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ORIGINAL ARTICLE FACIAL SURGERY

Comparison of Facial Proportions Between Beauty Pageant Contestants and Ordinary Young Women of Korean Ethnicity: A Three-Dimensional Photogrammetric Analysis

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Abstract

Background Although the harmony of facial proportions is traditionally perceived as an important element of facial attractiveness, there have been few objective studies that have investigated this esthetic balance using three-dimensional photogrammetric analysis.

Objectives To better understand why some women appear more beautiful, we investigated differences in facial proportions between beauty pageant contestants and ordinary young women of Korean ethnicity using three-dimensional (3D) photogrammetric analyses.

Methods A total of 43 prize-winning beauty pageant contestants (group I) and 48 ordinary young women (group II) of Korean ethnicity were photographed using 3D photography. Numerous soft tissue landmarks were identified, and 3D photogrammetric analyses were performed to evaluate 13 absolute lengths, 5 angles, 3 volumetric proportions, and 12 length proportions between soft tissue landmarks.

Results Group I had a greater absolute length of the middle face, nose height, and eye height and width; a smaller absolute length of the lower face, intercanthal width, and nasal width; a larger nasolabial angle; a greater proportion of the upper and middle facial volume, nasal height, and eye height and width; and a lower proportion of the lower facial volume, lower face height, intercanthal width, nasal width, and mouth width. All these differences were statistically significant.

Conclusions These results indicate that there are significant differences between the faces of beauty pageant contestants and ordinary young women, and help elucidate which factors contribute to facial beauty. The group I mean values could be used as reference values for attractive facial profiles.

Level of Evidence V This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings,

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Keywords Facial proportions · Average · Attractive · Women · Three-dimensional photogrammetry

Introduction

Facial beauty is a long-standing mystery in human history. Numerous scholars have investigated what facial beauty is, and whether it can be defined objectively. While artists have expressed their own concepts of facial beauty in their work, mathematicians and scientists have tried to analyze beauty and determine its rules and definitions [1, 2]. For example, the golden ratio, also known as the divine proportion, is considered by many to hold the key to the mystery of esthetics, attraction, and human beauty [3]. The golden ratio is denoted by the symbol Φ (phi) and is an irrational number near 1.618033988 [4].

Although all human beings have similarly shaped eyes, noses, and lips, each individual looks very different, even twins. Which factors create these differences between people? Although subjective preferences in facial beauty exist, commonalities are also known to exist, regardless of race, age, and sex. According to recent studies, facial beauty can be defined using three components: facial balance, youthfulness, and symmetry. Among these three factors, recent studies have found that differences between individuals are due to differences in facial balance, such as proportional differences in various facial landmarks.

Many investigators have used photography for this purpose. However, two-dimensional (2D) analyses of the face have a potential inevitable measurement bias. Three-dimensional (3D) analyses enable us to overcome this obstacle.

In this study, a comparison of facial proportions was performed between beauty pageant contestants and ordinary young women with Korean ethnicity using 3D photogrammetry. The results of this study may become a fundamental basis for the study of the concept of facial beauty, which would contribute to the clinical application of this concept for plastic surgeons.

Materials and Methods

All participants underwent 3D photography purely for research reasons and were evaluated with 3D photogrammetry. Each participant was photographed with 3D photography between October and November 2016 in Seoul, Korea. In all, 43 beauty pageant contestants (group I) and 48 ordinary young women (group II) were included. Group I was composed of prize-winning contestants in the Miss Korea contest, and group II consisted of patients who visited our outpatient clinic for non-facial treatment. The mean age for group I was 22.3 ± 3 years and the mean age for group II was 25 ± 5 years. Participants with histories of congenital, traumatic, or post-operative facial deformity, those with craniofacial syndromes, and those with severe facial asymmetry were excluded. Medical histories of prior plastic surgery or esthetic procedures were not considered. Informed consent was obtained from all participants, and the study design was reviewed and approved by our institutional review board.

Three-Dimensional Photogrammetry

Using a Morpheus 3D® light-emitting diode-based white structured-light scanner (Morpheus Co., Ltd., Seongnam, Gyunggi-do, Korea), 3D photographs of the participants were taken while they were sitting in a neutral head

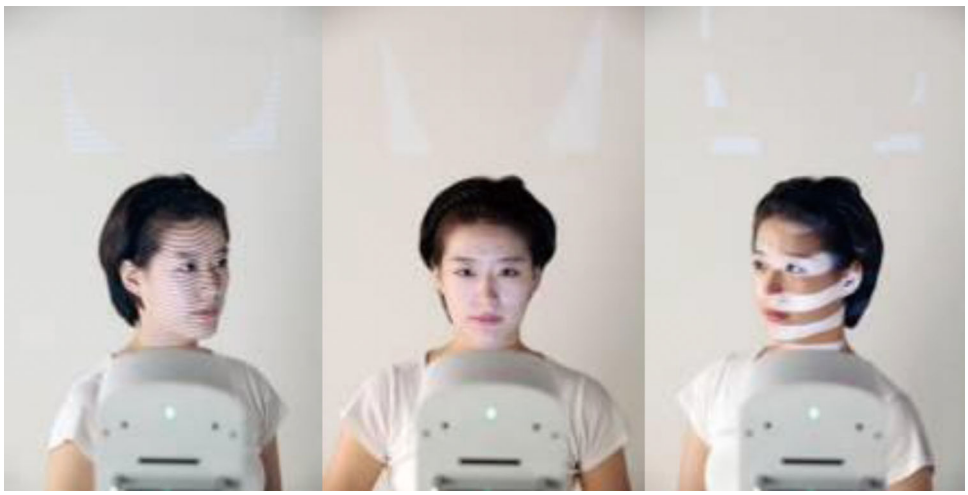


Fig. 1 The three-dimensional scan was performed three times in the frontal, left, and right oblique views

