Perception of Dental, Smile and Gingival Esthetic Components by Dental Specialists, General Dental Practitioners, Dental Assistants and Laypersons: A Cross-sectional Study

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ABSTRACT

Aim: This study aimed to evaluate perception of dental, smile, and gingival esthetic components by dental specialists, general dental practitioners, dental assistants, and laypersons.

Material and methods: Seven standard photographs representing dental, smile, and gingival components were manipulated digitally. The sample composed of 466 [74 dental specialists (DS), 152 general dental practitioners (GDP), 97 dental assistants (DA), and 142 laypersons (LP)] assessed the normal and the digitally manipulated images on a visual analog scale ranging from 1 to 5 where 1 is the less pleasant image and 5 is the standard normal image. The data was analyzed using Mann-Whitney and Kruskal-Wallis tests, and multiple linear regression analyses.

Results: Out of 100, the overall rate was 81.42 ± 10.8% with no statistical gender differences. Regarding the individual components, females exhibited significant perception for “midline diastema,” while males showed significantly better perception for “gingival marginal height.” General dental practitioners (GDP) showed significantly higher perception score than DS, DA, and LP did. Out of the seven evaluated components, five were differently perceived in favor of the GDP followed by DS, DA, and the lowest were for LP. Linear regression analyses revealed that the “participant’s category” (GDP vs others) was the only independent determinant of the overall esthetic perception in addition to six individual esthetic components.

Conclusion: GDP showed more favorable perception of dental, gingival, and smile esthetics than laypersons and other dental professionals with considerable variations.

Clinical significance: The patients’ perception toward esthetics is to be considered over that perceived by dental professionals during daily dental procedures and smile design.

Keywords: Dental professionals, Esthetics, Gingival, Perception, Smile.

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INTRODUCTION

People usually concern about the attractiveness and beauty of their face, smile, and teeth. This concern began since thousands of years ago. In some ancient Asians civilizations, some people in laid their teeth with precious materials to draw an attention and to show nobility or stained them black as signs of strength. Romans in first century covered their front teeth with urea to make them whiter in color as signs of beauty.1 The concept of dental beauty differs from culture to another and crosswise different regions, countries, populations, and hence continents. The components of beautiful smile are also dynamic, modifying from time to time for varying causes. For example, in the 20th century maxillary midline diastema was a sign of beautiful smile, but these days most of these individuals seek orthodontic treatment for closure of maxillary midline diastema.2

Generally, the term perception is a process involving personal analysis of a stimulus and identification of the object or individual producing a specific impression. Commonly, this impression toward others can cause an environmental condition which affected an individual's intellectual and social development.3 Hence, the perception is not an absolute issue; rather it varies considerably owing to many determinants.

References

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Perception of dental esthetics is not an exception. It is a relative trait influenced by several factors including, but not limited to,
cultural, ethnic, demographic, and geographic factors. Although being a subjective measure, dental esthetics has certain standards that can be applied for objectivity. Some standards came from either solid values of a specific population, or by comparing with individuals who are considered controversially beautiful. Dental esthetics is the key aspect of attractive smile. The latter may have accumulative effects over human being’s life.

Various dental/oral factors such as the clinical crown height and width, upper lip vertical position (smile line), buccal corridors, occlusal plan canting, maxillary midline position, and maxillary midline diastema, affect smile attractiveness. As these factors can be manipulated by dental and/or orthodontic treatment, clinicians should consider them while developing a treatment plan aiming at objective perfection and subjective satisfaction of the attractive smile. Overall, combining the patient’s preference and the objective values with the esthetic components as perceived by the dental practitioners and laypersons is essential.

Several studies have assessed the laypersons’ perception of specific esthetic parameters including gingival marginal discrepancy and occlusal canting. A recent systematic review aimed at analyzing studies that evaluated dental professionals’ and/or laypersons’ perception of different esthetic characters such as maxillary midline diastema, buccal corridors, gingival display in smile, gingival asymmetry, and lateral incisor crown width. So far, there has not been a single study that assessed the perception of the most important smile, dental and gingival esthetic components (all together) by the laypersons and dental professionals. Thus, the current study aimed to assess dental professionals’ and laypersons’ perception of seven smile, dental, and gingival esthetic components, and whether perception of these esthetic parameters is affected by gender and the level of exposure to dental practice.

