

# An evaluation of the influence of teeth and the labial soft tissues on the perceived aesthetics of a smile

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## In brief

Provides insight into how the lips and teeth may influence the aesthetic perception of a smile.

Explores how different fields of view may impact the overall perception of beauty in smile aesthetics.

Highlights how gender and occupation may affect the way beauty is perceived.

Helps the clinician understand the aesthetic demands of the patient.

**Objective** The aim of this study was to investigate how the lips and teeth may affect the perceived aesthetics of a given smile. Lips and teeth were collectively assessed in different fields of view to see how they may contribute to smile aesthetics. The perception of 'beauty' was assessed to determine whether differences existed between; dentists, non-dentists, males and females. **Methods** Five subjects were photographed to produce the following views: 1) retracted anterior teeth; 2) lips at rest; 3) zoomed smile; and 4) smile showing the lower face. Images were compiled in a survey questionnaire and shown to respondents who ranked the subjects in order of aesthetic appeal. Kendall's coefficient of concordance (W) and median rank scores were used to determine the statistical significance. **Results** All groups demonstrated statistically significant agreement in the perception of beauty. Both the teeth and lips seemed to contribute similarly to the attractiveness of a smile. Dentists seemed to be more influenced by teeth in a zoomed smile view, however, this was negated when viewing a broader field of view. All other groups showed no difference in perception of aesthetics with changing field of view. **Conclusion** Both lips and teeth seem to contribute to the aesthetic appeal of a smile. Dentists may have a tendency to place a disproportionate weight to teeth when assessing a smile close up.

## Introduction

Aesthetic dental procedures are often sought by patients to impart positive changes to their smile. Patients may be motivated by beautiful, youthful smiles portrayed in the media.<sup>1-6</sup> There are social implications of having a beautiful smile.<sup>6-10</sup> It has been shown to significantly influence how a person may be perceived in a social context.<sup>1</sup> An attractive smile is thought to enhance a person's interpersonal relationships, employment prospects, and financial success.<sup>6,7,9-13</sup> Indeed, clinicians may notice improvements in a patient's

self-esteem and quality of life after aesthetic treatment is performed.

The concept of a 'beautiful smile' is a complex phenomenon. It's something that most people can recognise in an instant, yet the actual components are difficult to comprehend. There is no single definition of beauty, and a significant factor may stem from societal constructs rather than science.<sup>13</sup> Beauty is therefore not absolute, but an extremely subjective concept.<sup>8,10,14</sup> Despite this, 'aesthetic clinicians' have attempted to quantify aspects of beauty as professional standards based on objective measures, rather than subjective norms.

Traditionally, aesthetic dentistry has primarily focussed on addressing the aesthetic parameters of the teeth and soft tissues encompassed in the 'aesthetic zone' – the 'dental hard and soft tissues surrounded by the lips that are visible during the act of smiling'.<sup>15</sup>

The teeth and periodontal soft tissue visible during a smile are immobile, but are displayed to varying degrees during function and smile. There are numerous studies in the literature

that have investigated individual parameters of the teeth and gingiva that can impart an aesthetically pleasing smile (which propose some generally accepted ideals in dental aesthetics and beauty). This includes aspects relating to: shade, symmetry, tooth form, height: width ratio; axial inclinations; gingival architecture; smile arch; and buccal corridor amongst others.<sup>1,3,6,16-23</sup>

However, a smile is a complex dynamic expression involving many aspects of the face beyond the 'aesthetic zone'.<sup>13</sup> Of particular importance are the lips – sometimes regarded as the frame to the smile.<sup>19,24</sup> A multitude of facial muscles work together during a smile. They animate the lips and effectively open up the 'smile curtain' to reveal teeth and periodontal structures.

In many parts of the world, dentists are including facial-injectable treatment to enhance the lips such as botulinum toxin and dermal fillers. Providing treatment to the lips may be a valuable procedure to complement the teeth during the aesthetic rehabilitation of a patient.<sup>3,8</sup> It allows the dentist to manage the smile as a dynamic entity rather than focusing

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on the dental hard and soft tissues alone. With the increase in popularity of aesthetic treatments, a clear understanding of the lip (labial) and teeth parameters that make up an attractive smile is required for optimal results.

