

A proportional appraisal of smile perception by laypersons, dental professionals, and a smile designing software: An *in vivo* study

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Abstract

Aim: To equivalence the perception of smile among laypersons, dental professionals and a commercially available popular smile designing software.

Settings and Design: *In vivo* – comparative study.

Materials and Methods: A total of 72 participants within age range of 18-30 years were randomly selected with a natural permanent dentition. All the subjects underwent extra oral and intra oral photographic evaluation as per the American Academy of Cosmetic Dentistry (AACD) guidelines. A total of 11 evaluators were selected for the study and were divided into four groups. The evaluation procedure comprised of assessment of patients' natural smile by laypersons, dental professionals and a smile designing software. A questionnaire was prepared for recording the responses which included a five-point Likert scale.

Statistical Analysis Used: Data was statistically analysed using SPSS version 23. Frequencies and chi square test were done for intergroup comparison.

Results: There was a statistically significant difference present in comparison across $P < 0.05$ all the groups.

Conclusions: There was significant difference in the perception of smile among evaluators and a smile designing software. Smile designing software prefers to modify the smile as per in built criteria and is more inclined towards creating an ideal smile.

Keywords: Comparison of the smile, perception of the smile, smile design, smile designing software

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INTRODUCTION

A human face has a unique facial expression called "smile," which frequently plays a major role in successful persons' personal as well as professional life. The smile adds to one's charm and beauty, plays a huge role in improving one's self-image, and is the biggest confidence booster. Esthetics is very much subjective perception

and is mutually related to harmony of oral and perioral structures with face. Miller in 1989 stated that asymmetry is easily detectable when an observer's eye is trained.^[1] For this reason, professional opinions regarding facial esthetics may not coincide with the perception and expectation of patients or laypersons.^[2]

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In the idiosyncratic evaluation, predilections of the esthetics can be evaluated by scales of ordinal and interval data measurement as they have expressiveness of preference from least preferred to most preferred. Observations and analysis of esthetics would greatly differ between a professional who regularly deals with esthetics and a layperson.

As the saying goes “beauty lies in the eyes of the beholder,” the perception of a beautiful smile varies with each individual. Thus, dental professionals dealing with dentofacial esthetics, professionals related to beauty and esthetics, laypersons, and a smile designing software were chosen for this study. Furthermore, it was necessary to evaluate whether the increasing popularity of smile designing software among dental professionals is warranted.

The intent of the study was to evaluate and compare the difference in the perception of smile by dental specialists who deal with smile design, laypersons, and a smile designing software.

MATERIALS AND METHODS

A study was conducted in the department of prosthodontics, crown, and bridgework and oral implantology to evaluate and compare the perception of smile among laypersons, dental professionals, and a smile designing software. The study was carried out after due approval from the institutional ethical committee (FDS/DDU/IEC/Prosthodontics/03/2018).

A total of 72 participants within the age range of 18–30 years were randomly selected with a natural permanent dentition. The exclusion criteria for the study were subjects with missing anterior teeth, fractured teeth, retained deciduous dentition, facial trauma or injury, any restorative dental treatment in maxillary and mandibular anterior teeth, any orofacial pathology, and subjects who underwent orthodontic treatment. Written informed consent for participation and for publishing photographs as part of the study was obtained from all the subjects in the language they could read and understand. For this study, all the subjects underwent extraoral and intraoral photographic evaluation.

All the photographs of the participants were obtained as per the American Academy of Cosmetic Dentistry guidelines by a single-blind operator using a digital single-lens reflex camera (Canon EOS 6D Mark II camera, Canon Inc., Tokyo, Japan) and lens (Canon EF 100 mm f/2.8 L IS USM, Canon Inc., Tokyo, Japan) and flashlight (Meike MK-MT24 Macro Twin Lite Flash, Hongkong Meike, Hongkong).^[3]

For nonretracted view, a subject exhibited a full natural smile with facial muscles relaxed and the interpupillary



Figure 1: Nonretracted view photograph with smiling face – Frontal

line parallel to the floor [Figure 1]. Camera was positioned parallel to the floor in the horizontal orientation projecting focal center near glabella (M/125/f8/ISO 200 with a magnification of 1:10 [1:15]).

For nonretracted close-up view, focus was on maxillary central and lateral incisors and incisal plane of maxillary teeth was in horizontal midline of the image [Figure 2]. Image was taken at 90° to the subject and directly in front of the subject with camera placed in horizontal orientation (M/125/f8/ISO 200 with a magnification of 1:2 [1:3]).

