Original Article

Comparison between Still Photography and Videography for Smile Analysis

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Abstract

Introduction: The aim of this systematic review was to compare still photography and videography for smile analysis. **Materials and Methods:** Based on the available data, two authors conducted an electronic database PubMed search from January 1, 2000, to December 31, 2015, and ten strategies were designed using five keywords along with their respective synonyms. Twelve articles were shortlisted for the systematic review. **Results:** The search yielded 91 articles, of which 12 were included based on the selection criteria. Of these 12, five concluded videography compared to be a better tool. Seven articles had variable conclusions based on the study setting and population evaluated. **Conclusions:** Digital video clips offer a tremendous amount of information for analyzing the dynamic character of the smile, but a standard digital photograph allows for immediate viewing.

Keywords: *Digital photograph, smile, smile analysis, smile esthetics, video clip*

Introduction

The smile plays an important part in orthodontic diagnosis and treatment planning. This has been recognized since the beginning of our specialty, and in the current esthetically oriented society, it seems to play a central part in self-perception and social image.[1]

Conventionally, photography is used for an orthodontic record, but new videographic and computer technologies have enabled other diagnostic assessments. As part of a facial esthetics evaluation, a clinician studies lip function and posture. During this evaluation, a patient is often asked to smile and a split-second image of that dynamic action is captured on a still photograph. This photograph, used as part of the diagnostic process to determine a course of treatment, remains as a permanent record in the patient's chart. If we want to depend on a still photograph to reflect the esthetics of patient's smile, it is necessary to capture a true representation of that smile. For instance, if the photograph was taken a few seconds earlier or later, would it show the same smile? If a different directive was used to elicit a smile, would it trigger the same response? Would videography rather than photography provide a more effective diagnostic impression? Studies in the psychology literature have found that people are better able to detect posed emotion from motion photography than from still photography.[2-8]

Analysis of orofacial esthetics during spontaneous smiling and speaking is now feasible because the optimal record can be selected from a video registration. The use of digital videography to capture an authentic, spontaneous smile combined with digital measurements has been tested lately, and it appeared to be reliable, reproducible, and valid for use in clinical practice.

Materials and Methods

This study was conducted and reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA).

Study screening criteria

Before the study, a screening protocol was developed, and the following inclusion and exclusion criteria were established.

Inclusion

1. Studies that provide information on comparison between still photography and videography
2. Study published between January 1, 2000, and December 31, 2015
3. Study written in English or should have a detailed summary in English.

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Exclusion

1. On-going studies
2. Reviews, abstracts, letters to editors, editorials, and *in vitro* studies
3. Studies that did not use any standardized method of photography and videography
   - Search strategy for the identification of studies
   - An electronic database (PubMed) search was performed for articles published in the dental literature using the following search strategy. Two reviewers have included the studies for this systematic review.

Study selection

Preliminary screening consisted of 91 articles, of which 25 articles were selected. The papers were screened independently by one reviewer (JC) and cross-checked by another reviewer (SA). At first, the papers were screened by title and abstract. As a second step, full-text papers were obtained when they fulfilled the criteria of the study aim. For full-text screening, the following criteria were taken into consideration: randomized controlled trials, controlled clinical trials, comparative studies, observational studies, case reports, and twin studies. The keywords and search strategy used are shown in Tables 1 and 2. Finally, a total of 12 articles were included after duplicate removal. Studies excluded were not answering the framed question in any form. All the articles selected in the electronic and manual searches were evaluated independently by the first and the second author in accordance with the established inclusion criteria. Any disagreement between the two reviewers was resolved after additional discussion [Figure 1].

Table 1: Keywords

Keywords	Synonyms
Smile	Laugh, dynamic smile
Digital photograph	Digital image, picture, photograph, portrait, still photography
Video clip	Video recording, motion picture, videography
Smile esthetics	Attractiveness
Smile analysis	Smile evaluation

Results

The database search showed 91 articles listed in PubMed. Twelve articles were selected after duplicate removal. Using the PRISMA flow diagram, an overview of the article selection process is illustrated in the flowchart.

