The Difference of Three-dimensional Perception of Mandibular Prominence between Males and Females

ความแตกต่างของการรับรู้ความยื่นของขากรรไกรล่างระหว่างเพศชายและเพศหญิง เมื่อประเมินด้วยภาพใบหน้าสามมิติ

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ABSTRACT

The aim of this study was to compare perception of mandibular prominence between males and females using three-dimensional (3D) facial models. 3D images of one male and one female with different mandibular positions (21°,17°, 13°, 9°, 5°, 1° and -3° FCA) in video formats were presented to 85 male and 85 female participants. Male images with 5° and 9° FCA were ranked most attractive by male participants and female participants evaluated male images with 5°, 9° and 13° FCA most attractive. Male participants significantly preferred female image with 9° FCA to 17° FCA while the significant difference between these two images was not found in female participants. Prognathism was more tolerated by males whereas retrognathism was more acceptable by females.

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อเปรียบเทียบการรับรู้ความยื่นของขากรรไกรล่างระหว่างเพศชายและเพศหญิงจากภาพใบหน้าสามมิติ โดยให้บุคคลทั่วไป เพศชาย 85 คน เพศหญิง 85 คน ประเมินภาพใบหน้าสามมิติที่มีค่ามุมเฟเชียลคอนทัวร์ที่แตกต่างกัน (21,17, 13, 9, 5, 1 และ -3 องศา) การศึกษานี้พบว่า ผู้ประเมินเพศชายให้คะแนนความสวยงามใบหน้าเพศชายที่มีค่ามุมเฟเชียลคอนทัวร์ 5 และ 9 องศา ในอันดับสูงสุด และผู้ประเมินเพศหญิงให้คะแนนความสวยงามใบหน้าเพศชายที่มีค่ามุมเฟเชียลคอนทัวร์ 5, 9 และ 13 องศา ในอันดับสูงสุด ผู้ประเมินเพศชายให้คะแนนใบหน้าเพศหญิงที่มีค่ามุมเฟเชียลคอนทัวร์ 9 องศามากกว่า 17 องศาอย่างมีนัยสำคัญทางสถิติ โดยไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างสองภาพนี้ในผู้ประเมินเพศหญิง จึงสรุปว่า เพศชายสามารถยอมรับตำแหน่งขากรรไกรล่างยื่นได้มากกว่า ในขณะที่เพศหญิงสามารถยอมรับตำแหน่งขากรรไกรล่างถอยหลังได้มากกว่า

Keywords: Esthetic perception, Facial contour angle, Three-dimensional facial images
คำสำคัญ: การรับรู้ความสวยงาม ค่ามุมเฟเชียลคอนทัวร์ ภาพใบหน้าสามมิติ

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Introduction

Facial esthetics is increasingly important in modern society. Numerous studies reported that physical attractiveness was associated with psychosocial well-being (Hamermesh and Abrevaya, 2013). Consequently, one of the major issues for patients seeking for orthodontic treatment was the desire to improve dental and facial appearance (Soh et al., 2007; Maple et al., 2005). Esthetics was also important for orthodontists as it was a part of orthodontic treatment goals (Wilmot et al., 1993). To achieve successful treatment outcome, understanding of patient's esthetic perception was very crucial (Maple et al., 2005). Perceived facial attractiveness by non-professional people has been investigated by numbers of orthodontic studies. (Maple et al., 2005; Gautam et al., 2013; Mantzikos, 1998; Pişiren et al., 2018; Türkkahraman and Gökalp, 2004)

The anteroposterior position of the mandible was indeed related to facial attractiveness. Previous studies found that in case of a greater degree of facial convexity or concavity, facial preference was less and orthognathic surgery was more needed (Pişiren et al., 2018; Naini et al., 2012; Naini et al., 2012).

