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Perceptions of Altered Dental Aesthetics: Influence of Ethnicity and Time

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ABSTRACT

Objectives: The aims of this study were to assess perceptions of altered dental aesthetics by Jordanian orthodontists, general dentists (GDs) and laypeople (LP), as well as to compare them with the original data derived from an American sample (2, 3).

Materials and Methods: Photographs of 8 symmetric and asymmetric altered anterior dental aesthetics were used. Symmetric alterations were incisor angulation (IA), lip to gingiva distance (GS) and bilateral papillary height of the maxillary anterior teeth (BPH), while asymmetric alterations were midline (ML), crown length (CL), crown width (CW), crown width and length (WL) and papillary height (UPH). Photographs were rated by a sample of orthodontists, GDs and LP. Raters were also asked to rank different dentofacial features according to their aesthetics focus.

Results: Thresholds for detection of IA, GS, and WL alterations were similar in all groups. However, orthodontists had the lowest detection threshold for ML. Orthodontists and LP had lower thresholds for BPH and UPH than GDs. However, CL and CW thresholds were lower for orthodontists and GDs. The most noticeable dentofacial feature was tooth position for orthodontists and eye colour for GDs and LP.

Conclusions: Orthodontists were more sensitive to deviations than general dentists and laypeople irrespective of their ethnic and cultural backgrounds. Jordanian raters were more sensitive to deviations of the midline, gingiva to lip distance and unilateral papillary height. Jordanian raters were generally more critical of discrepancies compared to their American counterparts. This was more likely a function of the decade of global expansion of media and telecommunications that Jordanian raters were exposed to compared to the original studies by Kokick et al. (2,3).

Keywords: Perception, Smile aesthetics, Laypeople, Professional dentists and orthodontists.

1. Introduction

An aesthetics smile is one of the most important features perceived for attractiveness and social interaction. Smile aesthetics has been a major concern of orthodontists and patients and has been found to be the main reason why patients seek orthodontic treatment (1). Evaluating a patient's smile enables the clinician to identify necessary treatments and determine what is aesthetically acceptable. Increased public awareness of beauty and aesthetics has amplified the need for orthodontists and dental professionals to understand laypeople's perceptions of smile aesthetics.

Smile analysis involves an evaluation of different components, such as midline coincidence, gingival display, crown length and width, buccal corridor space, incisor angulation, and gingival aesthetics (2-13). The sensitivity of detection of these components varies between dental professionals and laypeople and may be influenced by many factors, such as race, culture, education, and personal experience (6,8,11,14,15). As a result of their formal training and experience, orthodontists have been found to be more perceptive to

deviations in dentofacial appearance than the general public (2,3,5,6,13,16,17).

Studies on smile aesthetics have used both static photos of posed smiles (2,3,12,13) and smiles obtained from dynamic video clips (4,9,16) with no clinically significant differences found in the perception of smile aesthetics between the two methods (11). Photographs showing either the lower face (2-5) or full-face views (9,17-19) have also been used in the investigation of smile aesthetics. However, using views showing just the lower part of the face is preferred, because they remove any distraction which might arise from other facial features (20).

Symmetrical alteration of the various smile components has been the focus of most of the investigations on the perception of smile aesthetics (2-13). Only one study comprehensively investigated the influence of asymmetric alteration of smile components and found that raters were more critical of unilateral alteration when compared to symmetric smile alteration (3). Other studies looked at only one or two asymmetric alterations (7,17).

A review of the literature on the perception of smile aesthetics reveals only one study that assessed the perception of Jordanians to altered smile aesthetics (21). This study, however, focused on only three symmetrical smile components: buccal corridor, gingival display and median diastema. The review also indicated a lack of data on how this perception has changed over time.

The aims of this study were to assess perceptions of altered dental aesthetics by Jordanian orthodontists, general dentists (GDs) and laypeople (LP), as well as to compare them with the original data derived around a decade ago by Kokich et al. from an American sample (2,3).

2. Materials and Methods

The present study is a collaborative follow-up study of two original studies by Kokich et al. (2,3). Every attempt was taken to ensure that a similar methodology was followed in the current investigation. Raters in this investigation consisted of three groups: orthodontists, general dentists (GDs) and laypeople (LP). The orthodontists were selected randomly from a list of all members of the Jordanian Orthodontic Society (JOS). The total number of active members of the JOS amounted to 150 orthodontists.

