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Effects of Nasal and Chin Deviations Relative to the Dental Midline on Perceived Facial Attractiveness

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ABSTRACT

Introduction: Facial attractiveness plays a crucial role in social interactions, with the dental midline and smile being key factors in aesthetic perception. The aim of this study was to examine the effect of nasal and chin deviations relative to the dental midline on perceived facial attractiveness among laypersons, final-year dental students, and dental specialists.

Materials & Methods: In this observational-analytical study, 126 observers (42 from each group) evaluated digitally altered images of a female model with a 3 mm leftward nasal and chin deviation, along with varying dental midline shifts (from 2 mm right to 4 mm left in 1 mm increments). Observers rated the images using a 5-point Likert scale for aesthetics and attractiveness. Statistical analyses included Kruskal-Wallis, Mann-Whitney, and Wilcoxon tests (α=0.05).

Results: Laypersons did not significantly perceive leftward shifts of 1 to 3 mm (aligned with the nasal and chin deviation) as different from the symmetric image, but found rightward shifts and a 4 mm leftward shift less attractive ($p=0.004$, $p<0.001$, and $p=0.002$). Dental students detected all shifts except the 1 mm leftward deviation as significantly different. Specialists identified all deviations as statistically significant ($p<0.001$). No significant differences were found between male and female lay observers.

Conclusion: Dental midline deviations should be assessed in relation to overall facial symmetry rather than in isolation. When the deviation is in the same direction as nasal and chin asymmetry, correction may offer limited esthetic benefit. Therefore, treatment decisions should consider facial asymmetry and patient expectations before pursuing complex midline correction.

Keywords: Esthetics, Dental; Facial Asymmetry; Perception; Orthodontics

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Introduction

Facial attractiveness plays a crucial role in social interactions and is a strong motivator for enhancing facial aesthetics [1]. Among facial features, the mouth and eyes are recognized as focal points during interpersonal encounters [2]. The beauty of the smile and face largely depends on the harmony between intraoral and extraoral soft tissues [3].

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Orthodontic treatment has evolved from a primary focus on ideal occlusion, based on Angle's paradigm, to greater emphasis on soft tissue balance and facial aesthetics [4]. Contemporary aesthetic judgments are influenced more by soft tissue contours than by underlying skeletal structures. Laypersons tend to evaluate the proportional relationship of teeth to facial structures such as the lips, nose, and chin rather than the alignment of dentition with the skeletal framework [5]. Consequently, smile aesthetics is now assessed within the context of the entire face [6].

Both frontal and profile facial analyses are essential in orthodontic evaluation. The frontal view emphasizes facial symmetry and harmony among the facial thirds, while the profile view focuses on sagittal jaw relationships [7]. Multiple anatomical landmarks are used to define the facial midline, including the interpupillary line bisector, nasion, nasal tip, philtrum center, and chin midpoint [8]. However, asymmetries of the eyes, nose, or chin may create optical illusions that complicate accurate midline identification [9]. This ambiguity is so prevalent that even the American Association of Orthodontists and the Academy of Facial Plastic and Reconstructive Surgery have not provided a precise definition for the facial midline [10].

The dental midline, defined as the contact point between the two maxillary central incisors, is a critical parameter in orthodontic treatment planning and significantly influences smile aesthetics. However, depending on the clinical presentation, correcting dental midline deviations may require complex procedures such as unilateral extractions or surgery, which can increase both treatment cost and duration [11]. Therefore, the dentist must weigh the aesthetic benefits of correcting the midline against the treatment burden [12].

Because aesthetic perception is subjective and influenced by social and cultural factors, patient and clinician evaluations may differ. Patients may remain dissatisfied despite anatomical correction of the dental midline if their aesthetic preference differs from the clinician's assessment [13, 14]. Research has shown that dentists - particularly orthodontists - tend to be more sensitive to dental deviations and may overestimate the need for treatment [15].

Given the importance of the interplay among facial components in aesthetic perception and the potential differences in perspective between patients and clinicians, this study aimed to evaluate the effect of nasal and chin deviation on the perception of dental midline shift among three groups: laypersons, dental students, and dental specialists.

Materials & Methods

This observational-analytical study included 126 participants, equally divided among three groups: laypersons, final-year dental students, and dental specialists (including orthodontists, prosthodontists, restorative dentists, and oral surgeons). The study protocol was approved by the Ethics Committee of Babol University of Medical Sciences (IR.MUBABOL.HRI.REC.1401.055).

