

Influence of Different Parameters on the Smile Esthetic Perception of Dentists, Prosthodontists and Laypeople

Genel Diş Hekimleri, Protetik Diş Tedavisi Uzmanları ve Meslek Dışı Bireylerin Gülümseme Estetiği Algılarının Değerlendirilmesi

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Abstract

Objective: This study aimed to determine different parameters on the smile aesthetic perceptions of prosthodontists, general practitioner dentists and laypeople.

Materials and Methods: A close-up, posed smile image of a young woman was digitally altered by using software. The shape of the incisal curvature was arranged as ideal, flat, reverse and the width-to-length ratio of the maxillary central tooth was set to 75%, 80% and 85% in the photographs. Incisal edge asymmetries in the maxillary central, lateral and canine teeth and midline diastema at varying dimensions of 0.5 mm, 1 mm and 2 mm were created. As the control group, a photograph without any asymmetry or diastema was used. A questionnaire was created using these photographs and subsequently administered by a researcher. The images were assessed by 180 evaluators, which included 60 prosthodontists, 60 dentists and 60 laypeople. Each evaluator was asked to rate the smile images with the help of a visual analogue scale. Obtained data were analysed by using One-Way ANOVA with post hoc Tukey test.

Results: The ideal incisal curvature, small amount of diastemas and incisal asymmetries and 80% width-to-length ratio of the maxillary central teeth were more aesthetic to all participants ($p < 0.001$).

Conclusion: Laypeople's aesthetic scores were higher than those of general practitioner dentists and prosthodontists in all groups. Aesthetic scores increase as the size of asymmetries decreases. Diastemas and incisal edge asymmetries were less perceptible laterally.

Öz

Amaç: Bu çalışmanın amacı protetik diş tedavisi uzmanları, genel diş hekimleri ve meslek dışı bireylerin gülümseme estetiği algılarını belirlemektir.

Gereç ve Yöntemler: Bu çalışmada, kadın bir gönüllüden poz gülümsemesi esnasında alınan yakın çekim fotoğrafları kullanılmıştır. Fotoğraflar bir yazılım programıyla dijital olarak düzenlenmiştir. Fotoğraflarda insizal kurvatür şekli ideal, düz ve ters olarak ve maksiller santral dişin genişliği %75, %80 ve %85 olarak değiştirilmiştir. Maksiller santral, lateral ve kanin dişlerinde 0,5 mm, 1 mm ve 2 mm olmak üzere farklı boyutlarda insizal asimetri ve orta hatta aynı boyutlarda diastema oluşturulmuştur. Kontrol grubu olarak ise, herhangi bir asimetriye veya diastemaya sahip olmayan bir fotoğraf kullanılmıştır. Bu fotoğraflar kullanılarak bir anket oluşturulmuş ve bir araştırmacı tarafından uygulanmıştır. Fotoğraflar 60

genel diş hekimi, 60 protetik diş tedavisi uzmanı ve 60 meslek dışı birey olmak üzere toplam 180 kişi tarafından değerlendirilmiştir. Her bir katılımcıdan fotoğrafları görsel analog skala yardımıyla değerlendirmesi istenmiştir. Elde edilen veriler tek yönlü varyans analizi ve post hoc Tukey testi ile değerlendirilmiştir.

Bulgular: İdeal insizal kurvatür, küçük boyutlardaki diastemalar ve insizal asimetri ile %80 genişlik/uzunluk oranına sahip maksiller santral dişler bütün katılımcılar tarafından daha estetik bulunmuşlardır ($p<0,001$).

Sonuç: Tüm gruplarda meslek dışı bireylerin estetik skorları, genel diş hekimleri ve protetik diş tedavisi uzmanlarından yüksek bulunmuştur. Asimetri azaldıkça estetik skorlar artmıştır. Orta hattan lateral yönde gidildikçe, daha büyük boyutlardaki insizal kenar asimetrisi algılanmıştır.