For retracted frontal view, maxillary teeth were centered using the midline and frenum as references, to bisect the image vertically [Figure 3]. The image was taken at 90° to the subject and directly in front of the subject. The lens was positioned parallel to the Frankfort horizontal plane so that central incisor line and lens lie in the same neutral position (M/125/f22-29/ISO 200 with a magnification of 1:1 [1:1.5]).

For retracted lateral view, the lateral incisor was centered to bisect the image vertically and horizontally [Figure 4]. Image was taken at 90° to the facial of the lateral incisor (M/125/f22-29/ISO 200 with a magnification of 1:1 [1:1.5]).

A total of 11 blind evaluators were selected for the study and were categorized into four groups [Table 1].

A standard photographic template of 20.32 cm × 30.48 cm size was created using a photo editing software (Photoshop CC 2020 [21.1.0], Adobe Inc., Michigan). The standardized dimensions of each photograph were as follows: for the nonretracted view 1 – 17.5 cm × 12.5 cm, for the nonretracted view 2 – 12.5 cm × 6.3 cm, for the retracted



Figure 2: Nonretracted view full smile – Frontal view



Figure 3: Retracted view maxillary anteriors – Frontal view

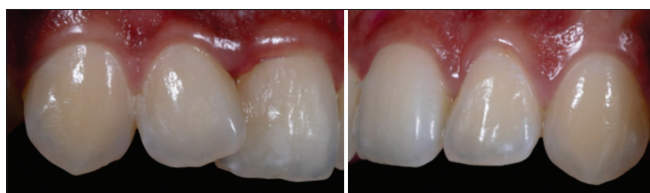


Figure 4: Retracted view maxillary anterior right and left lateral view

frontal view 3 – 12.5 cm × 6.3 cm, and for the retracted lateral view 4 – 6.3 cm × 3.5 cm.

An evaluator information sheet printed in English as well as the regional language was given to each evaluator. Each evaluator evaluated standard printed photographic templates individually. All the templates were printed in a standardized printing machine (Fuji Jet Press 750s Photo Lab Printing Machine, Fujifilm Holdings Corporation, Tokyo, Japan). Each evaluator received a questionnaire comprising nine questions pertaining to participants' smile with a five-point Likert scale for evaluation.^[4]

Each subject underwent a digital smile analysis using Digital Smile Analysis Software (VisagiSmile software 2018, Web Motion Ltd., Sofia, Bulgaria) by a blind observer who was well versed with digital smile designing followed by a questionnaire comprising nine questions pertaining to subjects' smile.

RESULTS

Based on the observations, statistical analysis was performed using IBM SPSS Statistics for Windows,

Table 1: List of evaluators

Evaluators	Group title	Category of the evaluators
Dental professionals	DS	Prosthodontist (DS1) Orthodontist (DS2) General dentist (DS3)
Other professionals dealing with esthetics	EP	Photographer (EP1) Beautician (EP2)
Laypersons	EL	EL1 EL2 EL3 EL4 EL5
Software analyzer	ES	ES

DS: Dental professional's evaluator, EP: Other professionals dealing with esthetics evaluator, EL: Layperson evaluator, ES: Software analyzer evaluator

Version 23.0. (Armonk, NY: IBM Corp.). Frequencies and Chi-square test were done for intergroup comparison.

There was a statistically significant difference present in comparison across all the groups. There was no significant difference found between dental professionals and the smile designing software for perception of the overall smile and upper lip position in relation to gingiva displayed.

DISCUSSION

A dental professional deals very closely with macro- and microelements of smile on a daily basis and plays a primary role in restoring smiles of their patients. Tjan *et al.* stated that beauty is usually expressed by social elements and personal choice.^[5] Jørnung and Fardal conducted a study on perceptions of patients' smile while comparing patients' and dentists' opinions. They found that patients' thoughts of their own smiles were significantly higher than the clinician's assessments of their smiles.^[6]

Kokich *et al.* compared that the observation of dental surgeons and laypersons changed dental esthetics. They concluded that orthodontists, general dentists, and laypersons distinguish explicit dental esthetic inconsistencies at different degrees of deviation, which may help the dental expert in making unambiguous treatment proposals.^[7]

The appealing smile is a perfect harmonization between facial and dental elements. The facial elements include the hard and soft tissues of the face. The dental elements are related more specifically to dentitions themselves and their relationship with gingiva. For evaluation of the perception of smile, criteria used in this study were uniformity of dental versus facial midline, size and shape of maxillary anterior teeth, shape of face and its relation to personality of an individual, color of teeth, lip position and subsequent display of soft tissue and teeth in the maxillary anterior

