

The influence of dental to facial midline discrepancies on dental attractiveness ratings

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SUMMARY This study investigated the perception of discrepancies between the dental and facial midlines by orthodontists and young laypeople. A smiling photograph of a young adult female was modified by moving the dental midline relative to the facial midline. Twenty orthodontists (10 males and 10 females) and 20 young adult laypeople (10 males and 10 females) scored the attractiveness of the smile on the original image and each of the modified images using a 10-point scale.

The results showed that the images were scored as less attractive both by the orthodontists and laypeople as the size of the dental to facial midline discrepancy increased. The scores were unrelated to the direction of the midline discrepancy (left or right) or to the gender of the judge. Further analysis revealed that the orthodontists were more sensitive than laypeople to small discrepancies between the dental and facial midline. It was estimated that the probability of a layperson recording a less favourable attractiveness score when there was a 2-mm discrepancy between the dental and facial midlines was 56 per cent.

Introduction

Achieving coincident mandibular and maxillary dental midlines is a well-established objective in orthodontic treatment. Coincident dental midlines are an important component of functional occlusion and provide a useful guide to the clinician in establishing good buccal inter-digitation (Proffit and Fields, 1993). It is also generally accepted that the maxillary dental midline should coincide with the facial midline and it has been reported that patients tend to relate their maxillary dental midline to their upper lip (Tjan *et al.*, 1984). A symmetrical dental arrangement is thought to be an important component of an attractive smile (Hulsey, 1970; Lombardi, 1973; Brisman, 1980; Jerrold and Lowenstein, 1990) and asymmetry can impair dental aesthetics (Bishara *et al.*, 1994). Tjan *et al.* (1984) claimed that patients readily recognized an incorrect midline in a smile, but they provided no scientific evidence to support this conclusion.

In clinical practice the orthodontist often encounters malocclusions where discrepancies

exist between the dental and facial midlines. In certain cases, correction of a dental to facial midline discrepancy is not straightforward, and may increase both the complexity and duration of orthodontic treatment. The decision to extract teeth for midline correction only can be difficult, especially if the discrepancy between the dental and facial midlines is small. Unfortunately, the orthodontic literature provides no guidance to the clinician in resolving this problem.

Several studies have investigated the impact of dental aesthetics on overall facial attractiveness (Shaw *et al.*, 1985; Phillips *et al.*, 1992; Mackley, 1993). However, most of these previous studies were flawed by virtue of their failure to control for the influence of variations in background facial attractiveness. In the study described in this paper, the influence of dental to facial midline discrepancies on overall facial attractiveness was investigated. The confounding influence of variations in background facial appearance was avoided by using modern computer-imaging techniques. Attractiveness ratings were awarded



Figure 1 (a) Coincident dental and facial midlines. (b) Coincident dental and facial midlines indicated.

by orthodontists and by laypeople. The overall aim of the study was to identify the threshold where dental to facial midline discrepancy begins to impair dentofacial aesthetics.

Materials and methods

A facial photograph was chosen of a female who was smiling and who had good dental alignment and tooth size symmetry (Figure 1). The photograph was scanned using a high-resolution colour scanner (OpticPro 9630P, Plustek Electronics GmbH, Hamburg, Germany) connected to a desktop personal computer. Using image processing software (Paint Shop Pro, JASC Inc., Eden Prairie, MN, USA) the digital image was manipulated to produce a series of images with the dental midline moved to the right or left of the middle of the upper lip philtrum by 1, 2, 4, 6 or 8 mm (Figures 2 and 3). Only the dentition was altered when modifying the images, with the soft tissues of the lips being unaffected. The images were then copied to 35-mm slides for projection.

The judges who evaluated the images comprised a group of 20 non-dental undergraduate students (10 males and 10 females, mean ages 18.4 and 19 years, respectively) and 20 orthodontists (10 males and 10 females, mean ages

44.7 and 40.3 years, respectively). Individual judges were shown the 11 images (including an image with coincident dental and facial midlines) sequentially in a random order for 10 seconds each using a portable desktop viewing screen. The judges were told that they would be shown a series of photographs of the same person, but the dental appearance was not the same in each image. They were requested to score the attractiveness of the smile in each image using a 10-point numerical dental attractiveness scale where a score of 1 represented 'very unattractive' and 10 represented 'very attractive'.

