The influence of maxillary gingival exposure on dental attractiveness ratings

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SUMMARY This study examined the influence of maxillary gingival display on the attractiveness ratings awarded by lay people. One hundred and twenty university students (94 females, 26 males) were shown seven photographs of a male and seven photographs of a female subject, each with varying levels of gingival display ranging from –2 to +4 mm. Attractiveness ratings were recorded on a 10-point numerical scale for each of the photographs. The photographs where the full height of the incisors were revealed and no gingival tissue was visible (0 mm of gingiva) were rated as the most attractive. Gingival display of more than 2 mm was rated as progressively less attractive. Linear regression analysis revealed that those students who had received orthodontic treatment rated the photographs representing the female student as more attractive than those representing the male ($P < 0.05$).

Introduction

Excessive gingival display or 'gummy smile' can severely detract from an otherwise pleasing smile (Fowler, 1999). Although it has been suggested that no more than 2 mm of the maxillary gingivae should be visible when a person smiles (Fricker, 1998), there is no scientific evidence to support this view. A gummy smile is caused by a variable combination of factors including vertical maxillary excess, increased overjet, and increased overbite (Allen, 1988). A short upper lip and short incisor crown length have been reported to be contributory factors (Allen, 1988), but other authors have found that these factors are not important (Peck *et al.*, 1992a). Females are twice as likely as males to have gummy smiles (Tjan *et al.*, 1984).

In mild gummy smile cases, the correction of an associated malocclusion is often completed using conventional orthodontic treatment. A reduction in the amount of gingival display is rarely achieved, but the orthodontist normally uses non-extrusive mechanics to limit any exacerbation of the gummy smile. The most effective method for the correction of a gummy smile is orthognathic surgery (Peck *et al.*, 1992a). However, the clinician has to rely on anecdotal evidence when deciding on the correct amount of gingival exposure.

Heightened awareness of the problem of a gummy smile has been driven by the profession's desire to address the aesthetic and functional needs of the patient (Robbins, 1999). However, what is beautiful or attractive to the orthodontist or surgeon based on their experience and/or training may not agree with what the patient or other individuals think is beautiful or attractive (Giddon, 1983). Previous studies have found that dental professionals are conditioned to take an overly critical view of any deviation from normal occlusion (Shaw *et al.*, 1975; Prahl-Andersen, 1978). Although many orthodontists and surgeons see a gummy smile as undesirable (Peck *et al.*, 1992a), patients may not perceive it as a problem. Very little information is available regarding the layperson's perception of dental attractiveness and in particular the influence of the amount of gingival display.

The current study was designed to determine the level of gingival display that is considered most attractive by a group of lay people.

Methods

One hundred and twenty first-year social science students were asked to rate the attractiveness of a number of smiles presented in a series of colour photographs. The images were derived from two master photographs, one of a male subject and one of a female subject. Both subjects were aged 22 years.

The original photographs of the male and female subjects had 3 mm of gingival exposure above the central incisors (Figures 1 and 2). These photographs were scanned onto a desktop computer using a high-resolution colour scanner (Epson GT-9600, Seiko Epson Corporation, Nagano, Japan). Image processing software (Paint Shop Pro, JASC Inc., Eden Prairie, MN, USA) was then used to manipulate the amount of gingival display of the male and female subject thereby producing a series of images representing –2 mm (2 mm of incisor coverage by upper lip), –1 mm (1 mm of incisor coverage),

0, +1, +2, +3, and +4 mm of gingiva. A total of 14 photographs (seven male and seven female) were created. The images were saved as a presentation in Microsoft PowerPoint 97 (Microsoft Corporation, Redmond, WA, USA).

The presentation was projected onto a 15×10 m screen in a lecture theatre. The images were displayed in a random order for 10 seconds each with a 5-second interval between images. During the 5-second interval a black screen was presented.

The students were told that the photographs represented the same male and female subject, but the dental appearance differed in each photograph. Subjects were asked to rate the attractiveness of each smile by circling the appropriate number on a 10-point numerical scale, where 1 represented a very unattractive smile and 10 a very attractive smile.

Each student was also asked about their personal experience of orthodontic treatment: if they had ever received orthodontic treatment, if they felt they needed orthodontic treatment, and if anyone in their family had received orthodontic treatment. The students also rated the attractiveness of their own smile as very unattractive, unattractive, attractive, or very

Figure 1 Original unmodified image of male subject showing 3 mm of gingival display.

