Laypeople's perceptions of frontal smile esthetics: A systematic review

TITLE PAGE

Title

LAYPEOPLE'S PERCEPTION OF FRONTAL SMILE AESTHETICS: A SYSTEMATIC REVIEW

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***Highlights (for review)**

HIGHLIGHTS

- Thresholds for the main features of smile and dental esthetics could be identified.
- Overall risk of bias was low to moderate
- This review is the first attempt to quantify laypeople smile aesthetic perception

ABSTRACT

Introduction The emphasis on dental esthetics has increased in recent years. There are, however, differences in esthetic perceptions among professional and lay groups. The aim of this comprehensive review is to update previous reviews and answer the following research question: Can lay thresholds for acceptance of smile aesthetic anomalies be defined? Methods: A systematic search in the medical Literature (Pubmed, PMC, NLM, Embase, Cochrane Central Register of Controlled Clinical trials, Web of Knowledge, Scopus, Google Scholar and LILACs) was performed to identify all peer-reviewed papers reporting data regarding the evaluation of laypeople's perception of dental esthetic factors. Results: Of 5660 analyzed articles, 62 studies were selected for the final review process. Ten of the selected articles investigated perception of diastema, 13 analyzed modifications in tooth size and shape, 8 considered incisor position, 15 evaluated midline discrepancy, XX investigated buccal corridors, 25 analyzed gingival display and design, 3 considered lip height, and 16 investigated miscellaneous factors. Threshold values were identified as follows: diastema (0-2 mm), tooth size and shape incisors position, midline discrepancy (0-3 mm), buccal corridors (5-16 mm), gingival exposure (1.5 – 4 mm), occlusal canting (0° - 4°) and overbite (2 –5 mm). Few others smile characteristics were found to be significantly associated with esthetic perception. Conclusions: On the basis of the obtained results threshold values for the main features of smile and dental esthetics were identified and may serve as a guide for esthetic orthodontic planning.

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INTRODUCTION

The emphasis on dentoalveolar esthetics has increased both among dental professionals and patients in recent years[1-4]. Moreover, while an ideal occlusion remains a primary goal of treatment, the esthetic outcome is critical in respect of patient satisfaction[5]. Many of those seeking orthodontic treatment are keen to improve dental esthetics and potentially to improve their quality of life regarding both functional aspects and appearance.

According to Sarver *et al.* [6,7], it may be inappropriate to place everyone in the same esthetic framework and an even more problematic to attempt this based prely on hard tissue relationships, as the soft tissues often fail to respond predictably to hard tissue changes. Nevertheless, it is accepted that esthetic considerations are paramount in planning appropriate and orthognathic treatment, but that rigid rules cannot be applied to this process. In view of our inability to apply rules defining optimal esthetics, use of scientific methods to plan the most esthetic treatment may therefore be complicated. [7]

Nevertheless, it is clear that laypeople are able to identify various factors affecting smile aesthetics[8-10, 11]. Perception is defined as a cognitive process involving interpretation of a stimulus and recognition of the object producing a sensation[12]. This process is based on earlier experience and it represents the instrument by which one becomes acquainted with the environment[13]. Perception has a psychological basis and therefore not simply allied with 'sensation'[14]. Commonly, the perceptions of others can produce an environment that might affect a person's social and intellectual development[15]. It has also variously been confirmed that others' perception could influence the way a person acts and even result in long-term developmental changes and varying levels of achievement [16-18]. Regarding facial appearance, Goldstein found that the eyes and the mouth were the most important factors in a hierarchy of characteristics for determining esthetic perceptions[19].

It is accepted that there is often a discord between lay and professional opinion in relation to dental esthetics [11, 20]. Thus, clinicians can expect their patients to be more attentive to some dental esthetic factors than they are to others. Furthermore, it is important to define the thresholds of aesthetics acceptability in respect of facial and dental esthetic problems i.e. the minimum level of aesthetic harmony that could be approved as pleasurable by an external observer. Thus, the aim of this work is to assess laypeople's evaluation of adult smile appearance aiming to identify thresholds of acceptance for esthetic alterations.

MATERIALS AND METHODS

Protocol and registration

This comprehensive review protocol was registered in the International Prospective Register of Systematic Review (http://www.crd.york.ac.uk/PROSPERO/) (Protocol N° CRD42015017781) and modified in January 2016.

Eligibility criteria

The inclusion and exclusion criteria are presented in Table 1. The reference lists of included articles were perused, and references related to the articles were followed up.

Information sources, search strategy, and study selection

On April 1, 2016 a systematic search in the medical literature was performed to identify all peer-reviewed papers reporting data regarding the evaluation of laypeople's perception of dental aesthetic factors. In order to retrieve lists of potential papers to be included in the review, searches of MEDLINE, Embase, Scopus, Cochrane Oral Health Group's Trial Register and Cochrane Register of Controlled Trials, Web of Science, LILACs, SciELO, Google Scholar were performed using the following search strategy: (dent* or tooth or teeth or smil*) AND (esthetic* OR aesthetic*) AND (perception OR perspective OR evaluat* OR awareness OR attention).

The bibliography of the selected articles were thoroughly analyzed in search for additional papers. Title and abstract screening was performed by two authors (GR, SP) to select articles for full text retrieval. Literature search were performed by two of the authors (GR, SP). Duplicates were removed and papers were selected for inclusion independently by two of the authors (GR, SP). Disagreements were resolved by discussion between all the authors. The list of papers that narrowly failed to meet inclusion criteria) together with the related reasons for exclusion is reported in Appendix A.

Data items and collection

A customized template for data extraction was created according to the review requirements because any standard template (e.g. PICOS) did not necessarily apply to all the included papers (Appendix B). The data extraction form was piloted on a sample of 15 articles, before being checked and revised if needed by authors which did not extract data (GR, SP). In order to summarize the findings of the review a synthesis has been provided in Table 2 according to GRADE criteria[22]. All papers were assessed separately by the investigators (TC, AF) and in cases of divergent assessments with regards to the assignment of strengths and weaknesses, consensus was reached by discussion with all of the authors.

The outcomes from each study were extracted and categorized as follows:

- Diastema
- Tooth size and tooth shape
- Incisors position
- Midline discrepancies
- Buccal corridors
- Gingival exposure
- Lip height
- Miscellaneous

Primary outcomes included laypeople's ratings of attractiveness scores for various dento-alveolar anomalies. The secondary outcome included the thresholds of acceptance identified. Each included outcome was assessed from smile or facial photographs which may have been digitally manipulated to outline the aesthetics alterations in different ways.

Quality assessment in individual studies

According to the CRD (Centre for Reviews and Dissemination, University of York)[21] and to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[23] statements, an evaluation of risk of bias within and across studies was performed by author AD in order to determine the level of evidence

related to each of them. Scoring systems obtained through consensus conferences, such as Cochrane Tool for Risk of Bias Assessment[24], are usually adopted for risk bias assessment. However, the studies analyzed in this review were non-clinical studies, thus they did not fit any standard tool for methodological quality analysis. Risk of bias among studies was assessed with a dedicated tool [20] (Table 3).

Summary measures and approach to synthesis

Clinical heterogeneity of the included studies was evaluated by assessing the participants and settings, index tests and measurement techniques. For accuracy of measurements mean differences, with measures of dispersion were reported where available.

RESULTS

Study selection and characteristics

Among the 6032 analyzed articles, 66 articles were selected for the final review process[1, 3,4,8-10, 25-84]. Among the selected articles, 10 investigated perception of diastema, 15 analyzed modifications in tooth size and shape, 8 considered incisor position, 15 evaluated midline discrepancy, 16 investigated buccal corridors, 26 analyzed gingival display and design, 3 considered lip height and in 20 miscellaneous factors were investigated. The overall number of recruited evaluators was 7088, 2887 females, 2123 males and 2078 unspecified, and ranged from 20 to 1275 per study. Mean age of the evaluated samples ranged from 12 to 74 years. A Visual Analog Scale (VAS) was adopted in 34 studies, a Likert-type scale was used in 7, 16 used generic pointed scales, 3 adopted surveys or questionnaires, 1 study used VAS and a separate questionnaire, 3 evaluated only the minimum and maximum values and in 2 studies used rank ordering .

Quality within studies

According to the criteria[20], the overall mean quality of the studies was 16.8 out of 22. The highest score assigned to an article was 22 points and the lowest score assigned was 13 points.

Results of individual studies, meta-analysis, and additional analyses

A meta-analysis of the results of the studies was planned. However, due to the high degrees of clinical heterogeneity and variation in terms of sampling and outcome analysis, meta-analysis was not possible. Sults from individual studies has therefore been assessed and estimates of esthetic thresholds have been suggested. Further research, however, is warranted to confirm these.

Diastema

Ten articles analyzed diastema perception and only three of them provided information on a threshold of acceptance[9, 25-33]. Kokich et al.[9] identified a threshold of 2 mm for diastema. Kumar et al[26] stated a

threshold of 1.5 mm. Machado et al[27] reported that for both extraction and non-extraction patients the most attractive smile was the one without spacing, whereas the greater and the more mesially located was the diastema the more unattractive. Noureddine et al[28] stated that the width of midline diastema has a significant impact on smile esthetics, even when associated with lateral spaces. Abu Alhaija et al[25] assumed a cut off as low as 1mm although they observed female judges to be more tolerant (3 mm threshold). Based on these studies an overall mean aesthetic cut-off in the region of 1.5mm may be reasonable.

Tooth size and shape

Fifteen papers evaluated discrepancies in tooth dimensions and shape[8, 9, 26, 31-40, 46, 61]. Anderson et al[35] in 2005 stated that square-round incisors were more attractive for masculine smiles and that incisor shape was instrumental in anterior dental esthetics. Only one study [36] focused on canine esthetics, reporting that the increasing of canine tip height and pointed canines were perceived to be unattractive. Five articles established a threshold of attractiveness for crown-length discrepancy, which ranged between 2mm and 4mm.

Tooth position

Eight papers investigated this feature[30, 34, 41-45, 83]. Machado et al [43] based on judgments of an ethnic sample, showed that smiles with a maximum of 0.5 mm of asymmetry on the lateral incisors were considered attractive. Furthermore, 0.5 mm of wear of the central incisor was considered extremely unattractive. These findings were corroborated by Ma et al. [42] who observed that discrepancies related to central had much a greater impact on smile esthetics than lateral incisors. Moreover, Rodrigues et al. showed that a lateral incisor distal inclination of 10 degrees does not affect smile aesthetics [30]. Regarding tooth position, the existing literature supports a laypeople threshold only for lateral edge position, corresponding to a range between 1.1 mm and 2 mm superior to the level of the central incisors, while the ideal position was calculated as 1.2 mm[41, 44]. Furthermore, Chang et al showed a different ideal value for female (1.2 mm) and male (2.0 mm) subjects.[45]

Midline discrepancy

Fifteen articles analyzed the perception of midline discrepancy[1, 8, 30, 32, 34, 47-54]. Seven papers established a mean threshold of acceptance for midline deviations (2.1 mm[46]; 2 mm[47], 2,92 +\- 1,1 mm[48], 2,63 mm[49], 1.83 mm[50], 2,40 mm[52], 2,6 mm[53]) while Kokich et al[8] and Pinho et al[54] were not able to identify a reference value. An overall mean acceptable value of 2.38 mm could be calculated from the sample. The minimum detected threshold was of 1.83 mm, while the maximum accepted one was 2.92 mm[48, 50]. However, Rodrigues et al[30] did not find any difference in the perception of an ideal smile and a midline deviation of 3mm highlighting the variability in perceptions. Regarding midline inclination, Thomas et al proposed a tolerance level of 10 +/- 6 degrees of angulation[51].

Buccal corridors

Sixteen articles evaluated the impact of buccal corridors (BCS) on smile aesthetics[3, 4, 10, 25, 37, 44, 46, 50, 55-62].

Moore et al[3] observed that the best rated amount of BCS was 2% of the smile area. Three papers stated a threshold value for acceptability of the amount of BCS (17%[44]; Min value: 5.5 mm or 8%, Max value: 16 mm or 22%[46]; Min value: 5.07mm, Max value: 14,25 mm[50]). Furthermore, the range of tolerance varied from 5 and 16 mm, while when calculated as ratio of smile area, a maximum level of 17% was identified. The ideal size of the BCS were therefore discordant with McLeod et al[50] alluding to a 6mm optimum value, while Ker et al[46] identified an optimum value of 11.6mm with an ideal percentage of 16%. Zange et al[55] highlighted a threshold of 28% of BCS in patients with long face and short face patterns, with short face patterns receiving better scores. Abu Alahjia et al[25] and Badran et al[56] showed that laypeople preferred minimal or absence of BCS even if BCS did not affect significantly smile esthetics, as confirmed by Roden-Johnson et al[62]. Parekh et al[4] observed that flat smile arcs increased the impact of BCS on esthetics. Clearly, there appears to be little consistency in respect of the preferred levels of buccal corridor.

Gingival display and design

Perception of gingival display and design have been analyzed by 26 articles[8, 9, 25, 26, 32, 34, 36, 37, 44-46, 50, 54, 61, 63-73, 81]. Eleven articles stated a threshold of acceptance for gingival exposure (4mm[8]; 3mm[9]; Likert scale – 1mm: 1.80/5, 4mm: 2,36/5[25]; VAS – Unaltered: 5,85/10, 4 mm: 5,7/10[26]; VAS – 0 mm: 63,1/100, 5 mm: 54,3/100[32]; VAS – 0 mm: 64,92/100, 2 mm: 21.89/100[34]; Min value: 0.8 mm, Max value: 4.5 mm[44]; Min value: 4.0 mm, Max value: -3.6 mm[46]; Min value: 2.7 mm, Max value: -2.52 mm[50], VAS – 0 mm: 41.5/100, 2.5 mm: 20.9/100[54]; -1 mm[61]) and two of them identified an ideal value (2.1 mm[46]; 2.7 mm[50]). Kaya et al[66] and Suzuki et al[72] stated that a gingival display of 2 mm or more negatively affects esthetics. Geron et al[65] highlighted 1 mm of exposure for the upper arch and 0 mm for lower arch as thresholds of acceptability, thus scores decreased together with the increasing of gingival display, as confirmed by Pithon et al[70]. Regarding gingival design, Musskopf et al[69] highlighted a 2mm threshold for gingival recession. Brough et al in 2010[36] assumed that canine gingival height 0.5 mm below the gingival margin of upper central incisor was the most attractive.