A common precept in society is that 'beauty is in the eye of the beholder'. What is perceived as beautiful by one person may not be so for another.<sup>25</sup> Numerous authors have suggested that dental professionals and laypeople may perceive aesthetic details differently.<sup>4,5,18,23,26,27</sup>

Dentists are likely to have a tendency to focus heavily on teeth by virtue of the profession. Some authors have proposed that the wider perspective of the smile in the lower face view could dilute the attention to detail of the teeth.<sup>5</sup> A change in one variable will be much smaller

relative to the overall image when viewing a larger image.<sup>5,28</sup> The attractiveness of the face can also alter the importance of the dental characteristics. Other studies have shown conflicting results, concluding no statistically significant influence of the face<sup>1,4,18,24</sup> when looking at a close up smile and a full face smile.

In the current literature, there are numerous publications that investigate aesthetic parameters of teeth, gingival tissues and lip form.<sup>1,3,13,14,18,20,21,23,29</sup> In contrast, there is very little published data that explores how the teeth, lips and facial soft tissues collectively contribute to the aesthetic appeal of a smile. This introduces the question of whether treating or simply giving due attention to the teeth is sufficient to fulfil the aesthetic demands of a

patient – or do lips require further consideration during the process of aesthetic treatment planning? Do the lips play a significant role in the aesthetic appeal in a smile?

## Aims and objectives

This study aimed to evaluate the aesthetic impact of lips and how this may affect the perception of teeth in an overall smile. The effects were evaluated for; gender, and professionals (dentists) versus laypeople in varying fields of view of smile.

## Materials and methods

This study was performed under the supervision of the Dental Institute of King's College London, and received ethics approval by the BDM Research Ethics Subcommittee.

### Subject selection

Five photographic subjects were recruited for the survey questionnaire. To minimise bias based on personal preferences, an inclusion criteria for subject selection was used. These were: (1) female; (2) having reasonable symmetry in the teeth; (3) reasonable alignment of teeth; (4) display of at least six maxillary incisors on full smile; (5) no visibly missing teeth; (6) intact teeth with no obviously visible dental restorations; (7) no obvious signs of inflammation or pathology in any of the hard or soft tissues; (8) in the age range of 20 to 40 years old; (9) Caucasian; and (10) similar complexion and hair colour. The subjects were not pre-evaluated for the presence of an aesthetic or un-aesthetic smile.

### Photography

Three standardised clinical photographs were taken of the subjects: (1) Retracted maxillary anterior teeth; (2) portrait view with lips at rest; and (3) portrait view with subject at full smile. These were taken using: a Canon EOS 70D DSLR; Canon EFS 60mm f/2.8 Macro USM Lens; Canon Macro Ring Lite MR14EX II; Canon EF 24-105mm f/4L IS USM Lens; and a Lighting Canon Speedlite 600EX-RT (Canon Inc., Tokyo, Japan).

A software-editing program – Photoshop Lightroom 5 (Adobe Systems Inc., San Jose, CA, USA) – was used to standardise the images. The portrait view of the full smile was duplicated and cropped to produce two views; zoomed smile, and a smile showing the lower two thirds of the face. Each subject had a total of four images (Figs 1–4).



Fig. 1 Maxillary anterior teeth



Fig. 2 Lips at rest



Fig. 3 Zoomed smile showing lips and teeth

### Questionnaire

The questionnaire was administered to patients in the waiting room of a private dental clinic, and dentists attending continuing education courses. To standardise the viewing conditions, this study was conducted on a digital format using a 12.9-inch iPad Pro (Apple Inc., CA, USA.) Data collection was conducted via a secured online platform (SurveyMonkey, CA, USA). Only completed surveys were counted towards the final data. The questionnaire was administered over a two month period in 2016.

The participants were shown the retracted anterior teeth view of the subjects (Fig. 5). All subjects in each view were shown simultaneously on one page and the participants asked to rank the subjects based on aesthetic appeal. The subject's teeth were ranked from 1 (most aesthetically pleasing) to 5 (least) in each view.

This was repeated for the view of lips at rest (Fig. 6), the zoomed smile (Fig. 7), and the smile showing the lower two thirds of the face (Fig. 8)



Fig. 4 Smile showing lower two thirds of the face



Fig. 5 Images grouped according to maxillary anterior teeth, showing Subjects A to E. Subject order was randomised differently for each questionnaire



Fig. 6 Images grouped according to lips at rest, showing Subjects A to E. Subject order was randomised differently for each questionnaire



Fig. 7 Images grouped according to zoomed smile view, showing Subjects A to E. Subject order was randomised differently for each questionnaire



Fig. 8 Images grouped according to smile showing lower two thirds of the face. Subjects A to E shown. Subject order was randomised differently for each questionnaire



