



Attractiveness of Posed and Spontaneous Smiles in Orthodontic Patients: Insights from Dentists, Orthodontists, and Laypeople

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/jammr/2024/v36i95567>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/122375>

Original Research Article

Received: 25/06/2024

Accepted: 31/08/2024

Published: 05/09/2024

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Cite as: Iunes, Augusto, Paula Cotrin, Celia Regina Maio Pinzan Vercelino, Renata Cristina Gobbi de Oliveira, Ricardo Gobbi de Oliveira, Fabricio Pinelli Valarelli, and Karina Maria Salvatore Freitas. 2024. "Attractiveness of Posed and Spontaneous Smiles in Orthodontic Patients: Insights from Dentists, Orthodontists, and Laypeople". *Journal of Advances in Medicine and Medical Research* 36 (9):174-84. <https://doi.org/10.9734/jammr/2024/v36i95567>.

ABSTRACT

Objective: The objective of this study was to compare the attractiveness of the posed and spontaneous smile at the end of orthodontic treatment in the view of dentists, orthodontists, and laypersons.

Methods: The sample comprised the photographs and videos of 5 orthodontically treated patients, capturing the posed and the spontaneous smiles. The smile attractiveness was judged using a scale from 0 to 10, with 0 being the least attractive and 10 being the most attractive. One hundred fifty-nine dentists, 191 orthodontists, and 126 laypeople of both sexes evaluated the smiles on a google forms questionnaire sent by Whatsapp. The age range of the evaluators varied from 18 to 70 years of age. A T-test was used to compare the attractiveness score between the posed and the spontaneous smiles. One-way ANOVA and Tukey tests were used to compare the attractiveness scores of the posed and spontaneous smiles between the three groups of evaluators.

Results: The spontaneous smile was significantly more attractive than the posed smile, and there was no difference in the attractiveness of the posed smiles between dentists, orthodontists, and laypeople. Laypeople considered spontaneous smiles significantly more attractive than dentists, and dentists also found them significantly more attractive than orthodontists.

Conclusion: The spontaneous smile was considered more attractive than the posed smile in orthodontically treated patients.

Keywords: Smile; orthodontics; dental photography.

1. INTRODUCTION

Facial attractiveness plays a fundamental role in social interaction, directly influencing the individual's personality and self-esteem [1-3]. The smile's attractiveness has been exhaustively investigated in this context. It is known that the smile exerts a more significant influence on facial attractiveness than other components of the face, such as hair, eyes, ears, chin, and skin, in both genders [4]. The investigation of the characteristics that impact the smile's attractiveness is usually the analysis of the posed smile. Still, there is some concern regarding the validity of a single photographic capture for esthetic assessment and treatment planning [5]. Moreover, spontaneous smiles provide parameters for better identification of smiling characteristics [6-8]. Facial measurements showed that the upper lip elevates by 28%, relative to the rest position, and the mouth increases in width by 27% [5].

The capture of spontaneous smiles is done through dynamic video images [9]. However, using a spontaneous smile as a reference by the clinician routinely suggests simplifying the registration form. Today's smartphones have cameras that generate good-quality images and are easy to use and affordable [3,9]. Orthodontic records' gold standard accurately replicates or

accurately portrays the "anatomic true" [10]. The anatomic truth is the actual three-dimensional anatomy of the face and surrounding soft and hard tissues [10]. Orthodontists routinely use an assortment of two-dimensional static imaging techniques to record the three-dimensional anatomy of the craniofacial region [10]. The type of smile changes significantly when posed and spontaneous smiles are compared [9]. Not all orthodontically well-treated patients with dental casts or digital scanning in good shape exhibit desirable anterior tooth display [11]. Dental treatments should be individually planned according to each patient's smile characteristics [9].

Clinicians' and laypersons' evaluations of the attractiveness of smiles have been used to establish references in obtaining greater convergence between function and aesthetics [8,12]. Several studies have assessed the smile's attractiveness [8,13-16]. Others, the simple registration of smiles, especially for diagnostic purposes [3,7,9,17]. There is a gap concerning the investigation of the means of recording the smile at the end of orthodontic treatment influencing the attractiveness assessment. Thus, the objective of this study was to compare the attractiveness of the posed smile and spontaneous smile at the end of orthodontic treatment in the view of dentists, orthodontists, and laypersons.