A sample representing approximately one-third of the total population, consisting of 150 members was randomly selected to ensure that the sample remains unbiased and reflective of the larger group.

Participants were contacted to participate in this study. GDs were chosen randomly from a list of all members of the Jordanian Dental Association. A sample size of 50 has been selected to match the number of the orthodontists. The LP group consisted of 50 non-dental trained teachers, businessmen, office clerks … etc. In the GD and LP groups, five more raters were selected to account for anticipated incompletely filled surveys. Each rater was directly contacted by one of the researchers and the general purpose of the study was explained in a standardized manner.

The assessment was carried out in two parts: smile evaluation using a visual analogue scale (VAS) of photographs showing the lower face views, and a separate section ranking the facial and dental features in terms of aesthetics importance not associated with the photographs.

2.1 Smile Evaluation

All photographs used in the current study were the same photographs used in the two studies by Kokich et al. without any modification (2,3). Details regarding how each photograph was altered incrementally were described in those studies (2, 3).

Eight aesthetics alterations of the anterior-smile variables were chosen; three symmetric alterations, including: incisor angulation (IA), lip to gingiva distance (GS) and bilateral papillary height of the maxillary anterior teeth (BPH) (2,3) and five asymmetric alterations of either the right or left side of the maxillary anterior teeth, including; midline (ML), crown length (CL), crown width (CW), crown length and width (WL) and papillary height (UPH) (2,3).

Each rater was given a booklet which contained all the forty (5x8) photographs arranged randomly. Four randomly selected photographs from the total 40 photographs were arranged in one page. Each page contained four different photographs of the eight aesthetics variables arranged in two columns. A 50-mm visual analogue scale (VAS) was used to assess the perception of aesthetics variations for each photograph with zero representing the least attractive and 50 representing the most attractive. Each rater was asked to mark a point on the VAS under each photograph. A digital caliper was used to measure the distance between

the mark on the VAS and zero to the nearest 0.01mm. Each rater was asked to answer additional questions to record the age and experience of the professional group.

2.2 Ranking of Facial/Dental Features

In addition, each rater was asked to rank 6 facial and 4 dental features from 1 (most noticeable) to 10 (least noticeable) according to the aesthetics focus of these features. The six facial features were: hair style, eye color, skin complexion, hair color, nose size, and eyebrow expression. The four dental features were: tooth position, tooth color, mouth expression, and lip shape.

Analysis of data was conducted using SPSS, version 16.0, (SPSS Inc., Chicago, USA). Normal demographic tests for age and gender were carried out for the three groups. Descriptive statistics for the ranking of facial and oral features were performed. A chi-squared test was used to compare the three groups for the number one and number ten rank. Repeated measure ANOVA was used to test for significance of the number of years in practice and professional group. A 2-way repeated measure ANOVA was used to test for significance among the 8 types of discrepancies among the three groups. In addition, multiple comparisons across all pairs of interaction levels and all pairs of groups were performed.

3. Results

The number, gender and age of raters are shown in Table 1. Five orthodontists and two GDs declined to participate in the study. In addition, three questionnaires were not included due to incomplete answers by laypeople.

Table 1: Descriptive statistics of the sample of raters

	Number	Male (%)	Female (%)	Mean Age	Range	Mean Experience
Orthodontists	42	38 (90)	4 (10)	38	26-60	13
Dentist	52	28 (54)	24 (46)	30	24-66	8
Laypeople	58	21 (36)	37 (64)	31	23- 62	NA

Table 1 shows the number of years in practice for the professional group. The mean experience in practice for orthodontists and GDs is 13 and 8 years, respectively. The results of ANOVA showed no effect of the years of professional experience on aesthetics perception ($p>0.05$). Table 2 shows the threshold at which a discrepancy was detected by each group for the eight aesthetics variations.

Table 2: Threshold at which a discrepancy was detected (mm)

	Orthodontists	Dentists	Laypeople
Incisor Angulation	1	1	1
Gingiva-to-lip Distance	2	2	2
Anterior Papillary Height	0.5	1	0.5
Midline Shift	1	2	2
Crown Length	1	1	1.5
Crown Width	2	2	3
Crown Width and Length	3	3	3
Unilateral Papillary Height	1	1.5	1

3.1 Incisor Angulation (IA)

All three groups detected a symmetric alteration of all four incisor angulations when incisors were angulated 1mm from the ideal.

