A Validated Assessment Scale for Asian Chin Projection

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BACKGROUND As the number of different aesthetic treatments increase, numerous photonumeric assessment scales have been developed and validated to measure the effectiveness of these new treatments and techniques. Photonumeric rating scales have been developed to objectively assess improvements in anatomical areas; however, these have been based on the features of Caucasian patients.

OBJECTIVE To develop and validate a Chin Projection Scale for use in the female Asian patient population.

METHODS AND MATERIALS During 2 validation sessions, 13 raters assessed full frontal and lateral facial views of 50 Asian subjects and also estimated their age and the aesthetic treatment effort required for each subject. Chin projection was rated on a scale from 0 (optimal) to 4 (very severely receding).

RESULTS Inter-rater reliability was 0.80 (substantial) for Validation Session 1 and 0.83 (almost perfect) for Validation Session 2. The results for Estimated Age and Estimated Treatment Effort were essentially the same.

CONCLUSION This study demonstrated the validity of the first photonumeric assessment scale for assessing the appearance of the female Asian chin. This new scale will provide a standardized measure of chin projection for Asian patients in clinical practice and clinical research settings.

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The number of aesthetic treatments available for improving the appearance of aging skin and various anatomical structures has greatly increased their popularity. These include toxins, fillers, and a variety of energy-based treatments. As the number of different types of treatments grow, an increasing number of assessment scales have been created and validated to measure the effectiveness of different aesthetic treatments and techniques. To date, photonumeric rating scales have been developed to objectively assess improvements in age-related changes in the upper face,[1] midface,[2] lower face,[3] global face,[4] platysma,[5] neck volume,[6] and décolleté.[7] These scales can be used alone to evaluate changes in specific areas or in combination to assess more global changes in appearance.

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Because of differences in morphology and the signs and rates of aging,[8–11] Asian patients may seek different aesthetic treatments than their Caucasian counterparts. For example, an Asian chin that is long or has a square contour is considered unattractive.[12–14] Similarly, a short or receding chin is also undesirable.[15] A long jaw may be treated with reduction genioplasty or chin retrusion,[10,12] whereas a short chin may be treated with augmentation genioplasty using bone grafts or other implants.[15–17]

Recent clinical trials involving Asian subjects have measured cosmetic changes using a variety of assessment scales including the Assessment of Aesthetic Improvement Scale,[18] Global Aesthetic Improvement Scale,[19–23] Wrinkle Severity Scale,[20,24] and Vancouver Scar Scale;[25] however, none of these scales were specifically developed for Asian patients. The following study was performed to develop and validate the first Chin Projection Scale specifically for use in the Asian patient population.

Methods

Subject Selection

Recruited subjects were Asian women 18 to 39 years old with all degrees of anterior chin contour from very flat chin to very optimal chin projection. An emphasis was placed on recruiting subjects from South Korea, China, and Japan. Subjects with scarring, skin disease, irregular skin tone, or tattoos in the target area were excluded. Each subject provided informed consent before participation. Demographic information and baseline characteristics were collected, and risk factors were assessed before enrollment.

Standardized Photography

Two-dimensional color photographs were obtained using professional, high-resolution photography equipment. Subjects were photographed in highly standardized positions and always with the same angles and standardized background and lighting conditions. Jewelry and decorative eye cosmetics were removed, and long hair was fixed with a hair ribbon to allow for a clear representation of the face. Photographs were taken from frontal and lateral views. Raw image files were converted to high-resolution JPEG files for use in the photo database.

Scale Creation

The process of scale creation generally followed the method described elsewhere for creating other Merz Aesthetic Scales.[1–6] Briefly, subjects were screened by an experienced medical team, and one subject was selected whose image was representative of general chin appearance. Additional images were then selected from the photographic database to superimpose varying degrees of chin appearance onto the base image to create composite computer-generated images for the chin scale (Figure 1). Photographs of subjects used as base images were not used again in the scale validation process. Each image was rated on a scale ranging from 0 (optimal) to 4 (very severely receding).