2. MATERIALS AND METHODS

2.1 Materials

The sample size calculation was based on an alpha significance level of 5% (0.05) and a beta of 20% (0.20) to achieve a test power of 80% to detect a minimum difference of 1 with a standard deviation of 0.5 for the smile attractiveness score [18]. Thus, the calculation resulted in the need for 5 individuals in the sample.

The sample comprised photographs and films of the smile of 5 patients (3 women and 2 men), aged between 18 and 25 years. All patients were treated orthodontically.

The inclusion criteria were: patients with complete orthodontic treatment in the last 12 months, all permanent teeth up to second molars, no size and shape anomalies, no anterior diastemas, Class I relationship, no dental fillings in the anterior teeth, good periodontal health, coincident midlines and characteristics for smile harmony like a good smile arc, buccal corridor, and gingival exposure when smiling.

The evaluator's groups comprised 159 dentists (44 men and 115 women), with a mean age of 33.22 years (SD=12.29), 191 orthodontists (68 men and 123 women), with a mean age of 38.71 years (SD= 10.86), and 126 laypersons (19 men and 107 women), with a mean age of 41.98 years (SD=12.30).

2.2 Methods

2.2.1 Posed smile register

Photographs of the posed smile were obtained with the patient in maximum intercuspation in frontal view with standardized natural head position. In addition, the patient was looking straight ahead on the horizon, sitting in an upright position facing the researcher with the camera located at a distance of 40 cm from the patient, supported on a tripod [9]. The tripod height was adjusted so that the camera lens was at the level of the patient's lips.

2.2.2 Spontaneous smile register

The spontaneous smiles were obtained filming the smiles with the cell phone. Filming was standardized with the natural head position not allowing movement filming. The camera was also positioned 40 cm from the patient's face to the shooting [17]. Patients were encouraged to talk

to the researcher, and with this stimulus, they were induced to manifest a spontaneous smile [9,17]. Each video had an average duration of 30 seconds. The frames of films were selected, and those who presented spontaneous smiles, as evidenced by the look semi-closed and the contraction of periocular muscles [19]. The images obtained were cropped and they showed only the smile area.

Photos and films were made by one operator (AI) using a smartphone (iPhone 11; Apple, USA) on a tripod with a light-type illuminating ring (260 x 260 mm diameter, 15 W power) (Fig. 1). The images were taken consistently at the same time of the day, considering the variation in the incidence of natural light did not influence the quality of the photos.

The images were cropped in the smartphone's photo editing program with a 16x9 template. Only the upper and lower teeth, with their surrounding soft tissue and lips, were left apparent to decrease distraction factors. Thus, the evaluators were not influenced by other facial structures like the chin, nose, and eyes and focus on the attractiveness of the teeth with soft tissues.

2.2.3 Questionnaire application

A form was created in Google Forms and sent to the evaluators via Whatsapp. The survey comprised 10 images, 2 of each patient, one picture of the posed smile, and one of the spontaneous smile.

Below each image, a score scale varying from 0 to 10 was placed. The evaluators rated the smile attractiveness, where 0 was the least attractive, and 10 was the greatest. (Fig. 3). In the second round of questions, the examiners evaluated each patient's posed and spontaneous smile, choosing what they considered more attractive (Fig. 4). In both sessions, there was a repetition of the image of a randomly selected patient so that the error of the method could be verified [20].

The form was available for responses for seven days, between 13 -16 March 2021. The data obtained were stored anonymously by the main investigator (AI).

2.2.4 Error of the method

To assess the method's reliability, one of the smiles was duplicated in the questionnaire answered by the evaluators. The two

attractiveness scores of the same smile were compared using the weighted Kappa test.

2.3 Statistical Analysis

The attractiveness score between the posed and spontaneous smile was compared with t-tests.

The age comparison between the groups was performed using one-way ANOVA and Tukey tests. The intergroup comparisons of gender distribution were checked with the chi-square test. The one-way ANOVA and Tukey tests were used to compare the attractiveness scores of the posed and spontaneous smile between the 3 groups of evaluators.



