

Perceptions of midline deviations among different facial types

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Introduction: The correction of a deviated midline can involve complicated mechanics and a protracted treatment. The threshold below which midline deviations are considered acceptable might depend on multiple factors. The objective of this study was to evaluate the effect of facial type on laypersons' perceptions of various degrees of midline deviation. **Methods:** Smiling photographs of male and female subjects were altered to create 3 facial type variations (euryprosopic, mesoprosopic, and leptoprosopic) and deviations in the midline ranging from 0.0 to 4.0 mm. Evaluators rated the overall attractiveness and acceptability of each photograph. **Results:** Data were collected from 160 raters. The overall threshold for the acceptability of a midline deviation was 2.92 ± 1.10 mm, with the threshold for the male subject significantly lower than that for the female subject. The euryprosopic facial type showed no decrease in mean attractiveness until the deviations were 2 mm or more. All other facial types were rated as decreasingly attractive from 1 mm onward. Among all facial types, the attractiveness of the male subject was only affected at deviations of 2 mm or greater; for the female subject, the attractiveness scores were significantly decreased at 1 mm. The mesoprosopic facial type was most attractive for the male subject but was the least attractive for the female subject. **Conclusions:** Facial type and sex may affect the thresholds at which a midline deviation is detected and above which a midline deviation is considered unacceptable. Both the euryprosopic facial type and male sex were associated with higher levels of attractiveness at relatively small levels of deviations. (Am J Orthod Dentofacial Orthop 2014;145:249-55)

Trends in the literature have indicated a gradual shift in orthodontics from the Angle paradigm—focused primarily on ideal static occlusion and anteroposterior jaw relationship—to one that emphasizes the soft tissues and facial esthetics.¹ This evolution is certainly justified, since research has shown that facial appearance might adversely affect one's self-perception and body image.² Likewise, studies have demonstrated that poor dental esthetics can have a detrimental effect on the way others perceive one's personality, intelligence, ability, motives, and other attributes.³

With the focus moving toward overall facial esthetics, the evaluation of patients' frontal symmetry is an increasingly important factor in orthodontic diagnosis. Unlike a patient's profile, it is a perspective that he or

she sees regularly, and it is judged by others during face-to-face encounters.⁴ Of all the dental and occlusal asymmetries, midline discrepancies might be the most obvious to the patient.⁵

Achieving coincidence between the maxillary dental and facial midlines can be particularly vexing. Virtually all mechanisms for midline correction have limitations and biomechanical side effects that must be controlled. Furthermore, complete correction of the midline can result in a substantially protracted treatment, single or multi-tooth extractions, cumbersome mechanics and wire manipulations, and, in the case of elastics, strict patient compliance to a veritable "cat's cradle" of rubber bands.

Therefore, the orthodontist must justify the burden of treatment when determining whether to correct or accept a maxillary midline deviation. Ultimately, the most important factor in that decision might be the degree to which the deviation negatively affects perceived dental and facial esthetics.

Numerous studies have attempted to determine how dental midline deviations affect perceptions of facial attractiveness and the threshold at which midline deviations become esthetically unacceptable. Orthodontists evaluate the midline position with the greatest discrimination, followed by dentists.^{4,6-8} The maximum amounts of deviation tolerated by orthodontists before

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adversely affecting smile esthetics have been reported at 1,⁷ 2,^{4,8,9} and 4 mm.⁶

Laypeople, however, are the ultimate arbiters of a patient's smile. Hence, it is important to consider how the lay observer, rather than dental professionals, perceives midline deviations. At least 5 studies have found that midline deviations less than approximately 2 mm are acceptable to laypersons.^{4,8-11} Ker et al¹² and Springer et al¹³ found an acceptance threshold of approximately 3 mm. Kokich et al⁶ and Pinho et al,⁷ on the other hand, found that midline deviations of 4 mm or less are generally acceptable.