Table 1 Landmarks for facial analysis

Landmarks	Abbreviation	Definitions
Trichion	Tr	Lowest point of the hairline in center of the face
Soft tissue glabella	G′	Midpoint between the center of eyebrows, the transecting point of the vertical line
Soft tissue nasion	N′	Midpoint of the transverse line of the highest points of the palpebrae superius
Ala	Al	Lateral portion of each alar curvature, left and right
Pronasale	Pn	Furthest anterior extension of the nose (tip of the nose)
Subnasale	Sn	Central junction of the columella and the upper cutaneous lip
Soft tissue A-point	A′	Posterior midpoint of the philtrum
Labiale superius	Ls	Midpoint of the upper vermilion line
Stomion	St	Midpoint of the junction between the upper and lower lip
Cheilion	Ch	The point located at each labial commissure, left and right
Labiale inferius	Li	Midpoint of the lower vermilion line
Soft tissue B-point	B′	Posterior midpoint on the labiomental soft tissue contour
Soft tissue pogonion	Pg′	Anterior midpoint of the chin
Soft tissue gnathion	Gn′	Constructed point formed by the intersection of the Sn–soft tissue pogonion line and the chin throat line
Soft tissue menton	Me′	Inferior midpoint on the soft tissue chin
Cervical point	C	Neck-throat junction: the junction of the inferoposterior extension of the soft tissue chin and the neck
Palpebrae superius	Ps	Highest point in the mid-portion of the free margin of each upper eyelid, left and right
Pupil	P	Hole located in the center of the iris of the eye, left and right
Palpebrae inferius	Pi	Lowest point in the mid-portion of the free margin of each lower eyelid, left and right
Exocanthion	Ex	Lateral point of the palpebral fissure, left and right
Endocanthion	En	Medial point of the eye fissure, left and right
Tragion	T	Point located at the upper margin of each tragus, left and right
Zygion	Zy	Lateral zygomatic point of the frontal face, left and right
Soft tissue gonion	Go′	Lateral point on the soft tissue contour of each mandibular angle
Soft tissue C point	C′	Meeting point of the straight line from Tr and T and the horizontal plane passing through G′, left and right
Soft tissue D point	D′	Meeting point of the straight line from each T and C and the horizontal plane passing through the subnasale, left and right
Soft tissue E point	E′	Meeting point of the straight line from T and C and the horizontal plane passing through the menton, left and right

position, with about a 600 mm distance from the face to the lens of the 3D scanner, without makeup. Each scan was performed with the same brightness, three times in the frontal, left, and right oblique views (Fig. 1). After each participant's 3D facial image was reconstructed by merging these images, the entire scanned image was automatically reoriented. The horizontal plane was set to contain the right and left pupils and the nasion, the sagittal plane was set as a perpendicular plane containing the nasion and subnasale, and the coronal plane was set to be perpendicular to these other planes. Then, the various facial landmarks of each of the participants were defined. Analyses of facial proportions included absolute lengths, angles, proportions of facial volumes, and vertical and horizontal lengths between each soft tissue facial landmark. More specifically, from each 3D photogrammetric image, after 27 soft tissue landmarks were marked (Table 1, Fig. 2), 13 defined absolute lengths, 5 angles, 3 volumetric proportions, and 12 length proportions from each scanned image were measured and analyzed using a commercial computer software tool (Morpheus Co., Ltd., Seongnam City, Gyunggi-do, Korea) (Table 2, Fig. 3).

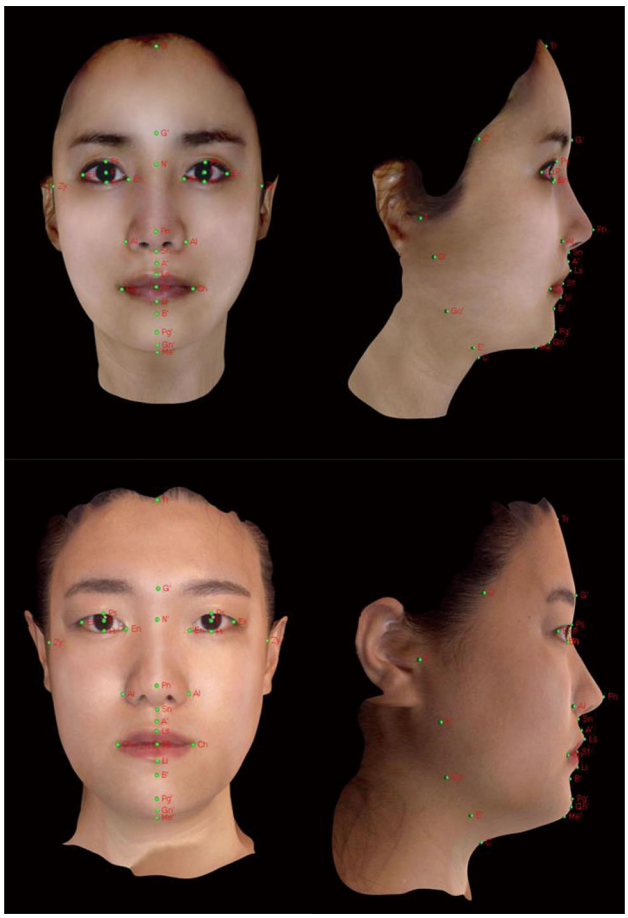


Fig. 2 Landmarks used in this study. See Table 1 for detailed definitions of each landmark. A representative participant of the beauty pageant contestants group (above) and a representative participant of the ordinary young women group (below)

Statistical Analyses

All statistical analyses were performed using SPSS 24.0 (IBM® SPSS® Statistics, Chicago, IL, USA). Data from each group were analyzed to determine the mean *P* value as well as the standard deviation of each measurement. The between-group mean differences were calculated using *t* test, with the significance level set to a *P* value of 0.05.