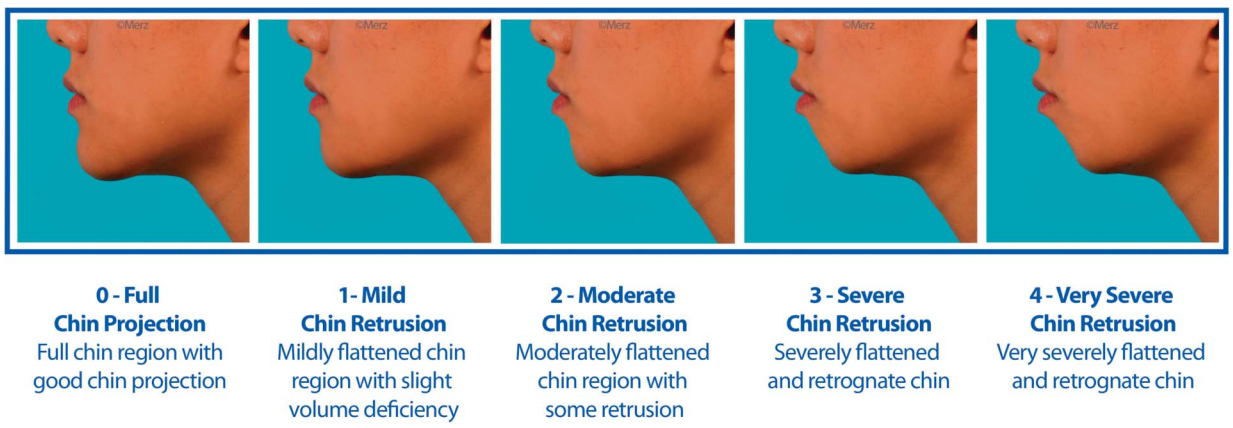

Figure 1. Five-point dynamic Chin Projection photonumeric assessment scale.

Procedure

Dermatologists, plastic surgeons, and other physicians with experience in aesthetic medicine were asked to participate as raters during 2 validation sessions performed 4 weeks apart. During each session, raters were provided with booklets containing images of 50 subjects. For each subject, the first page showed a full frontal face view, and the second page showed a lateral view including the chin. Raters were asked to assess the degree of chin projection, estimate the effort of aesthetic treatment required for each subject, and also their age. Raters generally completed their booklets at home and were blinded with respect any subject identifiers, characteristics, and randomization sequences. A different subject randomization sequence was issued for each validation session.

TABLE 1. Subject Demographics and Baseline Characteristics

Mean age, yrs (SD)	27.0 (4.0)
Median age, yrs (min–max)	26.5 (21–38)
Gender, *n* (%)	
Female	50 (100)
Mean BMI, kg/m^2 (SD)	21.0 (3.2)
Median BMI, kg/m^2 (min–max)	20.2 (16–33)
Race	
Asian	50 (100.0)
Country of origin	
China	10
Hong Kong	3
Korea	2
South Korea	4
Taiwan	2
USA	28
Vietnam	1
Ethnicity	
Chinese	30 (60.0)
Korean	6 (12.0)
South Korean	3 (6.0)
Taiwanese	5 (10.0)
Vietnamese	5 (10.0)
Korean/Vietnamese/Chinese	1 (2.0)
Smoker status	
Nonsmoker	45 (90.0)
Past smoker	5 (10.0)
Mean life-years smoking (SD)	4.2 (4.7)
Median life-years smoking (min–max)	2 (1–12)
Sunlight exposure, *n* (%)	
Never	0
Rarely	8 (16.0)
Sometimes	27 (54.0)
Often	15 (30.0)
Very often	0
Fitzpatrick skin type, *n* (%)	
I	1 (2.0)
II	12 (24.0)
III	22 (44.0)
IV	14 (28.0)
V	1 (2.0)

BMI, body mass index.

TABLE 2. Chin Projection Scale Ratings by Validation Session

Scale Score, n *(%)*	*Session 1, (*n *= 650)*	*Session 2, (*n *= 650)*
0, Optimal	135 (20.8)	150 (23.1)
1, Mild	219 (33.7)	247 (38.0)
2, Moderate	151 (23.2)	123 (18.9)
3, Severe	108 (16.6)	97 (14.9)
4, Very severe	37 (5.7)	32 (4.9)
Missing	0	1 (0.2)

Statistical Analysis

Categorical data were described by their absolute and relative frequencies. Scale ratings (range, 0–4) and metric data were summarized by total number (*n*), arithmetic mean, SD, 25% quantile, median, 75% quantile, minimum, and maximum. Validation session and rater, subject, sex, and ethnicity were summarized. Estimated effort of aesthetic treatment was summarized with absolute and relative frequencies by subject and validation session. Estimated effort of aesthetic treatment and Estimated Age was further summarized by *n*, arithmetic mean, SD, 25% quantile, median, 75% quantile, minimum, and maximum by subject and validation session.

