



Rating of smile attractiveness of patients finished to the American Board of Orthodontics standards

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Received: 26 October 2019 / Accepted: 19 February 2020 / Published online: 11 May 2020
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Abstract

Background This study collected 68 smiling photos of cases taken to American Board of Orthodontics clinical exam and were considered as successfully treated.

Materials and methods A panel of 52 raters from different specialties and laypeople were asked to rate the smile attractiveness on a scale from 1–10 and to also choose what components made the smile less attractive. Simple descriptive statistics were used to determine the mean, standard deviations, and quartiles of the smile attractiveness. Multilinear regression (MLR) analysis was used to examine the relationship of smile attractiveness when the variables of age, professional experience, and gender of the raters were considered. Receiver operating characteristic (ROC) was created to correlate the association between smile attractiveness and the perfect smile.

Results The mean rating of each picture ranged from 3.42 ± 1.83 (least attractive smile) to 8.46 ± 1.59 (most attractive smile). The overall mean for smile attractiveness was 6.23 ± 1.09 ; additionally, it was found that problematic teeth, gum, and lips reduce the smile attractiveness score by 1.7, 1.7, and 1.2, respectively.

Conclusion The study showed that only 2 out of 68 American Board of Orthodontics treatment finishes had an attractive and perfect smile.

Keywords Smile esthetics · Orthodontic treatment · Lips · Gingiva · Teeth

Bewertung der Attraktivität des Lächelns von nach ABO(American Board of Orthodontics)-Standard behandelten Patienten

Zusammenfassung

Hintergrund Diese Studie sammelte 68 Fotos von lächelnden Patienten, die nach klinischer Prüfung durch das American Board of Orthodontics (ABO) als erfolgreich behandelt betrachtet wurden.

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Materialien und Methoden Ein Panel von 52 Bewertenden, Mediziner verschiedener Fachrichtungen und Laien, wurde gebeten, die Attraktivität des Lächelns auf einer Skala von 1-10 zu bewerten und auch anzugeben, welche Komponenten das Lächeln weniger attraktiv machen. Einfache deskriptive Statistiken wurden für den Mittelwert, die Standardabweichungen und die Quartilen verwendet. Die multilineare Regressionsanalyse (MLR) wurde verwendet, um die Beziehung der Lächeln-Attraktivität zu untersuchen, wenn die Variablen Alter, Berufserfahrung und Geschlecht der Bewertenden berücksichtigt wurden. Zur Korrelation des Zusammenhangs zwischen der Attraktivität des Lächelns und dem perfekten Lächeln wurde eine ROC („receiver operating characteristic“)-Kurve erstellt.

Ergebnisse Die durchschnittliche Bewertung der einzelnen Bilder reichte von $3,42 \pm 1,83$ (am wenigsten attraktives Lächeln) bis $8,46 \pm 1,59$ (attraktivstes Lächeln). Der Gesamtmittelwert für die Attraktivität des Lächelns lag bei $6,23 \pm 1,09$; zusätzlich wurde festgestellt, dass problematische Zähne, Zahnfleisch und Lippen den Wert für die Attraktivität des Lächelns um 1,7, 1,7 bzw. 1,2 reduzieren.

Schlussfolgerung Die Studie zeigte, dass lediglich 2 von 68 nach ABO-Standards erfolgreich behandelten Patienten ein attraktives und perfektes Lächeln hatten.

Schlüsselwörter Ästhetik des Lächelns · Kieferorthopädische Behandlung · Lippen · Gingiva · Zähne

Introduction

Smiling is the principal nonverbal method for social communication. It is the most useful way people can use to express their emotions [1]. The smile often denotes the confidence of a person and projects an image of self-assurance and positiveness. It is also an expression denoting pleasure, sociability, happiness, joy or amusement. How a person depicts the smile certainly conveys emotions but also invokes a type of response. Ackerman asserts that there is no standard ideal smile to craft in every person, but a clinician's ultimate goal should be to achieve a “balanced” smile by positioning the teeth and the gingiva in harmony within the dynamic display zone [2, 3].