Correa et al[63] and Ker et al[46] showed that a discrepancy of 2mm for maxillary central incisor gingival height and a discrepancy of 1.2mm for maxillary lateral incisors gingival height were significantly correlated with a worse smile evaluation. Feu et al[64] noticed that asymmetries of incisal gingival height dicrepancy greater than 2mm were perceived by laypeople.

Lip height

Three papers evaluated lip height impact on smile score[37, 61, 74]. In respect of a Japanese and Korean sample, a range of attractiveness of -1 to +1 mm with reference to the average vermilion height was proposed by Ioi et al[74]. However, lip thickness and lower lip to upper incisor distance appeared to influence significantly the overall aesthetic smile score[37, 61].

Miscellaneous

Miscellaneous factors that may affect perception of esthetic were analyzed within 20 papers[33, 37, 44-47, 50, 54, 56, 60, 75-81, 82, 84]. Seven articles concluded that smile arc influences esthetic attractiveness[37, 44 - 46, 56, 60, 79].

Parekh et al[60] found flat smile arcs to be extremely objectionable, but it appears that there are increments flatter than ideal that are acceptable. Ker et al[46] found that the addition of more upward curvature beyond what follows the lower lip did not rate well. Springer et al[44] identified a threshold of 4mm for the distance between smile arc and lower lip (Ideal value 2mm), while Badran et al[56] highlighted that a reverse smile arc had a very negative effect on esthetic perception, considerably worse for orthodontists than for laypeople. Kim *et al*. stated that constricted arch widths are not a usual outcome of extraction treatment and that neither extraction nor non-extraction treatment has a preferential effect on smile esthetics[79]. Four papers analyzed the importance of occlusal canting with a threshold value of 4 degrees identified, with an ideal value of 0 degrees[46, 47, 50, 76]. Olivares et al[76] reported a significantly higher awareness of these defects among professionals when compared to laypeople.

Three articles indicated a threshold for overbite acceptance for 5mm, with an ideal value of 2mm[44-46]. According to Farzanegan et al[80] the role of the teeth seemed more important than that of the lips in making an esthetic smile, with orthodontists being more critical than laypeople. Pinho *et al*.[54] stated that the wear of the canine cusp had no esthetic impact. Thomas *et al*. found the symmetry of papillary height to be important for attractiveness[33]. Zhang *et al*. [84] reported that the arch width as observed during smile from a frontal point of view present a range of acceptability between 31.5 and 38.5 mm. Pithon *et al*. [82] stated that the lowest scores for maxillary anterior teeth exposure during smile were assigned to the lowest degree of incisor display (7 mm). Two papers analyzed smile attractiveness after a mandibular incisor extraction, reporting a significant negative effect on dental esthetics and significantly lower scores among orthodontists[77, 78]. Xu et al[75] identified a broad esthetic acceptability range for buccolingual inclinations of the maxillary canines and the premolars in the frontal view of a smile which ranges from 3° to -10° for the canines and 5° to -11° for the premolars.

DISCUSSION

Summary of evidence

Lay perception of smile esthetics is important in order to better understand the treatment goals from a patient viewpoint. The results of the present review permitted the identification of several smile features that should be well addressed during the definition of an orthodontic treatment plan. As stated by Proffit et al[89], the most important aspect of facial animation is the smile, which is a critically important part of social interaction. Various characteristics may contribute to smile esthetics [90] including: smile arc, maxillary central incisors ratio and symmetry, anterosuperior teeth ratio, presence of anterosuperior space, gingival design, levels of gingival exposure, buccal corridor, midline and tooth angulation, tooth color and anatomical shape, lip volume.

Maxillary incisors seem to be the most important teeth in defining smile aesthetics, followed by maxillary canines[33, 35, 36, 39, 40]. Key factors appear to be the width of visible teeth and the presence of shape irregularity of central incisors, while slight alterations of symmetry and inclination do not seem to affect significantly smile aesthetics[30, 40, 42, 43]. Ong et al[38] stated that golden proportions were not decisive for attractiveness and that overall dental attractiveness did not depend on any particular feature of the dentition. The ideal maxillary central incisor should be approximately 80% in width compared with height, but with a variability between 66% and 80%. A higher width/height ratio results in a squarer tooth, while a lower ratio indicates a longer appearance. However, from our results, crown-length discrepancies between 2mm and 4mm seem to be considered esthetically acceptable [8, 9, 26, 32, 34].

The vertical position of maxillary incisors, is the first analyzed feature by Machado[90] in planning a smile rehabilitation treatment: a range between 0.5 mm and 1.5 mm of difference between central and lateral incisors represent the gold standard. Furthermore, vertical positioning of central incisors was considered the key factor for smile arc design. Among our sample, the ideal position of the incisal edge of the lateral incisors' edge was observed to be between 1 and 2 mm above the plane of the central incisor [35].

Furthermore, the ideal distance between smile arc and lower lip was reported to be 2mm, with an esthetic threshold till 4 mm[44]. Furthermore, smile arcs which present excessive curvature or flattening or a reverse curvature have a negative effect on laypeople's perception[46, 56, 60].

Results from both the article by Machado[90] and our review indicate that gingival margins of lateral incisors should be positioned slightly inferior to the adjacent teeth. However, only discrepancies between teeth of the same kind were considered in the papers identified in the present review, with differences between 1,5 mm and 2 mm linked to a poorer smile score[46, 63]. Gingival display perception as an aesthetic problem is considerably influenced by personal choice. According to Sarver et al, orthodontists and oral and maxillofacial surgeons tend to see the ''gummy'' smile as an unaesthetic characteristic, whereas laypersons consider it a problem only in more extreme cases[6]. Machado reported a 3 mm limit of gingival exposure for esthetically accepted smile. Among our sample, laypeople judged as "non-aesthetic" gingival exposure of more than 4 mm and less than 1.5 mm, with a mean ideal value of 2.5 mm[8, 9, 25, 34, 46, 50, 64, 67, 68]. However, even if this agreement in stating a threshold for "gummy smiles" may represent a guideline for treatment, several authors reported discordant results regarding laypeople's judgement of gingival exposure[37, 61, 65, 66]. According to Chang et al[45] gingival display, as other smile variables, affects attractiveness only when considered within a facial context. Furthermore, when comparing average models with unattractive and attractive ones, an increase of gingival exposure was preferred. Thus, a there remains disagreement regarding the need for orthodontic treatment associated with gummy smiles; it is also important to mention that beyond adolescence incisal and gingival display tends to reduce with advancing years.

In the past it has been claimed that when the arch forms are narrow or collapsed, the smile may present inadequate esthetics[6]. Certainly, orthodontic expansion and widening of a collapsed arch form can dramatically improve the smile by decreasing the size of the buccal corridors and improving the transverse smile dimension in certain instances[7]. Furthermore, Machado[90] highlighted a preference for BCS of medium width, but it did not define any numerical value for this feature. The majority of analyzed papers concluded that wider BCS generally result in worse judgments, even if no significant correlation between scores and

BCS was found in all the sample except for the study by De Marchi et al[3, 10, 25, 37, 55-60]. Thus, lay tolerance for BCS was reported to be comprised between 5 and 16 mm, while the ideal BCS amount were discordant, ranging between 6 mm and 11.6 mm[44, 46, 50]. Parekh et al[4] in their 2006 paper observed that less attractive smiles presented excessive buccal corridors and flat smile arcs. Furthermore, flat smile arcs appear to decrease attractiveness ratings regardless of the buccal corridor. The absence of diastema as a strict condition for a healthy occlusion was included by Andrews in the six keys for ideal occlusion[91]. From an esthetic perspective, diastema represents an obstacle in reaching an ideal smile[27, 28, 90]. Furthermore, according to Rodrigues et al[30] and Thomas et al[33], diastema has high impact on aesthetic perceptions, even when full-face aesthetic is evaluated. However, laypeople's acceptance of diastema is characterized by an aesthetic threshold of approximately 2mm.

According to a previous review upper to lower midline discrepancy is considered acceptable up to a threshold of 2mm, even if it was stated to be less relevant than changes in tooth angulation. According to the results from our review, a 2mm deviation was also identified as the acceptance threshold. As expected, smile attractiveness decrease together with increasing midline discrepancy, both for maxillary to facial midline and maxillary to mandibular midline deviations[1, 31, 34, 45, 47, 51, 54]. Furthermore, Zhang et al[52] stated that similar degrees of deviation were most noticeable in male subjects with a tapered face type and least noticeable in female subjects with a square face type. Thus, on the basis of the current evidence, the influence of facial patterns on midline deviations perception requires more investigation. On the frontal plane, one of the most important issues to consider for smile aesthetics is the cant of the maxillary occlusal plane[7].

Little evidence exists in relation to the effect of lip thickness on smile judgments. Machado[90] suggested that lip support at the end of our treatment is improtant, advising against upper incisor retraction and evaluating the adoption of lip filling in association to orthodontic treatment. Regarding lip thickness and

distance from incisors, threshold values are not available. However, all authors concluded that these features seem to have some impact on perception[37, 44-46, 61, 74]. There is therefore a need for for further research in this field.

A limitation of the present review related to the lack of information about sample selection and selective outcome reporting. Therefore, a clear judgment regarding the risk of bias was very difficult, considering also that the majority of studies were non-clinical introducing a possible source of bias and a difficulty in attaching clinical significance to the observed values.

CONCLUSIONS

Threshold of acceptance of smile aesthetics characteristics were attempted in the present review. However, in view of the lack of overlapping studies, the subjective nature of the assessment and the difficulty in inferring clinical relevance from non-clinical studies, the clinical applicability of the results should be considered with caution.

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FIGURE LEGEND

Fig. 1 – Flow Chart according to the PRISMA Statement

Fig 1_Flow Chart

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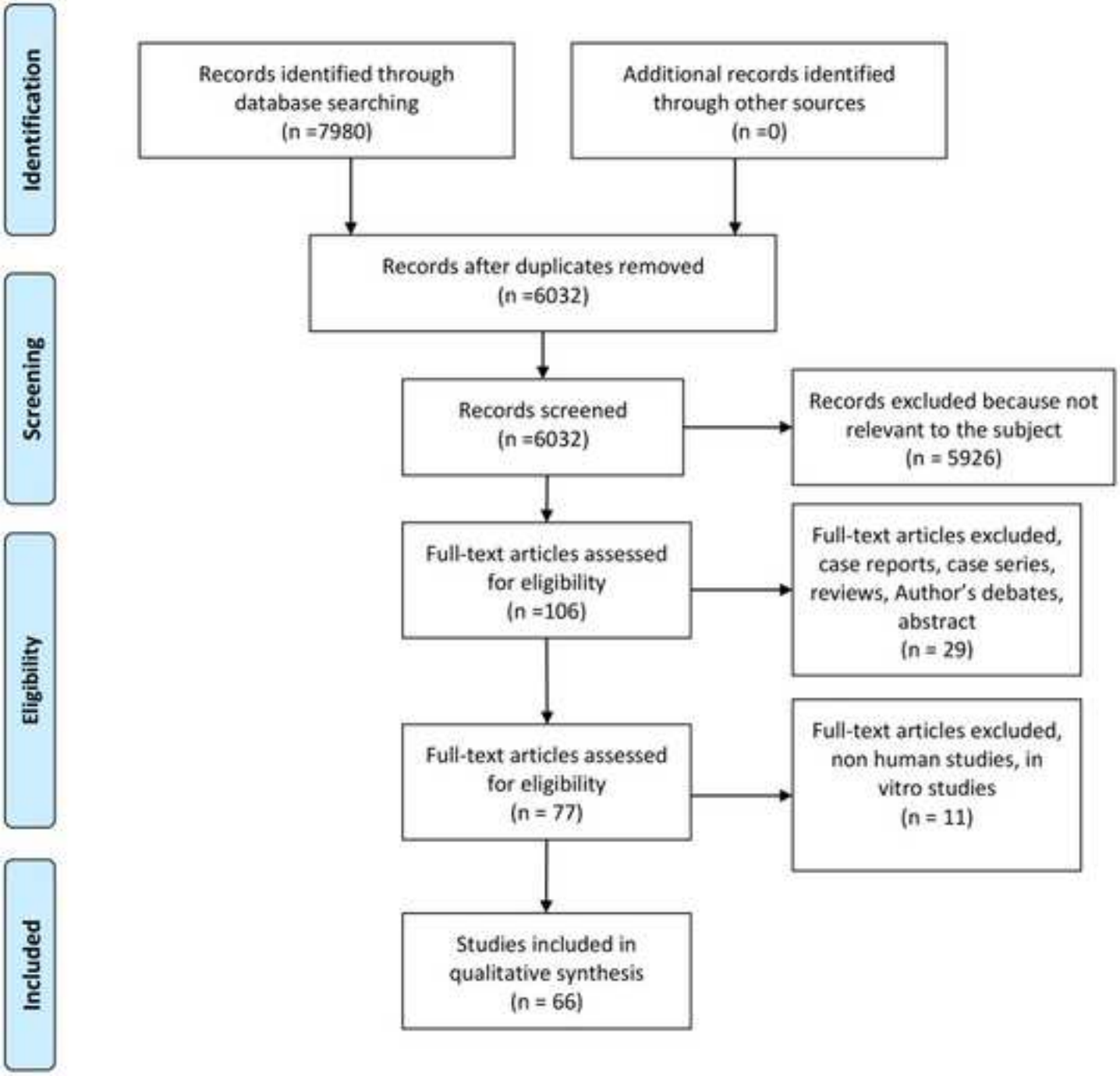


From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement.* PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Table 1 – Study selection criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Randomized and non-randomized prospective, retrospective and observational original studies analyzing the perception of laypeople about dental and smile esthetics	Studies which investigated only facial esthetics without any dentoalveolar link
Studies with adequate statistical analysis	Studies which investigated dental esthetics from a lateral aspect rather than from frontal aspect
Studies with analyzed sample of at least 10 observers	Studies that investigated self-perception of esthetics
	Studies which compared laypeople's esthetic perspectives with those of another group, without reporting the laypeople's specific opinions
	Descriptive studies
	Editorials
	Letters
	Reviews

Table 2

LAYPEOPLE'S THRESHOLDS OF ACCEPTANCE FOR SMILE AESTHETICS' DEFECTS

Population: Adult laypersons with no dental education

Intervention: scoring of adult smiles with altered aesthetics

Comparison: scoring of adult smiles with unaltered aesthetics

Outcomes	Threshold/Ideal Value (Range of Acceptability)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
Diastema	Cut-off value: 1,5 (0-2) mm	831 (10)	Moderate	5 RCTs among 10 papers.
Tooth size and shape	Crown-length discrepancy range: 2-4 mm	1706 (17)	Moderate	6 RCTs among 17 papers. For other features in this group no threshold have been identified
Incisor position	Lateral incisor's edge position (upper to the central incisor plane) Ideal value: 1,2 (1,1-2) mm	376 (6)	Moderate	2 RCT among 6 papers. For other features in this group no threshold have been identified
Midline discrepancy	Ideal value: 0 Cut-off value: 2,38 (1,83-2,92) mm	1916 (15)	Moderate	5 RCT among 15 papers.
Buccal corridors	Ideal value: 11.5 (5-16 mm/17% total smile)	2613 (16)	Moderate	3 RCT among 16 papers.