**Material and Methods**

This cross-sectional study was conducted during the period from November 2018 to April 2019 at the College of Dentistry, Jazan University, Saudi Arabia. It was approved by the Interns Review Committee, College of Dentistry, Jazan University. The study targeted dental specialists (DS) from different clinical disciplines, general dental practitioners (GDP) in the region, dental assistants (DA) in the college, and laypersons (LP) attending the college’s clinics. The participation was voluntary. All procedures performed were in accordance with the guidelines provided by Helsinki and the ethical standards of the hospital research committee.

Seven photographs of posed smile were obtained and considered as standard photographs. Each standard photograph was digitally manipulated using the Adobe Photoshop software program (version CS3; Adobe Systems, Inc., San Jose) to get four photographs differed somehow from each other and from the standard photograph. For each component five photographs were presented, one standard and four its manipulated analog, represented one category for one of the seven esthetic components (dental, smile, or gingival, Figs. 1 to 7). To score these photographs, a visual analog scale ranging from one to five was set, where five is the standard photograph and one denoted the least pleasing one. Within each group, the five images were randomly arranged, and even differently in the seven different categories. The scores of each component were summed together then multiplied by 2.857 to be tabulated out of 100 (Table 1).

The details of the above mentioned digital reformatting are described in Table 1 and photographically presented in Figures. 1 to 7.

The manipulated groups of photographs were given to each rater in the form of booklet of seven pages where each group (five photographs per a page) represented one of the esthetic components mentioned above (Figs. 1 to 7). The participants were asked to select the most pleasant image among the five images in each group. The participants marked their choices in a predesigned master sheet which included questions about participant’s occupation and gender. To ensure that the booklets were presented properly, fairly and unequivocally to all participants, they were printed using the same color saturation, and on papers with the same dimensions, thickness and glossiness; and distributed exclusively during the day light.

Intraobserver reliability was assessed by intraclass correlation coefficient based on a random re-evaluation of ten participants from each occupation group twice with at least 2-week interval.

Frequencies and their corresponding proportions were used to statistically present the qualitative variables, while the quantitative variables were presented as means and their corresponding standard deviations (SD), and as medians with their corresponding interquartile ranges (IQR). To check the normal distribution of the quantitative data (the overall and individual esthetic scores), Kolmogorov-Smirnov test was conducted. The differences by gender and occupation were assessed using Mann-Whitney U and Kruskal-Wallis tests followed by pairwise comparisons, respectively. The independent determinants were analyzed using stepwise multiple linear regression analyses.

Data were analyzed using the IBM-SPSS software, Version 21 (Armonk; IBM Corp.). A p value of < 0.05 was considered significant.

**Result**

There were 465 participants of which 228 (49%) were females. A 74 (15.9%) were dental specialists, 152 (32.7%) were general dental practitioners, 97 (20.9%) were dental assistants, and 142 (30.5%) were laypersons (Table 2). There was a moderate to very high agreement ranged between 0.727, for question number 7 (gingival symmetry), and 0.986 for question number two (buccal corridors).

The overall mean score was high (81.42 ± 10.8) with no difference between genders. The highest perception was reported for “midline deviation” (4.52 ± 0.98) followed by “maxillary midline diastema” (4.48 ± 1.1), while the lowest perception was reported for “gingival display” (3.41 ± 1.41) followed by “Gingival marginal height” (3.8 ± 1.1).

Most of participants perceived the “narrow buccal corridors” of 10% and 15% [Median (IQR) = 5 (4-5)], and perceived the normal and 1 mm reduction of “clinical crown width” [Median (IQR) = 5 (4-5) each]. Similarly, Symmetric “gingival margin height”, and 0.5 mm and 1 mm discrepancy were perceived by more than two third of the sample [Median IQR = 4 (3-5)]. Males perceived the “maxillary diastema” more precisely than females did (p < 0.05) while females significantly perceived “maxillary midline diastema” more precisely than males did (p < 0.05; Table 3).