Results

Anthropometric analyses of facial parameters are shown in Table 3. Average values ± standard deviations are discussed in the following section. There were statistically significant differences between the beauty pageant contestants and ordinary young women in 18 of the 33 measures taken.

Absolute Lengths and Angles

Middle face height was significantly longer ($P = 0.043$) in the beauty pageant contestants (72.36 ± 3.65 mm) than the ordinary young women (70.8 ± 3.55 mm). By contrast, lower facial height was significantly shorter ($P = 0.002$) in the beauty pageant contestants (60.26 ± 2.53 mm) than the ordinary young women (62.61 ± 4.26 mm). In terms of the nose, the vertical height of the nose was significantly higher ($P = 0.000$) in the beauty pageant contestants (54.56 ± 2.84 mm) than the ordinary young women (51.87 ± 2.74 mm), but the horizontal width of the nose was significantly shorter ($P = 0.001$) in the beauty pageant contestants (38.05 ± 1.82 mm) than the ordinary young women (39.59 ± 2.29 mm). In terms of the eye, the vertical height of the eye was significantly higher ($P = 0.000$) in the beauty pageant contestants (11.55 ± 1.03 mm) than the ordinary young women (9.14 ± 1.27 mm). The horizontal width of the eye was also larger ($P = 0.000$) in the beauty pageant contestants (28.01 ± 1.22 mm) than the ordinary young women (26.18 ± 1.6 mm). By contrast, the intercanthal width was significantly shorter ($P = 0.001$) in the beauty pageant contestants (34.36 ± 1.86 mm) than the ordinary young women (36.28 ± 3.16 mm) (Fig. 4). There were no significant differences between the groups in the vertical height of total face, upper face, chin, lip, or in the horizontal width of the total face and lip.

In terms of facial angles, only the nasolabial angle was larger in the beauty pageant contestants (118.4° ± 6.27°) than ordinary young women (108.32° ± 8.79°). This difference was statistically significant ($P = 0.000$). None of the other angle variables were statistically significantly different (Fig. 5).

Volumetric Proportions

The ratio between upper facial volume and total facial volume showed a significant difference between the two groups (beauty pageant contestants, 14.91 ± 2.01%; ordinary young women, 13.76 ± 2.39%; $P = 0.014$). The ratio between middle facial volume and total facial volume also showed a significant difference between the two groups (beauty pageant contestants, 52.96 ± 2.20%; ordinary young women, 51.33 ± 2.28%; $P = 0.001$). In terms of the ratio between lower facial volume and total facial volume, the beauty pageant contestants had a significantly lower proportion than the ordinary young women (beauty pageant contestants, 32.11 ± 2.42%; ordinary young women, 34.90 ± 3.16%; $P = 0.000$) (Fig. 6).

Table 2 Definitions of the measures used in the three-dimensional scanned images

	Names of measures	Definition	Measurement
Absolute length	H-facial	Total facial height	Tr–Me′
	H-upper	Upper facial height	Tr–G′
	H-middle	Middle facial height	G′–Sn
	H-lower	Lower facial height	Sn–Me′
	H-chin	Chin height	St–Me′
	H-nose	Nasal height	N′–Sn
	H-lip	Lip height	Ls–Li
	H-eye	Eye height	Ps–Pi
	W-facial	Facial width	Zy–Zy
	W-eye	Eye width	Ex–En
	W-intercanthal	Intercanthal width	En–En
	W-nose	Nasal width	Al–Al
	W-lip	Lip width	Ch–Ch
Angle	A-nasofrontal	Nasofrontal angle	Angle of (G′–N′–Pn)
	A-labiomental	Labiomental angle	Angle of (Li–B′–Pg′)
	A-nasofacial	Nasofacial angle	Angle of ([G′–Pg′]–[N′–Pn])
	A-nasomental	Nasomental angle	Angle of (N′–Pn–Pg′)
	A-nasolabial	Nasolabial angle	Angle of (Pn–Sn–Ls)
Volume proportion	PV-upper	Upper facial volume/Total facial volume	Volume of (Tr–C′–G′)/(Tr–T–C–Me′)
	PV-middle	Middle facial volume/Total facial volume	Volume of (G–C–T–D′–Sn)/(Tr–T–C–Me′)
	PV-lower	Lower facial volume/Total facial volume	Volume of (Sn–D′–E′–Me′)/(Tr–T–C–Me′)
Length proportion	P-facial	Total facial height/Total facial width	(Tr–Me′)/(Zy–Zy)
Height	PH-upper	Upper facial height/Total facial height	(Tr–G′)/(Tr–Me′)
	PH-middle	Middle facial height/Total facial height	(G′–Sn)/(Tr–Me′)
	PH-lower	Lower facial height/Total facial height	(Sn–Me′)/(Tr–Me′)
	PH-chin	Chin height/Total facial height	(St–Me′)/(Tr–Me′)
	PH-nose	Nasal height/Total facial height	(N′–Sn)/(Tr–Me′)
	PH-lip	Lip height/Total facial height	(Ls–Li)/(Tr–Me′)
	PH-eye	Eye height/Total facial height	(Ps–Pi)/(Tr–Me′)
Width	PW-eye	Eye width/Total facial width	(Ex–En)/(Zy–Zy)
	PW-intercanthal	Intercanthal width/Total facial width	(En–En)/(Zy–Zy)
	PW-nose	Nasal width/Total facial width	(Al–Al)/(Zy–Zy)
	PW-lip	Lip width/Total facial width	(Ch–Ch)/(Zy–Zy)

