AJO-DO

Differences in craniofacial and dental characteristics of adolescent Mexican Americans and European Americans

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Introduction: The purpose of this study was to compare the soft-tissue profiles of matched Class I adolescent European Americans and Mexican Americans. The secondary aim was to explain profile differences based on group differences in soft-tissue thickness, skeletal morphology, dental position, and tooth size. **Methods:** The study pertained to 207 untreated Class I adolescents, including 93 Mexican Americans and 114 European Americans. Lateral cephalometric and model analyses were performed to quantify morphologic differences. Two-way analyses of variance were used to evaluate ethnicity, sex, and their interaction. **Results:** Mexican Americans had significantly (P <0.05) greater lip protrusion and facial convexity than did European Americans. Mexican Americans had smaller craniofacial dimensions and larger teeth, resulting in maxillary and mandibular dentoalveolar protrusion. Mexican Americans also had thicker soft tissues and greater maxillary skeletal prognathism than European Americans. The combination of thicker soft tissues, maxillary skeletal prognathism, and dentoalveolar protrusion explained the protrusive lips of Mexican Americans. The greater facial convexity of Mexican Americans was due primarily to maxillary prognathism and mandibular hyperdivergence. Sex differences pertained primarily to size; the linear dimensions of the boys were consistently and significantly larger than those of the girls. **Conclusions:** European American normative data and treatment objectives do not apply to Mexican Americans. Knowledge of the soft-tissue, skeletal morphology, and dental position differences should be applied when planning treatment for Mexican American patients. (Am J Orthod Dentofacial Orthop 2011;140:839-47)

Development of an individualized treatment plan is paramount for successfully achieving optimal esthetics, function, periodontal health, and stability. Because of the potentially detrimental effects of orthodontic treatment, the soft-tissue profile has become an increasingly important determinant of the final treatment plan. However, orthodontists, general dentists, and laypeople have differing opinions concerning profile preferences, depending on their level of education, ethnicity, treated status, and sex.[1-3] The age, sex, and ethnicity of the subjects being judged have also been shown to affect esthetic preferences.[4,5]

The soft-tissue profile depends on various morphologic factors. The horizontal positions of the hard tissues are among the most important determinants of horizontal soft-tissue positions.[6,7] For example, extraction studies have consistently shown that lip position and the nasiolabial angle depend on the anteroposterior positions of the incisors.[8,9] Soft tissues thickness also affects lip and chin positions.[10,11] Orthodontic treatment can affect the interrelationships among the soft-tissue, skeletal, and dental components.

Although ethnic group differences have been well established for soft-tissue profile,[12,13] soft-tissue thickness,[14-16] skeletal morphology,[12,13,16] dental position and inclination,[12,13] and tooth size,[17-19] comparative data for Mexican Americans are lacking. Such comparisons are important because subjects of Mexican descent comprise a large percentage of the population in the United States, and they are increasing more rapidly than any other ethnic group.[20] Mexicans and Mexican Americans have been shown to be more protrusive, both skeletally and dentally, than European Americans.[21-24] Importantly, most studies comparing European Americans and

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Mexican Americans have focused on 1 or 2 morphologic components. Thus, they were unable to determine the basis of the differences in the profiles. For example, the lack of studies evaluating differences between Mexican Americans and European Americans in both soft-tissue profile and soft-tissue thickness makes it impossible to know whether these are related.

Because of the limited and inconsistent data pertaining to adolescent Mexican Americans, the primary aim of this study was to compare the soft-tissue profiles of matched Class I European Americans and Mexican Americans. To determine the basis of the group differences, the secondary aim was to evaluate differences in soft-tissue thickness, skeletal morphology, dental position, and tooth size between European Americans and Mexican Americans. This is the first comprehensive study on this topic.

MATERIAL AND METHODS

This study pertains to untreated adolescents with Class 1 malocclusion. The Mexican American sample was collected from a private practice in Houston, Texas. A total of 1285 consecutive untreated patients were evaluated by the primary author (E.V.) to identify the Mexican American sample based on their surnames and frontal photographs exhibiting mestizo features. The photographs were used to verify that they had brown skin, dark brown eyes, and black hair. A total of 2710 consecutive untreated subjects were evaluated from a private practice in Arlington, Texas, to identify the European American sample.