To investigate the preference of mandibular position, various types of 2D images were used in previous studies such as silhouette (Naini et al., 2011), black-and-white facial images (Jovic et al., 2016), and colored facial images. The main drawback of 2D illustrations was the limitation in realistic perception (Choi et al., 2017). Recently, 3D models were more used in esthetic perception studies. Choi et al. (2017) generated 3D facial images aimed to study the preference of mandibular position. The included participants in their study were dental students whose their esthetic concepts might be influenced by dental training (Tufekci et al., 2008). Therefore, the knowledge of preferred mandibular position by layperson using 3D technique remains unclear.

The background of the observers such as observer genders, ages, education levels or occupations could affect the preference of mandibular position. The influence of observer gender on preferred mandibular position has been reported in many studies. Several studies revealed that male and female shared the similar perception of esthetic perception (Naini et al., 2012; Oliveira et al., 2015). In contrast, some studies found the disagreement between these groups (Türkkahraman and Gökalp, 2004; Yin et al., 2014). The effect of observer genders on facial preference therefore was the controversial topic in orthodontic literatures.

Objectives of the study

This study aimed to investigate the preferred mandibular position assessed by male and female laypeople using 3D images.

Methodology

Ethical approval was obtained from the human research ethics committee of the Faculty of Dentistry, Chulalongkorn university, Bangkok, Thailand.

Participants

The following inclusion criteria for participants in this study were

- Adult Thai people who was in 18-45 years of age
- Living in Bangkok and Metropolitan area for more than 2 years
- Graduated at least at high school level

Individuals with a history of facial trauma, history of orthognathic surgery, severe psychological issues, conditions with syndromes, serious medical conditions, and dental professionals were excluded.

3D images generation

3D facial images were generated from 2D photos of the subjects who were Thai male and female with Class I skeletal pattern, harmonious facial profile, mesofacial type, middle to lower third ratio close to 1:1 and no previous plastic surgery. Five sets of 2D photos from each subject which consisted of frontal view, left and right lateral views and left and right oblique views were taken by Olympus OM-D E-M10 Mark II camera. These photos were converted into black and white pattern and finally were processed into 3D facial images by Zbrush 4r8 program.

The ideal mandibular position was set at 9° of facial contour angle (FCA) by Zbrush 4r8 program based on Thai norm (Sorathesn, 1988). This angle is formed by line connecting glabella; the most prominent point of the forehead to subnasale; the point where nasal septum and upper lip skin meet and line connecting subnasale to pogonion; the most prominent point of the soft tissue of the chin (Legan, Burstone, 1980). After that, the position of the pogonion was altered antero-posteriorly from ideal without changing vertical proportion by Zbrush 4r8 program. From each ideal 3D male and female image, pogonion was sequentially advanced to stepwise decrease FCA in 4 degrees, until it reached -3 degrees. Similarly, pogonion was retruded to stepwise increase the FCA in 4 degrees, until it reached 21 degrees. Therefore, 7 altered mandibular positions were obtained; 1 with an ideal mandibular position, 3 simulating mandibular protrusion, and 3 simulating mandibular retrusion. One image of each male and female set was selected randomly to be a duplicated 3D image to evaluate intra-examiner reliability.

All black-and-white 3D images were presented to the participants in video formats, which showed 180 degrees of subjects' faces from right lateral view to left lateral view. The videos were presented starting from male images and in random order by the software application of Microsoft PowerPoint®. The images used in the study were shown in Figures 1 and 2. Each observer was seated in an undisturbed room in front of the same laptop with 14 inches flat screen monitor.

Questionnaires

Participants were given a period of 90 seconds for evaluate of each 3D image. They were asked to score their perceived attractiveness by marking a position along 100-mm visual analog scales. The

left end of scales represented the least perceived attractiveness, and the right end represented the most perceived attractiveness. They were not permitted to go back to previous images that they had already scored.

Statistical analysis

Statistical analyses were performed by using SPSS (Version 500.0, SPSS, Chicago, Ill). The reliability of participants was analyzed by intraclass correlation coefficients. Data was not in normal distribution were evaluated with Kolmogorov-Smirnov test. The differences in scoring within images set were evaluated by Friedman test and Wilcoxon Signed rank test for pair-wise comparisons.