Gingival display	Ideal value: 2,5 (1,5-4) mm	2689 (24)	Moderate	8 RCT among 24 papers.
Lip height	Upper lip: 7,8/9,5 +/- 1 mm Lower lip: 12,2 +/- 1 mm	146 (3)	Moderate	1 RCT among 3 papers.
Miscellaneous	Occlusal plane cant Ideal value: 0 (0-4) °	1817 (17)	Moderate	5 RCT among 17 papers. For other features in this group no threshold have been identified

Table 2 – GRADE Summary of Findings.

Table 3

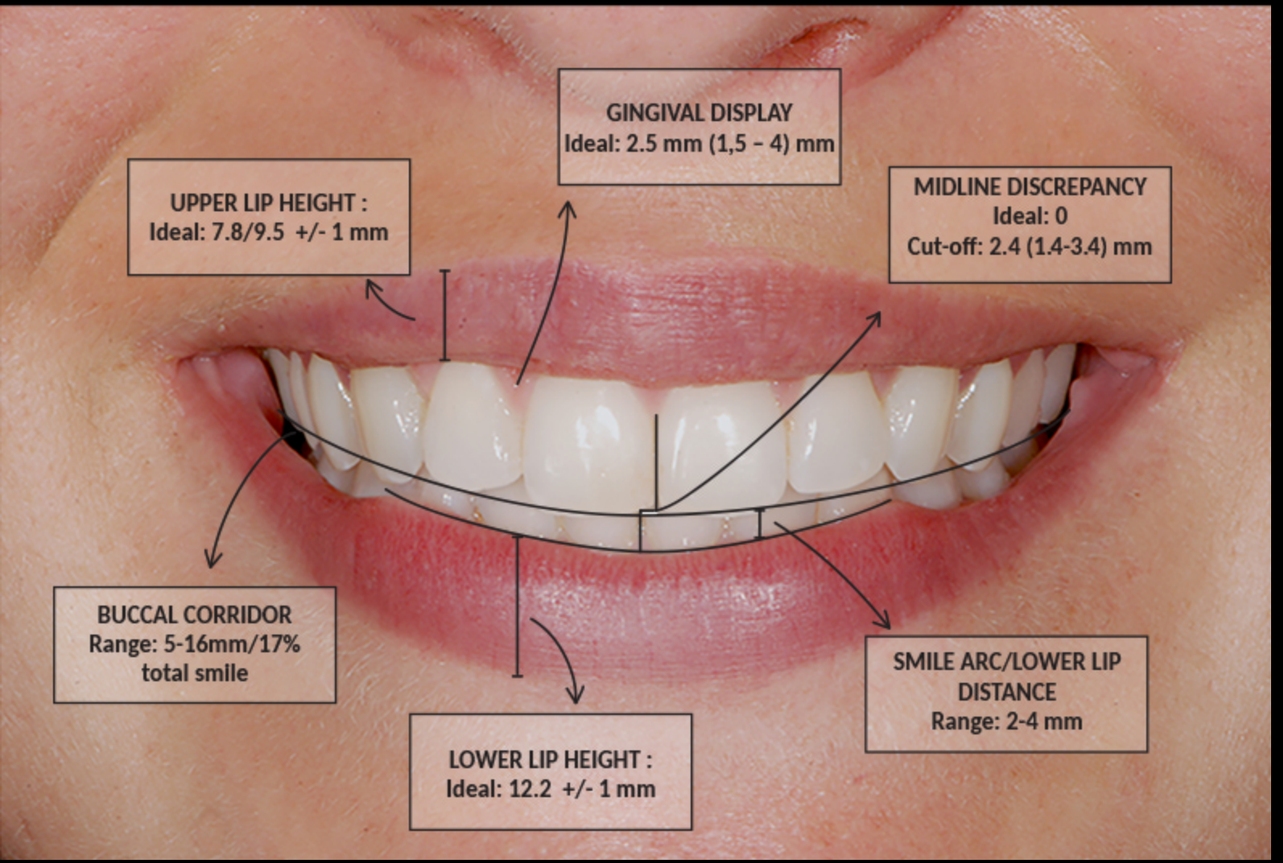
Author, year	No. of Participants (Judges) Involved in Evaluation	Participant Source	Presentation Type	Viewing Protocol	Intraexaminer Reliability	Scoring Technique	Methodological score according to Witt & Flores-Mir 2011
Abu Alhaija, et al 2011	4	3	4	2	2	3	18
An et al, 2009	4	3	4	1	1	1	14
An et al, 2014	4	3	5	4	2	3	21
Anderson et al, 2005	4	3	4	2	2	3	18
Badran et al, 2013	4	3	4	3	2	3	19
Beyer et al, 1998	3	2	4	3	2	3	17
Brough et al, 2010	3	3	6	4	2	1	19
Chang et al, 2011	4	3	6	2	1	3	19
Correa et al, 2014	3	2	6	2	1	3	17
De Marchi et al, 2012	2	2	4	4	2	3	17
Farzanegan et al, 2013	2	1	4	3	2	3	15
Feu et al, 2011	3	1	4	1	2	1	12
Geron et al, 2005	4	3	4	2	2	3	18
Gracco et al, 2006	4	1	4	2	1	2	14
Guo et al, 2013	4	2	6	4	1	2	19
Ioi et al, 2012	4	1	5	1	2	3	16
Ioi et al, 2014	4	2	4	1	2	3	16

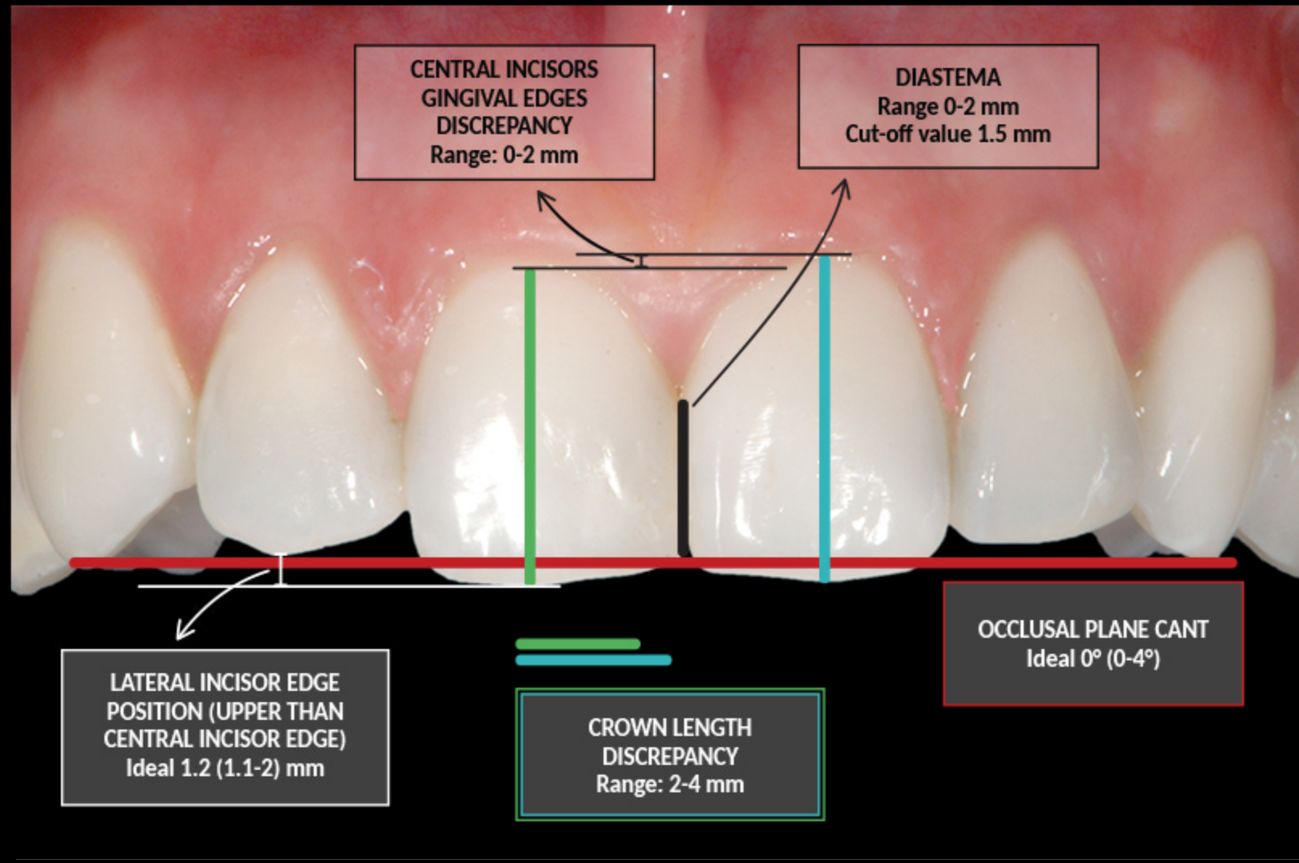
Johnston et al, 1999	2	2	6	1	2	3	16
Ker et al, 2008	4	3	4	2	2	3	18
Kim et al, 2003	3	1	4	1	2	2	13
Kaya et al, 2013	3	1	5	1	2	3	15
Kaya et al, 2016	3	1	4	4	2	3	17
King et al, 2008	3	1	5	4	2	2	17
Kokich et al, 1999	4	1	4	1	2	3	15
Kokich et al, 2006	4	1	4	1	2	3	15
Kumar et al 2012	3	2	4	1	2	3	15
Lavacca et al, 2005	3	2	5	4	2	3	19
Ma et al, 2014	4	1	4	1	2	3	15
Machado et al, 2013 (1)	4	2	6	4	1	2	19
Machado et al, 2013 (2)	3	1	5	2	2	3	15
Machado et al, 2013 (3)	3	1	5	2	2	3	15
Martin et al, 2007	3	3	4	2	2	3	17
McLeod et al, 2011	4	3	4	1	2	3	17
McNamara et al, 2008	3	1	4	2	1	3	14

Moore et al, 2005	3	1	6	4	2	3	19
Musskopf et al, 2013	3	2	4	4	2	3	18
Nascimento et al, 2012	3	1	4	2	1	3	14
Noureddine et al, 2014	3	1	6	4	2	3	19
Olivares et al, 2013	3	1	4	4	2	3	17
Ong et al, 2006	2	1	4	3	2	3	15
Parekh et al, 2006	4	3	5	4	2	3	21
Parekh et al, 2007	4	3	5	1	2	3	18
Pereira Silva et al, 2013	2	1	4	3	2	3	15
Pinho et al, 2007	3	1	4	3	2	3	16
Pithon et al, 2012	4	1	4	2	2	3	16
Pithon et al, 2012 (2)	3	1	4	4	2	3	17
Pithon et al, 2012 (3)	3	1	4	4	2	3	17
Pithon et al, 2013	3	1	5	4	2	3	18
Pithon et al, 2015	4	1	4	2	2	3	16
Roden-Johnson et al, 2005	2	1	5	1	1	3	13
Rodrigues et al, 2009	2	2	4	3	2	3	16

Rodriguez-Martinez et al, 2013	3	1	5	3	2	3	16
Rosa et al, 2013	3	1	3	2	2	3	14
Saunders et al, 2011	3	3	6	2	2	3	19
Springer et al, 2011	3	3	6	2	2	3	19
Suzuki et al, 2008	2	1	4	1	2	3	13
Talic et al, 2012	3	1	4	1	2	3	13
Thomas et al, 2003	3	2	6	4	2	3	20
Thomas et al, 2011	4	1	5	2	2	3	17
Williams et al, 2014	4	3	6	4	2	3	22
Wolfart et al, 2004	3	2	3	3	1	3	15
Xu et al, 2015	3	2	3	4	2	3	17
Yang et al, 2015	3	1	6	4	2	3	19
Zange et al, 2011	3	1	4	4	2	3	13
Zhang et al, 2010	4	2	6	4	2	3	21
Zhang et al, 2016	3	2	6	3	2	3	19

Table 3 – Risk of Bias assessment according to the criteria by Witt & Flores-Mir.