To control for extraneous variations, the subjects had to have Class I molar relationships, lateral cephalograms of sufficient quality to unambiguously identify all landmarks, study models without worn or broken teeth, extraoral color photographs, intraoral color photographs, permanent dentitions, and known surnames. The Class I molar relationship was clinically confirmed by using intraoral photographs and study models; the mesiobuccal cusp of the maxillary first molars had to be within 1 mm of the buccal groove of the mandibular first molars. To control for maturational differences, boys had to be between 12.5 and 15.5 years of age; girls had to be between 11.5 and 13.5 years of age. These ages were chosen to adjust for sex differences in the timing of peak adolescent growth velocity, which occurs approximately 1.9 years later in boys than in girls.[25] Subjects were excluded if they had congenital deformities or defects, a history of early treatment, impacted teeth (other than thirrd molars), or anterior crossbites.

The final sample included the pretreatment records of 207 adolescents: 114 European Americans and 93 Mexican Americans (Table I). The European American sample included 53 boys and 61 girls, with mean ages of 13.9 and 12.6 years, respectively. The Mexican American sample included 44 boys and 49 girls, with mean ages of 13.8 and 12.5 years, respectively (Table I).

Table I. Description of subjects by ethnic group and sex

	Boys		*Girls*			
	Mean age (y)	*n*	*Mean age (y)*	*n*	*Total (n)*	*Mean age (y)*
European Americans	13.9	53	12.6	61	114	13.3
Mexican Americans	13.8	44	12.5	49	93	13.2
Mean age	13.9		12.6			
Total		97		110		

Because the lateral cephalograms were taken on 2 different cephalostats, all size measurements were adjusted based on the subject-to-film distances to eliminate magnification differences. A custom analysis was created by using Dolphin Imaging Premium Software (version 11.0; Dolphin Imaging Systems, Chatsworth, Calif). Thirty landmarks (Fig 1) were digitized according to the hard-tissue and soft-tissue definitions of Riolo et al[26] and Molsted et al.[27] Landmarks were used to create 19 soft-tissue measurements, 25 skeletal measurements, and 9 dental measurements. All landmarks were digitized by 1 investigator (E.V.).

To measure the mesiodistal diameters of the 6 anterior teeth (central and lateral incisors, and canines) on both the maxillary and mandibular casts, a total of 24 mesial and distal contact points (2 points per tooth for each arch) were identified. The contact points were defined as the greatest distance between approximate surfaces, as observed when teeth were rotated or poorly aligned. The casts were measured by using digital calipers accurate to the nearest 0.01 mm. Anterior arch perimeters were measured with the continuous brass-wire technique.[28] The brass wire was contoured over the dentition to estimate where the contacts of the teeth would be in ideal alignment and upright over basal bone, and the distance between the mesial aspect of the first premolar on 1 side to the mesial aspect of the first premolar on the other side was measured with digital calipers accurate to the nearest 0.01 mm. All model analysis measurements were made by 1 investigator (E.V.).

Intraexaminer measurement reliabilities were based on replicate analyses performed on 32 lateral cephalograms and 25 sets of models, measured at 2 times. Random method errors ($\sqrt{[\sum d^2/2n]}$) for the linear and angular cephalometric measurements averaged 0.65 mm and 1.3°, respectively. Method errors for dental cast measurements averaged 0.15 mm.