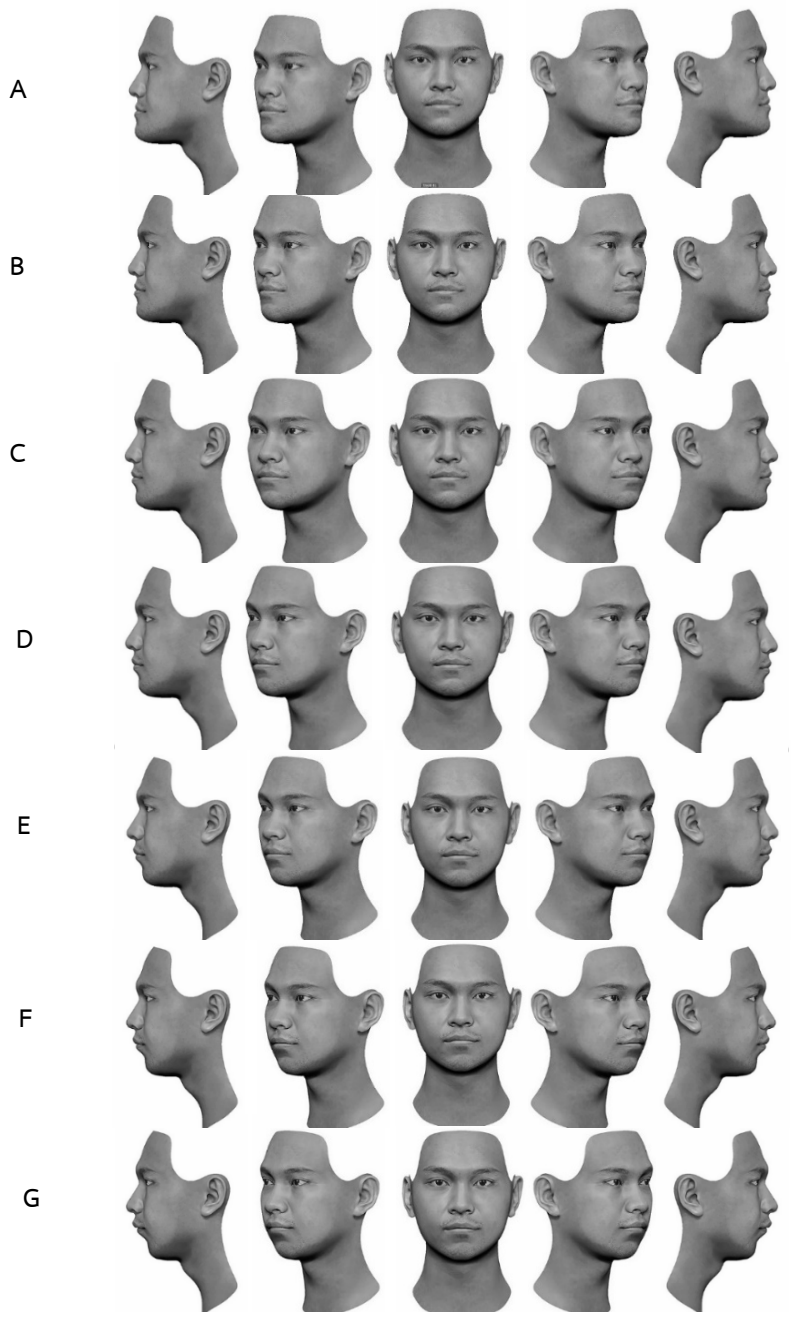

Figure 1 3D male images. Facial contour angle of -3(A), 1(B), 5(C), 9(D), 13(E), 17(F), 21(G)