GINGIVAL DISPLAY
Ideal: 2.5 mm (1,5 – 4) mm
UPPER LIP HEIGHT :
Ideal: 7.8/9.5 +/- 1 mm
MIDLINE DISCREPANCY
Ideal: 0
Cut-off: 2.4 (1.4-3.4) mm
BUCCAL CORRIDOR
Range: 5-16mm/17%
total smile
SMILE ARC/LOWER LIP
DISTANCE
Range: 2-4 mm
LOWER LIP HEIGHT :
Ideal: 12.2 +/- 1 mm


CENTRAL INCISORS
GINGIVAL EDGES
DISCREPANCY
Range: 0-2 mm
DIASTEMA
Range 0-2 mm
Cut-off value 1.5 mm
OCCLUSAL PLANE CANT
Ideal 0° (0-4°)
LATERAL INCISOR EDGE
POSITION (UPPER THAN
CENTRAL INCISOR EDGE)
Ideal 1.2 (1.1-2) mm
CROWN LENGTH
DISCREPANCY
Range: 2-4 mm

Laypeople's perceptions of frontal smile aesthetics: a systematic review

Simone Parrini, Gabriele Rossini, Tommaso Castroflorio, Arturo Fortini, Andrea Deregibus, Cesare Debernardi

Appendix A - Excluded articles.

Authors	Title	Reference	Reason for exclusion
Alanko OM et al	Patients' perceptions of orthognathic treatment, well-being, and psychological or psychiatric status: a systematic review.	Acta Odontol Scand. 2010;68(5):249-60.	Review paper
Almutairi TK et al	Influence of bimaxillary protrusion on the perception of smile esthetics	Saudi Med J 2015; Vol. 36 (1): 87-93	Evaluate 14 different smiles instead of modifying the same smile, thus results are not accurate enough
Batwa W et al	Effect of occlusal plane on smile attractiveness	Angle Orthod. 2012;82:218–223	No laypeople observers group
Batwa W et al	Lip asymmetry and smile aesthetics	Cleft Palate-Craniofacial Journal. 2013: 50 (6)	No laypeople observers group
Carlsson GE et al	An international comparative multicenter study of assessment of dental appearance using computer-aided image manipulation	Int J Prosthodont 1998; 18:246-254	No laypeople observers group
De Caroli A et al	Evaluation of gingival contour in the aesthetic of the smile	Rev Inst Ciênc Saúde 2008;26(2):242-5	No laypeople observers group
Dunn WJ et al	Esthetics: Patients' perceptions of dental attractiveness	J Prosthod 1996; 5:166-171	Evaluate 8 different smiles instead of modifying the same smile, thus results are not accurate enough
Fernandes L et al	Esthetic evaluation of dental and gingival asymmetries	International Orthodontics 2015 ; 13 : 221-231	Does not separate results between laypeople and dentists
Flores-Vignolo R et al	Gingival influence of exposure in the perception of aesthetic smile.	Rev. Estomatol Herediana. 2013 Abri-Jun;23(2):76-82.	No laypeople observers group

Foulger TE et al	The influence of varying maxillary incisal edge embrasure space and interproximal contact area dimensions on perceived smile aesthetics	British Dental Journal 2010; 209: E4	No laypeople observers group
Ghaleb N et al	Aesthetic evaluation of profile incisor inclination	European Journal of Orthodontics 33 (2011) 228–235	Evaluation of smile only on profile pictures
Hunt O et al	The influence of maxillary gingival exposure on dental attractiveness ratings	European Journal of Orthodontics 2002; 24:199-204	Scoring data not available in results section
Ioi H et al	Effects of Vertical Positions of Anterior Teeth on Smile Esthetics in Japanese and Korean Orthodontists and Orthodontic Patients	Journal of Esthetic and Restorative Dentistry 2013; 25(4):274–282	No laypeople observers group
Isiksal E et al	Smile esthetics: Perception and comparison of treated and untreated smiles	(Am J Orthod Dentofacial Orthop 2006;129:8-16)	Evaluation of smile on frontal and three-quarter pictures without distinctions
Janson G et al	Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness A systematic review.	Angle Orthodontist. 2011;81(1):153-61.	Review paper
Johnson DK et al	Smile esthetics after orthodontic treatment with and without extraction of four first premolars	AM J ORTHOD DENTOFAC ORTHOP 1995;108:162-7.)	Does not separate results between laypeople and dentists
Kerns LL et al	Esthetic Preference of the Frontal and Profile Views of the Same Smile	Journal of Esthetic Dentistry 1997; 9(2)	Evaluate 6 different smiles instead of modifying the same smile, thus results are not accurate enough
Krishnan V et al	Characterization of posed smile by using visual analog scale, smile arc, buccal corridor measures, and modified smile index	Am J Orthod Dentofacial Orthop 2008;133:515-23)	Does not separate results between laypeople and dentists
Mackley RJ	An evaluation of smiles before and after orthodontic treatment	Angle Orthod 1993;63:183-190	Evaluation of smile on frontal and profile pictures together

Manne P et al	“Redefining Smile-A Multidisciplinary Approach”.	J Clin Diagn Res. 2013;7(7):1527-9.	Review paper
Mehl CJ et al	Patients' and dentists' perception of dental appearance	Clin Oral Invest (2011) 15:193–199	No laypeople observers group
Motta AFJ et al	Influence of certain tooth characteristics on the esthetic evaluation of a smile	Dental Press J Orthod. 2012 May-June;17(3):25.e1-7.	No laypeople observers group
Ramesh AS et al	Assessment of perceptibility and acceptability of color variations between matched teeth among trainee dentist and lay person	J Pharm Bioallied Sci. 2015 Aug; 7(Suppl 2): S632–S635.	Evaluations based on colour variations, not of orthodontic concern.
Rodrigues CDT et al	Influence of aesthetic norm variations on the attractiveness of a smile	RGO - Rev Gaúcha Odontol., Porto Alegre, v. 58, n. 3, p. 307-311, jul./set. 2010	Less than 10 laypeople observers
Suzuki L et al	An evaluation of the influence of gingival display level in the smile esthetics	Dental Press J Orthod. 2011 Sept-Oct;16(5):37.e1-10.	Does not separate results between laypeople and dentists
Tikku T et al	Role of buccal corridor in smile esthetics and its correlation with underlying skeletal and dental structures	Indian J Dent Res 2012;23:18794	Less than 10 laypeople observers
Wagner et al	A comparative study of assessment of dental appearance by dentists, dentaltechnicians, and laymen using computer-aided image manipulation	Journal of esthetic dentistry, 1996, 8(5):199-200	No laypeople observers group
Witt M, Flores-Mir C	Laypeople's preferences regarding frontal dentofacial esthetics: Periodontal factors	JADA 2011;142(8):925-37.	Review paper
Witt M, Flores-Mir C	Laypeople's preferences regarding frontal dentofacial esthetics: Tooth-related factors	JADA 2011;142(6):635-645	Review paper
Wolfart S et al	Assessment of dental appearance following changes in incisor proportions	Eur J Oral Sci 2005; 113: 159–165	No laypeople observers group
Dalla Corte CC et al	Influence of occlusal plane inclination and mandibular deviation on esthetics	Dental Press J Orthod. 2015 Sept-Oct;20(5):50-7	Evaluation of mandibuar asymmetry

Fernandes L et al	Esthetic evaluation of dental and gingival asymmetries	International Orthodontics 2015 ; 13 : 221-231	Scoring data not available in results section
Pinho T et al	Esthetic Assessment of the Effect of Gingival Exposure in the Smile of Patients with Unilateral and Bilateral Maxillary Incisor Agenesis	Journal of Prosthodontics 00 (2014) 1–7	Scoring data of different smile alterations not available for laypeople only
da Silva Barros EC et al	The ability of orthodontists and laypeople in the perception of gradual reduction of dentogingival exposure while smiling	Dental Press J Orthod. 2012 Sept-Oct;17(5):81-6	Scoring data not available in results section

Laypeople's perceptions of frontal smile aesthetics: a systematic review

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Appendix B - Results summary.

Author, year	Population	Study methods	Evaluation scale	Attractiveness threshold	Values (SD)	Other significant variables	95% confidence interval
DIASTEMA							
Kokich et al, 2006	66 (26 M - 40 F) age range 21-65 y, mean age: 36.6 y	Frontal perioral photographs digitally altered	VAS		-	Diastema threshold 2.0 mm**	
Kumar et al, 2012	40 (20 M - 20 F), Mean age 31.3y	Frontal smile photographs digitally altered	VAS		Progressive increase in diastema: Unaltered 6.85 (1.57) +0.5 mm 4.60 (2.04) +1mm 4.20 (1.64) +1.5mm 4.05 (1.96) +2mm 3.25 (1.12)	Diastema threshold 1.5 mm	

Machado et al, 2013 (1)	60 (28 F - 32 M)	Obliqual photographs of two patients: one treated with extractions and one with no extractions. The space was digittaly added mesial and distal to the upper lateral incisor	VAS		Non extraction smile: No spacing 90.45 (7.37) 0.5 D 87.13 (8.15) 1.0 D44.45 (15.97) 1.5 D 34.41 (10.59) 0.5 M61.45 (12.27) 1.0 M27.51 (14.18) 1.5 M26.98 (14.73) 0.5 M and D 54.28 (14.5) 1.0 M and D 24.68 (10.05) 1.5 M and D 14.96 (10.73) Extraction smile: No spacing 90.33 (6.42) 0.5 D 87.25 (4.79) 1.0 D 41.75 (11.59) 1.5 D 26.7 (13.52) 0.5 M 57.72 (10.26) 1.0 M 27.29 (13.88) 1.5 M 20.61 (11.93) 0.5 M and D 41.86 (9.41) 1.0 M and D 26.11 (9.92) 1.5 M and D 10.62 (10.51)		
Noureddine et al, 2014	105 (55 F - 50 M)	Full frontal photographs digitally altered	1-10 point ranking scale	-	SD 6.91 FD 6.42 LD 4.94 MD 3.81	Age of evaluators effect on scores*	SD 6.46-7.36 FD 5.97-6.87 LD 4.49-5.39 MD 3.33-4.30

Pithon et al, 2012	150 (91 F - 59 M)	Digitally manipulated smile photographs	VAS		G1** No diastema 65.6 0.5 mm 61.1 1 mm 55.7 1.5mm 50.3 2 mm 45.8 2.5 mm 39.3 3.0 mm 35.5 3.5 mm 31.7 G2** No diastema 61.0 0.5 mm 55.5 1 mm 54.0 1.5mm 49.8 2 mm 45.9 2.5 mm 43.9 3.0 mm 42.0 3.5 mm 38.3 G3** No diastema 81.2 0.5 mm 81.5 1 mm 80.4 1.5mm 81.9 2 mm 80.8 2.5 mm 81.1 3.0 mm 80.5 3.5 mm 79.7	Spearman CC G1-G2 1.00** G1-G3 0.59 G2-G3 0.59	
Rodrigues et al, 2009	20 (10 F - 10 M)	Digitally manipulated smile photographs	Likert Scale		Face Framing D1 5.1 (2.6) Mouth Framing D1 4.7 (2.3(	Age*	Face Framing D1 -1.2 Mouth Framing D1 -1.1

Saunders et al, 2011	60 (27 F - 33 M)	Digitally manipulated full face photographs	Likert Scale		Diastema vs. chipped tooth OR 3.41**		2.44–4.76
Thomas et al, 2011	100 (43 F - 57 M) Average age 20-40 years	Frontal perioral photographs digitally altered	VAS		Midline diastema 4.21 (1.554)		Midline diastema 3.91 - 4.52
Abu Alhaija et al, 2011	200 (100 F - 100 M)	Digitally manipulated smile photographs	Likert Scale	2.12 ± 0.04	1 mm 2.58 ± 0.96 2 mm 2.93 ± 0.90 3 mm 3.53 ± 0.78 4 mm 3.40 ± 0.91	Significant cut-off 1 mm** 3 mm (Female observer)**	
Talic et al, 2012	30	Digitally manipulated smile photographs	VAS		Progressive increase in diastema: Unaltered 60 ± 23.7 +0.5 mm 55.2 ± 24.2 +1mm 45.2 ± 25.9 +1.5mm 38 ± 26 +2mm 35.1 ± 24.6 +2.5mm 26.5 ± 22.6		

TOOTH SIZE AND TOOTH SHAPE							
Ong et al, 2006	12 (6 M - 6 F) mean age 32,5 y	Frontal smile photographs	Likert Scale		R2 values Alignment .831 . Tooth color .632 Shape .864 Size .814 Crown proportions .837 Dentition proportions .820 Gum color .605 Gum contour .740 Mean incisors width-to-height ratio Entire sample R .83 (.09) L .82 (.09) Attractive R.80 (.10) L .78 (.10)* Unattractive R .84 (.08) L .83 (.08)*	Sex*	

Anderson et al, 2005	102 (80 F - 21 M - 1 Unspecified) Age: 21-30 19; 31-40 24; 51-60 11; >60 5; Unspecified 2	A series of smile photograps evaluated by judgers	VAS		FEMALE Incisor with flat canines: Sr 67.1 (19.2) S 66.1 (19.8) R 73.7 (18.0) R>S* Incisor with round canines: Sr 65.1 (19.5) S 65.8 (19.9) R 69.4 (19.5) Incisors with pointed canines Sr 64.5 (21.9) S 64.1 (18.9) R 65.6 (20.8) MALE Incisor with flat canines: Sr 63.8 (20.5) S 53.9 (20.7) R 66.1 (23.1) R>S* Sr>S* Incisor with round canines: Sr 65.3 (18.0) S 54.7 (19.9) R 56.3 (21.4) Sr>R* Sr>S* Incisors with pointed canines Sr 66.4 (20.1) S 56.0 (18.1) R 57.7 (20.8) Sr>S* FEMALE canines with square-round incisors: P 64.2 (18.9) F 67.1 (18.1) R 63.8 (20.3) Canines with round incisors:		