**Table 1** List of respondent demographic variables on the questionnaire concerning the ordinal scale and frequency of responses (Total N = 194, Percentage of total N)

Variable	Ordinal scale	Number	Percentage
Age	20–29 years	35	18.04%
	30–39 years	54	27.84%
	40–49 years	40	20.62%
	50–59 years	31	15.98%
	60+ years	34	17.53%
Gender	Male	77	39.69%
	Female	117	60.31%
Ancestry	Caucasian	135	69.59%
	Middle Eastern	1	0.52%
	Asian	52	26.80%
	Latino/Hispanic	1	0.52%
	Mixed	4	2.06%
	Other	4	2.06%
Professional Education	Primary school	1	0.52%
	Secondary education	32	16.49%
	Technical educational institution	38	19.59%
	University undergraduate	84	43.30%
	Post-graduate university	39	20.10%
Profession	Dentist	52	26.80%
	Non-dentist	142	73.20%
Colour vision Deficiency	No	188	96.91%
	Yes	6	3.09%

with each view shown on a separate page. The order of the photographs within each question were randomised for each respondent. However, the order of the questions was maintained in the same sequence so that they could not readily determine which teeth belonged to which lips until the smile view.

The survey was designed such that all questions must be answered prior to progressing to the next question. Previously answered questions could not be changed once submitted.

### Statistical analysis

Mean rank data was compiled, and Kendall's *W* was used to confirm reliability and test for inter-rater reliability and agreement.<sup>30–33</sup> *P* values of <0.05 were regarded as statistically significant. Calculations were completed using SPSS Statistics (version 23. IBM Corp. Armonk, New York, USA).

## Results

A total of 198 questionnaire responses were collected. Four responses were incomplete and excluded from the analysis, leaving 194 completed/valid responses. The frequency distribution of responses to the demographic background variables is shown in Table 1. There were 77 male participants, 117 female participants, 52 dentists and dental specialists, and 142 non-dentists.

Statistical calculations were conducted to determine if there was agreement between the participants in the way they ranked of each subject in each of the views: 'teeth', 'lips', 'zoomed smile', and 'lower smile'.

For the 'teeth' view, the 194 total respondents statistically agreed in the way they ranked aesthetic appeal where,  $W = 0.531$ ,  $P < 0.001$ .

The statistical analysis was repeated for the

different views of the: lips at rest ( $W = 0.668$ ,  $P < 0.001$ ), zoomed smile ( $W = 0.514$ ,  $P < 0.001$ ), and lower face ( $W = 0.651$ ,  $P < 0.001$ ). For all views, Kendall's *W* indicated statistically significant agreement. The results of the statistical calculations and Kendall's coefficient of concordance (*W*) can be seen in the Table 2. The *P*-value and Kendall's *W* was calculated further for the male, female, dentists, and non-dentist groups. Again, for all groups in all views it was found that there was statistically significant agreement in how the subjects were ranked.

### Anterior teeth

The mean rank scores were calculated for each subject in the anterior teeth view for males, females, dentists, non-dentists, and total respondents. These were then used to assign rank order to the subjects (Table 3). It was found that males, females, non-dentists and the total respondents agreed in the rank order of all subjects. The dentists group agreed with non-dentists for the most attractive three subjects' teeth, but disagreed on the last two.

### Lips at rest

All of the groups agreed that Subject A had the most attractive lips, with Subject E next and C having the least attractive lips. For all groups, there was no correlation between the ranking order of the subjects in the teeth view compared with the lips at rest.

### Smiles: zoomed and lower face

Almost all groups ranked the subjects' aesthetic appeal equal in both the zoomed smile and lower face view. The exception was by the dentist group, who ranked Subject A as 2 in the zoomed view but 1 in the lower face view.

### Ranking order

The median rank scores for all subjects by different groups in the various views can be seen in Table 3. For Subjects B and D, the zoomed smile and lower smile rank scores were the same as the calculated median rank. This would suggest that teeth and lips contribute with similar weighting to the aesthetic appeal of the smile. For Subject A, all groups ranked the teeth as 3 and lips as 1. However, the smile scores were almost consistently 1. The latter would suggest that the lips play a greater role than teeth in smile aesthetics. In contrast, Subject E received low rankings by all groups for teeth and high rankings for lips, but low overall smile rank. From this, it would be reasonable to infer that teeth have greater

influence than lips in smile aesthetics. Table 3 showed subject ranking in different views by the groups to be almost identical. Of note, the dentists group ranked four categories differently from the non-dentist population.