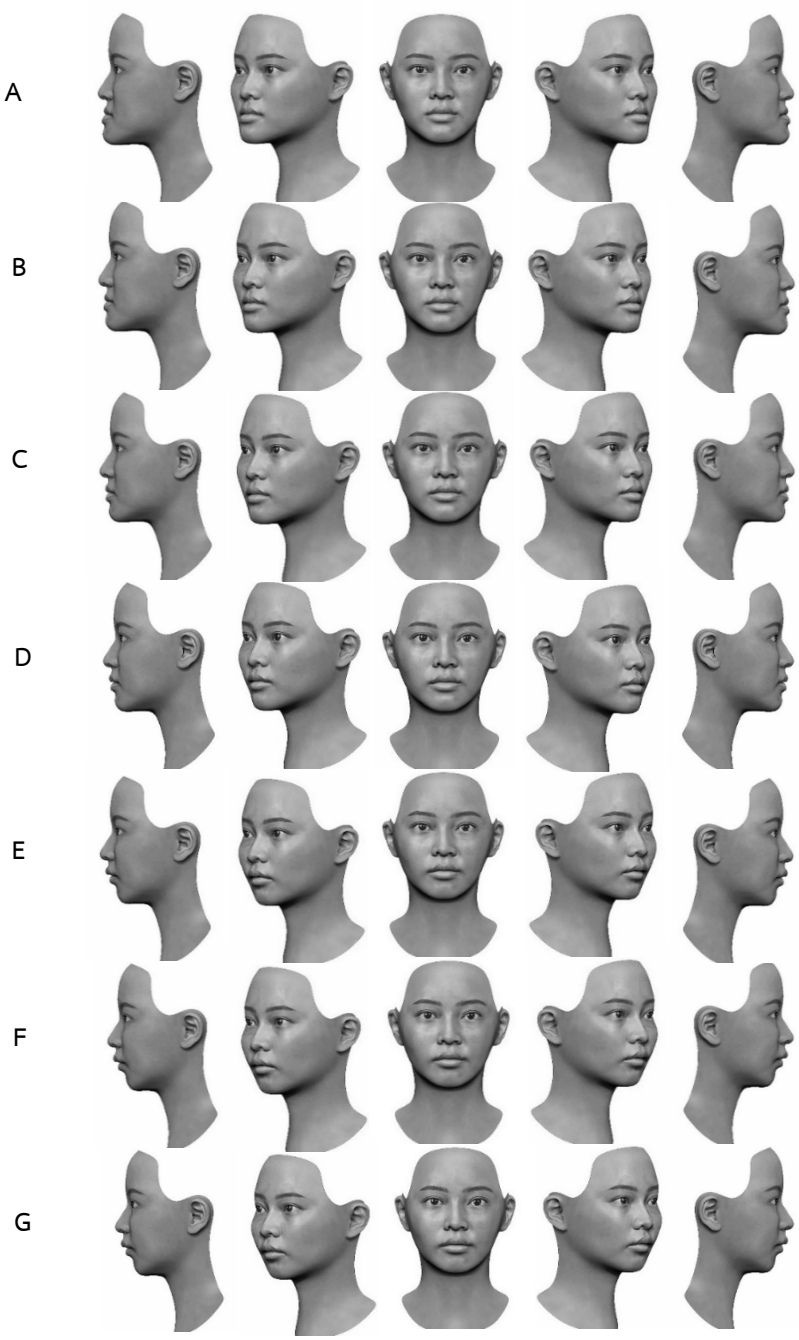

Figure 2 3D female images. Facial contour angle of -3(A), 1(B), 5(C), 9(D), 13(E), 17(F), 21(G)

Results

85 Thai males and 85 Thai females participated in this study. The mean ages of male and female groups were 29.13±7.14 and 27.45±6.22 years old respectively, which was not significantly different. 84.7% of male and 86.4% of female participants graduated at university level. The remaining participants graduated at high school level. There was no significantly difference of education level between two groups. The intraclass correlation coefficients for both male and female participants were higher than 0.79 for scoring repeated male image and female images.

