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ORIGINAL ARTICLE

Perception of altered smile esthetics among Moroccan professionals and lay people

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KEYWORDS

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Visual analog scale

Abstract *Objective:* To evaluate and compare the impact of altered smile characteristics on the perception of smile esthetics between Moroccan dentists and lay people.

Materials and methods: Thirty-four digital smile photographs displaying alterations in crown length and width, lateral incisor gingival margin position, gingival exposition, midline diastema, and upper midline deviation were presented to a sample of 30 dentists and 30 lay people. The ratings were assessed with a visual analog scale.

Results: Compared to that of lay people, Moroccan dentists' evaluation of the gingival smile was more critical when the decrease in central incisor crown length was 2.5 mm ($p < 0.001$) or greater and when the increase in gingival exposition was 4 mm or greater ($p < 0.01$). Moroccan dentists were also critical in their evaluation of maxillary lateral incisor crown width alterations ($p < 0.05$) and incisal midline deviations ($p < 0.05$). However, the professionals and lay people similarly evaluated irregularities in the incisor gingival margin position. Increases in the midline diastema were judged critically by both Moroccan dentists and lay people.

Conclusions: In this sample, Moroccan dentists evaluate smile esthetic alterations more critically than Moroccan lay people. This difference in perception of smile discrepancies must be taken into account during the finishing phases of orthodontic treatment and restoration of the anterior teeth in Moroccan patients.

1. Introduction

Smile is a dynamic position of the lips, which varies according to the degree of facial muscle contraction and the lip profile (Borghetti and Monnet-Corti, 2008). The elements that contribute to the esthetics of the smile involve the facial and labial framework, which are dependent on dental alignment and teeth/gingival interfaces. Examining the levels of defined orofacial parameters at which a smile is perceived to be acceptable

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Fig. 1 Photographs showing a decrease in the maxillary central incisor crown length by (a) 0.5 mm, (b) 1 mm, (c) 1.5 mm, (d) 2 mm, (e) 2.5 mm, and (f) 3 mm.

within the community is essential for making orthodontic treatment decisions.

Professional and attentive lay individuals can identify an imbalance or lack of harmony in a smile (Miller, 1989). The perception of dental esthetic transformations by professionals and nonprofessionals has been previously evaluated (Flores-Mir et al., 2004; Kokich et al., 1999; LaVacca et al., 2005; Moore et al., 2005). Asymmetric alterations make the teeth unattractive to not only dentists but also the public (Kokich et al., 2006). The visual analog scale (VAS) is regarded as a simple and reliable method for evaluating the perception of facial and dental esthetics (Talic and Al-Shakhs, 2008). This study aimed to assess and compare the impact of altered smile characteristics on perception of smile esthetics between Moroccan dentists and lay people. We hypothesized that the dentists' assessment of facial and particularly smile esthetics is different compared to that of the general lay population.

2. Materials and methods

The protocol used for this study, composed of two groups of 30 people each, was adapted from Talic et al. (2013). The first group consisted of 30 professionals (dentists, general practitioners, and specialists). The second group consisted of 30 Moroccan lay people of different socioeconomic backgrounds that had no involvement with dentistry.

A total of 34 digital photographs were presented to each participant in both groups. These photographs showed only the patient's smile. The other facial structures were excluded to minimize variables that may affect the participants' judgment. The smile characteristics in the photographs were altered incrementally with Adobe Photoshop software (Adobe Systems Incorporated, San Jose, CA, USA) in order to create discrepancies in smile esthetics. The photographs were grouped into six sets, with each set displaying alterations of a different smile characteristic in increments ranging from 0.5 to 1 mm. The altered smile features were as follows: crown length of the central incisors, gingival margin position of the lateral incisors, gingival exposition, crown width of the lateral incisors, maxillary midline, and midline diastema. The photographs were coded before VAS assessment of the participants' perception of smile esthetic discrepancies.

2.1. Crown length of the central incisors

The crown length of the central incisors was shortened in increments of 0.5 mm, using the incisal edge as reference for

Fig. 2 Photographs showing (a) no alteration and an increase in the maxillary lateral incisor gingival margin position by (b) 1 mm, (c) 2 mm, (d) 3 mm, (e) 4 mm, and (f) 5 mm.

crown length shortening from the uppermost point of the gingival margin (Fig. 1).

