Perception of maxillary dental midline shift in asymmetric faces

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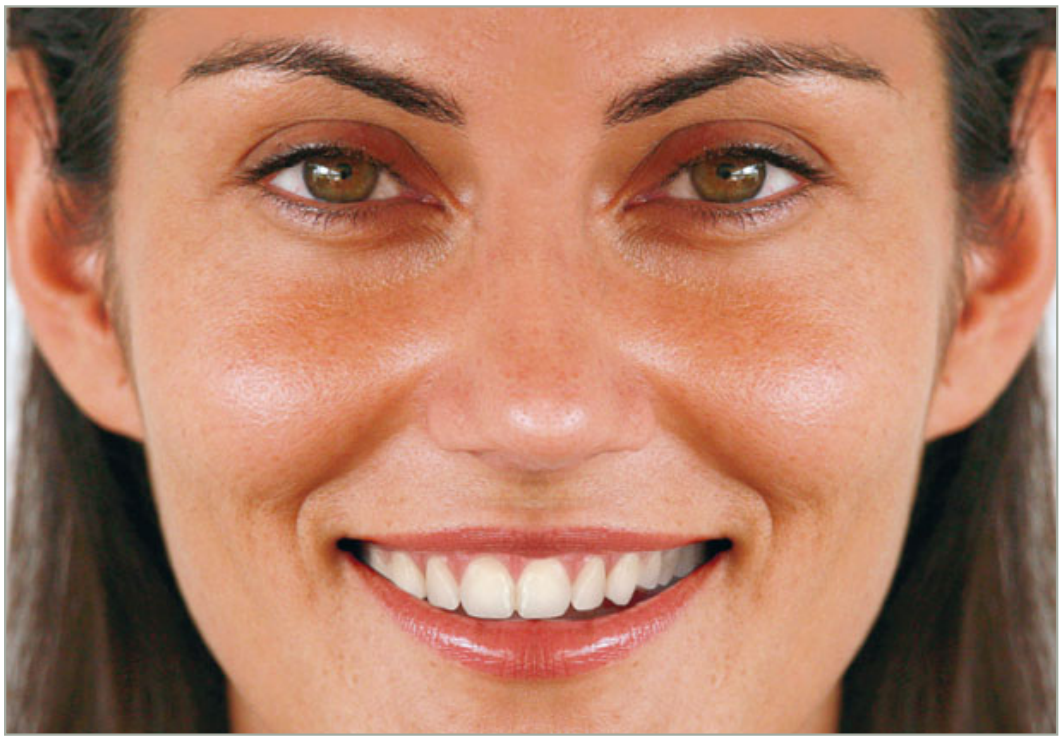

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Abstract

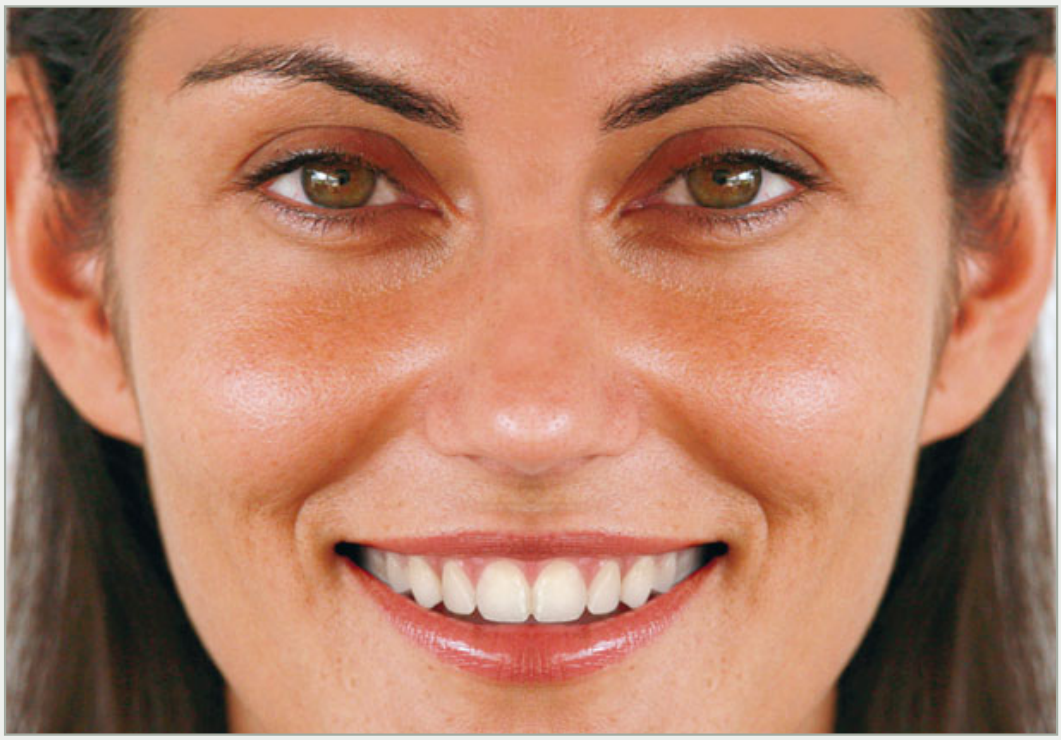
Purpose: The purpose of this article is to determine whether certain facial asymmetries (nose and chin) have an impact on the perception of the maxillary dental midline shift.