Introduction

Esthetics, which becomes increasingly important in modern dentistry, means an interest in beauty or liking of beauty (1). The smile plays a fundamental role in facial esthetics and attractiveness (2). Furthermore, an attractive and pleasant smile creates the first positive effect in the social lives of individuals and ensures that the person is accepted in bilateral relationships (3). Smile esthetics, one of the most essential components of dentofacial esthetics, is of major importance in dental treatments nowadays (4,5). In smile esthetics, factors such as gingival display (6,7), ratio and symmetry of maxillary incisors (8-10), incisal curvature (11-14), the presence of gingival and dental asymmetries (3,15-19), and the presence of midline diastema are effective (15,20,21).

Esthetic perception may vary from person to person with the effect of social environment and personal experiments (22). Due to the same reason, there are differences among beauty perceptions of laypeople and dental professionals (23). A smile that is beautiful and attractive to dentists may not create the same perception in other individuals (24). When evaluating esthetics, dentists were determined to be stricter than laypeople (15).

There are many studies in the dental literature comparing the perceptions of smile esthetics of dentists, orthodontists, and laypeople (3,9,15,18,25-36). However, there has been no extensive study in the dental literature examining the effects of the different smile esthetic parameters on prosthodontists' smile esthetic perception.

The aim of this study was to determine the effects of different smile esthetic parameters, such as incisal curvature shape, incisal asymmetry of anterior teeth, the presence of diastema, different width/length ratios of central teeth on the smile esthetic perceptions of prosthodontists, general practitioner dentists and laypeople. The hypothesis of the study

was that participants' occupations (general dentists, prosthodontists, laypeople) would not significantly affect their perceptions of smile esthetics.

Materials and Methods

This research obtained the research ethics committee approval from the Sakarya University Faculty of Medicine (protocol number: 71522473/050.01.04/537, date: 08.10.2020). Also, a female individual who posed for the study signed an image use authorization. All participants has signed an informed consent form (26).

Sample size in the study was determined by using a software (G*Power 3.01, Franz Faul, Christian-Albrechts-Universität Kiel, Kiel, Germany) to achieve 80% power, and "effect size" was 0.25. According to the results of this calculation, 56 subjects in each group were necessary. However, $n=60$ was determined as safety margin. Consequently the present study was conducted with a total of 180 volunteers which was consistent with the other studies that used similar methods (9,26,37).

In this study, three groups evaluated different smile images: Prosthodontists, dentists and, laypeople. The inclusion criteria for prosthodontists and dentists were completing their specializations or dental educations at least 2 years. This information was confirmed by the Turkish Society of Dentistry. For laypeople, inclusion criterias were being older than 18 years old, having a university education, not being a dental technician, oral hygienist and dental assistant, not having any dental education, not being associated with artistic activities or not being an artist. The present study was conducted among laypeople in a shopping mall (38). While, conducted among general practitioner dentists and prosthodontists in a congress center.

A close-up smile image of a young female volunteer having an attractive smile without any facial asymmetries (39) were taken by using a DSLR

camera (Nikon, DX SWM VR ED IF Aspherical ϕ 72, Thailand). Changes were made in photographs by using a software (Photoshop CS6 v.13.0.4; Adobe Inc, Mountain View, CA, USA) (9,18,23-25,36-44).

By using the photoshop program a symmetrical smile (right to left) was created, most parts of chin, cheeks and, nose were removed discoloration in skin and, lips were retouched, to reduce variables within the images (15,16). Photographs were arranged to achieve identical measurements of volunteer. It was provided that each millimeter measured on the digital image was equivalent to the volunteer, determining maxillary central teeth as a reference point (45). Furthermore, all of the images were standardized in 300 dots per inch resolution (9,46).

In the photographs, the shape of the incisal curvature was changed to be ideal, flat, and reverse (Figure 1) (7,11,18,25,32,37,47). Midline diastemas were also created at varying dimensions: 0.5 mm, 1 mm, 1.5 mm and 2 mm (Figure 2) (17,25,33,34). Furthermore, 0.5 mm, 1 mm, and 2 mm incisal edge asymmetries were created in maxillary central, lateral and canine teeth (Figure 3-5) (3,16,25,34). The width to length ratio of the maxillary central tooth was changed to be 75%, 80%, and 85% (Figure 6) (48,49). A questionnaire was created by the changing esthetic



Figure 1. Alterations in smile arc a) ideal b) flat c) reverse



Figure 2. Different degrees of midline diastema a) 0.5 mm b) 1 mm c) 2 mm



Figure 3. Different incisal asymmetries in maxillary central teeth a) 0.5 mm b) 1 mm c) 2 mm



Figure 4. Different incisal asymmetries in maxillary lateral teeth a) 0.5 mm b) 1 mm c) 2 mm

parameters in the photographs and turning them into questions by a software (Google Docs, Google Inc., Mountain View, CA) (46).