The process of symmetry detection is a focus of research in the cognitive sciences. Humans are sensitive to bilateral symmetry in visual patterns, particularly along a vertically oriented axis. The type of symmetry important for discerning differences between the left and right sides of an object, such as the face, is known as "mirror symmetry." Several studies have described possible models for how mirror symmetry is processed. Although the precise mechanisms are unclear, some general principles are common: identification of the axis of symmetry, detection of prominent features of the object or image, and comparison of those features over a distance. The detection of mirror symmetry mostly depends on the features' distance from the axis; however, the edges of the image are also important.^{11,14}

Zhang et al¹¹ were the first to relate the process of human symmetry detection to the orthodontic research of facial asymmetries. They found that a person's facial shape may affect a layperson's perception of a midline deviation and the threshold below which deviations are considered acceptable.

In general, the head is characterized by 3 basic shapes: dolichocephalic, brachycephalic, and mesocephalic. The dolichocephalic head form is characterized as long and narrow, and the brachycephalic head form is considered to be wide, short, and globular. The topography of the face, when viewed frontally, is established as a function of these head forms. The dolichocephalic head form gives rise to a face that is narrow, long, and protrusive; this is referred to as the "leptoprosopic" facial type. The brachycephalic head form, on the other hand, establishes the "euryprosopic" face that is broader, shorter, and less protrusive. The facial form between these is commonly called "mesoprosopic."¹⁵

The aim of this study was to evaluate how smiles are perceived when coupled with changes in midline deviation and facial type. Bearing in mind the challenges and limitations of midline correction, our ultimate goal was to aid clinicians in determining which patients might benefit from full correction of a midline

deviation and which might not benefit, as it would not change the overall perception of the patient's facial attractiveness.

MATERIAL AND METHODS

One male subject and one female subject were sought among the residents at the postgraduate orthodontic residency program at Seton Hill University, Greensburg, Pa. The requirements for these 2 subjects were the following characteristics: (1) adequate tooth display upon smiling (100% maxillary incisor display), (2) general frontal symmetry, (3) no obvious dental abnormalities or irregularities (crowding or spacing), (4) a facial pattern considered to be mesoprosopic, and (5) age between 18 and 29 years.

The facial type of the subjects was determined using the facial index, which is based on the ratio of bizygomatic width to anterior face height. Bizygomatic width is defined as the distance between the most laterally positioned points on the zygomatic arches; nasion is the soft-tissue point at which the frontonasal suture intersects the midsagittal plane; and gnathion is the most inferior point on the lower border of the mandible. The formula used to calculate the facial index (FI) is as follows.

$$FI = \frac{\text{nasion-gnathion distance}}{\text{bizygomatic width}} \times 100$$

Designation of the subjects' facial type as mesoprosopic was confirmed according to the following standards: euryprosopic, ≤ 83.9 ; mesoprosopic, 84.0-87.9; and leptoprosopic, ≥ 88.0 .¹⁶

Once a man and a woman meeting all inclusion criteria were identified and agreed to participate in the study, frontal smiling photographs were obtained of each in natural head position. The photographs were altered using Adobe Photoshop (CS5; Adobe Systems, San Jose, Calif) to introduce 2 additional independent variables. First, each subject's midline was altered to deviate to the left and right in increments of 1.0 mm, up to 4.0 mm. The patient's facial midline was defined by the center of the philtrum and the nadir of the cupid's bow of the upper lip.^{12,17} After each midline modification, the dentition was morphed to maintain equal buccal corridors on the left and right sides in each photograph.

After alteration of the dental midline, each image was modified to change each subject's facial type (Fig 1). In each sex and midline combination, euryprosopic and leptoprosopic variations were created according to the facial index ranges.¹⁶ We used a factorial design engineering a total of 54 distinct photographs.

The evaluators were drawn from the student population at Seton Hill University and consisted of undergraduate students between the ages of 18 and 29. The

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