Original Article

Evaluation of factors affecting dental esthetics in patients seeking orthodontic treatment

ABSTRACT

Aim: It is not well documented which dental traits predominantly motivate patients to seek orthodontic therapy. This study was designed to recognize anterior occlusal traits that impact the perception of dental esthetics in patients with different types of malocclusion seeking orthodontic treatment.

Materials and Methods: Forty-five pairs of intraoral photographs belonging to patients with various malocclusions were selected for this study. Each pair of photographs included a frontal view and a right-side view of the patient's occlusion at maximum intercuspation. A total of 60 laypersons (30 males and 30 females) were requested to rate the overall appearance of the dentition in the photographs, using a 100 mm line that served as a visual analog scale. The study models of the patients were evaluated by a single investigator to determine the amount of overjet, overbite, crowding, and midline deviation. A multiple linear regression analysis was employed to detect the dental features that predicted the overall attractiveness of the dentition.

Results: The multiple linear regression analysis revealed that according to the judgment of female, male, and total female and male raters, overall dental attractiveness could be predicted by two features, the crowding of upper arch ($P < 0.05$) and overbite ($P < 0.05$).

Conclusions: Dental attractiveness could be predicted by two main variables including upper anterior crowding and overbite. Sufficient priority should be accorded to these factors in orthodontic diagnosis and treatment planning to decrease the probability of misinterpretation of patients' expectation from treatment.

Key words: Attractiveness; crowding; dental; esthetics; midline; orthodontic; overbite; overjet.

Introduction

Enhancement of dental and facial appearance is the primary aim for most patients seeking orthodontic therapy, because the appearance of the teeth has a great influence on the overall attractiveness of the face. A pleasing dental appearance is also a cornerstone for constituting an esthetic smile, which could play a key role in the general success of the patients throughout their lives. It has been documented that malocclusion leads to reduced self-perception,[1] self-esteem,[2] and self-confidence[3] in adolescents and young adults, thus adversely influencing their quality of life[4,5] and social interactions.[6-8]

Although dental esthetics is defined as the presence of aligned teeth from the point of most laypeople, other anterior occlusal characteristics such as overjet, overbite, and midline discrepancy could also affect the beauty of the dentition. The few studies that assessed different

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dental traits in terms of overall dental attractiveness reported controversial outcomes. Soh *et al*.[9] indicated that for both groups, laypersons and orthodontists, overjet was the major occlusal feature that affected the perception of dental attractiveness. Onyeaso and Sanu[10] demonstrated that upper and lower anterior irregularities, spacing, midline diastema, anterior open bite, and molar relation deviations were more frequently observed in patients whose teeth were perceived as unfavorable. Kerosuo *et al*.[6] found that among Finnish students, incisal crowding or spacing represented a social disadvantage compared to normal or protruded incisors. Ong *et al*.[11] reported that all dental features contributed significantly to overall dental attractiveness, but a hierarchy of factors was established, in the way that tooth shape had the strongest and the color of the teeth and gums had the lowest association with overall dental scores.

It is not well clear which features are most important in differentiating between unpleasing and pleasing dentitions according to the viewpoint of laypersons. In other words, it is not well documented which dental traits predominantly motivate the patients to seek orthodontic therapy. Knowledge about these factors could play an important role in orthodontic diagnosis and treatment planning to deal with more satisfied patients at the end of the therapy. This study was designed to identify occlusal traits that impact the perception of dental esthetics in patients with different types of malocclusions seeking orthodontic therapy, based on laypersons' opinions.

Materials and Methods

Forty-five pairs of intraoral photographs belonging to female patients demanding orthodontic treatment were selected. Each pair of photographs included a frontal view and a right-side view of occlusion at maximum intercuspation. The inclusion criteria dictated that the patients should be aged between 14 and 20 years, presenting complete permanent dentition (except third molars) without missing, supernumerary or malformed teeth, and without any history of orthodontic therapy. An equal number of skeletal Class I, skeletal Class II, and skeletal Class III patients were chosen to include a broad range of malocclusions in the sample. The ANB angle and Wits appraisal were used for patient selection (patients with ANB $\geq$ 4° and wits $\geq$ 1 mm were categorized as skeletal Class II, whereas those with ANB $\leq$ 0 and wits ≤ -2 were classified as skeletal Class III).[12] The patients with visible caries or periodontal diseases were excluded from the sample.

