.6158	ns	0.0490	ns
Mx1-ULS (mm)	4.70	1.60	3.90	1.20	0.4428	ns	0.0000	*
Sn-Mx1 (mm)	25.70	2.10	28.40	3.20	0.5652	ns	0.5759	ns
Md1-ME` (mm)	48.60	2.40	56.00	3.00	0.6340	ns	0.0006	*
Soft tissue: projection to TVL (True Vertical Line)								
TVL:Gl` (mm)	-8.50	2.40	-8.00	2.50	0.5802	ns	0.0041	*
TVL:OR` (mm)	-18.70	2.00	-22.40	2.70	0.0520	ns	0.3512	ns
TVL:CB (mm)	-20.60	2.40	-25.20	4.00	0.0300	ns	0.5122	ns
TVL:SP (mm)	-14.80	2.10	-18.40	1.90	0.0678	ns	0.4955	ns
TVL:AB (mm)	-12.90	1.10	-15.00	1.70	0.9069	ns	0.4050	ns
TVL:Prn (mm)	16.00	1.40	17.40	1.70	0.5039	ns	0.3465	ns
TVL:A` (mm)	-0.10	1.00	-0.30	1.00	0.0000	*	0.0422	ns
TVL:LS (mm)	3.70	1.20	3.30	1.70	0.0000	*	0.6550	ns
TVL:Mx1 (mm)	-9.20	2.20	-12.10	1.80	0.0215	ns	0.6649	ns
TVL:Md1 (mm)	-12.40	2.20	-15.40	1.90	0.0583	ns	0.1388	ns
TVL:LL (mm)	1.90	1.40	1.00	2.20	0.0234	ns	0.5659	ns
TVL:B` (mm)	-5.30	1.50	-7.10	1.60	0.0277	ns	0.0729	ns
TVL:PG` (mm)	-2.60	1.90	-3.50	1.80	0.1839	ns	0.0854	ns
Facial harmony								
LL: LS (mm)	1.80	1.00	2.30	1.20	0.3514	ns	0.7564	ns
A`:B` (mm)	5.20	1.60	6.80	1.50	0.4878	ns	0.3429	ns
OR`:A` (mm)	18.50	2.30	22.10	3.00	0.0000	*	0.0000	*
OR`:PG` (mm)	16.00	2.60	18.90	2.80	0.0003	*	0.0002	*
Gl`-Sn-PG` (°)	169.30	3.40	169.40	3.20	0.5516	ns	0.0044	*
Gl`:A` (mm)	8.40	2.70	7.80	2.80	0.5896	ns	0.0140	ns
Gl`:PG` (mm)	5.90	2.30	4.60	2.20	0.6281	ns	0.0773	ns
Dentoskeletal variables								
OJ (mm)	3.20	0.40	3.20	0.70	0.0727	ns	0.6304	ns
OB (mm)	3.20	0.70	3.20	0.70	0.0811	ns	0.0005	*

females in the Portuguese sample. The exposure of the upper incisor (Mx1-ULS) is significantly lower in males than in females of the Portuguese sample and significantly lower in males of the Portuguese sample compared to males of the North American sample.

The Soft Tissue Glabella (TVL:Gl`) is significantly more posterior in males than females, and more posterior in the Portuguese male sample compared to the North-American male sample. The variables corresponding to the midface (TVL:OR`, TVL:SP, TVL:AB) are significantly more posterior in males than in females in the Portuguese sample and do not demonstrate ethnic dysmorphism. The anteroposterior position of the upper lip TVL:LS is more advanced in males (3.58 ±2.2 mm) than in females (2.11 ±1.49 mm), and in comparison to the North-american sample the lip recess in Portuguese women is significantly higher. The anteroposterior position of the lower lip TVL:LL is not statistically significant in both sexes of the Portuguese sample and do not demonstrate ethnic dysmorphism. The positioning of the upper incisors TVL:Mx1 and lower incisors TVL:Md1 is not statistically significantly different between both sexes in the Portuguese sample and neither between the two ethnic groups.

In the relationship between the lips LL:LS there are no significant differences either between the sexes nor between the two ethnic groups. Regarding the harmony between the soft-tissue landmarks that best represent the sagittal position of the jaw (A`:B`) it was not verified a statistically significant anteroposterior difference.

The overbite (OB) is significantly higher in the North American males than in the Portuguese males, while the overjet (OJ) has no significant difference between the two ethnic groups. The A-N-B angle that describes the intermaxillary sagittal relationship is almost the same in both sexes, 2.66 ± 1.78º in females and 2.68 ± 1.84º in males.

Discussion

The differences in the structure and placement of the soft tissue profile is a result of many factors including heredity and environment. As the profile varies with the type of malocclusion, this study only included patients with a Class I occlusion, although there are aesthetically pleasing faces in patients with malocclusion. There may also be large skeletal variations in individuals with a class I molar and canine. These considerations are some of the reasons why the study was conducted only with subjects possessing a normal occlusion associated with good facial aesthetics.

