Esthetic Preferences of Laypersons of Different Cultures and Races with Regard to Smile Attractiveness

Abstract

Background: Culture and ethnicity are among the factors affecting esthetic judgment of individuals. Aims: This study aimed to assess the acceptability threshold of variations in four components of an esthetic smile namely vertical lip thickness, dental midline deviation, buccal corridor, and the golden ratio in maxillary lateral incisors display among laypersons of different races and cultures. Subjects and Methods: Raters (n = 35 in each city) among laypersons of nine cities namely Istanbul, Isfahan, Tabriz, Tehran, Doha, Rome, Sydney, Chicago, and Yazd, were given a photo album containing 27 random images of an attractive female smile, digitally altered with regard to the four smile components. They scored each picture from 0 to 100 in terms of smile attractiveness. Statistical Analysis: Data were analyzed using SPSS 13 and the acceptability threshold for each component was calculated in each city using the Spearman and Wilcoxon tests. Results: No significant differences were noted with regard to the increased vertical lip thickness, and an acceptability threshold could not be determined for it. The acceptability thresholds for midline deviations, buccal corridor, and the golden ratio were different among different cities. One-millimeter increase in the displayed width of maxillary lateral incisors was more desirable than the golden ratio standard width. Conclusion: Culture and race may significantly affect the esthetic preference of individuals with regard to smile attractiveness.

Keywords: Culture, esthetic preference, race, smile attractiveness

Introduction

Several components are known to be involved in an esthetic smile.[1,2] However, beauty is a subjective concept. Evidence shows that the standards of beauty are widely variable depending on the social and cultural background, age, gender, ethnicity, and race of observers.[3,4] Norms of beauty are constantly changing, and smile esthetics would not be an exception.[5] Smile attractiveness factors have been the subject of many studies.[1,2,6-9] Maxillary midline deviation significantly compromises smile attractiveness.[10,11] Another critical feature is the optimal size of buccal corridors.[2,6,9,11] Alterations in vertical lip thickness have also been shown to affect smile esthetics.[12] The role of the golden ratio standards in smile attractiveness has been discussed in several studies as well.[9,13] Despite attempts, a consensus on acceptability thresholds for variations in esthetic smile components has not yet been reached.

Perspectives of laypersons with regard to smile esthetics have been compared in many previous studies.[6,8,14-16] However, to the best of our knowledge, the number of studies comparing the esthetic preferences of individuals of different races and cultural background with regard to smile attractiveness is scarce.[3,5,17] Thus, this study aimed to assess the perspectives of raters from nine cities worldwide with regard to changes in special factors influencing smile attractiveness and determine an acceptability threshold for each.

Subjects and Methods

This descriptive, analytical study was conducted on laypersons selected among male and female ethnic residents of nine cities in the age range of 18–45 years with native, ethnic parents living in the same city. A total of 35 laypersons were selected from each city according to a similar previous study.[18] A picture of an attractive female smile measuring 2.5” × 5” with 1000 pixels resolution was selected by unanimous
agreement of three orthodontists.\textsuperscript{[19]} Using Photoshop CS3 (Adobe Systems Inc., San Jose, CA), the following smile components were digitally manipulated:

1. Maxillary dental midline was deviated by 1 mm toward the right and left relative to the upper lip vermilion
2. Size of buccal corridor was altered by changing the arch width posterior to the canine to narrow or widen the arch width by 10%
3. Increasing the vertical lip thickness at the vermilion by 1 mm
4. Changing the golden ratio in the maxillary lateral incisors by increasing or decreasing the teeth width symmetrically by 1 mm.

The pictures were converted to black and white.\textsuperscript{[20]} A total of 27 digitally manipulated images were randomly arranged in a photo album grouped into four series\textsuperscript{[21]} [Figure 1]. After each series of photos (related to each altered smile component), a landscape image was placed to prevent tiredness of observers\textsuperscript{[18]} [Tables 1–4].

A questionnaire was prepared in Farsi and English, containing demographic information of raters including age, sex, place of birth of the rater and parents, and the right-handedness or left-handedness. The next pages contained 27 horizontal 10 cm long visual analog scales.\textsuperscript{[22]} The photo album, the questionnaire, and related instructions were mailed to all participants in Sydney (Australia), Rome (Italy), Chicago (US), Doha (Qatar), Istanbul (Turkey) and Tabriz, Tehran, Isfahan, and Yazd (Iran). Cases gave their informed consent for participation. They were instructed to first take a look at all images from 30 cm distance under adequate daylight without pausing on a specific image or comparing them.\textsuperscript{[23]} In the second review, they rated the images one by one from 0 to 100 based on attractiveness without any comparison between them.\textsuperscript{[21]} Subjects were free to quit.