2.2. Lateral incisor gingival margin position

The vertical position of the gingival margin of each maxillary lateral incisor was increased relative to that of the adjacent central incisor. Modifications were made in increments of 1 mm (Fig. 2).

2.3. Gingival exposition

These alterations were based on the position of the upper lip relative to the gingival margin of the maxillary incisors. The gingival exposition (distance between the gingiva and the lip margin) was augmented in increments of 1 mm to create a "gummy" smile (Fig. 3).

2.4. Crown width of the lateral incisors

For this feature, the mesiodistal width of the maxillary lateral incisors was symmetrically decreased in increments of 1 mm. The incisal edge was maintained at the same level (Fig. 4).

2.5. Maxillary midline

A maxillary midline deviation toward the patient's left side was made in increments of 1 mm. The lower midline and Cupid's bow of the upper lip were fixed and used as reference. (Fig. 5).

2.6. Midline diastema

A midline diastema was created between the maxillary central incisors and progressively increased in 0.5 mm increments, as measured from the interproximal contact point (Fig. 6).

2.7. Presentation of photographs to the study participants

All photographs displaying the incremental changes were coded using serial numbers ranging from 1 to 34, organized into the six sets, and the photographs in each set displayed in random order. An evaluation form containing the VAS with panels showing the 34 photographs of smiles was given to each participant in both judging groups. The VAS was 150 mm in length. The left end of the scale, represented by the number 0, was labeled as "very unattractive", while the right end of the scale, represented by the number 100, was labeled as "very attractive". The study participants were asked to place marks along the VAS according to their personal perception of smile esthetics. These marks were then measured with a caliper and recorded.

2.8. Statistical analysis

Differences in perception of altered smile esthetics between dentists and lay people were analyzed using Student's *t*-test,

Fig. 3 Photographs showing (a) no alteration and an increase in the gingival exposition by (b) 1 mm, (c) 2 mm, (d) 3 mm, (e) 4 mm, and (f) 5 mm.

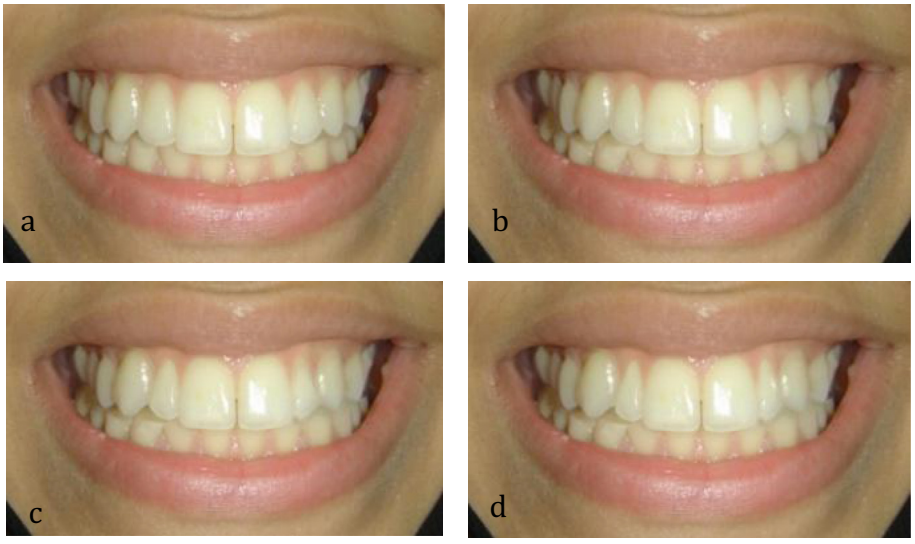

Fig. 4 Photographs showing a decrease in the maxillary lateral incisor crown width by (a) 1 mm, (b) 2 mm, (c) 3 mm, and (d) 4 mm.

Fig. 5 Photographs showing (a) no deviation and a left-side deviation of the maxillary midline by (b) 1 mm, (c) 2 mm, (d) 3 mm, (e) 4 mm, and (f) 5 mm.