Materials and methods: From a digitally created symmetric facial model (SFM) constructed in a previous study, a new asymmetric facial model (AFM) was created, with nose and chin deviated to the same side. Modifications were made on the AFM for shifts in the maxillary dental midline in both directions, resulting in a total of eight different images. Through a web survey, 112 randomly selected laypersons were asked to evaluate each image according to their own personal beauty and esthetic criteria using a visual Likert scale.

Results: 1 mm of dental midline shift to the left of the AFM was not noticed; 1 mm of dental midline shift to the right of the AFM had a negative impact on perception of facial attractiveness; 2 and 3 mm of dental midline shift to left or right of the AFM had a negative impact on perception of facial attractiveness.

Conclusions: Facial asymmetries such as nose and chin inclinations have an impact on the perception of maxillary dental midline shift. Direction of dental midline shift can be a major factor in this perception.

(Int J Esthet Dent 2015;10:588–596)



Introduction

Today, clinicians practice in a treatment environment where not only function and utility but also esthetics is demanded in almost every procedure. The dentition is no longer separable from the smile. While the primary goal of any restorative therapy should be the reestablishment of function, esthetics should not be neglected, and restorations must harmonize with an appropriate esthetic concept in order for the individual patient to psychologically achieve his or her dental expectation.

Just as visual perception is mandatory for the esthetic evaluation, so the visual examination is mandatory for the clinical examination.[1,2] For this reason, an understanding of all the processes involved in beauty perception helps the clinician in the process of esthetic diagnosis.

There are different types of tissues interacting in the smile: teeth, lips, gums, and skin. Moreover, the smile interacts with the other facial structures to compose the facial expression. Numerous studies have analyzed the smile in order to discover which characteristics make it more attractive or less attractive so as to establish objective esthetic criteria to guide the restorative dentist. However, few studies have been published regarding the importance of the facial composition in the context of the perception of dental discrepancies.

The location of the maxillary dental midline relative to the face is often an important factor in restorative and/or orthodontic diagnosis.[3,4] The symmetrical arrangement of the teeth is considered a very important factor in the perception of the beauty of the smile.[5-11] Patients can easily identify an incorrect position of the maxillary dental midline in the context of the face.[8] This idea was understood very early in dental practice without supporting evidence. The first published studies attempting to quantify the midline deviation only appeared toward the end of the 1990s. However, the published research presents very disparate results,[12-14] with discrepancies existing between the materials and methods employed in these studies. While some used full-facial photographs to assess facial composition, others used smile photographs of the lips only, with the evaluation of dentofacial composition disregarding the eyes and chin.

We cannot ignore the role of the facial structures on smile perception. In 1998, Beyer published an investigation about the impact that different facial structures played on the midline and their effect on the esthetic perception of the dental midline.[15] Although Beyer was not able to reach conclusions regarding how the different facial structures influence our perception of the smile, the study concluded that facial structures and their deviations do play a role in the way observers perceive smile esthetics.[15]

It is very important, therefore, to take a step back from our routine clinical position, since shortening the observation distance from that of a normal social conversation reduces the visual examination field, creating a dentofacial analysis rather than an overall impression of the face. This overall impression helps the clinician to reach a diagnosis that is based on the perception of the entire face.

This study was motivated by the increasing importance of acquiring a wider knowledge of the mechanisms comprising

the perception of smile beauty, and of the role of certain facial structures on the perception of the alteration of dental esthetics. The purpose of this study was to determine whether some facial asymmetries have an impact on the perception of the maxillary dental midline shift.