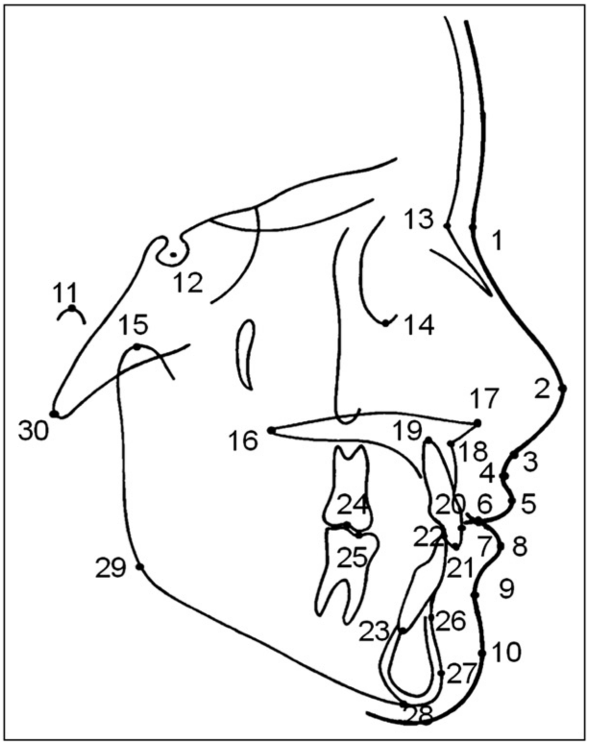

Fig 1. Cephalometric hard-tissue and soft-tissue landmarks: *1*, Soft-tissue nasion (N′); *2*, pronasale (P); *3*, subnasale (Sn); *4*, superior labial sulcus (SLS); *5*, labrale superiorus (Ls); *6*, stomion superiorus (Ss); *7*, stomion inferiorus (Si); *8*, labrale inferiorus (Li); *9*, inferior labial sulcus (ILS); *10*, soft-tissue pogonion (Pg′); *11*, porion (Po); *12*, sella (S); *13*, nasion (N); *14*, orbitale (Or); *15*, condylion (Co); *16*, posterior nasal spine (PNS); *17*, anterior nasal spine (ANS); *18*, A-point (A); *19*, upper incisor root ($U1_{root}$); *20*, upper incisor most labial ($U1_{labial}$); *21*, upper incisor tip ($U1_{tip}$); *22*, lower incisor tip ($L1_{tip}$); *23*, lower incisor root (LL_{root}); *24*, upper molar occlusal (U6); *25*, lower molar occlusal (L6); *26*, B-point (B); *27*, pogonion (Pg); *28*, menton (Me); *29*, gonion (Go); *30*, basion (Ba).

Statistical analysis

Skewness and kurtosis statistics showed that the variables were normally distributed. Two-way analysis of variance (ANOVA) was used to simultaneously evaluate ethnicity (European American vs Mexican American), sex (male vs female), and their interactions. No statistically significant interactions were found between ethnicity and sex. All analyses were performed by using SPSS software (version 15; SPSS, Chicago, Ill), with a significance level of 0.05 for the statistical comparisons.

RESULTS

There were statistically significant (P <0.05) differences between the European Americans and Mexican Americans for all soft-tissue profile variables (Table II). Mexican Americans had significantly more protrusive upper (2.0-3.0 mm) and lower (0.6-2.4 mm) lips than did European Americans, with differences depending on the reference plane used. Mexican Americans were also more convex, with larger H-angles and larger soft-tissue facial angles than European Americans. Soft tissues were consistently thicker in Mexican Americans, with significant differences at the vermilion border, B-point, and soft-tissue pogonion.

European Americans and Mexican Americans also differed significantly (P <0.05) in their skeletal dimensions (Table III). All 4 measures of anteroposterior maxillary position showed greater protrusion among Mexican Americans; SNA was 2.4° larger, A-point was 1.8 mm farther in front of nasion perpendicular, maxillary depth was 1.9° greater, and ANS was located 1.8 mm farther ahead of nasion. In contrast, the anteroposterior positions of the mandible of Mexican Americans and European Americans did not differ significantly. Only pogonion to nasion-basion (NB) showed a significant group difference, with chin protrusion 1.4 mm greater among European Americans. Mexican Americans had significantly larger ANB angles, greater convexity, and smaller maxillomandibular differential than European Americans. The Mexican Americans were also more hyperdivergent than were the European Americans, with mandibular plane angles 1.6° to 2° greater. Except for lower anterior face height, European Americans were significantly larger for all size and length measurements than Mexican-Americans, with differences between 2.5% and 4.2% for all measurements except for the sella-nasion line, which differed by 8.6%.

The maxillary incisors of Mexican Americans were significantly more protrusive and proclined (Table IV), with differences ranging from 2.3° to 3.2° and 2 to 3 mm. The mandibular incisors were also significantly more protrusive and proclined among Mexican Americans than European Americans; IMPA was 4.1° greater, FMIA was 6.0° greater, mandibular incisor to the A-pogonion reference plane was 1.9 mm greater, and mandibular incisor to NB was 2.3 mm greater. The interincisal angle was 8.7° smaller in the Mexican Americans than in the European Americans.

