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LAYPERSONS AND DENTISTS' PERCEPTION OF SMILE ESTHETICS IN SPACING BETWEEN MAXILLARY CENTRAL AND LATERAL INCISORS TEETH: A CROSS-SECTIONAL STUDY

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Abstract

A smile is an important component of facial attractiveness. However, perceptions of gaps between adjacent teeth, known as diastema, may vary among different individuals and regions depending on cultural or other factors. This study aimed to evaluate perceptions of midline diastema and lateral diastema among individuals of different ages, genders, education levels, and occupations. A cross-sectional study based on a survey with manipulated pictures was conducted at the Department of Prosthodontics, Islamic International Dental Hospital and College, Islamabad, Pakistan, from 1 March to 31 May 2020. The surveyed population included dentists and laypeople and comprised 198 (44.4%) men and 248 (55.6%) women with a mean age of 30.52±13.46 years. Data were analyzed using the Statistical Package for Social Sciences (SPSS), version 23.0 (IBM Corporation, Armonk, USA) for Microsoft Windows. The statistical hypothesis test and chi-square test were used to validate significant differences ($p \leq 0.05$). Of the 446 participants who completed the survey, 384 (86.09%) preferred a midline diastema of 0mm, and 320 (71.74%) preferred a lateral diastema of 0mm. Approximately 71.71% of the male and 83.6% of the female participants preferred a maxillary midline diastema of 0mm. A significantly ($P \leq 0.05$) greater percentage of dentists (91.12%) than laypeople (70.40%) rated a midline diastema of 0mm as most attractive. The negative perceptions of midline and lateral diastema appear to be related to their location and width. The participants rated a diastema of 0mm more attractive than a diastema of 1.5mm or 2mm.

Keywords: Dental Esthetics. Lateral Diastema. Midline Diastema. Teeth Morphology.

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1. Introduction

Many factors influence patients' attitudes about dental care and can impede or help dental professionals. Patients' perceptions of dental care play a crucial role in the work of dental care providers and depend on the types of care received. Evaluating the perceptions and opinions of patients regarding a dentist's services, including satisfaction, can provide valuable feedback for fulfilling patients' demands (Abu-Hussein and Watted 2016). These types of evaluations are also important for assessing dental care services, procedures, and results. Better awareness of patient perceptions can help dentists improve public knowledge of dentistry and their interpersonal relationships with patients (Abu-Hussein and Watted 2015).

Like other features of human behaviour, perceptions are subject to manipulation. The complex accumulation of previous experiences establishes the response to a given stimulus (Sabri et al. 2023). Some experiences are specific to particular cultures, and the resulting differences in human behaviour among cultures can give rise to divergent perceptual tendencies. These discrepancies in perception may even extend to ubiquitous human features, such as a space or gap between two teeth known as a diastema (Araújo et al. 2023).

Diastema is frequently present between maxillary central incisors; however, it can also be found in different regions, including mesial or distal to both the lateral incisor and canine teeth. A diastema between the central incisors is also called a midline / central/median maxillary diastema because of its site in the maxillary arch (Alhammadi et al. 2018; Al-Sehaibany et al. 2021; Althagafi 2021). A diastema may be a malocclusion with functional and aesthetic outcomes that require management or a typical characteristic of kids or adults that does not necessitate treatment (Althagafi 2021; Araújo et al. 2023). Studies of the occurrence of diastemata in different groups and populations have reported a prevalence of 1.6% to 25.4% in the adult population, whereas the majority of younger age groups exhibit diastema (Bolas-Colvee et al. 2018; Ahiaku and Millar 2023).

There may also be wide variations in how individuals of various cultures, genders, education levels, and socioeconomic groups perceive diastemata (Araújo et al. 2023). Moreover, dentists and laypeople will likely differ in attitudes towards diastemata (Bolas-Colvee et al. 2018). Previous studies of these differences in attitudes have yielded conflicting results, with some noting divergent perspectives between dentists and laypeople and others finding no differences in the midline and lateral diastemata perceptions. However, these studies were mainly based on dentists' perceptions collected via self-reports, focus groups, and biomechanical modeling to promote tool design (Chaves et al. 2021; Araújo et al. 2023). Aesthetics is an essential criterion for smile design, and the effects of a midline or lateral diastema on the perception of aesthetics have primarily been examined using manipulated images (Alhammadi et al. 2018; Al-Sehaibany et al. 2021). Compared with self-reports, using images conveys a more genuine and authentic method of eliciting perceptions of diastema, as images represent the actual movements of the dentofacial tissues during smiling and speaking (Cho et al. 2022).