Participants' sociodemographic datas including age, gender, occupation and education level were gathered by using a questionnaire (17). Images were arranged in a random order (15,45) and showed to the participants individually by a single researcher. The observation time for each image was determined as 20 seconds (38). The participants were allowed to view one image at a certain time, and it was not allowed to go back to other photographs and compare the images (50).

The esthetic value of each image was determined using the visual analog scale (VAS) (9,15,23,26,41-46). The VAS was prepared to be 10 mm long, and the participants were asked to score different smiles according to their own esthetic values. The esthetic score was arranged to be between 0-10. Zero corresponds to the minimum (least attractive), while ten corresponds to the maximum (most attractive) esthetic value (49).

Statistical Analysis

Statistical analysis was performed using the SPSS program (version 22.0, SPSS). Kolmogorov-Smirnov normality test was conducted to the assessment of the data for skewness, kurtosis, and outliers, it was concluded that the data was normally distributed. Then, One-Way ANOVA tests were performed within each group to assess how the study groups rated at each level of deviation and within each level of variation to compare each groups' esthetic scores. Multiple comparisons corrected with Bonferroni adjustments and post hoc Tukey test were performed to calculate the threshold level of deviation at which each study group was differentiated and also to determine how groups' esthetic scores have distinguished from the



Figure 5. Different incisal asymmetries in maxillary canine teeth a) 0.5 mm b) 1 mm c) 2 mm



Figure 6. Different width to length ratio of maxillary central teeth a) 75% b) 80% c) 85%

other groups. The level of significance was set at $\alpha=0.05$.

Results

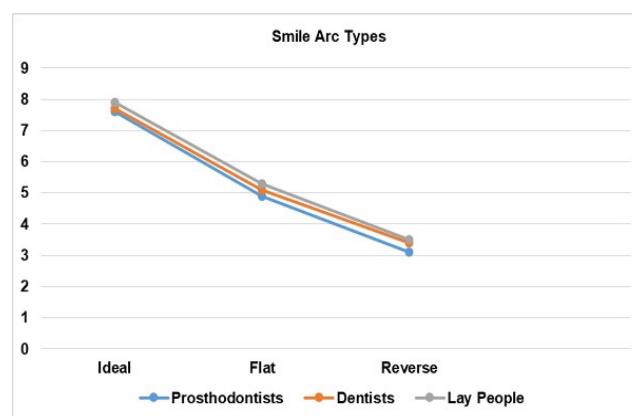
The results of the study presented that, 47.2% of the participants were men while 52.8% were women, 27.8% were between 26-35 years and 24.4% were between 36-45 years old. The participants' demographic characteristics are shown in Table 1.

The mean esthetic score of the smiles with the ideal incisal line was 8.4, flat incisal line was 5.1 and reverse incisal line was 3.3. The esthetic scores of smiles with ideal incisal line were higher than flat and reverse incisal lines ($p<0.001$). In addition, esthetic scores of laypeople were higher than dentists and laypeople in each incisal line type but there wasn't any difference between groups ($p>0.05$) (Graphic 1).

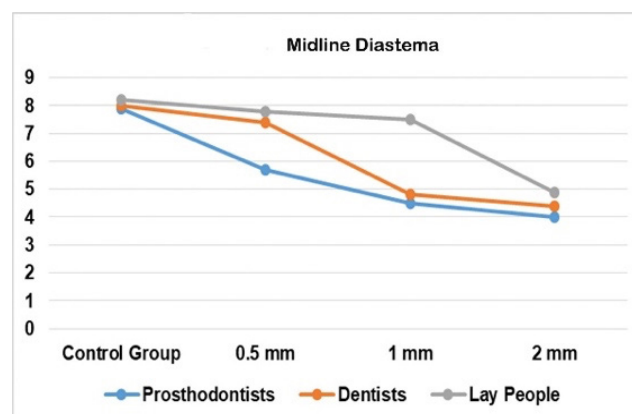
As a result of the study, the highest esthetic scores were observed in 0.5 mm midline diastema (mean: 7.8); lowest esthetic scores in 2 mm midline diastema (mean: 4.4) in all study groups ($p<0.001$). Dentists' and prosthodontists' esthetic scores were lower than laypeople's in each level of diastema ($p<0.001$). Threshold levels of significant difference of esthetic scores were 0.5 mm for prosthodontists, 1 mm for dentists, 2 mm for laypeople. Prosthodontists were more critical than general practitioner dentists and laypeople when evaluating midline diastemas (Graphic 2).