The mean score of overall perception was highest amongst GDP and lowest amongst LP. However, no statistical differences were found between LP and DA or between DA and DS, although the latter scored statistically higher than LP did (Table 4). Pairwise comparisons revealed no differences between LP and...
Table 1: Scoring system of the perception of overall, smile, dental and gingival components

| Variable                      | Score |
|-------------------------------|-------|
| **Overall**                   | 100 (35\*2.857) |
| **Smile components**          |       |
| Q1 (gingival display)         |       |
| Normal gingival display       | 5     |
| 1 mm increased gingival display | 4   |
| 2 mm increased gingival display | 3   |
| 3 mm increased gingival display | 2   |
| 4 mm increased gingival display | 1   |
| Q2 (Buccal corridors)         |       |
| Obliterated buccal corridor (2%) | 2   |
| Narrow buccal corridor (10%)  | 4     |
| Normal buccal corridor (15%)  | 5     |
| Wide buccal corridor (22%)    | 3     |
| Very wide buccal corridor (28%) | 1   |
| **Dental components**         |       |
| Q3 (Midline deviation)        |       |
| No maxillary midline deviation | 5   |
| 1 mm maxillary midline deviation | 4   |
| 2 mm maxillary midline deviation | 3   |
| 3 mm maxillary midline deviation | 2   |
| 4 mm maxillary midline deviation | 1   |
| Q4 (Midline diastema)         |       |
| No maxillary midline diastema | 5     |
| 0.5 mm maxillary midline diastema | 4   |
| 1 mm maxillary midline diastema | 3   |
| 1.5 mm maxillary midline diastema | 2   |
| 2 mm maxillary midline diastema | 1   |
| Q5 (Clinical crown width)     |       |
| Normal clinical crown width   | 5     |
| 1 mm reduction of clinical crown width | 4   |
| 2 mm reduction of clinical crown width | 3   |
| 3 mm reduction of clinical crown width | 2   |
| 4 mm reduction of clinical crown width | 1   |
| Q6 (Occlusal canting)         |       |
| No frontal occlusal canting   | 5     |
| 1 mm frontal occlusal canting | 4     |
| 2 mm frontal occlusal canting | 3     |
| 3 mm frontal occlusal canting | 2     |
| 4 mm frontal occlusal canting | 1     |
| **Gingival components**       |       |
| Q7 (Gingival marginal height) |       |
| Symmetric gingival margin height | 5   |
| 0.5 mm asymmetric gingival margin height | 4   |
| 1 mm asymmetric gingival margin height | 3   |
| 1.5 mm asymmetric gingival margin height | 2   |
| 2 mm asymmetric gingival margin height | 1   |

Table 2: Characteristics of the participants of the study

| Category                  | Males n (%) | Females n (%) | Total N (%) | p value |
|---------------------------|-------------|---------------|-------------|---------|
| Laypersons                | 68 (28.6)   | 74 (32.5)     | 142 (30.5)  |         |
| Dental assistants         | 37 (15.6)   | 60 (26.3)     | 97 (20.9)   | < 0.001 |
| General dental practitioners | 80 (33.8) | 72 (31.6)     | 152 (32.7)  |         |
| Dental specialists        | 52 (21.9)   | 22 (9.6)      | 74 (15.9)   |         |
| Total                     | 237 (51)    | 228 (49)      | 465 (100)   |         |
Fig. 1: Smile (lip) line: (A) normal smile line, (B) 1 mm higher smile line, (C) 2 mm higher smile line, (D) 3 mm higher smile line, (E) 4 mm higher smile line

Table 3: Mean and median scores of perception of dental, gingival and smile esthetic components and overall esthetic for the whole sample and by gender