Tooth sizes and arch lengths were consistently larger in Mexican Americans than in European Americans (Table V). The teeth of Mexican Americans were 4.2% to 6.4% larger; the maxillary central incisors (2.6%-3.1%) had the smallest difference, and the maxillary lateral incisors (8.8%-9.3%) had the largest ethnic differences.

There were no statistically significant sex differences in soft-tissue profile or facial convexity. Boys

Table II. Soft-tissue differences between European Americans and Mexican Americans

Soft-tissue measurement	Unit	European Americans		Mexican Americans		P
		Mean	SD	Mean	SD	
Profile						
Ls ⊥ P-Pg′	mm	−3.29	2.19	−0.53	1.97	<0.001
Ls ⊥ S line	mm	−0.54	1.87	1.90	1.70	<0.001
Ls ⊥ Sn-Pg′	mm	2.96	1.57	4.98	1.51	<0.001
Ls ⊥ N′-Pg′	mm	8.75	2.58	11.71	2.22	<0.001
Sn ⊥ Ls-Pg′	mm	4.19	2.21	6.96	2.12	<0.001
SLS ⊥ Sn-LS	mm	3.15	1.24	4.34	1.72	<0.001
Li ⊥ P-Pg′	mm	−2.04	2.41	0.35	2.36	<0.001
Li ⊥ Ls-Pg′	mm	0.13	1.39	0.70	1.59	0.007
Li ⊥ S line	mm	−0.25	2.17	1.87	2.17	<0.001
Li ⊥ Sn-Pg′	mm	2.03	1.90	3.78	1.99	<0.001
Li ⊥ N′-Pg′	mm	5.75	2.47	7.90	2.23	<0.001
Convexity						
N′-Pg′-Ls	°	14.03	3.98	18.89	3.64	<0.001
(Po-Or)-(N′-Pg′)	°	91.31	2.80	92.28	3.30	0.026
Soft-tissue thickness						
A-SLS	mm	13.95	1.53	14.23	1.68	0.191
Ls-$U1_{labial}$	mm	13.24	2.19	13.87	2.19	0.040
Ls-$U1_{tip}$	mm	16.78	2.62	16.62	2.36	0.533
Li-$U1_{tip}$	mm	11.52	1.80	11.83	1.91	0.227
B-ILS	mm	11.56	1.66	12.31	2.16	0.006
Pg-Pg′	mm	12.72	2.36	14.48	2.75	<0.001

Table III. Skeletal differences between European Americans and Mexican Americans

Skeletal measurement	Unit	European Americans		Mexican Americans		P
		Mean	SD	Mean	SD	
Maxilla						
SNA	°	81.55	3.25	83.97	3.65	<0.001
(Po-Or)-(N-A)	°	90.39	2.89	92.31	3.56	<0.001
A ⊥ (N ⊥ [Po-Or])	mm	0.42	3.00	2.26	3.44	<0.001
ANS ⊥ (N ⊥ [Po-Or])	mm	4.77	2.98	6.52	3.21	<0.001
Mandible						
SNB	°	78.52	3.47	79.36	3.22	0.067
Pg ⊥ (N ⊥ [Po-Or])	mm	−3.12	5.22	−3.79	5.65	0.370
Pg ⊥ (N-B)	mm	1.88	1.69	0.45	1.34	<0.001
(S-N)-(N-Pg)	°	79.53	3.55	79.60	3.37	0.846
Maxillomandibular relationships						
ANB	°	3.06	2.05	4.62	2.12	<0.001
Wits	mm	−0.44	2.32	0.13	2.72	0.121
N-A-Pg	°	4.56	5.61	9.41	5.23	<0.001
A ⊥ (N-Pg)	mm	2.13	2.63	4.28	2.38	<0.001
(Co-Pg)-(Co-ANS)	mm	21.01	4.11	19.90	4.33	0.045
Ba-S-N	°	131.33	4.73	133.77	5.11	<0.001
(Po-Or)-(Go-Me)	°	24.56	4.44	26.55	4.22	0.002
(S-N)-(Go-Me)	°	33.39	4.97	34.92	5.11	0.039
Sizes/lengths						
N-Me	mm	113.23	7.75	110.44	6.00	<0.001
N-ANS	mm	53.26	3.69	51.29	3.20	<0.001
ANS-Me	mm	62.38	5.49	62.49	4.34	0.976
S-N	mm	70.02	3.54	64.45	3.19	<0.001
ANS-PNS	mm	52.27	3.30	50.29	2.79	<0.001
Co-A	mm	87.00	4.50	84.72	5.21	<0.001
Co-Pg	mm	110.39	6.28	106.96	6.33	<0.001
Go-Pg	mm	72.10	4.56	69.21	4.54	<0.001
S-Go	mm	75.24	5.84	73.39	6.15	0.007