Materials and methods

From a digitally created symmetric facial model (SFM) or control photograph constructed in a previous study[16] (Fig 1), a new asymmetric facial model (AFM) was created (Fig 2). Adobe Photoshop CS3 Extended (for Mac/Windows Vista) was used for image editing. On this AFM, both nose and chin were deviated 3 mm toward the left side of the facial model. These deviations were below the visual threshold of recognition determined in a previous study.[16] The aim of constructing this AFM was to create a naturally appearing asymmetric face.

On both models (SFM and AFM), the dental midline was coincident with the philtrum and perpendicular to the interpupillary line.[17]

On the AFM, modifications were made to the dental midline (shift). The shifting of the dental midline occurred in three progressive steps of 1 mm each in two directions, ie, toward the left (+) and the right (-) side of the facial model, which resulted in six images (Figs 3 to 8). A total of eight images (Figs 1 to 8) were obtained: the SFM, the AFM, and the images with the modifications to the dental midline (shift).

One hundred and twelve laypersons (raters) – 58 females and 54 males – with no specific dental training and who were at least 21 years of age were randomly selected. The raters ranged from 21 to 71 years of age, with a mean age of 43 years.

The images were shown to all the raters, using digital online survey software (surveygizmo.com), either on a tablet or laptop personal computer. Each rater was given consistent instructions.

The images were randomly organized into two assessment sessions. In the first session, the raters were asked to view each image. In the second session, a different image sequence was employed. Observers rated each image in accordance with their own personal beauty and esthetic criteria. No additional instructions were given to the raters that would bias their rating or shift their attention to any other parameter.

The sequence of viewing the images was randomized in all sessions to avoid systematic inaccuracies or predispositions that could lead to observer error.

The raters were instructed to rate each image using a Likert scale, from 1 to 4, with 1 being the least attractive and 4 being the most attractive.

Once all the questionnaires were completed, the scores were transferred to a chart using SPSS 14 Amos 6 software (Windows), and statistical analysis was performed on the sample.

The Student *t* test was used for multiple comparisons, with the Bonferroni adjustment, to determine which images were statistically significant. The Mann-Whitney test was used to determine whether gender and age were factors throughout the evaluation. Finally, the Kruskal-Wallis test was performed to evaluate whether the four different image sequences were of significance in the raters' evaluation.

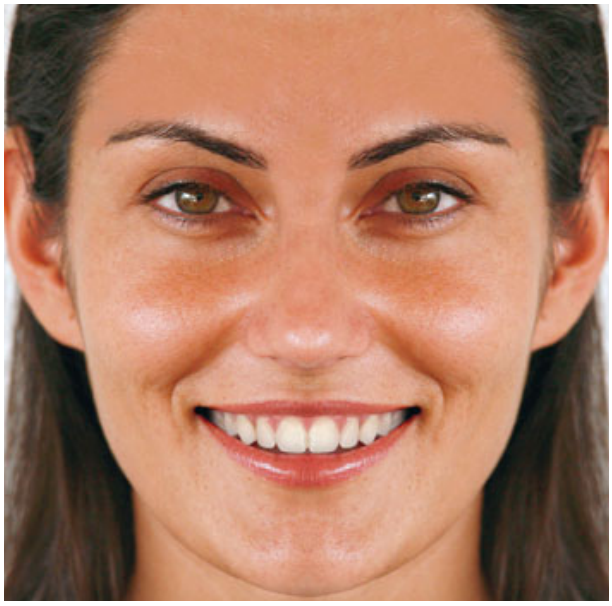


Fig 1 Symmetric facial model (SFM)

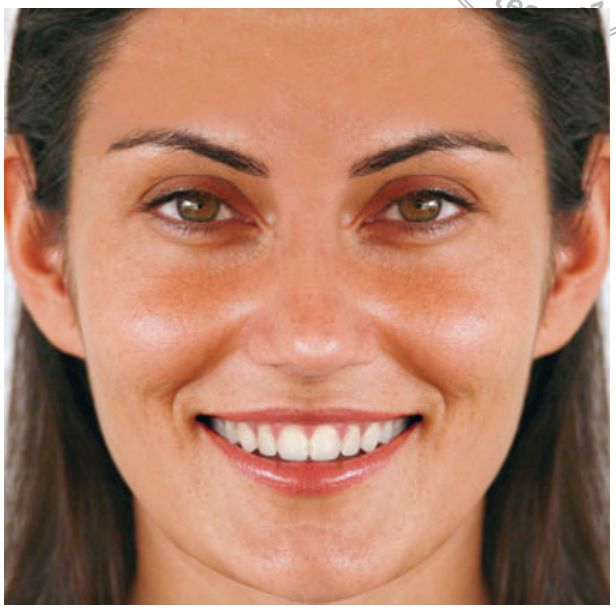


Fig 2 Asymmetric facial model (AFM)

