

RESEARCH ARTICLE

Layperson's perception of axial midline angulation in asymmetric faces

Bruno Pereira Silva¹  | Emilio Jiménez-Castellanos² | Kyle Stanley³ | Eduardo Mahn⁴ | Christian Coachman⁵ | Sivan Finkel⁶

¹Clinical Professor Department of Periodontology School of Dentistry, University of Seville, Sevilla, Spain

²Professor of Prosthodontics, School of Dentistry, University of Seville, Sevilla, Spain

³Division of Restorative Sciences, Adjunct Faculty, Hermann Ostrow School of Dentistry of USC, Los Angeles, California

⁴Research Department, Faculty of Dentistry, Universidad de los Andes, Santiago, Chile

⁵Private Practice, Sao Paulo, Brazil

⁶Adjunct Clinical Instructor, Department of Cariology and Comprehensive Care, New York University College of Dentistry, New York, NY

Correspondence

Dr Bruno Pereira da Silva, Departamento de Periodoncia, Facultad de Odontología, Calle Avicena, 41009, Sevilla, España.
Email: brunopereira.doc@gmail.com

Abstract

Objective: Asymmetric facial features such as a deviated nose and chin are common and known to affect smile esthetics. When presented with these asymmetries, the clinician must consider the impact they will have on the smile design parameters—especially the placement and angulation of the dental midline, which is a common starting point for a case involving smile design. The purpose of this article is to determine if the nose and chin deviations affect the perception of dental midline angulation.

Materials and Methods: An asymmetric facial model (AFM) was created from a digital symmetric facial model, used in a previous study by digitally deviating the nose and chin to the same side. Eight different pictures of this AFM were created, each with different degrees of maxillary midline angulation (both in and against the direction of the deviated nose and chin). Using a visual Likert scaled delivered via Websurvey in the private practice setting, one hundred and ninety-six randomly selected laypersons were asked to evaluate each image according to their own notions of beauty.

Results: A minor axial dental midline angulation of 3.5° can be perceived independently of the direction of the cant. All pictures where the midline was canted pointing in the opposite direction of nose and chin deviations presented lower rating mean values.

Conclusions: Off-center noses and chins can influence the perceived attractiveness of a smile with a canted dental midline. The degree and direction of a canted midline can influence the harmony between the smile and overall face, with canting in the same direction of the asymmetric features being rated as more attractive.

Clinical Significance

The dental midline should be as vertically straight as possible. If a midline cant is present, however, it is more favorable to have a dental midline angulation which points in the same direction as nose and chin deviations, rather than in the opposite direction.

KEYWORDS

asymmetric facial model, axial midline angulation, face asymmetry

1 | INTRODUCTION

Esthetic dentistry has evolved over many decades from a profession based on relieving pain and fixing function to having esthetics at the forefront of the profession. Even patients that present to their dentist with a chief complaint of pain expect an esthetic outcome when

treatment is completed. Modern dentistry has moved beyond simply being concerned with teeth and gums and requires clinicians to integrate the smile with the “frame” of the overall face. One of the key factors of facial integration is the position of the maxillary dental midline which is classically defined simply in a relation to the philtrum and interpupillary line.



FIGURE 1 Symmetrical facial model—control picture (left), Asymmetrical facial model (right)

The dental midline is defined by the contact surface between the two central incisors and is considered one of the most important esthetic factors in the positioning of the anterior teeth^{1–3} because it defines the maxilla's plane of symmetry, which is considered one of the most critical elements of a beautiful smile.^{4–6} Additionally, a properly placed dental midline maximizes a smile's harmony with the overall face and thus is a common starting point in esthetic and orthodontic diagnosis.^{6,7}

The discussion about the correct positioning of the dental midline, from an esthetic point of view, has divided schools and authors throughout time, going back to the development of complete dentures.⁴ Some defended the idea that the dental midline should coincide with the facial midline or with the center of the mouth, using the interincisive papilla and the labial frenum as anatomic references, while others argued that the dental midline should never coincide with the center of the mouth because it would give an artificial appearance.⁴

Frush⁷ argued that a canting of the dental midline is much more detrimental than its shifting, meaning a laterally displaced midline is not offensive to the layperson's eye, as long as it maintains parallelism to the facial midline.^{8–10} It is interesting to note that Jimenez-Castellanos and cols¹¹ found that the natural occurrence of a midline cant was 13% in a southern European population, while the incidence of a lateral midline shift was 36%.