When the incisal edge asymmetries of maxillary anterior teeth were compared, the highest esthetic scores were observed in canine teeth with 0.5 mm incisal asymmetry (mean: 7.2); the lowest esthetic

scores were observed in the central teeth with 2 mm incisal asymmetry (mean 3.4). When the amount of incisal asymmetries increased, the esthetic scores of maxillary central, lateral, and canine teeth decreased ($p<0.001$). Laypeople had higher esthetic scores than



Graphic 1. Attractiveness of images with different smile arc types



Graphic 2. Attractiveness of images with different degrees of midline diastema

Table 1. Demographic characteristics of the participants

Characteristics	Prosthodontists	Dentists	Laypeople
Genders			
Male	31 (51.7%)	26 (43.3%)	28 (46.7%)
Female	29 (48.3%)	34 (56.7%)	32 (53.3%)
Age groups			
18-25 y	0 (0%)	3 (5%)	16 (26.7%)
26-35 y	20 (33.3%)	17 (28.3%)	13 (21.7%)
36-45 y	19 (31.7%)	14 (23.3%)	11 (18.3%)
46-55 y	11 (18.3%)	14 (23.3%)	9 (15%)
55-65 y	7 (11.7%)	8 (13.3%)	6 (8.3%)
>65 y	3 (5%)	3 (6.8%)	6 (10%)

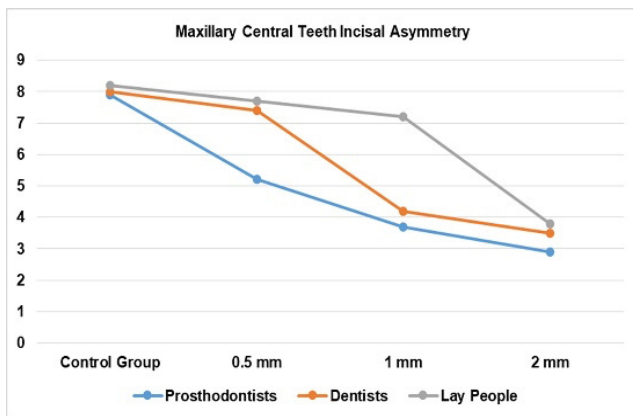
dentists and laypeople in each level of asymmetries of all teeth ($p < 0.001$). Prosthodontists were more critical than general practitioner dentists and laypeople when evaluating incisal edge asymmetries. Threshold levels of significant difference of esthetic scores were 0.5 mm for prosthodontists, 1 mm for dentists, 2 mm for laypeople in all teeth. Canine teeth's esthetic scores in each level of incisal asymmetries were higher than central and lateral incisors, in all groups ($p < 0.001$) (Graphic 3-5).

Maxillary central teeth with 80% width/length ratio had highest esthetic scores (mean 7.9), while the 85% ratio had lowest esthetic scores (mean: 5.9). Esthetic scores of prosthodontists and dentists were lower than laypeople in 75% width/length ratio ($p = 0.011$), in 80% ratio ($p = 0.007$), in %85 ratio ($p = 0.002$) (Graphic 6).