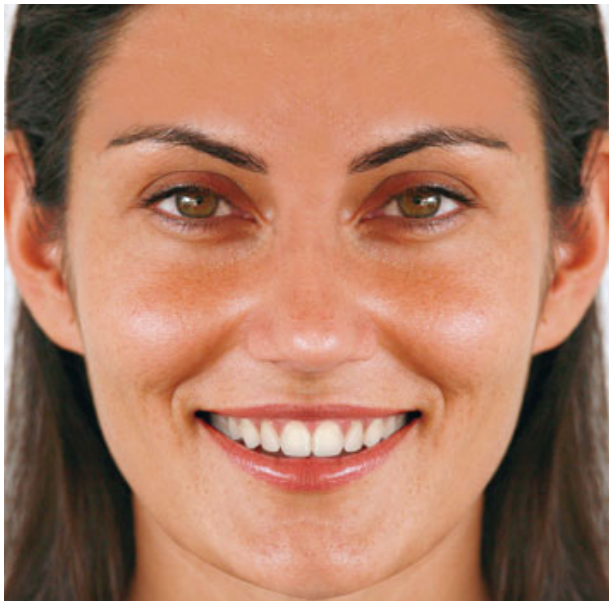


Fig 3 1 mm dental midline shift toward the left side of the AFM.

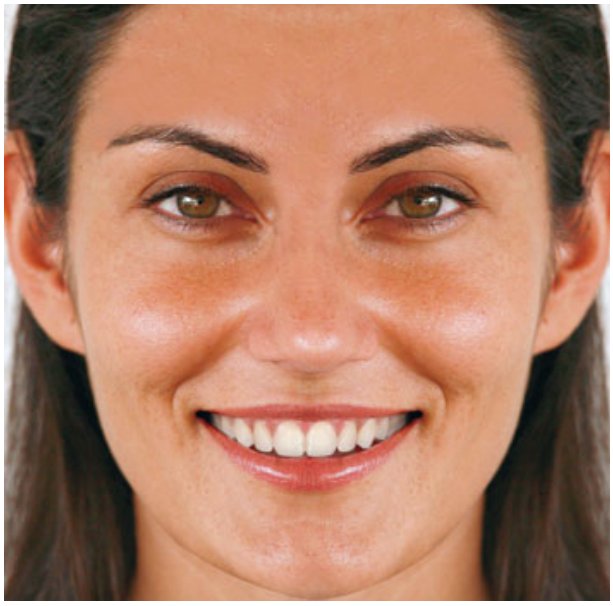


Fig 4 1 mm dental midline shift toward the right side of the AFM.

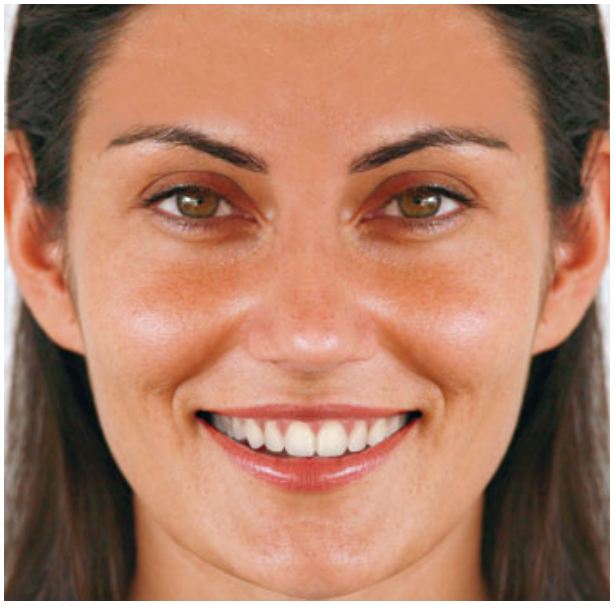


Fig 5 2 mm dental midline shift toward the left side of the AFM.