Any perceived inclination of the dental midline compared with the classical horizontal reference lines (bipupilar line, intercomisural line, base of the nose, base of the ears, etc) is considered unattractive because it creates visual tension in the composition of the face.^{2,6,7}

Kokich,⁵ in 1999, concluded that 2 mm of dental midline canting (approx. 4°) was perceived as esthetically unacceptable by most of the population. Thomas,¹¹ in his facial photograph studies, however, stated that a 10° cant was esthetically acceptable to laypeople, versus 6° for orthodontists.

Gul-e-rum¹² studied small groups of orthodontic residents, laypeople, art students, and orthodontic patients and all of them perceived a

5° axial midline angulation. Silva¹³ came to very similar conclusion in a study done utilizing a completely symmetrical facial model.

While some of these earlier studies used facial photographs to assess facial composition, others used pictures of just the lower two thirds of the face, evaluating dentofacial composition while disregarding the eyes and chin.

We cannot ignore the role that the surrounding facial structures play in influencing the perception of a smile.

Beyer¹⁴ was the first author to investigate the impact that different facial structures, such as the nose and chin, played on the dental midline perception. He concluded that facial structures and their deviations influence the way observers perceive smile esthetics and facial structures situated in the center of the face such as the nose and chin can play a crucial role in perception of symmetry. Beyer's study, however, fell short of concluding how the different facial structures might interfere in our perception.¹⁴

A pleasing smile requires the proper placement and interaction of several components—lips, gingiva, teeth, and skin—and ultimately a smile's pleasantness depends on how well it harmonizes with the composition of the overall face.¹⁵ Numerous studies have analyzed the smile, in hopes of defining objective criteria for attractiveness. Few studies, however, have investigated the perception of dental discrepancies against the background of the overall face.

Silva et al.¹⁶ have previously demonstrated that the nose and chin position can affect the perception of the horizontal dental midline shift.¹⁷ Facial structures situated in the center of the face such as the nose can play a crucial role in perception of symmetry.

The aim of this study is to determine if asymmetric facial features have an impact on the perception, and acceptability, of a canted dental midline.

2 | MATERIALS AND METHODS

Starting with a digital image of a completely symmetric facial model (SFM), used in a previous study¹³ (Control—Figure 1), a new



FIGURE 2 Midline cant + 3.5° (left), Midline cant -3.5° (right)

asymmetric facial model (AFM—Figure 1) was created by digitally shifting the dorsum and tip of the nose and the chin to the same side. This new image has the nose and chin deviated 3 mm toward the left side of the face (Figure 1), a value that a previous study determined to be below the visual threshold of recognition. This way the aim was to create a naturally asymmetric face where nose and chin were off centered.¹³ Both the SFM and AFM displayed a dental midline that was perpendicular to the interpupillary line and horizontally coincident with the philtrum. Asymmetry was created to only one side since some literature support that the direction of the deviation is not a factor,¹⁴ and also to avoid the excessive number of pictures to be evaluated by the observers that can produce fatigue, loss of interest and criticism.

The next step was to create six different versions of the AFM face, each one of them with a different degree of maxillary midline angulation (both in and against the direction of the deviated chin and nose.)

Three progressive steps of dental midline canting 3.5°, 5°, and 7.5° were created, both towards the left (signed with "+") and the right side (signed with "-") of the AFM (Figures 2–4). In total, eight photographs were created: SFM (the control), AFM, and six versions of the AFM with the varying midline cants (Figures 1–4).

Afterward, a visual Likert scaled was used and delivered via Websurvey. As in the author's previous publication, the Likert scale was used as an alternative to VAS type scale to try to get more objective responses from the subjects and avoid some subjectivity inherent to the natural rating process.¹⁷ One hundred and ninety-six laypersons were selected randomly and asked to evaluate each image according to their own notions of beauty. To determine the sample size, a first pilot study was carried out with 30 observers to determine the value of the variance and the minimum value of the difference to be detected (determining the threshold of recognition

