

## Soft-Tissue Facial Characteristics of Attractive and Normal Adolescent Boys and Girls

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### ABSTRACT

**Objectives:** To identify possible esthetic canons in facial size and shape of Italian adolescent boys and girls.

**Materials and Methods:** The three-dimensional coordinates of 50 facial landmarks (forehead, eyes, nose, cheeks, mouth, jaw, ears) were collected in 231 healthy, reference adolescents (10–17 years old) and in 93 similar age group “attractive” adolescents selected by a commercial casting organization. Soft-tissue facial angles, distances, areas, and volumes were computed. Comparisons were made with analysis of variance.

**Results:** Attractive adolescents had wider, shorter, and less deep faces than reference adolescents, with a relatively larger forehead and maxilla, and a reduced mandible relative to the maxilla. Lips were larger and more prominent, and the nasolabial angle was reduced, but in older boys the effect was reversed. The prominence of the soft-tissue profile, and of the maxilla relative to the mandible, were larger in attractive boys, but smaller in attractive girls than in their reference peers. In the horizontal plane, attractive “young” adolescents had a flatter face, while the opposite pattern was observed in the “old” adolescents, with a relatively more prominent chin. Attractive adolescents had smaller noses than reference subjects of the same age and sex.

**Conclusions:** Overall, all the measurements appeared sufficiently homogenous, and the quantitative characteristics of an “attractive” face well defined. Esthetic reference values can be used to determine optimal timing and goals in orthodontic treatment.

**KEY WORDS:** Face, adolescents; Attractiveness; Soft tissues

### INTRODUCTION

Facial appearance is fundamental for communication and interaction with the environment.<sup>1,2</sup> In contem-

porary Western society, there is a widespread growing interest for facial esthetics.<sup>3–5</sup> Esthetic criteria appear to have been defined in almost all cultures,<sup>1,6–8</sup> even if scientific research on the quantitative, measurable bases of facial attractiveness is still in progress.<sup>1,9–12</sup>

In the perception of attractiveness, there seem to be several components: averageness, symmetry, youthfulness, and neoteny (or babyiness).<sup>3,4,11,13</sup> Additionally, sexual dimorphism plays a role for adult men, who should convey perceptions of masculinity, health, developmental stability, and social dominance.<sup>3,14,15</sup>

Attractiveness is also becoming a matter of concern during childhood and adolescence, with a notable contribution by the media, ie, television, cinema, advertisements, fashion industries, all entering into our life bringing facial “standards” that should convey perceptions of beauty, healthiness, fitness, mixed with feelings of social achievement, intelligence, richness, and happiness. A beautiful face becomes the key to success.<sup>16–18</sup>

The clinical specialists working in the facial area en-

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counter an increasing demand for treatments mainly based on esthetic requests.<sup>5</sup> As a result, orthodontists and maxillofacial and plastic surgeons should have a deep understanding of those quantifiable, objective facial characteristics that are considered by the public as “attractive.”<sup>4,13,19,20</sup>

In a previous investigation, the faces of attractive and reference, normal children, age 4 to 9 years, were analyzed, and attractive children maintained several characteristics of babyfacedness, ie, a large face, with a relatively large maxilla and forehead, and reduced vertical dimensions. Lips were more voluminous, the mouth was bigger and the soft-tissue facial profile more convex in attractive children, with a more prominent maxilla relative to the mandible than in the reference subjects of the same age and sex.<sup>20</sup>

In the current study, three-dimensional facial measurements of adolescent boys and girls considered “attractive” were obtained noninvasively, and compared to those collected in healthy reference subjects, selected using criteria of dentofacial normality.<sup>1,8,11</sup> The presence of measurable esthetic characteristics was assessed. A preliminary report showed that attractive adolescent girls, and young adolescent boys, had esthetic characteristics similar to those found in attractive children.<sup>21</sup> In contrast, older boys had distinct facial features.<sup>21</sup>

In the current report, a more detailed analysis of facial dimensions, angles, and ratios of esthetically pleasing faces was performed, to find if codified measurements could be used by orthodontists and maxillofacial surgeons as a reference for dentofacial modifications.