					P 62.8 (19.4) F 67.9 (22.3) R 64.4 (18.7) Canines with square incisors P 62.7 (20.6) F 60.9 (18.5) R 64.7 (20.0)		
McNamara et al, 2008	30 (15M - 15 F)	Digitally manipulated smile image	VAS		Width 3-3 38.7 (2.8) Width of visible teeth 46.0 (4.8) Incisor exposure 7.6 (1.6) Upper right 1 width (mm) 8.8 (0.6) Upper right 1 height (mm) 9.2 (0.8) Lingual maxillary 3-3 (mm) 24.9 (2.1) Cusp tip maxillary 3-3 (mm) 33.9 (2.2) Buccal maxillary 3-3 (mm) 37.9 (2.1) Lingual maxillary 6-6 (mm) 31.6 (2.1) Buccal maxillary 6-6 (mm) 54.8 (2.2)		

Kumar et al, 2012	40 (20 M - 20 F), Mean age 31.3y	Frontal smile photographs digitally altered	VAS	Unilateral crown lenght shortening of greater than 1.5mm; Asymmetrical alterations in mesio-distal width of lateral incisor 1.5mm; Symmetrical alterations in mesio-distal width of lateral incisor 2.0mm;	Progressive decrease in crown length: Unaltered 6.3 (1.72) -0.5mm 6.05 (1.36) -1mm 5.25 (1.37) -1.5mm 5.55 (1.28) -2mm 4.8 (1.47) Progressive decrease in both lateral incisors width: Unaltered 8.25 (1.21) -0.5mm 8.15 (1.53) -1mm 8.1 (1.33) -1.5mm 7.55 (1.54) -2mm 7.65 (1.35) Progressive decrease in right lateral incisors width: Unaltered 8.3 (1.22) -0.5mm 8.05 (1.23) -1mm 8.15 (1.18) -1.5mm 8.1 (1.29) -2mm 8.35 (1.18)		
Ker et al, 2008	243 (66% females)	Frontal perioral photographs digitally altered	Judges selected minimum and maximum tolerable values		Maxillary central-to-lateral incisal step Max tolerable value 2.9mm Ideal 1.4mm		

De Marchi et al, 2012	20 Ip (10 M - 10 F) mean age 30.01 ± 4.11 y	Digitally altered photographs	VAS	50,99	Mean measurements of dental attributes (mm) Width of visible teeth GC VAS < 50.99: 50.35 [4.26] VAS > 50.99: 51.91 [2.43] SRC VAS < 50.99: 50.65 [3.42] VAS > 50.99: 47.21 [3.43] SOI VAS < 50.99: 49.21 [3.91] VAS > 50.99: 48.08 [2.34] Width 3 to 3 GC VAS < 50.99: 63.25 [5.45] VAS > 50.99: 63.82 [2.70] SRC VAS < 50.99: 61.52 [5.44] VAS > 50.99: 60.02 [2.89] SOI VAS < 50.99: 60.27 [4.73] VAS > 50.99: 58.81 [3.15]	Pearson's R correlation between attributes and judgement CG Unpleasant Width of visible teeth *r* = -0.557/0.038	
Thomas et al, 2011	100 (43 F - 57 M) Average age 20-40 years	Frontal perioral photographs digitally altered	VAS		Crown length 6.55 (1.829) Crown width 6.468 (1.6880)		Crown length 6.18 - 6.91 Crown width 6.133 - 6.803
Kokich et al, 2006	66	Frontal perioral photographs digitally altered	VAS		-	Threshold Crown length 1.5-2.0 Crown width 2.0 Crown width and length 4.0	

Wolfart et al, 2004	30 art students, mean age 24 +/- 3 y (12 M - 18 F)	Digitally altered photographs	Attractiveness survey 6-point scale		Incisors inclination Ideal axes 2.5 10° angulation of one lateral incisor 2.8 10° angulation of both lateral incisors 2.5 10° angulation of one central incisor 4.2 10° angulation of both lcentral incisors 4.6		
Talic et al, 2012	30	Digitally manipulated smile photographs	VAS		Crown lenght discrepancy: Unaltered 48.4 ± 28.6 0.5mm 57.7 ± 29 1 mm 57.9 ± 26.3 1.5mm 52.8 ± 22.9 2mm 60.5 ± 24.7 2.5mm 57.2 ± 25.4 3mm 57.3 ± 25.7		

Rosa et al, 2013	80	Simulation of treatment options rated by judgers (smile A to H)	VAS		Laypeople A 28.0 (19.9) B 19.3 (15.7) C 46.9 (18.9) D 53.9 (18.2) E 55.1 (14.1) F 36.1 (21.2) G 59.8 (21.4) H 73.2 (16.5) I 93.4 (6.59) L 8.3 (9.1) M 31.4 (13.4) N 33.7 (17) Patients A 36.4 (22.4) B 21.3 (19.7) C 46.3 (24.8) D 41 (22.3) E 52.6 (22.4) F 43 (20.7) G 60.5 (24.3) H 77.5 (21.6) I 85.2 (17.9) L 10.6 (10.3) M 30.8 (20.9) N 32.1 (18.3)		

Brough et al, 2010	40 lp (12 M - 28 F) age range 26-65 y, mean age: 33.9 +/- 7.8 y	Digitally manipulated smile photographs	5-point scale (lower the better)		Maxillary canine height and tip Original image 3.68 (2.13) Increased 0.5 mm 4.93 (2.67) Increased 0.5 mm (img copy) 3.54 (2.25) Reduced 0.5 mm 4.02 (2.6) Increased 1.0 mm 3.66 (2.34) Reduced 0.5 mm and pointed 6.29 (1.9) Increased 1.5 mm 5.85 (2.13) Increased 0.5 mm and pointed 6.1 (2.18) Increased 1.0 mm and pointed 6.93 (2.32) Maxillary canine width Original image 2.98 (1.59) 1.5 mm wider 4.03 (1.39) 1.5 mm wider (img copy) 3.38 (1.69) 3.0 mm wider 4.65 (1.29) 1.5 mm narrower 2.78 (1.73) 3.0 mm narrower 3.20 (1.84)		

An et al, 2014	100 (50 non treated orthodontically 38 F - 12 M mean age 22.0 ± 2.9y; 50 treated orthodontically 44 F - 6 M mean age 23.8 ± 3.6y)	Digitally manipulated smile photographs	VAS		Score for altered crown widths and lenghts 0 mm G1 68.39 (17.78) G2 69.40 (14.62) 1.0 mm G1 63.01 (19.33) G2 67.22 (16.20) 2.0 mm G1 65.82 (16.32) G2 63.69 (14.43) 3.0 mm G1 56.97 (16.61) G2 57.42 (19.13) 4.0 mm G1 56.96 (18.62) G2 50.95 (17.54)		
Kokich et al, 1999	74	Frontal perioral photographs digitally altered	VAS		-	Threshold Crown length 2.0 Crown width 4.0 Incisor angulation 2.0	

Saunders et al, 2011	60 (27 F - 33 M)	Digitally manipulated full face photographs	Likert Scale		ORs for comparisons of facial attractiveness and tooth conditions C2 vs. C1 1.45 C4 vs. C1 86.62 C5 vs. C1 196.27		LF vs. MF 0.72–1.31 LM vs. MF 0.71–1.29 MM vs. MF 0.69–1.25 C2 vs. C1 1.04–2.01 C3 vs. C1 2.44–4.76 C4 vs. C1 56.27–1733.34 C5 vs. C1 124.05–310.54
TOOTH POSITION							
Yang et al, 2015	61	Full face photographs digitally altered	100mm VAS		Mesiodistal angulation of maxillary central incisors Male, full face 0°: 80,17 (8,78) -4°: 75,29 (8,72) -2°: 79,58 (7,54) +2°: 78,77 (8,47) +4°: 72,42 (8,78) +6°: 71,92 (9,48) +8°: 68,23 (10,49) Female, full face 0°: 80,31 (8,54) -4°: 75,35 (10,06) -2°: 76,73 (9,41) +2°: 77,13 (7,47) +4°: 74,31 (9,57) +6°: 73,29 (8,18) +8°: 71,13 (10,89)		

King et al, 2008	40	Animated frontal perioral photographs were judged	Scoring a range of acceptability	0.84mm (0.33)	Most pleasing tooth position (mm) -0.61 (0.20) Upper limit acceptability -1.10 (0.29) Lower limit acceptability -0.26 (0.37)		
Machado et al, 2013 (2)	60 (28 F - 32 M)	Digitally manipulated smile photographs of a white woman and of an Afro-brasilian woman	VAS		Altered asymetry in white woman No asymmetry 87.26 (9.71) 0.5mm lateral incisor 87.15 (8.31) 1.0mm lateral incisor 80.43 (13.89) 1.5mm lateral incisor 61.91 (10.92) 0.5mm central incisor 72.44 (9.25) 1.0mm central incisor 29.34 (14.29) 1.5mm central incisor 22.36 (12.21) Altered asymetry in Afro-Brazilian woman No asymmetry 87.61 (8.74) 0.5mm lateral incisor 86.16 (7.26) 1.0mm lateral incisor 80.32 (8.79) 1.5mm lateral incisor 50.38 (12.61) 0.5mm central incisor 72.52 (11.35) 1.0mm central incisor 29.18 (14.32) 1.5mm central incisor 23.98 (15.00)		

Springer et al, 2011	96 lp (49 M - 47 F) age range 18-72 y, mean age 25 y	Frontal facial photographs digitally altered	VAS		Ideal central to lateral step (mm) 1.2 Maximum central to lateral step (mm) 2.0 1.9 2.0 Maximum incisal cant (°)* 2.8 2.5 3.3		Ideal central to lateral step (mm) 1.2-1.1 Maximum central to lateral step (mm) 2.0-1.9 Maximum incisal cant ( )* 3.3-2.5
An et al, 2014	100 (50 non treated orthodontically 38 F - 12 M mean age 22.0 ± 2.9y; 50 treated orthodontically 44 F - 6 M mean age 23.8 ± 3.6y)	Digitally manipulated smile photographs	VAS		Score for canted incisal planes 0 mm G1 72.15 (15.32) G2 74.89 (15.28) 1.0 mm G1 67.18 (16.33) G2 70.94 (19.23) 2.0 mm G1 64.78 (17.50) G2 58.78 (20.37) 3.0 mm G1 62.55 (14.40) G2 60.35 (18.15) 4.0 mm G1 55.46 (19.25) G2 46.29 (22.83)		

Ma et al, 2014	60 pt (31 with experience with orthodontic treatment - 29 without experience with orthodontic treatment)	Digitally manipulated smile photographs	5-point scale	Noticeable maxillary misalignment Laypeople with prior orthodontic treatment Unilateral U1: 2.0 mm Unilateral U2: ND Bilateral U1: 3.0 mm Bilateral U2: ND Bilateral U1, U2: 6.0 mm Laypeople without history of orthodontic treatment Unilateral U1: 2.0 mm Unilateral U2: ND Bilateral U1: 4.0 mm Bilateral U2: ND Bilateral U1, U2: 6.0 mm	-		
Rodrigues et al, 2009	20 lp (10 F - 10 M)	Digitally manipulated smile photographs	Likert Scale		Face Framing I 8.4 (1.4) 10D 8.4 (1.4) Mouth Framing I 8.2 (1.6) 10D 8.3 (1.5)	Age*	Face Framing I 0.7 10D 0.6 Mouth Framing I 0.8 10D 0.7

Chang et al, 2011	576	Full frontal photograph digitally altered	VAS		Lateral incisal step ideal Female Attactive 1.2 (0.8) ; Average 1.2 (0.8); Uanattractive 2.0 (0.6) Male 2.0 (0.5); Average 2.0 (0.6); Unattractive 2.0 (0.6)		

MIDLINE DISCREPANCY							
An et al, 2014	100 (50 non treated orthodontically 38 F - 12 M mean age 22.0 ± 2.9y; 50 treated orthodontically 44 F - 6 M mean age 23.8 ± 3.6y)	Digitally manipulated smile photographs	VAS		Scores for midline shift 0 mm G1 56.09 (21.75) G2 53.98 (22.31) 1.0 mm G1 50.87 (21.77) G2 48.62 (19.37) 2.0 mm G1 50.76 (20.83) G2 46.60 (21.41) 3.0 mm G1 49.52 (21.18) G2 40.66 (21.20) 4.0 mm G1 46.26 (19.77) G2 38.62 (18.32)		
Pereira Silva et al, 2013	100 divided in two groups (group 1 and group 2) Group 1: 50 (21 F - 29 M) Group 2: 50 (25F - 25M)	Digitally manipulated smile image	VAS	Midline shift 2mm	SFM (symmetric face model) 0mm 37.92 (8.502) Dental midline shift 1mm 37.11 (7.024) 2mm 31.28 (11.506) 3mm 22.58 (10.891) 4mm 17.87 (10.492)		
Williams et al, 2014	160 students, age range 18-29 y	Frontal facial photographs digitally altered	VAS + questionnaire		Overall mean threshold 2.92 +/- 1.10 mm Male mean threshold 2.80 +/- 1.27 mm** Female mean threshold 3.04 +/- 0.9 mm**	Mean Male threshold** Mean female threshold **	Overall 2.84 - 3.01 M 2.66-2.94 F 2.95-3.14

Guo et al, 2013	222 orthodontic patients (123 F-99 M) Aged from 12 to 39y Mean age 19.9y (81 <18y; 141 >18)	Frontal facial photographs digitally altered	Questionnaire		Left midline discrepancy (mm) Detectable level: 1.40 (0.77) Tolerable level: 2.70 (1.08) Right midline discrepancy Detectable value: 1.26 (0.66) Tolerable level: 2.55 (0.93) Average Ideal value: -0..20 (0.38) Detectable value: 1.33 (0.63) Tolerable value: 2.63 (0.203)	education level, orthodontic history and malocclusion severity of the judgers influence aesthetic perception	
McLeod et al, 2011	103 lp (61 M - 42 F)	Digitally manipulated smile image	Interactive survey		Maximum tolerable value 1.83 mm	-	
Pinho et al, 2007	50 University students	Frontal perioral photographs digitally altered	VAS		Midline shift (mm): 0 54.1 (21.2) 1.0 53.4 (17.9) 2.0 54.5 (18.5) 3.0 46.9 (19.5) 4.0 46.8 (19.7)		