A 2-mm threshold was discovered for considerable unattractiveness by laypersons in two investigations that used visual analog scales to assess the influence of midline diastema width (Motamedian et al. 2023). For orthodontists and dentists, this cutoff was lower. In contrast, the midline diastema measured by Carneiro and Singh was only 0.5 mm wide (Carneiro et al. 2022; Singh and Chaudhary 2022). The existence of diastema—between the maxillary central and lateral incisors, not in the midline—is a common problem when managing esthetics cases. The worry is whether the space will be detected (Cho et al. 2022). Determining the appropriate spacing is crucial if it is evident and therapy is needed. Concerns with the visual perception of facial and dental structures can be addressed by recent eye-tracking studies (Althagafi 2021; Cousineau et al. 2022; Motamedian et al. 2023). In dentistry, eye tracking is a technique that measures metrics related to eye movements and logs the resulting tracks for examination. By enabling them to evaluate the aesthetic value of a diastema more accurately between the maxillary central and lateral incisors, this new technology can assist dentists in suggesting alternative treatments for their patients (Ahmed et al. 2022). We hypothesized that Laypeople are less observant than general dentists in assessing facial and, specifically, smile esthetics. The current study set out to assess the symmetry of permanent teeth space on both sides of the dental arches in various individuals to ascertain whether people prefer

symmetrical values related to permanent teeth space and what the differences are between teeth that are symmetric relative to each other and those that are not.

2. Material and Methods

A cross-sectional survey was performed of a population in the Department of Prosthodontics, Islamic International Dental Hospital and College, Islamabad, Pakistan, from 1 March to 31 May 2020, comprising dental and medical students, graduates, and laypeople. Ethical approval for the study was obtained from the Department of Prosthodontics, Islamic International Dental College. Every participant received an explanation of the study's goals and guiding principles. Confidentiality of the data obtained was guaranteed, and informed consent was gathered. The study's participants were informed of their voluntary nature and right to withdraw at any moment with advance notice. The excluding factors were orthodontic treatment and issues related to refractory.

Seven uniform photographs showing the aesthetic smiles of women were chosen for the present study, including two without a diastema and five with a diastema. The smiles selected for inclusion in the present study were significantly considered pleasing according to the basic standards of an ideal smile reported in other studies (Alhammadi et al. 2018; Althagafi 2021). The selected photographs were digitally manipulated using Adobe Photoshop CS3 (Adobe Systems Inc., San Jose, CA) to adjust brightness, contrast, and color and remove any skin and lip staining. The photographs were then compressed to obtain an image with values matching those of the actual subject. With the maxillary central and lateral incisor serving as a guide, every millimeter measured on the digital and printed images was compared precisely with every millimeter recorded clinically on the individual. The papillary zeniths, gingival margins, and incisal edges were not changed in all photographs.

The photographs of midline diastema were edited to show a diastema with a width of 0mm, 1.5mm or 2mm, and the pictures of lateral incisor diastema were edited as follows: photograph 1, no diastema; photograph 2, diastema mesial to the lateral incisor only; photograph 3, diastema distal to the lateral incisor only; photograph 4, both mesial and distal diastema. An image folder was created containing all photos from each group in random order. The definitive photographs were digital records with 300 dots per inch resolution. They were efficiently printed using a Canon SELPHY CP1300 Color Photo Printer (Japan) on regular 6×4" size format Canon photo paper (Japan).

Eight numbered photographs—four for the midline diastema and four for the lateral diastema—were used in a survey to show the altered photos to the targeted audience at offices, clinics, residences, and colleges, as shown in figure 1. The following question accompanied each slide as a heading: "Which one is your favorite?" The participants provided answers on a pre-made form that asked about their occupation, age, gender, and degree of education. All participants marked a point on the scale according to their perception of diastema. The values were then calculated in millimeters (AWM) using an electronic digital caliper (Electron Microscopy Sciences, USA).