Males presented a thicker upper lip and lower lip in comparison to females. The highest growth of the lips is verified in girls between the ages of 10 and 14 and in boys between the ages of 8 and 16[11]. If the thickness of the upper lip LS-LSI is greater than 18mm, it does not follow the movement of the incisors during treatment. But if the thickness is less than 12mm, then, the lip is already tracking the incisive contraction.[12,13]

The nasolabial angle decreases with age[11] and can be modified either through the nose growth, either by sagittal chang-es of the lips during orthodontic or orthodontic-surgical treatment[14]. The values found in this study (111 ± 6 females; males 105 ± 11) and the values of other authors[5,15-20] demonstrate quite well the variability of this angle and consequently the interest in using different normative values in individuals of different populations.

The length of the upper lip (Sn-ULS) is significantly higher in males versus females in the Portuguese sample. The largest growth of the upper lip occurs in men between 10 and 16 years of age and in women between 10 and 14 years of age.[21] The implication of a short lip in facial aesthetics is important because it causes a higher incisive exposition and a relative increase in the height of the lower face.

The labial measurements allow us to identify if the length of the soft tissue is normal or abnormal and, consequently, provides information about the length of structures of the dentoskeletal tissues. Farkas[17] described an increased lip length of 0.77mm/year in men of 9 to 18 years of age and an increase of 0.46mm/year in girls of 8 to 16 years of age.

In this study, the interlabial gap (ULS-LLS), with relaxed lips, does not present significant differences between the two sexes which is consistent with other studies[15,17-20]. Regarding ethnic dysmorphism, the values found in the Portuguese sample were significantly lower than those presented in the North American sample. This measure depends on the length of the lips, skeletal vertical length, projection of the incisors and lip posture.[21]

The exposure of the upper incisor (Mx1-ULS) is significantly lower in males than in females of the Portuguese sample and significantly lower in males of Portuguese sample compared to males of the North American sample. Looking at the above data, it is noticeable that these differences relate to differences in the upper lip length. Subtelny[22] in a study of 30 adolescents verified the existence of a constant vertical relationship between the incisal edge of the central incisor and the upper lip growth.

The nasal projection TVL:Prn is not significantly different between the sexes and between ethnic groups. Authors like Arnett and Bergman[1,2] and Lehman[20] considered a big nose when projected to more than 20 mm and a small one when projected less than 14 mm. The values found in this investigation are within those ranges (16 ±2.36 mm).

The variables TVL:OR`, TVL:CB and TVL:SP are indicative of the sagittal position of the upper jaw and the TVL:AB variable demonstrates the anteroposterior position of the upper and lower jaw. The significant recess verified in males pertains to sexual differences of the facial structure, considering the greatest projection of cheekbones verified in females.

The facial contour angle Gl`-Sn-PG` relates the three portions of the face. For this variable, ethnic dysmorphism was not found in females, and it was verified a wider Gl`-Sn-PG` in females (168.64 ±4.79º) than in males (165.11 ±5.47º). These values are consistent with the values found by several authors.[1,15,16,18-20]

The S-N-A angle oscillated between 83,29º in the male sample and between 82,69º in the female sample, thus, not presenting significant differences. These values are consistent with the values found by several authors.[23-26]

The two variables that indicate a sagittal jaw position, S-N-B e S-N-Pg, statistically were the same in both males and females; however, the male population has a slightly advanced position of the mandible. Other authors[24,27] had significantly different values in both sexes. This may be justified because these authors did not include an aesthetic criteria as part of the selection process of their samples.

The results are to be understood only as reference values for a well-characterized population. Therefore, when comparing some of the variables with the results of other investigations it is natural to observe differences in the results that may not be entirely related to ethnicity. Some studies use different selection criteria for the population, some studies do not use the natural head position, and the exact way of measuring the same variable may be different from study to study.

Then, in a cephalometric analysis, we must consider gender, age and ethnic background in order to obtain correct clinical information. The Natural Head Position, relaxed lips and the use of metallic markers to identify some parts of the soft tissue structures of mid-face are essential for proper cephalometric analysis when used as a diagnostic and treatment planning tool. The harmony between the constituent parts of the face is determined regardless of the True Vertical positioning.

Conclusions

1. In the Portuguese sample, males in comparison to females, presented: a higher total face height and a higher lower face height; more posterior position of soft tissue glabella and variables corresponding to the midface; thicker and longer upper and lower lips with a more advanced anteroposterior position of the upper lip; smaller naso-labial angle; and lower exposure of the upper incisors.
2. Females, in the Portuguese sample in comparison to the North American sample, presented: a higher naso-labial angle; higher total face height; lower upper lip angle; lower anteroposterior position of the upper lip. Males, in the Portuguese sample in comparison to the North American sample, presented: lower overbite; lower exposure of the upper incisor; more posterior soft tissue glabella. In the Portuguese sample in comparison to the North American sample, the thickness of the Soft Tissue Menton is higher in both genders.
3. If the cephalometric standards obtained in this study are accepted as ideal for the population, then, orthodontic treatment and/or orthodontic-surgical treatment based on dental-skeletal standards is not sufficient to obtain good facial aesthetics and could even lead to undesirable clinical outcomes.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interest

The authors have no conflicts of interest to declare.

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