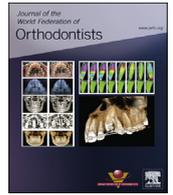




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Research Article

Esthetic perception of facial profile contour in patients with different facial profiles



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ABSTRACT

Background: Patients' perception is crucial for developing a treatment plan, one factor being facial profile. The aim of this study was to evaluate the influence of an individual's facial profile on his or her perception of attractiveness of another's facial profile.

Materials and methods: Photographs of one male and one female individual were modified by altering the facial contour angle (FCA) in 4° increments and shown to a group of 153 orthodontic patients divided into three groups (n = 51): Convex, FCA >13°, Straight, FCA 5°–13°, and Concave, FCA <5°, who scored the attractiveness of each image using a visual analog scale.

Results: All groups considered a normal or slightly convex profile as the most attractive, and an extremely concave profile as the least attractive. For male images, there was no significant difference between groups, except for the extremely convex profile, which was preferred by the convex group compared with the concave group. For female images, no significant difference was found between groups, except for the slightly convex profile. The concave group rated this profile higher compared with the convex group. Comparing within each group demonstrated that there were no significant differences between the slightly convex and the normal subgroups, as well as the extremely convex and the slightly concave subgroups, among the three groups.

Conclusions: All groups shared similar perception. The most and least attractive profiles were the normal and extremely concave profiles, respectively. Slightly convex profiles were recognized as attractive as normal profiles, whereas slightly concave and extremely convex profiles were equally unattractive.

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1. Introduction

The severity of skeletal and soft tissue disproportion is a crucial factor in the decision-making process in orthodontics. If the amount of disproportion is considerable, orthognathic surgery is always required; however, some patients are considered as borderline for surgical treatment. Therefore, treatment planning for these patients may be based on the patients' perception of esthetics.

Previous studies have evaluated facial esthetics in terms of profile convexity [1–3], anteroposterior position of the mandible

and maxilla [4–11], and anteroposterior position of the upper and lower lip [12,13]. The results of most studies suggested that the esthetic perceptions of people from different professional backgrounds were dissimilar. Clinicians are more sensitive in their judgment of facial profile, less tolerant of profile change, have a greater ability to discriminate profile changes, and are more sensitive to the profile outline compared with laypeople [1,4,11]. In addition, some studies found that the esthetic perception of orthognathic patients differed from laypeople. Orthognathic patients are more discriminating in their perception of their own profile and critical in assessing attractiveness based on facial profile convexity compared with laypeople [1,14]. This discrepancy may lead to a greater sensitivity in detecting different facial profiles.

Another factor affecting esthetic perception is ethnicity. Class II profiles are prevalent among European ethnicity, whereas Class III profiles are frequently found in Asian individuals [15]. Most studies have indicated that a Class II profile was considered less attractive than a Class III profile in Western countries [1,3,10,11]. Class II patients have a higher level of dissatisfaction with their appearance, motivation to receive orthodontic treatment, and are

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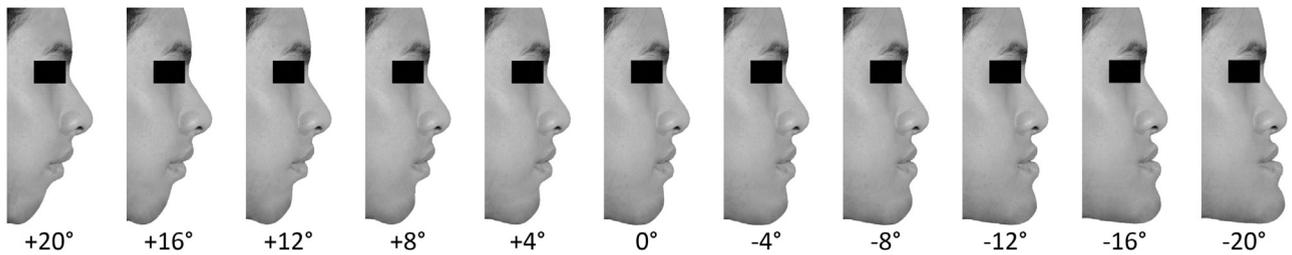


Fig. 1. Altered FCA of male images in 4° increments.

more likely to change their overall appearance compared with Class III patients [16].