All photographs had been taken under the same conditions by the same photographer. Using Adobe Photoshop software (version 7.0; Adobe Systems Inc., San Jose, CA, USA), each set of images were turned into grayscale pictures to eliminate the effect of environmental factors such as lighting conditions, gingival color, and tooth color that might affect the perception of dental beauty. The standardized images were then coded and printed on 10 cm × 15 cm sheets of white paper with a high resolution. The 45 pairs of photographs were randomly organized into a folder to decrease the ordering effect. Each pair of photographs was positioned on the same page above a 100 mm line that served as a visual analog scale (VAS). An example of the photographs is shown in Figure 1.

A total of 60 laypersons (30 males and 30 females), with their age ranging from 35 to 55 years, were requested to rate the overall appearance of the dentitions. The raters were selected from family members of patients in waiting room areas of the Department of Orthodontics, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran. A layperson was defined as someone without any previous official education in dentistry or oral hygiene. The raters were asked to score each pair of occlusion photographs on a 100 mm line (VAS) in which the left side (0) indicated the least attractive and the right side (100) showed the most attractive. There was no time limit during the rating procedure. The rater's questions were answered verbally. The marks on the VAS scale were then measured by one of the investigators with a ruler to the nearest 0.5 mm.

The study models of all the 45 patients were used to measure the amount of overjet, overbite, crowding, and midline deviation. The casts were trimmed using a wax recording of patient's bite at the time of examination. The occlusal traits were measured by a single investigator using a caliper to the nearest 0.5 mm. Overjet was determined by measuring the distance in millimeters between the incisal edge of the most proclined or retroclined upper central incisor with the corresponding point on the labial surface of the mandibular incisor. To determine the amount of overbite or open bite, the greatest overlap or interincisal gap between the maxillary and mandibular central and lateral incisors was measured.
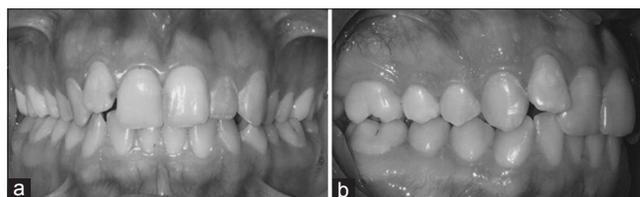

Figure 1: (a and b) A pair of dentition photographs used for assessing esthetic rating of laypeople

The severity of dental crowding was assessed by summing the displacements of contact points from canine to canine in each arch. Midline discrepancy was defined as the distance in millimeter between the upper and lower midlines.

To calculate the systematic error of the measurements, 15 dental models were selected and the measurements were repeated 1 week later. A paired sample *t*-test indicated no significant difference between the two assessments ($P > 0.05$).

Statistical analysis

The normal distribution of VAS scores was confirmed by the Kolmogorov–Smirnov test ($P > 0.05$). A multiple linear regression analysis was employed separately on the VAS scores of females, males, and total female and male raters to detect the dental features that predicted the overall attractiveness of the dentition. The statistical analysis was performed by SPSS software (version 16.0, SPSS for Windows, Chicago, IL, USA), and $P < 0.05$ was considered statistically significant.

Results

Table 1 presents the means, standard deviation, and the range of the dental variables in different malocclusions. The average scores given to the esthetics of the dentition by female, male, and total female and male raters are shown in Table 2.

Table 3 indicates the results of the multiple linear regression analyses for detecting the dental traits that predicted the overall attractiveness of the dentition. The multiple linear regression analysis revealed that according to the judgment of female ($R^2 = 0.582$), male ($R^2 = 0.604$), and total female and male ($R^2 = 0.629$) raters, overall dental attractiveness could be predicted by two features including the crowding of upper arch ($P < 0.05$) and overbite ($P < 0.05$) [Table 3].