| Esthetic components | All sample (N = 465) | Males (n = 237) | Females (n = 228) | p value |
|---------------------|----------------------|-----------------|-------------------|--------|
|                     | Mean (SD) Median (IQR) | Mean (SD) Median (IQR) | Mean (SD) Median (IQR) | |
| Overall             | 81.42 (10.8) 82.85 (74–88) | 81.08 (11.5) 82.85 (74–88) | 81.85 (10.02) 82.85 (77–88) | 0.435 |
| Smile components    |                     |                 |                   |       |
| Q1 (gingival display) | 3.41 (1.41) 4 (2–5) | 3.35 (1.46) 4 (2–5) | 3.47 (1.34) 4 (2–5) | 0.473 |
| Q2 (Buccal corridors) | 4.12 (1.28) 5 (4–5) | 4.14 (1.21) 5 (4–5) | 4.11 (1.36) 5 (4–5) | 0.503 |
| Dental components   |                     |                 |                   |       |
| Q3 (Midline deviation) | 4.52 (0.98) 5 (5–5) | 4.59 (0.92) 5 (5–5) | 4.45 (1.3) 5 (4–5) | 0.095 |
| Q4 (Midline diastema) | 4.48 (1.1) 5 (5–5) | 4.3 (1.27) 5 (4–5) | 4.67 (0.85) 5 (5–5) | < 0.001 |
| Q5 (Clinical crown width) | 4.24 (1.18) 5 (4–5) | 4.2 (1.27) 5 (4–5) | 4.29 (1.9) 5 (4–5) | 0.797 |
| Q6 (Occlusal canting) | 3.93 (0.95) 4 (3–5) | 3.91 (0.97) 4 (3–5) | 3.95 (0.94) 4 (3–5) | 0.755 |
| Gingival components |                     |                 |                   |       |
| Q7 (Gingival marginal height) | 3.8 (1.1) 4 (3–5) | 3.89 (1.11) 4 (3–5) | 3.71 (1.8) 4 (3–5) | 0.038 |

IQR: interquartile range
Fig. 2: Buccal corridor: (A) 2% buccal corridor (obliterated), (B) 10% buccal corridor (narrow), (C) 15% buccal corridor (normal), (D) 22% buccal corridor (wide), (E) 28% buccal corridor (very wide)

Table 4: Mean and median scores of sample perception of dental, gingival and smile esthetic components and overall esthetic by participant’s category

| Esthetic components | Layperson (n = 142) | Dental assistant (n = 97) | General dental practitioner (n = 152) | Dental specialist (n = 74) | p value |
|---------------------|---------------------|--------------------------|---------------------------------------|---------------------------|---------|
|                     | Mean (SD)           | Median (IQR)             | Mean (SD)                             | Median (IQR)              |         |
| Overall             | 78.3 (9.5)          | 78 (71–85)a              | 81.02 (11.2)                          | 80 (74–88)a              | < 0.001 |
| Smile components    |                     |                          |                                       |                           |         |
| Q1 (gingival display) | 3.41 (1.41)        | 3 (2–5)                  | 3.44 (1.52)                           | 4 (2–5)                  | 0.941   |
| Q2 (Buccal corridors) | 3.8 (1.48)         | 5 (3–5)a,b               | 3.8 (1.4)                             | 4 (3–5)b                 | < 0.001 |
|                     |                     |                          |                                       |                           |         |
| Dental components   |                     |                          |                                       |                           |         |
| Q3 (Midline deviation) | 4.3 (1.8)         | 5 (4–5)a                 | 4.93 (1.8)                            | 5 (4–5)b                 | < 0.001 |
| Q4 (Midline diastema) | 4.63 (0.9)        | 5 (5–5)                  | 4.61 (0.96)                           | 5 (5–5)                  | 0.081   |
| Q5 (Clinical crown width) | 4.06 (1.19)     | 4 (3–5)a                 | 4.24 (1.13)                           | 5 (4–5)b                 | 0.004   |
| Q6 (Occlusal canting) | 3.89 (0.9)         | 4 (3–4)c                 | 3.64 (0.96)                           | 4 (3–4)b                 | < 0.001 |
|                     |                     |                          |                                       |                           |         |
| Gingival components |                     |                          |                                       |                           |         |
| Q7 (Gingival marginal height) | 3.33 (1.25)   | 4 (2–4)a                 | 3.7 (1.12)                            | 4 (3–4)b                 | < 0.001 |

IQR: interquartile range
Within the same raw different superscript letters over the medians (IQR) are statistically different
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Fig. 3: Maxillary dental midline: (A) no deviation, (B) 1 mm deviation, (C) 2 mm deviation, (D) 3 mm deviation, (E) 4 mm deviation