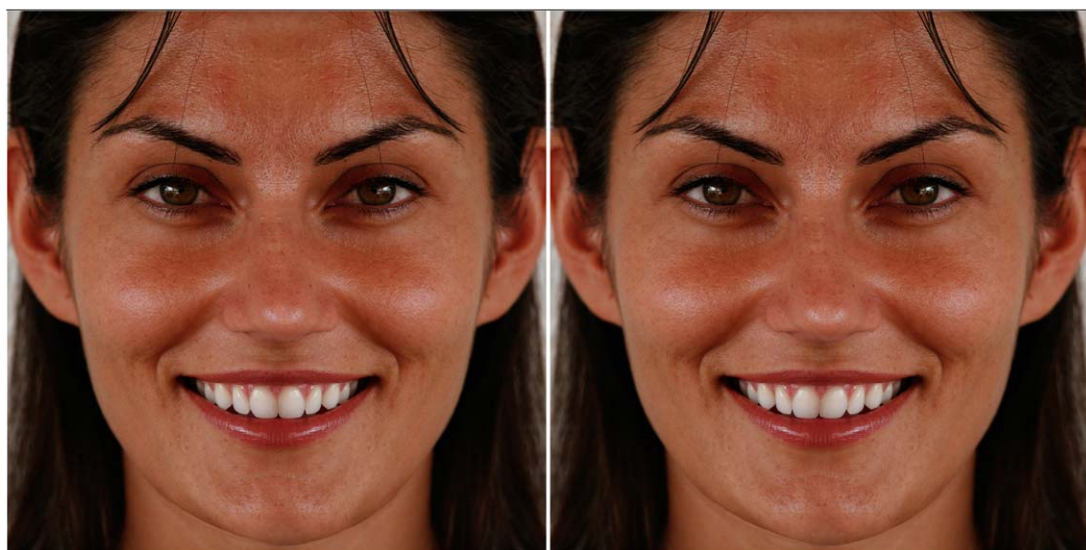


FIGURE 3 Midline cant + 5 degrees (left), Midline cant -5° (right)



FIGURE 4 Midline cant + 7.5 degrees (left), Midline cant -7.5° (right). Rating means: Symmetrical facial model - control picture (Blue), Asymmetrical facial model (blue)

for the different inclinations of the dental midline) following the Fernandez's formula.

These selected people, were at least 21 years of age, did not have any specific dental training and were randomly chosen from a pool of patients who visited 4 different dental practices between January and July 2014. This group included 101 females and 95 males, and their age ranged from 21 to 65, with a mean of 40 years old.

Photographs were presented randomly to the subjects, via online survey software (surveygizmo.com) in two different sessions. In the first session, subjects were asked to simply observe the images, while in the second session, the sequence of images were different and random and the observers had to classify the image according to their criteria of beauty and personal esthetics. The instructions were: Rate each photo's attractiveness on a scale from 1 to 4, with 1 being least attractive and 4 being most attractive. No additional instructions were given to the raters, as to not bias their ratings.

After all the data were gathered, the ratings were charted using SPSS® 14-Amos6 Windows, and a statistical analysis was performed. The Friedman test (after verification that there was no similarity of variances) was found to be significant ($P < .01$), so the multiple-sample analysis was completed with the Wilcoxon test for paired samples with Bonferroni correction ($P < .002$)

A Mann Whitney test was used to determine if the raters' gender and age played any role in their evaluations. Finally, a Kruskal-Wallis test was used to find out if the order in which the photos were presented was of significance in the raters' evaluations.

The materials and methods of this study closely mirror those of a previously conducted study by the same authors.¹⁷

3 | RESULTS

As the descriptive analysis (Table 1) shows, the mean ratings of the control picture SFM, and the AFM (Figure 1) are very similar. This

finding supports the study methodology, which attempted to create a natural looking asymmetric facial model.

For all pictures where the midline was canted to the right side (-) of the AFM, that is, in the direction opposite the nose and chin deviations (Figure 2-4), there were lower rating mean values. This indicates that the midline cant direction does contribute to the perceived attractiveness of faces with asymmetric noses and chins (Table 1, Figure 5). This is very significant for clinicians to understand because if they have a patient with a midline cant, they may not have to change it to remain with an esthetically pleasing result.

Standard deviations were found to be consistent, which favors the data dispersion from the average. The maximum value was reached on all pictures, and the same was registered for minimum values except for the SFM and AFM pictures (Figure 1). This supports the notion that the inclination of the dental midline has a significant effect on the perception of facial beauty.

The Wicoxm test was performed for multiple comparisons with the Bonferroni correction, with $P < .001$ (Table 2).