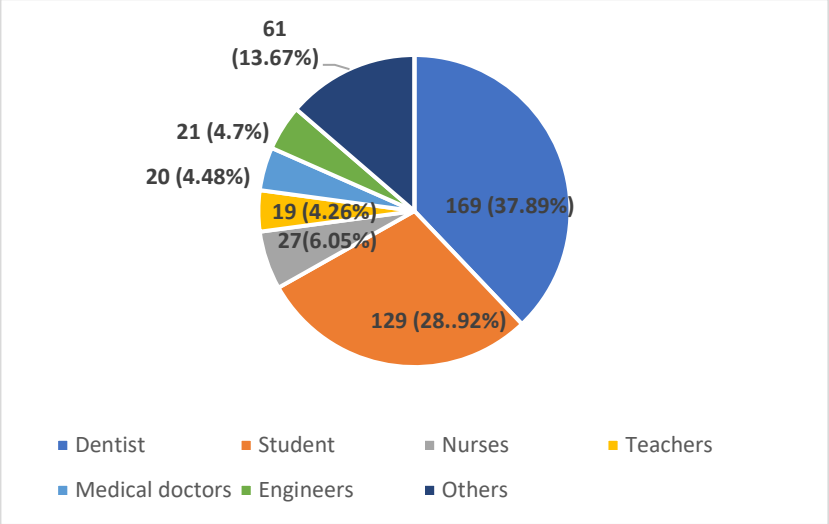

Figure 1. Occupations of the study sample

The Statistical Package for Social Sciences (SPSS), version 23.0 (IBM Corporation, USA), for Microsoft Windows was used for data collection and analysis. The presentation of the results took the form of cross-tabulated frequencies. For proportional variables, statistical significance was assessed with the statistical hypothesis test and chi-square test ($p \leq 0.05$).

3. Results

The profile of the participants is shown in Table 1. In total, 446 participants completed the survey, including 198 (44.4%) men and 248 (55.6%) women. The participants ranged in age from 18 to 65 years, with a mean of 30.52±13.46 years; 321 belonged to the 18- to 36-year-old group, and the remaining 125 belonged to the 37- to 65-year-old group. The participants had various levels of education: 201 (48.2%) were undergraduates, 161 (38.7%) were graduates, and 84 (13.5%) were postgraduates. The frequencies of different occupations among the participants were as follows: 169 (37.89%) dentists, 129 (28.92%) students, 27(6.05%) medical doctors, 19 (4.26%) engineers, 20 (4.48%) housewives, 21 (4.7%) teachers, and 61 (13.67%) other (including bankers, army officers, businessmen and media personnel), as shown in Figure 2.

Table 1. Sociodemographic characteristics of the participants

	Frequency (%)
Age (years)	
18- 26 (142)	(31.8)
27-36 (179)	(40.13)
37-45 (67)	(15)
45-55 (37)	(8.2)
56-70 (21)	(4.7)
Total (446)	(100)
Gender	
Male (198)	(44.39%)
Female (248)	(55.6%)
Total (446)	(100)
Occupation	
Dentist (169)	(37.89)
Students (129)	(28.92)
Doctors (27)	(6.05)
Engineers (19)	(4.26)
Teachers (21)	(4.7)
Housewives (20)	(4.48)
Others (61)	(13.61)
Total 446	(100)
Education	
Undergraduates (201)	(48.2)
Graduates (161)	(38.7)
Postgraduates (84)	(13.5)
Total (446)	(100)

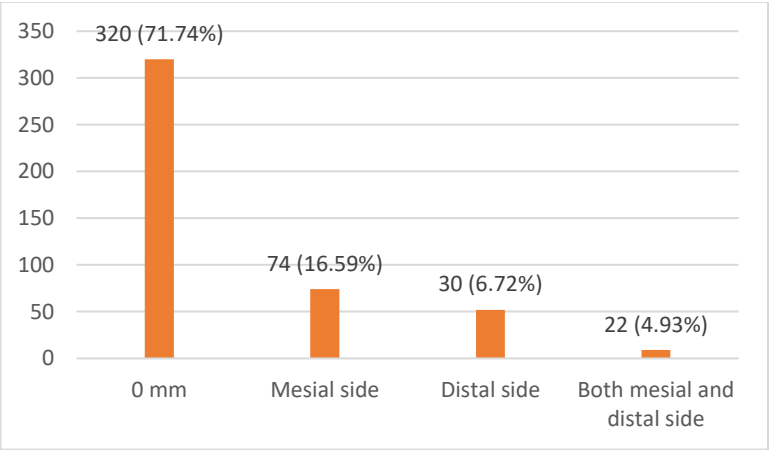

Figure 2. Preferences for lateral Diastema.