Table IV. Dental inclination differences between European Americans and Mexican Americans

Dental measurement	*Unit*	*European Americans*		*Mexican Americans*		P
		Mean	*SD*	*Mean*	*SD*	
Maxilla						
(S-N)-($U1_{tip}$-$U1_{root}$)	°	102.27	6.56	105.50	6.61	0.001
(Po-Or)-($U1_{tip}$-$U1_{root}$)	°	111.09	6.00	113.83	6.50	0.002
$U1_{tip}$ ⊥ (N-A)	mm	2.97	2.20	3.51	2.19	0.080
$U1_{tip}$ ⊥ (A-Pg)	mm	4.68	2.00	6.94	1.98	<0.001
Mandible						
(Go-Me)-($L1_{tip}$-$L1_{root}$)	°	90.63	6.70	94.72	6.41	<0.001
Po-Or-($L1_{tip}$-$L1_{root}$)	°	64.77	6.49	58.81	6.18	<0.001
$L1_{tip}$ ⊥ (A-Pg)	mm	1.22	1.67	3.15	1.97	<0.001
$L1_{tip}$ ⊥ (N-B)	mm	3.93	1.88	6.21	2.04	<0.001
Maxillomandibular relationship						
($U1_{tip}$-$U1_{root}$)-($U1_{tip}$-$U1_{root}$)	°	133.68	8.18	124.97	9.37	<0.001

Table V. Tooth size differences between European Americans and Mexican Americans

Measurement	*Unit*	*European Americans*		*Mexican Americans*		P
		Mean	*SD*	*Mean*	*SD*	
UR canine	mm	7.96	0.47	8.35	0.54	<0.001
UR lateral incisor	mm	6.70	0.59	7.32	0.51	<0.001
UR central incisor	mm	8.64	0.48	8.91	0.49	<0.001
UL central incisor	mm	8.64	0.51	8.86	0.49	0.002
UL lateral incisor	mm	6.62	0.60	7.20	0.53	<0.001
UL canine	mm	7.87	0.49	8.25	0.46	<0.001
U ant perimeter	mm	46.30	3.16	48.18	3.23	<0.001
LR canine	mm	6.87	0.41	7.19	0.44	<0.001
LR lateral incisor	mm	5.98	0.37	6.32	0.38	<0.001
LR central incisor	mm	5.50	0.31	5.73	0.35	<0.001
LL central incisor	mm	5.48	0.33	5.71	0.34	<0.001
LL lateral incisor	mm	5.95	0.35	6.33	0.44	<0.001
LL canine	mm	6.88	0.44	7.29	0.47	<0.001
L ant perimeter	mm	35.07	2.57	36.53	2.74	<0.001
Bolton	%	79.01	2.22	78.93	2.34	0.833

UR, Upper right; *UL*, upper left; *U*, upper; *ant*, anterior; *LR*, lower right; *LL*, lower left; *L*, lower.

had significantly thicker soft tissues than did girls, with differences ranging from 1.3 to 1.7 mm for the upper lip, and from 1.1 to 1.4 mm for the lower lip (Table VI).

The skeletal variables showed only limited sex differences. Boys had significantly larger maxillomandibular differentials (2.6 mm), smaller cranial base angles (1.3°), and protrusion of pogonion to NB (0.8 mm). There were significant sex differences in sizes and lengths of the skeletal measurements; boys were significantly larger than girls. Sex differences ranged from 5.2% for ANS-PNS to 9.7% for S-Go.

Dental positions, inclinations, and interrelationships showed no significant sex differences. All teeth tended to be larger in boys, with statistically significant differences for the maxillary central incisors and all 4 canines (Table VII). Maxillary anterior arch perimeter was also significantly larger in the boys.