Table 1 Assessment of smile following decreased maxillary central incisor crown length.

Crown length decrease (mm)	Lay people		Professionals		
	Mean VAS score	SD	Mean VAS score	SD	*p*-Value
0.5	44.50	18.12	42.01	16.47	0.58
1	44.04	23.86	35.78	14.39	0.11
1.5	44.32	21.08	43.61	16.37	0.88
2	48.16	24.24	38.31	16.58	0.07
2.5	49.67	23.71	31.13	14.74	0.0006[a]
3	42.82	23.20	27.27	10.67	0.002[b]

[a] $p < 0.001$.
[b] $p < 0.01$.

with $p < 0.05$ considered as statistically significant. Data are presented as mean ± standard deviation (SD).

3. Results

3.1. Perception following altered maxillary central incisor crown length

The difference in perception between the two groups became significant when the central incisor crown length was increased by at least 2.5 mm. The professional group was more critical than lay people when evaluating symmetric crown length discrepancies (Table 1, Fig. 7).

3.2. Perception following altered maxillary lateral incisor gingival margin position

With regard to this smile characteristic, there was no difference in perception between the two groups (Table 2, Fig. 8).

3.3. Perception following altered gingival exposition

Compared to the lay people, the professional group evaluated this smile esthetic discrepancy more critically when the gingival exposition increase was 4 mm or greater ($p < 0.01$). This difference was also significant when no modification of the gingival exposition was made (Table 3, Fig. 9).

3.4. Perception following altered maxillary lateral incisor crown width

Compared to lay people, dentists gave lower ratings when the lateral maxillary incisor crown width decrease was 2 mm and 4 mm (both $p = 0.03$). No difference in perception was found at crown width decreases of 1 mm and 3 mm (Table 4, Fig. 10).

Fig. 6 Photographs showing (a) no alteration and an increase in the maxillary midline diastema by (b) 0.5 mm, (c) 1 mm, (d) 1.5 mm, (e) 2 mm, and (f) 2.5 mm.

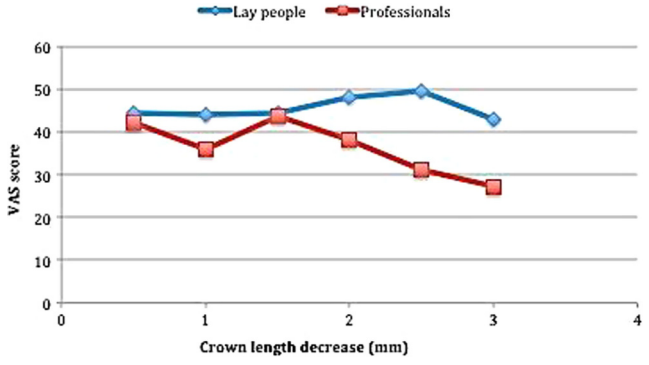

Fig. 7 Mean ratings by dentists and lay people following incremental decrease in the maxillary central incisor crown length.

3.5. Perception following maxillary midline deviation

Moroccan dentists gave significantly lower ratings, compared to lay people, in response to all incremental deviations of the maxillary midline. This difference was also significant when no alteration of the maxillary midline was made (Table 5, Fig. 11).

3.6. Perception following altered maxillary midline diastema

Both dentists and lay people rated the increases in spacing between the maxillary central incisors as unattractive. Compared to the lay group, the professional group gave a lower rating ($p = 0.03$) for a diastema increase of 2 mm (Table 6, Fig. 12).

4. Discussion

In this study, we evaluated the visual perception of smile esthetic discrepancies among Moroccan lay people and professionals. The results confirm our hypothesis that the dentists have a different assessment of smile esthetic features compared to that of the lay people (Ousehal et al., 2011; Rosa et al., 2013; Musskopf et al., 2013; Soh et al., 2006). The use of the VAS to objectively evaluate the study participants' perception of smile esthetic discrepancies has been reported in several other studies (Talic and Al-Shakhs, 2008; Talic et al., 2013; Cracel-Nogueira and Pinho, 2013). Indeed, the VAS is regarded as a simple and reliable assessment tool. Using the VAS, the dentists in our study rated smile esthetic discrepancies more critically. Another study revealed the same finding when dentists rated general facial esthetic discrepancies (Ousehal et al., 2011). Kokich et al. (2006) have noted that orthodontists are more

Table 2 Assessment of smile following increased maxillary lateral incisor gingival margin position.