It has been suggested that the smile may be made up of three components (Fig. 1) as follows:

Gingival component The gingival component consists of four elements: the texture, the color, the shape, and the amount that shows on smiling. A healthy gingiva is stippled and firm, normally coral pink but the color depends on

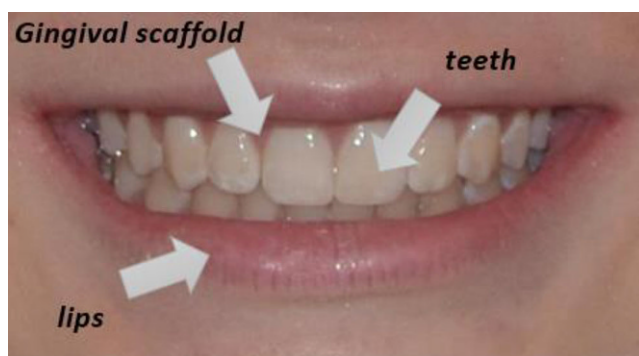


Fig. 1 Components of a smile showing the gingiva, teeth, and lips

Abb. 1 Bestandteile eines Lächelns, bei dem sich Zahnfleisch, Zähne und Lippen zeigen

the amount of pigmentation and the race of the subject [4]. In addition, the dental papilla normally should fill the interdental space showing no “black triangles”. Furthermore, according to Kokich et al. [5], up to 3 mm of gingival height showing on smiling is considered acceptable.

Dental component This component consists of five elements: the color, the shape, the size, the position, and the alignment. Any decalcification, interior or exterior staining can affect the teeth color and ultimately affect the smile esthetics because, from the patient perspective, the teeth color is one of the most important factors in smile attractiveness [6, 7]. According to Heravi et al. [8], the teeth shape is a very essential element in creating a charming smile. Most people prefer the round shaped incisors compared to triangular and square incisors. Additionally, the size of the teeth was also proven to be important [9]. An example is the lateral incisor size and how this tooth's width to height ratio and the crown size proportion relates to the rest of the anterior teeth [10, 11]. The position of the anterior teeth in the three-dimensional space is fundamental in designing a charming smile. In the vertical dimension, the upper anterior teeth's incisal edges are supposed to be in harmony with the curvature of the lower lip upon full smile [1, 12, 13] and the upper central incisors should be parallel to the facial midline [14]. Lastly, the sagittal position and inclination of the upper front teeth is a major component in providing an adequate anterior guidance, anterior teeth exposure, and ensure good lip support that is essential for smile esthetics.

Soft tissue component Many believe that the lips are the frame of the smile [3]. The lip position, its curvature, and thickness are vital elements of a pleasant smile. The optimal position should show the full crown length of upper teeth, revealing more than 2 mm of gingival display when

a high lip position is present, or exposing less than 70% of the upper central incisors when a low lip position is present. Also, the curvature and the symmetry of the upper lip were found to be important parts of the smile [15], but this position depends primarily on neuromuscular factors. Lastly, the thickness of the upper lip appears to have significant influence on the overall smile attractiveness [16].

Orthodontics by definition is “the specialist branch of dentistry concerned with the growth and development of the face and jaws and the treatment of irregularities of the teeth” [17]. The treatment philosophies have evolved significantly through history, driven by occlusal, esthetic, and stability reasons. In order to achieve these goals, clinicians had to create treatment modalities that aligned or splinted teeth together, followed by understanding the ideal dental relationships of teeth (i.e., Angle’s molar classification) [18]. Some philosophies advocated keeping the patient’s entire dentition (Angle) while others the extraction of certain specified teeth. Until recently, clinicians have started to concentrate on the soft tissue paradigm focused on the planning philosophy of keeping the position of the upper anterior teeth in the optimal position of the patient’s face and smile [3].

Objective measurements of orthodontic excellence

Orthodontic excellence is the aspiring goal for every specialist practitioner. In order to achieve the best possible result, many attempts were made to quantify the treatment outcome by identifying standards of care and developing measurable indices.

In 1972 Andrews [19] analyzed 120 casts of people with “normal occlusion”. In order to create the perfect harmonious occlusion of norms in the static state, he identified six keys for normal occlusion in any given orthodontic result. These were molar relationship, crown angulation, crown inclination, no rotations, no spaces, and occlusal plane. The occlusal goals are technically difficult to achieve and in order to determine whether the goals were met, a large number of resources and time was required [18]. In addition, the six keys do not correlate difficulty to end point results. In the United States, as a result of the lack of a precise, reliable and reproducible way to discriminate between the minor inadequacies of tooth position that are found in American Board of Orthodontics (ABO) case reports, the American Board of Orthodontics objective grading system (ABO-OGS) [20] was developed between 1994 and 1998 as a way to objectively assess the final result of the cases submitted to the board exam part III, and as a self-evaluation tool for the examinee to determine if the treatment results insure passing the Board exam. The ABO-OGS con-