Participants were recruited using a convenience sampling approach. Verbal informed consent was obtained from all participants, and their personal information was kept confidential. Participants were fully informed about the study objectives and assured of their right to withdraw at any stage without penalty.

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Sample Size Calculation

The minimum sample size for each group was determined based on a previous study that investigated the perception of dental deviations among laypersons and professionals [16]. Considering proportions of P_1=0.83 and P_2=0.56, a 95% confidence interval ($\alpha = 0.05$), and a study power of 80% (β=0.20), the required sample size per group was calculated to be 42 using the following formula:

$$n \geq \frac{(Z_{1-\alpha/2}+Z_{1-\beta})^2(P_1(1-P_1)+P_2(1-P_2))}{(P_1-P_2)^2} \approx 42$$

Inclusion and Exclusion Criteria

Lay participants were selected from individuals aged 20–50 years attending the university dental clinic, with no educational or professional background in dentistry or other aesthetic-related fields. The dental student group consisted of final-year students from the School of Dentistry, Babol University of Medical Sciences, while the specialists group included dentists with at least three years of professional experience in orthodontics, prosthodontics, restorative dentistry, or oral surgery.

Exclusion criteria included a history of facial surgery or trauma involving the jaw or nose (for lay participants), as well as uncorrected visual impairments.

Image Preparation

A frontal facial photograph of a 25-year-old female with completed orthodontic treatment and perfectly aligned dental midlines was used as the baseline image, after obtaining informed consent. Using Adobe Photoshop CC 2021 (Adobe Inc., San Jose, USA), a 3 mm deviation of both the nasal tip and chin toward the left was digitally created.

The dental midline was then shifted incrementally from 2 mm to the right (–2 mm) to 4 mm to the left (+4 mm) in 1 mm intervals. This resulted in eight total images: seven asymmetric and one symmetric. The images were printed on high-quality paper at a size of 15 × 20 cm, approximating life-size proportions to minimize perceptual errors due to image magnification (Figure 1).

Image Evaluation

Participants were shown the images in random order and asked to rate the aesthetic appeal of each using a five-point Likert scale (1 = very unattractive, 2 = unattractive, 3 = neither attractive nor unattractive, 4 = attractive, and 5 = very attractive). A researcher recorded each participant's demographic data - age, gender, and educational level - and documented their scores for each image using a standardized data collection form.

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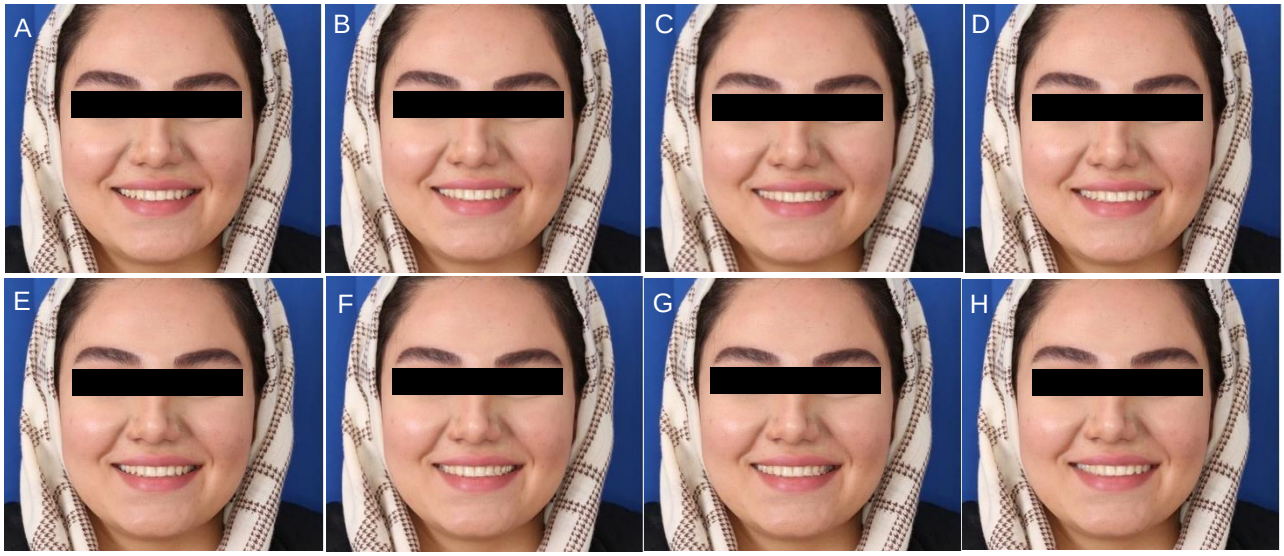