In contrast to the perception among other ethnic groups, in Asian communities, a Class III profile with mandibular prognathism is considered the least attractive [2,5,7,9]. Patients with a Class III profile were considered as less attractive and tended to seek orthognathic surgery more often than those with a Class II profile [2].

Most of these studies found a relationship between ethnicity and esthetic perception of facial profile in laypeople. However, to the best of our knowledge, the influence of patients' facial profile on their perception of attractiveness remains unresolved. Therefore, the objective of this study was to evaluate the influence of an individual's facial profile on his or her perception of attractiveness of another's facial profile. The null hypothesis was that patients with different facial profiles have similar esthetic perception.

2. Material and methods

The study protocol was approved by the Human Research Ethics Committee of the Faculty of Dentistry, Chulalongkorn University (HREC-DCU 2018-009), Thailand. The sample size calculation was based on a previous study [5], using n4Studies (Version 1.4.1) using power of 0.80 with a significance level of $\alpha = 0.05$ and $\beta = 0.20$, indicating that 43 subjects were needed in each group.

The subjects were selected by purposive sampling. They were all Asian subjects. A total of 160 orthodontic patients in the Department of Orthodontics, Faculty of Dentistry, Chulalongkorn University, were asked to participate. Subjects who were dental professionals, younger than 16 years, with a history of facial trauma, orthognathic surgery, severe psychological issues, syndromic conditions, or serious medical conditions were excluded. Of the 160 participants, 7 (4%) were excluded because they did not complete the questionnaires. The remaining 153 participants were categorized into three groups ($n = 51$) based on their facial contour angles (FCAs): Convex, $>13^\circ$; Straight, 5° to 13° ; and Concave, $<5^\circ$, measured using Adobe Photoshop CS6 (Adobe Systems Inc., San Jose, CA).

2.1. Photo album

Photographs of a male and female individual with a Class I occlusion and normal soft tissue measurements [17] were taken in the right

nonsmiling profile view in the natural head position [18] using a digital SLR Camera with a 60-mm lens (D7000; Nikon Photo Products, Tokyo, Japan). The distance between the front of the lens and the subject was 2 m. The profile images were used to create 10 other images by altering the FCA in 4° increments from 0° to +20° and 0° to -20°, using the same software. In each image, the eyes and hair were concealed and the lips were changed, maintaining the relationship between the lip outline and subnasale–soft tissue pogonion line. The images were converted to black and white. The photo album consisted of one set each of male and female images, each set containing 11 images (Figs. 1 and 2). One image was shown per page and the pages were placed in random order in an album using Microsoft PowerPoint Presentation software (Microsoft, Redmond, WA).

2.2. Questionnaires

The participants were requested to review their own facial profile from the pretreatment photographs before taking the questionnaires. The first part of the questionnaires elicited the demographic data of the participants, such as age and sex, and the second part consisted of 100-point visual analog scale (VAS) used to rate the facial attractiveness and labeled at the left end (0) as "least attractive" and the right end (100) as "most attractive." The participants were asked to mark the VAS according to their perception and not to turn back to previous pages, and were allowed 60 s to rate each image.

To compare the scores within a given group, the rating scores were distributed into five subgroups: extremely convex: +20°, +16°; slightly convex: +12°, +8°; normal: +4°, 0°, -4°; slightly concave: -8°, -12°; and extremely concave: -16°, -20°, and then ranked from 1 (least attractive) to 5 (most attractive).

Ten percent (15) of the participants were asked to rate the images at least 4 weeks after the initial assessment to determine test-retest reliability. The FCA measurement was also repeated at least 4 weeks after the initial measurement to assess the intraexaminer reliability.