Gingival margin position increase (mm)	Lay people		Professionals		*p*-Value
	Mean VAS score	SD	Mean VAS score	SD	
0	52.84	21.57	51.79	13.73	0.82
1	47.19	18.10	52.74	14.26	0.19
2	48.00	21.88	45.00	17.04	0.56
3	50. 33	22.81	52.60	17.20	0.67
4	50.17	21.19	56.85	18.90	0.20
5	51.83	20.95	53.40	18.09	0.76

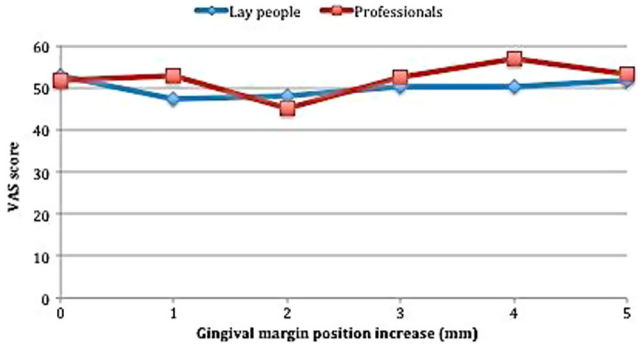

Fig. 8 Mean ratings by dentists and lay people following incremental increase in the maxillary lateral incisor gingival margin position.

Table 3 Assessment of smile following increased gingival exposition.

Gingival exposition increase (mm)	Lay people		Professionals		*p*-Value
	Mean VAS score	SD	Mean VAS score	SD	
0	66.51	22.41	55.12	18.00	0.03[a]
1	64.17	22.05	58.84	18.16	0.31
2	65.84	20.35	60.00	15.27	0.21
3	67.06	21.02	59.92	18.78	0.17
4	64.32	18.48	51.72	15.05	0.005[b]
5	63.15	24.09	44.81	18.26	0.002[b]

[a] $p < 0.05$.
[b] $p < 0.01$.

critical in rating altered dental esthetics than general dentists, who are more stringent than the general public in rating such discrepancies. Cracel-Nogueira and Pinho (2013) made the same observations in the Portuguese population.

When modifying the crown length of the maxillary central incisors, the results showed a significant difference in perception between lay people and professionals when the decrease was greater than 2 mm. These results are perfectly consistent with those published by Talic et al. (2013). Kokich et al. (2006) have reported that the modification of the crown length is more noticeable when it is carried out asymmetrically. With respect to the maxillary lateral incisor gingival margin position, our study showed no significant difference in perception between lay people and dental professionals. Correa et al. (2014) noted that, compared to the general public, orthodontists are more perceptive to changes of 1 mm or greater in the gingival margin position of canine teeth. Kaya and Uyar (2013) made the same observations and concluded that orthodontists and dentists perceive the irregularity of gingival collars more critically than nondentists do.

Dental professionals in our study were also more critical of a gummy smile than lay people were. The difference became very significant at a gingival exposition increase of 4 mm or greater. In a normal smile, the entire maxillary incisor is visible and 1–2 mm of gingival exposure is considered as acceptable (Vig and Brundo, 1978; Chiche and Pinault, 1994). Our results

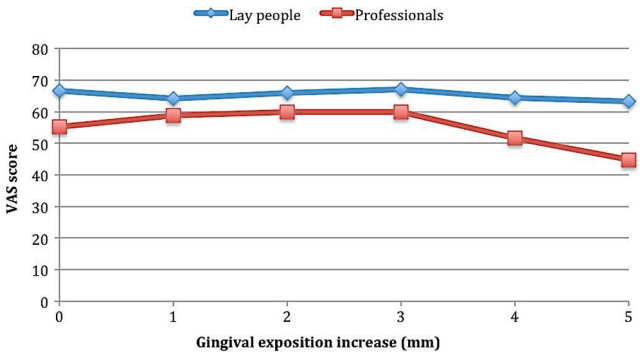

Fig. 9 Mean ratings by dentists and lay people following incremental increase in the gingival exposition.