Statistical analysis

The scores were standardized to remove the inter-examiner variation that exists due to the fact that some judges will use the full range of a rating scale, while others will tend to award scores which extend over a small section of the scale. This standardization did not, however, remove differential effects between groups of judges. Standardized scores were calculated for each judge as follows:

$$\text{Standardized score} = \frac{(\text{score} - \text{mean})}{\text{standard deviation}}$$



Figure 2 (a) Modified image with 2-mm dental to facial midline discrepancy. (b) 2-mm discrepancy. Short line indicates dental midline and long line facial midline.



Figure 3 (a) Modified image with 6-mm dental to facial midline discrepancy. (b) 6-mm discrepancy. Short line indicates dental midline and long line facial midline.

These standardized scores were then subjected to a multiple regression analysis with the following explanatory variables (and levels): the size of midline discrepancy (0, 1, 2, 4, 6, 8 mm), the side of midline discrepancy (left or right), the type

of judge (lay person or orthodontist) and the gender of the judge.

The multiple regression analysis provides estimates of the coefficients β and the residual standard deviations σ . The coefficients β can be

Table 1 Attractiveness scores awarded by judges.

Discrepancy	Female laypeople (<i>n</i> = 10)		Male laypeople (<i>n</i> = 10)		Female orthodontists (<i>n</i> = 10)		Male orthodontists (<i>n</i> = 10)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Left 8 mm	4.1	1.5	3.9	1.4	2.7	1.2	3.4	2.2
Left 6 mm	3.9	1.7	3.9	1.7	3.2	1.5	2.9	1.4
Left 4 mm	4.9	1.3	4.5	1.6	4.4	1.1	3.7	1.0
Left 2 mm	6.2	1.5	5.7	1.4	5.8	1.4	6.6	1.5
Left 1 mm	7.1	1.0	5.6	2.1	7.0	1.6	7.3	1.2
0 mm	6.7	1.3	7.2	1.5	7.0	1.4	7.4	1.7
Right 1 mm	7.0	1.3	6.8	1.0	6.5	2.0	6.8	1.5
Right 2 mm	6.0	0.5	6.4	1.7	5.6	1.2	5.5	1.2
Right 4 mm	4.8	0.9	5.2	1.0	4.1	1.5	4.8	2.2
Right 6 mm	4.2	1.6	3.8	1.0	3.1	1.1	3.2	1.3
Right 8 mm	3.7	1.0	4.3	1.7	2.7	1.2	2.8	1.1

regarded as a measure of how far in standardized terms the distribution of judges' scores depart from what would be expected in an ideal situation (i.e. where the dental and facial midlines were coincident). Therefore, a large coefficient for a particular image indicates that the judges rated that image as less attractive than another image with a smaller coefficient. The standard deviations σ are a measure of how agreed individual judges are on the estimates of coefficients and, therefore, of inter-judge reproducibility. Two assumptions are made. First, that the distribution of standardized scores, within a single group of judges and size of midline discrepancy, is assumed to be normally distributed. Secondly, it is assumed that any judge who can actually tell that the image presented is less attractive than one with coincident dental and facial midlines will score the image as less attractive. These assumptions allow the estimation of the probability of a judge drawn at random detecting a difference at a particular distance of dental to facial midline discrepancy. The probabilities are estimated as:

$$\text{Probability} = 1 - 2 * \text{prob} (z > \beta/\sigma)$$

where β is the coefficient for that distance and type of judge (orthodontist or layperson), σ is the standard deviation associated with that group

of judges' scores and z is the standard normal statistic.

Results

The attractiveness scores are summarized in Table 1, and show that the images were judged to be less attractive as the size of the discrepancy between the dental and facial midlines increased.

Multiple regression analysis of the standardized scores revealed that the direction of the midline discrepancy (left or right) and the gender of the judge were not statistically significant, and these variables were removed from further analysis. However, the type of judge was found to be significant by the multiple regression analysis. Therefore, further analysis involved the independent evaluation of the data from these two groups. The coefficients and standard deviations are shown in Table 2. The orthodontists had larger coefficients and smaller standard deviations, indicating that they were more sensitive in their ability to detect changes in dental attractiveness than the laypeople. The size of the standard deviations σ in both the orthodontist and laypeople groups indicated a satisfactory level of reproducibility in both groups.

The estimated probabilities of a randomly selected judge rating an image as less attractive than one with coincident midlines are shown in

Table 2 Coefficients of difference in standardized scores from ideal.

