



RESEARCH ARTICLE

COMPARATIVE PERCEPTION OF THE SMILE AESTHETICS SYSTEMATIC REVIEW

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ABSTRACT

Aim/Objective: This study aimed to assess the real influence of four criteria on smile attractiveness: diastema, smile line, gingival display and midline. **Material and Method:** A search on MEDLINE (PubMed), chochrane, embase and EBD review was conducted using 7 key words via Boolean equations. Papers published between 2005 and 2016 and meeting the eligibility criteria were identified after reading their titles and abstracts. During the reading of the full text, a critical analysis of the methodology followed was conducted on the basis of the reading grid and the literature analysis. **Results:** Among the 1376 references initially found, 37 articles met the inclusion criteria. 31 articles were classified as high quality, 5 as average and one article as lower. Articles concluded that the diastema decreases the attractiveness such as the gingival display, but a limit of 2 mm is admitted for gingival exposure and a value of 1mm of diastema remain acceptable. A smile line parallel to the lower lip is the ideal form but the flat smile can be acceptable even preferred for the Men models. For the midline a small deviation of 3 mm can be considered acceptable. Compared to the professionals, patients are less sensitive only for the midline and the diastema in its minimal variations **Conclusion:** The results of this study reveal that the four criteria influence the smile attractiveness. This approach that we followed can be applied to other aesthetic criteria as well as to other parameters influencing such as gender, ethnic differences etc.

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INTRODUCTION

The perception of the aesthetics smile influences the first impression that we have of an individual. Indeed, in every social relationship the interlocutor focuses on the various components discovered by the smile, the latter represents a real way to seduce and a powerful means of communication between people. (29, 49). As a result, it represents the main reason for consultation in joint prosthesis. The revalorization of the smile can meet difficulties. Indeed, the rehabilitation of a natural smile requires the intervention of several actors, on one hand the professionals (general dentists, orthodontists, prosthodontists), and on the other hand, the non professionals (patients and their entourage). The perception of every participant is influenced by multiple factors: personal background, experience, gender, socio-cultural background ... etc. (17,19,28). As a result / therefore, expert judgment may not only diverge between the practitioners of various specialties, but can also not coincide with that of patients. The smiles considered aesthetic by the professionals may not be according to the patients (44). This difference of opinion can be at the origin of the misunderstandings or even of a failure of the treatment further to the non satisfaction of the patients. To mitigate this problem, it would not be more practical to base

our judgment on valid morphological and architectural criteria, allowing to objectify the aesthetics of the smile? Indeed, despite the subjective concept of aesthetic judgment, the analysis of these criteria by the practitioner would allow to make an objective statement on precise data. This would establish a starting point for discussion with the patient objectively and would facilitate the choice of the most appropriate treatment. In this sense, the literature detailed well a very large number of aesthetic criteria and the studies to prove their validity are numerous. However, the results remain controversial and the existence of a common perception of these criteria between patients and their doctors is not proved yet to be able to incorporate them systematically into every treatment plan. In addition, the most of the studies published over the last ten years is cross-sectional. The syntheses allowing to group the found results, to interpret and to compare them remain rare (23,38). Therefore, the objective of our present study was to analyze the influence of four aesthetic criteria: diastema, the smile line, gingival display and midline on smile attractiveness.

MATÉRIEL ET MÉTHODES

Our present study is a systematic review of the literature concerning 11 years including articles dealing with the subject of the perception of smile esthetics.

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To conduct this study, literature was searched from January first, 2005 to 31 septembr 2016 through 4 accessible databases: Pubmed, Embase, EBD reviews and Chocrane library. 9 Anglo-Saxon keywords from recent publications that deal with the topic were used: Smile, Dental aesthetics and Facial aesthetics. Orthodontics, Prosthodontics, Periodontics, Dentists, Lay persons and Attractive. The following inclusion criteria were defined and applied to select articles:

- Articles published in the period from 01/01/2005 to 31/09/2016
- Publications studying the influence of aesthetic criteria on the smile attractiveness
- Publications studying ? the 4 chosen aesthetic criteria: Diastema, smile line, gingival display and midline.

After a first selection based on the content of the titles and abstracts, we obtained the full text of the selected articles. Then, were evaluated the content and the methodological quality by the critical grids of articles proposed by R. SALMI 2008 and Yves MATILLON based on their full text. The final sample of the selected publications was classified, before its analysis, in 3 grades: high, average and low. This rating was based on four evaluation criteria borrowed from the study of Janson G and all (23): Sample description, confounding factors, validity of the method and validity of the statistical analysis. The verification of these 4 criteria allowed us to classify the articles into 3 categories: The articles respecting the 4 criteria were classified as high quality work, the articles with absence of one to two criteria were classified as average and those with absence from 3 to 4 criteria have been described as low. To reduce the subjectivity, all the steps mentioned above were carried out individually by the 3 authors. Then repetitive meetings between them were programmed at the end of each step and allowed to discuss and validate the results.