Data were analyzed using SPSS 13 (Microsoft, IL, USA). The Cronbach’s alpha was calculated to assess the reliability of results in each city.\textsuperscript{[8]} For this purpose, the kappa statistic was calculated for the four duplicate images (#3, 11, 16, 22) randomly placed among other images.\textsuperscript{[13,18,24]} The reliability of the results was excellent (>0.6) except for Doha with moderate reliability [Table 5].

The Spearman’s correlation test was applied to analyze the correlation of scores for each photograph with the score

\textbf{Figure 1: Randomly arranged images}
of the original image. The acceptability thresholds were calculated for raters in each city using the Wilcoxon test. 

RESULTS

A total of 293 subjects (135 males, 158 females) participated in this study. Participants were in the age range of 17–46 years. 221 were right-handed, and 72 were left-handed.

Midline deviation

In Istanbul, significant correlations were found between S3 (reference picture) and S4 and S7 (P < 0.05). Therefore, the acceptability threshold for midline deviation was found to be 2 mm. The difference in the mean scores given to images S1 to S9 was not significant when compared to S3 (P > 0.05).

In Isfahan, a significant correlation was found between S3 and S7. Therefore, the acceptability threshold for midline deviation was found to be 1 mm. The difference in the mean scores given to images S1, S2, S5–S7, and S9 was significant when compared to S3 (P < 0.05).

In Tabriz, significant correlations were found between S3 and S7. Therefore, the acceptability threshold for midline deviation was found to be 1 mm. The difference in the mean scores given to images S1, S2, S5–S7, and S9 was significant when compared to S3 (P < 0.05).

In Yazd, significant correlations were found between S3 and S4, S7, and S8. Therefore, the acceptability threshold for midline deviation was found to be 2 mm. The difference in the mean scores given to images S1, S2, S4–S7, and S9 was significant when compared to S3 (P < 0.05).

In Rome, significant correlations were found between S3 and S1, S2, S4, S5–S9 (P < 0.05). Therefore, the acceptability threshold could not be determined.

In Chicago, significant correlations existed between S3 and S1, S2, S4, S6–S9 (P < 0.05). Therefore, the acceptability threshold could not be determined.

Table 1: Random arrangement of images showing midline deviation

| Image# | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 |
|--------|----|----|----|----|----|----|----|----|----|
| 3mm-2mm-Original | 2mm-3mm-4mm-1mm-1mm-4mm-left | right image | left | right | right | left | right | left |

Table 2: Random arrangement of images showing buccal corridor alterations

| Image | S10 | S11 | S12 | S13 | S14 | S15 |
|-------|-----|-----|-----|-----|-----|-----|
| +10%  | Original image | +50% | +30% | +20% | +40% |

Table 3: Random arrangement of images showing vertical lip thickness manipulation

| Image | S16 | S17 | S18 | S19 | S20 |
|-------|-----|-----|-----|-----|-----|
| Original image | +3mm | +2mm | +4mm | +1mm |

Table 4: Random arrangement of images showing golden ratio manipulation

| Image | S21 | S22 | S23 | S24 | S25 | S26 | S27 |
|-------|-----|-----|-----|-----|-----|-----|-----|
| 3mm | No change | 2mm | +2mm | +1mm | 1mm | +3mm |

Table 5: Reliability assessment: The Cronbach’s alpha coefficient

| Istanbul | Isfahan | Tabriz | Tehran | Doha | Rome | Sydney | Chicago | Yazd |
|----------|---------|--------|--------|------|------|--------|---------|------|
| 0.66     | 0.63    | 0.81   | 0.61   | 0.41 | 0.78 | 0.72   | 0.81    | 0.64 |
In Tehran, a significant association was found between S11 and S15 (P < 0.05). Thus, the acceptability threshold could not be determined.

In Doha, a significant association was found between S11 and S10. Thus, the acceptability threshold for variations in buccal corridor was found to be 10%. The difference in the mean scores given to S10, S13–S15 was significant when compared to S11 (P < 0.05).

In Rome, significant associations were found between S11 and S10, S13–S15. Therefore, the acceptability threshold for variations in buccal corridor was found to be 40%. The difference in the mean scores given to S12–S15 was significant when compared to S11 (P < 0.05).

In Sydney, significant associations were found between S11 and S10 and S12–S15. Therefore, the acceptability threshold for variations in buccal corridor was found to be 10%. The difference in the mean scores given to S12 and S13–S15 was significant when compared to S11 (P < 0.05).