## MATERIALS AND METHODS

### Subjects

Two groups of white, Northern Italian adolescent boys and girls, age 10–17 years, were analyzed. All persons had no previous craniofacial trauma, surgery or congenital anomalies. One hundred forty-one boys and 90 girls were healthy, “reference” adolescents; they had normal dentofacial dimensions and proportions. They were attending several schools in Milan and the surroundings.<sup>22</sup>

Forty-six boys and 47 girls were “beautiful,” “attractive” adolescents selected by a commercial casting agency. The same selection criteria that had been used in the previous investigation performed on young children<sup>20</sup> were used. The agency was asked to provide adolescents with a “beautiful,” “attractive” face, considered “positive” and “acceptable” for cinema, television, advertising, and the fashion industry.<sup>5</sup>

All analyzed adolescents, and their parents/legal guardians gave their informed consent to the experi-

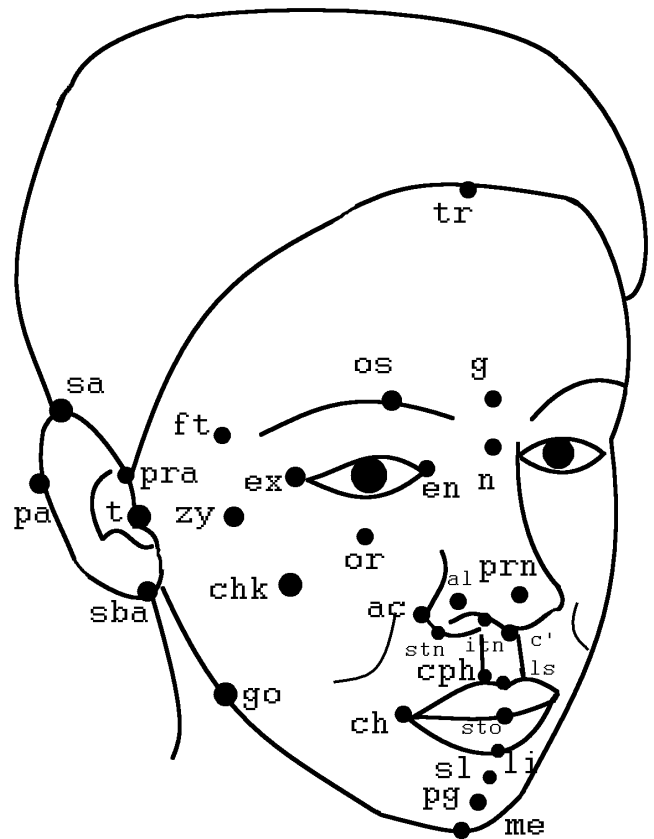


Figure 1. Digitized facial landmarks.

ment. All procedures were noninvasive, did not provoke damages, risks or discomfort to the subjects, and were approved by the local ethics committee.

### Data Collection and Analysis

The same procedure used in the previous study<sup>20</sup> was followed. For each child, a single experienced operator located and marked 50 soft-tissue landmarks by inspection and palpation (Figure 1; Table 1).<sup>22</sup> During landmark marking, the children sat relaxed with a natural head position. For each child, this phase lasted less than 5 minutes.

Three-dimensional coordinates of the 50 facial landmarks were obtained with a computerized electromagnetic digitizer (3Draw, Polhemus Inc, Colchester, Vt). During data collection, the adolescents sat in a natural head position in a chair with a backrest, with their head fixed by cephalostat. They remained motionless, with closed eyes and the mandible in rest position. The digitization of landmarks took approximately 1 minute. Duplicate data collections gave random errors corresponding to 1.1% of nasion-mid tragon distance, without differences between reference and attractive adolescents. Files of the three-dimensional coordinates were obtained, and computer programs were used for all the subsequent off-line calculations.

