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Evaluation of the facial dimensions of young adult women with a preferred facial appearance

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Objective: The aim of this study was to evaluate the facial dimensions of young adult women with a preferred facial appearance and compare the results with those from the general population. **Methods:** Twenty-five linear, nine angular, and three area measurements were made and four ratios were calculated using a sample of standardized frontal and lateral photographs of 46 young adult women with a preferred facial appearance (Miss Korea group) and 44 young adult women from the general population (control group). Differences between the two groups were analyzed using multivariate analysis of variance (MANOVA). **Results:** Compared with the control group, the Miss Korea group exhibited a significantly greater facial height, total facial height (TFH; trichion–menton), facial width (tragus right–tragus left), facial depth (tragus–true vertical line), and trichion–nasion/TFH ratio and smaller subnasale–menton/TFH and facial width/TFH ratios. Furthermore, the control group had smaller intercanthal and interpupillary widths. **Conclusions:** The Miss Korea group exhibited longer, wider, and deeper faces compared with those from the general population. Furthermore, the Miss Korea group had larger eyes, longer but less protruded noses, longer and more retruded lower lips and chins, larger lip vermilion areas, and smaller labiomental angles. These results suggest that the latest trends in facial esthetics should be considered during diagnosis and treatment planning for young women with dentofacial abnormalities.
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INTRODUCTION

While esthetics, function, and stability are essential objectives of orthodontic treatment, the number of adults pursuing treatment due to esthetics has increased during the past decade.[1,2] An increased awareness of facial esthetics has resulted in a growing demand for orthodontic treatment for the correction of perioral esthetic conditions, particularly bimaxillary protrusion.[3]

Attractive lip proportion is a cornerstone in the esthetics of the lower facial region.[4-6] Several studies assessing the lip position and proportion have been conducted on lateral and frontal photographs.[6-8] Bisson and Grobbelaar[9] compared the frontal facial dimensions of models with those of subjects from the general population. Kang et al.[10] evaluated differences in esthetic preferences for the lower facial region (subnasale [Sn]–menton [Me]) between Korean and Caucasian subjects. Furthermore, studies have assessed facial esthetic preferences in different age groups and compared them between professionals and nonprofessionals.[11-13]

The eyes, nose, and lips are the preferred targets during the visual perception of faces, because, according to an eye tracking study, the center of the gaze is in the middle of the face near the symmetry plane.[14] Meyer-Marcotty et al.[15] reported that increased facial asymmetry near the midline of the face resulted in a more negative evaluation of the face in direct face-to-face interactions, suggesting that the midfacial area is crucial during facial perception. In addition, Salehi et al.[16] demonstrated the impact of the forehead and neck on facial esthetics. Currently, the parameters determining the assessment of facial attractiveness remain controversial.

Row and Rhu[17] evaluated the facial esthetics of Korean beauty pageant contestants in the late 80s using a cephalometric study. However, beauty standards change over time and are affected by concurrent fashion trends, media, and social and economical-security environments.[18-21] In addition, they also interact with ethnicity, local customs, and culture[22,23]; therefore, an ongoing assessment of facial esthetic standards is necessary.

Despite the growing influence of the Koreans in global media, no recent evaluation of Korean esthetic standards has been performed. Therefore, the aim of this study was to evaluate the facial dimensions of young adult women with a preferred facial appearance and compare the results with those for women from the general population.

MATERIALS AND METHODS

The sample comprised standardized frontal and lateral facial photographs of 46 young adult women with a preferred facial appearance who participated in the final round of the Miss Korea Pageant in 2012 (Miss Korea group) and 44 young adult women from Wonkwang Health Science University, Korea (control group). The participants were aged between 18.8 and 32.2 years (mean, 25.3 ± 4.7 years). They provided consent to participate in this study, which was approved by the institutional review board of The Catholic University of Korea (KC14OISE0057).

The inclusion criteria for the control group were females with a mesocephalic face type, straight profile, balanced facial appearance, no history of plastic or maxillofacial surgery or orthodontic treatment, absence of mentalis hyperactivity, and an interlabial gap of less than 1 mm. The surgical history was not available for the Miss Korea group.

