

# Skeletofacial Morphology of Attractive and Nonattractive Faces

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## ABSTRACT

The aim of this study was to answer the question: Is facial beauty related to specific skeletofacial morphology? Thirty attractive (25 females, 5 males) and 32 nonattractive (11 females, 21 males) subjects were compared. Facial attractiveness was assessed by the aid of en-face facial photographs. Skeletofacial morphology was determined using lateral head films. The radiographs were analyzed with respect to sagittal and vertical jaw relationships, facial height, profile convexity, and lip position. The relationship between the skeletofacial variables and "divine" facial proportions was evaluated with a facial disproportion index in the transverse and vertical plane. When comparing attractive with nonattractive females, the attractive females had a larger ANB angle and Wits-appraisal ( $P < .05$  and  $P < .001$ , respectively), the soft tissue profile was more convex ( $P < .01$ ), and the distances of the upper and lower lips to the "Esthetic Line" (E-line) were smaller ( $P < .01$ ). When comparing nonattractive females with nonattractive males, the males had a larger Wits-appraisal ( $P < .01$ ), the soft tissue profile was more convex ( $P < .01$ ), and the distances of the upper and lower lips to the E-line were smaller ( $P < .01$ ). A significant correlation ( $P < .05$ ) between the skeletofacial variables and the transverse and vertical facial disproportion indices was found only for the ML/NL angle (transverse:  $r = -0.73$ , and vertical:  $r = 0.68$ ) and for the posterior facial height (transverse:  $r = 0.80$ ). It could be concluded that facial beauty in frontal view is related only to a minor degree to specific skeletofacial morphology in lateral view. (*Angle Orthod* 2006;76:204–210.)

**KEY WORDS:** Facial beauty; Cephalometrics

## INTRODUCTION

Facial attractiveness is very important in interhuman communication. Beauty means social power and success and has a positive influence in all areas of civilized society.<sup>1–7</sup>

The ancient Egyptians (5000 BC) were possibly among the first to deal with harmonious (attractive) proportions of the face and body. The Egyptian ideal of beauty and harmony is reflected in the monuments and sculptures from that time (King Mycerinus, Queen Nefertiti).<sup>8</sup> In ancient Greece, Apollo Belvedere and

Aphrodite of Melos represented the ideal facial proportions<sup>9</sup> because they were perceived by the sculptors in the fourth century BC. Angle<sup>8</sup> considered these both gods and the ideals of facial beauty.

Influenced by the thinking of Pythagoras, the concept of the so-called "golden" or "divine" proportions (sectioning) developed in the fifth and sixth century BC and were described for the first time by Euclid in his (book *Element II*).<sup>10</sup>

The golden section is defined as follows (Figure 1): A point S divides a line AB in golden section if the relation of the smaller portion (m) to the larger portion (M) is the same as that of the larger portion to the original line.<sup>11</sup> This relation is named Phi ( $\varphi = 1.618$ ) and goes back to the famous Greek sculptor Phidias, who used it in his architecture (eg, the temple of Parthenon).

The assessment of facial attractiveness in the frontal view is certainly more important than the assessment in the lateral view.<sup>12,13</sup> On the other hand, radiographic cephalometry in the lateral view provides more important information about the skeletofacial morphology<sup>14,15</sup> than in the frontal view.

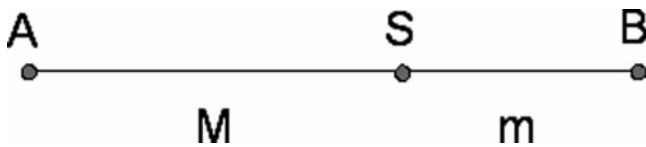
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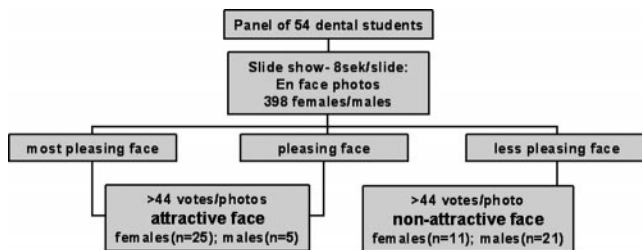
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**FIGURE 1.** The arithmetic expression of the golden section:  $M/m \sim 1.618 = \varphi$  (Phi).