Table 5: Independent determinants of sample perception of dental, gingival and smile esthetic components and overall esthetic as shown by stepwise multiple linear regression analyses

| Determinants            | B       | CI95% of B           | Adjusted $R^2$ | p value |
|-------------------------|---------|----------------------|----------------|---------|
| **Smile components**    |         |                      |                |         |
| Q1 (gingival display)   | No variables were entered into the equation. |         |                |         |
| Q2 (Buccal corridors)   |         |                      |                |         |
| Participant’s category  | 0.26    | 0.153–0.366          | 0.045          | < 0.001 |
| **Dental components**   |         |                      |                |         |
| Q3 (Midline deviation)  |         |                      |                |         |
| Participant’s category  | 0.106   | 0.024–0.189          | 0.012          | 0.012   |
| Q4 (Midline diastema)   |         |                      |                |         |
| Gender                  | 0.342   | 0.142–0.541          | 0.027          | 0.001   |
| Participant’s category  | -0.111  | -0.204– -0.018       | 0.036          | 0.019   |
| Q5 (Clinical crown width)|      |                      |                |         |
| Participant’s category  | 0.111   | 0.011–0.211          | 0.008          | 0.029   |
| Q6 (Occlusal canting)   |         |                      |                |         |
| Participant’s category  | 0.082   | 0.002–0.163          | 0.007          | 0.045   |
| **Gingival components** |         |                      |                |         |
| Q7 (Gingival marginal height)|     |                      |                |         |
| Participant’s category  | 0.279   | 0.189–0.369          | 0.072          | < 0.001 |
| **Combined components** |         |                      |                |         |
| Overall score           |         |                      |                |         |
| Participant’s category  | 2.36    | 1.54–3.18            | 0.063          | < 0.001 |

The independent variables which entered into the models were: gender and occupation. Gender was coded as: 1 for male and 2 for female; Participant’s category was coded as: 1 for layperson, 2 for dental assistant, 3 for general dental practitioner and 4 for dental specialist.
esthetic perception, although there might be tiny variations in perception of dental, smile, and gingival esthetics. In a recent systematic review, Del Monte et al. assessed 20 studies on esthetic perception; 10 studies included laypersons only and the other 10 compared laypersons with the dental professionals. Nevertheless, most of these studies addressed one esthetic variable or at best three esthetic variables. In addition, the maximum number of participants in these studies was 60. So far, this is the first study assessed seven esthetic components (dental, smile, and gingival components) once, and targeted a large sample of individuals who had different dental education and clinical experience, along with including lay persons.

Overall, the perception of esthetic components by the whole sample was almost high (81.42 ± 10.8 out of 100) with no gender differences. Considerable variations in perception of dental, smile, and gingival esthetics by LP, DA, GDP, and DS do exist, with the most precise perception recorded for GDP.

**Discussion**

The degree of exposure to the dental environment as well as the level of dental education might be influential factors for better esthetic perception, although there might be tiny variations in perception of dental, smile, and gingival esthetics.

In a recent systematic review, Del Monte et al. assessed 20 studies on esthetic perception; 10 studies included laypersons only and the other 10 compared laypersons with the dental professionals. Nevertheless, most of these studies addressed one esthetic variable or at best three esthetic variables. In addition, the maximum number of participants in these studies was 60. So far, this is the first study assessed seven esthetic components (dental, smile, and gingival components) once, and targeted a large sample of individuals who had different dental education and clinical experience, along with including lay persons.

Overall, the perception of esthetic components by the whole sample was almost high (81.42 ± 10.8 out of 100) with no gender differences. Moore et al. and Ioi et al. reported equal scores for males and females with regard to perception of smile attractiveness. In the current study, the highest perception was for the “midline deviation” with no gender difference. In contrast, Liu et al. claimed that the shift of the maxillary midline of 2 mm or less was not perceived by females and up to 3 mm was acceptable.
buccal corridors (22%). In one study, up to 20% was an acceptable threshold as perceived by DS, contrasting another study which reported that dental students and DS preferred wider smiles. “Maxillary midline diastema” was perceived equally by all groups of participants. This is in agreement with Abu Alhaija et al. and Kokich et al. who found that orthodontists, LP, and GDP rated the smile as unattractive when the “midline diastema” width was 1 and 2 mm, respectively. Based on a recent systematic review, the authors argued against diastema stating that ideally a smile should have no diastema; however, the space can be esthetically acceptable as long as it is less than 1.00 to 1.75 mm.