Reliability between raters (inter-rater reliability) was assessed by using the intraclass correlation coefficient with 2-way random single measures (ICC 2,1) of Shrout and Fleiss[26] and the Kappa values using Fleiss–Cohen weights.[27] The following ranges of ICC 2,1 were used for interpretation of results, with "substantial" regarded as minimum score to achieve:[28,29]

- 0.00 to 0.20, slight;
- 0.21 to 0.40, fair;
- 0.41 to 0.60, moderate;
- 0.61 to 0.80, substantial;
- ≥0.81, almost perfect.

Reliability between the first and second validation ratings (intra-rater reliability) was also evaluated using the weighted ICC 2,1. The statistics were calculated for each rater and were pooled. For the pooled ICC 2,1, the 2 identifiers for subject and rater were first combined into one single subject-rater identifier. The intra-rater ICC 2,1 was then calculated as the ratio of the between-subject-rater variance and the total variance. The same ICC 2,1 ranges were used for interpreting the results.

To determine validity of the assessment scales, correlations between the scale scores and subject demographic variables were performed (Pearson and Spearman correlation) using data from the first validation session. The first session was preferred because it reflects an initial unbiased use of the scale. For interpretation of the Pearson and Spearman coefficients, a mean coefficient >0.6 was considered high.

In addition, a mixed-effect regression model for the scale and additional question as dependent variables and subject demographic variables as possible

TABLE 3. Chin Projection Scale Ratings by Validation Session

Session	*Statistic*	*Chin Projection Validation Scale*
1, *N* = 650	Mean (SD)	1.53 (1.16)
	Median (min–max)	1.0 (0–4)
	Q25–Q75	1.0–2.0
2, *N* = 649	Mean (SD)	1.41 (1.14)
	Median (min–max)	1.0 (0–4)
	Q25–Q75	1.0–2.0

TABLE 4. Estimated Effort of Aesthetic Treatment and Estimated Age

Session	*Statistic*	*Aesthetic Treatment Effort*	*Estimated Age*
1, *N* = 650	Mean (SD)	4.31 (2.29)*	28.67 (5.84)
	Median (min–max)	4.0 (0–10)	28.0 (16–50)
	Q25–Q75	3.0–6.0	25.0–33.0
2, *N* = 650	Mean (SD)	4.26 (2.18)†	30.17 (5.51)*
	Median (min–max)	4.0 (0–10)	30.0 (16–48)
	Q25–Q75	3.0, 6.0	26.0, 34.0

*n = 645.
†n = 644.

predictors were implemented. Subject and rater were considered as random effects and all other possible predictors as fixed effects. Model selection was based on stepwise backward selection with a *p*-value of 0.3 required for a variable to stay in the model.

Results

The raters consisted of a panel of male (*n* = 7) and female (*n* = 6) individuals who were dermatologists (*n* = 9), plastic surgeons (*n* = 2), and other physicians (*n* = 2). There were 650 planned ratings (13 raters × 50 subjects) during each validation session. All 50 subjects were female with a mean (SD) age of 27.0 (4.0) years (range, 21–38 years). Demographic information and baseline characteristics are shown in Table 1. One missing rating occurred during Session 2.

Chin Projection Scale

The scale ratings range from 0 (full chin region with good chin projection) to 4 (very severely flattened and retrognathic chin) (Table 2). All grades were represented by the enrolled subjects. Most subjects were rated as Grades 0 to 2 in Session 1 (78.0%) and Session 2 (80.0%) while a much smaller proportion were rated as Grade 4 in Session 1 (5.7%) and Session 2 (4.9%). The overall mean (SD) rating was 1.53 (1.16) for the first session and 1.41 (1.14) for the second validation session (Table 3).

The mean ratings for estimated effort of aesthetic treatment were 4.31 (2.29) for Session 1 and 4.26 (2.18) for Session 2 (Table 4). The mean Estimated Age was 28.67 (5.84) years for Session 1 and 30.17 (5.51) years for Session 2 (Table 4). The actual mean age was 27.0 (4.0) years (range, 21–38 years).