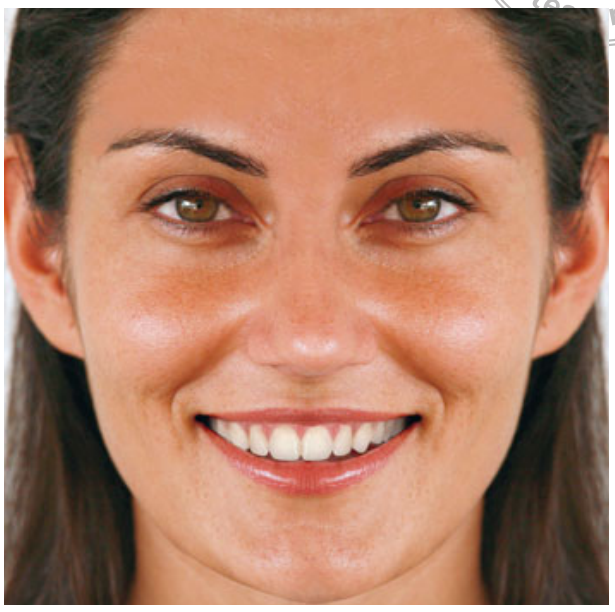


Fig 6 2 mm dental midline shift toward the right side of the AFM.

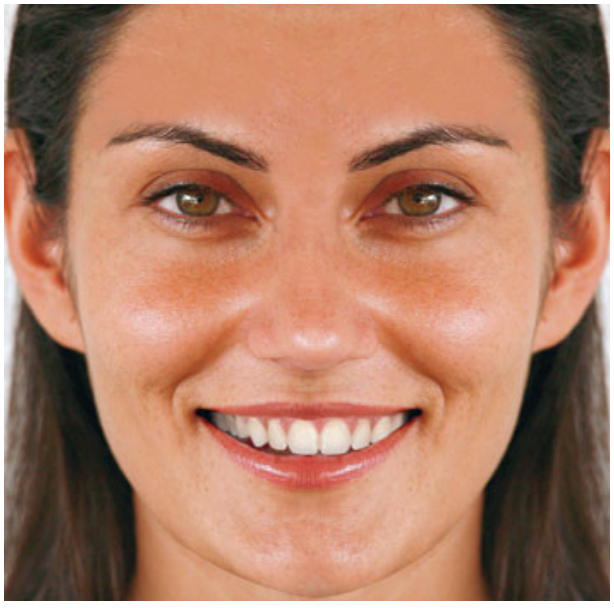


Fig 7 3 mm dental midline shift toward the left side of the AFM.

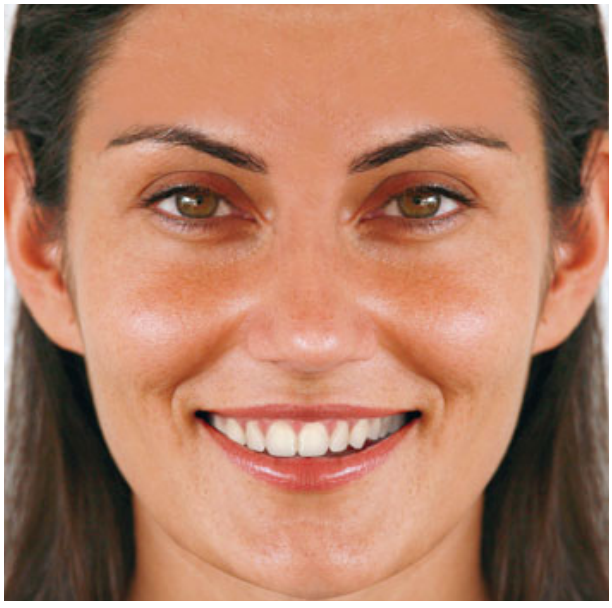


Fig 8 3 mm dental midline shift toward the right side of the AFM.

Table 1 Mean, standard deviation, maximum, and minimum values

Image	Mean	Std dev	Max	Min
Midline shift + 1 mm	3.29	.740	4	1
Midline shift + 2 mm	2.55	.837	4	1
Midline shift + 3 mm	1.98	.788	4	1
Midline shift - 1 mm	2.79	.799	4	1
Midline shift - 2 mm	2.17	.869	4	1
Midline shift - 3 mm	1.74	.878	4	1
Symmetric facial model (SFM)	3.53	.629	4	2
Asymmetric facial model (AFM)	3.46	.614	4	2

Results

The descriptive analysis is presented in Table 1. The rating mean of the control image SFM (Fig 1) is very similar to the mean of image AFM (Fig 2), which supports the study methodology that attempted to reproduce a naturally asymmetric facial model.

All images where the midline was shifted to right side (-) of the facial model, pointing in the opposite direction of the nose and chin (Figs 4, 6, and 8) presented lower rating mean values, indicating that the midline shift direction is a relevant factor in faces with nose and chin asymmetries (Table 1).