2.3. Statistical analysis

Statistical analysis was performed by using SPSS (Version 22.0.0.0; SPSS, IBM Corp., Chicago, IL), and intraclass correlation

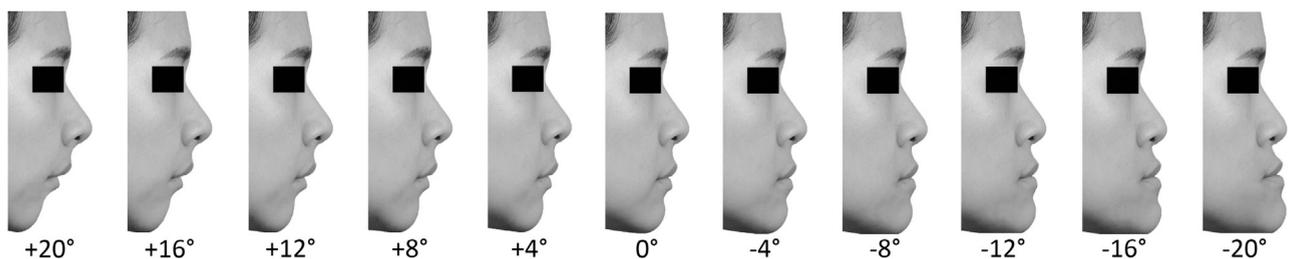


Fig. 2. Altered FCA of female images in 4° increments.

Table 1
Rating scores for male and female images

Deviation from normal FCA	Male		Female		P Value
	Median	IQR	Median	IQR	
+20°	23.1	4.7–39.2	13.4	0–31.7	0.01*
+16°	37.3	23.3–62.1	31.7	15.7–50.3	0.01*
+12°	50.2	30.3–68.0	50.6	35.6–74.7	0.23 NS
+8°	65.1	49.4–77.2	74.7	50.8–85.3	0.00*
+4°	76.9	55–91.2	77.8	64–95.7	0.10 NS
0°	76.9	59.6–90.1	77.2	64.3–95.2	0.36 NS
-4°	61.7	42.9–76.4	60.3	49.1–82.8	0.31 NS
-8°	38.1	23.8–50.8	50.0	25–64.8	0.00*
-12°	16.9	4.7–36.5	24.4	7.8–46.3	0.00*
-16°	8.4	0–23.8	10.1	0–23.9	0.49 NS
-20°	0.0	0–11.2	0.0	0–14.3	0.42 NS

IQR, Interquartile range; NS, not significant.

* $P < 0.05$, Mann-Whitney U test.

coefficients (ICC) were used to assess the test-retest and intra-examiner reliability of the participants and examiner. The Kolmogorov-Smirnov test indicated that the data were not normally distributed. The differences in scores between images within a group were evaluated using Friedman's test. The scores between groups were compared with the Kruskal-Wallis test. If there was significant difference between images or groups, Dunn's test was performed for pairwise comparisons. The tests were analyzed at a 0.05 significance level.

3. Results

The mean FCA of the male and female subjects was 9.6° and 10.5°, respectively. The demographic data of our study indicated that the number of male and female subjects and mean ages in each group were not significantly different. In contrast, a significant difference was found in the FCA between the groups. The mean FCA in the Convex, Straight, and Concave groups was 16.0, 8.49, and -0.66, respectively. The ICC for intraexaminer reliability was 0.99, which indicated excellent reliability. The ICC for test-retest reliability of the participants ranged from 0.67 to 0.95, which indicated moderate to excellent reliability [19].

There was no significant difference in the rating scores between male and female raters; therefore, the data for the male and female participants were combined and used for further analysis.

3.1. Images of male and female

The most attractive male and female images were 0° and +4°, respectively, whereas -20° was perceived as the least attractive

(Table 1). For the male images, +20° and +16° had higher scores compared with female images. In contrast, deviations from +12° to -20° were given higher scores for the female images compared with the male images. There were significant differences between the male and female image scores for +20°, +16°, +8°, -8°, and -12°. Male images with a convex profile were rated more attractive than convex female images. Conversely, female images with a concave profile were perceived as more attractive than concave male images.