Fig. 1. Posed and spontaneous smiles



Fig. 2. Positioning for recording images

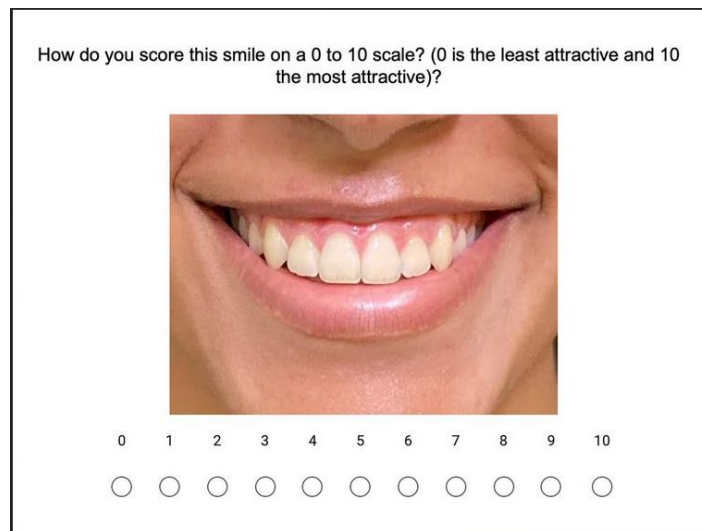


Fig. 3. Smile picture and rating scale

Among the smiles below, choose the one you find most attractive



Fig. 4. Comparison between posed and spontaneous smile

The attractiveness scores of the posed and spontaneous smile between female and male, younger and older, and more or less experienced professionals were compared with t-tests.

All tests were performed with the software Statistica for Windows (version 12 .0; StatSoft, Tulsa, Oklahoma, USA), considering statistically significant values for $P < 0.05$.

3. RESULTS

The Kappa coefficient was 0.89, which is considered an excellent agreement [21]. The spontaneous smile was significantly more attractive than the posed one, with 58% of the evaluators preferring the spontaneous one and 42% the posed one (Table 1).

There was a statistically significant difference between dentists, orthodontists, and laypersons,

with dentists being the youngest group and laypersons the oldest group (Table 2). Furthermore, the lay group had significantly more women than the dentists and orthodontists (Table 2).

There was no statistically significant difference in the posed smile attractiveness score between dentists, orthodontists, and laypersons. However, laypersons found it significantly more attractive for the spontaneous smile than dentists, who also found it significantly more attractive than orthodontists (Table 3).

Female raters found spontaneous smiles significantly more attractive than male raters; there was no difference between genders for the posed smile attractiveness score (Table 4).

When comparing the younger and older evaluators, there was a statistically significant

difference in assessing the spontaneous smile attractiveness score for the orthodontists and lay groups (Table 5). Older orthodontists and laypersons rated spontaneous smiles more attractive than younger ones (Table 5).

More experienced orthodontists judged a spontaneous smile more attractive than orthodontists with less experience (Table 6).

4. DISCUSSION

This is the first study to compare the attractiveness of the posed and spontaneous smile after orthodontic treatment. In smile objective analysis, the record spontaneous smile as a parameter for evaluation to an accurate diagnosis has been suggested [9]. The visualization of most complete smile component

structures is opposed to that made possible by posed smiling records, which show a decrease of the lips line height, exposure of the teeth, and smile wide [7]. These characteristics could compromise the diagnosis and the aesthetic perception of the treated case.

The present study speculated whether greater exposure to dental and gingival structures could affect the smile's attractiveness. This greater exposure to specific parameters is a factor of increased attractiveness [16]. Our results showed that the spontaneous smile was significantly more attractive than the posed smile and agreed with current orthodontic literature. In the attractiveness scores and the percentage of evaluators, the spontaneous smile was significantly more attractive than the posed smile.

Table 1. Comparison of the attractiveness score between posed and spontaneous smiles (dependent t test)

Variables	Posed smile		Spontaneous smile		p
	Mean	SD	Mean	SD	
Smile attractiveness scores	6.37	2.21	6.73	2.12	0.000*
%	42%		58%		0.000*
	n=200		n=276		

* Statistically significant for $p < 0.05$

Table 2. Intergroup comparison of age and sex distribution

Variables	Dentists n=159	Orthodontists n=191	Layperson n=126	P
	Mean (SD)	Mean (SD)	Mean (SD)	
Age(years)	33.22 (12.29) ^A	38.71 (10.86) ^B	41.98 (12.30) ^C	0.000* ^o
Sex	n (%)	n (%)	n (%)	X ² =16.03
Male	44 (27.7%)	68 (35.6%)	19 (15.1%)	GL=2
Female	115 (72.3%)	123 (64.4%)	107 (84.9%)	p=0.000* ^q

* Statistically significant for $p < 0.05$

^o One-way ANOVA; ^q Chi-square test

Different letters in a row indicate the presence of a statistically significant difference between the groups (Tukey tests)