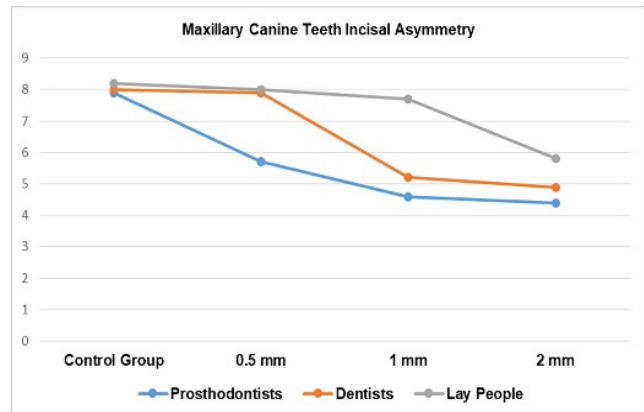
Discussion

Dental and gingival asymmetries adversely affect esthetics in adults (9). Age, genders, professions, ethnicities may influence people's smile esthetic perceptions (28-31). As a consequence of the present study, while the esthetic scores of smiles which had different incisal curvature shapes, the esthetic scores of smiles had different amounts of asymmetry, rotation, and diastema in the anterior teeth and different width to length ratios of the central tooth, differed among dentists, prosthodontists and laypeople. The null hypothesis, which estimated that there would be no differences among the study groups, was partially accepted.

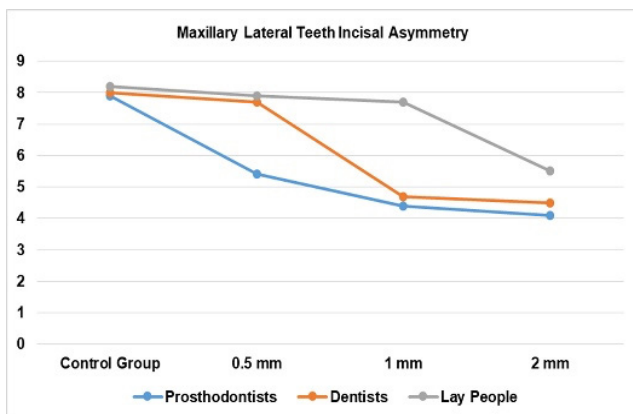
When the incisal edge curvatures of the upper anterior teeth is parallel to the lower lip curvature, this is defined as the ideal smile arc (11). While the ideal smile arc increases the attractiveness of the



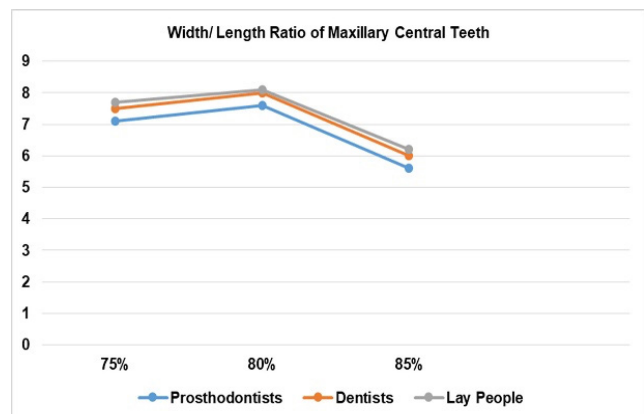
Graphic 3. Attractiveness of images with different incisal asymmetries of central teeth



Graphic 5. Attractiveness of images with different incisal asymmetries of canine teeth



Graphic 4. Attractiveness of images with different incisal asymmetries of lateral teeth



Graphic 6. Attractiveness of images with maxillary central teeth's different width/length ratios

smile, the straight smile arc decreases it (11,32,45). In different ethnicities, different smile arcs can be considered esthetic (31). In the literature, it was reported that orthodontists, dentists, and laypeople found the ideal smile arc more esthetic, while they found the flat smile arc less esthetic (7,25,45). Rodrigues et al. (20) stated that laypeople found the reverse smile arc less esthetic. In our study, similarly to studies in the literature (7,11,25,32,45), while the ideal smile arc was perceived to be more esthetic by prosthodontists, dentists, and laypeople, flat smile arc obtained lower esthetic scores. Furthermore, in our study, similarly, Rodrigues et al. (20) reverse smile arc received the lowest esthetic scores in all groups.