Photographs were obtained in the natural head position, with standardized settings using a digital single-lens reflex camera (EOS 450D; Canon, Tokyo, Japan)

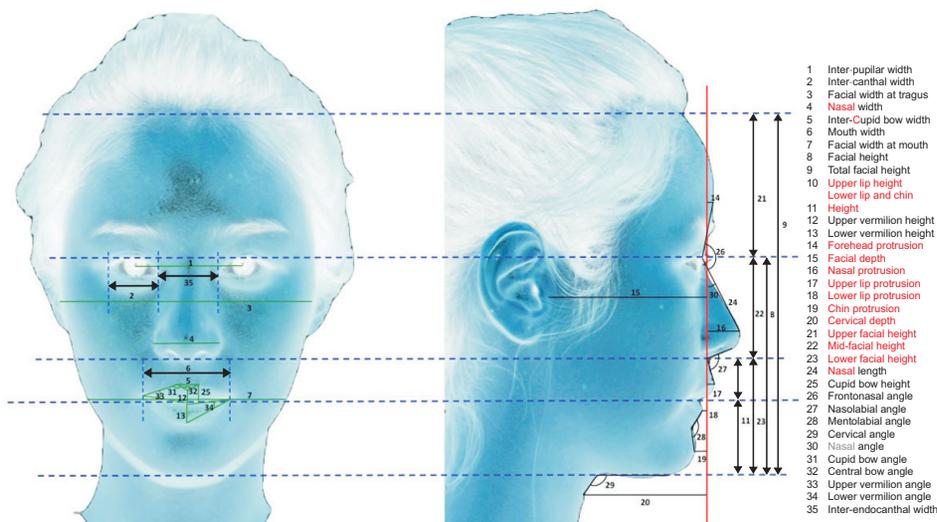| 1 | Inter-pupilar width |
2	Inter-canthal width
3	Facial width at tragus
4	Nasal width
5	Inter-Cupid bow width
6	Mouth width
7	Facial width at mouth
8	Facial height
9	Total facial height
10	Upper lip height
	Lower lip and chin
11	Height
12	Upper vermilion height
13	Lower vermilion height
14	Forehead protrusion
15	Facial depth
16	Nasal protrusion
17	Upper lip protrusion
18	Lower lip protrusion
19	Chin protrusion
20	Cervical depth
21	Upper facial height
22	Mid-facial height
23	Lower facial height
24	Nasal length
25	Cupid bow height
26	Frontonasal angle
27	Nasolabial angle
28	Mentolabial angle
29	Cervical angle
30	Nasal angle
31	Cupid bow angle
32	Central bow angle
33	Upper vermilion angle
34	Lower vermilion angle
35	Inter-endocanthal width

Figure 1. Landmarks and linear and angular measurements on the frontal and lateral facial photos.

with a shutter speed of 1/60, relative aperture (f/5.6), and a distance of 1 m from the volunteer under good illumination conditions. Moreover, to correct for any possible variations in image size, all linear and area dimensions were expressed as a ratio of the interendocanthal distance on the frontal image, which was assigned a nominal value of 10 units according to the method of Bisson and Grobbelaar.[9] Then, the scale was transferred to the lateral view through a variable (total facial height) measured on both images.

Twenty-five linear dimensions, nine angles, and three areas were measured on the frontal and lateral images using Digimizer 4.2.2 (MediCalc Software, Ostend, Belgium; Figure 1 and Table 1). In addition, four ratios were calculated as follows: trichion (Tr)−nasion (N)/total facial height (TFH; Tr−Me), N−Sn/TFH, Sn−Me/TFH,