**Table 1.** Digitized Facial Landmarks

Midline		Paired	
tr	trichion	ex	exocanthion
g	glabella	en	endocanthion
n	nasion	os	orbitale superius
prn	pronasale	or	orbitale
c'	columella	ft	frontotemporale
sn	subnasale	chk	cheek
ls	labiale superius	zy	zygion
sto	stomion	t	tragion
li	labiale inferius	al	alare
sl	sublabiale	ac	nasal alar crest
pg	pogonion	itn	inferior point of the nostril axis
me	menton	stn	superior point of the nostril axis
		chp	crista philtri
		ch	cheilion
		go	gonion
		pra	preaurale
		sa	superaurale
		pa	postaurale
		sba	subaurale

Landmark coordinates were used to estimate several linear distances, angles, areas, and facial volumes<sup>7,20,22</sup> (Table 2).

**Statistical Calculations**

“Reference” and “attractive” boys and girls were divided into two age groups for each sex. For girls, 24 attractive and 39 reference girls were age 10–12 years (“young” adolescent girls); 23 attractive and 51 reference girls were age 13–15 years (“old” adolescent girls). For boys, 22 attractive and 87 reference boys were age 12–14 years (“young” adolescent boys); 24 attractive and 54 reference boys were age 15–17 years (“old” adolescent boys). Mean ages did not differ within each sex and age group. Different age groups were used for the two sexes because of the different timing of pubertal growth spurt.<sup>22</sup>

Descriptive statistics were computed for each group, and comparisons were performed within each sex and age group using 2-way factorial analyses of variance (factor 1: group, factor 2: age, the group × age inter-

**Table 2.** Measurements Calculated From the Digitized Landmarks

	Measurement	Landmarks	
Distances, mm	Facial height	n-pg	
	Anterior upper facial height	n-sn	
	Anterior lower facial height	sn-pg	
	Upper facial width	ex-ex <sub>i</sub>	
	Middle facial width	t <sub>r</sub> -t <sub>i</sub>	
	Upper facial depth	n-(t <sub>r</sub> -t <sub>i</sub> )	
	Middle facial depth	sn-(t <sub>r</sub> -t <sub>i</sub> )	
	Mandibular corpus length	pg-(go <sub>r</sub> -go <sub>i</sub> )	
	Mouth width	ch <sub>r</sub> -ch <sub>i</sub>	
	Vermilion height	ls-li	
	Upper lip to E-line distance	ls-(prn-pg)	
	Lower lip to E-line distance	li-(prn-pg)	
	Angles, degrees	Facial convexity excluding the nose	n-sn-pg
		Facial convexity including the nose	n-prn-pg
Upper facial convexity in the horizontal plane		t <sub>r</sub> -n-t <sub>i</sub>	
Middle facial convexity in the horizontal plane		t <sub>r</sub> -prn-t <sub>i</sub>	
Lower facial convexity in the horizontal plane		t <sub>r</sub> -pg-t <sub>i</sub>	
Maxillary prominence		sl-n-sn	
Nasolabial		prn-sn-ls	
Areas, cm <sup>2</sup>	Interlabial	sn-ls <sup>2</sup> /sl-pg	
	Vermilion of the upper lip	ch <sub>r</sub> , ls, ch <sub>i</sub> , sto	
	Vermilion of the lower lip	ch <sub>r</sub> , li, ch <sub>i</sub> , sto	
Volumes, mm <sup>3</sup>	Facial area	External cutaneous surface up to a line connecting tr, t <sub>r</sub> , t <sub>i</sub> , go <sub>r</sub> , go <sub>i</sub>	
	Total facial volume	Facial structures from the external cutaneous surface up to a surface passing through tr, t <sub>r</sub> , t <sub>i</sub> , go <sub>r</sub> , go <sub>i</sub>	
	Facial upper third volume	Forehead (between trichion and a quasi-horizontal plane passing through the tragi and the exocanthia)	
	Facial middle third volume	Maxilla (between a plane passing through the tragi and the exocanthia, and a plane connecting the cheilion landmarks and the tragi)	
	Facial lower third volume	Mandible (between a plane connecting the cheilion landmarks and the tragi, and a plane passing through pogonion and the gonion)	
	Nose	n, prn, ac <sub>r</sub> , ac <sub>i</sub> , sn	