sists of two parts: dental cast evaluation and radiographic assessment. The dental cast portion evaluates seven components: alignment, marginal ridges, buccolingual inclination, occlusal relationship should be class I according to Angle’s classification with cusp to fossa for the canines and premolars relationship, occlusal contacts, overjet, interproximal contacts: no spaces should exist in between the teeth. Finally, the radiographic part evaluates the root angulation and requires all roots supposed to be parallel in between each other and perpendicular to the occlusal plane.

Other aspects of the smile

The dentition, however, is not the only component of the smile. The lips and surrounding musculature are very important parts as well. The human smile is a complex neuromuscular movement, it involves the movement of several facial expression muscles, essentially the muscles inserted in the orbicularis oris that separate the lips and pull the corner of the mouth laterally and up [21].

Nonetheless, every individual possesses more than one type of smiles. Ekman [22] found that each person can smile in two ways: posed or spontaneous. Moreover, Ackerman et al. [23] were more specific and defined the spontaneous (enjoyment) smile as follows: involuntary, unavoidable, cannot be sustained, and requires the participation of almost all facial expression muscles. On the other hand, they described the posed smile as voluntary and sustainable. Finally, when it is used for research and treatment planning purposes, the reproducibility of the smile had to be taken into account [1, 24].

Current trends on smile attractiveness

There have been many attempts in the literature to study the esthetic outcome of the orthodontic treatment [1, 3, 25, 26]. Furthermore, there have been various different ways the information is collected, analyzed, and reported in the data [5, 27, 28].

In 1970, Hulsey [1] conducted a study to compare the smile attractiveness of 20 orthodontically treated with 20 untreated cases with normal occlusion. The panel consisted of 10 males and 10 females with different careers. He found that the orthodontically treated cases were significantly less attractive than the untreated cases, and he concluded that the smile arc, lip line, upper lip curvature, and smile symmetry are significant for an esthetically pleasing smile. However, the buccal corridors were not found to be related to smile attractiveness.

In 2008, Schabel et al. [28] tried to find a correlation between the elements of the American Board of Orthodontics Objective Grading System (ABO-OGS) and the smile

attractiveness. No correlation was found between the smile attractiveness and final score or any of its components. More recently, in 2014, a study done by Akyalcin et al. [27] investigated whether there were any common smiles characteristics in patients treated to the American Board standards. They used a panel of 10 orthodontists, 10 dentists, and 10 laypeople to judge 90 smiles. They concluded that out of the 11 elements that they measured only the smile arc and the gingival display were importantly related to smile esthetics. Finally, Batra et al. [29] conducted a study to evaluate the opinion of 100 laypeople on smile esthetics after altering some gingival factors. They concluded that smiles with black triangles presented at the interdental gingival area received the lowest score. On the other hand, changing the shape of the free gingiva and altering the zenith point had the least effect on a rater's judgment but any asymmetric alteration was graded as less attractive compared with the bilateral one.

Aims of the study

At the time of the study, no study has been conducted to rate the attractiveness of the smile using a mixed group of individuals and professionals. Furthermore, no study has tried to quantify what further work needs to be done to complete an attractive smile.

The basis for this study was conducted on the hypothesis that all ABO finished orthodontic cases had attractive smiles.

The aims of the study were the following:

- Evaluate the smile attractiveness of 68 patients treated successfully according to the American Board of Orthodontics standards as determined by a pass in the board examination.
- Determine whether perceiving smile attractiveness is different for different groups of raters.
- Determine whether there are other variables that affect the smile: gums, teeth, and lips.

Materials and methods

In order to complete the study, the following materials and methods were obtained at the Department of Orthodontics, University of Alabama at Birmingham. Approval for the study was obtained and granted by the Institutional Review Board of the University of Alabama at Birmingham.

Case selections

All orthodontic treated cases that were taken to the American Board of Orthodontics examination in Saint Louis, Missouri were considered for the study and analysis. Each of

these cases needed to have smiling photos after completion of treatment and these were available from the University of Alabama at Birmingham, Department of Orthodontics American Board Cases archive. All patient's records were considered eligible if they had successfully passed the ABO clinical exam within the past 5 years of recruitment time. Based on a previous similar study, the sample size of 68 was required to detect an effect with 85% power and a significance level of $P=0.05$.