The standard deviations were consistent, which favors the data dispersion from the mean. The maximum value was reached on all the images, and the same was registered for minimum values, except for the SFM and AFM images. This seems to indicate that the dental midline shift has a significant impact, both positive and negative, on the perception of facial esthetics.

The Student *t* test was performed for multiple comparisons, with the Bonferroni adjustment, with $P < 0.001$. All the comparisons between the images' rating values were statistically significant ($P < 0.001$), except for: + 1 mm midline shift (Fig 3) vs SFM (Fig 1); + 1 mm midline shift (Fig 3) vs AFM (Fig 2); SFM (Fig 1) vs AFM (Fig 2); - 1 mm midline shift (Fig 4) vs + 2 mm midline shift (Fig 5); - 2 mm midline shift (Fig 6) vs + 3 mm midline shift (Fig 7). This seems to indicate that in asymmetric faces (nose and chin), a minor dental midline shift such as 1 mm can be visibly perceptible, depending on the direction of the shift.

The Mann-Whitney test was conducted to disclose whether gender and age were determinant factors. There were no significant differences in the ratings between males and females for any classified image ($P < .01$). In order to analyze rater age as a potential factor, subjects in both groups were divided into decades of life, and no differences were found ($P < .01$).

Discussion

According to the statistical analysis, it can be concluded that extraoral facial structures such as the nose and chin can have an impact on the perception of dental midline shift.

Based on the mean values, it can be established that the results are quite consistent. When the midline shift became greater, the observer ratings became smaller, supporting the facial model and the current study design.

When the rating values of the SFM (Fig 1) and the AFM (Fig 2) were compared, no statistically significant difference was found, meaning that the asymmetries introduced to the nose and chin were not perceptible, thereby supporting the reliability and validity of the study methodology.

When reviewing the rating means of the different midline shifts, all the shifts toward the direction of the nose and chin presented higher scores. It seems clear that in a face with an asymmetric nose and chin, the direction of the dental midline shift can be a major factor in the visual perception of facial beauty. Even a small midline shift such as 1 mm can have a negative impact on this perception. Attention should therefore be given to facial diagnosis in order to achieve predictable esthetic results in restorative or orthodontic treatments.

When these results are compared with existing published studies, the majority of studies regarding the shifting of the dental midline, such as Beyer et al,[15] Ker et al,[13] and Johnston et al,[18] established that a 2 mm or greater dental midline shift is easily recognized. The difference between these studies and the present study is that this facial model had controlled facial asymmetries – the dental midline shift was consistent in both directions, ie, toward both the right and the left side of the facial model, in order to establish a relationship between these facial asymmetries and the perception of the dental midline shift.

Some investigators have reported discordant results, such as Kokich et al[4] in 1999, and Pinho et al,[14] who concluded that a 4 mm dental midline shift had no impact on the layperson's esthetic perception. Ker et al[13] argued that the maximum deviation from the facial midline allowed by a layperson was 2.9 mm.[5] There are significant differences between the results of the present study and those obtained in these cited studies. The main difference regarding materials and methods is that for this study, full-facial images were used, whereas those used in the studies that obtained higher thresholds were images limited to the perspective of the smile or to the lower third of the face.

Age and gender did not represent a significant factor, which was a very interesting finding considering that women are more discerning when it comes to beauty and esthetics.[19-21]

The Likert scale was used in this study instead of a VAS-type scale in order to try to overcome some subjectivity inherent in the rating process.

The images were shown in two separate sessions, the first being a trial visualization and the second for the purposes of the study. As observers tend to score toward the middle without using scale extremes,[22] this may help to overcome the limitations inherent in the scoring process.

Deviations that were made digitally over the facial model in Photoshop CS3

Extended attempted to portray and access reality to the maximum, but even these images have limitations, since there is infinite individual variability attached to the perception of the human face. The aim of this study was not to establish minimum recognition threshold levels that can be applied to the general population but rather to establish the role that some facial structures have on the perception of smile esthetics.

Further investigations are needed to study other dental discrepancies and the perception of esthetics on the asymmetric facial model.

Conclusions

According to the results obtained in this investigation, it can be concluded that:

1. Nose and chin inclinations have an impact on the perception of dental midline shift.
2. On asymmetric faces (nose and chin), the direction of the dental midline shift can be a major factor.
3. A 1 mm dental midline shift can have a negative impact on the perception of facial beauty.

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