Table 3. Intergroup comparison of the smile attractiveness scores (One-way ANOVA and Tukey tests)

Smile Attractiveness Score	Dentists n=159	Orthodontists n=191	Layperson n=126	P
	Mean (SD)	Mean (SD)	Mean (SD)	
Posed smile	6.39 (2.16)	6.29 (2.11)	6.47 (2.42)	0.263
Spontaneous Smile	6.80 (2.06) ^A	6.26 (2.08) ^B	7.34 (2.11) ^C	0.000*

* Statistically significant for $< 0,05$

Different letters in a row indicate the presence of a statistically significant difference between the groups (Tukey tests)

Table 4. Comparison of the posed and spontaneous smiles attractiveness score between female and male evaluators (t-tests)

Smile Attractiveness Score	Females n=345		Males n=131		p
	Mean	SD	Mean	SD	
Posed smile	6.38	2.29	6.34	1.99	0.629
Spontaneous smile	6.82	2.18	6.48	1.95	0.001*

* Statistically significant for <0,05

Table 5. Comparison of the attractiveness score of posed and spontaneous smiles between younger and older evaluators (t-tests)

Smile attractiveness Score	Younger (Bellow 35 years of age)		Older (Above 36 years of age)		p
	Mean	SD	Mean	SD	
Dentists					
Posed Smile	6,40	2,24	6,38	2,03	0,936
Spontaneous smile	6,82	2,08	6,77	2,04	0,733
Orthodontists					
Posed Smile	6,20	2,09	6,37	2,12	0,207
Spontaneous Smile	6,11	2,07	6,40	2,08	0,030*
Layperson					
Posed Smile	6,18	2,48	6,59	2,39	0,055
Spontaneous smile	7,03	2,27	7,47	2,02	0,019*

* Statistically signigicant for <0,05

Table 6. Comparison of the posed and spontaneous smile attractiveness score between dentists and orthodontists according to their time of professional experience (t-tests)

Smile attractiveness Score	Less experienced (Below 10 years of professional experience)		More experienced (Above 10 years of professional experience)		p
	Mean	SD	Mean	SD	
Dentists					
Posed Smile	6.40	2.26	6.37	2.00	0.833
Spontaneous Smile	6.89	2.07	6.65	2.03	0.115
Orthodontists					
Posed Smile	6.15	2.07	6.41	2.14	0.062
Spontaneous Smile	6.12	2.08	6.39	2.08	0.045*

* Statistically significant for p<0,05

In addition to the causal relationship between ideal objective aspects of the smile and positive attractiveness assessment, another explanation for the obtained results is speculated. When in function, the action of the orbicularis oculi muscle is the spontaneous smile sustaining, influencing the perception of attractiveness, even when the image of the eyes is not visible to the evaluators [22]. Thus, when perceived by the observer, even without direct observation of the eyes, the spontaneous smile triggers positive emotions, known as emotional contagion [23].

Volunteers of both genders (3 women and 2 men) were selected to minimize gender-related

biases in the evaluated smile models [24]. The age range of the volunteers, from 18 to 25 years, was determined due to the progressive decrease in muscle capacity to maintain a smile from 30 years of age onwards, which could mask some aspects of smiles and influence the assessments [25].

The posed and spontaneous smiles were recorded with footage taken with a smartphone. The choice for smartphones instead of professional cameras was due to the excellent resolution of cameras on current devices and the lower cost, practicality, and universality of their use. Protocols for acquiring and editing

smartphone photographic and video images have already been established [3,9]. The option of using films instead of photographs to record the spontaneous smile was made given the difficulty in capturing the exact moment of manifestation of the spontaneous smile with pictures [7]. We opted for the natural stimulus of the smile in a conversation between the researcher and volunteers [7,9,26]. The phrases and phonemes commonly used in similar studies proved inefficient for manifesting spontaneous smiles in some volunteers [25,27]. Close-up cropped frontal images of the smile were used for evaluations because they allow complete visualization of the smile characteristics and avoid possible distracting factors and influence on the assessments [13].

The dentist group was significantly younger than the orthodontist group, which was also significantly younger than the lay group. The participation of the evaluators took place spontaneously, with no prior homogenization of groups in terms of gender or age. The disagreement between previous studies regarding the influence of age on the subjective evaluation of the smile does not decide forcefully that such differences in compatibility have caused bias [28-30]. The attractiveness scores showed that the group of dentists, even the youngest, was not the most rigorous in the evaluations, falling behind the orthodontists. It seems that the greater evaluation rigor, characteristic of younger evaluators, has not had more influence on the assessments than the more discerning look of orthodontists.