3.2 Gingiva to Lip Distance (GS)

All three groups could identify a uniform 2-mm distance from gingiva to lip as unattractive ($p< 0.001$).

3.3 Bilateral Anterior Papillary Height (BPH)

A 0.5-mm change in the unilateral papillary height was rated as being unattractive by the orthodontists and LP ($p<0.001$, $p<0.01$, respectively). GDs, however, were less discriminating than the other groups as a 1-mm shortening of the papillary height was considered unattractive.

3.4 Midline Shift (ML)

Orthodontists were more sensitive to midline discrepancies than the other two groups (Table 2). They were critical of midline changes of 1mm, whereas GDs and LP did not rate a midline shift as being unattractive until the discrepancy was 2mm or greater ($p<0.01$, $p<0.04$, respectively).

3.5 Crown Length (CL)

Orthodontists and GDs could detect asymmetric crown-length decrease of 1mm compared to the normal contralateral incisors ($p< 0.01$, $p< 0.001$, respectively). LP were less perceptive, as they identified a decrease in unilateral crown length of 1.5 mm as unattractive ($p<0.05$).

3.6 Crown Width (CW)

GDs and orthodontists were more critical than LP when rating asymmetric crown-width discrepancies. Both GDs and orthodontists detected a 2-mm decrease in crown width ($p< 0.001$) compared to the contralateral lateral incisor. LP were less perceptive of minor alterations than the professional groups. They could not detect unilateral crown-width discrepancies until the crown was 3mm narrower than the contralateral lateral incisor ($p< 0.01$).

3.7 Width and Length (WL)

All three groups could not identify a proportional unilateral narrowing of the lateral incisor width until it was 3mm smaller than the contralateral tooth ($p< 0.01$, Table 2).

3.8 Unilateral Anterior Papillary Height (APH)

GDs did not find apical positioning of the papilla between incisor teeth unattractive until 1.5 mm or more. LP and orthodontists were more critical than GDs and noted a 1-mm discrepancy as unattractive ($p< 0.05$).

Table 3 shows data for dental and facial features that were most important (rank of 1) to all 3 groups of raters. Eye color was the most frequently chosen by GDs and LP, while orthodontists chose eye color as most noticeable only in 7.1% of the time. Tooth position was chosen most frequently as the highest rank by orthodontists. The difference between the groups was statistically significant ($p<0.01$).

Table 3: The most important (ranked 1) dental and facial features

	Group			Total
	Orthodontists	**Dentists**	**Laypeople**	
Dental and Facial Feature	Number (%)	Number (%)	Number (%)	Number (%)
Hair Style	4(9.5)	5(9.6)	4(6.9)	13(8.6)
Eye Colour	3(7.1)	20(38.5)	21(36.2)	44(28.9)
Mouth Expression	2(4.8)	0(0)	1(1.7)	3(2)
Skin Complexion	3(7.1)	10(19.2)	12(20.7)	25(16.4)
Hair Colour	3(7.1)	0(0)	2(3.4)	5(3.3)
Lip Shape	2(4.8)	0(0)	3(5.2)	5(3.3)
Nose Size	1(2.4)	0(0)	4(6.9)	5(3.3)
Tooth Colour	2(4.8)	5(9.6)	3(5.2)	10(6.6)
Eye Expression	0(0)	1(1.9)	0(0)	1(0.7)
Tooth Position	22(52.4)	11(21.3)	8(13.8)	41(27)

There were no statistically significant differences between the three groups of raters when selecting the

least noticeable dental and facial feature. Eyebrow expression was ranked number 10 by all 3 groups; orthodontists (38.1%), GDs (40.4%), and LP (29.8%) (p>0.50, Table 4).

Table 4: The least important (ranked 10) dental and facial features

	Group			Total
	Orthodontists	**Dentists**	**Laypeople**	
Dental and Facial Feature	Number (%)	Number (%)	Number (%)	Number (%)
Hair Style	10 (23.8)	9(17.3)	9(15.8)	28(18.5)
Eye Colour	2(4.8)	3(5.8)	2(3.5)	7(4.6)
Mouth Expression	0(0)	1(1.9)	2(3.5)	3(2)
Skin Complexion	4(9.5)	3(5.8)	2(3.5)	9(6)
Hair Colour	5(11.9)	7(13.5)	12(21.1)	24(15.9)
Lip Shape	2(4.8)	2(3.8)	3(5.3)	7(4.6)
Nose Size	0(0)	5(9.6)	5(8.8)	10(6.6)
Tooth Colour	2(4.8)	0(0)	1(1.8)	3(2)
Eye Expression	16(38.1)	21(40.4)	17(29.8)	54(35.8)
Tooth Position	1(2.4)	1(1.9)	4(7)	6(4)