Table 1. Definitions of variables assessed in this study

No.	Variable	Definition
1	Inter-pupilar width	The horizontal distance between right and left pupils
2	Inter-canthal width	The horizontal distance between endo- and exocathi
3	Facial width at tragus	The horizontal distance between right and left Tragi
4	Nasal width	The horizontal distance between right and left alae
5	Inter-Cupid bow width	The horizontal distance between right and left Cupid bows
6	Mouth width	The horizontal distance between right and left oral commissures
7	Facial width at mouth	The horizontal distance between right and left farthest facial points on the vertical level of the oral commissures
8	Facial height	The vertical distance between nasion (N) and menton (Me)
9	Total facial height	The vertical distance between Trichion (Tr) and Me
10	Upper lip height	The vertical distance between Subnasale (Sn) and stomionsuperioris (Stms)
11	Lower lip and chin height	The vertical distance between stomioninferioris (Stmi) and Me
12	Upper vermilion height	The vertical distance between Stms and upper lip point (UL)
13	Lower vermilion height	The vertical distance between Stmi and lower lip point (LL)
14	Forehead protrusion	The sagittal distance between Glabella (G) and true vertical line (TVL)
15	Facial depth	The sagittal distance between tragus (T) and TVL
16	Nasal protrusion	The sagittal distance between pronasale (Prn)–TVL
17	Upper lip protrusion	The sagittal distance between UL and TVL
18	Lower lip protrusion	The sagittal distance between LL and TVL
19	Chin protrusion	The sagittal distance between Pogonion (Pog) and TVL
20	Cervical depth	The sagittal distance between cervical point and TVL
21	Upper facial height	The vertical distance between Tr and N
22	Mid-facial height	The vertical distance between N and Sn
23	Lower facial height	The vertical distance between Sn–Me
24	Nasal length	The distance between N and Prn
25	Cupid bow height	The vertical distance between Stms and Cupid bow
26	Frontonasal angle	The angle between G, N, and Prn
27	Nasolabial angle	The angle between columella, Sn, and UL
28	Mentolabial angle	The angle between LL, B' point, Pog
29	Cervical angle	Angle between cervical point, point connecting neck to submandibular tissues, and Me
30	Nasal angle	Angle between TVL and N–Prn line
31	Cupid bow angle	Angle between oral commissure, Cupid bow and UL
32	Central bow angle	Angle between right Cupid bow, UL, and left Cupid bow
33	Upper vermilion angle	Angle between Cupid bow, oral commissure, and Stms
34	Lower vermilion angle	Angle between LL, oral commissure, and Stmi
35	Inter-endocanthal width	The horizontal distance between the right and left endocanthi

and facial width (tragus $[T]_{Rt}-T_{Lt}$)/TFH.

The photographs of 10 participants were redigitized and measured at least 2 weeks after the first evaluation. The intraclass correlation coefficient (ICC) was used to assess the reliability of measurements. All measurements showed an ICC of > 0.9.

Statistical analysis

All statistical analyses were performed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA). A normal distribution was confirmed using the Shapiro-Wilk test, kurtosis, and skewness. Only the pronasal−true vertical line (TVL) distance did not exhibit a normal distribution, and it was consequently evaluated using the Mann-Whitney U test. A paired *t*-test was performed to compare the right and left sides within each group. For comparisons between the Miss Korea and control groups, multivariate analysis of variance (MANOVA) was used.

RESULTS

Comparisons of paired variables showed no significant differences between the right and left sides within both groups (Table 2). Therefore, for each of those variables, the mean of the values obtained for either side was used for comparison between groups.

Multivariate analysis showed a significant main effect of group ($p < 0.001$) on the comparison. Univariate analysis showed that the Miss Korea group had a significantly greater facial height (N−Me), TFH (Tr−Me), facial width ($T_{Rt}-T_{Lt}$), facial depth (T−TVL), and Tr−N/TFH and smaller Sn−Me/TFH and facial width/TFH ratios compared with those in the control group (Table 3).

Furthermore, the forehead height was greater in the Miss Korea group than in the control group, although there were no differences in the amount of protrusion of the forehead from the TVL and frontonasal angle between the two groups. The intercanthal and interpupillary widths were smaller in the control group than in the Miss Korea group (Table 3).

The nasal width was not significantly different between groups; however, the nasal height and length were greater in the Miss Korea group than in the control group, whereas the amount of nasal protrusion and nasal angle were significantly smaller (Table 3).

The mouth width, upper vermilion height, and Cupid bow angle were greater in the Miss Korea group than in the control group, while the amount of lower lip

Table 2. Comparison of facial dimensions between right and left sides within the Miss Korea and control groups

	Miss Korea			General population		
	Right	**Left**	***p*-value**	**Right**	**Left**	***p*-value**
Inter-canthus width (mm)	7.77 ± 0.72	7.83 ± 0.69	0.126	6.93 ± 0.75	7.01 ± 0.80	0.101
Cupid bow height (mm)	2.41 ± 0.40	2.37 ± 0.38	0.124	2.34 ± 0.45	2.33 ± 0.45	0.773
Cupid bow angle (°)	132.79 ± 11.11	135.03 ± 11.33	0.076	127.57 ± 12.32	125.97 ± 13.45	0.379

Values are presented as mean ± standard deviation.
By paired *t*-test.