When all participants were asked to choose among the three widths of midline diastema, i.e., 0mm, 1.5mm, and 2mm, 384 (86.09%) chose 0 mm, 42 (9.41%) chose 1.5 mm, and 20 (4.48%) chose 2 mm. Among the four types of lateral diastema, 320 (71.74%) chose 0 mm, 74 (16.59%) chose the mesial diastema, 30 (6.72%) chose the distal diastema, and 22 (4.93%) chose both diastema, as shown in Figure 3. In the 37- to 65-year-old group, 86.1% of the participants chose a midline diastema width of 0mm, and 13.9% chose 1.5mm. In the 18- to 36-year-old group, 86.1% chose 0mm, 9.41% chose 1.5mm, and 4.48% chose 2mm. The differences in preference between the two age groups were insignificant (P = 0.0008), as shown in Table 2. Concerning the four types of lateral diastema, the tendency for 0mm was significantly higher in the younger group than in the older group. In contrast, the preference for mesial diastema was considerably higher in the older group than in the younger group.

Table 2. Cross-tabulation analysis of the preference for a midline diastema or lateral diastema according to age.

Age	Midline diastema				Lateral diastema				
	0 mm	1.5 mm	2 mm	**Total**	0 mm	Mesial	Distal	Mesial and distal	**Total**
18-36	285	25	11	321	249	43	17	12	321
37-65	99	17	9	125	71	31	13	10	125
Total	384	42	20	446	320	74	30	22	446

Table 2 shows that age was not significantly associated with the preference for a midline diastema (P=0.007) but was significantly associated with the preference for a lateral diastema (P=0.005).

When stratified by gender, the preference for midline diastema was higher among men (21.97%) than women (19.73%). The intentions for mesial, distal and both diastema were also higher among men (14.57%) than women (11.88%), as shown in Table 3.

Table 3. Cross-tabulation analysis of the preference for a midline diastema or lateral diastema according to gender.

Gender	Midline diastema				Lateral diastema				
	0 mm	1.5 mm	2 mm	**Total**	0 mm	Mesial	Distal	Mesial and distal	**Total**
Male	142	34	22	198	133	44	16	5	198
Female	206	31	11	248	195	27	19	7	248
Total	348	65	33	446	304	38	41	9	446

Table 4 shows that the perceptions of midline and lateral diastema were higher among graduates (19.25%) than undergraduates (18.90%) and postgraduates (15.47%). Stratification by occupation revealed that the dentists preferred the smile without a diastema and found the 2mm midline diastema and combined medial and distal diastemata least desirable. From the laypeople's perspective, the most pleasant smiles were the ones with no diastema, a 1.5mm distal of lateral incisor diastema. In contrast, those with a 2-mm midline diastema or combined mesial and distal diastemata were the least attractive smiles. The differences in perception of lateral diastemata between dentists and laypeople were significant ($p< 0.05$), as shown in Table 5.

Table 4. Cross-tabulation analysis of the preference for a midline diastema or lateral diastema according to education.

Education	Midline diastema				Lateral diastema				
	0 mm	1.5 mm	2 mm	**Total**	0 mm	Mesial	Distal	Mesial and distal	**Total**
Undergraduate	163	26	12	201	127	45	19	10	201
Graduate	130	22	9	161	114	21	15	11	161
Postgraduate	71	10	3	84	61	10	8	5	84
Total	373	49	24	446	302	76	42	26	446

Table 4 shows that education was significantly associated with both the preference for a midline diastema (P=0.034) and the preference for a lateral diastema (P=0.029).

Table 5. Cross-tabulation analysis of the preference for a midline diastema or lateral diastema with occupation.

Occupation	Midline diastema				Lateral diastema				
	0 mm	1.5 mm	2 mm	**Total**	0 mm	Mesial	Distal	Mesial and distal	**Total**
Dentist	154	12	3	169	149	14	4	2	169
Laypersons	195	53	29	277	173	49	29	26	277
Total	344	70	32	446	322	63	33	28	446

Table 5 shows that occupation was not significantly associated with the preference for a midline diastema but was significantly associated with the preference for a lateral diastema (P=0.0599).