Length Proportions

As described above, the proportions of all vertical heights were calculated as a ratio to the total vertical length of the face, and the proportions of all horizontal widths were calculated as a ratio to the total width of the face. The proportion of lower face was significantly smaller ($P = 0.000$) in the beauty pageant contestants ($32.12 \pm 1.27\%$) than the ordinary young women ($33.46 \pm 1.64\%$). There were no differences between the two groups in the proportions of facial index, upper, and middle facial height, and chin height. In terms of the proportions of nose, the proportion of nasal vertical height was significantly greater ($P = 0.000$) in the beauty pageant contestants ($29.08 \pm 1.42\%$) than the ordinary young women ($27.76 \pm 1.61\%$). By contrast, the proportion of nasal horizontal width was significantly smaller ($P = 0.000$) in the beauty pageant contestants ($29.33 \pm 1.44\%$) than ordinary young women ($31.01 \pm 2.11\%$). In terms of the eye, both vertical height proportion and horizontal width proportion were significantly greater in the beauty pageant contestants (6.15 ± 0.54 and $21.58 \pm 0.69\%$, respectively) than the ordinary young women (4.89 ± 0.7 and $20.48 \pm 0.99\%$) ($P = 0.000$ and 0.000, respectively). The proportion of intercanthal width was significantly smaller ($P = 0.000$) in

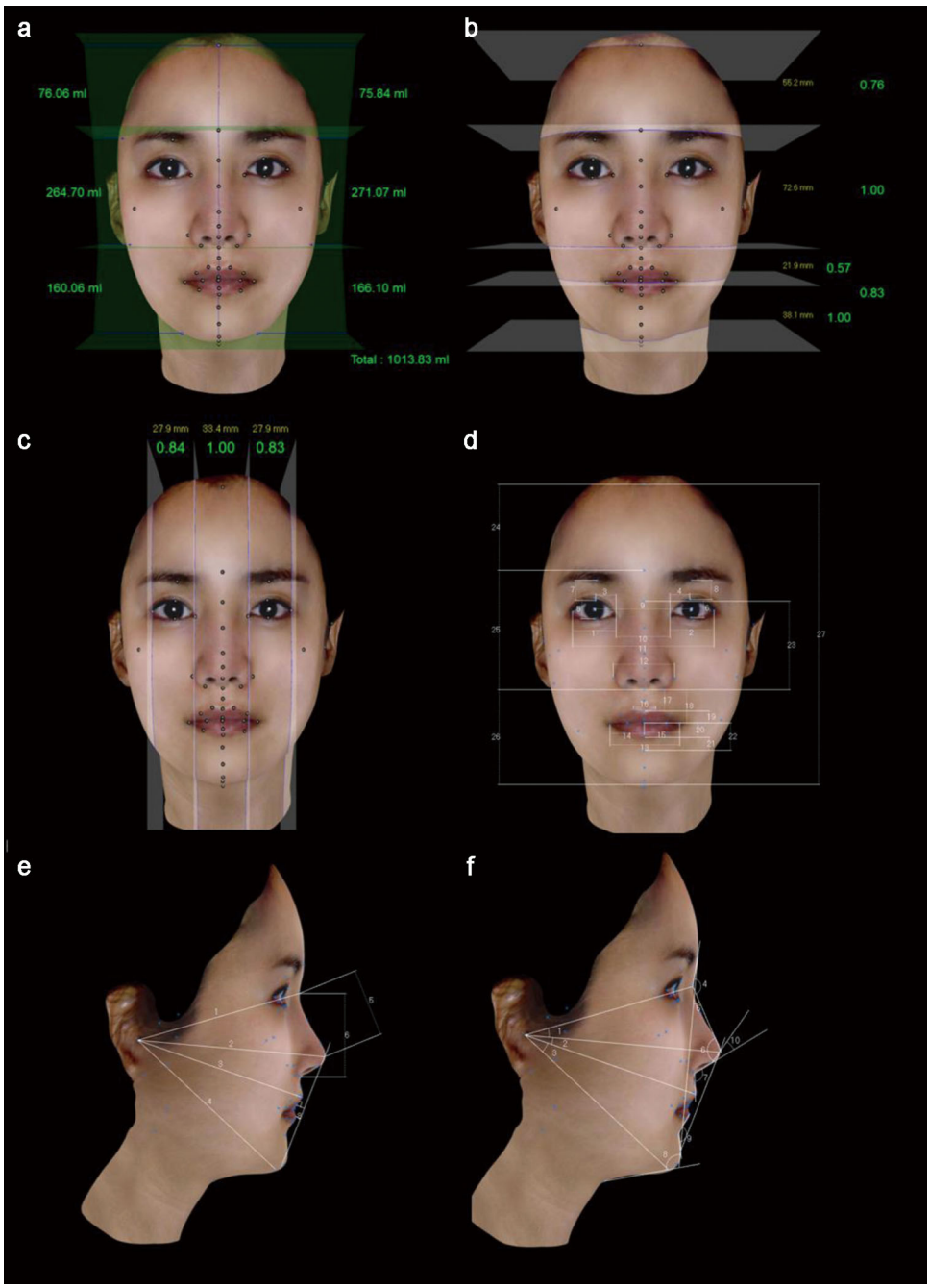


Fig. 3 The Morpheus software tool (Morpheus Inc., Seoul, South Korea) was used for the three-dimensional photogrammetric analyses: volumetric analyses (**a**), vertical and horizontal length analyses (**b**), (**c**), (**d**), (**e**), and angular analyses (**f**) of the face. See Table 2 for detailed definitions of each proportion

the beauty pageant contestants (26.47 ± 1.15%) than the ordinary young women (28.36 ± 1.91%). Although the proportion of horizontal mouth width showed a significant difference between the two groups (beauty pageant contestants, 33.88 ± 2.11%; ordinary young women, 34.78 ± 2.16%), there was no difference between the two groups in the proportion of vertical mouth height (beauty pageant contestants, 9.24 ± 1.05%; ordinary young women, 8.83 ± 1.25%) (Fig. 7).