Table 3. Comparison of facial dimensions between the Miss Korea and control groups

	Miss Korea	General population	Difference	Significance
Total facial height (TFH)	53.23 ± 2.71	47.46 ± 3.79	5.78 (0.69)	<0.001
Facial height (N-Me)	31.50 ± 1.66	29.7 ± 2.23	1.8 (0.41)	<0.001
Upper & mid-face variables				
Upper facial height	21.67 ± 1.63	17.75 ± 2.32	3.92 (0.42)	<0.001
Mid–facial height	13.36 ± 0.93	11.86 ± 1.05	1.5 (0.21)	<0.001
Interpupilar width	17.77 ± 0.76	16.75 ± 0.89	1.02 (0.17)	<0.001
Intercanthal width	7.80 ± 0.69	6.97 ± 0.76	0.82 (0.15)	<0.001
Nasalwidth	10.31 ± 0.82	10.10 ± 0.73	0.21 (0.16)	0.207
Facial width at tragus	40.23 ± 2.46	38.63 ± 2.48	1.59 (0.52)	0.003
Nasallength	11.15 ± 1.02	10.23 ± 1.07	0.92 (0.22)	<0.001
Frontonasal angle	144.01 ± 8.28	143.07 ± 9.68	0.94 (1.90)	0.622
Nasal angle	26.62 ± 3.95	31.16 ± 4.15	−4.54 (0.85)	<0.001

Table 3. Contineud

	Miss Korea	General population	Difference	Significance
Lower-face variables				
Lower facial height (mm)	18.20 ± 1.13	17.84 ± 1.51	0.36 (0.28)	0.206
Upper lip height (mm)	6.10 ± 0.52	6.06 ± 0.69	0.04 (0.13)	0.751
Lower lip and chin height (mm)	12.32 ± 0.78	11.78 ± 1.01	0.55 (0.19)	0.005
Cupid bow height (mm)	2.39 ± 0.38	2.34 ± 0.44	0.05 (0.09)	0.532
Upper vermilion height (mm)	2.01 ± 0.28	1.84 ± 0.34	0.17 (0.07)	0.013
Lower vermilion height (mm)	3.23 ± 0.38	2.82 ± 0.52	0.41 (0.10)	<0.001
Inter–Cupid bow width (mm)	3.29 ± 0.42	3.26 ± 0.48	0.03 (0.10)	0.750
Mouth width (mm)	13.19 ± 1.14	12.66 ± 1.23	0.53 (0.25)	0.038
Facial width at mouth (mm)	32.36 ± 1.97	33.03 ± 2.61	–0.68 (0.49)	0.168
Forehead protrusion (mm)	1.07 ± 0.50	0.92 ± 0.50	0.15 (0.11)	0.150
Facial depth (mm)	27.23 ± 1.97	25.09 ± 2.11	2.14 (0.43)	<0.001
Nasal protrusion* (mm)	4.78 ± 0.78	5.21 ± 0.65	–0.43 (0.15)	0.001
Upper lip protrusion (mm)	1.37 ± 0.94	3.18 ± 0.92	–1.81 (0.20)	<0.001
Lower lip protrusion (mm)	0.19 ± 1.23	2.52 ± 1.12	–2.33 (0.25)	<0.001
Chin protrusion (mm)	–1.81 ± 1.51	0.97 ± 1.43	–2.78 (0.31)	<0.001
Cervical depth (mm)	14.89 ± 2.22	11.66 ± 2.17	3.23 (0.46)	<0.001
Nasolabial angle (°)	98.85 ± 11.68	98.11 ± 14.81	0.74 (2.81)	0.793
Cupid bow angle (°)	133.91 ± 10.42	126.77 ± 11.43	7.14 (2.30)	0.003
Central bow angle (°)	134.29 ± 11.84	130.28 ± 11.76	4.01 (2.49)	0.111
Upper vermilion angle (°)	31.33 ± 6.66	30.50 ± 8.48	0.83 (1.60)	0.605
Lower vermilion angle (°)	40.90 ± 7.95	36.95 ± 8.31	3.94 (1.71)	0.024
Mentolabial angle (°)	113.82 ± 15.29	131.01 ± 14.05	–17.19 (3.10)	<0.001
Cervical angle (°)	126.28 ± 17.67	142.28 ± 10.47	–16.00 (3.08)	<0.001
Upper lip vermilion area (mm^2)	21.36 ± 4.63	20.13 ± 5.19	1.23 (1.04)	0.239
Lower lip vermilion area (mm^2)	28.57 ± 4.70	23.86 ± 5.60	4.71 (1.09)	<0.001
Total lip vermilion area (mm^2)	49.93 ± 7.42	43.99 ± 10.15	5.94 (1.87)	0.002
Ratios				
Facial width/TFH	0.76 ± 0.03	0.82 ± 0.03	–0.06 (0.007)	<0.001
Sn–Me/TFH	0.34 ± 0.01	0.38 ± 0.02	–0.03 (0.004)	<0.001
Tr–N/TFH	0.41 ± 0.02	0.37 ± 0.03	0.03 (0.005)	<0.001
N–Sn/TFH	0.25 ± 0.01	0.25 ± 0.02	0.00 (0.003)	0.805