DISCUSSION

Compared with Mexican Americans, the craniofacial complex of adolescent European Americans was 2.5% to 4.2% larger. Phelan et al[23] previously showed larger maxillas and mandibles among Class II European Americans than Class II Mexicans. Swleranga et al[24] reported that European Americans girls were larger than Mexican American girls, although the European American boys were smaller. Mexican Americans might be expected to exhibit smaller craniofacial structures because of their smaller body size. The Hispanic Health and Nutrition Examination Survey and the National Health and Nutrition

Table VI. Sex difference in soft-tissue measurements

Measurement	*Unit*	*Boys*		*Girls*		P
		Mean	*SD*	*Mean*	*SD*	
Soft-tissue measurements						
A-SLS	mm	14.76	1.54	13.47	1.40	<0.001
Ls-U1$_{labial}$	mm	14.40	2.13	12.74	1.99	<0.001
Ls-U1$_{tip}$	mm	17.58	2.56	15.94	2.19	<0.001
Li-U1$_{tip}$	mm	12.39	1.82	11.01	1.64	<0.001
B-ILS	mm	12.48	2.01	11.38	1.72	<0.001
Pg-Pg′	mm	14.14	2.76	12.95	2.50	0.001
Skeletal measurements						
Pg ⊥ (N-B)	mm	1.63	1.84	0.88	1.47	0.001
(Co-Pg)-(Co-ANS)	mm	21.89	4.17	19.30	3.94	<0.001
Ba-S-N	°	131.76	4.53	133.02	5.40	0.001
N-Me	mm	116.30	5.65	108.16	6.08	<0.001
N-ANS	mm	54.13	3.11	50.82	3.29	<0.001
ANS-Me	mm	64.89	4.14	60.26	4.69	<0.001
S-N	mm	69.46	4.16	65.80	3.82	<0.001
ANS-PNS	mm	52.76	3.15	50.17	2.80	<0.001
Co-A	mm	88.42	4.65	83.82	4.16	<0.001
Co-Pg	mm	112.74	5.29	105.42	56.50	<0.001
Go-Pg	mm	72.90	4.61	68.95	4.10	<0.001
S-Go	mm	78.08	5.42	71.17	4.52	<0.001

Table VII. Sex differences in tooth size

Measurement	*Unit*	*Boys*		*Girls*		P
		Mean	*SD*	*Mean*	*SD*	
UR canine	mm	8.35	0.52	7.94	0.48	<0.001
UR lateral incisor	mm	7.04	0.59	6.92	0.67	0.160
UR central incisor	mm	8.83	0.46	8.69	0.54	0.049
UL central incisor	mm	8.82	0.50	8.67	0.51	0.026
UL lateral incisor	mm	6.93	0.60	6.84	0.67	0.269
UL canine	mm	8.19	0.51	7.91	0.49	<0.001
U ant perimeter	mm	48.10	3.29	46.31	3.11	<0.001
LR canine	mm	7.21	0.41	6.84	0.41	<0.001
LR lateral incisor	mm	6.16	0.44	6.11	0.39	0.412
LR central incisor	mm	5.65	0.36	5.57	0.34	0.067
LL central incisor	mm	5.62	0.35	5.55	0.36	0.104
LL lateral incisor	mm	6.18	0.44	6.07	0.43	0.038
LL canine	mm	7.28	0.46	6.87	0.44	<0.001
L ant perimeter	mm	35.98	2.84	35.50	2.64	0.226
Bolton	%	79.12	1.99	78.84	2.49	0.339

UR, Upper right; *UL*, upper left; *U*, upper; *ant*, anterior; *LR*, lower right; *LL*, lower left; *L*, lower.

Examination Surveys (I, II, and III) have consistently shown that Mexican Americans are shorter than their European American counterparts.[29,30] Based on US health examination data, Zavaleta and Malina[31] showed that Mexican Americans 9 to 14 years of age are shorter, lighter, and smaller than European Americans.