Careful consideration was taken to only accept cases that qualified with the following:

- Inclusion criteria:
 - Patients with full final records,
 - Taken to the American Board of Orthodontics exam between 2013 and 2018, and considered successfully treated.
- Exclusion criteria:
 - Patients with smiling picture of poor quality,
 - Final smiling pictures that do not meet the American Board of Orthodontics standards,
 - Inability to calibrate the photo.

Survey A broad panel made up of two main groups were surveyed. The first group consisted of dental or medical professionals, such as, orthodontists, prosthodontists, periodontists, and dermatologists. A second group consisted of laypeople from different age groups.

The survey contained two questions:

- Rate the smile attractiveness on a visual analogue scale.
- What component(s) makes the smile less attractive in your opinion?

A sample of a single patient survey is represented in Fig. 2. Furthermore, based on the grading, the smiles were divided into three groups: attractive, neutral, and unattractive.

A 16×9 standardized template was used to crop the photos, leaving a proportionate area around the lips to prevent any confounding factors. All photos were imported into Adobe Photoshop CS version 9.0 (Adobe Systems, San Jose, CA, USA) and were aligned using the interpupillary line as reference.

Statistical analysis

A simple visual analogue scale was used in the survey. Raters were asked to rate the smile attractiveness by choosing a number from 1 to 10; 1 being least attractive and 10 being most attractive. Descriptive statistics were used to determine the mean, standard deviations and quartiles of the smile attractiveness. Further considerations were made

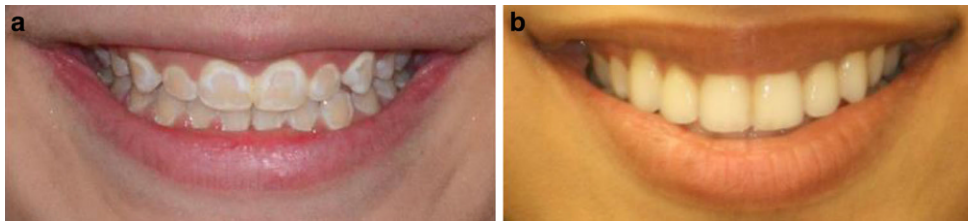


Fig. 2 Worst and best smiles. **a** The worst smile showing significant discoloration of the teeth and lack of gingival contours. **b** The most highly rated smile with nice teeth, gingival display and lip contour

Abb. 2 Schlechtestes und schönstes Lächeln. **a** Das schlechteste Lächeln mit deutlichen Verfärbungen der Zähne und fehlenden Zahnfleischkonturen. **b** Das am besten bewertete Lächeln mit schönen Zähnen, sichtbarer Gingiva und Lippenkontur

Table 1 The allocation of the group of raters and relevant distribution

Tab. 1 Zuteilung der Bewertergruppe und entsprechende Verteilung

Occupation	Age (20–30)	Age (30–40)	Age (40–50)	Age (50–60)	Total number	Percent
Dermatologist	1	1	0	0	2	3.85
Orthodontist	6	6	1	0	13	25.00
Periodontist	3	1	0	0	4	7.69
Prosthodontist	2	4	1	0	7	13.46
Other	7	8	8	3	26	50.00
Total	19	20	10	3	52	100.00
Percentage	36.53	38.46	19.23	5.76	100	100.00

for the gender of the raters and the professional experiences of the raters.

Multilevel mixed linear regression (MLR) analysis was used to examine the relationship of smile attractiveness when the variables of age, professional experience, and gender of the raters were considered. In addition, the MLR analysis was also used to determine whether the gums, lips, and teeth were associated in the final smile attractiveness outcomes. Finally, a receiver operating characteristic (ROC) curve was created to correlate the association between smile attractiveness and the perfect smile. All the statistical analyses were conducted using SAS 9.4 (Cary, NC, USA).

Results

Demographics

In all, 68 consecutively treated cases were chosen for the study. A total of 52 raters (58% women, 42% men) responded and completed the survey. The age group representation of the raters were 37% aged 20–30 years, 39% aged 30–40 years, 19% aged 40–50 years, and 6% older than 50 years old. Table 1 shows the allocation of the group of raters and relevant distribution.