4. Discussion

Studies evaluating the characteristics of an ideal smile have primarily focused on the maxillary incisors. Negative aesthetic features of the maxillary teeth are more readily seen than posterior teeth and thus impact the perceived attractiveness of a smile (Sriphadungporn and Chamnannidiadha 2017; Revilla-León et al. 2020; Runte and Dirksen 2021). There are various clinical scenarios in which diastemata may affect these teeth (Alhammadi et al. 2018; Bolas-Colvee et al. 2018; Motamedian et al. 2023). Dentists and laypeople generally accept midline diastemata of less than 0.5 mm (Motamedian et al. 2023). The findings support our hypothesis that dentists have a distinct perception of smile esthetic aspects than ordinary persons. In contrast, even a tiny space between the lateral and central incisors of the maxilla may be considered unpleasant (Ousehal et al. 2016; Tanaka et al. 2020).

Similarly, it has been shown that asymmetric variances provide the appearance that teeth are unsightly to both dentists and the public (Abu-Hussein and Watted 2016; Tanaka et al. 2020). In this study, the Participants looked at pictures of a grin where the maxillary central and lateral incisors had varying diastema. Overall, both dentists and laypeople focused their interest on the maxillary central and lateral incisors (Reis et al. 2020), and it didn't seem like the participants agreed with the African cultural view that a midline diastema is a beautiful sign (Singh and Chaudhary 2022).

In this investigation, the perception of smile attractiveness varied across non-dental professionals, dentistry students, and dentists as the midline and lateral diastema grew from 0.5 to 4.0 mm. As a minor dental imperfection, diastema with a gap width of 0.5 mm is widely accepted by both laypeople and dentists involved in the study. Despite varying degrees of dental information exposure, both laypeople and dentists concur that diastema<2.0 mm does not substantially affect the overall appearance of a smile. Conversely, orthodontists who are more critical of aesthetic deviation felt that a woman's dental look is impacted by a 0.5 mm diastema. The investigation of diastema aesthetic perception in different widths was carried out after the participants were categorized according to sociodemographic factors. When compared to a broader gap width, the influence of sociodemographic was more pronounced in 0.5 mm diastema (Wang et al. 2018; Witt and Flores-Mir 2011).

Midline diastema greater than 1mm was perceived negatively in the present study, consistent with previous reports that even small diastema may negatively influence attractiveness (Sękowska et al. 2018; Chaves et al. 2021; Chrapla et al. 2022). Most research participants found a maxillary midline width of 0 mm to be the most appealing, consistent with an earlier study but contradicts past findings indicating patients find a midline diastema of less than 1 mm acceptable (Abu-Hussein et al. 2015; Hasan et al. 2020). In contrast to a report that diastema of 1 to 2mm is not perceptible by laypeople (Singh and Chaudhary 2022) and that a midline diastema of 2 mm is unsatisfactory to patients (Gomes et al. 2021), a maxillary midline width of 2mm was rated unattractive by most of the participants, like an earlier study (Alhammadi et al. 2018). These results emphasize that in the participants' culture, the presence of a diastema is not associated with beauty (Bolas-Colvee et al. 2018; Cousineau et al. 2022; Ahmed et al. 2022). In this study, a maxillary midline diastema's width of 0 mm was deemed acceptable; wider widths were considered unattractive.

The perception of 0.5 mm MMD smile attractiveness is influenced by educational attainment. Higher educated people, according to the study, were less sensitive to slight variations in grin attractiveness. This result was in line with a study by (Thakur et al. 2020), which showed that as education levels increased, so

did the aesthetic scores of social and spontaneous smiles. One explanation for this might be that even in the face of minor dental defects, those with greater education levels have better levels of self-acceptance due to their enhanced self-esteem (Thakur et al. 2020; Yemitan et al. 2020).

According to our findings, people of all ages preferred smiles without any spacing or with a diastema of 0 mm and distal to the lateral incisor, while smiles with a diastema of 2 mm or spacing found mesially, or on both the mesial and distal sides of the lateral incisor, were the least attractive (Bolas-Colvee et al. 2018). Similarly, people of diverse genders, educational backgrounds, and vocations also favor a gap-free smile, have a minimal inclination toward a diastema of one or two millimeters, and are located on either the mesial or both the distal and mesial sides. According to our findings, 364 individuals in the midline diastema and 364 participants in the lateral diastema selected no space with a 0 mm width. Most of these participants were female, between the ages of 15 and 25; they had undergraduate degrees and were students. It was observed in this study that participants' perceptions and views of midline diastema varied. Regardless of its width, some people liked midline diastema, while others didn't think it was a beautiful feature. This alludes to the existence of additional crucial elements that could influence participants' opinions regarding the allure of midline diastema.