Despite their smaller body size, the anterior teeth of Mexican Americans were substantially larger than those of European Americans. The mesiodistal widths of the canines, lateral incisors, and central incisors were all significantly larger among Mexican Americans, with differences ranging from 4.2% to 6.4%. Interestingly, the maxillary central and lateral incisors showed the smallest (2.5%-3.1%) and largest (8.8%-9.3%) ethnic differences, respectively. Smith et al[18] also found that Hispanics have significantly larger anterior teeth, both maxillary and mandibular, than do European Americans. Bishara et al[32] reported larger anterior teeth among Mexicans than European Americans, but the differences were not statistically significant. Chilean mestizos, who are genetically similar to Mexican Americans, have significantly larger arch and tooth sizes than European

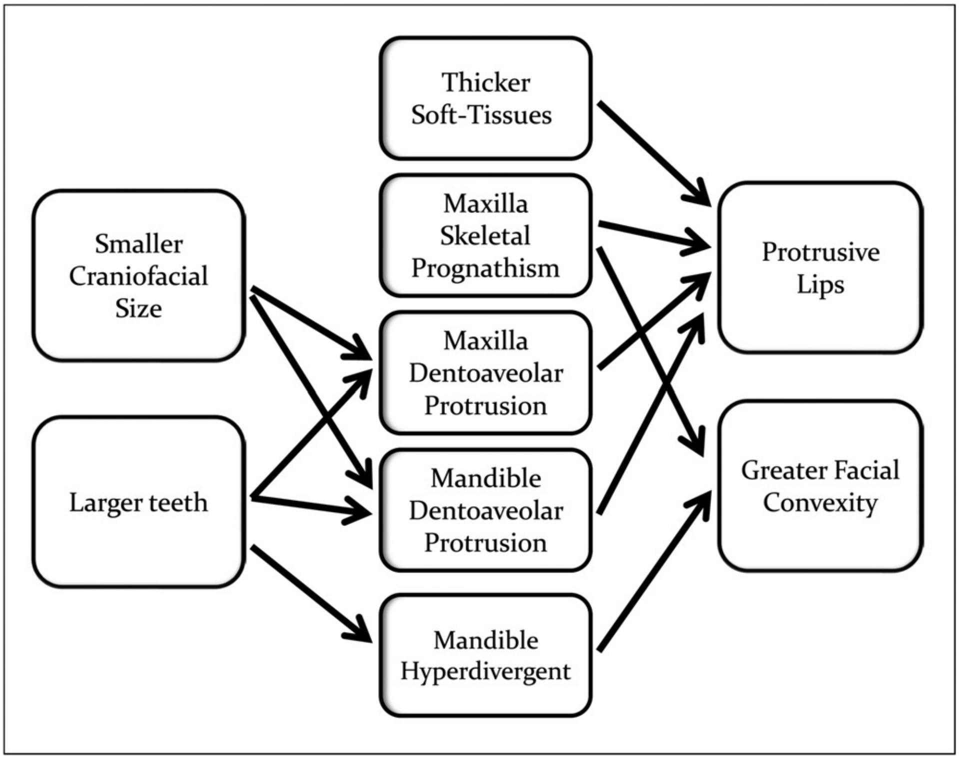

Fig 2. Interrelationships among soft-tissue, skeletal, and dental components.

Americans from northern Italy.[33] The tooth size differences are undoubtedly genetic. The contemporary gene pool of Mexican Americans has been estimated to be 31% native American, 61% Spanish, and 8% African,[34] with the native Americans derived primarily from Asia.[35,36] Asian and Indian populations of Mexico have been shown to have larger anterior teeth than European Americans.[37] Brook et al[19] also showed that Asians from southern China have significantly greater mesiodistal tooth sizes than North Americans of European ancestry.

The teeth of Mexican Americans are more protrusive and proclined than those of European-Americans. Greater dental protrusion and proclination among Mexicans and Mexican Americans than European Americans have been previously reported.[21-24] Mexican Americans might be expected to be more protrusive than European Americans because they have a smaller craniofacial complex and larger teeth. With smaller maxillas and mandibles, combined with larger anterior teeth and anterior arch lengths, it can reasonably be assumed that proclination and protrusion of the maxillary and mandibular anterior teeth relative to the skeletal base must occur because of space limitations (Fig 2). These interrelationships, which have not been previously identified, have important clinical implications. European American norms that are commonly used for establishing treatment goals should not be applied to Mexican Americans because the anteroposterior position of the incisors and their inclinations differ. Greater amounts of incisor protrusion and proclination might be acceptable in Mexican Americans and should be taken into account in treatment planning.