Smile attractiveness

The smile attractiveness of each patient was calculated to produce a mean and standard deviation. The mean rating of

each picture ranged from 3.42 ± 1.83 (least attractive smile) to 8.46 ± 1.59 (most attractive smile). Please refer to Fig. 2. The overall mean for smile attractiveness was 6.23 ± 1.09 and Table 2 shows a representation of the data.

Perfect smile and associated problems

The results showed that there was no smile picture among the finished orthodontic cases that was unanimously rated as the “perfect smile”. The best smile had an agreement score of 53% and an attractiveness rating of 8.46 ± 1.59 . The least attractiveness score had a unanimous score indicating that it was not perfect smile. In addition, the raters rated it having problems with the teeth in 94% of the responses, 12% in the lips and 50% in the gums.

When the lips were considered the sole factor for the smile outcome, the least problematic score (4% of raters) had an attractiveness score of 7.58 ± 1.63 and the most prob-

Table 2 Distribution of ratings for the total sample based on the visual analogue scale

Tab. 2 Verteilung der Bewertungen für die gesamte Stichprobe auf der Grundlage der visuellen Analogskala

Quantile	Value
Minimum	3.42
25%	5.39
Median	6.38
75%	7.11
Maximum	8.46

Table 3 Predictors of attractiveness identified by multilevel mixed linear regression. Lips, gums, and teeth had an effect on the attractiveness, but gender, age, and occupation did not

Tab. 3 Durch mehrstufige gemischte lineare Regression ermittelte Prädiktoren der Attraktivität. Lippen, Zahnfleisch und Zähne hatten einen Einfluss auf die Attraktivität, nicht jedoch Geschlecht, Alter und Beruf

Effect	Estimate	Standard error	DF	t Value	Pr> t
Intercept	8.6666	0.8473	43	10.23	<0.0001
Problematic lips	-1.2353	0.06284	3210	-19.66	<0.0001
Problematic gums	-1.7421	0.05955	3210	-29.26	<0.0001
Problematic teeth	-1.7150	0.05659	3210	-30.31	<0.0001
Age_Group 20–30 vs. 50–60	-0.7407	0.7933	43	-0.93	0.3557
Age_Group 30–40 vs. 50–60	-0.8956	0.7896	43	-1.13	0.2629
Age_Group 40–50 vs. 50–60	-0.3212	0.8064	43	-0.40	0.6924
Occupation: dermatologist vs. orthodontist	-1.4702	0.9480	43	-1.55	0.1283
Occupation: other vs. orthodontist	-0.4306	0.4500	43	-0.96	0.3440
Occupation: periodontist vs. orthodontist	-0.7966	0.7028	43	-1.13	0.2633
Occupation: prosthodontist orthodontist	-0.05258	0.5971	43	-0.09	0.9302
Female vs. male	0.4790	0.3964	43	1.21	0.2335

lematic score (75% of raters) had an attractiveness score of 5.08 ± 1.88 .

When the gums were considered the sole factor for the smile outcome, the least problematic score (2%) had an attractiveness score of 8.12 ± 1.42 and the most problematic score (96% of raters) had an attractiveness score of 4.69 ± 1.98 .

Finally, when the teeth were considered the strongest factor for the smile outcome, the least problematic score (8%) had an attractiveness score of 8.46 ± 1.59 and the most problematic score (94% of raters) had an attractiveness score of 3.42 ± 1.83 . Interestingly, the best and worst scores for attractiveness corresponded to the assessor's ratings of the teeth.

Multilevel mixed linear regression analysis of smile attractiveness and problems

In this study, a MLR was performed to predict the rating of the smile attractiveness to the variables of lips, gums, teeth, age, occupation, and gender orientation. Table 3 represents the predictors of attractiveness by the MLR. It was interesting to note that:

- Problematic lips reduced the smile attractiveness rating by 1.2, $p < 0.0001$
- Problematic gums: reduced the smile attractiveness rating by 1.7, $p < 0.0001$
- Problematic teeth: reduced the smile attractiveness rating by 1.7, $p < 0.0001$.

The rater's age, occupation, and gender were not associated with the smile attractiveness ratings.