3.2. Male images

For the three groups, +4° and 0° were perceived as the most attractive, whereas -20° was perceived as the least attractive. There was no significant difference between groups except for the rating scores for +20°. Pairwise comparisons indicated that the convex group gave this FCA a higher score compared with the concave group (Table 2).

For the analysis within a given group, there were no significant differences in any group between the slightly convex and normal subgroups and the extremely convex and slightly concave subgroups (Table 3).

3.3. Female images

All three groups rated +4° and 0° as the most attractive, whereas -20° was rated as the least attractive. No significant difference was found in images rating between groups except for +8°, which the concave group was rated higher compared with the convex group (Table 4).

Comparison within a given group indicated that no significant difference was found in the pairwise comparisons between the slightly convex and normal subgroup and the extremely convex and slightly concave subgroup for all groups (Table 5).

4. Discussion

The present study assessed the differences in the esthetic perception of profiles between patients with convex, straight, and concave profiles. Orthodontic patients older than 15 years were included in this study because their perceptions differ from those of laypeople [1,14,20]. Moreover, this generation is more attentive to their facial appearance and the need for orthodontic treatment compared with the younger age group [21]. The black-and-white photographs with concealed hair and eyes were manipulated in this study to remove the influence of other facial features and colors. In addition, a previous study suggested that photographs

Table 2
Comparison of rating scores of male images between groups

Deviation from normal FCA	Convex		Straight		Concave		P Value
	Median	IQR	Median	IQR	Median	IQR	
+20°	25.5	6.7–45.5	24.4	6.1–43.8	13.2	0–27.4	0.04*
+16°	34.5	23.8–50.9	37.9	15.4–64.6	38.7	23.3–59.6	0.98 NS
+12°	50.8	25.2–76.1	50.5	30.3–74.4	50.2	37.5–66.3	0.96 NS
+8°	67.4	49.7–76.4	56.7	49.4–77.2	74.7	44.7–85.9	0.42 NS
+4°	76.4	50.9–87.6	75.8	53.1–85.9	79.6	62.3–97.7	0.22 NS
0°	75.2	50.8–90.1	79.2	63.7–91.3	77.5	58.7–90.1	0.47 NS
-4°	50.7	31.1–69.9	62.6	48.8–76.2	64.0	47.7–82.3	0.07 NS
-8°	42.6	22.4–50.8	42.4	25.6–51.6	34.9	17.1–50.2	0.27 NS
-12°	12.0	3.3–34.2	20.2	8.9–39.6	16.0	0–32.9	0.27 NS
-16°	9.8	0–24.1	9.8	0–22.7	0.0	0–14.6	0.11 NS
-20°	1.9	0–14	0.0	0–12	0.0	0–8.4	0.24 NS

IQR, Interquartile range; NS, not significant.

* $P < 0.05$, Kruskal-Wallis test, Dunn's test for pairwise comparisons.

Table 3
Comparison of ranking scores of male images within group

Facial profile	Convex			Straight			Concave		
	Median	IQR	Result*	Median	IQR	Result*	Mean	SD	Result*
Extremely convex	3.00	2.0–3.0	B	2.00	2.0–3.0	B	3.00	2.0–3.0	B
Slightly convex	4.00	4.0–5.0	A	4.00	4.0–5.0	A	4.00	4.0–4.0	A
Normal	5.00	4.0–5.0	A	5.00	4.0–5.0	A	5.00	5.0–5.0	A
Slightly concave	2.00	2.0–3.0	B	3.00	2.0–3.0	B	2.00	2.0–3.0	B
Extremely concave	1.00	1.0–1.0	C	1.00	1.0–1.0	C	1.00	1.0–1.0	C

Friedman's test, Dunn's test for pairwise comparisons.

IQR, Interquartile range.

* Scores of the images with the same letter were not significantly different.

were more appropriate than silhouettes when evaluating soft tissue profile preferences [22]. Facial contour angle was used because it is significantly associated with the rating of attractiveness. As the degrees of convexity or concavity increase, the attractiveness rating decreases [1,2,4]. The participants were asked to review their own facial profiles before responding to the questionnaires to recognize their self-perception, because most people rarely see their faces in this view. Prior studies found that when pretreatment photographs were shown to patients, their profile self-awareness increased, leading to less disagreement between clinicians and patients [23,24]. The sequence in which the images were presented was randomized to reduce pattern recognition bias and to encourage the participants to pay close attention during the assessment.