A standard pilot form in Excel Sheet was initially used, and then, all those headings which were not applicable for our review were removed. Data extraction was done for one article initially and this form was reviewed by an expert and finalized. This was followed by data extraction for all the articles.

A summary of the main findings and the data regarding participants, intervention, comparisons, outcomes study design (PICOS) in this systematic review is presented in Table 3.

PICOS

- P-Participants: Individuals
- I-Intervention: Videography
- C-Comparison: Photography
- O-Outcomes: Smile
- S-Study designs: Comparative studies.

Description of various studies

As previously mentioned, there are twelve studies which were conducted mainly in the United States, United Kingdom, Netherland, Germany, Iran, and China and were published between 2002 and 2013. Their main objectives were to compare and evaluate smile esthetics using videography and photography. The age of the participants ranged from 12 to 55 years. Some studies showed significant differences among the spontaneous smile and posed smile using videography and photography. Some studies concluded that digital video clips offer a tremendous amount of information for analyzing the dynamic character of the smile, but a standard digital photograph allows for immediate viewing and is a valid tool for analysis of the

Table 2: Search strategy

Serial number	Search strategy	Number of articles	Number of selected articles	After duplicate removal
1	Digital photographs and smile esthetics	10	3	3
2	Digital image and smile evaluation	5	3	1
3	Photography and smile esthetics	58	10	7
4	Videography and smile	2	2	1
5	Video clip and dynamic smile	1	0	0
6	Videography and dynamic smile evaluation	1	1	0
7	Photography and dynamic smile evaluation	4	1	0
8	Photography and dynamic smile esthetics	6	3	0
9	Digital videography and smile analysis	1	1	0
10	Digital videography and digital image	3	1	0
Total		91	25	12

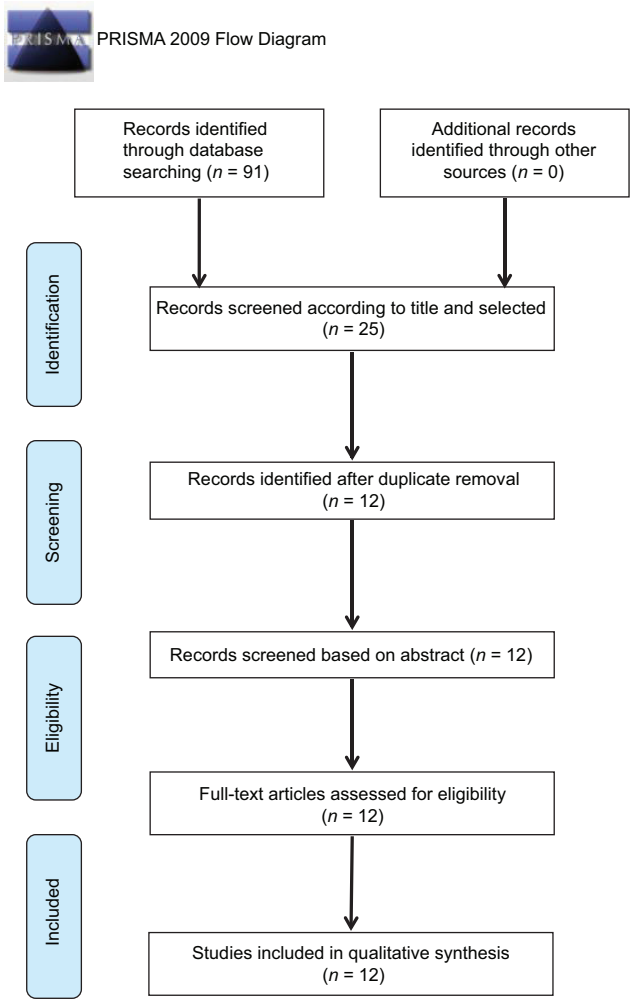

Figure 1: Flow diagram of the article-selection process

post-treatment smile and some found the need to continue to investigate and standardize the methods of eliciting and recording a smile of diagnostic quality. The fast onset and fading out of a spontaneous smile makes it impossible to capture the right moment with a static photograph. Therefore, it is proposed to switch from static to dynamic video recording of the smile for diagnostic purposes.