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Table 2: Comparison of responses of dental professional group, other professionals dealing with esthetic group, layperson group, and the smile designing software

Comparison between	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Dental professionals									
Other professionals	0.005*	<0.001**	<0.001**	0.003*	0.102 (NS)	<0.001**	0.118 (NS)	<0.001**	0.218 (NS)
Dental professionals									
Laypersons	<0.001**	<0.001**	0.017*	0.256 (NS)	0.014*	0.021*	<0.001**	0.511 (NS)	<0.001**
Dental professionals									
Software	0.777 NS	<0.001**	<0.001**	<0.001**	<0.001**	0.010*	0.363 (NS)	<0.001**	0.065 (NS)
Other professional									
Laypersons	<0.001**	0.130 (NS)	0.019*	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
Other professional									
Software	0.019*	<0.001**	<0.001**	<0.001**	<0.001**	0.039*	0.043*	<0.001**	0.008*
Laypersons									
Software	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	0.238 (NS)	0.118 (NS)	<0.001**	0.211 (NS)

*Significant ($P < 0.05$), **Highly significant ($P < 0.001$). NS: Not significant ($P > 0.05$)

region, and position of the gingival zenith of the six maxillary anterior teeth.

The results of the present study [Table 2] showed that there were statistically significant differences in the perception of a smile among individuals. With regard to components and characteristics of the smile of all 72 participants, there was a statistically significant difference found between dental professionals dealing with dentofacial esthetics and the smile designing software. This observation can be correlated to a research conducted by Al-Saleh *et al.* which assessed the esthetic introspection of smiles among a group of dental students and found negative esthetic introspection among the dental students in their self-reported satisfaction with their appearance.^[8]

For excellent esthetic situation, facial and dental midlines should coincide. For the present study, smile of participants in which the facial midline did not coincide with the dental midline were considered to be disagree to strongly disagree. For perception of the midline, prosthodontists, orthodontists, and the smile designing software were highly perceptive as compared to other groups such as laypersons and other professionals dealing with esthetics ($P = 0.001$). Similar observations were found by Kokich who showed that as long as the lines are parallel, a deviation of up to 4 mm is not perceptible to the layperson.^[9]

For the size of the teeth, dental professionals, smile designing software, and other professionals dealing with esthetics had a higher perception as compared to the layperson group ($P = 0.001$). The software only follows in-built tooth size criteria for the analysis, but dental professionals and laypersons found some amount of variation in tooth size to be acceptable. This is in agreement with a study conducted by Chandra Pani *et al.* who, in their study, stated that most of the participants preferred shorter and wider lateral incisors compared to the ideal image.^[10]

For an acceptable smile, the shape of the teeth should relate to the facial form. Williams classification of facial form is widely accepted among dental professionals, which comprises oval-, square-, round-, and ovoid-shaped face.^[11] Williams geometric theory evaluated the correlation between the tooth form and the face form. Among the many studies conducted, some studies showed a positive correlation with this theory,^[12-14] while others disproved, which might attribute due to racial and gender differences.^[15-17]

Smile designing software analyses and divides patients' facial form in accordance with four typical facial maps which include strong, dynamic, delicate, and calm. Visagism concept was introduced by Dr. Braulio Paolucci, which interprets smile design based on personality traits. He stated that patients' individual preferences and patients' psychological analysis should be considered, and treatment planning should be inclusive of these factors along with general smile designing parameters.^[18] VisagiSmile is a program fully evolved over the Visagism concept. In facial analysis, the software was more precise and showed more disagreement while analyzing the 72 participants. For the dental professionals, responses were neutral, and for the other groups, the shape of the face, teeth, and personality was acceptable. Smile designing does not just mean rearranging the teeth but also denote harmonization between face and personality.^[19] Smile designing software was found to be highly perceptive as compared to all other groups for the type of the face and its relation to the teeth ($P = 0.001$). The layperson group had a far lower perception regarding the type of face and its relation to the teeth; however, they found the smile pleasing which contrasts with the smile designing software. Montero *et al.* in 2015 stated that personality of a person has a weak but significant correlation with esthetic inclination and oral health values.^[20]

The relationship of tooth color and its impact on facial attractiveness is widely accepted and has been studied

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extensively.^[21,22] In the present study, laypersons found most participants smiles to be acceptable as far as the tooth color was concerned. However, significant differences were found between the observations made by dental professionals compared to laypersons and other professionals associated with beauty and esthetics. Thus, color perception was evaluated critically by dental professionals.