In Chicago, significant associations were found between S11 and S10 and S12–S15. Therefore, the acceptability threshold for variations in buccal corridor was found to be 20%. The difference in the mean scores given to S12–S15 was significant when compared to S11 (P < 0.05).

In Yazd, significant associations were found between S11 and S10, S12–S15. Therefore, the acceptability threshold for variations in buccal corridor was found to be 10%. The difference in the mean scores given to S12–S15 was significant when compared to S11 (P < 0.05).

Vertical lip thickness

In Istanbul, significant associations were found between S16 (reference picture) and S17–S19 (P < 0.05). Thus, the acceptability threshold could not be calculated.

In Isfahan, significant associations were found between S16 and S17–S20 (P < 0.05). Thus, the acceptability threshold could not be calculated.

In Tabriz, significant associations were found between S16 and S17–S20 (P < 0.05). Thus, the acceptability threshold could not be calculated.

In Tehran, significant associations were found between S16 and S17 and S20 (P < 0.05). Thus, the acceptability threshold for variations in vertical lip thickness was found to be 4 mm. The difference in the mean scores given to S16–S20 was not significant (P > 0.05).

In Doha, significant associations were found between S16 and S17, S18, and S20 (P < 0.05). Thus, the acceptability threshold for variations in vertical lip thickness was found to be 3 mm. The difference in the mean scores given to S16–S20 was not significant (P > 0.05).

Golden ratio

In Istanbul, significant associations were found between S22 (reference picture) and S21, S23, and S26 (P < 0.05). Thus, the acceptability threshold for variations in the golden ratio of the maxillary lateral incisors was reduction by 3 mm. The difference in the mean scores given to S25–S27 (P = 0.00) was significant when compared to S22.

In Isfahan, significant associations were found between S22 and S21, S23–S26. Thus, the acceptability threshold for variations in the golden ratio of the maxillary lateral incisors was its increase or reduction by 2 mm. The difference in the mean scores given to S21, S23–S27 was significant when compared to S22 (P < 0.05).

In Tabriz, significant associations were found between S22 and S21, S23–S27 (P < 0.05). Thus, the acceptability threshold could not be determined.

In Tehran, significant associations were found between S22 and S21, S23–S25. Thus, the acceptability threshold for variations in the golden ratio of the maxillary lateral incisors was increased by 2 mm and decreased by 1 mm. The difference in the mean scores given to S21, S23, S26, and S27 was significant when compared to S22 (P < 0.05).

In Doha, significant associations were found between S22 and S23–S26. Thus, the acceptability threshold for variations in the golden ratio of the maxillary lateral incisors was increased by 2 mm and decreased by 2 mm. The difference in the mean scores given to S21 and S23 was significant when compared to S22 (P < 0.05).

In Rome, significant associations were found between S22 and S21, S23 and S26 (P < 0.05). Thus, the acceptability threshold for variations in the golden ratio of the maxillary lateral incisors was reduction by 3 mm. The difference in the mean scores given to S21, S23–S27 was significant when compared to S22 (P < 0.05).
In Chicago, significant associations were found between S22 and S21, S23, S24, and S26 \((P < 0.05)\). Thus, the acceptability threshold could not be determined.

In Yazd, significant associations were found between S22 and S21, S23, and S26. Thus, the acceptability threshold for variations in the golden ratio for maxillary lateral incisors was reduction by 3 mm. The difference in the mean scores given to S21, S23, and S26 was significant when compared to S22 \((P < 0.05)\).

Summary of the acceptability thresholds in different cities is shown in Table 6.

**Discussion**

Assessments of smile components have been done in the previous studies by rating photographs of smiles showing only teeth and lips.\[^{20}\] To enable comparison among different cities, the effect of demographic factors was adjusted for as potential confounders.\[^{23,25}\] In this study in agreement with some other studies, randomly placed images in four series prevented the raters to notice the incremental trend of altered components and probably made a more accurate judgment.\[^{5,18,20,21}\] Moreover, black and white pictures would eliminate the confounding effect of skin color on judgment.\[^{20}\]

Inter-observer reliability \((>0.6)\) was among the strengths of the current study. Only in Doha, results had moderate reliability, which may be due to less attention paid to instructions by the judges. In a previous study with similar methodology, moderate reliability \((0.3–0.6)\) was reported except for the buccal corridor.\[^{20}\] In another study by Chang et al. reliability of all results except for buccal corridor was reported to be moderate to excellent \((>0.3)\).\[^{18}\]

In the current study, judges were asked to rate an esthetic smile with 4 modified components.