Discussion

This systematic review assessed the existing evidence on the esthetics of smile and the relationship between smiles captured by clinical photography and smile images obtained from digital video clips. Because esthetic concerns have become more critical in orthodontic diagnosis and treatment planning, a fundamental question arises: Are standard static records obtained routinely by orthodontists capable of capturing the smile accurately?

The literature has addressed many aspects of the smile, but only a few studies have been touched on the aspect of the reproducibility of the smile by videography and photography together.

Walder *et al*.[9] analyzed smiles of 22 individuals simultaneously by videography and photography on two separate occasions. Objective measurements showed that the posed smile prompted with a visual or a verbal clue, or taken on day 1 or 2 can be reliably reproduced, whether captured by videography or still photography. However, subjectively, the panel members detected differences between the posed smiles taken on different days 80% of the time.

Schabel *et al*.[10] used the Smile Mesh program in their study to quantify and compare 14 characteristics of smiles captured by clinical photography and digital videography. A significant difference was found between 7 of the 14 mean Smile Mesh measurements. These were maximum incisor exposure, upper lip drape, buccal corridor right, left, buccal corridor ratio, upper lip height, and lower lip height. Other than lower lip to maxillary incisor, all showed moderate to strong relation with each other (P values 0.47–0.82; $P < 0.001$). In other studies, Schabel *et al*.[11,12] evaluated the reliability of and the relationship between the Q-sort and visual analog scale methods used to measure esthetic preferences. Kappa agreement and the McNemar test were used to evaluate the level of agreement between orthodontists and parents for "attractive" and "unattractive" images of smiles captured with clinical photography. A statistically significant result ($P < 0.05$) of the McNemar test indicated that the raters disagreed on the percentage of "attractive" images.

Sarver and Ackerman[13] and Ackerman and Ackerman[14] described the evolution of smile analysis and reviewed the dynamic records needed. They concluded that visualization and quantification of the dynamics of the smile is a two-stage process. The first crucial step is the clinical examination and second is record taking.

Van Der Geld *et al*.[15] used records of spontaneous smiling next to posed smiling; diagnostics can be improved so that they approach the daily perceptions of patients by their social analysis. They found that for four-grade scale estimation, kappa values were slightly lower. Posterior-tooth kappa values for spontaneous smiling varied between moderate and substantial. Significant correlation for rating errors of smile line height of spontaneous smiling (Central incisor: $r = 0.20$, $P = 0.026$; second premolar: $r = -0.26$, $P = 0.007$).

Oshagh *et al*.[16] addressed one of the numerous factors determining smile esthetics and showed that, generally, dental students, art students, and laypeople do not prefer smiles with minimal and excessive buccal corridors for both male and female individuals. They concluded that regarding the male individuals, art students rated 10% buccal corridor as most attractive and 28% least attractive, but dental students rated 15% buccal corridor the best and 28% buccal corridor the least attractive. Art and dental students rated 22% buccal corridor the best and 2% buccal corridor the least attractive in female individuals.