For male images, male participants rated male with normal (9° FCA) and slightly protrusive mandible (5° FCA) most attractive. Male participants scored male with slightly retrusive mandible (13° FCA) in significantly lower score than male with normal mandibular position (9° FCA) (P<0.001). Female participant evaluated male with normal (9° FCA), slightly retrognathism (13° FCA) and slightly prognathism (5° FCA) most attractive. Statistically significant difference of perceived attractiveness was not found between male with normal (9° FCA) and slightly retrusive mandible (13° FCA) rated by female participants (P>0.05). Both male and female participants rated male with severe protrusive mandible (-3° FCA) and severe retrusive mandible (21° FCA) as the least attractive. (Table 1)

Table 1 Ranking of male images ordered from the highest to the lowest score

Females participants						
Ranking order	FCA (Degree)	VAS	SD	Result[(a)]	95% CI	Median
1	9	7.18	1.45	A	6.87-7.50	7.41
2	13	6.71	1.73	A	6.34-7.09	6.71
3	5	6.64	1.82	A	6.24-7.03	6.63
4	17	5.86	1.45	B	5.55-6.18	5.79
5	1	5.4	2.14	B	4.94-5.86	5.44
6	21	4.64	1.55	C	4.31-4.98	4.81
7	-3	4.24	1.95	C	3.82-4.66	4.22
Males participants						
Ranking order	FCA (Degree)	VAS	SD	Result[(a)]	95% CI	Median
1	9	7.42	1.57	A	7.08-7.76	7.68
2	5	6.92	1.69	A, B	6.55-7.28	6.78
3	13	6.78	1.54	B	6.44-7.11	6.78
4	17	6.03	1.81	C	5.64-6.42	5.82

Table 1 Ranking of male images ordered from the highest to the lowest score (Cont.)

Males participants						
Ranking order	**FCA (Degree)**	**VAS**	**SD**	**Result[(a)]**	**95% CI**	**Median**
5	1	5.64	1.84	C	5.25-6.04	5.56
6	21	4.55	1.78	D	4.17-4.94	4.34
7	-3	4.28	1.74	D	3.91-4.66	4.23

[a] Score with different letters indicated significantly different

The most perceived attractive female image was the one with slight retrusive mandible (13° FCA) rated by male and female participants. Female with severe prognathism (-3° FCA) received the lowest score and significantly lower than severe retrognathism (21° FCA) rated by male ($P<0.001$) and female participants ($P<0.001$). Male participants significantly preferred female with normal mandibular position (9° FCA) more than female with moderate retrognathism (17° FCA) ($P=0.032$). (Table 2)

Table 2 Ranking of female images ordered from the highest to the lowest score

Females participants						
Ranking order	**FCA (Degree)**	**VAS**	**SD**	**Result[(a)]**	**95% CI**	**Median**
1	13	7.4	1.65	A	7.04-7.76	7.44
2	9	6.59	1.96	B	6.17-7.01	6.29
3	17	6.32	1.84	B, C	5.92-6.71	6.14
4	5	5.84	2.11	C, D	5.39-6.30	5.58
5	21	5.67	1.87	D	5.27-6.08	5.53
6	1	4.68	2.16	E	4.22-5.15	4.9
7	-3	2.69	1.85	F	2.29-3.09	2.45
Males participants						
Ranking order	**FCA (Degree)**	**VAS**	**SD**	**Result[(a)]**	**95% CI**	**Median**
1	13	7.34	1.72	A	6.97-7.71	7.52
2	9	6.63	1.71	B	6.26-7.00	6.63
3	17	6.14	1.77	C	5.76-6.52	5.72
4	5	5.69	1.75	C, D	5.32-6.07	5.59

Table 2 Ranking of female images ordered from the highest to the lowest score (Cont.)

Males participants						
Ranking order	**FCA (Degree)**	**VAS**	**SD**	**Result[(a)]**	**95% CI**	**Median**
5	21	5.59	1.87	D	5.19-6.00	5.45
6	1	4.43	2.03	E	3.99-4.87	4.96
7	-3	2.45	1.61	F	2.10-2.79	2.43

[a] Score with different letters indicated significantly different

Discussion

The prominence of mandible was one of the important factors in perceived facial attractiveness. To date, most of objective evidence of facial preference regarding of different mandibular position was obtained by using 2D images. Therefore, the aim of this study was to compare the preference between male and female laypeople by using 3D facial images. In this study, we found the inconsistency between male and female opinions in preferred mandibular position. This result rejected our research hypothesis that preferred mandibular position was not influenced by observer genders.