Results of the chi-square tests comparing the ranking of the four dental features, mouth expression, lip shape, tooth color and tooth position, showing significant differences only in tooth color and tooth position (p=0.003) (Table 5). General dentists judged that tooth color was more noticeable than other dental features. Tooth position was ranked the most noticeable feature compared to other dental features by orthodontists. LP, however, rated lip shape and mouth expression as more noticeable among the four dental features (Table 5).

Table 5: Results of the chi-square test comparing ranking of the four dental features for the three groups

	Mouth Expression	**Lip Shape**	**Tooth Color**	**Tooth Position**
Chi-square	5.938	2.325	11.418	11.679
df	2	2	2	2
P-value	0.051	0.313	0.003	0.003

Table 6: Comparison of thresholds at which a discrepancy was detected (mm)

	Orthodontists		**Dentists**		**Laypeople**	
	Jordan^	USA*	Jordan^	USA*	Jordan^	USA*
Incisor Angulation	1	2	1	2	1	2
Gingiva-to-lip Distance	2	3	2	ND	2	3
Bilateral Papillary Height	0.5	1	1	ND	0.5	1.5
Midline Shift	1	4	2	ND	2	ND
Crown Length	1	0.5	1	2	1.5	2
Crown Width	2	2	2	2	3	2
Crown Width and Length	3	3	3	3	3	4
Unilateral Papillary Height	1	1	1.5	0.5	1	ND

^ Present Study
* From Kokich et al. (1999, 2006).
ND= Not Detectable

Table 6 illustrates a comparison of the threshold at which asymmetry was detected between Jordanian and

US raters at two different time points. American and Jordanian orthodontists chose similar thresholds for discrepancies of unilateral papillary height, crown width and crown with and length. American orthodontists were more critical of discrepancies in crown length, whereas Jordanian orthodontists were more critical of incisor angulation, gingiva to lip distance, midline shift, and bilateral papillary height (Table 6). Jordanian dentists were more critical of discrepancies in incisor angulation, gingiva to lip distance, midline shifts, crown length and bilateral papillary height. Jordanian laypeople were more critical of most discrepancies compared to Americans, except for crown width (Table 6).

4. Discussion

The purpose of the present study was to investigate whether there is any difference in the perception of minor variations in eight anterior aesthetics alterations between orthodontists, GDs and LP in Jordan. A matched sample of Jordanian raters was selected to rate 40 photographs depicting incremental variation of eight aesthetics variables. In order to allow comparison with the original studies of Kokich et al., a similar methodology was followed using the same original photographs without alteration and the same measurement scale (VAS) and questions (2,3).

The current study found no differences in the professionals' and laypeople perceptions of incisal plane angulation between the Jordanian raters and the raters from the United States (3). The literature on the perception of the altered incisal plane of the anterior teeth showed disagreement on the amount of the axial angulation that is considered unattractive. A deviation of 1 mm is considered unattractive in the present study, as well as by Kokich et al. (2). Other studies reported 5 and 10 degrees of angulation to be considered unattractive (2,3).

The results of this investigation showed an agreement on the amount of the gingival display that is perceived as unattractive by the three groups. A 2-mm gingiva-to-lip distance was rated as less attractive. A gingiva – to –lip distance of 3 mm was considered unattractive by Kokich et al. (2). These findings differ from those of this study, as orthodontists and laypeople in Kokich et al.'s study were more tolerant to gingiva display than the Jordanian raters (Table 6). When assessing the gingival tissue of the papilla and the gingiva-to-lip distance, the Jordanian raters were more discriminate than the US raters (2). This was in agreement with another study on Jordanian raters that found that 2-mm of gingival display was judged as unattractive (21). Similar findings were found in other studies (24,25). Studies on other populations found that orthodontists were less tolerant of gingival display, as they reported a zero-mm gingival exposure (12). The difference in the amount of acceptable gingival display which is considered pleasing to laypeople and professionals of different populations may be attributed to variations in the perception of different ethnic and cultural backgrounds.