Figure 2 Original unmodified image of female subject showing 3 mm of gingival display.

attractive, and they rated the importance which they attributed to having a nice smile as very unimportant, unimportant, important, or very important. The students were asked not to confer when completing the questionnaires.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA). Backward stepwise linear regression analysis was used to determine the relationship between the students' ratings of the photographs and the characteristics of the students. The chi-square test was used for tests of association involving categorical data.

Results

The sample comprised 94 females (78.3 per cent) and 26 males (21.7 per cent). The mean age was 19.8 years (95 per cent confidence interval 19.24–20.46). A small number of participants returned incomplete questionnaires ($n = 14$), which usually involved failure to rate one or two of the photographs.

Table 1 shows the characteristics of the sample. Fifty-four (45 per cent) of the sample reported that they had received orthodontic treatment, while 63 (52.5 per cent) had not. Twenty-five (20.8 per cent) of the sample

felt they needed orthodontic treatment now. Fifty-eight (48.3 per cent) subjects reported that a family member had received orthodontic treatment.

Stepwise backward linear regression analysis was used with the subjects' mean rating of the attractiveness of the photographs entered as the dependent variable. Order of presentation of photographs, gender of the subject in the photographs, and the amount of gingival display were included as the independent variables. Initial analysis suggested a quadratic response to the photographs potentially maximizing at 0 mm of gingival exposure. The level of gingival display was therefore entered both as a linear and squared term. Stepwise backward linear regression analysis revealed that the order of presentation of the photographs had an effect on the students' ratings of the photographs ($P < 0.001$) with the photographs presented later in the series being rated as less attractive than those presented earlier in the series (Table 2).

Table 2 also shows that the photographs representing the female subject were rated as significantly more attractive than those representing the male ($P < 0.001$).

Analysis revealed a symmetrical reduction in attractiveness that followed a quadratic

Table 1 Characteristics of the sample.

	Yes n (%)	No n (%)	Missing n (%)
Have you ever received orthodontic treatment?	54 (45.0)	63 (52.5)	3 (2.5)
Do you think you need orthodontic treatment now?	25 (20.8)	93 (77.5)	2 (1.7)
Has anyone in your family ever received orthodontic treatment?	58 (48.3)	60 (50.0)	2 (1.7)

Table 2 Linear regression model showing relationship between ratings of attractiveness and gender of model, order of presentation, and amount of gingival display.

	Regression coefficient	Standard error	t	Significance
Gender of model (female versus male)	–1.82	0.070	–26.0	$P < 0.001$
Order of presentation (1 to 14)	–0.0501	0.009	–5.45	$P < 0.001$
Amount of gingival display squared (–2 to +4 mm)	–0.0380	0.007	–5.43	$P < 0.001$

relationship with little penalty in moving from 0 to 2 mm of gingival exposure, but with an increasing deficit beyond this. The quadratic term therefore remained in the analysis. The photographs of subjects with 0 mm of gingiva were considered to be the most attractive. However, the photographs representing 3 and 4 mm of gingiva were considered to be progressively less attractive. A plot of the residuals from the model showed that they were normally distributed, supporting the underlying assumptions of the analysis.

Order of presentation was entered into the regression equation (of mean scores) as a linear term and was found to be statistically significant. The coefficient obtained was then used to adjust every case to what would have been expected if an average order of presentation of 7.5 had prevailed (i.e. the average of first = 1 and last = 14). Since the linear regression analysis showed an effect due to the order of presentation of the photographs and also for the gender of the subject in the photograph, expected scores were calculated, which accounted for the order and gender effect thereby giving the best estimate (Figure 3).

Linear regression was also used to determine whether any of the students' characteristics had influenced their scoring. An initial factor analysis strongly suggested that the photographs of the male and female subject should be analysed separately. First, the mean scores of

attractiveness for the photographs of the male subject were entered as the dependent variable into the regression analysis. Independent variables included age, gender, whether or not participants had ever received orthodontic treatment, and if they felt they needed treatment. The importance of having a nice smile and the students' opinion regarding the attractiveness or otherwise of their own smile were also entered into the analysis. No significant relationship was found between participants' ratings of the attractiveness of the photographs of the male subject and any of the independent variables. Secondly, a similar linear regression was conducted in relation to the photographs representing the female subject. In this case, a significant relationship was found for the ratings of the photographs among those subjects who had received orthodontic treatment. The differential in ratings between female and male subject was significantly higher amongst those who had received orthodontic treatment ($P < 0.05$). This finding further confirmed the need to dichotimize the analysis on the basis of gender.