Thomas et al, 2003	50 lp (22 M - 28 F) mean age 40.2 +/- 16.1 y	Digitally manipulated smile image	5-point scale		Degrees of angulation Males 20 L 4.48 (0.95) 15L 3.72 (1.03) 10L 3.24 (1.04) 5L 2.67 (1.17) 0 2.10 (1.16) 5R 2.46 (1.01) 10R 3.44 (1.13) 15R 3.98 (1.11) 20R 4.38 (0.81) Females 20 L 4.30 (0.93) 15L 3.98 (0.84) 10L 3.70 (0.93) 5L 2.63 (1.01) 0 2.44 (0.91) 5R 2.85 (1.07) 10R 3.20 (1.05) 15R 4.16 (0.94) 20R 4.34 (0.96) Mean acceptable threshold M 10.7+/-6.2 Mean acceptable threshold F 10 +/- 6.1	Occupation* Sex*	
Talic et al, 2012	30	Digitally manipulated smile photographs	VAS		Progressive midline deviation: Unaltered 53 ± 25.4 1 mm 57.4 ± 24.2 2mm 50.3 ± 26 3mm 52.4 ± 27.1 4mm 48.9 ± 24.2 5mm 49 ± 24.7		

Zhang et al, 2010	108 lp (61 M - 47 F)mean age 21.037 6 1.176, age range 19-25 y	Frontal facial photographs digitally altered	10-point scale		Score per facial types Male <2 mm Square0.003 +/- 0.966 Oval 0.129+/-0.941 Tapered 0.764+/-1.180 >2mm Square -0.618+/-1.161 Oval -0.314+/-1.164 Tapered -1.064+/-1.575 Female <2mm Square -0.243+/-1.048 Oval 0.328+/-0.994 Tapered 0.469+/-1.009 >2mm Square -1.010+/-1.246 Oval -1.219+/-1.142 Tapered -1.107+/-1.110 overall mean threshold 2.403 +/- 1.372 mm Male mean threshold 2.574 +/- 1.280 mm Female mean threshold 2.232 +/- 1.438 mm	Gender*	mean threshold 2.315–2.491 M threshold 2.458–2.690 F threshold 2.102–2.326
Kokich et al, 1999	74	Frontal perioral photographs digitally altered	VAS		Mean threshold nondetectable		
Beyer et al, 1998	60 lp 30 patients (15M - 15F) 30 parents (15M-15F)	Digitally manipulated smile photographies	"acceptable-non acceptable" rating		Mean thresholds Male photographs Patients 2.80 +/- 1.23 Parents 2.48 +/- 0.86 Female photographs Patients 2.43 +/- 0.99 Parents 2.02 +/- 0.88		

Johnston et al, 1999	20 University students (10 F - 10 M) Mean ages 18.4y and 19y respectively	Full frontal photograph digitally altered	Likert Scale		Discrepancy Female laypeople Left 8mm 4.1 (1.5) Left 6mm 3.9 (1.7) Left 4mm 4.9 (1.3) Left 2mm 6.2 (1.5) Left 1mm 7.1 (1.0) 0mm 6.7 (1.3) Right 1mm 7.0 (1.3) Right 2mm 6.0 (0.5) Right 4mm 4.8 (0.9) Right 6mm 4.2 (1.6) Right 8mm 3.7 (1.0) Male laypeople Left 8mm 3.9 (1.4) Left 6mm 3.9 (1.7) Left 4mm 4.5 (1.6) Left 2mm 5.7 (1.4) Left 1mm 5.6 (2.1) 0mm 7.2 (1.5) Right 1mm 6.8 (1.0) Right 2mm 6.4 (1.7) Right 4mm 5.2 (1.0) Right 6mm 3.8 (1.0) Right 8mm 4.3 (1.7)	no sex differences	
Ker et al, 2008	243 (66% females)	Frontal perioral photographs digitally altered	Judges selected minimum and maximum tolerable values		Maxillary midline to face Max tolerable value 2.9mm Ideal value 0mm Maxillary to mandibular midline Max tolerable value 2.1mm Ideal 0mm		
Rodrigues et al, 2009	20 (10 F - 10 M)	Digitally manipulated smile photographs	Likert Scale		Face Framing I 8.4 (1.4) LM3 8.1 (1.8) Mouth Framing I 8.2 (1.6) LM3 8.3 (1.7)	Age*	Face Framing I 0.7 LM3 0.9 Mouth Framing I 0.8 LM3 0.8

Chang et al, 2011	576	Full frontal photograph digitally altered	VAS		Maxillary to mandibular midline Female Attactive 4.1 (1.1) ; Average 3.7 (1.4); Uanattractive 3.5 (1.5) Male 3.6 (1.1); Average 3.5 (1.1); Unattractive 3.7 (1.4)		

BUCCAL CORRIDORS							
De Marchi et al, 2012	20 lp (10 M - 10 F) mean age 30.01 ± 4.11 y	Digitally altered photographs	VAS	50,99	Right buccal corridor GC VAS < 50.99: 1.49 [0.50] VAS > 50.99:1.28 [0.43] SRC VAS < 50.99: 1.40 [0.98] VAS > 50.99:1.00 [0.55] SOI VAS < 50.99: 1.57 [0.77] VAS > 50.99:1.35 [0.59] Left buccal corridor GC VAS < 50.99: 1.27 [0.38]* VAS > 50.99:1.24 [0.45] SRC VAS < 50.99: 1.24 [1.31]* VAS > 50.99:1.30 [0.43] SOI VAS < 50.99:1.58 [0.67] VAS > 50.99:1.19 [0.45] Buccal corridor ratio GC VAS < 50.99: 0.95 [0.02] VAS > 50.99:0.95 [0.01] SRC VAS < 50.99: 0.95 [0.03] VAS > 50.99:0.95 [0.01] SOI VAS < 50.99: 0.93 [0.04] VAS > 50.99:0.95 [0.02]	Pearson's R correlation between attributes and judgement CG Unpleasant Left buccal corridor *r*=0.609/0.021 SCR Unpleasant Left buccal corridor *r*=-0.588/0.013	

Zange et al, 2011	42 Ip (22 F-20 M)	Digitally manipulated smile photographies	100mm VAS		Short Face 2% 48.88 10% 44.08 15% 40.17 22% 32.89 28% 18.62 * Long Face 2% 47.78 10% 47.08 15% 41.74 22% 34.75 28% 15.84*		
Abu Alhaija et al, 2011	200 (100 F - 100 M)	Digitally manipulated smile photographies	Likert Scale	2,12 +/- 0,04	Narrow 1.54 +/- 0.74 Wide 2.36 +/- 0.86	Profession** Gender**	Narrow 1.78 +/- 1.90 Wide 2.32 +/- 2.46
McLeod et al, 2011	103 Ip (61 M - 42 F)	Digitally manipulated smile image	Interactive survey		Maximum tolerable value 14.25 mm Ideal Value 6.33 mm Minimum tolerable value 5.07 mm	-	
Badran et al, 2013	104 Ip (53 F-51 M) mean age 28.7 y, age range 17-65 y	Digitally manipulated smile image	10-point scale		0% BCS 7.42 (1.873) 5% BCS 6.85 (1.863) 10% BCS 6.64 (1.695) 15% BCS 6.71 (1.909) 20% BCS 6.67 (1.983) 25% BCS 5.94 (2.293)	Age*	

Nascimento et al, 2012	30 lp	Digitally manipulated smile image	VAS		Buccal corridor Male Afro-descendant Narrow 48.37 (28.96); Medium 76.46 (21.28); Wide 39.00 (27.10) Caucasian Narrow 44.51 (27.91); Medium 54.49 (29.98); Wide 49.03 (27.81) Female Afro-descendant Narrow 54.49 (29.98); Medium 80.51 (22.06); Wide 31.72 (24.35) Caucasian Narrow 49.03 (27.81) Medium 75.90 (22.97); Wide 38.12 (24.39)		

Ioi et al, 2012	96 Japanese orthodontic patients (36 males, 60 females; age range, 15-29 years; SD, 21.5 6 3.8 years) 72 Korean orthodontic patients (33 males, 39 females; age range, 15-29 years; SD, 22.2 6 3.2 years)	Digitally manipulated smile image	VAS		Median (P25-P75) Japanese orthodontic patients Male 0% 73.3 (64.2-86.0) 5% 82.2 (62.4-94.0) 10% 75.6 (52.4-88.3)* 15% 52.0 (33.5-75.3)* 20% 35.1 (22.0-57.1)* 25% 18.7 (7.3-50.7)* Female 0% 82.1 (59.2-95.4) 5% 78.6 (61.1 -88.6) 10% 71.4 (52.1 -84.2)* 15% 41.1 (26.3-54.2) * 20% 26.3 (11.3-46.3)* 25% 8.8 (0.0-29.9)* Korean orthodontic patients Male 0% 79.2 (50.5-91.6) 5% 86.1 (71.2-93.3) 10% 73.1 (52.4-83.2)* 15% 40.9 (24.6-58.1)* 20% 27.7 (13.2-43.4)* 25% 11.6 (4.2-24.4) * Female 0% 76.3 (42.4-93.1) 5% 79.5 (51.1-93.0) 10% 70.4 (56.1- 83.9)* 15% 53.1 (29.2-79.5)* 20% 21.4 (13.8-37.8)* 25% 6.2 (1.8-12.0)	Sex*	

Springer et al, 2011	96 lp (49 M - 47 F) age range 18-72 y, mean age 25 y	Frontal facial photographs digitally altered	VAS		Ideal buccal corridor (%) 13 Minimum buccal corridor (%) 17 Maximum buccal corridor (%) 17		Ideal buccal corridor (%) 13-12 Minimum buccal corridor (%) 19-16 Maximum buccal corridor (%) 18-16
Gracco et al, 2006	1275 lp (413 M - 862 F) age range 14-77 y	Digitally manipulated smile image	Survey		Preferences 18.46% buccal corridors 65.72%* 24.77% buccal corridors 27.13%* 31.08% buccal corridors 7.13%*		
Martin et al, 2007	94 LP (40 M - 54 F)	Digitally manipulated smile image	VAS		6-6 tooth display - symmetrical 100% 54.23 (28.92) 96% 49.27 (26.71) 92% 48.99 (24.08) 88% 44.17 (28.05) 84% 36.11 (27.85) 5-5 tooth display - symmetrical 96% 60.45 (23.74) 92% 50.01 (24.68) 88% 48.30 (23.93) 84% 48.02 (27.67)		
Moore et al, 2005	30 (15 F - 15 M)	Frontal facial photographs digitally altered	Point system		percentage of buccal corridors in order of acctractiveness 2% buccal coridors rated best 10% buccal corridors 15% buccal corridors 22% buccal corridors 28% buccal corridors	No significative differences between male and female	

Parekh et al, 2006	115 (55 F - 60 M)	Frontal perioral photographs digitally altered	VAS		Female Flat SA Excessive BC 41.7 Exvessive SA Excessive BC 56.2 Ideal SA Excessive BC 60.1 Flat SA Ideal BC 46.8 Excessive SA Ideal BC 60.1 Ideal SA Ideal BC 68.1 Flat SA No BC 47.2 Excessive SA Flat SA 60.6 Ideal SA No BC 70.1 Male Flat SA Excessive BC 38.5 Exvessive SA Excessive BC 53.3 Ideal SA Excessive BC 55.9 Flat SA Ideal BC 42.2 Excessive SA Ideal BC 57.3 Ideal SA Ideal BC 65.9 Flat SA No BC 42.4 Excessive SA Flat SA 59.0 Ideal SA No BC 65.9	No significative differences between male and female	
Parekh et al, 2007	115 (55 F - 60 M)	Frontal perioral photographs digitally altered	VAS		Percentage of accepatiblity No BC 81.1 Ideal BC 82.3 Excessive BC 71.9		
McNamara et al, 2008	30 (15M - 15 F)	Digitally manipulated smile image	VAS		Left buccal corridor 11.2 (2.4) Right buccal corridor 11.2 (2.5) Buccal corridor ratio 0.6 (0.0) Left posterior corridor 7.7 (2.6) Right posterior corridor 7.4 (2.4) Posterior corridor ratio 0.8 (0.1)		
Ker et al, 2008	243 (66% females)	Frontal perioral photographs digitally altered	Judges selected minimum and maximum tolerable values		Max tolerable value 16.0mm (22% of smile) Ideal value 11.6mm (16% of smile) Min tolerable value 5.5mm (8% of smile)		
Roden-Johnson et al, 2005	20 (aged between 28 and 64 years)	Frontal perioral photographs digitally altered	VAS		W buccal corridors 50.6 W/o buccal corridors 50.8		

GINGIVAL DISPLAY AND DESIGN							
Kaya et al, 2016	68 laypeople (40F - 28 M; aged 30,9 ± 11,4)	Intraoral photographs digitally altered	0-80 VAS		-2 mm: 54,2 +/- 17,3 -1 mm: 51,3 +/- 16,7 0 mm: 46 +/- 16,4 +1 mm: 39,9 +/- 17 +2 mm: 34,2 +/- 17,4		
De Marchi et al, 2012	20 lp (10 M - 10 F) mean age 30.01 ± 4.11 y	Digitally altered photographs	VAS	50,99	Gingival display GC VAS < 50.99:-2.16 [1.54] VAS > 50.99: -1.71 [1.64] SRC VAS < 50.99: 3.03 [3.41] VAS > 50.99: 1.80 [5.08]* SOI VAS < 50.99: -3.03 [2.30] VAS > 50.99: -2.51 [0.97]	Pearson's R correlation between attributes and judgement SCR Pleasant Gingival display r=-0.681/0.043	