Table 3: Data extraction

Study ID	Place of study	Year of publication	Population	Intervention	Method to elicit smile	Assessment parameter	Outcome of the study	Conclusion
1	University of Michigan	2010	12-20 years	Photography and videography	For clinical photography - photographer instructed the individual to smile. For digital videography - individuals were asked to smile and then relax lips three separate times with lips lightly touching together. Asked to smile until told to relax	Maximum incisor exposure, upper lip drape, lower, lower lip to maxillary incisor, interlabial gap, smile width, smile index, commissure corridor, buccal corridor, upper lip height, lower lip height	A significant difference found between 7 of the 14 mean smile mesh measurements and they are maximum incisor exposure, upper lip drape, buccal corridor right, left, ratio, upper lip height, lower lip height. All showed moderate to strong relation with each other (P=0.47-0.82; P<0.001) other than lower lip to maxillary incisor	A significant positive correlation was noted between smile mesh measurements obtained from smiles captured by clinical photography and digital video clips. Digital video clips offer a tremendous amount of information for analyzing the dynamic character of the smile, but a standard digital photograph allows for immediate viewing and is a valid tool for analysis of the posttreatment smile
2	New York University	2013	20-49 years, 11 men and 11 women	Photography and videography	Two cameras arranged, each individual photographed and videotaped simultaneously. Still photography - two photographs taken, first by saying "give me a nice big smile, that shows your teeth" and second by showing a poster	Commissure to commissure, vermilion upper to lower lip, superior to inferior lower lip, upper incisal edge to inferior upper lip, to vermilion upper lip and interpupillary line, intercanthal distance	No statistically significant differences were found between smile measurements taken on day 1 and 2 except commissure to commissure distance between visually commanded smile on day 1 and 2 and in verbally commanded smiles only difference was in intercanthal distance recorded on day 1 and 2	The following are our specific conclusions Posed smiles can be reliably reproduced as measured objectively, but, subjectively, differences were noted When the entire face is visible, practitioners can detect important differences between posed and spontaneous smiles. However, this ability is decreased when only the smile is shown Spontaneous smiles are preferred to posed smiles by professional diagnosticians Videography provides diagnostic information that cannot be obtained with still photography alone Video images are preferred to still images by professional diagnosticians

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Table 3: Contd...

Study ID	Place of study	Year of publication	Population	Intervention	Method to elicit smile	Assessment parameter	Outcome of the study	Conclusion
3	Radboud University	2011	20-55 years	Videography	For spontaneous smile - funny jokes from a film shown. Smiling with maximum visibility of teeth and gingivae were selected	Smile line - measurement of most incisal point line and lip edge, interpupil line	For four-grade scale estimation - kappa values were slightly lower. Posterior-tooth kappa values for spontaneous smiling varied between moderate and substantial. Significant correlation for rating errors of smile line height of spontaneous smiling (CI: r=0.20, P=0.026; second PM: r=−0.26, P=0.007)	Smile line analysis can be performed reliably with semiquantitative estimation by using a three-grade scale. For a more comprehensive diagnosis, additional measuring is proposed for patients with disproportional gingival display
4	University of Michigan	2009	12-20 years	Photography and videography	For clinical photography - photographer instructed the individual to smile. For digital videography - individuals were asked to smile and then relax lips 3 separate times with lips lightly touching together. Asked to smile until told to relax	Smiles from digital video clips and clinical photographs	Clinical photography - Q-sort and VAS scores of smiles were highly variable among raters. Correlation coefficients vary from −1 to +1	The findings of this investigation are as follows The Q-sort was more reliable than the VAS for measuring the esthetics of the smile Orthodontists and parents of orthodontic patients agreed with respect to “attractive” and “unattractive” smiles. Orthodontists rated more smiles “attractive,” but this difference was not significant Men and women agreed poorly with respect to “attractive” and “unattractive” smiles. Women rated significantly more smiles as “attractive” than males
5	Perking university school	2013	20-35 years	Videography	A laptop was placed at individual’s eye level behind camera showing three 1 min long comedic film to capture spontaneous smile	Commissure to commissure dynamic smile and upper lip curvature	Female individuals showed higher percentage of commissure smile, upper curvature and lower percentage of cuspid smile, downward curvature during dynamic smile than male individuals (P<0.05)	In upper lip curvature and smile classifications, differences clearly exist based on race, when comparing Chinese individuals with those of Caucasian descent, and gender