TABLE 1 Mean, standard deviation, minimum and maximum for each picture

	Mean	Std dev	Max	Min
Symmetrical Facial Model - Control	3.47	0.611	4	2
Asymmetrical Facial Model	3.4	0.652	4	2
Midline cant +3,5°	3.06	0.669	4	1
Midline cant -3,5°	2.81	0.711	4	1
Midline cant +5°	2.67	0.714	4	1
Midline cant -5°	2.31	0.785	4	1
Midline cant +7°	2.21	0.779	4	1
Midline cant -7°	2.00	0.829	4	1

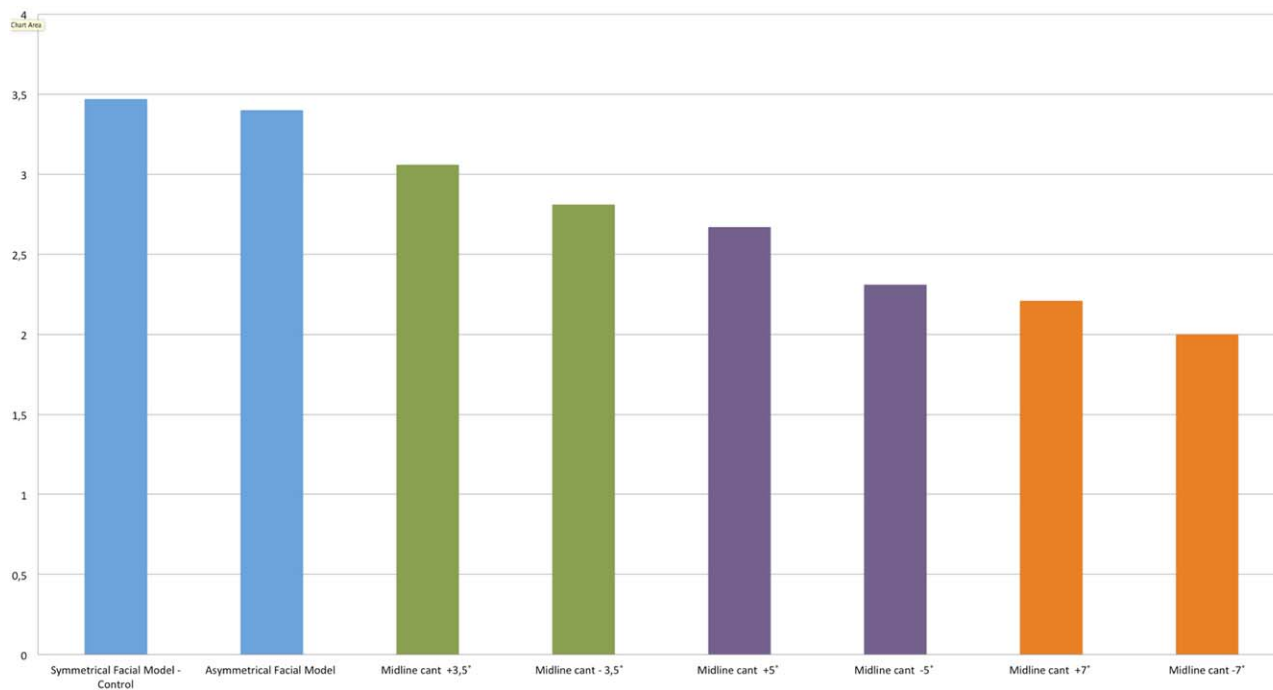


FIGURE 5 Midline cant + 3.5° (green), Midline cant −3.5° (green), Midline cant + 5° (purple), Midline cant −5° (purple), Midline cant + 7.5° (orange), Midline cant −7.5° (orange)

All the comparisons between the pictures' rating values were statistically significant except for the following pairs: SFM and AFM (Figure 1), −3.5° midline cant (Figure 2) and +5° midline cant (Figure 3); −5° midline cant (Figure 3) and +7° midline cant (Figure 4). This seems to indicate that in asymmetric faces (nose and chin), a minor axial dental midline angulation such as 3.5° can be perceptible independently of the direction of the cant.

A Mann Whitney test was conducted to disclose if gender and age were determinant factors. There were no significant differences in the ratings between males and females for any classified picture ($P < .01$). This is significant because popular media often implies that only females are esthetically driven or knowledgeable but in the study, there was no difference with men and women.

To analyze age of the rater as a potential factor, subjects in both groups were divided into decades of life and no differences were found ($P < .01$).