Machado et al, 2013 (3)	60 (28 F - 32 M)	Frontal smile (Full smile, incisal close-up, gingival close-up) photographs digitally altered	VAS		Altered vertical positions "full smile": 0mm 80.2 (13.2) +0.5 mm extruded 86.27 (9.79) +1mm extruded 77.1 (13.3) +1.5mm extruded 61.18 (15.56) +0.5 mm intruded 60.91 (14.9) +1mm intruded 39.6 (12.61) Altered vertical positions "incisal close-up": 0mm 74.15 (18.23) +0.5 mm extruded 84.63 (12.45) +1mm extruded 76.02 (12.46) +1.5mm extruded 59.62 (23.33) +0.5 mm intruded 70.27 (14.88) +1mm intruded 51.12 (17.52) Altered vertical positions "gingival close-up": 0mm 78.55 (15.87) +0.5 mm extruded 75.01 (16.26) +1mm extruded 72.32 (19.76) +1.5mm extruded 63.74 (22.71) +0.5 mm intruded 63.61 (21.69) +1mm intruded 66.57 (19.01)		
McNamara et al, 2008	30 (15M - 15 F)	Digitally manipulated smile image	VAS		Gingival display -1.0 (2.6)		

Ker et al, 2008	243 (66% females)	Frontal perioral photographs digitally altered	Judges selected minimum and maximum tolerable values		Gingival display Max tolerable value -3.6mm Ideal value 2.1mm Min tolerable value 4.0mm Maxillary central incisor gingival height discrepancy Max tolerable value 2.0mm Ideal 0mm Maxillary lateral incisor gingival height discrepancy Max tolerable value 1.2mm Ideal value -0.4mm Min tolerable value -2.9mm		
Rodriguez-Martinez et al, 2013	40 (20 F - 20 M) aged between 40 and 50 years	Frontal perioral photographs digitally altered	Point scale		Gingival exposure 0mm 1.75 ± 0.70 4mm 1.45 ± 0.71 6mm 1.65 ±0.73 8mm 2.05 ±0.78		
Pinho et al, 2007	50 University students	Frontal smile photographs digitally altered	VAS		Altered gingival margin of maxillary central incisor 0mm 41.5 (21.1) 0.5mm 40.2 (21.0) 1.0mm 36.4 (17.8) 1.5mm 34.0 (19.7) 2.0mm 26.0 (16.8) 2.5mm 20.9 (15.2)		

Correa et al, 2014	50 with a college education	Frontal facial photographs digitally altered	VAS		Canine gingival asymmetries Woman 1 0.0mm 79.76 (17.20) 0.5mm 73.08 (19.96) 1.0mm 67.95 (21.51) 1.5mm 63.80 (21.83) 2.0mm 54.00 (26.50) 2.5mm 48.86 (26.93) Woman 2 0.0mm 74.17 (18.36) 0.5mm 74.56 (16.90) 1.0mm 68.82 (16.83) 1.5mm 63.70 (20.75) 2.0mm 44.30 (23.34) 2.5mm 43.98 (25.92) Man 1 0.0mm 79.29 (18.02) 0.5mm 74.52 (18.92) 1.0mm 68.14 (21.46) 1.5mm 66.12 (27.76) 2.0mm 52.12 (29.14) 2.5mm 49.23 (27.19) Man 2 0.0mm 75.97 (17.71) 0.5mm 71.13 (18.04) 1.0mm 68.53 (19.51) 1.5mm 55.45 (23.27) 2.0mm 41.74 (24.85) 2.5mm 37.02 (26.53)		
Chang et al, 2011	576	Full frontal photograph digitally altered	VAS		Central-lateral gingival difference ideal Female Attactive -0.75 (0.75) ; Average -0.375 (0.75); Uanattractive -0.375 (0.75) Male Attractive -0.75 (0.75); Average -0.75 (0.75); Unattractive -0.375 (0.75)		

					Central-lateral gingival difference minimum Female Attactive -1.875 (0.75) ; Average -1.875 (0.75); Uanattractive -1.875 (0.75) Male Attractive -1.875 (0.75); Average -2.25 (0.75); Unattractive -1.8 (0.9) Central-lateral gingival difference maximum Female Attractive 0.375 (0.75) ; Average 0.375 (0.75); Uanattractive 0 (0.75) Male Attractive 0.375 (0.75); Average 0.375 (0.75); Unattractive 0.375 (0.75) Central-central gingival discrepancy Female Attactive 1.8 (0.9) ; Average 2.1 (1.1); Uanattractive 1.8 (1.3) Male Attractive 2.1 (1.1); Average 2.1 (1.1); Unattractive 1.8 (1.2) Gingival display ideal Female Attactive 1 (1.5) ; Average 2.4 (1.0); Uanattractive -0.5 (0.5) Male Attractive 1.5 (0.75); Average 2.25 (1.5); Unattractive 0 (1) Gingival display minimum Female Attactive -0.5 (0.8) ; Average 0.8 (1.5); Uanattractive -1.5 (1.0)		

					Male Attractive 0.3 (1.0); Average 0.4 (1.5); Unattractive -1.5 (1.5) Gingival display maximum Female Attactive 2.9 (1.0) ; Average 5.0 (1.7); Uanattractive 0.5 (1.0) Male Attractive 3.0 (1.0); Average 4.5 (1.7); Unattractive 1.0 (1.8)		
Kaya et al, 2013	70 (45 F - 25 M) Mean age 31.1±11.6 years	Frontal perioral photographs digitally altered	VAS		SA1 GD -4mm 48±28.0 SA1 GD -2mm 55.4±21.2 SA1 GD 0mm 40.0±24.8 SA1 GD +2mm 22.8±24.5 SA2 GD -4mm 54.3±28.7 SA2 GD -2mm 58.2±25.9 SA2 GD 0mm 46.9±25.8 SA2 GD +2mm 25.1±21.9 SA3 GD -4mm 51.2±30.2 SA3 GD -2mm 68.1±24.5 SA3 GD 0mm 50.5±22.4 SA3 GD +2mm 24.0±24.7 SA4 GD -4mm 50.8±30.5 SA4 GD -2mm 58.1±26.3 SA4 GD 0mm 51.3±25.4 SA4 GD +2mm 31.6±25.7 SA5 GD -4mm 42.1±29.9 SA5 GD -2mm 63.3±30.0 SA5 GD 0mm 55.9±25.0 SA5 GD +2mm 31.5±26.3 SA6 GD -4mm 50.3±28.5 SA6 GD -2mm 55.9±31.0 SA6 GD 0mm 52.3±28.0 SA6 GD +2mm 32.7±27.2 SA7 GD -4mm 42.1±26.8 SA7 GD -2mm 57.3±27.6 SA7 GD 0mm 54.3±27.8 SA7 GD +2mm 35.9±25.3		

Geron et al, 2005	100 dental patients 51 (27F - 24 M) judged female photographs; 49 (23 F - 26 M) judjed male photographs	Frontal perioral photographs digitally altered	Likert scale		Exposure 0-3.3mm Male images 4.41±1.78 Female images 3.69±1.48 Exposure 0-2mm Male images 4.78±1.90 Female images 4.06±1.51 All smile images Male images 5.71±1.29 Female images 4.92±0.99	Sex*	
McLeod et al, 2011	103 lp (61 M - 42 F)	Digitally manipulated smile image	Interactive survey		Maximum tolerable value -2.52 mm Ideal Value 2.7 mm Minimum tolerable value 2.7 mm Lateral-Central Gingival Discrepancy Maximum tolerable value -0.5mm Ideal Value -0.06	-	
Kokich et al, 2006	66	Frontal perioral photographs digitally altered	VAS		-	Threshold Unilateral papillary height ND Bilateral papillary height 1.5 Gingiva-to-lip distance 3.0	

Talic et al, 2012	30	Digitally manipulated smile photographs	VAS		Gingival margin 0mm 64 ± 27.5 1mm 59.03 ± 23.6 2 mm 56.3 ± 26.9 3mm 53.4 ± 23.9 4mm 50.2 ± 24.4 5mm 49.8 ± 26.8 Gingival to lip margin 0mm 63.1 ± 24.6 1mm 63.1 ± 22.8 2 mm 58.4 ± 21.9 3mm 55.3 ± 25.6 4mm 62.3 ± 25 5mm 54.3 ± 27.8		
Pithon et al, 2013	50 (22 F - 28 M) Age: <16y 3; 16-30y 36; 31-45y 9; >45y 2	Digitally manipulated smile image	10-point scale		Smile gingival display Original 4.26 (2.39) -0.5mm 4.79 (1.87) -1mm 5.99 (2.19) - 1.5mm 6.55 (2.00) - 2mm 6.80 (2.21) - 2.5mm 6.29 (2.14) - 3mm 5.50 (2.21) - 3.5mm H 4.63 (2.36) - 4mm3.63 (2.43) - 4.5mm 2.94 (2.64)		
Musskopf et al, 2013	41 (25 F - 16 M) Mean age 45.3 ± 16.3	Digitally manipulated smile photographs	VAS		Healthy periodontum 5.6 (2.5) Unilateral incisor recession 5.1 (2.4) Bilateral lateral incisor recession 5.1 (2.5) Unilateral canine recession 4.6 (2.6) Bilateral canine recession 5.0 (2.5) Generalized gingival recession 5.0 (2.3)		

Kumar et al, 2012	40 Mean age 31.3y	Frontal smile photographs digitally altered	VAS	Not detectable	Progressive increase in gingival-lip distance: Unaltered 5.85 (2.23) +1 mm 6.4 (1.96) +2mm 4.75 (1.33) +3mm 5.7 (2.34) +4mm 5.7 (2.30)		
Springer et al, 2011	96 lp (49 M - 47 F) age range 18-72 y, mean age 25 y	Frontal facial photographs digitally altered	VAS		Ideal gingival display (mm) 2.3 Minimum gingival display (mm) 0.8 Maximum gingival display (mm) 4.5 Central to central gingiva (mm) 2.1 Ideal central to lateral gingiva (mm) 0.4 Minimum central to lateral gingiva (mm) 1.9 Maximum central to lateral gingiva (mm) 0.4		Ideal gingival display (mm) 2.4-2.3 Minimum gingival display (mm) 0.8-0.3 Maximum gingival display (mm) 5.0-4.5 Central to central gingiva (mm) 2.3-1.8 Ideal central to lateral gingiva (mm) 0.8-0.4 Minimum central to lateral gingiva (mm) 2.3-1.9 Maximum central to lateral gingiva (mm) 0.4-0.4

Feu et al, 2011	80 patients	Digitally manipulated smile photograph	Choose of the most pleasant smile by judgers		Harmonoius 44.2% Central incisor 4mm below and lateral incisor 1mm above 10.4% Central incisor 2mm below and lateral incisor 0.5mm above 24.7% All 19.5% None 1.3%		
Brough et al, 2010	40 lp (12 M - 28 F) age range 26-65 y, mean age: 33.9 +/- 7.8 y	Digitally manipulated smile photographs	5-point scale (lower the better)		Maxillary canine gingival margin height (rank by laypeople) Original image (1) 0.5 mm lower (4) 0.5 mm lower [img copy] (2) 0.5 mm higher (3) 1.0 mm higher (5) 1.5 mm higher (6)		
Suzuki et al, 2008	20	Digitally manipulated smile photographs	VAS		Gingival display: 0mm 7.077 (1.821) 1 mm 6.829 (1.984) 3mm 5.748 (2.174) 5mm 4.118 (2.425) 7mm 3.408 (2.313)		
Kokich et al, 1999	74	Frontal perioral photographs digitally altered	VAS		Mean threshold Gingival margin Not detectable Gingiva-to-lip distance 4.0mm		
An et al, 2009	500 aged from 11y to 79y	Frontal intraoral photographs digitally altered on the basis of a callibrated grid	Scoring by rank order		Mesiodistal location of gengival zenith Grid 4.3-6.3 213 Grid 4.8-6.8 228 Grid 5.3-7.3		
Abu Alhaija et al, 2011	200 (100 F - 100 M)	Digitally manipulated smile photographs	Likert Scale	2.12 ± 0.04	1 mm 1.80 ±0 .82 2mm 2.13 ± 0.92 3mm 2.48 ± 0.93 4mm 2.36 ± 0.96	Gender*	

An et al, 2014	100 (50 non treated orthodontically 38 F - 12 M mean age 22.0 ± 2.9y; 50 treated orthodontically 44 F - 6 M mean age 23.8 ± 3.6y)	Digitally manipulated smile photographs	VAS		Scores for gingival margin heights of the maxillary central incisor 0 mm G1 70.46 (16.38) G2 67.19 (17.00) 64.92 (17.00) 0.5 mm G1 71.92 (15.57) G2 71.10 (17.23) 69.44 (14.14) 1.0 mm G1 63.61 (19.02) G2 63.09 (20.29) 53.20 (18.86) 1.5 mm G1 52.83 (19.16) G2 53.53 (21.41) 35.24 17.94 2.0 mm G1 47.28 (18.44) G2 42.93 (22.03) 21.89 (15.03)		

Lavacca et al, 2005	50 divided in two groups: Prosthodontic patients (male to female ratio 9:16, mean age 61 comprised 36 to 87); Orthodontic patients (male to female ratio 12:13, mean age 33 comprised 18 to 59)	Frontal perioral photographs digitally altered	6 points scale		PAPILLARY HEIGHT Median (Mode) Prosthodontic patients male +3mm 3.0 (2.0) +3mm 2.0 (2.0) +2mm 2.0 (2.0) +1mm 2.0 (2.0) Control 2.0 (2.0) Control 2.0 (2.0) -1mm 2.0 (2.0) -2mm 3.0 (2.0) -2mm 3.0 (2.0) Prosthodontic patient female +3mm 3.0 (2.0) +3mm 3.0 (2.0) +2mm 3.0 (2.0) +1mm 3.0 (3.0) Control 3.0 (2.0) Control 2.3 (2.0) -1mm 3.0 (3.0) -2mm 3.0 (3.0) -2mm 3.0 (3.0) Orthodontic patient male +3mm 2.0 (2.0) +3mm 3.5 (4.0) +2mm 3.0 (3.0) +1mm 2.5 (2.0) Control 2.5 (2.0) Control 2.0 (2.0) -1mm 2.5 (2.0) -2mm 3.0 (3.0) -2mm 3.0 (3.0) Orthodontic patient female +3mm 3.0 (2.0) +3mm 4.0 (3.0) +2mm 2.0 (2.0) +1mm 3.0 (3.0) Control 3.0 (2.0) Control 2.0 (2.0) -1mm 2.0 (2.0) -2mm 3.0 (2.0) -2mm 3.0 (4.0)	No differences in sex	