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Study ID	Place of study	Year of publication	Population	Intervention	Method to elicit smile	Assessment parameter	Outcome of the study	Conclusion
6	University of North Carolina	2002	Not mentioned	Videography	The patient is asked to say the sentence "Chelsea eats cheesecake on the Chesapeake," relax, and then smile	Maximum incisor exposure, upper lip drape, lower, lower lip to upper incisor, interlabial gap, upper - 3 or 4 width, smile width, midline offset, smile index, commissure right left and tooth above below intercommissure, corridor, buccal corridor right left and ratio, smile arc, upper lip thickness, lower lip thickness	Clinician should rank smile attributes in order of their importance in creating a balanced smile	Smile analysis and smile design generally involve a compromise between two factors that are often contradictory: the esthetic desires of patient's anatomic and physiologic limitations. Using digital video and computer technology, the clinician can evaluate the patient's dynamic anterior tooth display and incorporate smile analysis in to routine treatment planning
7	University of North Carolina	2003	Not mentioned	Photography and videography	The patient is asked to say the sentence "Chelsea eats cheesecake on the Chesapeake," relax, and then smile	Commissure height, philtrum height, interlabial gap, incisor shown at rest, crown height, gingival display, smile arc, percentage of incisor display on smile	Direct measurement permits the clinician to quantify resting and dynamic lip-tooth relationships. Philtrum and commissure height, interlabial gap, incisor show at rest and smile, crown height, gingival displace, and smile arc measured systematically	Visualization and quantification of the dynamics of the smile is a 2-stage process. The first crucial step is the clinical examination. The key element in this evaluation is the direct measurement of lip-tooth relationships both dynamically and in repose. Record taking is the second step in this process. These records are taken frontally and obliquely to allow for a three-dimensional description of smile characteristics

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Study ID	Place of study	Year of publication	Population	Intervention	Method to elicit smile	Assessment parameter	Outcome of the study	Conclusion
8	Shiraz University of Medical Sciences	2010	18-25 years	Photography	Posed smile	Buccal corridors	Regarding the male individual, art students rated 10% buccal corridor most attractive, 28% least attractive, but dental students rated 15% best and 28% buccal corridor the least attractive. The data provided no significant differences ($P>0.05$) between the male and female judges or between male and female individuals for each of the images using Mann–Whitney test	Minimal or excessive buccal corridors should be included in the problem list during orthodontic diagnosis and treatment planning. Dental students are more discriminating about buccal corridor changes. No significant differences are found *n* between male and female judges from art and dental students in judging smile attractiveness with varying levels of smile fullness. Laypeople and art and dental students-*n* dents prefer smaller buccal corridors for male individuals and larger buccal corridors for female individuals
9	Peking University, Charite University	2012	20-35 years	Photography	Numerous images of each individual were taken, and the one with the maximum enjoyment smile was selected	Tooth display, gingival display and papillary display	Complete display of lateral incisor and first premolar is found more frequently in Chinese than in Caucasian. Chinese women show more gingiva, papilla than men	In upper lip curvature and smile classifications, differences clearly exist based on race, when comparing Chinese individuals with those of Caucasian descent, and gender
10	University of Michigan	2009	12-20 years	Photography	Photographer instructed the individual to smile	Maximum incisor exposure, upper lip drape, lower, lower lip to maxillary incisor, interlabial gap, smile width, smile index, commissure corridor, buccal corridor, upper lip height, lower lip height	Objective-smiles with greater distance between incisal margin of maxillary incisors and lower lip were considered most unattractive. Individuals with excessive height of smile or deficient smile width were considered most unattractive	The findings of this investigation showed the following Mean differences of the smile mesh measurements between individuals with attractive or unattractive smiles were not significant Extremely unattractive smiles were characterized by a greater distance between the incisal margin of the maxillary incisor and lower lip and by excessive height of the smile or deficient smile width No smile mesh measurement could predict an attractive or unattractive smile