Furthermore, there were significantly more female evaluators in the lay group than in the dentists and orthodontists groups. There are contradictory results regarding women participation in studies. There are contradictory results when women evaluating smiles. Some studies indicated women as less criterious, [18,22,31] more criterious [32] or that don't exist sexual dimorphism when assessing smiles [33-36]. Specific aspects set, in addition to cultural and personal standards, seem to have more influence than the gender of the evaluators.

There was no significant difference in the posed smile attractiveness between the evaluators' groups. It could be speculated that, as the results of the orthodontic treatment were satisfactory, evaluations of laypersons, orthodontists, and dentists tend to be similar [1,37]. However, concerning spontaneous smiles, laypersons

found them significantly more attractive than dentists, and they also considered them significantly more attractive than orthodontists (Table 3). The greater evaluation rigor of orthodontists seen in other studies was also observed in the evaluations of the spontaneous smile in this research [8,12,13,15,36]. The difference between the groups is the attention to detail that makes up the smile's aesthetics. Orthodontists are more accurate in the relationship between incisors, lips, and gingival exposure. At the same time, dentists, more than laypersons, focus on the more general characteristics of the smile, such as tooth shape, color, and gingival contour [7,38]. Emotional contagion, speculated as the reason for the best assessment of the attractiveness of a spontaneous smile, seems to find limits in the criticality characteristic of the professional gaze.

Men and women attributed similar scores to the attractiveness of the posed smile, in agreement with previous studies that found no influence of gender on the perception of the smile's aesthetics [6,28, 29,36,39]. However, regarding the spontaneous smile, female evaluators gave higher scores than their male counterparts. Some authors [22,31] found similar results. However, a greater accuracy assessments by evaluators were reported by Zange et al. [32]. Other investigations have also found gender differences in subjective smile assessments [8,15,20].

To verify whether the evaluator's age influences their aesthetic perception, the evaluator's groups were subdivided according to their age. The evaluators up to 35 years old were considered younger and older than 36 years were considered old. According to this criterion, orthodontists and older lay people attributed significantly higher scores only to spontaneous smiles. The younger evaluators of these two groups were more careful than the older ones. For the others, the age of the evaluator did not influence the results. Higher scores of attractiveness by older evaluators were found in previous studies showing greater contempt in both objective and subjective evaluations of smiles [29,30,40]. Greater evaluation rigor of younger orthodontists was expected due to the combination of the greater detail inherent in the specialist's trained gaze associated with the greater severity of younger evaluators found in other studies [30,40]. The difference also found in younger lay people may reflect this group's massive presence on social networks. The

significant influence of social media in this age group, mainly with short videos posted on Instagram, Tiktok, and Youtube, was reported in other study [41].

Orthodontists with less experience time gave significantly lower scores for spontaneous smiles than their more experienced peers. In this group, there was confirmation of the pattern found for evaluators in general, regardless of technical background, of an increase in evaluation rigor inversely proportional to age [30,40]. Although not significant, it was possible to observe that orthodontists attributed lower scores than dentists, regardless of professional experience, evidencing the greater criticality of specialists in orthodontics [8,12,38].

Some points should be considered limitations of this study, such as the influence that subjective, social, and cultural differences exert on the aesthetic perceptions of the smile [15]. In addition, evaluators were invited to participate in the study by a message via Whatsapp sent by the researcher. They reached people from the same circle of relationships who share social and cultural conditions that are not very stratified. It is suggested in future investigations to vary the study design so that there is greater diversity among evaluators.

The present study showed that the spontaneous smile was significantly more attractive than the posed smile by dentists, orthodontists, and laypersons. The recording of spontaneous smiles performed as suggested in this study is presented in a simple, cheap, and effective way as a diagnosis, assessment during treatment, and post-treatment. It can be incorporated into the routine of the orthodontist.

5. CONCLUSIONS

Orthodontists, dentists, and laypersons found a spontaneous smile more attractive than a posed smile after orthodontic treatment.

Laypersons assigned higher marks to the attractiveness of the spontaneous smile, followed by dentists and orthodontists.

Age influenced the ratings, with younger raters being more rigorous.

Older orthodontists and older laypersons rated spontaneous smiles as more attractive than their younger counterparts. Orthodontists with less

experience were more rigorous in evaluating the SE than their more experienced colleagues.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

It is not applicable.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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