Discussion

The concept of facial beauty proposed by Leonardo da Vinci is the standard concept in modern esthetic plastic surgery [5]. It hypothesizes that the golden ratio is ideal, even in facial beauty. This concept has played a key role in the innovation of surgical techniques, including in blepharoplasty, rhinoplasty, and so on. Thus, the golden ratio classically depends on the concept of facial proportion. Why do people prefer the facial beauty of certain individuals? Which factors contribute to these preferences? To

Table 3 Comparison of the variables between group I (beauty pageant contestants) and group II (ordinary young women)

	Names of measures	Group I ($N = 43$)		Group II ($N = 48$)		Difference	Statistical significance
		Mean	SD	Mean	SD	Mean	*P*
Absolute length	H-facial	187.66	5.37	187.06	8.21	0.609	0.674
	H-upper	55.03	4.26	53.64	4.91	1.395	0.151
	H-middle	72.36	3.65	70.80	3.55	1.554	0.043*
	H-lower	60.26	2.53	62.61	4.26	− 2.351	0.002*
	H-chin	41.66	2.04	41.61	3.25	0.043	0.938
	H-nose	54.56	2.84	51.87	2.74	2.694	0.000*
	H-lip	17.33	1.91	16.49	2.21	0.840	0.056
	H-eye	11.55	1.03	9.14	1.27	2.407	0.000*
	W-facial	129.77	4.11	127.88	5.90	1.893	0.077
	W-eye	28.01	1.22	26.18	1.60	1.822	0.000*
	W-intercanthal	34.36	1.86	36.28	3.16	− 1.924	0.001*
	W-nose	38.05	1.82	39.59	2.29	− 1.540	0.001*
	W-lip	43.93	2.45	44.44	2.86	− 0.513	0.360
Angle	A-nasofrontal	147.19	4.35	145.61	5.01	1.580	0.111
	A-labiomental	147.18	8.14	143.58	10.47	3.598	0.069
	A-nasofacial	28.79	2.42	29.12	2.94	− 0.329	0.560
	A-nasomental	134.69	3.90	135.03	4.53	0.348	0.697
	A-nasolabial	118.40	6.27	108.32	8.79	10.086	0.000*
Volume proportion	PV-upper	14.91	2.01	13.76	2.39	1.151	0.014*
	PV-middle	52.96	2.20	51.33	2.28	1.631	0.001*
	PV-lower	32.11	2.42	34.90	3.16	− 2.782	0.000*
Length proportion	P-facial	144.68	4.46	146.47	7.51	− 1.792	0.165
Height	PH-upper	29.30	1.81	28.65	1.96	0.656	0.102
	PH-middle	38.56	1.81	37.88	1.82	0.683	0.077
	PH-lower	32.12	1.27	33.46	1.64	− 1.345	0.000*
	PH-chin	22.20	1.02	22.23	1.21	− 0.030	0.897
	PH-nose	29.08	1.42	27.76	1.61	1.319	0.000*
	PH-lip	9.24	1.05	8.83	1.25	0.409	0.094
	PH-eye	6.15	0.54	4.89	0.70	1.262	0.000*
Width	PW-eye	21.58	0.69	20.48	0.99	1.099	0.000*
	PW-intercanthal	26.47	1.15	28.36	1.91	− 1.883	0.000*
	PW-nose	29.33	1.44	31.01	2.11	− 1.674	0.000*
	PW-lip	33.88	2.11	34.78	2.16	− 0.904	0.047*

*Statistically significant

help answer these questions, we obtained 3D images of prize-winning contestants in the Miss Korea contest to represent attractive women. Because the prize-winning standards of beauty pageants not only focus on the face, but also on body shape, with body mass index or even overall body ratios taken into account, it may be ambitious to conclude that beauty pageant standards reflect the absolute facial beauty standard. Although it is disputed whether Miss Korea contestants represent ideal facial beauty, considering the fact that the judges include not only experts such as plastic surgeons, orthodontists, and photographers, but also laypeople such as journalists and celebrities, we believe that Miss Korea contestants provide an appropriate approximation of ideal beauty that could be considered as a facial beauty standard.

Many ordinary young women in northeastern Asia would prefer to have a smaller and slenderer facial contour. Why? This preference relates to the proportions between the face and the body. Asians are somewhat smaller in stature than Western people, so their faces are somewhat larger in proportion to their bodies [6]. In addition, contemporary Asian facial contouring surgery often deals with

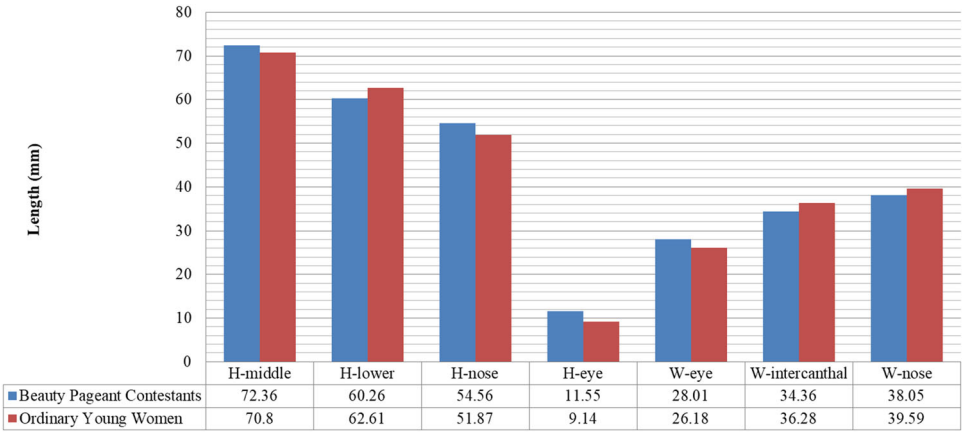


Fig. 4 Comparison of the mean absolute length values with statistically significant differences. The beauty pageant contestants group had greater middle face length, nasal height, eye height, and eye width; they also had a smaller lower face height, intercanthal width, and nasal width than the ordinary young women group