**FIGURE 2.** The subject selection procedure in attractive and non-attractive faces.

The question is now whether a facial assessment in frontal view allows any conclusions with respect to the existing lateral skeletofacial morphology.<sup>8,16,17</sup> To our knowledge, no such study exists.

The purpose of this study using lateral head films and facial photographs was to compare the skeletofacial morphology of attractive and nonattractive subjects. In particular, the study aimed at answering the question: Is facial beauty in the frontal view reflected by specific skeletofacial morphology in the lateral view?

## MATERIALS AND METHODS

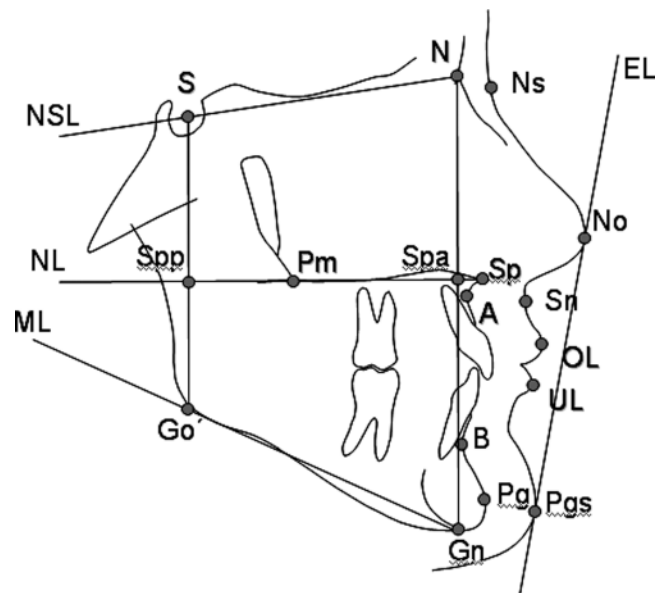
The material was obtained from the doctoral thesis of Heiß.<sup>18</sup> At the Orthodontic Department, University of Giessen, the facial photographs in frontal view of 398 former orthodontic patients were examined by a panel of 54 dental students with respect to their facial attractiveness. The subjects were categorized as follows.

- Most pleasing look
- Pleasing look
- No pleasing look.

After these subjective assessments, the subject photos were divided into two groups using a specific evaluation system<sup>18</sup> (Figure 2).

- Attractive ( $n = 34$ )
- Nonattractive ( $n = 34$ ).

For the assessment of the skeletofacial morphology, lateral head films taken on the same occasion as the facial photograph were analyzed. Because the lateral head films for six subjects were missing, they were excluded from the study. Thus, finally available were



**FIGURE 3.** Reference points and lines used in the head film analysis.

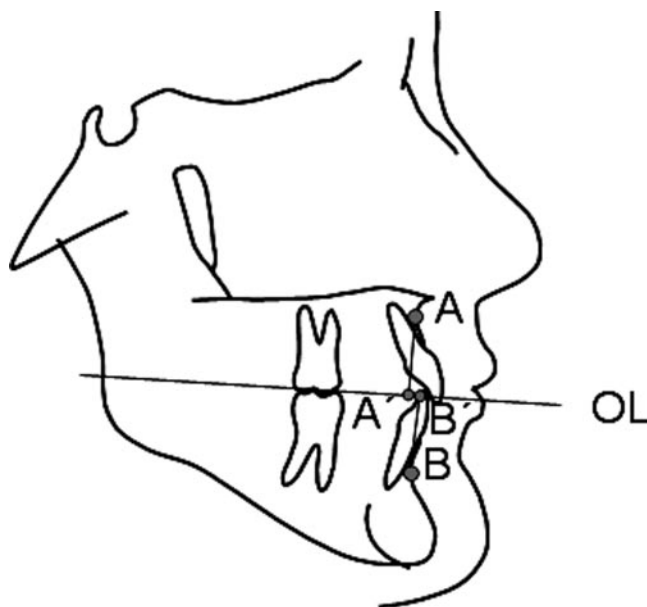
30 attractive (25 female, 5 male) subjects ranging in age from 14 to 22 years and 32 nonattractive (11 female and 21 male) subjects ranging in age from 14 to 24 years (Figure 2).