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Study ID	Place of study	Year of publication	Population	Intervention	Method to elicit smile	Assessment parameter	Outcome of the study	Conclusion
11	Eastman Dental Institute	2012	25 years or older	Photography	Smile of lower 1/3 of face captured	Occlusal plane	10° rated as most attractive by patients and 15° smile as most attractive by dentist	Patients tended to rate the 10° smile better than 0° and 20° smiles, and dentists tended to rate the 15° smile better than 0° and 20° smiles. Patients showed higher tolerance to occlusal plane changes (accepting 5°, 10°, and 15° smiles) than did dentists (accepting 10° and 15° smiles). This study suggested that large changes in the occlusal plane angle would affect relative smile attractiveness, but small changes are unlikely to affect smile attractiveness
12	Radboud University Nijmegen Medical Centre	2008	20-55 years	Videography	For spontaneous smile - funny jokes from a film shown. Smiling with maximum visibility of teeth and gingivae were selected	Maxillary and mandibular lip-line heights, tooth display, and smile width	Maxillary lip-line heights during spontaneous smiling are higher than during posed smiling	Spontaneous smiling should be the logical focus point for the esthetic diagnosis of lip-tooth relationship during smiling. The fast onset and fading out of a spontaneous smile makes it impossible to capture in the right moment with a static photograph. Therefore it is proposed to switch from static to dynamic video recording of the smile for diagnostic purposes

CI – Central Incisor; VAS – Visual analog scale; PM – Premolar

Laypeople rated 10% buccal corridor the best in male and 15% in female individuals. They rated 28% buccal corridor the least attractive in both genders. The data provided no significant differences ($P > 0.05$) between the male and female judges or between male and female individuals for each of the images using Mann–Whitney test.

Batwa *et al*.[17] measured the occlusal plane angle to the true horizontal rather than to the sella-nasion line. The occlusal plane range that was investigated in this study was 0–20° to the true horizontal. 10° rated as most attractive by patients and 15° smile as most attractive by dentist.

Van Der Geld *et al*.,[18] Liang *et al*.,[19] and Hu *et al*.[20] used the videographic method to capture spontaneous smiling and posed smiling images reproducibly. The spontaneous smile is a more relevant emotion than a photographic posed smile and approaches the way patients are perceived by their social environment. For most patients, the outcome of orthodontic therapy is directly related to visible improved dentofacial attractiveness and not so much to the more invisible occlusal relationships according to scientific standards. The central question in these studies was whether the use of posed smile rather than spontaneous smile is sufficient as a diagnostic record for facial esthetics and, more specifically, lip-tooth relationships. They concluded that the fast onset and fading out of a spontaneous smile makes it impossible to capture the right moment with a static photograph. Therefore, it is proposed to switch from static to dynamic video-recording of the smile for diagnostic purposes. Experiences of plastic surgeons, oral and maxillofacial surgeons, and orthodontists show that (digital) video registration in clinical practice is feasible.

Limitations

Overall, studies lacked a standardized technique to investigate the method of eliciting and recording a smile of diagnostic quality.

Conclusions

Digital video clips offer a tremendous amount of information for analyzing the dynamic character of the smile, but a standard digital photograph allows for immediate viewing and is a valid tool for analysis of the post-treatment smile.

Posed smiles can be reliably reproduced as measured objectively, but, subjectively, differences were noted. Spontaneous smiles are preferred to posed smiles by professional diagnosticians.

Video images are preferred to still images by professional diagnosticians. Videography provides diagnostic information that cannot be obtained with still photography alone.

Future implications

In orthodontic treatment planning, certain treatment modalities (in particular, intrusion, extrusion, and expansion) are based on an analysis of the full spontaneous smile. Since the videographic method is better able to capture this smile, it may be a preferred method of obtaining pre- and post-treatment facial photographs.

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Conflicts of interest

There are no conflicts of interest.

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