Receiver operating characteristic curve

Finally, the results were analyzed to determine whether there was an association between the smile attractiveness and the perfect smile. In order to do this evaluation, sensitivity and specificity calculation was employed to produce the receiver operating characteristic (ROC) curve (Fig. 3). It was found that a cut-off value of 8 for smile attractiveness rating has the best combination of sensitivity and specificity

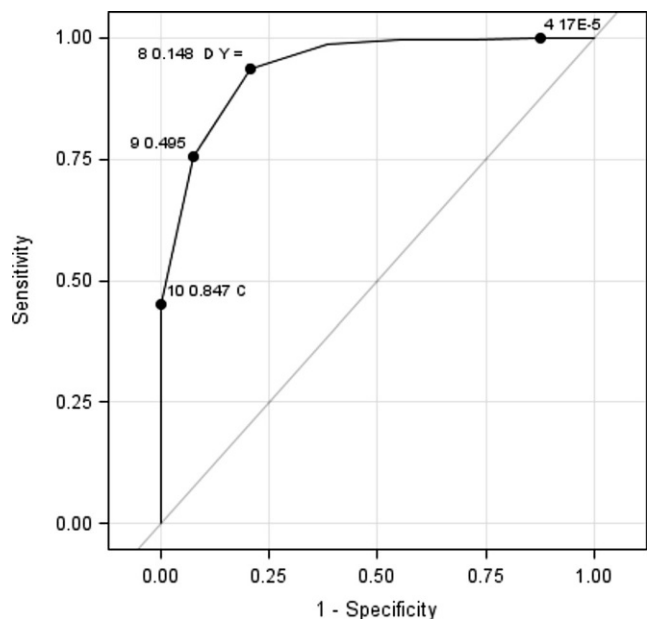


Fig. 3 Receiver operating curve: the curve showing a cut-off value of 8 for smile attractiveness rating has the best combination of sensitivity and specificity with the perfect smile

Abb. 3 „Receiver operating curve“: Die Kurve mit einem Cut-off-Wert von 8 für die Bewertung der Attraktivität des Lächelns weist die beste Kombination von Sensitivität und Spezifität mit dem perfekten Lächeln auf

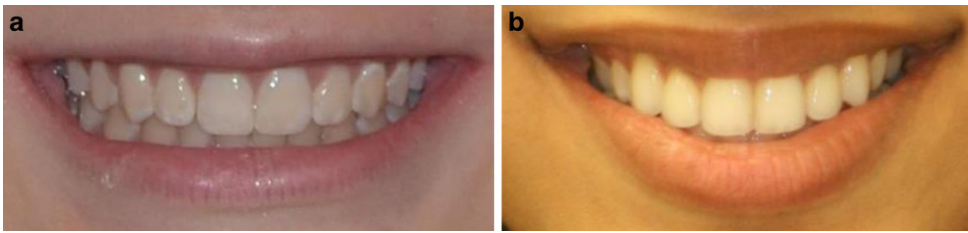


Fig. 4 The two perfect smiles in the sample group. Both smiles were deemed by the raters to have good show of teeth, gums, and lips

Abb. 4 Die beiden perfekten Lächeln in der Beispielgruppe. Beide wurden von den Bewertenden als Lächeln mit guter Darstellung von Zähnen, Zahnfleisch und Lippen bewertet

with the perfect smile. In other words, this number produced the smallest difference (sensitivity–specificity = 0.148) between sensitivity and specificity between variables. In looking back at the entire sample of ratings of smile attractiveness, only 2 out of 68 or 2.94% of the total cases represented in this sample Fig. 4.

Discussion

The aim of the study was to determine the smile attractiveness of 68 patients treated successfully according to the standards of excellence set out by the American Board of Orthodontics. The goal of the study was to determine whether smile attractiveness was different for different groups of raters and determine whether there are variables that affect the perfect smile: gums, teeth, and lips.

Smile attractiveness

A previous study [27] analyzed the smiles of 90 patient and used a panel of 30 raters (10 orthodontists, 10 dentists, and 10 parents of patients). The study found a mean smile attractiveness score of 6.66 and a median of 6.61 with a standard deviation of 1.02 for smiles of patients treated to the American Board of Orthodontics standards. Their results were similar to our score of 6.23, 6.38, and 1.09 for mean, median, and standard deviation, respectively. However, in the previous study, no attempt was made to determine the breakdown and quantify the attractive smiles. Another study in 1970 [1] tried to determine whether orthodontically treated patient had attractive smiles. This study used a panel of 10 people from different careers to evaluate the smiles of 20 orthodontically treated patients and 20 persons who had never had orthodontics treatment. The result concluded that orthodontically treated patients had less attractive smiles than normal people. It is interesting to note that another study [37] could not find any correlation between the smile esthetics and any element of the (ABO-GS). This study is similar to our study. However, we found that even though the patients in our sample had successful

orthodontic treatments (according to the Cast Radiographic Analysis) only two of them (2.94%) had perfect smiles!