The en-face photographs of each subject were assessed using five transverse and seven vertical facial distances, which were measured and compared with the corresponding calculated divine distances.<sup>18,19</sup> Finally, for the assessment of the facial proportions, two facial disproportion indices<sup>18</sup> in the transverse and vertical plane, respectively, were created. In constructing the two indices, the mean value of the sum of the absolute percentage deviations of the measured distances from their corresponding divine distances were calculated.

Standardized lateral head films were analyzed. The focus-film distance amounted to 1.55 m. No correction was made for linear enlargement (approximately 7% in the median plane).

Tracings of the radiographs were made, and linear and angular measurements were performed to the nearest 0.5 mm and 0.5 degrees, respectively. To reduce the method error in defining the different measuring points and reference structures, all head films were analyzed twice by the same person with a 2-week interval between the recordings. For every variable, the mean value of the two recordings was used as the final measuring value. The reference points and lines are given in Figure 3. The analysis comprised the following variables.

1. Sagittal jaw relationship:
  - SNA, SNB, ANB, SNPg, and Wits (Figure 4).



**FIGURE 4.** The reference points A' and B' used for the Wits-appraisal.

2. Vertical jaw relationship:
  - ML/NSL, mandibular plane angle;
  - NL/NSL, maxillary plane angle;
  - ML/NL, interjaw-base angle.
3. Facial height:
  - Spa-Gn/N-Gn  $\times$  100, anterior lower facial height index
  - Spp-Go'/S-Go'  $\times$  100, posterior lower facial height index.
4. Profile convexity:
  - NAPg, hard tissue profile angle;
  - NsSnPgs, soft tissue profile angle without the nose;
  - NsNoPgs, soft tissue profile angle with the nose.
5. Lip position:

- UL-E-Line, distance of OL to the "Esthetic line";
- LL-E-Line, distance of UL to "Esthetic line."

### Statistical method

The statistical analysis was performed by the software Microsoft Excel Xp® (Redmond, Wash) and SPSS 11.0® manager (Chicago, Ill). The mean value (Mean) and the standard deviation (SD) were calculated for each variable. Student's *t*-tests for independent samples were used for group comparisons. For interrelation calculations between the radiographic data and the data from the facial measurements, the Spearman correlation test was applied. The significance levels used were \*\*\**P* < .001, \*\**P* < .01, \**P* < .05, and *P*  $\geq$  .05 was considered not significant (ns).

### Method errors (ME)

The size of the combined ME in locating the cephalometric reference points and measuring the variables was assessed on double registrations of all 30 attractive and 32 nonattractive subjects. The formula of Dahlberg was used in the calculations:

$$ME = \sqrt{\frac{\sum d^2}{2n}}$$

where *d* is the difference between two measurements of a pair and *n* is the number of subjects

The results of the ME calculations are shown in Table 1.

### RESULTS

The variables of the 30 attractive (A) (25 females [f], 5 males [m]) and 32 nonattractive (NA) (11f, 21m) subjects are presented in Tables 2 through 4. Four group comparisons were meaningful:

**TABLE 1.** ME Calculations on Double Registrations of 30 Attractive (A) and 32 Nonattractive (NA) Subjects

Variables			A	NA
Sagittal jaw relationship	SNA	degrees	0.68	0.61
	SNB	degrees	0.51	0.44
	ANB	degrees	0.54	0.46
	SNPg	degrees	0.62	0.33
	Wits	mm	0.54	0.67
Vertical jaw relationship	ML/NSL	degrees	0.84	0.88
	NL/NSL	degrees	1.15	0.71
	ML/NL	degrees	0.87	1.02
Facial height	Spa-Gn/N-Gn $\times$ 100	index	0.82	0.93
	Spp-Go'/S-Go' $\times$ 100	index	1.00	0.99
Profile convexity	NAPg	degrees	1.07	1.05
	NsSnPgs	degrees	0.63	0.72
	NsNoPgs	degrees	0.84	0.70
Lip position	UL-E-Line	mm	0.42	0.21
	LL-E-Line	mm	0.64	0.21

**TABLE 2.** Cephalometric Radiographic Variables (Mean, SD) of 30 Attractive (A) (25 Females [f], 5 Males [m]) and 32 Non attractive (NA) (11 Females [f], 21 Males [m]) Subjects