One hundred and one subjects (84.2 per cent) thought it was important or very important to have a nice smile. Eighty-five (71 per cent) students rated their own smile as attractive or very attractive. Further analysis revealed no significant association between subjects who rated their own smile as attractive and whether they had had orthodontic treatment (Chi square = 0.294, degrees of freedom = 1, $P = 0.74$).
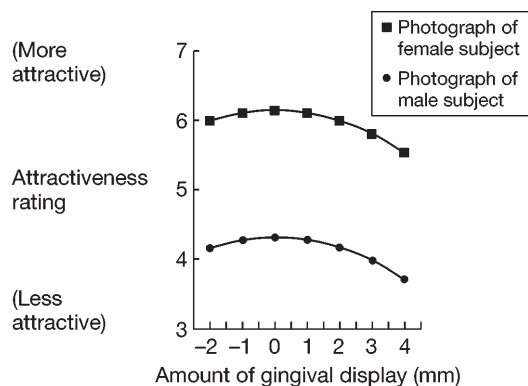
Discussion

The influence of the amount of gingival display on the attractiveness of the smile has not been previously investigated in a scientifically meaningful way. Excessive gingival display or gummy smile is a common feature, which has been reported to affect 7 per cent of young adult males and 14 per cent of young adult females (Tjan *et al*., 1984). Peck *et al*. (1992a) reported that 26 per cent of a sample of orthodontic patients displayed 2 mm or more of maxillary gingiva when smiling. While surgical treatment of a gummy smile is possible using maxillary impaction techniques, there are currently no

Figure 3 Expected attractiveness ratings for the male and female subject with varying amounts of gingival display (adjusted for order effect and gender of model).

scientifically based treatment goals for the surgeon and orthodontist.

The present study controlled for the potential confounding influence of background facial appearance by using only two original images (one male and one female), which were modified, rather than using a series of images of different males and females. The photographs were of young adults and the judges were also young adults, and as such represented the peer group of the two subjects. The results showed that the group of judges were dentally aware with 84 per cent of subjects rating an attractive smile as important or very important.

Gingival exposure during smiling was regarded as unattractive in both the male and female images. Further analysis of the results showed that the ratings were symmetrical around 0 mm of gingival exposure and that the range of rating scores awarded between –2 mm and +2 mm was relatively small. However, with 3 mm or more of gingival display, the attractiveness ratings reduced substantially. Extrapolating these results to the clinical situation it is suggested that the acceptable range for gingival exposure lies between 0 and 2 mm with an ideal of no gingival exposure.

Peck *et al*. (1992b) noted that on average a young adult female displays 5.3 mm of the upper incisor crown when the upper lip is relaxed, while an adult male will display 4.7 mm of the central incisors. In some patients, a gummy smile may be due to a hyperactive upper lip (Robbins, 1999). Surgical correction of this type of gummy smile where there is a normal degree of upper incisor exposure in relaxed lip posture could result in a reduction in the amount of incisor exposure at rest. Therefore, the suggested treatment goal for gingival exposure during smiling should be applied with caution in patients with a normal pre-treatment resting lip position. However, this combination of excessive gingival display during smiling together with normal incisor display with the upper lip relaxed appears to be uncommon. Peck *et al*. (1992a) compared 27 subjects with more than 2 mm of smiling gingival exposure with an unselected reference group of 88 orthodontic patients. They found that subjects with excessive gingival exposure during smiling also had an increased upper incisor

exposure at rest. Nonetheless, when assessing patients with a gummy smile it would be prudent to evaluate carefully the relationship between the upper lip and the upper incisors in both relaxed and active positions.

It is difficult to explain why those subjects who had received orthodontic treatment rated the female photograph as more attractive. It might be that individuals who have received orthodontic treatment are more sensitive to differences in dentofacial attractiveness than those who have not received orthodontic treatment.

Conclusions

This study found that the attractiveness of a person's smile is influenced by the amount of maxillary gingival exposure. More attractive ratings were awarded to those smiles where the amount of gingival exposure was within the range of 0–2 mm.

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