Discussion

The present study evaluated the anterior occlusal traits that impact the overall esthetics of the dentition in patients before orthodontic treatment, according to the perspectives of the lay persons. The VAS was employed for scoring pretreatment dentition photographs. The use of VAS is common in various fields of dental research such as subjective assessment of dental and facial esthetics and measurement of pain associated with dental treatments.[9,13-17] The sample consisted of patients with Class I, Class II, and Class III malocclusions to present different aspects of dentofacial discrepancies in a pool of patients requiring orthodontic therapy.[12] To rate the esthetics of the dental systems, the present study took benefit from the right buccal view of the dentition in addition to the frontal occlusal view at maximum intercuspation. Soh *et al*.[9] assumed that the inclusion of the right buccal view is required for precise assessment of dental esthetics, as it reveals the proclination or retroclination of incisors in Class II Division 1 and Class II Division 2 malocclusions, respectively, as well as reverse overjet associated with the Class III malocclusion.

The perception of esthetics varies from person to person and is influenced by various factors such as age, gender, level of education, and cultural and ethnic backgrounds.[9,11,18,19] For the same reasons, there can be differences of opinion regarding the beauty of dentofacial characteristics between laypersons and professionals.[20,21] In the present study, the opinion of laypeople was asked regarding the esthetics of pretreatment dentition, because the perception of laypeople may be closer to what patients or their parents perceive as contributing factors to poor dental esthetics before orthodontic therapy and the improvement they expect at the end of the treatment. A previous study[9] exhibited that orthodontists and laypersons have visual differences regarding the esthetics of anterior occlusal traits. In contrast, McNamara *et al*.[22] and Krishnan *et al*.[23] indicated a high correlation between specialists and laypersons on the overall smile evaluation.

Both male and female raters were selected in this study with an age range that was similar to that of the parents of orthodontic patients. The mean VAS scores given to the dentition photographs by female raters were comparatively lower than that of the male raters. No significant differences were found in the opinion of male and female raters regarding the factors that predicted dental esthetics in the present sample. Brisman[21] reported that male and female patients

Table 1: The mean and standard deviation and the range of the dental variables in different malocclusions as measured in this study

Class	Overjet			Overbite			Upper crowding			Lower crowding			Midline deviation		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
I	2.04	0.78	1-3.5	2.31	1.00	1-4	4.22	3.12	0-9.5	2.95	2.45	0-8	1.91	0.76	1-2.5
II	4.71	3.16	0.5-11.5	3.96	1.21	1.5-6	4.96	1.68	2-8.5	4.35	3.44	1-12.5	2.10	0.57	1-3.5
III	−1.59	2.66	−6.5-1	0.90	2.60	−3.5-5	6.31	2.40	3-9	3.63	4.07	0-11.5	1.58	0.28	1-2
Total	1.97	3.59	−6.5-12	2.52	2.10	−3.5-6	5.15	2.48	0-9.5	3.70	3.35	0-12.5	1.80	0.39	1-3.5

SD: Standard deviation

had a similar opinion regarding the esthetics of shape, symmetry, and proportion of maxillary central incisors. Heravi et al.[24] found that sex and age of the laypersons did not influence their esthetic perception regarding the shape of the maxillary anterior teeth. Other studies indicated no influence of sex and age of the raters on the evaluation of smile esthetics.[12,25,26]

The results of this study indicated that according to the judgment of female, male, and total female and male raters, dental esthetics could be predicted by two parameters including crowding of upper arch and overbite. The greater the degree of dental crowding and greater the amount of overbite, the lower the dental VAS scores of laypersons would be. The emphasis on the upper crowding can be expected as the upper anterior teeth are usually more visible during smile and speech and thus in social interactions. Similarly, Tessarollo et al.[27] indicated that anterior irregularity significantly influenced satisfaction from dental appearance in adolescents. Marques et al.[28] showed that the upper anterior crowding ≥2 mm was significantly associated with the desire for treatment in Brazilian adolescents and their parents. Tuominen and Tuominen[29] demonstrated that irregularity and malposition of anterior teeth were most often connected with orthodontic treatment need in Finnish young adults. Helm et al.[30] indicated that unfavorable perception of the teeth was more frequently observed in both adolescents and adults with extreme maxillary overjet, extreme deep bite, and crowding. Soh et al.[9] found that Asian laypeople laid a greater emphasis on the overjet of >6 mm and severe maxillary crowding when assessing dental esthetics, but the presence of deep overbite or open bite was not a predictor of their esthetic ratings.[9]