Table 4 Assessment of smile following decreased maxillary lateral incisor crown width.

Crown width decrease (mm)	Lay people		Professionals		*p*-Value
	Mean VAS score	SD	Mean VAS score	SD	
1	45.62	20.91	42.34	18.25	0.52
2	50.84	20.84	39.68	18.23	0.03[a]
3	40.42	22.77	38.61	18.25	0.74
4	43.65	19.09	32.57	19.61	0.03[a]

[a] $p < 0.05$.

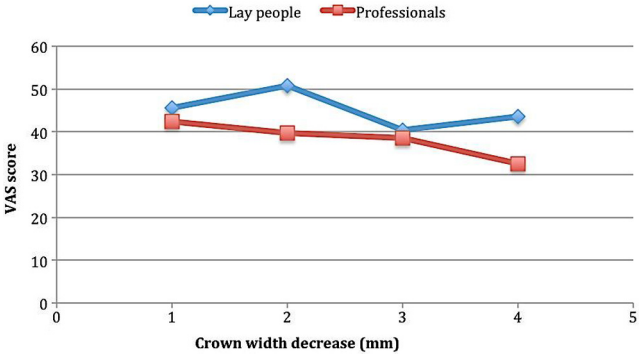

Fig. 10 Mean ratings by dentists and lay people following incremental decrease in the maxillary lateral incisor crown width.

Table 5 Assessment of smile following maxillary midline deviation.

Midline deviation (mm)	Lay people		Professionals		*p*-Value
	Mean VAS score	SD	Mean VAS score	SD	
0	52.15	18.72	36.65	17.31	0.002[b]
1	53.67	21.41	36.08	17.36	0.0009[c]
2	46.11	19.01	34.85	17.96	0.02[a]
3	51.50	19.70	36.67	15.64	0.002[b]
4	48.82	20.32	36.29	18.64	0.02[a]
5	51.00	19.89	37.46	17.14	0.007[b]

[a] $p < 0.05$.
[b] $p < 0.01$.
[c] $p < 0.001$.

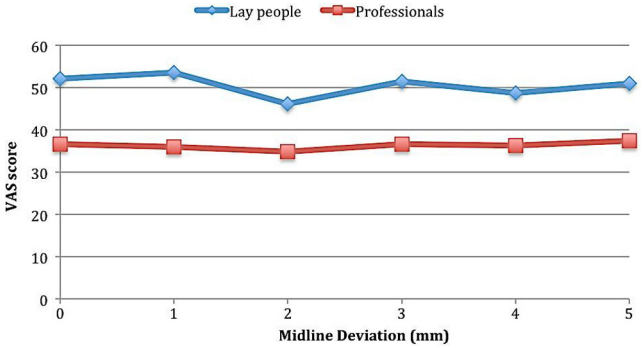

Fig. 11 Mean ratings by dentists and lay people following incremental left-side deviation of the maxillary midline.

Table 6 Assessment of smile following increased maxillary midline diastema.

Diastema increase (mm)	Lay people		Professionals		*p*-Value
	Mean VAS score	SD	Mean VAS score	SD	
0	53.62	22.29	44.87	16.00	0.09
0.5	41.82	20.79	41.11	16.52	0.88
1	41.79	17.62	37.32	15.95	0.31
1.5	38.03	18.85	29.87	18.15	0.09
2	38.33	14.27	29.24	17.52	0.03[a]
2.5	30.83	19.21	23.01	14.30	0.08

[a] $p < 0.05$.

agree with those of a study of Americans (Kokich et al., 2006), which also showed that the difference between professionals and lay people becomes noticeable when the gingival exposure exceeds 3 mm. Cracel-Nogueira and Pinho (2013) and Kaya and Uyar (2013) reported the same conclusions. However, Talic et al. (2013) revealed that the Saudis perception is more sensitive to this parameter: The threshold for unattractiveness was only 2 mm of gingival exposure. A smile with 2 or 3 mm of gingival exposure is considered as acceptable for the young adult, because with age the lip muscles tend to relax and the upper lip margin is lowered, thus reducing the gingival exposure (Kokich et al., 2006; Mackley, 1993).