The positioning of the upper lip is important for an acceptable smile. It should be positioned in harmony with the amount of gingiva and teeth displayed. Rufenacht classified lip line into high lip line, medium lip line, and low lip line.^[23] Along with the total height of the maxillary dentition, the high lip line shows a huge variation of gingiva extending from the inferior border of the upper lip to the free gingival margin. Compared to the high lip line, medium lip line displays only the tip of interdental papilla and cervical and middle one-third of maxillary anterior teeth, whereas the low lip line has no gingival exposure and shows $\frac{3}{4}$ of the maxillary anterior teeth.^[23] In the present study, the prosthodontist found most of the participants' smile to be nonacceptable as far as the lip position was concerned. However, significant differences were found among other groups such as laypersons and other professionals dealing with esthetics and the smile designing software. Borges *et al.* evaluated the impact of the width/height ratio of upper anterior teeth on the beauty of smile among laypersons and orthodontists and stated that the opinions of orthodontists and laypersons did not differ statistically with one another.^[24] Scott *et al.* stated that differences in lengths of upper and lower lips have a huge role in persons' attractiveness.^[25]

The gingival zenith position plays a major role in the smile perception.^[26] It was found that the smile perception was statistically significant when the smile designing software was compared to the other groups. It was found that gingival zenith position was not appealing for the prosthodontist and the smile designing software. Kokich *et al.* stated that the layperson could not notice 2.0-mm discrepancies of unilateral gingival papilla, whereas dentists noticed discrepancy in height of unilateral papilla and found it unesthetic.^[9]

For the purpose of this study, two-dimensional photographs were used for smile analysis. Three-dimensional photography is always not accessible to the clinicians, hence two-dimensional photographs were chosen for the study. Revilla-León *et al.* studied the perception of esthetic between two-dimensional and three-dimensional simulated dental discrepancies and concluded that raised inclination of occlusal plane was associated with reduced grades by dental professionals as well as laypersons;

however, two-dimensional and three-dimensional images of smile were rated highly esthetic by laypersons. In general, three-dimensional smile simulations received higher grades than two-dimensional smile simulations.^[27] Ward stated that photographs give unlimited time to observers and permit one to perform mathematical analysis for smile design.^[28]

Depending on factors like the smile line, smile designing may not just include only six anterior teeth but may also involve posterior teeth. Patients' dentofacial esthetic analysis plays a decisive role in determining number of teeth to be involved.^[29] The factors which are crucial in smile designing include age, gender, facial shape, facial height, and facial profile. The dental parameters include precision in form and position of dentition and their relation to surrounding hard and soft tissues. Therefore, it is mandatory to evaluate hard and soft tissues of face before proceeding for smile designing.^[19]

A change in a similar perception was observed among the group of dental professionals after evaluating the smile as per the basic parameters of the study. This implies that dental professionals may steer toward favoring an ideal smile, as compared to the layperson group, which still prefers a more natural smile. From a statistical point of view, we may draw a conclusion that dental professionals and the smile designing software prefer to modify the smile and are inclined toward a more ideal smile. The software perceives a smile according to the in-built criteria and suggests changes accordingly.

It is not always necessary to adhere to the standard principles of symmetry, color, or perfection for a smile to be deemed as beautiful. The sentiment of what may be considered as a pleasing smile may vary individualistic. The natural beauty of smile is not maintained by perfect and precise mathematical formulas. It is perfection which lies within minute imperfections which makes it attractive. For these reasons, smile design rules that use an ideal model as an objective have a tendency to be rigid, and therefore, smile designing should not be performed by fixed rules and parameters which are rigid and may not be able to design naturally beautiful smile satisfactory to dental professionals and laypersons.

Looking at the technological advancement, further studies should be carried out comparing 2D photographs with 3D photographs. Furthermore, comparison of smile enhancement using different software may be conducted.

CONCLUSION

Within the purview of this study, it can be concluded that there was a statistically significant difference in

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the perception of smile analysis by laypersons, dental professionals, and a smile designing software. The dental professionals were found to have a more methodical and technical approach toward analysis of a smile with the usage of smile designing software than a person who is not trained in smile analysis. Smile designing software prefers to modify the smile as per in-built criteria and is more inclined toward creating an ideal smile.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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