The soft tissues of Mexican Americans were also thicker than those of European Americans. Mexican American adolescents have significantly thicker upper and lower lips; soft tissues at pogonion are especially thicker than in European Americans. Although these differences have not been previously reported for Mexican Americans, European Americans have been previously shown to have thinner soft tissues than Persians,[14] Croatians,[15] and Japanese,[38,39] several of whom have an Asian gene pool. This suggests that Mexican Americans have thicker soft tissues than European Americans because of their Asian heritage.

Because of the size and positions of their teeth, as well as thicker soft tissues, Mexican Americans have more protrusive upper and lower lips than do European Americans. The upper and lower lips were 2 to 3.0 mm and 0.6 to 2.4 mm more protrusive, respectively, in Mexican

Americans than in European Americans. Velarde[21] also reported that Mexicans have more protrusive lower lips. Swleranga et al[24] found that adult Mexican Americans also have more protrusive upper lips than do European American adults. The upper and lower lips have been consistently reported as more protrusive in Asian adolescents and adults.[12,13,39] Since anteroposterior lip position depends on the horizontal position of the maxillary and mandibular incisors, the combination of larger teeth, smaller skeletal size, and thicker soft tissues exhibited by Mexican Americans might be expected to produce protrusive lips (Fig 2).[7-10,40] This reinforces the notion that treatment goals would be difficult to achieve when European American norms are applied to Mexican Americans. Additionally, the soft tissues of Mexican Americans should not be expected to react the same to treatment as the thinner soft tissues of European American; anchorage requirements might need to be altered, with more anteroposterior retraction of incisors to affect the profile.

Mexican American faces are more convex than those of European Americans, both in terms of hard and soft tissues. Their increased convexity is partially related to their hyperdivergent mandibles and steep mandibular plane angles (Fig 2). Greater convexity and hyperdivergence have been previously reported among Mexican Americans and Mexicans.[22,23] Velarde[21] reported greater convexity among Mexicans, but with hypodivergent rather than hyperdivergent vertical patterns. Similarly, Swleranga et al[24] found that Mexican American men have lower mandibular plane angles, and Mexican American women have higher mandibular plane angles and more convex profiles. Greater convexity and hyperdivergence among Mexican Americans might be related to their shorter ramus height (S-Go) and mandibular body length (Go-Pg and Co-Pg).

The craniofacial complex was 5.2% to 9.7% larger in boys than in girls. Boys and girls were measured at mean ages of 13.9 and 12.6 years, respectively; this placed them at approximately the same point of the adolescent growth curve.[25] In other words, the age differences partially controlled for maturational differences, which tended to favor girls over boys. Phelan et al[23] also found that Mexican males were larger than Mexican females. Generally, the craniofacial skeletal size of male subjects has consistently been reported to be larger than that of females, regardless of ethnicity.[41-43] The larger size of the craniofacial complex in males is consistent with general overall body size differences favoring males over females.[44] It is also clear that males have thicker soft tissues than females. Sex differences favoring males have been reported for European Americans and other ethnic groups.[14,45] Longitudinal growth studies have demonstrated thicker soft tissues in males, from their greater increments and longer periods of growth.[46]

Males also have slightly larger teeth than females; sex differences were most pronounced for the canines. Sex differences in tooth size favoring males have been previously reported for Mexicans,[32,47] other Hispanics,[17,18] and other ethnic groups.[48] Despite the size differences, there were no clear sex differences in ratios and angles describing the skeletal, dental, or profile relationships. Garcia[22] also reported no statistically significant differences in cephalometric relationships between Mexican American boys and girls. Comparisons of European Americans have shown sex differences in size, but no differences in most ratios and angles evaluating the dentoskeletal relationships of males and females.[41]

CONCLUSIONS

European American treatment objectives do not apply to Mexican American adolescents because (1) the craniofacial complex is smaller, and the anterior teeth are larger among Mexican Americans; (2) Mexican Americans are dentally more protrusive; (3) Mexican Americans have thicker soft tissues; and (4) Mexican Americans exhibit greater soft-tissue convexity and have more protrusive lips.

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