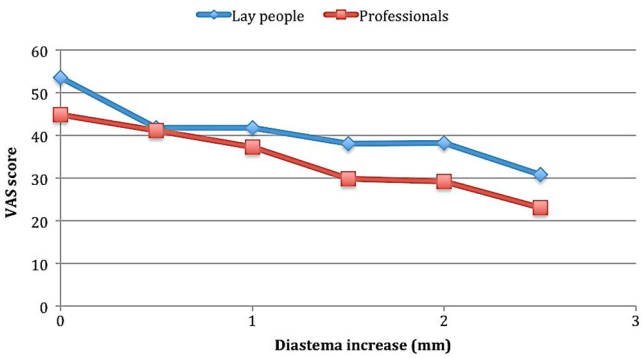

Fig. 12 Mean ratings by dentists and lay people following incremental increase in the maxillary midline diastema.

Our study showed that Moroccan dentists gave lower ratings compared to lay people when the crown width of the maxillary lateral incisors was symmetrically reduced by at least 2 mm. This threshold is comparable to values found in previous studies (Kokich et al., 2006; Talic et al., 2013). These changes are perceived even more critically when they are asymmetric. It has been noted that when the width of the lateral incisors is altered asymmetrically, the attractiveness of the smile decreases with a change in crown width exceeding 2 mm, whereas the attractiveness of the smile decreases with a crown width change exceeding 3 mm when symmetric alterations are made (Kokich et al., 2006). Consequently, to obtain an esthetic smile, the orthodontist must integrate dental golden proportions in the treatment procedure. Composite restorations or porcelain veneers of small lateral incisors must be used to ensure the symmetry of anterior tooth diameters. Ideally, the lateral incisor width should be two-thirds the width of the central incisor (Levin, 1978; Lombardi, 1973).

In addition, the Moroccan professionals in our study were very critical of alterations in smile symmetry, compared to lay people. These results are consistent with those of Talic and Al-Shakhs (2008) and Kokich et al. (2006) who found similar results among Americans. However, Portuguese lay people and professionals are less critical of this parameter (Cracel-Nogueira and Pinho, 2013). With the exception of a diastema increase of 2 mm, both groups in our study gave equally poor ratings for central incisor diastema increase without any significant difference. This finding is comparable to that of Saudi dentists and lay people who rated as unattractive a small amount of space between the maxillary central incisors (Talic et al., 2013).

Musskopf et al. (2013) have reported the same results among Brazilians. By contrast, Kokich et al. (2006) have noted that American orthodontists are more tolerant of central incisor diastema. This esthetic alteration is seen as a clinical disturbance only if it is greater than 1.5 mm, probably because of its frequent recurrence in the American population. This observation was previously made by Sullivan et al. (1996), who noted that when a recurrent diastema does not exceed 1 mm, it is not necessary to retreat the patient.

5. Conclusions

Based on our findings, we can conclude that, when assessing some types of smile esthetic discrepancies, Moroccan profes-

sionals are more critical than the general public. Specifically, dental professionals are more critical of symmetric crown length discrepancies of more than 2 mm, gingival exposition of 4 mm or greater, and all increments of maxillary midline deviation. Compared with these smile characteristics, Moroccan dentists are less critical of alterations in maxillary lateral incisor crown width. Dental professionals and lay people have similar perceptions of irregularities in the incisor gingival margin position, and both groups give poor ratings when midline diastema is present. These findings must be taken into account during the finishing phases of orthodontic treatment and the restoration of the anterior teeth. Finally, the patients' perceptions of dental esthetic irregularities are important for achieving a successful functional and esthetic outcome.

Conflict of interest

The authors have no conflict of interest to declare.

Ethical statement

The study was approved by the doctoral committee of Hassan II University that serves as the ethics committee.

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