Orthodontics and/or restorative procedures may be used to close diastema. The magnitude of the gap is a factor that influences the choice to treat diastema in addition to the opinions of nondental and dental workers (Onyejaka et al. 2021; Lopes 2022). In this study, every group under investigation consented to treat diastema as the gap widths widened. In contrast to dental students, laypeople and dentists demonstrated greater agreement to fix gaps wider than 4.0 mm in the intergroup comparison. This is probably because different people perceive art differently. A 4.0 mm gap width in a grin was deemed unpleasant by both laypeople and dentists, however, dental students were more understanding.

The diastemas' width and location also revealed important details about the awareness of esthetics. Evaluation of the three diastemically positioned parts indicated that the more space there was, the less beautiful the image was assessed, and the more mesially located the diastema, the more unpleasant the grin. According to these data, detecting the clinical hypothesis that diastemas are located far from the midline is more complicated. Smiles with diastemas in the mesial and distal surfaces were generally the least attractive, followed by those with diastemas in the mesial and distal surfaces, respectively (Romero et al. 2018).

A higher proportion of laypeople saw diastema as acceptable than dentists did. This study corroborates earlier findings from Saudi Arabia, showing that dental education students are more adept at identifying the ideal smile than the general public (Araújo et al. 2023). Midline or lateral diastema was not considered unsightly by laypeople or dentists in a prior study (Cousineau et al. 2022) until there was more than 1mm of gap between the central incisors or between the primary and lateral incisors. Human behaviour can be impacted by various factors, including perception (Ahmed et al. 2022). The study's results indicate that dental education and exposure impact perception.

The finding that diastema greater than 1mm is considered unattractive (Wang et al. 2018; Romero et al. 2018) can provide necessary guidance on the threshold at which a diastema warrants a dentist's attention (Adigun et al. 2022). Such advice is essential because clinical practice should be focused on aesthetics and function (Vasques et al. 2022). Consequently, these findings should be discussed with patients seeking aesthetic treatments specifically for midline and lateral diastemata. Future studies using this methodology may provide a better understanding of the influence of midline and lateral diastema on perceived attractiveness. The results of this study indicated that before beginning any treatment plan, the dentist should first assess the difference in width between the maxillary lateral incisors. Restoration is usually not required if the difference is 1 mm or less, as it is unlikely to be seen. However, if the difference is 2 mm or greater, the narrower tooth should be restored. The study has a number of drawbacks. While photo digital manipulation is the most widely used technique to assess how people perceive the aesthetics of a smile, simulated two-dimensional images are less suitable than video presentation to fully illustrate the impact of maxillary midline diastema on dentofacial aesthetics because the latter offers a more dynamic view of the face and smile. Future research should be conducted to determine the tolerance threshold of dental specialists, such as orthodontists, prosthodontists, and restorative specialists, who frequently handle aesthetic cases, in addition to understanding the aesthetic perception of dental students and general dental

practitioners. Determining other elements that influence an appealing grin, such as the relationship between the dental and facial midlines, tooth proportions, tooth shade, and incisor and gingival exposure, is crucial to further assess the perception of an aesthetic smile. One limitation of this study is that it only included people of Pakistani origin. The perception of grin esthetics varies by demographic group. To have a better understanding, we propose conducting research comparing views of grin esthetics among different demographic groups.

5. Conclusions

Within the limitations of this study, it can be concluded that the presence of maxillary midline or lateral diastema greatly affected the perception of dentofacial aesthetics when evaluating photographs. According to dentists and laypeople, the most attractive photographs were those without diastema, whereas photographs with a diastema of 1.5mm or broader were considered unattractive.

Authors' Contributions: ALQARNI, A.: Contributed to the study design, data analysis and interpretation, manuscript writing, and critical revision of intellectual content; CHAUDHARY, M.A.G.: Involved in data collection, analysis and interpretation of results, article writing, and critical review of intellectual content. RANA, M.H.: Contributed to the study conception, data analysis, manuscript writing, and critical content review; QASIM, M.: Participated in literature review, data collection, result analysis, and critical review of intellectual content; KHALID, I.: Collaborated in statistical data analysis, literature review, and critical review of intellectual content. BAVABEEDU, S.S.: Contributed to the study conception, result interpretation, and critical content review; SAINUDEEN, S.: Involved in data collection and analysis, literature review, and critical content review; JAVALI, M.A.: Actively participated in study conception, data analysis and interpretation, manuscript writing, and critical review of intellectual content; Das, G.: Involved in funding and manuscript writing; KHAN, A.A.G: Contributed to the data analysis and critical content review.

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