RESULTS

The search identified initially 1376 studies, from which we selected 39 articles based on the contents of the titles and summaries. From the 39 articles, we eliminated 2 publications that did not met our inclusion criteria after reading the full text. No article was rejected after the analysis with reading grids for cross-sectional studies and systematic reviews. The 37 references selected were written by researchers from different countries. 36 were written in English, only one paper was written in Russian with an English summary. Its translation was realized by two Moroccan dentists who lived and studied in Russia. 3 articles were systematic reviews, 34 were cross-sectional studies. The influence of the diastema, smile line, gingival exposure and the midline was stated in 9, 14, 22 and 16 articles , respectively . The summarized data of the 37 articles are shown in Tables 1,2,3 and 4. After the quality analysis, 28 studies were classified as high quality level , 5 as average and only one article is considered low.

Influence of diastema: The authors concluded that the presence of a diastema of any size was considered as unattractive by all the evaluators (1,7,13,41,42, 47,10). Only one study in South Africa showed that diastema is a sign of beauty (4). Five studies evaluated the influence of the profession on the perception of diastema. 3 studies showed that patients are less sensitive to variations compared to

orthodontists and dentists (1,42,26), while 2 studies did not found significant differences between groups (47,10). Kumar S and all in 2012 concluded that orthodontists are more critical than dentists. (26)

Influence of smile line: The smile line is the most important aesthetic criterion on perception for all studies except for Janson's work in 2011 (23). A consonant smile (smile arc parallel to the lower lip) is the most acceptable (7,5,24,9,23,25,36,37,38,45,27,50). Witt M and all in 2011 reported that this type of line is preferred for both genders, but the flat smile is tolerable for Men (50). 2 studies found that the flat smile is preferred for the Males models more than Females (9,20). Only one study showed that the non consonant smile (inverted), even if it receives low scores compared to the other criterion studied, it does not influence the perception of the smile (41). The comparison between the groups showed that the perception of smile line is not influenced by the evaluator sex (9,36,45,40) or by the profession (5,24,36,37,38,27 , 20). Two studies confirmed the influence of the whole face (9,45), only one study didn't find correlation (41).

Influence of gingival display (gingival exposure): All authors found that the presence of a gingival smile (gummy smile) was judged negatively. As the amount of gingival display increased, the ratings for smile attractiveness decreased (24,17,21,30,40,49,3,10,33,20). Except for One study has demonstrated that the amount of gingival display is a detail whose importance decreases with the presence of malocclusions (29). As for the other studied criteria, Several parameters which can influence were evaluated: The sex of the evaluator does not influence the perception (1,9,45,22,10,3,33), but 2 studies proved the opposite (17,51). The profession does not influence the perception according to the majority of the studies (1,5,24,30,29,40,3,10,20,34), 2 studies only found contradictory results confirming that the doctors are more sensitive than the patients (21,33). The synthesis of found data indicates that the ideal value for gingival exposure or dental coverage should not exceed 2mm. the acceptable range of gingival display was tolerance -4mm to 4mm, the smile becomes unattractive once it exceeds 4mm (1,3,5,9,10,17, 20,21,22,24,25,29, 31,33,34,40,45,49,50).

Influence of the midline: The impact of the midline was investigated in 16 studies. Authors concluded that patients are less sensitive to variations compared to dental experts (23, 25, 39, 42, 45,14,46). Orthodontists are less tolerant than prosthodontists and dentists (20,39,23). For the evaluator sex, the researchers did not find correlation (9,13,45,41). Espana and all noted an influence of age and the antecedent of orthodontic treatment on the perception of maxillary dental midline compared to the mandibular midline (13). MC Lood and all in 2011 demonstrated a significant influence of culture on the perception of maxillary dental midline compared to the facial midline (31). It is also influenced by the model sex, contrary to the upper dental midline compared to the lower (9). The attractiveness of the whole face can also influence the perception of the evaluator, 3 studies confirmed (9,45,50) and only the study of Rodrigues did not find a correlation (41). The results of the studies found different values but all the authors agreed that a perfect coincidence is the ideal situation (7,50). A slight deviation which does not exceed 3mm is acceptable and common between the different publications.