Almost all GDP perceived “midline deviation” accurately while up to 75% of the other participants perceived absence or 1 mm midline deviation. Sadrhaghighi et al. concluded that dental specialists were more sensitive to alterations in gingival display than laypeople.

GDP and DS preferred slightly narrow (10%) and normal buccal corridor (15%), this agrees with orthodontists’ threshold of this esthetic component. In the current study, LP and DA had the same preference in addition to their preference of the slightly wide buccal corridors (22%). In one study, up to 20% was an acceptable threshold as perceived by DS, contrasting another study which reported that dental students and DS preferred wider smiles. “Maxillary midline diastema” was perceived equally by all groups of participants. This is in agreement with Abu Alhaija et al. and Kokich et al. who found that orthodontists, LP, and GDP rated the smile as unattractive when the “midline diastema” width was 1 and 2 mm, respectively. Based on a recent systematic review, the authors argued against diastema stating that ideally a smile should have no diastema; however, the space can be esthetically acceptable as long as it is less than 1.00 to 1.75 mm.

Almost all GDP perceived “midline deviation” accurately while up to 75% of the other participants perceived absence or 1 mm midline deviation. Sadrhaghighi et al. found that the acceptable midline deviation was the same for orthodontists and laypersons (1 mm shift) while it was 3-mm for GDP. Another study found that a midline shift of 1 mm was acceptable by orthodontists but up to 4 mm for LP.
Most of the esthetic components were perceived more precisely by GDP compared with DS. This is most likely due to the heterogeneity of DS participated in this study where they represented different dental disciplines; the sample didn’t exclusively included DS that care more about esthetics like orthodontists, prosthodontists, and conservative dentistry specialists. Hence, it is recommended that similar studies be conducted with more focus on DS whose main focus of care is the smile and dental esthetics in comparison with other DS.

One of the limitations of this study is that the level of general education and socioeconomic status of laypersons was not considered. Another limitation is related to the specialty of the dental specialists that should be addressed in future researches.

Conclusions
The perception of dental, smile, and gingival esthetics was almost high and perceived differently in favor of the GDP followed by DS; the lowest perception scores were reported for LP with no gender differences.
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Fig. 7: Marginal gingival height of right maxillary central incisor: (A) normal marginal gingival height, (B) increased by 0.5 mm, (C) increased by 1 mm, (D) increased by 1.5 mm, (E) increased by 2 mm