Variables			A (f)		NA (f)		A (m)		NA (m)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sagittal jaw relationship	SNA	degrees	81.85	2.95	80.04	3.86	82.45	3.12	80.27	4.00
	SNB	degrees	77.38	2.94	77.00	3.62	79.75	3.95	76.68	4.10
	ANB	degrees	4.45	1.61	3.04	2.34	2.70	1.59	3.69	2.36
	SNPg	degrees	78.26	2.98	78.68	4.18	81.65	3.83	78.37	4.32
	Wits	mm	1.87	1.57	-0.55	2.41	0.95	2.13	2.99	3.52
Vertical jaw relationship	ML/NSL	degrees	33.53	4.27	33.50	5.84	27.60	4.43	33.44	8.02
	NL/NSL	degrees	8.33	3.55	9.16	2.89	6.50	3.90	7.52	3.71
	ML/NL	degrees	25.97	4.11	25.18	4.52	21.85	4.17	27.11	7.14
Facial height	Spa-Gn/N-Gn $\times$ 100	index	54.89	1.85	54.89	1.65	55.98	2.27	55.77	1.96
	Spp-Go'/S-Go' $\times$ 100	index	42.78	4.49	44.01	5.65	46.65	4.43	43.87	4.43
Profile convexity	NAPg	degrees	172.45	4.83	177.09	6.79	178.20	1.92	175.79	6.33
	NsSnPgs	degrees	162.88	4.18	169.25	8.66	166.85	6.72	161.48	6.30
	NsNoPgs	degrees	129.64	3.80	131.23	5.20	131.60	3.70	127.26	4.61
Lip position	UL-E-Line	mm	-3.93	2.40	-7.20	3.44	-5.45	2.03	-4.07	2.72
	LL-E-Line	mm	-1.00	2.17	-3.55	3.67	-2.70	1.92	-2.37	3.15

**TABLE 3.** Difference (D) in Cephalometric Radiographic Variables, When Comparing 21 Attractive (A) Females (f) With 11 Non attractive (NA) Females (f) and 11 Non attractive (NA) Females (f) With 21 Non attractive (NA) Males (m)

Variables			A (f)-NA (f)			NA (f)-NA (m)		
			Mean (D)	t Value	P Value	Mean (D)	t Value	P Value
Sagittal jaw relationship	SNA	degrees	1.81	1.54	ns <sup>a</sup>	-0.23	-0.16	ns
	SNB	degrees	0.38	0.33	ns	0.32	0.22	ns
	ANB	degrees	1.41	2.09	*	-0.65	-0.74	ns
	SNPg	degrees	-0.42	-0.35	ns	0.31	0.20	ns
	Wits	mm	2.42	3.60	***	-3.54	-2.98	**
Vertical jaw relationship	ML/NSL	degrees	0.03	0.02	ns	0.06	0.02	ns
	NL/NSL	degrees	-0.83	-0.68	ns	1.64	1.27	ns
	ML/NL	degrees	0.79	0.52	ns	-1.93	-0.81	ns
Facial height	Spa-Gn/N-Gn $\times$ 100	index	0.00	0.00	ns	-0.88	-1.28	ns
	Spp-Go'/S-Go' $\times$ 100	index	-1.23	-0.70	ns	0.14	0.08	ns
Profile convexity	NAPg	degrees	-4.64	-2.34	*	1.30	0.54	ns
	NsSnPgs	degrees	-6.37	-3.00	**	7.77	2.91	**
	NsNoPgs	degrees	-1.59	-1.03	ns	3.97	2.21	*
Lip position	UL-E-Line	mm	3.27	3.30	**	-3.13	-2.82	**
	LL-E-Line	mm	2.55	3.08	**	-1.18	1.43	ns

<sup>a</sup> ns indicates not significant ( $P \geq .05$ ).\*  $P < .05$ .\*\*  $P < .01$ .\*\*\*  $P < .001$ .

- Attractive females-nonattractive females
- Nonattractive females-nonattractive males
- Attractive males-nonattractive males
- Attractive females-attractive males.

However, because of the small sample size of the attractive males ( $n = 5$ ), no comparison between the groups 3 and 4 was performed.

### Sagittal jaw relationship

*Comparison: attractive females-nonattractive females.* There was no significant difference between

the groups with respect to the angles SNA, SNB, and SNPg. The mean ANB angle and the Wits-appraisal were larger (1.41 degrees,  $P < .05$  and 2.42 mm,  $P < .001$ , respectively) in the attractive females in comparison with the nonattractive females.