Table 1. The results of the studies for the perception of diastema

Diastema

Type of study	Quality of studies	Studied zone/ evaluated area	Methodology	Influence on smile esthetics	Factors Influencing the perception
Cross-sectional study:9 (1,7,4,13,41, 42,47,10,26) Systematic review : 0	High :6 (1,41,42,47,10,26)	Mouth area : (1,7,13,42,47,10, 26) Face : (41)	Digital alteration: (1,13,41,42,47,10,26)	Yes : 9	-Sexe : No : (1,4,13,41,47,10,26) -Profession : yes : (1,42,26) No : (47,10) -Age : No (4,13,47,10) Ethnic factor :No (4) -Level of study in dentistry: No (13,10) -orthodontic treatment No (13,10) The whole of face: No (41)
	Average : 2 (7,13)		Real smile:(4,7)	No : 0	

Table 2 .The results of the studies for the perception of the smile line

Smile Line

Type of study	Quality studies of	Methodology	Studied zone/ evaluated area	Influence on smile esthetics	Factors Influencing the perception
Cross-sectional study (9,41,25,36,37,45,27, 20,7,24) Systematic review : (50,38,23)	High :8 (9,41,25,36,37,4 5,27,20) Average : 3 (7,5,24)	Digital alteration: (9,41,25,36,37,45,20,24) Real smile:3 (5,7,27)	Mouth area: (25,36,37,27,5,24) Face : (7,9,20,41,45)	Yes : (11) No : (23)	Evaluator sex: No : (9,36,45,41) Model's sex : Yes : (9,20,50) No : 36,37 Profession : No :(36,37,38,5 27,20,24) -Gingival Exposure : Yes (5,24,20) -Corridor buccal:Yes : (36,37) -Face: 3 yes :9,45 No: 41

Table 3. The results of the studies for the perception of the gingival display

Gingival display

Type of study	Quality of studies	Studied zone/ evaluated area	Methodology	Influence on smile esthetics	Factors Influencing the perception
Cross-sectional study:20 (1,5,24,9,17,25,21,2 2,29,30,31,34,40,49, 45,51,3,10,20,33) systematic review : 2 (38,50)	High : 18 (1,5,9,17,25,21,22,2 9,30,31,34,49,45,51, 3,10,20,33) Average : 2 (24,40)	Mouth area :12 (1,5,24,17,25,21,22, 30,31,40,51,10) face: 8 (9,29,34,49,45,3,20, 33)	Digital alteration: 16 (1,24,9,17,25,21,22,30,3 1,34,40,45,3,10,20,33) Real smile : 4 (5,29,49,51)	Yes : 21 (1,5,24,9,17,25, 21, ,30,31,34,40,49, 45,51,3,10,20,3 3) No: 1 (29) A Detail / malocclusions	- Evaluator sex : Yes 17,22,51,38 No : 1,9,45,3,10,33 - Model sex : (9,17,38,20) ,30,31,34,40,49, -Profession : No: (1,5,24,30,29,40,3,10,20) Yes : (21,22) -Age : yes (38,10) Culture : yes (31) -level of study in Dentistry: yes (10) -Orthodontics treatment : yes(10) the whole of face: yes 9,45 Facial type: yes (33,34)

Table 4 . The results of the studies for the perception of the midline

Midline

Type of study	Quality of studies	Studied zone/ evaluated area	Methodology	Influence on smile esthetics	Factors Influencing the perception
Cross-sectional study:15 (7,9,13,25,31,39,45,4 1,50,14,46,10,20,42,4 3) Systematic review: 1 (23)	High : 13 (9,13,25,31,39,45,41, 50,14,46,10,20,42,43) Average : 1 (7)	Mouth area :8 (13,25,31,39,50, 14,10,42) Face: 7 (7,9,20,41,43,45, 46)	Digital alteration: 13 (9,13,25,31,39,45,41,50,14,46, 10,20,42,43) Real smie: 1 (7)	Yes	- Evaluator sex : No : (9,13,45,41) - Model sex : 1 Yes (9) -Profession : 10 yes : (23,25,39,42,45,14,46,20,39,23) -Age : yes (13) -Culture : yes (31) -ATCD traitement ortho : yes (13) the whole of face: yes : 9,45,50 no :41

DISCUSSION

In aesthetic restorations, the perception of an aesthetic criterion can differ from an individual in the another one . Therefore, an adequacy between the practitioners and patients is imperative before realizing any treatment with esthetic aim (purposes). We were confronted with the difficulty of synthesizing all the conclusions of the research due in particular to the difference of the recommended protocols: with and without numerical alteration, the zone studied. In our study, we have chosen to study the influence of 4 criteria on the smile attractiveness. We collected 37 relevant publications studying the real influence of these 4 criteria.

Evaluation of the methodological quality: The 3 systematic reviews (Janson G in 2011, Passia N in 2011 and Witt M in 2011) respected the methodology recommended by the reading grid adapted to their type. Cross-sectional studies find their place despite their lower level of proof, their protocols followed the recommended approach with some shortcomings/gaps? that may be at the origin of a number of biases. No difference was noted between the characteristics of the groups or the smiles.. The choice and the random distribution were successfully realized so preventing the risk of selection bias except for the study of Al-johany and all in 2011 . Indeed, the team followed a biased selection so preventing the possibility of standardization of photos. In addition to the study quoted above, the Akinboboye team did not clearly describe in a clear way its smiles, whats prevented verification of whether or not this parameter was respected.