**Discussion**

The purpose of this study was to assess how the teeth and labial soft tissues contribute to the perceived aesthetics of a smile, and whether this changed depending on the field view, as well as to investigate the existence of any differences in the perception of aesthetic appeal between dentists, non-dentists, males and females respectively. The features that comprise a smile were collectively assessed. This approach is somewhat in contrast to other such studies that have investigated specific dental and labial aesthetic parameters such as: height to width ratio, tooth width ratio, angulation, gingival architecture, and buccal corridor.<sup>1,24,34-37</sup> As part of this investigation, each smile was divided into broad component groups of the teeth, lips, zoomed smile and smile showing the lower face. The impact of each part was assessed on the total perception of smile aesthetics.

The results of this study showed statistically significant agreement in the way attractiveness is perceived. There also appeared to be consistency amongst dentists, non-dentists, males and females in all the different views in the ranking of the subjects. The latter suggests that the concept of beauty may be measured and quantified scientifically, and not completely subjective to the eye of the beholder. These results are concurrent with numerous studies that suggest certain anatomical parameters may be regarded as being more universally attractive when expressed in certain ways.<sup>4,5,9,16-18,21,22,26,29,38-40</sup>

This investigation also showed that both the teeth and lips contribute significantly to the attractiveness of a smile. Within all respondent groups, the ranking order of teeth differed from the ranking order of the lips at rest. This was perhaps to be expected, as the retracted anterior view of the teeth did not show lips, and vice versa for the lips at rest. The respondents viewed each part with no knowledge of the other. However, when both teeth and lips were visible together in a smile, it was found that the smile ranking order was influenced by both components. This was consistent for both the zoomed smile and lower face smile. The results showed that for three subjects (B, C and

**Table 2 Statistically significant (P <0.05) associations between different views, respondent groups and Kendall's coefficient of concordance, W**

View	P-value	Statistical significance	Kendall's W
<b>Males (N = 77)</b>			
Anterior teeth	P <0.001	Yes, reject H0	0.476
Lips at rest	P <0.001	Yes, reject H0	0.586
Zoomed smile	P <0.001	Yes, reject H0	0.457
Lower face smile	P <0.001	Yes, reject H0	0.626
<b>Females (N = 117)</b>			
Anterior teeth	P <0.001	Yes, reject H0	0.57
Lips at rest	P <0.001	Yes, reject H0	0.746
Zoomed smile	P <0.001	Yes, reject H0	0.569
Lower face smile	P <0.001	Yes, reject H0	0.686
<b>Dentists (N = 52)</b>			
Anterior teeth	P <0.001	Yes, reject H0	0.715
Lips at rest	P <0.001	Yes, reject H0	0.75
Zoomed smile	P <0.001	Yes, reject H0	0.536
Lower face smile	P <0.001	Yes, reject H0	0.672
<b>Non-dentists (N = 142)</b>			
Anterior teeth	P <0.001	Yes, reject H0	0.492
Lips at rest	P <0.001	Yes, reject H0	0.641
Zoomed smile	P <0.001	Yes, reject H0	0.516
Lower face smile	P <0.001	Yes, reject H0	0.649
<b>All (N = 194)</b>			
Anterior teeth	P <0.001	Yes, reject H0	0.531
Lips at rest	P <0.001	Yes, reject H0	0.668
Zoomed smile	P <0.001	Yes, reject H0	0.514
Lower face smile	P <0.001	Yes, reject H0	0.651

D), the smiles approached the median ranking of the teeth and lips, suggesting that both teeth and lips had similar weighting on aesthetic appeal. However, for Subject A it seemed that the lips had a greater influence on the smile. In contrast, Subject E showed that teeth had a greater influence. This observed inconsistency may be due to the methodology of this study. Whilst ranking order differentiates aesthetic preference, it does not take into account the magnitude of differences.

Dentists have a tendency to place more emphasis on the teeth than lips when evaluating the zoomed smile compared to non-dentists. For two Subjects (A and B), the zoomed smile rankings were more influenced

by the teeth than lips when compared to the non-dentist groups (Table 3). However, in the lower face view where more of the face is visible, the dentist group ranked the same two subjects similar to the other groups. This would suggest that dentists may display a tendency towards placing a disproportionate weighting to teeth when they are in zoomed view. When the field of view is increased, the visual effects of the teeth are diminished by the face. This suggests that dentists changed their perception of beauty depending on the field of view. These findings support the observations of Springer *et al.*<sup>5</sup> who suggested that an increased view of the face diluted the effects of the teeth.