LIP HEIGHT							
De Marchi et al, 2012	20 lp (10 M - 10 F) mean age 30.01 ± 4.11 y	Digitally altered photographs	VAS	50,99	Lower lip to incisor GC VAS < 50.99: 1.59 [1.16] VAS > 50.99: 2.49 [2.09] SRC VAS < 50.99: 2.61 [2.08] VAS > 50.99: 1.35 [0.82] SOI VAS < 50.99: 2.67 [1.63]* VAS > 50.99: 2.21 [1.19] Interlabial gap GC VAS < 50.99: 9.22 [1.82] VAS > 50.99: 9.62 [1.50] SRC VAS < 50.99: 10.47 [3.07] VAS > 50.99: 8.78 [0.94] SOI VAS < 50.99: 9.90 [1.33] VAS > 50.99: 9.50 [0.91] Incisor exposure GC VAS < 50.99: 7.57 [1.56] VAS > 50.99: 7.72 [1.15] SRC VAS < 50.99: 7.69 [2.03] VAS > 50.99: 7.44 [0.51] SOI VAS < 50.99: 7.22 [1.75] VAS > 50.99: 7.28 [0.74]	Pearson's R correlation between attributes and judgement SOI Unpleasant Lower lip to incisor *r*=-0.550/0.033	

Ioi et al, 2014	96 Japanese orthodontic patients (36 males, 60 females; age range, 15-29 years; SD, 21.5 6 3.8 years) 72 Korean orthodontic patients (33 males, 39 females; age range, 15-29 years; SD, 22.2 6 3.2 years)	Digitally manipulated smile image	VAS	"-1/+1 range"	Median (p25-p75) JP Male -3 mm 51.1 (23.3-71.0) -2mm 55.9 (45.2-77.2) -1mm 55.2 (45.8-81.2) 0mm 71.8 (57.2-79.7) 1mm 55.0 (38.4-73.1) 2mm 47.0 (23.8-65.0) 3mm 23.3 (10.1-35.0) Female -3mm 28.6 (13.5-47.4) -2mm 51.0 (25.0-74.6) -1mm 54.9 (34.1-73.4) 0mm 71.1 (50.5-86.4) 1mm 51.3 (26.1-67.0) 2mm 51.3 (24.1-69.5) 3mm 17.5 (4.5-34.8) KP Male -3mm 29.5 (23.2-54.6) -2mm 55.6 (31.5-75.4) -1mm 60.8 (49.4-81.2) 0mm 72.4 (53.3-90.7) 1mm 57.2 (46.9-70.4) 2mm 51.6 (34.2-66.5) 3mm 25.1 (20.0-51.3) Female -3mm 22.0 (9.0-37.0) -2mm 42.7 (26.9-72.1) -1mm 51.8 (37.0-69.7) 0mm 80.3 (64.3-89.2) 1mm 73.2 (45.6-89.2) 2mm 44.3 (20.5-57.3) 3mm 21.0 (9.0-38.7)		

McNamara et al, 2008	30 (15M - 15 F)	Digitally manipulated smile image	VAS		Layperson raters 1. Upper lip thickness 1.000 11.343 2. Upper lip thickness 0.700 16.671 1.000 Lower lip thickness 0.700 4.642 .836		
MISCELLANEOUS							
De Marchi et al, 2012	20 lp (10 M - 10 F) mean age 30.01 ± 4.11 y	Digitally altered photographs	VAS	50,99	Smile index GC VAS < 50.99: 7.05 [1.12] VAS > 50.99: 6.76 [0.93] SRC VAS < 50.99: 6.32 [1.74] VAS > 50.99: 6.90 [0.73] SOI VAS < 50.99: 6.20 [0.97] VAS > 50.99: 6.24 [0.68] Smile width GC VAS < 50.99: 52.84 [4.39]* VAS > 50.99: 54.37 [1.96]* SRC VAS < 50.99: 53.49 [3.72] VAS > 50.99: 49.90 [3.44] SOI VAS < 50.99: 52.82 [4.99] VAS > 50.99: 50.65 [2.64]	Pearson's R correlation between attributes and judgement CG Unpleasant Smile width *r*=-0.578/0.030 Pleasant Smile width *r*=-0.787/0.020	

Xu et al, 2015	60 college students (30 F - 30 M) Mean ages, 20.7 and 21.4 years, respectively	Digitally altered images with different virtual setups	VAS	Range of inclinations Canines from 3° to -10° Premolars from 5° to -11°	Buccolingual inclinations of canine, first premolar, and second premolar (°) 2, 5, 5 79.17 (14.88) -1 ,1, 1 81.17 (13.79) -4, -3, -3 82.33 (11.98) -7, -7, -7 82.00 (11.17) -10, -11, -11 80.83 (13.44) -13, -15, -15 70.33 (15.19) -16, -19, -19 71.17 (13.42) 6, 5, 5 73.50 (14.12) 3, 1, 1 80.83 (15.44) 0, -3, -3 80.67 (12.74) -3, -7, -7 80.83 (13.31) -6, -11, -11 81.83 (11.12) -9, -15, -15 77.83 (13.91) -12, -19, -19 71.33 (13.71) -2.6, -8.4, -7.2, -8.7, -6.3, -6.9 78.33 (15.09)	no differneces with sex	
Parekh et al, 2007	115 (55 F - 60 M)	Frontal perioral photographs digitally altered	VAS		Percentage of accepatiblity Flat SA 60.0 Ideal SA 91.9 Excessive SA 84.4		
Ker et al, 2008	243 (66% females)	Frontal perioral photographs digitally altered	Judges selected minimum and maximum tolerable values		Smile arc Max tolerable value 8.5mm at 7s; 3.3mm at 3s Ideal value 7.2m at 7s; 2.7mm at 3s Min tolerable value 2.3mm at 7s; 1.2mm at 3s Overbite Max tolerable value 5.7mm Ideal value 2.0mm Min tolerable value 0.4mm Occlusal cant Max tolerable value 4 degrees Ideal 0 degrees		

Pinho et al, 2007	50 University students	Frontal smile photographs digitally altered	VAS		Canine cusp wear 0mm 48.5 (17.2) 0.5mm 51.2 (17.6) 1.0mm 52.8 (20.6) 1.5mm 52.3 (18.2) 2.0mm 49.4 (19.4)		
Pereira Silva et al, 2013	100 divided in two groups (group 1 and group 2) Group 1: 50 (21 F - 29 M) Group 2: 50 (25F - 25M)	Digitally manipulated smile image	VAS	Nose deviation 4mm Chin deviation Not detectable Midline cant 5° Incisal plane cant 3°	GROUP 1 SFM (symmetric face model) 0mm 37.92 (8.502) Nose 1mm 37.71 (7.502) 2mm 36.56 (7.444) 3mm 36.56 (7.889) 4mm 30.71 (11.815) Chin 1mm 38.30 (7.573) 2mm 37.48 (8.545) 3mm 34.50 (9.519) 4mm 36.22 (9.011) 5mm 35.71 (8.253) 6mm 35.18 (8.214) GROUP 2 SFM (symmetric face model) 0° 69.9 (33.5) Dental midline cant 5° 63.5 (16.265) 10° 19.1 (18.721) 15° 29.5 (18.225) 15° 24.7 (15.940) Incisal plane cant 2° 68.3 (18.705) 3° 60.9 (19.654) 4° 56.2 (20.013) 5° 39.1 (20.558)		

Chang et al, 2011	576	Full frontal photograph digitally altered	VAS		Overbite ideal Female Attractive 2.3 (1.2); Average 2.3 (1.1); Unattractive 2.4 (1.7) Male Attractive 2.3 (1.7); Average 2.4 (0.9); Unattractive 2.4 (1.4) Overbite minimum Female Attractive 1.1 (2.0); Average 0.8 (2.6); Unattractive 1.5 (2.7) Male Attractive 1.1 (2.6); Average 0.8 (2.3); Unattractive 0.8 (2.3) Overbite maximum Female Attractive 6.2 (1.1); Average 6.0 (1.7); Unattractive 6.0 (1.2) Male Attractive 6.6 (1.1); Average 5.7 (1.7); Unattractive 6.6 (1.9) Smile arc ideal Female Attractive -1.5 (3); Average -2.5 (1.5); Unattractive -2 (2.5) Male Attractive -3 (2); Average -2 (2.5); Unattractive -3 (2) Smile arc minimum Female Attractive -4 (2.25); Average -4.5 (2.75); Unattractive -4 (2.25) Male Attractive -4.5 (0.75); Average -4 (2.75); Unattractive -5 (2.25) Smile arc maximum Female Attractive 2.5 (1.5); Average 1.5 (2); Unattractive 1.75 (2.5) Male Attractive 1.5 (2); Average 1.5 (2); Unattractive 1.75 (2) Occlusal cant Female Attractive 3.5 (2.0); Average 2.8			

Olivares et al, 2013	40 (20 F - 20 M) aged between 40 and 50 years	Digitally manipulated smile image	3 point scale		Canting degrees 2° 1.50 (0.71) 0° 1.65 (0.69) 4° 2.45 (0.56)		
Pithon et al, 2012 (2)	30 (12 F - 18 M) Age group: 16-30 years 23 31-45 years 7 >45 years 0	Digitally manipulated smile image	10 point scale		A 6.59 (1.99 B 5.80 (2.34) C 5.42 (2.36) D 5.32 (2.41) E 5.49 (2.66)		
Pithon et al, 2012 (3)	90 (36 F - 54 M) Age group: 16-30 years 69 31-45 years 21 >45 years 0	Digitally manipulated smile image	10 point scale		A 8.00 (1.56) B 7.12 (1.72) C 5.97 (1.88) D 4.93 (2.29) E 4.24 (2.24) F 2.96 (2.30)		
Kim et al, 2003	50	Frontal perioral photographs digitally altered	Likert Scale		Non extraction patients 7.02 (1.19) Extraction patients 6.46 (1.09)	no differences	
Farzanegan et al, 2013	20 lp (10 F-10M) age range 28-50 y	Digitally manipulated smile image	100-point scale		Mean Teeth Score 56.83 ± 10.07 Mean Lips Score52.53 ± 15.75 Mean Full Smile Score 60.37 ± 3.50		
McLeod et al, 2011	103 lp (61 M - 42 F)	Digitally manipulated smile image	Interactive survey		Occlusal cant Maximum tolerable value 1 degree	-	
Rodrigues et al, 2009	20 (10 F - 10 M)	Digitally manipulated smile photographs	Likert Scale		Face Framing I 8.4 (1.4) LSRV 7.1 (2.0) Mouth Framing I 8.2 (1.6) LSRV 6.6 (2.0)	Age*	Face Framing I 0.7 LSRV 0.9 Mouth Framing I 0.8 LSRV 0.9

Thomas et al, 2011	100 (43 F - 57 M) Average age 20-40 years	Frontal perioral photographs digitally altered	VAS		Papillary height symmetry 5.762 (1.5481)		Papillary height symmetry 5.455 - 6.069
Springer et al, 2011	96 lp (49 M - 47 F) age range 18-72 y, mean age 25 y	Frontal facial photographs digitally altered	VAS		Ideal smile arc (mm) 2.0 Maximum smile arc (mm) 4.0 Minimum smile arc (mm) 1.5 Ideal overbite (mm) 2.3 Minimum overbite (mm) 0.9 Maximum overbite (mm) 5.4		Ideal smile arc (mm) 2.5 2.0 Maximum smile arc (mm) 4.5 4.0 Minimum smile arc (mm) 1.0 2.0 Ideal overbite (mm) 2.3 2.4 Minimum overbite (mm) 0.8 1.5 Maximum overbite (mm) 5.4 6.0
Badran et al, 2013	104 lp (53 F-51 M) mean age 28.7 y, age range 17-65 y	Digitally manipulated smile image	10-point scale		Smile Arch Consonant SA 7.13 (2.029) Flat SA 6.13 1.984) Reverse SA 2.65 (1.853)	Age*	
Kaya et al, 2016	68 laypeople (40F - 28 M; aged 30,9 ± 11,4)	Intraoral photographs digitally altered	0-80 VAS		Highest score Occlusal Cant up to 2° with -2 mm of gingival display: 68.7 +/- 26.7 Lowest score Occlusal cant up to 6° with 0 mm of gingival display: 27,5 +/- 22,6		

Pithon et al, 2015	150 laypeople divided in three gruops: 50 aged 15 to 19 y (29 F - 21 M); 50 aged 35 to 44 y (28 F - 22 M); 50 aged 65 to 74 y (45 F - 5 M)	Intraoral photographs digitally altered	0-10 VAS		Maxillary anterior tooth exposure Lowest score 15-19y, -7 mm: 3,44 (2,7) 35-44y, -7 mm: 3,26 (2,6) 65-74y, -6 mm: 4,39 (2,7) -2 mm* 15-19y: 7,05 (1,6) 35-44y: 6,53 (2,0) 65-74y: 5,79 (2,4) -7 mm* 15-19y: 3,44 (2,7) 35-44y: 3,26 (2,6) 65-74y: 4,5 (2,6)		
Zhang et al, 2016	30 undergraduates (15 F - 15 M)	Full face photographs digitally altered	Numeric Rating Scale (NRS)		Arch width Acceptability range -3,61 mm to 2,23 mm from original width (35,24 +/- 0,47 mm)		

Appendix B – Summary of results.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1-2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	-
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	-

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	8
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9-13
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8
-Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	14-18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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