Smile modification protocol requires special attention, 27 cross-sectional studies used digitally-modified smiles to create variations in the criteria studied, only 7 studies followed a protocol without alteration (7,4,5,29,49,27 , 51). In the alteration method, the modified smile must keep a natural look. This characteristic has been respected in all studies. Four study which were rated as average to low had a failure in the control of confounders. (4,24,13,40). Still in the method, evaluation of the criteria in the perioral area facilitates the detection of any changes contrary to their evaluation when they are included in the whole of face. Only 11 studies incorporated changes in the face (3,7,9,20,33,34, 41,43,45,46,49). We noted that the majority of the studies had a small samples sizes with the exception of 5 studies: Chan et al in 2011 conducted with 576 evaluators, Abu Alhaija with 600, the team of cracel with 634, Fernandes and al with 619 participants and the study AN RYAKHOVSK with 3710. Despite this weakness we decided to retain all the papers . No studies presented a failure in its statistical analysis.

Evaluation of the influence of the criteria: To answer the problem of the perception, the authors adopted various protocols. However, despite the differences; the authors concluded the same results. Concerning the diastema, there is an agreement on its negative influence. Only the study by Akinboboye and all which reported that the presence of the diastema is a sign of beauty. The result of this work is not retained seen its low methodological quality. The found results concerning the profession are not contradictory. Indeed, Abu Alhaija and all in 2011 found a significant difference only for 1 mm modification. No significant difference was noted for the 2, 3, and 4 mm changes.

Rosa.M and all in 2013 confirmed the same result (1.42), and it's the same for the team of Kumar. It is logical to find a difference between patients and practitioners for a diastema less than or equal to 1 mm, the critical eye of practitioners especially the orthodontists remains more developed seen their expertise but the gap (l'écart) is not very important. The easy detection of the diastema (less than or equal to 1mm) can be related to its study in the perioral zone, its integration in the facial context is essential to verify the influence of the whole face on perception. It is the same for the ethnic parameter and the sex model. For the smile line, its influence is proved by articles. Nevertheless, the systematic review of Janson G in 2011 is the only work which found that the smile line alone does not influence the smile attractiveness (23). This study ignored all the work which used a modified smile and based its conclusions only on the results of the studies without protocol alteration. We judge that the results of a digitally modified protocol should be retained if the latter ends in a natural smile. Gingival exposure decreases the attractiveness of the smile. An ideal value of less than 2mm for gingival exposure or dental coverage is admitted, and a tolerance range of 4mm coverage at 4mm exposure is to be adopted for treatment plans. Beyond 4mm, the smile is perceived as ungraceful. A strong association between the gingival exposure and the smile line was noted (Akyalycin in 2014, kaya in 2013 and Gul-e-rum et al in 2008). Other studies are essential to verify the association with other aesthetic criteria.

The deviation of the midline from norms influences the perception for all the studies, but Al johany and all in its study, despite its average quality, found that more than a third of their sample (considered as attractive) had a midline deviation. The team insisted on the parallelism between the axes in spite of the presence of a deviation. The ideal is to have a perfect coincidence between the two midlines (7,50), but a slight deviation not exceeding 3mm does not compromise the smile aesthetics. One study is not sufficient to confirm the results found for the model's sex (9). It is the same for the influence of the cultural factor (31) age and the antecedent of orthodontic treatment (13). The verticality of the axes should be the subject of further study. The findings of our systematic review confirm the influence of the four aesthetic criteria: Diastema and gingival display decrease the smile attractiveness, but a minimal diastema less than 1mm can be accepted by the patients, this value must be verified in the whole face. For the gingival exposure, An ideal value less than 2mm is admitted. Beyond 4mm, the smile is perceived as unattractive. A consonant smile is the ideal form but the flat smile remains acceptable in men more than in women. For the midline, the coincidence is to be sought, but no prosthetic approach attempt to modify the dental proportions should be envisaged to improve a slight discrepancy except in case of patient request, or envisaged orthodontic treatment. Further studies on the angulations of axes must be led. Our results show that the difference in perception according to the profession is not confirmed for all the criteria: Patients are less sensitive only for the midline and the diastema in its minimal variations. Patients are able to detect like professionals The orthodontists are more sensitive than prosthodontists. The facial context influences the perception, that is why it is necessary to provide facial pictures for our prosthetists. Tools which allow the taking into consideration of the facial parameters as Ditramax are to be

developed and used to make successful prosthetic reconstructions for aesthetic purposes.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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