**Table 3.** Facial Volumes Estimated in 93 Attractive and 231 Reference Adolescents<sup>a</sup>

		Forehead, mm <sup>3</sup>	Maxilla, mm <sup>3</sup>	Mandible, mm <sup>3</sup>	Total, mm <sup>3</sup>	Forehead/ Face, %	Mand/ Max, %	Area/ Volume, %	Nose, mm <sup>3</sup>
Girls, 10–12 y									
Attractive (n = 24)									
Mean		196.1	245.4	210.8	655.5	42.80	86.16	75.56	3.17
SD		27.5	19.4	24.8	53.1	5.75	10.23	2.16	0.70
Reference (n = 39)									
Mean		180.3	225.8	207.0	616.3	41.28	92.19	80.54	3.18
SD		30.8	24.7	26.9	68.1	5.53	11.95	6.58	1.51
Girls, 13–15 y									
Attractive (n = 23)									
Mean		203.0	265.7	229.2	701.6	40.80	86.09	74.29	3.79
SD		32.0	29.3	35.5	86.8	4.98	7.72	3.34	1.00
Reference (n = 51)									
Mean		174.0	255.7	244.9	679.1	34.28	97.02	80.24	4.55
SD		35.7	38.9	29.7	92.1	4.51	12.48	7.88	0.87
P (ANOVA)	Group	<.001	.025	NS	NS	<.001	<.001	<.001	.015
	Age	NS	<.001	<.001	<.001	<.001	.046	NS	<.001
	X	NS	NS	NS	NS	NS	NS	NS	NS
Boys, 12–14 y									
Attractive (n = 22)									
Mean		217.1	299.4	255.7	776.8	38.87	85.36	71.43	4.51
SD		35.0	24.6	31.0	75.8	5.66	6.42	2.52	1.24
Reference (n = 87)									
Mean		178.9	265.8	263.6	712.8	33.51	100.00	79.34	4.64
SD		35.1	41.5	42.8	104.9	4.41	13.69	7.23	1.27
Boys, 15–17 y									
Attractive (n = 24)									
Mean		245.8	331.8	309.5	892.5	40.93	93.39	68.36	5.30
SD		27.0	23.6	36.2	65.2	12.97	9.21	1.83	1.02
Reference (n = 54)									
Mean		270.6	363.3	337.4	978.0	38.27	93.13	66.52	6.66
SD		53.2	54.4	53.4	148.1	5.09	8.43	3.43	1.72
P (ANOVA)	Group	.009	NS	NS	NS	<.001	.021	<.001	.038
	Age	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	X	<.001	<.001	.015	<.001	NS	<.001	<.001	<.001

<sup>a</sup> ANOVA: 2-way factorial analysis of variance, factor 1: group, factor 2: age; the group × age interaction (X) was also assessed. NS indicates not significant,  $P > .05$ .

action was also assessed). Significance was set at 5% ( $P < .05$ ).

## RESULTS

Total facial volume significantly increased with age in both sexes (Table 3); it was larger in attractive girls and in attractive “young” adolescent boys than in the reference subjects, but smaller in “old” adolescent attractive boys than in their reference peers. Overall, volumes were more homogenous in attractive than in reference adolescents. Sexual dimorphism (boys larger than girls) was present in both age groups. The forehead (facial upper third) occupied a significantly larger part of the face in attractive boys and girls than in reference subjects. The ratio significantly decreased with

age (older adolescents had a relatively smaller forehead than younger adolescents), and, in each age group, it was larger in girls than in boys.