Figure 1. One symmetric and seven asymmetric images. A) Initial symmetrical image. B) Initial asymmetrical image: deviation of the tip of the nose and chin 3 mm to the left. C) Image +1: deviation of the dental midline 1 mm to the left in the initial asymmetrical image. D) Image +2: deviation of the dental midline 2 mm to the left in the initial asymmetrical image. E) Image +3: deviation of the dental midline 3 mm to the left in the initial asymmetrical image. F) Image +4: deviation of the dental midline 4 mm to the left in the initial asymmetrical image. G) Image -1: deviation of the dental midline 1 mm to the right in the initial asymmetrical image. H) Image -2: deviation of the dental midline 2 mm to the right in the initial asymmetrical image.

Statistical Analysis

Data were analyzed using the Wilcoxon signed-rank test to compare each asymmetric image with the symmetric image within each group, and the Kruskal-Wallis test was used to compare scores among the three observer groups, using SPSS version 26 (IBM, Armonk, USA). A significance level of 0.05 was adopted for all analyses.

Results

A total of 126 participants with a mean age of 33.57 ± 9.31 years took part in the study, divided into three groups. The demographic characteristics of the participants are presented in Table 1. Table 2 shows the scores assigned to each image by the three observer groups and compares the ratings across groups.

Table 1. Demographic characteristics of participants by group

Observer Group	Gender (N)		Age (year)
	Male	Female	(Mean ± SD)
Laypersons	21	21	35.45 ± 11.03
Final-year dental students	19	23	25.5 ± 3.19
Specialists	22	20	39.79 ± 4.77
Total	**62**	**64**	**33.58 ± 9.31**

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As expected, the specialists gave the highest score (4.64 ± 0.82) to the symmetric image and the lowest (1.60 ± 0.54) to the image with a 2 mm shift to the right. Laypersons awarded the highest score (4.29 ± 0.77) to the image with a 1 mm leftward shift and the lowest (3.45 ± 0.99) to the 2 mm rightward shift. Dental students gave their highest scores to both the symmetric (4.26 ± 0.91) and 1 mm left-shifted (4.26 ± 0.80) images, and their lowest to the 2 mm rightward shift, similar to the specialists.

There were statistically significant differences between the observer groups for all images. Pairwise comparisons of the groups are presented in Table 3.

Table 2. Comparison of scores assigned to each image by laypersons, dental students, and specialists

Image	Group	N	Mean ± SD	Min	Max	Quartile			*P-value**
						Q1	Median	Q3	
Symmetric	Laypersons	42	4.26 ± 0.89	1	5	4	4	5	**< 0.001**
	Students	42	4.26 ± 0.91	2	5	4	5	5	
	Specialists	42	4.64 ± 0.82	2	5	5	5	5	
-2 mm	Laypersons	42	3.45 ± 0.99	1	5	3	3	4	**< 0.001**
	Students	42	2.48 ± 1.06	1	5	2	2	3	
	Specialists	42	1.60 ± 0.54	1	3	1	2	2	
-1 mm	Laypersons	42	3.69 ± 0.90	2	5	3	4	4	**< 0.001**
	Students	42	3.40 ± 0.83	1	5	3	3	4	
	Specialists	42	2.19 ± 0.77	1	4	2	2	3	
0 mm	Laypersons	42	3.76 ± 0.91	1	5	3	4	4	**< 0.001**
	Students	42	3.52 ± 0.74	2	5	3	4	4	
	Specialists	42	2.69 ± 1.07	1	5	2	2	3	
+1 mm	Laypersons	42	4.29 ± 0.77	3	5	4	4	5	**< 0.001**
	Students	42	4.26 ± 0.80	3	5	4	4	5	
	Specialists	42	3.36 ± 0.73	2	4	3	3	4	
+2 mm	Laypersons	42	3.98 ± 1.00	2	5	3	4	5	**< 0.001**
	Students	42	3.62 ± 1.08	1	5	3	4	4	
	Specialists	42	2.26 ± 0.77	1	4	2	2	3	
+3 mm	Laypersons	42	4.07 ± 0.78	2	5	4	4	5	**< 0.001**
	Students	42	3.81 ± 1.02	2	5	3	4	4	
	Specialists	42	3.21 ± 1.00	1	5	3	3	4	
+4 mm	Laypersons	42	3.57 ± 0.91	2	5	3	3	4	**0.006**
	Students	42	3.36 ± 1.06	1	5	2	3	4	
	Specialists	42	2.31 ± 0.68	1	3	2	2	3	