Values are presented as mean ± standard deviation or mean (standard error).
By multivariate analysis of variance (MANOVA).
*Mann-Whitney U test.

protrusion (UL−TVL) was smaller (Table 3).

The lower lip and chin height (Stmi−Me), lower vermilion height and angle, lower and total vermillion areas, and the amount of lower lip (LL−TVL) and chin (Pog−TVL) retrusion were greater, while the labiomental angle was smaller in the Miss Korea group than in the control group. The former also showed a smaller cervical angle and a deeper cervical point (cervical−TVL) compared with the latter (Table 3).

DISCUSSION

Facial appearance plays an essential psychosocial role, particularly in terms of self-esteem. An attractive face is associated with good health, fitness, social skills, and prosperity; therefore, it may be considered a key to a

successful life.[24] However, esthetic standards are subjective and usually influenced by the media and fashion trends, with a diverging gap between the media-defined ideals and reality.[25]

Norms for facial dimensions and esthetic preferences have been evaluated in several populations,[26,27] but there was no consensus among these studies. With fast-developing globalization ideologies, these trends are differently affected by different cultures. Currently, many patients are seeking medical help to improve their facial esthetics in response to media figures. Therefore, this study was designed to clarify the current differences in facial esthetics between common young adult women and the Miss Korea group through an evaluation of both frontal and lateral photographs.

Our results showed that the Miss Korea group had longer, wider, and deeper faces compared with the control group. Furthermore, the lower facial ratio (SN−Me/TFH) was smaller and the upper facial ratio and width (Tr−N/TFH and $T_{Rt}−L_{Lt}$) were greater for the women in the Miss Korea group, resulting in a more downward tapering of their faces than those of the general population group. Meanwhile, the faces of women in the control group were flatter and more square. These findings were somewhat contradictory to the findings of Ferrario et al.,[27] who reported shorter faces in the beauty group than in the control group, with no significant differences in the facial width and depth at the tragus between the two groups. They also reported a greater lower facial width in the beauty group.[27] However, the upper facial height was greater in the beauty group than in the control group, with no significant differences in the lower facial height between the two groups; these findings were consistent with ours.

Moreover, the Miss Korea group showed a greater nasal height and smaller nasal angle compared with the control group. In contrast, Ferrario et al.[27] showed a smaller nasal height in the beauty group and no significant difference in the nasal angle.

Several landmarks and dimension defined in the study by Ferrario et al.[27] were modified from conventional medical anthropometry, although they identified the landmarks directly on the subject's faces using palpation before imaging. On the other hand, in our study, the landmarks and definitions were modified because the digitization process was performed after imaging, making it impossible to identify some landmarks such as the gonion through palpation. Despite this disadvantage, the digitization of images is a faster and more comfortable process with an easy learning curve.

The Miss Korea group had a greater eye width compared with those in the control group. This finding was consistent with that of Sforza et al.,[28] who reported greater eye widths in beauty groups than in normal groups of both men and women.

Although the lower lip and chin height was significantly greater in the Miss Korea group, while the upper lip height was not significantly different between groups, the lower third of the face can be divided into a third for the upper lip and two-thirds for the lower lip and chin in both groups. A previous study showed this ratio to be 30% and 70%, respectively, and considered it to be a historically lasting canon.[29] However, this difference, in addition to racial factors, could be due to differences in the landmarks used to define the lower border of the chin (i.e., menton in our study and gnathion in the previous study).