In the literature, some researchers (15,25) noted that the esthetic scores of those with small diastemas (0.5 mm) in the midline were generally higher than those with 1 mm, 1.5 mm and 2 mm diastemas. Kokich et al. (15) stated that in order not to find the smile attractive, the threshold value of the diastema in the midline was 1 and 1.5 mm for orthodontists, and 2 mm for dentists and laypeople. At the same time, Al Taki et al. (25) concluded that the threshold value of midline diastema was 1 mm for orthodontists and dentists and 1.5 mm for laypeople. While in India, for accepting that the diastema is esthetic, the threshold value is 1.5 mm for orthodontists, general dentists, and laypeople (34), in Africa, this value is 2-3 mm for laypeople (33). According the results of this study, different from other studies (15,25,33) threshold values were 0.5 mm for prosthodontists, 1 mm for dentists, 2 mm for laypeople. In our opinion, this difference is because of the fact that prosthodontists are stricter than orthodontists in detecting midline diastemas.

In the dental literature, Kokich et al. (3) evaluated asymmetries in the length of teeth, and they reported that orthodontists could distinguish even a 0.5 mm shortness of the crown length of teeth, dentists could notice a 1.5 mm shortness of the crown length, and laypeople could notice a 2 mm shortness of the crown length. It was reported that laypeople living in the United States did not accept teeth with a 1.5-2 mm shortness as symmetric (16), while those in India did not accept teeth with a shortness of more than 1.5 mm (34), and the Arabic people did not accept a 2 mm shortness as symmetric (25). As a result of the current study, similarly to the study by Kokich et al. (3)

only the esthetic scores of prosthodontists decreased in the case of a 0.5 mm shortness in lateral and central incisors and canine teeth. Similarly to other studies in the literature (16,25), the esthetic scores of general dental practitioners decreased in the case of a 1 mm shortness, while the esthetic scores of laypeople decreased in the case of a 2 mm shortness.

Furthermore, Chiche and Pinault (14) considered that symmetry at the midline was essential, while more laterally a certain amount of asymmetry was permissible. According to the results of this study, supporting Chiche and Pinault (14) incisal asymmetries of central teeth had the lowest while canine teeth had the highest esthetic scores, and also esthetic scores increased laterally.

The ideal width to length ratio of maxillary central incisors is between 75-85% (37). Sterrett et al. (48) stated that the teeth size of males was larger than that of females, and while the width/length ratio was expected to be closer to 75% for females, values close to 85% were more acceptable for males. Álvarez - Álvarez et al. (27) reported that maxillary central teeth with a width/length ratio of 85% were considered to be more esthetic by dentists and laypeople. Unlike the study by Álvarez - Álvarez et al. (27) as a results of the current study, the esthetic scores of maxillary central teeth, which had a width/length ratio of 80%, were higher in all three groups. This situation is thought to be related to the changes in esthetic perception due to the difference in ethnicity in the two studies.

In our opinion, information obtained about the perceptions of smile esthetics of prosthodontists, dentists and laypeople as a result of the current study will help clinicians in treatments in the esthetic zone. Knowing which situations are found as esthetic or unesthetic by patients can help dental professionals to avoid unnecessary treatments, especially in the esthetic zone. The first limitation of the current study is that not all parameters of the esthetic checklist were evaluated. The another limitation was that 2D photographs of volunteer were evaluated and 3D models were not used. The third limitation is that individuals were not asked to evaluate the photographs repetitively over a specific period of time, and the results were obtained with the evaluation performed by the individuals once. The fourth limitation is that this study was performed only in one ethnicity, and the results of the study did not

provide general information about the smile esthetics of prosthodontists, dentists, and non-professionals around the world.

Conclusion

Within the limitations of the present study, it was concluded that:

1. Ideal smile arc had the highest esthetic scores.
2. Prosthodontists can notice smaller diastemas and asymmetries in comparison with dentists and laypeople.
3. As the size of asymmetries and diastemas increases, esthetic scores decrease at that rate.
4. The maxillary central tooth with a width/length ratio of 80% has the highest esthetic scores.

Ethics

Ethics Committee Approval: This research obtained the research ethics committee approval from the Sakarya University Faculty of Medicine (protocol number: 71522473/050.01.04/537, date: 08.10.2020).

Informed Consent: All participants has signed an informed consent form.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: M.K., Design: M.K., Supervision: F.B., Fundings: M.K., Materials: M.K., Data Collection or Processing: M.K., Analysis or Interpretation: M.K., Literature Search: M.K., Critical Review: F.B., Writing: M.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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