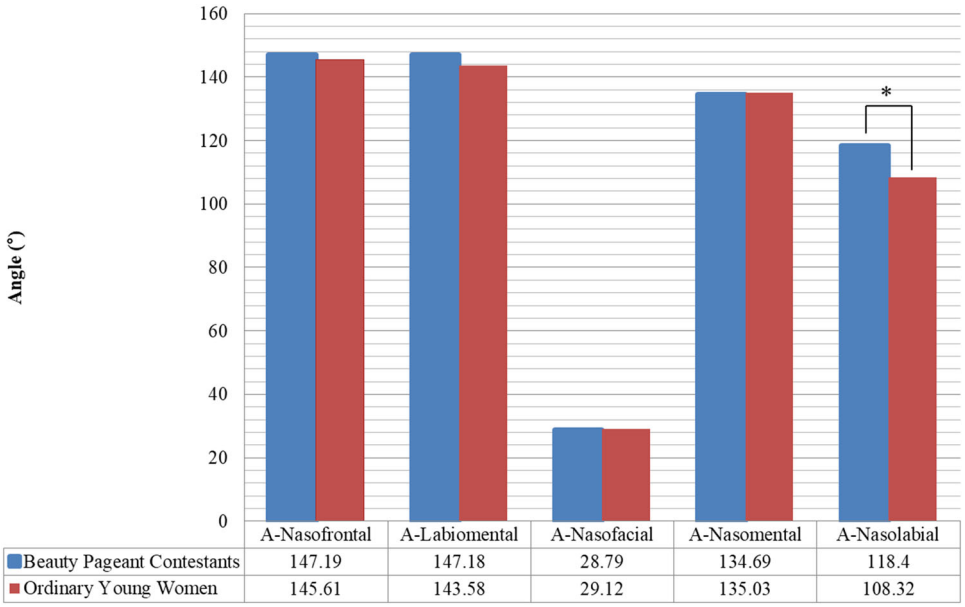


Fig. 5 Comparison of the mean facial angle values with statistically significant differences. Only the nasolabial angle was significantly different (larger) the beauty pageant contestants group compared with the ordinary young women group (asterisk)

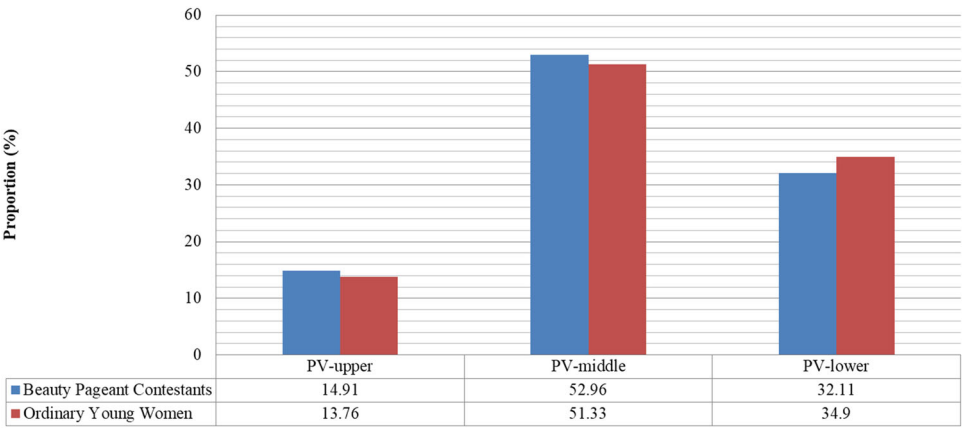
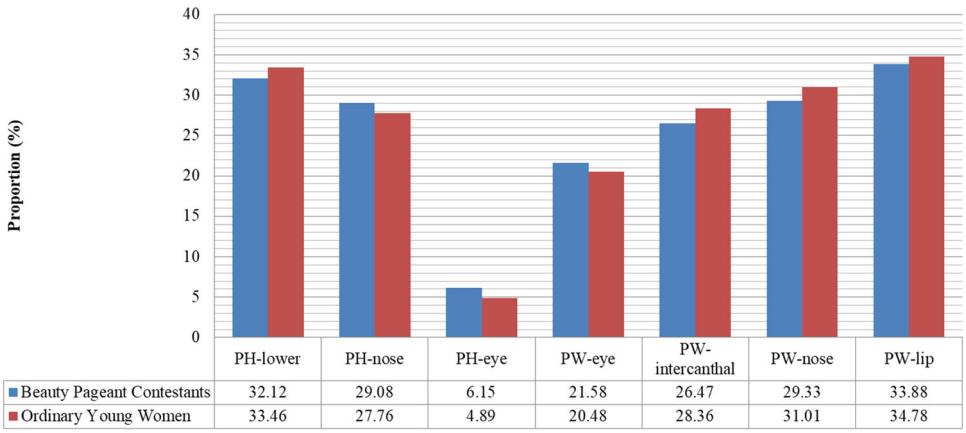


Fig. 6 Comparison of the mean volumetric proportion values with statistically significant differences. The beauty pageant contestants group had a larger proportional volume of the upper and middle face than the ordinary young women group, and had a smaller proportional volume of the lower face

mandible reduction, which is a procedure to change the proportions of the lower third of the face [7–9]. In the present study, participants in the beauty pageant contestants group had smaller absolute length, volumetric proportion, and length proportion in their lower faces than the ordinary young women.