Male participants significantly preferred male image with slightly protrusive mandible (5° FCA) rather than male image with slightly retrusive mandible (13° FCA). However, this significantly difference was not found in female participants. In addition, quite considerable difference was also found in female images. Female participants perceived female image with moderate retrognathism (17° FCA) as attractive as female image with normal mandibular position (9° FCA). Whereas, male participants considered female image with moderate retrognathism (17° FCA) was less pleasing than the one with normal mandibular position (9° FCA). This finding indicated that males tend to preferred prognathism pattern and females tend to preferred retrognathism. Previous studies reported that mandibular or chin prominence was related to masculine impression (Yin et al., 2014). From our results, it could imply that male individuals desired to be looked strong which is contrast to female individuals. This finding also suggested that to maintain man- like appearance was important for male patients seeking for orthognathic surgery. Additional advancement genioplasty should be considered after mandibular setback surgery in skeletal Class III male patients.

We found that adult laypeople most preferred male with normal mandibular position (9° FCA). The correspond results also found in the previous studies surveyed in both western and eastern population (Oliveira et al., 2015; Yin et al., 2014). Our study revealed that male with both severe retrognathism (21° FCA) and prognathism (-3° FCA) were rated least preference. This finding was not in agreement with previous studies. Türkkahraman and Gökalp (2004) reported that male retrognathic profile was judged to be more pleasing than prognathic profile. However, other studies reported that

male with protrusive mandible was assessed to be the least attractive (Soh et al., 2007; Oliveira et al., 2015).

All participants agreed that the female image with the most protruded chin (-3° FCA) was the least acceptable. In contrast, female image with slightly retrognathism (13° FCA) considered most attractiveness. Our finding coincided with those of earlier studies which indicated that female individual with concave facial profile was the least pleasing (Soh et al., 2007; Oliveira et al., 2015). This emphasized that layperson perceived retrusive mandible as the pattern that more fit to female faces. Anthropometric study reported the difference of facial pattern between males and females, e.g., female tend to have less supraorbital ridge prominence and nose projection (Burton et al., 1993). These patterns may exaggerate prognathic mandible looking more obvious for females. Moreover, previous study indicated that small and retrusive mandible were related to feminine characteristic and youthful appearance (Yin et al., 2014).

It was interesting that female with normal mandibular position (9° FCA) according to Thai norm (Sorathesn, 1988) received significant lower score than slightly retrognathism image (13° FCA). This norm was derived from study done in 1988, from adult population with balanced facial profile. It therefore implied that esthetic standard had been changing over time. The updated study of esthetic perception was very important for orthodontists, especially in orthognathic surgery cases.

We found that the most preferred mandibular position in female was slightly retrognathism. It was contrast to previous studies which reported that female with straight profile was the most attractive (Soh et al., 2007; Oliveira et al., 2015). The disagreement may cause by the different of races and ethics of the observers. In addition, most of previous studies used 2D image for facial evaluation. In this study, we decided to use 3D images presented in video format to enhance the realism of facial images compared to 2D illustrations. The observers able to witness all views of the faces in this study.

Black-and-white images were selected instead of colored pattern aimed to eliminate the observers bias. Hair features were cut off for the same reason. The other parts which may dominate facial preferences such as nose, eye, facial index, vertical proportion were under control in the same characteristic. The comparison of using 2D and 3D images for facial esthetic perception was reported by Todd et al. (2005) but had a great of variation and was unable to conclude that there was a difference between 2D and 3D formats when assessing facial attractiveness. The further studies to compare 2D and 3D images used in evaluation of facial esthetic perception according to different sagittal mandibular positions were required.

Conclusion

Based on 3D facial evaluation, males and females had dissimilar preferred mandibular position. Male preferred prognathism while female preferred retrognathism. Orthognathic treatment plan provided for male patients therefore should be different from female patients. Normal mandibular

position (9° FCA) perceived as the most attractive for male image whereas slightly retrusive mandible (13° FCA) perceived as the most pleasing for female image. In addition, it was important for clinicians to keep in mind that esthetics perception by laypeople could change by time and might not correspond with orthodontic norm.

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