Other dental features including overjet, lower anterior crowding, and midline discrepancy did not contribute to the overall scoring of the dentition in this investigation. It is possible that the range of overjet in the pretreatment sample was not so wide to influence the esthetic rating of laypeople. Usually, the lower anterior teeth are not observed in frontal or lateral view of the dentition, except in Class III patients with reverse overjet in whom the crowding of the lower arch may be visible. This may be the reason that mandibular crowding did not significantly contribute to the overall dental attractiveness. Soh et al.[9] also found that the crowding of lower incisors was a nonsignificant occlusal trait in the perception of dental esthetics.

In this study, midline discrepancy was not a significant predictor of dental attractiveness. The average discrepancy between the upper and lower midline was 1.8 mm in the sample, which could not be identified by most laypersons. Furthermore, the assessment of lower dental midline is difficult in patients with deep overbite or severe overjet. It should be noted that the position of dental midlines relative to facial midline was not evaluated in this study, because only dentition photographs were employed. It is believed that the discrepancy between the upper midline and facial midline

Table 2: The average scores given to the esthetics of the dentition by female, male, and total female and male raters

Class	Females		Males		Total females and males	
	Mean	SD	Mean	SD	Mean	SD
I	32.57	10.60	41.46	10.09	37.01	10.04
II	28.57	6.96	32.79	8.61	30.68	7.58
III	26.19	9.33	30.24	7.35	28.21	7.93
Total	29.25	9.03	34.98	9.79	32.12	9.06

SD: Standard deviation

Table 3: The results of the multiple linear regression analysis to detect the dental features that best predicted overall attractiveness of the dentition according to female, male, and total female and male raters

	Unstandardized coefficients		Standardized coefficients	t	Significant
	B	SE	Beta		
Females					
Constant	55.989	7.871		7.113	<0.001
Overbite	−5.414	2.482	−0.514	−2.181	0.046
Upper crowding	2.516	0.842	0.705	2.990	0.017
Males					
Constant	64.042	7.299		8.774	<0.001
Overbite	−5.160	2.302	−0.515	−2.242	0.045
Upper crowding	2.459	0.781	0.723	3.151	0.014
Total females and males					
Constant	60.016	7.034		8.532	<0.001
Overbite	−5.287	2.218	−0.530	−2.384	0.044
Upper crowding	2.488	0.752	0.735	3.307	0.011

SE: Standard error

is a more significant factor in the perception of dentofacial attractiveness than the upper-to-lower midline discrepancy.

The present study evaluated the influence of crowding, overjet, overbite, and midline deviation on laypeople's dental attractiveness rating. There are also other dental features that can influence dental appearance such as tooth shape, size, color, and factors relating to the periodontium including gingival contour, color, and texture. The esthetic values of these variables may be better recognized if color photographs of the dentitions are employed for comparing dental esthetics in orthodontically treated patients with well-aligned dentitions or patients with minor degrees of malocclusion. Further studies are suggested to clarify the esthetic impact of various degrees of crowding, overjet, overbite, and midline discrepancy on the rating of dental attractiveness by laypersons, orthodontic patients, and professionals.

Conclusions

The presence of upper anterior crowding and deep overbite can significantly predict the perception of dental attractiveness, based on the judgment of female, male, and total female and male raters. It is expected that laypeople with increased upper crowding and/or deep bite would be less satisfied with dental esthetics and would seek orthodontic treatment to improve their dental appearance. Sufficient priority should be given to these dental issues in the orthodontic diagnosis and treatment planning to eliminate the probability of misinterpretations of patients' expectation from treatment.

Conflicts of interest
There are no conflicts of interest.

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