In attractive adolescents, the mandible was significantly reduced relatively to the maxilla. In girls, the ratio significantly increased with age, with a relative larger mandible than maxilla; in boys, the ratio increased in attractive subjects but decreased in the reference ones (significant group × age interaction). In attractive adolescents, the facial area/volume ratio was significantly smaller than in the reference subjects, with a relatively more rounded face. The effect was reversed in the “old” boys (significant group × age interaction). External nasal volume increased with age, and it was larger in boys than in girls. Attractive

**Table 4.** Soft-Tissue Facial Linear Distances Measured in 93 Attractive and 231 Reference Adolescents<sup>a</sup>

	ex-ex	t-t	n-sn	sn-pg	n-pg	n-(t-t)	sn-(t-t)	pg-(go-go)	
<b>Girls, 10–12 y</b>									
Attractive (n = 24)									
Mean	90.8	130.9	45.7	47.7	91.9	90.1	96.4	70.3	
SD	3.7	5.1	3.3	3.7	4.4	4.3	3.1	4.8	
Reference (n = 39)									
Mean	85.9	126.2	45.4	49.7	93.5	91.5	97.2	69.3	
SD	3.3	4.0	3.7	3.6	5.5	4.0	4.1	5.3	
<b>Girls, 13–15 y</b>									
Attractive (n = 23)									
Mean	92.34	131.3	48.3	49.9	97.0	92.3	98.3	73.0	
SD	4.1	4.9	3.4	3.6	5.3	4.4	5.5	5.6	
Reference (n = 51)									
Mean	89.8	132.0	50.5	50.2	99.2	95.0	102.0	74.4	
SD	4.0	4.2	3.3	3.3	4.9	4.6	4.4	4.9	
P (ANOVA)	Group	<.001	.048	.035	NS	.012	.004	.001	NS
	Age	<.001	<.001	<.001	NS	<.001	<.001	<.001	<.001
	X	.012	<.001	NS	NS	NS	NS	NS	NS
<b>Boys, 12–14 y</b>									
Attractive (n = 22)									
Mean	94.1	137.7	47.8	52.1	98.2	95.7	103.4	75.5	
SD	4.5	7.5	3.1	4.3	5.6	5.2	4.7	5.3	
Reference (n = 87)									
Mean	91.3	135.4	50.0	51.4	99.7	97.3	104.6	76.4	
SD	4.6	5.5	3.7	3.9	5.5	4.6	5.1	5.4	
<b>Boys, 15–17 y</b>									
Attractive (n = 24)									
Mean	96.8	142.6	50.6	54.1	102.7	99.9	109.6	78.3	
SD	3.7	5.4	3.2	5.1	5.6	4.3	4.5	4.3	
Reference (n = 54)									
Mean	96.6	147.3	54.3	55.8	107.9	102.4	112.0	79.8	
SD	8.2	10.3	3.5	5.1	6.8	4.6	5.3	4.9	
P (ANOVA)	Group	.028	NS	<.001	NS	.024	NS	NS	NS
	Age	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
	X	NS	.004	.003	NS	.024	NS	NS	NS

<sup>a</sup> All values are mm. ANOVA: 2-way factorial analysis of variance, factor 1: group, factor 2: age; the group × age interaction (X) was also assessed. NS indicates not significant, *P* > .05.

adolescents had significantly smaller noses than reference subjects of the same age and sex.

Attractive adolescents had a wider upper (ex-ex) face than reference adolescents; additionally, attractive girls had a significantly wider middle (t-t) face (Table 4). In both sexes and in both age groups, facial height (total, n-pg; upper, n.sn; lower, sn-pg) was smaller in attractive adolescent than in their reference peers, with statistically significant differences for n-pg and n-sn. Reduced upper (n-t, *p* = 0.004 in girls) and middle facial depth (sn-t, *p* = 0.001 in girls), and mandibular corpus length (pg-go) were observed in attractive adolescents. Age and sex influenced all measurements, with wider, longer and deeper faces in males than in females, and in “old” than in “young” adolescents.