*Comparison: nonattractive females-nonattractive males.* There was no significant difference between the groups with respect to the angles SNA, SNB, ANB, and SNPg. The mean Wits-appraisal was smaller (3.54 mm,  $P < .001$ ) in the nonattractive females in comparison with the nonattractive males.

**TABLE 4.** Correlation (*r*) Between Cephalometric Radiographic Variables and the Transversal and Vertical Facial Disproportion Indices. Analysis of 21 Attractive (A) and 11 Non attractive (NA) Females (f) and 21 Non attractive (NA) Males (m)

Variables		Subjects	Disproportion Index			
			Transversal		Vertical	
			<i>r</i>	<i>P</i>	<i>r</i>	<i>P</i>
Sagittal jaw relationship	SNA	A (f)	0.01	.95	0.16	.45
		NA (f)	0.40	.22	−0.54	.09
		NA (m)	−0.01	.95	0.12	.60
	SNB	A (f)	0.08	.72	0.07	.74
		NA (f)	0.37	.27	−0.47	.15
		NA (m)	0.01	.96	0.02	.92
	ANB	A (f)	−0.03	.87	0.22	.28
		NA (f)	0.05	.87	−0.16	.64
		NA (m)	0.84	.05	0.05	.84
	SNPg	A (f)	0.06	.79	−0.01	.98
		NA (f)	0.19	.58	−0.65	.03
		NA (m)	−0.15	.53	0.03	.88
	Wits	A (f)	−0.13	.54	−0.34	.10
		NA (f)	0.14	.69	−0.48	.14
		NA (m)	−0.24	.29	−0.03	.91
Vertical jaw relationship	ML/NSL	A (f)	0.01	.97	0.21	.33
		NA (f)	−0.56	.07	0.52	.10
		NA (m)	0.28	.21	−0.04	.85
	NL/NSL	A (f)	−0.08	.70	−0.16	.45
		NA (f)	0.10	.77	−0.05	.89
		NA (m)	0.09	.71	−0.41	.06
	ML/NL	A (f)	0.09	.66	0.23	.27
		NA (f)	−0.73	.01	0.68	.02
		NA (m)	0.38	.09	0.19	.42
Facial height	Spa-Gn/N-Gn × 100	A (f)	−0.40	.05	0.20	.33
		NA (f)	0.37	.26	0.23	.50
		NA (m)	−0.08	.74	0.34	.13
	Spp-Go'/S-Go' × 100	A (f)	−0.39	.06	−0.22	.30
		NA (f)	0.80	.00	−0.20	.55
		NA (m)	−0.42	.06	−0.40	.07
Profile convexity	NAPg	A (f)	0.01	.95	−0.35	.09
		NA (f)	0.15	.67	−0.55	.08
		NA (m)	−0.08	.72	−0.03	.89
	NsSnPgs	A (f)	−0.16	.44	−0.03	.88
		NA (f)	0.34	.31	−0.41	.21
		NA (m)	−0.16	.48	0.09	.71
	NsNoPgs	A (f)	0.15	.48	−0.12	.57
		NA (f)	0.54	.09	−0.25	.46
		NA (m)	−0.20	.39	0.13	.56
Lip position	OL-E-Line	A (f)	0.16	.43	0.19	.36
		NA (f)	−0.25	.45	0.23	.50
		NA (m)	0.23	.31	0.03	.89
	UL-E-Line	A (f)	0.11	.61	0.48	.02
		NA (f)	−0.07	.84	0.17	.62
		NA (m)	0.20	.38	0.05	.84

### Vertical jaw relationship

*Comparison: attractive females-nonattractive females.* There was no significant group difference for the angles ML/NSL, NL/NSL, and ML/NL.

*Comparison: nonattractive females-nonattractive males.* There was no significant group difference for the angles ML/NSL, NL/NSL, and ML/NL.

### Facial height

*Comparison: attractive females-nonattractive females.* There was no significant group difference for the anterior (Spa-Gn/N-Gn × 100) and posterior lower facial heights (Spp-Go'/S-Go' × 100).

*Comparison: nonattractive females-nonattractive males.* There was no significant group difference for the anterior and posterior lower facial heights.



## Profile convexity

**Comparison: attractive females-nonattractive females.** The NAPg angle (hard tissue profile convexity) and the NsSnPgs angle (soft tissue profile convexity without the nose) were on average smaller (4.64 degrees,  $P < .05$  and 6.37 degrees,  $P < .01$ , respectively) in the attractive females when compared with the nonattractive females. There was no significant group difference for the NsNoPgs angle (soft tissue profile convexity with the nose).