There are generally three methods used for facial analysis: cephalometry, direct anthropometry, and 2D



	PH-lower	PH-nose	PH-eye	PW-eye	PW-intercanthal	PW-nose	PW-lip
Beauty Pageant Contestants	32.12	29.08	6.15	21.58	26.47	29.33	33.88
Ordinary Young Women	33.46	27.76	4.89	20.48	28.36	31.01	34.78

Fig. 7 Comparison of the mean values of proportions of length with statistically significant differences. The beauty pageant contestants group had a greater nasal height, eye height, and eye width than the ordinary young women group, and a smaller lower face height, intercanthal width, nasal width, and mouth width

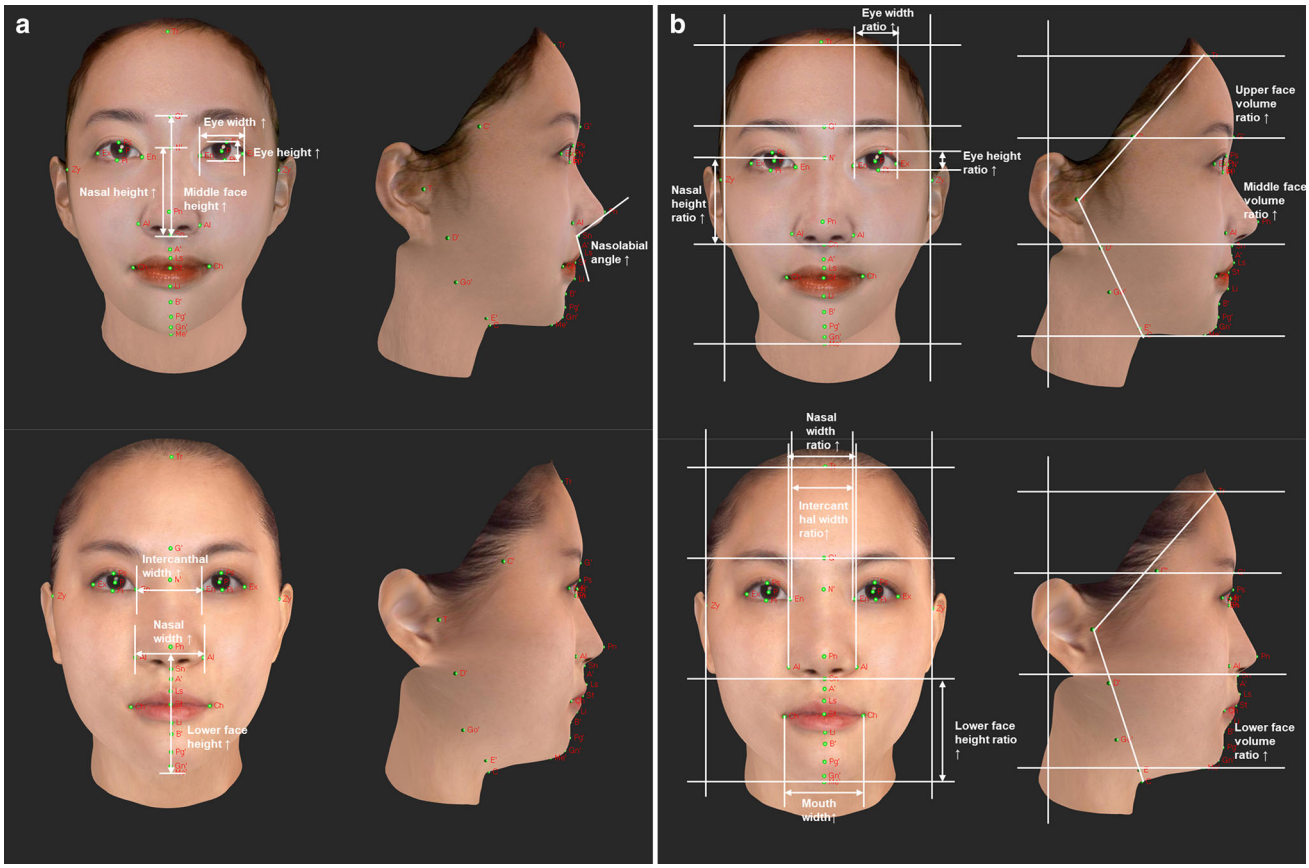


Fig. 8 **a** Beauty pageant contestants had a greater middle face length, nasal height, and eye height and width, and a larger nasolabial angle (above), whereas ordinary young women had a greater lower face length, intercanthal width, and nasal width (below). **b** Beauty pageant contestants had a larger proportion of eye width, height, nasal height, and upper and middle facial volume (above). By contrast, ordinary young women had a larger lower facial volume and height, intercanthal width, nasal width, and mouth width (below)

photogrammetry (indirect anthropometry). Each of these methods has deadly flaws and pitfalls [10]. Cephalometry is generally a valuable technique when used for surgical planning and evaluation of pre- and post-operative outcomes. However, its validity, sensitivity, and significance are matters of ongoing dispute. Cephalometric normative data, for example, are not representative of facial attractiveness [11]. Anthropometry is also widely used in clinical settings. However, it is a very laborious procedure and is subject to some error. Currently, 2D photogrammetry is the most widely used method. However, it offers only a limited number of reliable measurements, due to distortion and the 2D nature of the photographs [12–14]. This is particularly true for frontal views. Thus, we used