Differences in facial dimensions were coupled with

differences in facial shape: attractive boys had more acute soft tissue profiles than reference boys, with smaller angles of facial convexity (n-sn-pg, n-prn-pg, Table 5). In girls, the reverse pattern was found, with less acute facial profiles, and reduced maxillary prominence relative to the mandible (soft tissue analog of skeletal ANB angle, sl-n-sn) in attractive than in reference subjects. Overall, attractive girls and “young” boys had a flatter face in the horizontal plane (t-n-t; t-prn-t; t-pg-t; *p* < 0.001 in girls).

Attractive adolescents had relatively more prominent lips (except the “old” boys), with reduced nasolabial (prn-sn-ls) and interlabial (sn-ls sl-pg) angles, and reduced distances to the esthetic E-line (prn-pg), than reference subjects (Table 6). Attractive adolescents had a larger vermilion area of the total (upper plus lower) lip than reference adolescents, with a large

**Table 5.** Soft-Tissue Facial Angles Measured in 93 Attractive and 231 Reference Adolescents<sup>a</sup>

		n-sn-pg	n-prn-pg	t-n-t	t-prn-t	t-pg-t	sl-n-sn	prn-sn-ls	sn-ls/sl-pg
Girls, 10–12 y									
Attractive (n = 24)									
Mean		160.5	130.3	72.0	63.2	61.8	10.6	129.4	155.7
SD		4.6	4.2	2.9	1.9	1.6	2.3	10.0	11.2
Reference (n = 39)									
Mean		159.8	127.9	69.2	60.5	59.8	10.7	130.3	156.7
SD		5.2	4.6	2.4	2.0	1.9	2.6	9.0	11.2
Girls, 13–15 y									
Attractive (n = 23)									
Mean		162.3	130.0	70.9	61.7	60.3	9.6	126.9	159.5
SD		5.4	4.4	2.8	2.4	2.6	2.2	9.3	12.4
Reference (n = 51)									
Mean		160.7	129.5	69.6	60.2	59.3	10.9	128.3	161.5
SD		5.6	4.3	2.5	2.1	2.2	2.5	11.5	12.1
P (ANOVA)	Group	NS	NS	<.001	<.001	<.001	NS	NS	NS
	Age	NS	NS	NS	.018	.009	NS	NS	.025
	X	NS	NS	NS	NS	NS	NS	NS	NS
Boys, 12–14 y									
Attractive (n = 22)									
Mean		159.6	127.9	71.1	61.6	60.4	11.2	127.8	157.4
SD		4.8	3.9	3.3	2.7	2.9	2.2	11.0	12.4
Reference (n = 87)									
Mean		159.6	129.8	69.7	60.7	59.6	11.3	129.0	158.7
SD		5.3	4.3	2.2	1.8	2.1	2.4	10.5	10.5
Boys, 15–17 y									
Attractive (n = 24)									
Mean		158.3	125.6	71.1	60.6	59.7	12.4	127.6	163.6
SD		4.9	4.0	2.9	2.6	2.6	2.3	8.7	9.7
Reference (n = 54)									
Mean		158.0	126.8	71.4	61.0	60.1	12.1	129.2	160.8
SD		5.6	4.5	3.5	2.9	2.3	2.6	10.0	11.5
P (ANOVA)	Group	NS	.008	NS	NS	NS	NS	NS	NS
	Age	NS	<.001	.008	NS	NS	.012	NS	.048
	X	NS	NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> All values are degrees. ANOVA: 2-way factorial analysis of variance, factor 1: group, factor 2: age; the group × age interaction (X) was also assessed. NS indicates not significant,  $P > .05$ .

er contribution of the upper lip. Their vermilion height (ls-li) was a larger percentage of mouth width (ch-ch) than in reference subjects.

## DISCUSSION

Facial esthetics is one of the principal concerns of orthodontists and maxillofacial surgeons.<sup>4,6,13</sup> The creation of a harmonic occlusion, within a well-functioning stomatognathic apparatus,<sup>8</sup> must always consider the effect of tooth position on facial soft tissues. The clinician should therefore be provided with esthetic guidelines referred to subjects of the same age, sex, and ethnic group of their patients. The guidelines should also be updated, considering the evolution of the esthetic canons within a given society.<sup>6,23</sup> These guidelines may offer useful indications for the best

kind, timing, and goals of orthodontic treatment, with the best cost/benefit ratio.