**Table 3** Mean rank scores for all subjects in all views for different groups. Group headings: M = males, F = females, De = dentists, N-De = non-dentists, To = total respondents, median = numeric average rank score between teeth & lips

Median Rank Scores	Group	Teeth	Lips	Median	Zoomed smile	Lower smile
Subject A	M	3	1	2	1	1
	F	3	1	2	1	1
	De	3	1	2	2	1
	N-De	3	1	2	1	1
	All	3	1	2	1	1
Subject B	M	1	4	2.5	2	2
	F	1	3	2	2	2
	De	1	3	2	1	2
	N-De	1	3	2	2	2
	All	1	3	2	2	2
Subject C	M	5	5	5	4	4
	F	5	5	5	5	5
	De	4	5	4.5	5	5
	N-De	5	5	5	5	4
	All	5	5	5	5	5
Subject D	M	2	3	2.5	3	3
	F	2	4	3	3	3
	De	2	4	3	3	3
	N-De	2	4	3	3	3
	All	2	4	3	3	3
Subject E	M	4	2	3	5	5
	F	4	2	3	4	4
	De	5	2	3.5	4	4
	N-De	4	2	3	4	5
	All	4	2	3	4	4

In contrast, Kokich *et al.*<sup>4</sup> and numerous other authors in the literature found no statistically significant influence of the face over the aesthetic features of a smile.<sup>1,18,24</sup> The results of this study also support this concept, as there were no changes in ranking for the male, female and total respondent groups when viewing the results of the zoomed smile versus that of the lower face smile.

It seems clear that there are potential differences in the way dentists and non-dentists evaluate the aesthetics of a smile. This is true when dentists are focused on viewing smile aesthetics from a close up perspective. It should also be remembered that the viewing perspective may potentially change what dentists see as aesthetically pleasing and differ from what the patient perceives. Whilst the aesthetic dentist

is familiar with working in minute detail up close, indeed it is good practice to step back and view the patient from afar for a different perspective.

The ranking order of all subjects when viewing the teeth were the same for all groups except dentists. Dentists preferred the appearance of Subject C over Subject E, where this was reversed for the other groups. Subject E's teeth show important dental aesthetic parameters described by the literature to be unfavourable, including poor crown to root ratio (96%), and midline cant.<sup>24,36,41,42,43</sup> The teeth of Subject C show very minor incisal edge chipping, which may be perceived as more important to laypersons.

Beauty is a complex phenomenon and this is reflected in the results. Subject C was

ranked fifth by males in both teeth and lips view, yet when the two views were combined in the zoomed and lower face smile the ranking improved to fourth. Similarly, Subject E was ranked fourth for teeth and second for lips, yet ranked fifth for both smiles by males. It may be inferred that perceived attractiveness of lips at rest may not directly correlate with the smile due to the dynamic nature of muscle and soft tissue movement. Subject E has a complex smile type with highly activated elevator and depressor facial muscle whereas Subject C has a commissure smile type with more gentle elevator muscle action. Despite Liang *et al.*<sup>44</sup> suggesting that smile types did not necessarily affect attractiveness, the results here suggest otherwise. Further study into this area is appropriate.

## Conclusion

According to the results of the present study, both the lips and teeth seem to contribute to the aesthetic appeal of a smile, and may have a similar magnitude of influence. Whether or not one aspect has more weight on the aesthetic outcome, depends on the patient. Due to this, it is important and clinically relevant to assess the smile in its entirety rather than 'teeth only' for the aesthetically driven patient. The clinician should therefore give due consideration to the lips and soft tissues as well as the teeth for treatment planning aesthetic improvements in the smile. Given the influence of the lips and smile dynamics on the aesthetic perception of a smile, further research into the effect of adjunctive treatments for the lips and soft tissues on the perceived aesthetics of a smile should be considered.

Dentists are more likely influenced by teeth when evaluating a smile up close compared to non-dentists. However, the results of this investigation show that when looking at the lower face to evaluate the smile, this bias is nullified. This is a relevant aspect to note, so that the clinician can truly understand what the patient sees.

Where the common adage states that 'beauty is in the eye of the beholder', for dentists it may be more appropriately phrased: 'aesthetics is in the perspective of the viewer'. It may be prudent for the aesthetic dentist to assess the smile by looking at more of the face to achieve a viewpoint more similar to that of the patient.

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