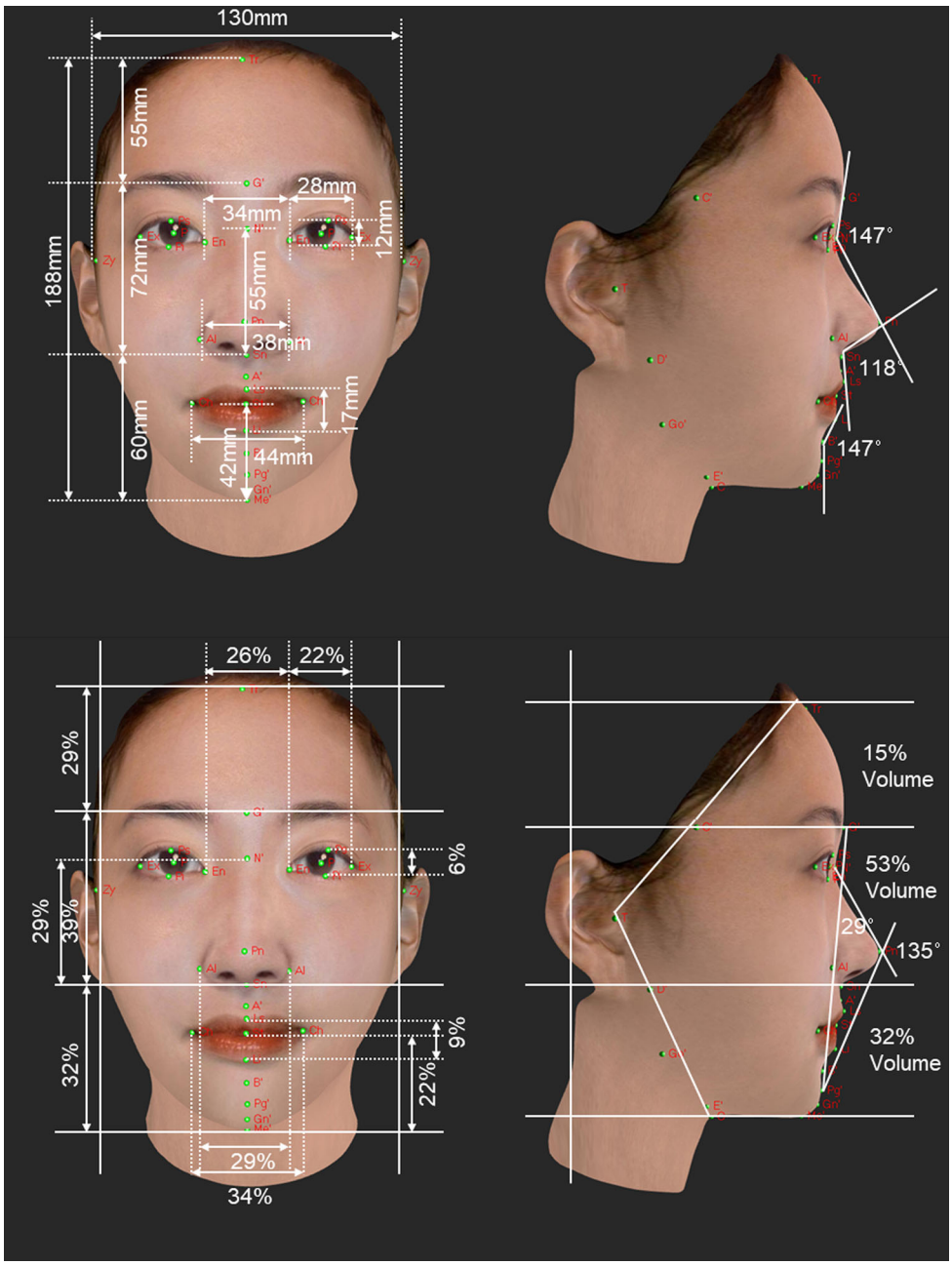


Fig. 9 Ideal facial profile created using the 3D photogrammetric analyses of images of prize-winning Miss Korea contestants

3D photogrammetry, because it is a relatively error-free and objective method [15, 16]. It does not suffer from the limitations listed above. Indeed, our results indicate that this method was reliable and stable for evaluating facial beauty.

There have been various subjective and objective studies on standards of facial attractiveness, and numerous studies on the differences among races, between the sexes, and due to changing times [17, 18]. Rhee et al. [10] tried to develop a new digital photogrammetric method of facial analysis known as balanced angular and proportional analysis. However, that study was based on 2D photogrammetry and focused on sex differences. There have been very few studies that have compared facial proportions between ordinary young women and beauty pageant contestants of Asian ethnicity, based on 3D photogrammetry.

Although the purpose of reconstructive surgery can be achieved by creating an average face, the aim of esthetic surgery is to create an attractive face. Most studies have proposed the average face as a standard, or compared proportional differences between pre- and post-operative measures, assuming that all post-operative results have attractive proportions. However, we have tried to present the true standard of an attractive face by comparing prize

winners in the Miss Korea contest, who are generally recognized as beautiful young women, to ordinary young women.

Of course, the proportions of facial volumes and lengths are more important than absolute values [19]. However, in practice, it is undeniable that the proportion of the face and the absolute length of the facial structure are invaluable when evaluating a patient's facial profile, communicating with a patient, or performing surgery. For this reason, we have included information on absolute facial lengths as well as facial proportions. Our results document differences between beauty pageant contestants and ordinary young women. Beauty pageant contestants have a greater length of the middle face, nasal height, and eye height and width, and a smaller length of lower face, intercanthal width, and nasal width. They also have a smaller proportion of lower facial volume and height, intercanthal width, nasal width, and mouth width. Further, they have a larger proportion of eye width and height, nasal height, and nasolabial angle. These results remind us of the importance of facial proportions (Fig. 8).

Finally, it is possible that the average values of the profiles of the Miss Korea contestants listed in Table 3 could be used to give approximations for attractive facial profile for young women. This would be useful information when performing esthetic and reconstructive surgeries in clinical settings (Fig. 9).

Conclusions

This 3D photogrammetric study has revealed that there are differences between the faces of ordinary young women and beauty pageant contestants, and has identified the factors that contribute to facial beauty. This is the first investigation of facial beauty based on 3D photogrammetric analyses of ordinary young women and beauty pageant contestants in East Asia.

Compliance with Ethical Standards

Conflict of interest The authors declare no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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