4 | DISCUSSION

The participants were shown the images in two separate sessions: first, a trial visualization, followed by a second session where the data for

TABLE 2 The Wilcoxon test was performed for multiple comparisons with the Bonferroni correction, with $p < 0.001$

Symmetrical facial model—control vs. asymmetrical facial model	Midline cant −3.5° vs Midline cant +5°	Midline cant −5° vs Midline cant +7°
0.88	0.23	0.87

the study was collected. This approach was chosen because observers tend to score toward the middle instead of using scale extremes,¹⁸ and so beginning with a trial visualization may help to overcome the inherent limitations of the rating process.^{15,19}

The mean values show a very clear correlation: as the degree of midline canting increases, the subject is rated as less attractive. When comparing equally canted midlines in both directions, the layperson consistently preferred an axial midline inclination in the same direction as the nose and chin asymmetries (the “+” values) Figure 5.

There were no statistically significant differences between the rating values of the SFM and the AFM (Figure 1), which suggests the asymmetries introduced in the nose and chin were not perceptible (Table 2). This supports the validity and reliability of the study's methodology.

When shown the images of the different midline angulations, the study's participants consistently rated those images in which the cant followed the direction of the nose and chin as more attractive than the opposite scenario. When the ratings of the pictures with the same degree of inclination but in opposite directions were compared statistically significant differences were found. Based on the results, it seems that in a face with an asymmetric nose and chin, the direction of the dental midline cant can be a relevant factor to consider.

Even a small midline cant like 3.5° can negatively impact the visual perception of facial beauty; however, if this cant follows the direction of nose and chin asymmetries, it can be more attractive to laypeople (Table 2). This could save some patients from getting esthetic dental treatment that is not needed simply to fix their small midline cant.

It is noteworthy that besides the comparison of the two control pictures, the only other two comparisons that did not present

statistically significant differences were the midline cant of -3.5° versus $+5^\circ$, and -5° versus $+7^\circ$ (Table 2). The close values obtained for these pairings support the conclusion that a larger cant in the same direction as nose and chin is as equally acceptable as a smaller cant in the opposite direction.

From the results obtained in this study, it can be concluded that the dental midline should be as vertically straight as possible, although if there is a cant, it is more favorable to have a dental midline cant which points in the same direction as nose and chin deviations, rather than in the opposite direction.

When comparing these results with existing publications, it is difficult to establish objective comparisons, as each study differs in materials and methods.

Kokich,⁵ in 1999, had used a smile frame picture and used linear units to measure incisor crown angulation, concluding that 2 mm was the threshold of recognition no matter if the observer was dentally trained or a layperson. Conversely, Thomas,¹⁰ in his facial photographs study stated a 10° midline cant was aesthetically acceptable to laypeople, versus 6° for orthodontists. Gul-e-rum¹² found that 5° of axial incisal angulation was noticeable by all people.

In this study, to avoid the interference of other variables, a symmetric facial model was the starting point, where the nose and chin were skewed. Gul-e-rum¹² used natural patient pictures, with evident facial asymmetries, and came to the conclusion that axial midline angulation was more noticeable on the right side of the face. He attributed his findings to the possibility that people might be more observant of the right side of the face than the left side. However, in the authors' opinion, facial asymmetries present on the specific facial pictures used on that study might be the explanation for such a finding. Moreover, Thomas et al.,¹⁰ in a perception study about facial and dental discrepancies, came to the conclusion that the direction of midline inclination was not a factor.

It is interesting to note that the age and gender of the study's participants did not seem to play any significant role in the ratings of the different faces, since typically, women are known as being more critical and demanding with beauty and esthetics.¹⁸⁻²⁰

The simulated changes made to the facial model (Photoshop CS3®) attempted to simulate realistic scenarios, but these images are of course limited in that there are countless individual variabilities influencing the perception of the human face. The aim of this study was not to establish minimum recognition thresholds for the general population, but rather to explore specifically the influence that a limited number of facial structures have on the perception of smile esthetics.

It would be interesting to study the perception of even smaller midline canting (less than 3.5°), as perhaps there is a minimum threshold below which the directionality of a cant makes it perceptible or unnoticed for the same degree of inclination.

As in the author's previous publication the Likert scale was used as an alternative to VAS type scale to try to get more objective responses from the subjects and avoid some subjectivity inherent to the natural rating process.¹⁷

More studies are needed to evaluate other dental discrepancies and the perception of esthetics on the asymmetric facial model.