References

1. Rodrigues Cde D, Magnani R, Machado MS, et al. The perception of smile attractiveness. Angle Orthod 2009;79(4):634–639. DOI: 10.2319/030508-131.1
2. Dunn WJ, Murchison DF, Broome JC. Esthetics: patients’ perceptions of dental attractiveness. J Prosthodont 1996;5(3):166–171. DOI: 10.1111/j.1532-849x.1996.tb00292.x
3. Parrini S, Rossini G, Castroflorio T, et al. Laypersons’ perceptions of frontal smile esthetics: a systematic review. Am J Orthod Dentofacial Orthop 2016;150(5):740–750. DOI: 10.1038/sj.ajodo.2017.75
4. Broer PN, Juran S, Liu YJ, et al. The impact of geographic, ethnic, and demographic dynamics on the perception of beauty. J Craniofac Surg 2014;25(2):e157–e161. DOI: 10.1097/SCS.0000000000000406
5. Rodrigues CDT, Magnani R, Machado MSC, et al. The perception of smile attractiveness: variations from esthetic norms, photographic framing and order of presentation. Angle Orthod 2009;79(4):634–639. DOI: 10.2319/030508-131.1
6. Anderson C, John OP, Keltner D, et al. Who attains social status? Effects of personality and physical attractiveness in social groups. J Pers Soc Psychol 2001;81(1):116–132. DOI: 10.1037//0022-3514.81.1.116
7. Tosun H, Kaya B. Effect of maxillary incisors, lower lip, and gingival display relationship on smile attractiveness. Am J Orthod Dentofacial Orthop 2020;157(3):340–347. DOI: 10.1016/j.ajodo.2019.04.030
8. Flores-Mir C, Silva E, Barriga MI, et al. Lay person’s perception of smile aesthetics in dental and facial views. J Orthod 2004;31(3):204–209; discussion 1. DOI: 10.1179/146531204225022416
9. Chang CA, Fields HW Jr, Beck FM, et al. Smile esthetics from patients’ perspectives for faces of varying attractiveness. Am J Orthod Dentofacial Orthop 2011;140(4):e171–e180. DOI: 10.1016/j.ajodo.2011.03.022
10. McLeod C, Fields HW, Hechter F, et al. Esthetics and smile characteristics evaluated by laypersons. Angle Orthod 2011;81(2):198–205. DOI: 10.2319/060510-309.1
11. Silva BP, Jiménez-Castellanos E, Martinez-de-Fuentes R, et al. Laypersons’ perception of facial and dental asymmetries. Int J Periodontics Restorative Dent 2013;33(6):e162–e171. DOI: 10.11607/prd.1618
12. Ker AJ, Chan R, Fields HW, et al. Esthetics and smile characteristics from the layperson’s perspective: a computer-based survey study. J Am Dent Assoc 2008;139(10):1318–1327. DOI: 10.14219/jada.archive.2008.0043
13. Del Monte S, Afrashtehfar KI, Emami E, et al. Lay preferences for dentogingival esthetic parameters: a systematic review. J Prostheth Dent 2017;118(6):717–724. DOI: 10.1016/j.prosdent.2017.04.032
14. Abu Alhajia ES, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. Eur J Orthod 2011;33(4):450–456. DOI: 10.1093/ejo/cjq100
15. Kumar S, Gandhi S, Valiathan A. Perception of smile esthetics among Indian dental professionals and laypersons. Indian J Dent Res 2012;23(2):295. DOI: 10.4103/0970-9290.100456
16. Pithon MM, Santos AM, Viana de Andrade AC, et al. Perception of the esthetic impact of gingival smile on laypersons, dental professionals, and dental students. Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115(4):448–454. DOI: 10.1016/j.oooo.2012.04.027
17. Correa BD, Vieira Bittencourt MA, Machado AW. Influence of maxillary canine gingival margin asymmetries on the perception of smile esthetics among orthodontists and laypersons. Am J Orthod Dentofacial Orthop 2014;145(1):55–63. DOI: 10.1016/j.ajodo.2013.09.010
18. Alhammadi MS, Halboub E. Perception of facial, dental, and smile esthetics by dental students. J Esthet Restor Dent 2018;30(5):415–426. DOI: 10.1111/1708-8240.12405
19. Ioi H, Kang S, Shimomura T, et al. Effects of vertical positioning of anterior teeth on smile esthetics in Japanese and Korean orthodontists and orthodontic patients. J Esthet Restor Dent 2013;25(4):274–282. DOI: 10.1111/j.1708-8240.2012.00323.x
20. Jon LYTC, Morante DRH, Bernabé E, et al. Esthetic perception towards different combinations of facial contours and upper incisor shape. Braz J Oral Sci 2009;8(4). DOI: 10.20396/bjos.v8i4.8642059