Esthetic guidelines could be obtained by measuring attractive persons (cinema and television actors and actresses, fashion and advertising models), who are often believed to possess distinct esthetic relationships, even if these do not seem to be a necessary condition for attractiveness.<sup>9,13,18</sup> Considering the components believed to enter in the perception of attractiveness,<sup>3,4,11,13</sup> attractive adolescent girls, and young adolescent boys, analyzed in the current study maintained several characteristics of youthfulness and neoteny. In contrast, the oldest boys had some initial characteristics of male adult attractiveness, with a relative increment of the facial lower third (a facial marker of increasing testosterone levels).<sup>3–5,14,15,24</sup>

**Table 6.** Lip Characteristics Measured in 93 Attractive and 231 Reference Adolescents

		ch-ch, mm	ls-li, mm	(ls/li)/ (ch-ch), %	ls-(prn-pg), mm	li-(prn-pg), mm	Total Area, cm <sup>2</sup>	Upper Lip Area, cm <sup>2</sup>	Lower Lip Area, cm <sup>2</sup>
Girls, 10–12 y									
Attractive (n = 24)									
Mean		43.7	16.4	37.68	2.22	1.96	4.19	2.26	1.93
SD		3.8	2.2	5.31	1.24	1.15	0.83	0.75	0.55
Reference (n = 39)									
Mean		44.2	15.1	34.54	2.81	2.12	3.90	1.93	1.97
SD		3.8	2.5	7.07	2.23	1.65	0.73	0.69	0.59
Girls, 13–15 y									
Attractive (n = 23)									
Mean		45.8	16.8	36.65	3.98	2.73	4.48	2.30	2.17
SD		3.2	2.6	5.85	1.97	1.82	0.84	0.50	0.70
Reference (n = 51)									
Mean		45.5	16.0	35.22	4.03	2.96	4.26	2.18	2.08
SD		3.4	2.2	5.25	2.23	1.89	0.72	0.65	0.62
P (ANOVA)	Group	NS	.022	.037	NS	NS	NS	NS	NS
	Age	.011	NS	NS	<.001	.005	.017	NS	NS
	X	NS	NS	NS	NS	NS	NS	NS	NS
Boys, 12–14 y									
Attractive (n = 22)									
Mean		48.2	17.4	36.41	2.44	2.57	4.94	2.90	2.04
SD		3.6	3.4	7.72	1.70	2.11	0.97	0.89	0.86
Reference (n = 87)									
Mean		47.2	17.1	36.48	2.71	2.19	4.74	2.48	2.26
SD		3.9	2.7	6.19	1.73	1.42	0.91	0.79	0.79
Boys, 15–17 y									
Attractive (n = 24)									
Mean		50.5	17.5	34.77	3.56	3.09	5.05	2.45	2.60
SD		3.6	3.0	6.43	1.61	1.73	0.95	0.74	0.61
Reference (n = 54)									
Mean		52.7	17.0	32.62	4.09	3.44	5.16	2.30	2.86
SD		5.3	3.0	6.55	2.05	1.94	1.00	0.80	0.90
P (ANOVA)	Group	NS	NS	NS	NS	NS	NS	NS	NS
	Age	<.001	NS	.001	<.001	<.001	.015	NS	<.001
	X	.022	NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> ANOVA: 2-way factorial analysis of variance, factor 1: group, factor 2: age; the group × age interaction (X) was also assessed. NS indicates not significant, *P* > .05.