Small midline deviations have been reported to be undetectable by laypersons.\[^{16,21,26}\] Based on our results, the acceptability threshold of midline deviation was 2–3 mm in Istanbul, Tabriz, Isfahan, Doha, Rome, and Yazd. The acceptability threshold in Tehran, Sydney, and Chicago could not be determined. Future studies are required on a larger sample size to better elucidate this subject. Moreover, the method of study must be more thoroughly explained to layperson judges. The difference in the threshold of acceptability in Doha (3 mm) and other cities (2 mm) may show different esthetic preferences of raters residing in different geographical locations. Janson et al. reported that dental midline deviation by 2.2 mm was esthetically acceptable by orthodontists and laypersons.\[^{26}\] McLeod et al. reported that the acceptability threshold of midline deviation for Canadians was 1.1 mm less than that for Americans.\[^{25}\] Pinho et al. in Brazil showed that laypersons did not notice midline deviations.\[^{21}\] Zhang et al. reported an acceptable threshold of 1–3 mm for midline deviation in China\[^{27}\] and Parekh et al. reported an acceptability threshold of 3.2 mm in the United States.\[^{9}\] These values along with our findings may show the effect of race and ethnicity on esthetic preferences. However, as these studies did not aim to assess the effect of ethnicity on esthetic perception the inclusion criteria of raters might be a confounding factor.

Effect of right-handedness or left-handedness of the raters on their judgment with regard to the side of midline deviation was suggested by Thomas et al.\[^{28}\] Zhang et al. found no significant association between the side of deviation and scores allocated to images.\[^{27}\] We evaluated midline deviation to both right and left sides. However, due to small number of left-handed individuals, we could not statistically assess this effect and future studies are required to better elucidate this subject.

Janson et al. showed that excessive buccal corridor was mainly the reason behind an unesthetic smile.\[^{26}\] In our study, an acceptability threshold for variations in buccal corridor could not be determined in Istanbul and Tehran. However, this was 20% in Isfahan and Chicago, 40% in Rome, and 10% in Tabriz, Doha, and Yazd. These findings indicate the variability in esthetic preferences of individuals in different cities. Ioi et al. in Japan reported an acceptability threshold of 10% for the size of buccal corridor.\[^{22}\] McLeod et al. showed that the acceptability threshold was 19.5% in Canada and 22% in the United States.\[^{25}\] Moore et al., in the US reported this value to be 10%.\[^{14}\] Overall, race and ethnicity seem to have significant effects on raters’ esthetic judgment with regard to alterations in buccal corridor.

Raters in Sydney and Doha preferred fuller lips. The difference in this regard among other raters was not significant. McNamara et al., in the UK showed that raters believed that fuller lips were more attractive.\[^{12}\] Considering the scarcity of studies on this topic, further investigations seem necessary.

In this study, the golden ratio in the maxillary lateral incisors was modified by both decreasing and increasing

| Table 6: The acceptability thresholds in different cities |
|-----------------------------------------------|
| Istanbul | Isfahan | Tabriz | Tehran | Doha | Rome | Sydney | Chicago | Yazd |
|---|---|---|---|---|---|---|---|---|
| Midline deviation | +2 | +1 | +2 | - | +3 | +2 | - | - | +2 |
| Buccal corridor | - | 20% | 10% | - | 10% | 40% | 10% | 20% | 10% |
| Vertical lip thickness | - | - | - | +4 | +3 | - | +3 | - | - |
| Golden ratio | -3 | -2 | - | -1, +2 | +2, -2 | -3 | - | - | -3 |
the teeth widths. An interesting finding was that 1 mm increase in the width of the maxillary lateral incisors improved smile attractiveness according to the opinions of the judges in all cities. In some areas, 2–3 mm increase was even more desirable. This finding supports the results of Kokich et al. in the US that the golden ratio may not be accurate enough with respect to the width of maxillary lateral incisors in symmetric assessments. [6,13] In Chicago, Sydney, and Tabriz, an acceptability threshold could not be determined. Results in other cities were widely variable and showed the effect of race and ethnicity on aesthetic judgment with regard to changes in the golden ratio and its role in smile attractiveness. Considering the lack of similar studies, future studies are required.

Conclusion

Ethnicity, race, and culture may significantly affect the aesthetic judgment of individuals. The golden ratio must not be necessarily adhered to when it comes to the width of the maxillary lateral incisors to maximize esthetics.

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Conflicts of interest

There are no conflicts of interest.

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