5 | CONCLUSION

This study found that increasing the axial maxillary midline angulation consistently decreases the attractiveness of a smile. In a face with an asymmetric nose and chin, the direction of the dental midline cant can be a relevant factor to consider.

The dental midline should be as vertically straight as possible. If a midline cant is present, however, it is more favorable to have a dental midline angulation which points in the same direction as the nose and chin deviations, rather than in the opposite direction.

DISCLOSURE OF INTERESTS

The authors do not have any financial interest in the companies whose materials are included in this article.

ORCID

Bruno Pereira Silva  <http://orcid.org/0000-0002-2701-1485>

REFERENCES

- [1] Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent.* 1973;29(4):358-82.
- [2] Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. *J Prosthet Dent.* 1984;51(1):24-8.
- [3] Miller EL, Bodden WR, Jamison HC. A study of the relationship of the dental midline to the facial midline. *J Prosthet Dent.* 1979;41(6):657-66.
- [4] Naini FB, Moss JP, Gill DS. The enigma of facial beauty: esthetics, proportions, deformity, and controversy. *Am J Orthod Dentofacial Orthop.* 2006;130(3):277-82.
- [5] Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. *J Esthet Dent.* 1999;11(6):311-24.
- [6] Chiche GJ, Pinault A. Esthetics of Anterior Fixed Prosthodontics. Quintessence, Chicago; 1994:13-301
- [7] Frush J. Swissdent Technique and Procedure Manual. Los Angeles: Swissdent Corp; 1971.
- [8] Saavedra C, Garcia-Adámez R, Garcia-Baeza D. La angulación de la línea media interincisiva. Concepto de asimetría facial armónica Parte 1. Quintessence; 2015;3:183-18.
- [9] Rufenacht C. Fundamental of Esthetics. Chicago: Quintessence Publishing; 1990:11-93
- [10] Thomas JL, Hayes C, Zawideh S. The effect of axial midline angulation on dental esthetics. *Angle Orthod.* 2003;73:359-36.
- [11] Jiménez-Castellanos E, Orozco-Varo A, Arroyo-Cruz G, Iglesias-Linares A. Prevalence of alterations in the characteristics of smile symmetry in an adult population from southern Europe. *J Prosthet Dent.* 2016;115(6):736-40.
- [12] Gul-e-Erum, Fida M. Changes in smile parameters as perceived by orthodontists, dentists, artists, and laypeople. *World J Orthod.* 2008 Summer;9:132-40.
- [13] Silva BP, Jiménez-Castellanos E, Martínez-de-Fuentes R, et al. Laypersons' perception of facial and dental asymmetries. *Int J Periodontics Restorative Dent.* 2013;33(6):162-71.
- [14] Beyer JW, Lindauer J. Evaluation of dental midline position. *Semin Orthod.* 1998;4(3):146-52.

- [15] Silva BP, Jiménez-Castellanos E, Finkel S, et al. Layperson's preference regarding orientation of the transverse occlusal plane and commissure line from the frontal perspective. *J Prosthet Dent.* 2017; 117(4):513–6. Apr
- [16] Meyer-Marcotty P, (1), Stellzig-Eisenhauer A, Bareis U, et al. Three-dimensional perception of facial asymmetry. *Eur J Orthod.* 2011;33(6):647–53. Dec
- [17] Silva BP, Jiménez-Castellanos E, Martínez-de-Fuentes R, et al. Perception of maxillary dental midline shift in asymmetric faces. *Int J Esthet Dent.* 2015;10(4):588–96. Winter
- [18] Witt M, Flores-Mir C. Laypeople's preferences regarding frontal dentofacial esthetics: periodontal factors. *J Am Dent Assoc.* 2011; 142(8):925–37.
- [19] Graber LW, Lucker GW. Dental esthetic self evaluation and satisfaction. *Am J Orthos.* 1980;77(2):163–73.
- [20] Tedesco LA, Albino JE, Cunat JJ, et al. A dental-facial attractiveness scale. Part II Consistency of perception. *Am J Orthod.* 1983;83(1): 44–6.

How to cite this article: Silva BP, Jiménez-Castellanos E, Stanley K, Mahn E, Coachman C, Finkel S. Layperson's perception of axial midline angulation in asymmetric faces. *J Esthet Restor Dent.* 2017;00:1–7. <https://doi.org/10.1111/jerd.12347>