**Comparison: nonattractive female-nonattractive males.** There was no significant group difference for the NAPg angle. The NsSnPgs angle and the NsNoPgs angle were on average greater (7.77 degrees,  $P > .01$  and 3.97 degrees,  $P < .05$ , respectively) in the nonattractive females when compared with the nonattractive males.

## Lip position

**Comparison: attractive females-nonattractive females.** The distances of the upper and the lower lips to the "Esthetic line" were, on average, smaller (3.27 mm,  $P < .01$  and 2.55 mm,  $P < .01$ , respectively) in the attractive females in comparison with the nonattractive females.

**Comparison: nonattractive females-nonattractive males.** The mean distance of the upper lip to the Esthetic line was greater (3.13 mm,  $P < .01$ ) in the nonattractive females than in the nonattractive males. There was no significant group difference for the distance of the lower lip to the Esthetic line.

## Comparison: skeletal variables and facial disproportion indices in the transverse and vertical planes

A moderate association for the nonattractive females existed when correlating the ML/NL angle with the transverse ( $r = -0.73$ ,  $P = .01$ ) and the vertical ( $r = 0.68$ ,  $P > .01$ ) facial disproportion indices. A moderate association for the nonattractive females also existed when correlating the posterior facial height index ( $Spp-Go'/S-Go' \times 100$ ) with the transverse facial disproportion index ( $r = 0.80$ ,  $P = .00$ ) (Table 4).

## DISCUSSION

Ideals and standards of beauty change with time. In the past (ancient Greece, Renaissance), more flattened and retrusive profiles were preferred. These ideals were reflected in the sculptures from that time<sup>8,20</sup> (eg, Apollo Belvedere, Aphrodite).

In modern times, however, our perception of an ideal profile is one with fuller and more protrusive lips.<sup>8,21-27</sup> Furthermore, from an en-face facial view,<sup>24,28</sup> full and protrusive lips are found to be very attractive. In com-

parison with males, fuller and more convex profiles are preferred in females.<sup>29</sup>

The results of this study are in accordance with these findings. The ANB angle and the Wits-appraisal, which describe the sagittal jaw relationship, were greater for the attractive than for the nonattractive females. This implies that the attractive females present a more convex hard tissue profile. This is confirmed by the measurements of the soft profile angles (hard tissue profile angle and soft tissue profile angle without the nose), which were smaller for the attractive females than for the nonattractive females. These findings are in agreement with those of Woolnoth,<sup>30</sup> Foster,<sup>29</sup> and Douglas and Turley,<sup>25</sup> who found that a more convex face has a younger look compared with a more straight or concave face, which looks older.<sup>20</sup>

Finally, the distance of the upper and lower lips to the "Esthetic line" were greater for nonattractive than for attractive females. An explanation for this could be the bigger nose and chin for nonattractive females.<sup>26,31</sup> This relative lip retrusion is perceived as unattractive.

When comparing the nonattractive females with the nonattractive males, the soft tissue profile angles (with and without nose) were greater for the nonattractive females. Furthermore, the Wits-appraisal was greater for the nonattractive males than for the nonattractive females, this implies a greater profile convexity for the nonattractive males. This is further confirmed by the smaller distance of the upper lip to the "Esthetic line" for the nonattractive males. These results are in accordance with those of Foster,<sup>29</sup> who found that in males, a straighter profile is considered attractive. In females, on the other hand, a more convex profile is perceived as more attractive. However, there are also studies that show that attractive males follow the modern trend, with fuller and more protrusive lips<sup>25</sup> resulting in a more convex profile.

There were only a few correlations between the skeletofacial variables (ML/NL and posterior facial height) and the corresponding transverse and vertical facial disproportion indices. This means that the attractiveness of a face hardly can be explained by objective parameters.<sup>8,27,32-35</sup> Instead, our perception of a beautiful face is affected by many nonmetric factors, eg, face color, hair, facial expression, and cultural environment of the beholder.<sup>36-43</sup> In this connection, the words of Alexander Pope<sup>28</sup> would be appropriate:

*"Tis not a lip or eye we beauty call  
But the joint force and full result of all"*

## CONCLUSIONS

- Facial beauty in the frontal view is related only to a minor degree to specific skeletofacial morphology in the lateral view.

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