Inter-rater Reliability

The ICC and weighted Kappa estimates for Inter-rater Reliability of the Chin Projection Scale for each validation session are presented in Table 5. Inter-rater

TABLE 5. Inter-rater Reliability by Validation Session

		Mean Weighted Kappa (CI)
	ICC (1,2)	*Fleiss–Cohen*
Validation Session 1		
Chin projection	0.80 (substantial)	0.80 (0.78–0.81)
Estimated age	0.27 (fair)	0.29 (0.26–0.33)
Estimated treatment effort	0.20 (slight)	0.20 (0.16–0.23)
Validation Session 2		
Chin projection	0.83 (almost perfect)	0.83 (0.82–0.84)
Estimated age	0.30 (fair)	0.34 (0.30–0.37)
Estimated treatment effort	0.15 (slight)	0.14 (0.08–0.19)

CI, confidence interval; ICC, intraclass correlation coefficient.

TABLE 6. Intra-rater Reliability: ICC 2,1 and Kappa Values for Chin Projection Scale

		Mean Weighted Kappa (CI)
Scale	*ICC 2,1*	*Fleiss–Cohen*
Chin projection	0.85 (almost perfect)	0.85 (0.82–0.88)
Estimated age	0.56 (moderate)	0.51 (0.39–0.63)
Estimated treatment effort	0.67 (substantial)	0.44 (0.27–0.60)

CI, confidence interval; ICC, intraclass correlation coefficient.

reliability based on ICC for Chin Projection was "substantial" and "almost perfect" in Sessions 1 and 2, respectively, with scores being ≥0.80. The inter-rater reliability for Estimated Age and Estimated Treatment Effort ranged from "Slight" to "Fair" for both sessions. Mean weighted Kappa values with Fleiss–Cohen weights showed the same results as the ICC values for inter-rater reliability for the Chin Projection. Estimated Age and Estimated Treatment Effort were essentially the same.

Intra-rater Reliability

The ICC and Kappa estimates for Intra-rater Reliability of the Chin Projection Scale and Estimated Age and Treatment Effort are presented in Table 6. Intra-rater reliability based on ICC was "almost perfect" for Chin Projection with scores of 0.85. The weighted Kappa values for Chin Projection and Estimated Age were nearly identical to their ICC values while the mean weighted Kappa values for Estimated Treatment