Previous investigations on facial attractiveness in children and adolescents mostly focused on dentolabial characteristics: faces with malocclusion, irregular dental arches and thin lips were considered less attractive than faces with normal occlusion, well-arranged dental arches, and medium or thick lips.<sup>12,19</sup> When analyzed in three dimensions, attractive children age 4 to 9 years shared several of the facial characteristics found in attractive women,<sup>7,10,11</sup> ie, a relatively large forehead and more prominent maxilla, reduced vertical dimensions, voluminous lips and more prominent soft-tissue facial profile.<sup>20</sup>

In adolescents, some of the previous esthetic characteristics were maintained, but also some sex- and age-related differences emerged.<sup>21</sup> In accordance with previous findings,<sup>20</sup> attractive subjects had wider,

shorter and less deep faces than reference subjects, with relatively larger upper and middle facial thirds, and a reduced mandible relative to the maxilla. Lips were larger and more prominent; vermilion height was a larger percentage of mouth width than in reference subjects, thus confirming the esthetic importance of labial area, as previously found for women, adolescents, and children.<sup>1,2,6,7,10,19,20</sup>

Also, the nasolabial angle was reduced in girls and younger boys, but in older boys the effect was reversed. The prominence of the soft-tissue profile, and of the maxilla relative to the mandible, were larger in attractive boys, but smaller in attractive girls than in their reference peers. An increased facial convexity was also found in previous cephalometric studies<sup>1,12</sup> for adolescents considered attractive, and preferred by

patients and mothers.<sup>25</sup> In the horizontal plane, attractive children and “young” adolescents had flatter faces (typical of newborns), but the trend reversed in the “old” adolescent subjects, with a relatively more prominent chin. This feature is consistent with current reports on adult male attractiveness<sup>3,15,26</sup>: high prenatal testosterone levels, and high circulating testosterone produce a more prominent lower face.

Nasal volume was smaller in attractive adolescents than in reference subjects, as previously found in adult women,<sup>7</sup> but in contrast with the patterns observed in attractive children.<sup>20</sup> Even if the reduced nasal volume in attractive women may be an effect of surgical interventions, the current finding seems to depend upon actual esthetic preferences.

Adolescent selection was made using the same procedure followed for attractive children<sup>20</sup> and women.<sup>6,7,10,27</sup> Boys and girls were independently selected by professionals in a casting agency among those already involved in cinema, television, and the advertising industry. Their faces were to be considered “positive” and “acceptable” for mass media.<sup>5</sup> The specialized opinions of dental and surgical professionals, that are often relatively more critical in their assessment of facial esthetics than nonprofessionals<sup>5,8,16,23,28</sup> was avoided, even if different findings about plastic surgeons have recently been reported.<sup>19</sup> Additionally, esthetics should be evaluated by the laypersons, who actually seek (and finally judge) orthodontic or maxillofacial treatment.<sup>12,23,25</sup>

Male and female attractive adolescents were subdivided into groups of different ages, girls being 2–3 years younger than boys. This procedure was made to take the sex-related discrepancies in the timing of pubertal growth spurt into account,<sup>22</sup> thus allowing the assessment of more homogenous biological ages. Nevertheless, the analysis of only two age groups for each sex is a limitation, and the extension of the study to other age groups could allow a deeper understanding of the actual biological processes. Indeed, the number of significant differences was limited, and for several measurements only trends, not substantiated by statistically significant values, were found.

A further limitation resides in the selected measurements, and the analysis of soft-tissue facial dimensions and angles should be implemented with the assessment of symmetry<sup>13,18,16,27</sup> and facial shape (independently from dimensions).<sup>15,26</sup> Also, a wider set of angles and distances should be analyzed, with the inclusion of other facial structures (eyes and ears).<sup>3,4,18</sup>

## CONCLUSIONS

When compared with reference subjects, attractive adolescents, age 10 to 17 years, had:

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- Wider, shorter, and less deep faces with relatively larger upper and middle facial thirds, and a reduced mandible relative to the maxilla;
- Larger and more prominent lips, with a reduced nasolabial angle;
- Smaller noses;
- In boys, more prominent soft-tissue profile, and maxilla relative to the mandible;
- In older boys, a more prominent chin.

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