21. Sharma N, Rosenstiel SF, Fields HW, et al. Smile characterization by U.S. white, U.S. Asian Indian, and Indian populations. J Prostheth Dent 2012;107(3):327–335. DOI: 10.1016/j.prosdent.2010.07.022
22. Springer NC, Chang C, Fields HW, et al. Smile esthetics from the layperson’s perspective. Am J Orthod Dentofacial Orthop 2011;139(1):e91–e101. DOI: 10.1016/j.ajodo.2010.06.019
23. Wolfart S, Thomann H, Freitag S, et al. Assessment of dental appearance following changes in incisor proportions. Eur J Oral Sci 2005;113(2):159–165. DOI: 10.1111/j.1600-0722.2005.00206.x
24. Barros ECdS, Carvalho MDoD, Mello KCFR, et al. The ability of orthodontists and laypeople in the perception of gradual reduction of dentogingival exposure while smiling. Dental Press J Orthod 2012;17(5):81–86. DOI: 10.1590/s2176-94512012000500012
25. Cooper GE, Tredwin CJ, Cooper NT, et al. The influence of maxillary central incisor height-to-width ratio on perceived smile aesthetics. Br Dent J 2012;212(12):589–599. DOI: 10.1038/sj.bdj.2012.522
26. Foulger TE, Tredwin CJ, Gill DS, et al. The influence of varying maxillary incisal edge embrasure space and interproximal contact area dimensions on perceived smile aesthetics. Br Dent J 2010;209(3):E4. DOI: 10.1038/sj.bdj.2010.719
27. Ghaleb N, Bouserhal J, Bassil-Nassif N. Aesthetic evaluation of profile incisor inclination. Eur J Orthod 2011;33(3):228–235. DOI: 10.1093/ejo/cjq059
28. Machado AW, Moon W, Gandini LG, Jr. Influence of maxillary incisor edge asymmetries on the perception of smile esthetics among orthodontists and laypersons. Am J Orthod Dentofacial Orthop 2013;143(5):658–664. DOI: 10.1016/j.ajodo.2013.02.013
29. Thomas JL, Hayes C, Zawaideh S. The effect of axial midline angulation on dental esthetics. Angle Orthod 2003;73(4):359–364. DOI: 10.1043/0003-3219(2003)073<0359:TEOMAMA>2.0.CO;2
30. Moore T, Southard KA, Casko JS, et al. Buccal corridors and smile esthetics. Am J Orthod Dentofacial Orthop 2005;127(2):208–213; quiz 61. DOI: 10.1016/j.ajodo.2003.11.027
31. Ioi H, Nakata S, Counts AL. Effects of buccal corridors on smile esthetics in Japanese. Angle Orthod 2009;79(4):628–633. DOI: 10.2319/080708-410.1
32. Zhang Y-f, Xiao L, Li J, et al. Young people's esthetic perception of dental midline deviation. Angle Orthod 2010;80(3):515–520. DOI: 10.2319/052209-286.1
33. Yin L, Jiang M, Chen W, et al. Differences in facial profile and dental esthetic perceptions between young adults and orthodontists. Am J Orthod Dentofacial Orthop 2014;145(6):750–756. DOI: 10.1016/j.ajodo.2014.01.021
34. Pinzan-Vercelino CRM, Costa ACS, Ferreira MC, et al. Comparison of gingival display in smile attractiveness among restorative dentists, orthodontists, prosthodontists, periodontists, and laypeople. J Prosthodont Dent 2020;2016:7815274. DOI: 10.1016/j.psd.2019.03.023
35. Al Taki A, Khalesi M, Shagmani M, et al. Perceptions of altered smile esthetics: a comparative evaluation in orthodontists, dentists, and laypersons. Int J Dent 2016;2016:7815274. DOI: 10.1555/2016/7815274
36. Sadrhaghighi H, Zarghami A, Sadrhaghighi S, et al. Esthetic perception of smile components by orthodontists, general dentists, dental students, artists, and laypersons. J Investig Clin Dent 2017;8(4). DOI: 10.1111/jicd.12235
37. Kokich VO, Kokich VG, Kiyak HA. Perceptions of dental professionals and laypersons to altered dental esthetics: asymmetric and symmetric situations. Am J Orthod Dentofacial Orthop 2006;130(2):141–151. DOI: 10.1016/j.ajodo.2006.04.017
38. Pinho S, Cunha C, Faber J, et al. Impact of dental asymmetries on the perception of smile esthetics. Am J Orthod Dentofacial Orthop 2007;132(6):748–753. DOI: 10.1016/j.ajodo.2006.01.039
39. Olivares A, Vicente A, Jacobo C, et al. Canting of the occlusal plane: perceptions of dental professionals and laypersons. Med Oral Patol Oral Cir Bucal 2013;18(3):e516–e520. DOI: 10.4319/medoral.18335
40. Padwa BL, Kaiser MO, Kaban LB. Occlusal cant in the frontal plane as a reflection of facial asymmetry. J Oral Maxillofac Surg 1997;55(8):811–816. DOI: 10.1016/s0227-3919(97)90338-4
41. Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Dent 1999;11(6):311–324. DOI: 10.1111/j.1708-8240.1999.tb00414.x