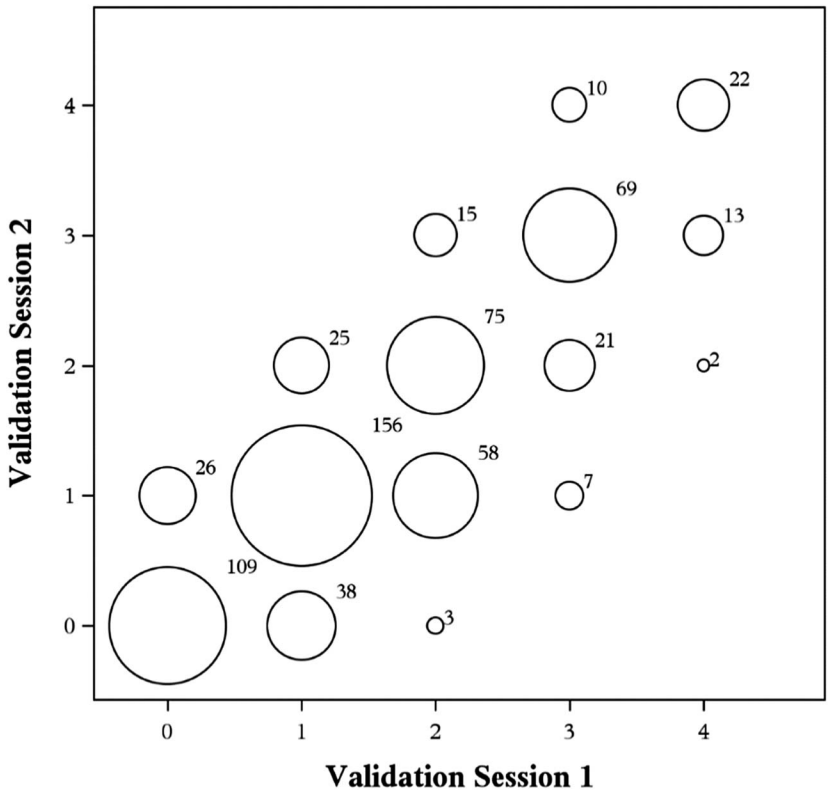

Figure 2. The bubble plot for Chin Projection Scale: First versus second validation session for all raters pooled. Bubble plot for rating combinations between the first and second validation cycles for the Chin Projection photonumeric assessment scale. The rating combinations between the Session 1 and Session 2 are plotted using proportional circles to represent the frequencies of rating combinations (13 raters × 50 subjects = 650 overall ratings). High reliability is evident if the bubbles are located along the diagonal line; hence, the plots illustrate high intra-rater reliability. Low reliability is evident if the bubbles are scattered randomly on the plot. The scale from 0 to 4 on both axes represents the severity grades of the scales.

TABLE 7. Spearman Correlation Coefficient for Chin Projection Scale

	Chin Projection	*Estimated Age*	*Estimated Treatment Effort*	*BMI*
Chin projection	1	—	—	—
Estimated age	0.01	1	—	—
Estimated treatment effort	0.43	0.04	1	—
Body mass index (BMI)	−0.15	0.20	0.03	1
Age	−0.09	0.40	0.06	0.54

Effort were considerably lower than the corresponding ICC value. The bubble plot visualizing the frequency of rating combinations of the first and second validation session is shown in Figure 2.

Scale Validity

Substantial Spearman correlations are presented in Table 7. The final regression model of the stepwise regression for the Chin Scale is shown in Table 8. Smoker Status was the only variable that showed a trend toward relatedness to the scale rating. There was no significant correlation between the estimated and actual age of the subjects and almost no correlation between age and the Estimated Treatment Effort within this relatively young population.

Discussion

Chin length and contour are important determinants for the attractiveness of the female Asian face,[12–15] and several techniques have been developed to reduce or enhance chin projection;[10,12,15–17] however, there has been no means for assessing aesthetic outcomes after corrective procedures. As most available scales are based on the appearance of Caucasian features, the objective of this study was to develop and validate a new Merz photonumeric scale for objectively assessing chin projection in Asian women and to validate it or use in clinical and research settings. This scale has been validated for use on facial photographs using standard photographic parameters. This scale is focused on Asian chin projection in general, but other factors may significantly influence aesthetically pleasant appearance of the chin such as submental fat, jawline, or frontal chin; width and skin quality represent different treatment and assessment concepts.

During the 2 validation sessions, most of the evaluated subjects (78%–80%) presented with Chin Projection Scale Ratings of Optimal to Moderate, although some (4.9%–5.7%) also presented with Very Severe Rating. Thus, subjects with a range of chin projection severity were represented.

Inter-rater agreement for the Chin Projection scale was substantial or almost perfect in the 2 sessions (ICC = 0.80 and 0.83) and which was also demonstrated by the bubble plots. Accordingly, intra-rater reliability was almost perfect with an ICC estimate of 0.85 across all raters. There was no significant correlation between the estimated and actual age of the subjects and almost no correlation between age and the Estimated Treatment Effort within this relatively young population (mean age of 27.0 years) as chin projection relates primarily to genetic factors and not age.

This 5-point scale is a reliable means for assessing Chin Projection. Similar to other aesthetic scales, which have been developed and validated for assessing changes in the appearance of the face,[1–4] neck,[5,6] chest[7]

TABLE 8. Final Model of Stepwise Mixed-Effects Regression for Chin Projection Scale

Covariate	*Category*	*Regression Coefficient*	p
Intercept	—	0.892	.063
Smoker status	Never	0.706	.157
	No, but in the past	0.000	—

and hands,[30] the Merz Chin Projection Scale will likely become a valuable aesthetic tool for treating the Asian population.

Conclusion

The aesthetic value of this new photonumeric assessment scale for evaluating chin projection severity in Asian subjects was demonstrated based on a very high degree of intra-rater and inter-rater reliability. This new assessment scale is another important addition to the range of validated aesthetic scales currently available for other anatomical areas and will provide a standardized measure of chin appearance for Asian patients in clinical practice and research settings.

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