Symmetric alteration of the papillary height showed different trends, as general dentists did not find apical positioning of the papilla between incisor teeth unattractive until it was 1mm or more. Interestingly, laypeople and orthodontists were more discriminate than general dentists to apical lowering of the papilla.

When comparing the perceptions of midline deviation as rated by orthodontists, general dentists and laypeople, there was a general agreement that orthodontists were more critical than the other two groups to mild midline deviation. There is, however, no clear agreement on the threshold when midline deviation is considered unattractive. The threshold varied between 1mm (17), 2 mm, (9,18,19) and 4 mm. (3,26). The threshold of 2mm for the midline deviation that is considered unattractive in the current investigation by general dentists and laypeople was close to the reported 2.2mm acceptable midline deviation in a recent systematic review (6).

The results of this investigation showed that general dentists and orthodontists identify a 1-mm shortening of the unilateral central incisor length as unattractive. Laypeople were less discriminate than the professional groups, as they rated a 1.5-mm shortening of the unilateral central incisor crown length as unattractive. When comparing the results to those of the US raters (Table 6), similar trends were observed, as laypeople were less discriminate than both orthodontists' and dentists' groups, although the threshold is not similar in both studies (3). Brazilian orthodontists and laypeople were more critical to asymmetric shortening of the central incisor, as 0.5 mm of wear in the central incisor was considered unattractive (7).

In the present study, general dentists and orthodontists perceived asymmetric discrepancy of lateral incisor width of 1 mm as unattractive. Laypeople did not identify a unilateral crown-width discrepancy

until it was 3 mm (Table 2). Similar threshold values were found for general dentists and orthodontists in the US studies (Table 6) (2,3). Furthermore, the results of this investigation found a similar trend that asymmetric changes in the crown width was rated as less attractive than symmetric crown-width changes (2,3).

All three groups rated a unilateral proportional narrowing of the lateral incisor width and length as unattractive when it was 3mm less than the normal lateral incisor. The threshold scores were in agreement with the US professional raters (3). There is a limited number of studies on the aesthetics perception of proportional alteration of the width to length ratio of anterior teeth. One study showed that significant differences exist between the aesthetics perceptions of dentists, technicians and laypeople with a lack of agreement within each group (27).

In the present study, orthodontists and laypeople had lower threshold for detection of unilateral papillary height than general dentists. General dentists, however, had a lower threshold for detection in Kokich et al.'s study (2).

The general trend seen in Table 6 was that Jordanian raters were more critical of discrepancies than Americans. It is our view that these differences are not due to the ethnic variations of the raters, rather they are a result of the different time points at which each study was conducted. The present study was conducted several years after the original study by Kokich et al. (3). Since then, there has been an explosive global expansion of media and telecommunications. The media (including social media) now influences the population of the world in a manner never seen before, so that geographic boundaries have ceased to exist. Perceptions of aesthetics of the general public have become more fine-tuned and are likely to become similar to those of dental professionals in the near future.

Orthodontists agreed on the most noticeable dental and facial feature, regardless of their ethnic background. Tooth position was ranked number one in both studies. Furthermore, there was an agreement between both studies regarding the least noticeable feature, as the three groups chose eyebrow expression as the least noticeable dental and facial feature (Table 3). Eye color was the most frequently chosen feature as the most important feature by general dentists (38.5%) and laypeople (36.2%). This finding disagrees with the original study, as hair style was chosen as the number-one feature (2). These results highlight that several factors influence the aesthetics focus of laypeople among which are racial and cultural characteristics. The result of the present study agrees with the finding of Jørnung (28), as patients rated teeth and eye color as the most important feature in an attractive face. Furthermore, other investigations suggested that dental appearance affects rating of facial attractiveness regardless of background facial attractiveness (29).

5. Conclusions

Within the limitations of the current study, the following conclusions could be drawn:

- Orthodontists were more sensitive to deviations than general dentists and laypeople, irrespective of their ethnic and cultural backgrounds.
- Jordanian raters were more sensitive to deviations of the midline, gingiva-to-lip distance and unilateral papillary height.
- Jordanian raters were generally more critical of discrepancies compared to their American counterparts. This was more likely a function of the decade of global expansion of media and telecommunications that Jordanian raters were exposed to compared to Kokick et al. (2,3).

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Conflict of Interests

The authors declared no conflict of interest.

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