Perfect smile and associated problems/variables

The smile has three components, and each component has a role to play in relation to smile design of the perfect smile. Ackerman, Sarver, and Dong [30–33] emphasized the role of the lips in the beauty of the smile; they describe the smile index, the mini esthetic, the relationship of the upper lip to the lower teeth, and the upper lip curvature and symmetry.

The component of the gums is another component in the smile esthetics. Kokich, Tjan and Dong [5, 30, 34] shed some light on the importance of the gingival health, shape, and the lip line (gingival display) upon smiling. Finally, the last part that contributes to smile esthetics is the teeth. The presence of decalcification, the color, the shape, and the size of the teeth were found by previous studies to have a great influence on the smile esthetics [3]. In our study, we found these statements to be true and lips, gums, and teeth played a significant role in the attractiveness of the smile as the ratings of attractiveness were significantly affected by these variables.

Several studies with contradictory results were conducted to discover if different groups of people perceive the smile esthetics differently. In some other studies it was found that orthodontists have low threshold in discovering small discrepancies compared to laypeople [35]. In our study, we found no difference between the groups based on occupation.

Age was found in other studies to influence the participant's answers. Many investigators have found that the younger the rater, the more critical they were when judging a smile [36–38]. These results were opposite to ours and Kokich's findings when he studied the effect of altering some dental and gingival factor on the smile esthetics [35]. Based on the findings of this study, we conclude that age group of the raters does not affect outcome on smile attractiveness.

The gender of the rater was found to have no impact on the answers in our survey. This result was similar to the re-

sults of Moore et al. [25] who found no difference between males and females laypeople when judging different factors of smile attractiveness. On the other hand, Geron and Atalia [39] and Zange et al. [40] concluded that women are more critical than men when judging the smile esthetics. This was not seen in our study.

Clinical implications

This study demonstrated the need to approach patient care in a holistic manner. While the ABO goals for treatment provided an occlusal goal for the ideal set-up of teeth in a static position, it did not take into account other aspects of the smile. In “everyday orthodontics”, smile esthetics are what patients are seeking when they visit an orthodontic practice, and clinicians have to also pay close attention to the abovementioned aspects [3, 41]. The gums, teeth, and lips are beyond the routine scope of an orthodontic practitioner but many options exist today that include gingival surgery, surgical movement of the jaws [42, 43], prosthodontic rehabilitation (to shape ideal tooth size and color) and lip augmentations [44]. As a result, orthodontic clinicians need to either seek advanced education to perform these procedures or collaborate extensively within a multidisciplinary team to provide the best care for our patients.

Study limitations

One limitation of our study is using colored pictures. Other studies have advised the use of black and white pictures to eliminate bias [28], but in our study the decision was made to use colored photo to be able to capture the role of the teeth color and gums on smile esthetics.

Another limitation is using photos taken at debonding for some patients, and for not bringing the patient back after the reduction of the gingival inflammation caused by the orthodontic appliances. Thus, due to the limited time available, we decided to use all available photos only.

Finally, some people suggest that the photos are not a reliable way to study smile esthetics, and the best was to evaluate the smile is by capturing videos for the dynamic smile [2]. However, due to the limited time available we could not bring the patients back to record the short videos.

Conclusion

The following conclusions may be drawn from this research study:

- Two out of 68 American Board of Orthodontics treatment finishes had an attractive and perfect smile.

- Smile attractiveness is affected by the lips, gums, and teeth.
- Smile attractiveness seems to be affected most by the teeth.
- The raters’ age, gender and occupation did not significantly affect the ratings of smile attractiveness.

Funding Orthodontic Department Funds.

Compliance with ethical guidelines

Conflict of interest C. H. Kau, T. Christou, R. B. Xie and T. Abou-Saleh declare that they have no competing interests.

Ethical standards All procedures performed in studies involving human participants or on human tissue were in accordance with the ethical standards of the institutional and/or national research committee and with the 1975 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. IRB obtained under UAB-2018-MS-Ortho-01.

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