** Kruskal-Wallis test and P<0.05 is significant.*

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Table 3. Pairwise *P*-values* for comparisons between observer groups

Image	Symmetric	+4 mm	+3 mm	+2 mm	+1 mm	0 mm	-1 mm	-2 mm
Laypersons vs Students	0.823	0.512	0.357	0.13	0.915	0.107	0.165	**< 0.001**
Laypersons vs Specialists	**0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**
Students vs Specialists	**0.014**	**< 0.001**	**0.004**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**

** Mann-Whitney U test and P<0.05 is significant.*

Significant differences in mean ratings were observed between specialists and both of the other groups across all images. However, a significant difference between laypersons and students was found only for the image with a 2 mm rightward shift.

Table 4 presents a comparison of the scores assigned to each image by laypersons, categorized by gender. Across all images, there was no statistically significant difference between male and female laypersons' ratings.

Table 4. Comparison of ratings by laypersons based on gender

Image	Gender	N	Mean ± SD	Min	Max	Quartile			*P*-value*
						Q1	Median	Q3	
Symmetric	Female	21	4.52 ± 0.51	4	5	4	4	5	0.216
	Male	21	4.00 ± 1.10	1	5	4	4	4	
−2 mm	Female	21	3.62 ± 1.16	1	5	3	4	4	0.441
	Male	21	3.28 ± 0.78	2	5	3	3	4	
−1 mm	Female	21	3.76 ± 0.94	2	5	3	4	4	0.804
	Male	21	3.62 ± 0.86	2	5	3	3	4	
0 mm	Female	21	3.81 ± 0.68	3	5	3	4	4	0.353
	Male	21	3.71 ± 1.10	1	5	3	4	5	
+1 mm	Female	21	4.38 ± 0.80	3	5	4	4	5	0.267
	Male	21	4.19 ± 0.75	3	5	4	4	5	
+2 mm	Female	21	3.81 ± 1.03	2	5	3	4	5	0.43
	Male	21	4.14 ± 0.96	2	5	4	4	5	
+3 mm	Female	21	3.95 ± 0.92	2	5	4	4	5	0.689
	Male	21	4.19 ± 0.60	3	5	4	4	5	
+4 mm	Female	21	3.52 ± 0.93	2	5	3	3	4	0.073
	Male	21	3.62 ± 0.92	2	5	3	4	4	

** Mann-Whitney U test and P<0.05 is significant.*

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Table 5 shows the significance levels (P values) for the differences in scores between each asymmetric image and the symmetric image, as evaluated by each observer group.

Table 5. *P*-values* for comparisons between each asymmetric image and the symmetric image within each group

Observer \ Asymmetric Image	-2 mm	-1 mm	0 mm	+1 mm	+2 mm	+3 mm	+4 mm
Specialists	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**
Students	**< 0.001**	**< 0.001**	**< 0.001**	0.811	**0.001**	**0.025**	**< 0.001**
Laypersons	**< 0.001**	**0.004**	**0.001**	0.917	0.234	0.185	**0.002**
Laypersons (Male)	**0.004**	0.174	0.153	0.653	0.439	0.614	0.231
Laypersons (Female)	**0.006**	**0.006**	**0.003**	0.444	**0.03**	**0.021**	**0.001**

** Wilcoxon test and P<0.05 is significant.*

From the specialists' perspective, all asymmetric images differed significantly from the symmetric one (P < 0.001). Among dental students, only the 1 mm leftward shift image did not differ significantly from the symmetric image, while the rest did (P < 0.05). Among laypersons, only the image with no midline deviation and those with a 1 mm or 2 mm rightward deviation and 4 mm leftward deviation showed significant differences from the symmetric image. Male laypersons perceived a significant difference only in the image with a 2 mm rightward shift (P = 0.004), while female laypersons showed significant differences for all asymmetric images except the 1 mm leftward shift.