The necks of the women in the Miss Korea group were farther from the TVL and made a smaller angle with the chin compared with those of the control group. This may partially support the perception of Salehi et al.,[16] who showed that the anteroposterior position of the neck affects the esthetics of the sagittal jaw relationship. They reported that patients with Class I malocclusion showed the best esthetics with normal or retruded necks, while those with Class III malocclusion showed the best esthetics with protruded necks.

A previous study including Miss Korea contestants in the late 80s demonstrated that they had a greater nasolabial angle (105.0°) compared with women from the general Korean population and Caucasian women.[17] They also had a less prominent nose, more prominent lips, and a deeper sulcus.

Interestingly, our study showed that a less prominent nose and an accentuated mentolabial sulcus are considered to be signs of beauty in the Korean society. However, the nasolabial angle in the Miss Korea group (98.9°) in our study was not significantly different from that in the control group. In addition, the lips of women in the Miss Korea group were more retruded (UL−TVL and LL−TVL) than those of the control group and those observed in the previous study.[17] This may be considered a manifestation of the increasing effects of the Western mass media on the perception of beauty in the current Korean society.

Our results support the notion of a continuous change in esthetic standards over time. It may be interesting to conduct a lateral cephalometric analysis of a current beauty pageant sample to assess the changes in skeletal traits. However, similar to the situation in a previous study,[28] the women in the Miss Korea group preferred not to disclose their surgical history. Not only did they refuse to undergo lateral cephalometry, they also declined to answer questions about previous plastic or orthognathic surgeries. Nonetheless, this was not significant because they represented beauty standards of the current Korean society, even if the surgical correction was in the interendocanthal width which affects all the

other variables. Therefore, whether they met the beauty standards naturally or through surgical enhancement was inconsequential.

Kang et al.[10] compared facial dimensions measured on frontal views between models and women from the general population and showed that the models had fuller lower and thinner upper vermilion areas. Our study also demonstrated that the lower lip vermilion height, angle, and area were greater in the Miss Korea group than in the control group. However, there were no significant differences in the upper lip vermilion angle and area between the two groups. Moreover, as opposed to the findings of Kang et al.,[10] there was no significant difference between groups in the central bow angle, while the Miss Korea group showed a greater Cupid bow angle.

Generally, full and rounded lips are considered more attractive and give a more youthful appearance.[30,31] Park and Hwang[6] reported an increase in the nasolabial angle and philtrum length and a decrease in the vermilion length and lip width after anterior segment osteotomy. Cha et al.[32] suggested that the values in some post-treatment records for the general population approached the esthetic standards for models. Therefore, it is important to pay extra attention to the frontal facial features, particularly those in the lower facial region, while planning orthodontic or orthognathic treatment.

In our study, the Miss Korea and control groups wore no make-up to allow more accurate evaluation of the landmarks. In addition, evaluations were made by measuring linear dimensions divided by the inter-endocanthal width to provide standardized results.[9] It may be important to consider proportions as well as absolute values when comparing different groups. In addition, differences in linear dimensions, particularly vertical dimensions, may be attributed to differences in body height. However, this aspect was not considered in this study. However, a recent study reported no significant correlations between body height and oro-facial measurements, including facial and lip heights and ratios, in women.[33]

Further studies using three-dimensional stereophoto-grammetry are recommended to evaluate differences in esthetics between individuals with a preferred facial appearance and those from the general population to provide more detailed esthetic norms. Furthermore, a comparison of facial esthetics between different ethnic groups may shed light on cultural differences between societies.

CONCLUSION

- The women in the Miss Korea group had longer, wider, and deeper faces compared with those in the control group, with more downward tapering of faces in the former than in the latter, who showed flatter and more square faces.
- The women in the Miss Korea group had larger eyes, longer but less protruded noses, less protruded upper lips, longer and more retruded lower lips and chins, greater lip vermilion areas, and smaller labio-mental angles.

These findings suggest the necessity to consider the latest trends in facial esthetics during diagnosis and treatment planning for young adult women with dento-facial abnormalities.

ACKNOWLEDGEMENTS

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