Discrepancy (mm)	Coefficient β orthodontists	Coefficient β laypeople
0	0.00	0.00
1	0.15	0.16
2	0.64	0.53
4	1.49	1.22
6	2.05	1.81
8	2.20	1.79
Standard deviation σ	0.47	0.68

Table 3 Probability of a randomly selected judge detecting a dental to facial midline discrepancy.

Discrepancy (mm)	Probability orthodontists	Probability laypeople
0	0.00	0.00
1	0.26	0.19
2	0.83	0.56
4	1.00	0.93
6	1.00	0.99
8	1.00	0.99

Table 3. When the images with a 2-mm discrepancy were scored by the judges, there was a predicted 83 per cent probability that a randomly selected orthodontist would rate the dentition as less attractive than when the dental and facial midlines were coincident. The probability of a randomly selected layperson rating an image with a 2-mm dental to facial midline discrepancy as less attractive than the image with coincident midlines was 56 per cent. With a 4-mm dental to facial midline discrepancy, the predicted probabilities for rating the image as less attractive than one with coincident dental and facial midlines were 100 per cent for orthodontists and 93 per cent for laypeople.

Discussion

The present study aimed to examine the impact on dentofacial aesthetics of moving the dental midline away from the facial midline. It is

recognized that changes in facial features other than the arrangement of the teeth may also affect dentofacial attractiveness. To minimize these possible confounding influences, the current study used the novel approach of generating multiple images of the same person with the same facial expression, but with the distance between the dental and facial midlines altered.

Dental attractiveness was rated by the judges using a 10-point numerical scale. This scale was not intended to be used as a clinical tool, but it was designed to simply allow the judges to express their perception of the relative attractiveness of each of the images. Therefore, no calibration of judges was carried out, although the results were standardized to allow comparison of the scores awarded by the different judges. The standardized results revealed that for both orthodontists and laypeople, progressively less favourable dental aesthetic ratings were awarded as the dental midline was moved further away from the facial midline indicating that the scale used was a valid method of evaluating perceptions of dentofacial attractiveness. The study was designed so that each size of midline discrepancy (with the exception of 0 mm) was assessed twice by each judge (once to the left side and once to the right side). As the direction of the discrepancy (left or right) was not statistically significant and the standard deviations σ were small in both the orthodontist and laypeople groups, this indicated an acceptable level of reproducibility in both groups.

The precise influence of dental to facial midline discrepancies has not been studied previously. However, several investigations have evaluated the influence of gender and training on overall dentofacial attractiveness ratings. In one study, it was found that trainee orthodontists gave higher scores when rating overall dentofacial attractiveness than dental undergraduates or laypeople (Phillips *et al.*, 1992). In the present study, the orthodontists were found to be more critical of dental aesthetics than the lay judges when the midline discrepancies were small. However, as the size of the midline discrepancy was increased to 4 mm or more, both groups showed a similar degree of sensitivity to the deterioration in dentofacial aesthetics.

In another study in which dentofacial appearance was rated by young adults, no significant difference was found between males and females in the scores that they awarded (Shaw *et al.*, 1985). Similarly, in the present investigation, no gender differences in scoring were noted for either the orthodontists or the lay judges.

In clinical terms, it is important to know what size of dental to facial midline discrepancy is acceptable and unlikely to adversely affect dentofacial aesthetics. In making this judgement, the aesthetic ratings awarded by laypeople are likely to be more relevant than those awarded by orthodontists. This study and previous investigations have revealed that, by virtue of their training and experience, orthodontists are more sensitive to aberrations in dentofacial appearance than the general public.

The probability of a randomly selected layperson identifying a reduction in the quality of the dentofacial appearance when the difference between the facial and dental midlines was increased to 2 mm was 56 per cent. This appears to indicate that even minor midline discrepancies have an influence on dentofacial aesthetics. Midline discrepancies of less than 2 mm appear to have a less noticeable impact on dentofacial aesthetics. Although many factors must be considered by the orthodontist when treating a malocclusion, the results of this study indicate that discrepancies of 2 mm or more between the facial and dental midlines will have a negative effect on dentofacial aesthetics.

Conclusions

In a clinical context, the current findings demonstrate that dental to facial midline discrepancies are a factor in reducing the attractiveness of the smile. Discrepancies of 2 mm or more are likely to be noticed by 83 per cent of orthodontists and more than 56 per cent of young laypeople. Orthodontic treatment objectives should include correction of the dental midline to within 2 mm of the facial midline where possible.

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