Discussion

The main findings showed that dental midline deviations in the same direction as the nasal and chin asymmetry were generally perceived as less unattractive, whereas deviations in the opposite direction were more readily detected. In addition, dental specialists demonstrated the highest sensitivity to all deviations, while laypersons showed the lowest sensitivity. This finding is consistent with the study by Dong et al., which showed that chin deviation significantly affects facial esthetics and that aligning the dental midline shift with chin deviation could minimize perceived unattractiveness [17].

As one of the key focal points of a smile, the dental midline plays a significant role in facial attractiveness [11, 16]. However, soft tissue asymmetries such as nasal and chin deviations also influence the perception of facial symmetry, and focusing solely on dental midlines in orthodontic planning may be insufficient. Previous studies have shown that observers can tolerate soft tissue deviations only up to a certain threshold, beyond which the face is perceived as asymmetric or unattractive [18-20].

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Dong et al. reported that a 4-mm chin deviation in either direction was readily recognized by laypersons [17]. Hodali & Massad reported similar findings, showing that deviations up to 3 mm were still considered acceptable and even attractive in the absence of other facial structures [21].

In the present study, male laypersons perceived only the image with a 2-mm rightward dental midline shift as different, while female laypersons identified all images as different except for the 1-mm leftward shift. However, there was no statistically significant difference between male and female laypersons in the scores given to the images. This aligns with the findings of Tanbakuchi et al., who reported no gender differences in smile attractiveness ratings [22]. In contrast, Flanze et al. found that females were more sensitive to dental midline deviations and that shifts greater than 3 mm adversely affected their oral health-related quality of life [18]. Similarly, Sayahpour et al. concluded that female participants - both dental professionals and laypersons - were more sensitive to midline deviations [23].

Other factors such as ethnicity, age, and profession have also been shown to influence esthetic perception. For example, Musa et al. found that perception of midline deviation was significantly affected by the observer's ethnicity, profession, gender, and age [24]. Likewise, Sabri et al. reported that perceptions of midline diastemas varied by specialty, education, ethnicity, age, and gender [25].

In this study, final-year dental students significantly distinguished all midline deviations from the symmetric image except for the 1-mm leftward shift. Jarosz et al. also reported that general dentists were more sensitive to chin asymmetries than laypersons, likely due to their greater attention to facial and dental structures [26]. Martins et al. similarly found that dentists, particularly those specializing in esthetics, were better at detecting even minor dental midline deviations [27]. Sagunteo et al. also observed that residents in orthodontics and oral surgery perceived facial asymmetry differently, a result attributed to their specific training and clinical experience [28].

In the present study, all dental midline deviations in asymmetric images were recognized as significantly different by dental specialists, including orthodontists, prosthodontists, restorative specialists, and oral surgeons. This aligns with the findings of Sagunteo et al., where orthodontists exhibited the highest sensitivity to facial asymmetries [28]. Jarosz et al. also reported that orthodontists could detect chin deviations as small as 1–2 degrees, sensitivity levels not observed among other dentists or laypersons [26].

One limitation of this study was the use of only one image with a 3-mm nasal and chin deviation in a single direction, which precluded evaluation of different degrees or directions of asymmetry. Moreover, dental specialists were analyzed as a single group, without distinguishing between specialties. The availability of studies with comparable designs was limited.

Future research should evaluate individual dental specialties (orthodontics, restorative dentistry, oral surgery, and prosthodontics) separately. It is also recommended to assess nasal and chin deviations both independently and in combination, across various angles and intensities. Using multiple facial images with diverse soft tissue asymmetries would provide more precise data to guide treatment planning for enhancing patients' facial esthetics.

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Conclusion

Dental midline deviations should be assessed in relation to overall facial symmetry rather than in isolation. When the deviation is in the same direction as nasal and chin asymmetry, correction may offer limited esthetic benefit. Therefore, treatment decisions should consider facial asymmetry and patient expectations before pursuing complex midline correction.

Acknowledgments

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Conflict of interest

The authors declare no potential conflict of interest regarding the authorship or publication of this paper.

Author's Contribution

Ghazale Forouhar: Literature search, data acquisition, and manuscript preparation. Manouchehr Rahmati Kamel: Concepts, design, and manuscript review and editing. Seyedali Seyedmajidi: Manuscript editing and formal data analysis. Reza Faraji: Project supervision and manuscript revision. All authors read and approved the final manuscript.

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