VAS were used in this study because this method provides a continuous variable, reduces bias on the preferred value, and is simple, rapid, easily understood, and accepted by participants. In contrast, a VAS has a limitation in that the same score by different raters does not imply a similar perception. In doing that, some raters use only a portion of the scale in the assessment [6,25,26]. Thus, ranking scores were used in this study to overcome this problem. However, the highest or lowest ranking score does not imply whether the image is beautiful or not, it indicates only that it is the most or least attractive. Therefore, the present study analyzed the rating and ranking scores for comparing between groups and within a given group, respectively.

There were no significant differences in the rating scores between male and female participants, which is likely because they shared similar perceptions in their esthetic profile preferences. This result was in agreement with other studies that demonstrated no significant difference in the sex of the assessors when choosing preferred facial profiles [10–13]. In contrast, inconsistent results were found in a study in which the sex of the assessors had an effect on female profile preferences in a Turkish population [8]. Female raters preferred convex profiles with a retrognathic mandible,

whereas a concave profile with a prognathic mandible was favored by male raters. Because the raters in the present study were all Asian, the differences between our study and theirs are likely due to the heterogeneity in the ethnicity of the raters and the method for altering the images.

In comparing male and female images, male +20° and +16° images were given higher scores compared with the respective female images. These results suggest that the extreme convex profiles were more acceptable to male than to female individuals. The findings coincide with that of a previous study that demonstrated that male profiles with feminine facial features were perceived as attractive by laypeople [5]. In addition, female individuals with slightly convex (+8°) and slightly concave profiles (−8° and −12°) received higher scores compared with male individuals. However, these findings are in disagreement with some studies that indicated that a straighter profile with a more prominent chin was preferred by male individuals [1,3]. The divergent results in this aspect is an interesting finding and should be examined in a future study to achieve more appropriate treatment planning.

For male images, there were no significant differences between groups except for the rating scores for +20°. These results revealed that an extremely convex profile was considered more attractive in participants who had a convex profile compared with a concave profile. Convex profile groups are likely to be more tolerant of this appearance than concave profile groups. This result was not in agreement with a previous study that found that Class II patients had a higher level of dissatisfaction with their appearance compared with Class III patients [16]. The disagreement in the results might be related to ethnic and social differences in profile preference; however, additional studies are required to confirm these findings.

Regarding the female images, a significant difference between groups was found only in the rating scores for +8°. The participants

Table 4
Comparison of rating scores of female images between groups

Deviation from normal FCA	Convex		Straight		Concave		P Value
	Median	IQR	Median	IQR	Median	IQR	
+20°	12.6	0–31.7	15.9	0–34.2	12.6	0–27.2	0.98 NS
+16°	27.2	10.6–50.5	31.7	20.3–48.3	44.1	17.4–62.6	0.45 NS
+12°	52.8	37.6–76.1	49.5	28–63.2	50.8	35.1–79.4	0.25 NS
+8°	62.0	46.3–79.2	75.0	51.2–83.4	78.6	58.6–93.2	0.02*
+4°	76.4	58.7–87.9	77.8	67.3–93.2	83.1	67.9–100	0.11 NS
0°	76.8	63.4–92.4	75.8	53.6–95	78.4	69.3–100	0.24 NS
−4°	54.2	49.7–85.6	62.6	49.1–82.8	64.6	45.2–85.4	0.79 NS
−8°	48.8	23.8–61.7	50.0	34.5–64.8	50.3	25.5–66.5	0.44 NS
−12°	24.4	3.9–40.1	23.0	12.4–41.8	24.4	0.8–46.9	0.99 NS
−16°	5.3	0–24.4	13.8	3.3–23.8	6.4	0–24.1	0.23 NS
−20°	1.4	0–16.2	1.9	0–16	0.0	0–10.3	0.19 NS

IQR, Interquartile range; NS, not significant.

* $P < 0.05$, Kruskal-Wallis test, Dunn's test for pairwise comparisons.

Table 5
Comparison of ranking scores of female images within group

Facial profile	Convex			Straight			Concave		
	Median	IQR	Result*	Median	IQR	Result*	Median	IQR	Result*
Extremely convex	2.00	2.0–3.0	B	2.00	2.0–3.0	B	2.00	2.0–3.0	B
Slightly convex	4.00	3.0–4.0	A	4.00	4.0–4.0	A	4.00	3.0–5.0	A
Normal	5.00	4.0–5.0	A	5.00	5.0–5.0	A	5.00	4.0–5.0	A
Slightly concave	3.00	2.0–3.0	B	3.00	2.0–3.0	B	3.00	2.0–4.0	B
Extremely concave	1.00	1.0–1.0	C	1.00	1.0–1.0	C	1.00	1.0–1.0	C

Friedman's test, Dunn's test for pairwise comparisons.

IQR, interquartile range.

* Scores of the images with the same letter were not significantly different.

with a concave profile considered a slightly convex profile to be more attractive compared with the participants with a convex profile. These results coincided with those of a previous study that reported a female individual with a slightly more retruded chin was the most attractive profile among Japanese orthodontists and dental students [2].

Comparison within each group for the male and female images revealed that the participants with different facial profiles had similar esthetic perceptions. A normal profile was the most attractive and an extremely concave profile was the least attractive. The ranking scores between the slightly convex and the normal subgroup, as well as the extremely convex and the slightly concave subgroup, were not significantly different. This implies that slightly convex was recognized as attractive as normal profiles, whereas slightly concave and extremely convex profiles were equally unattractive. These findings correspond with most studies that reported that a Class III profile with mandibular prognathism was the least attractive profile [2,5,7,9], whereas a Class II profile was more favored than a Class III profile in Asian individuals [2,9]. The difference between Asian and Caucasian subjects' perception is likely related to their facial morphology. A study investigating the facial morphologies of Asian and Caucasian patients found that Caucasian faces had more protrusion of the glabella, nasion, and rhinion compared with Asian faces [27]. These features may harmonize with a prognathic mandible and prominent chin in the lower face, but do not fit with a retruded chin. In contrast, less protrusion of these structures, which was found in Asian individuals, may conform to less prominent chin but not with a protruded mandible.

We also found that the rating scores of almost all the images of $+12^\circ$ to $+20^\circ$ and -8° to -20° were below 50. These profiles are likely the threshold of acceptability; thus, it can be assumed that patients with an FCA of more than 12° or less than -8° from normal were considered as unattractive. Treatment planning for these patients might require more complex analysis compared with less deviated individuals. For example, if a patient has an FCA less than -8° and cannot make the decision, the results indicated that more complex treatment should be performed. Orthodontic camouflage may not satisfy this patient, thus orthognathic surgery should be considered. However, the perception of an attractive facial profile remains individually subjective. Understanding a patient's perception will lead to a successful and positive outcome. Therefore, effective communication between clinicians and patients is crucial for optimal treatment planning.

The limitation of this study was that all the participants were Asian. Previous studies indicated that esthetic profile perception is affected by ethnicity. Another limitation is the number of individuals analyzed, one subject in each sex may be not enough because they do not represent the other facial types (e.g., brachy-facial and dolichofacial type). Future studies should investigate profile perception among patients with different profiles in other races and using the subjects with different facial types.

5. Conclusions

Based on the results of this study, the participants with a convex, straight, or concave profile had similar facial profile preferences. The participants considered a normal or slightly convex profile as the most attractive, and an extremely concave profile as the least attractive. Individuals with a convex profile were more tolerant of male individuals with an extremely convex profile compared with those with a concave profile, whereas female individuals with a slightly convex profile were recognized as more attractive by the concave group compared with the convex group. This perception may be affected by the influence of media and social and culture norms. The results of this study could aid clinicians and patients in the treatment planning process.

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