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Influence of Chin Position in Sagittal on Facial Profile Attractiveness through Ricketts' E-Line in among Orthodontists and Laypeople: An Observational Study

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Abstract

Background: Understanding the perception of attractiveness in the chin position relative to the aesthetic level of the E-line is crucial for improving aesthetic outcomes in orthodontic. This study aimed to examine the extent to which changes in the chin position at sagittal plane relative to the E-line are observed in terms of attractiveness among laypeople, dentists and orthodontists. ***Material and methods:*** A digital portrait of adult woman was generated by artificial intelligence (AI) for the study. The image was digitally altered using Adobe Photoshop to create 3 images and presented to 60 orthodontists and 60 laypeople for evaluation of their perception of facial profile attractiveness on a visual value rating scale of (1 to 5). ***Results:*** The study results showed that a repeat measures ANOVA was conducted to examine the effect of chin position profile in relation to the E-line (based on three images) on facial attractiveness ratings, and whether this effect differed between orthodontists and laypeople. However, there was a significant interaction between image type and participant group (Wilks' Lambda Test). ***Conclusions:*** Orthodontists and Laypeople rated the retrusive chin as more attractive than the protrusive of the chin. Future research should further explore how demographic and cultural factors influence these aesthetic judgments.

Keywords: Aesthetics; Perception; Chin protrusive, Chin retrusive E-line.

INTRODUCTION

Facial attractiveness plays a crucial role in social interactions, self-esteem, and the overall perception of one's image. Among the various facial structures that contribute to facial harmony, the E-line, extending from the tip of the nose to the tip of the chin, is a primary reference in clinical practice for assessing facial proportions. The anteroposterior position of the chin particularly in profile view-has been identified as a key determinant of perceived attractiveness. [1,2]

Research indicates that the lips tend to move backward in relation to E-line due to changes in both skeletal and soft tissue structures [3] Understanding these changes is essential for developing appropriate treatment strategies, as the growth and development of the face dynamically alter both soft and hard tissues, impacting perceived attractiveness [4].

A commonly used reference in assessing facial profile esthetics is the esthetic line (E-line), drawn from the tip of the nose to the soft tissue pogonion (chin). Deviations of the lips and chin from this line are often used by orthodontists to guide treatment planning [5,6].

Numerous recent studies emphasize the complex interaction between skeletal factors, dental positioning, and soft tissues in shaping facial aesthetics [7]. For instance, nasal features can vary significantly among different skeletal classifications [8], and the interplay of the lips, nose, and chin collectively influences perceptions of attractiveness across various malocclusion patterns [9].

In clinical orthodontics, the E-line provides a standardized method for evaluating soft tissue harmony and guiding facial profile enhancement. However, there is increasing awareness that aesthetic standards vary between professionals and the public, leading to discrepancies in the perception of what constitutes an "ideal" profile. For instance, orthodontists may rely heavily on cephalometric norms, while laypersons might

prioritize more subjective or culturally informed ideals of beauty [10,11].

Recent studies have continued to explore this divergence. Alshammari *et al.,* (2023) found that orthodontists are more critical of minor deviations in lip or chin positioning relative to E-line, while laypersons are generally more tolerant [12]. Similarly, Sahu *et al.,* (2023) demonstrated that laypeople showed a broader acceptance of different chin positions, whereas dental professionals preferred profiles aligning closely with established norms. These findings suggest that professional training significantly influences aesthetic evaluations [13].

Despite the significant impact of facial profile aesthetics on social and psychological well-being, there is still a limited understanding of how cultural factors may influence the perception of lip protrusion and thickness with respect to facial attractiveness. While orthodontic treatment often aims to improve facial harmony and balance, the lack of consensus on universal beauty standards and the potential for cross-cultural variation in aesthetic preferences raises questions about the extent to which orthodontic interventions can address the diverse needs and expectations of different populations [14-19].

Furthermore, most available studies either focus on the profile as a whole or isolate the lips without considering the independent role of the chin in shaping lower facial aesthetics (Zorlu & Camcı, 2023). Therefore, the objective of this study was to evaluate the effects of chin in sagittal on Facial Profile Attractiveness through Ricketts' E-line in among Orthodontists and laypeople

MATERIALS AND METHODS

1. Study Design

This study employed a quantitative, cross-sectional design using digitally manipulated profile images to assess the impact of chin position relative to the E- line on perceived facial attractiveness. A repeated measures design was used to evaluate differences in attractiveness ratings across image types and between participant groups (orthodontists and laypeople).

2. Participants

A total of 120 participants were recruited and divided into two groups:

- **Orthodontists** (n = 60): Licensed professionals with a minimum of 3 years of clinical orthodontic experience.
- **Laypeople** (n = 60): Individuals with no formal training or background in dentistry or facial aesthetics.

Participants were selected using a convenience sampling approach through academic institutions, professional networks, and online platforms. Inclusion criteria included age between 20-40 years, normal or corrected-to-normal vision, and the ability to provide informed consent.

3. Image Preparation

Photographs were used on A4 glossy paper. To determine attractiveness, an ideal facial portrait was created using AI and edited by Adobe Photoshop CS3 (Adobe Systems Inc.), which was subsequently modified to create Three standardized profile images were used to isolate the impact of chin projection

- **Image A (Neutral):** Original profile with the chin in ideal position aligned with the E-line.
- **Image B (Retruded):** Chin digitally modified to be retruded by 3 mm behind the E-line.
- **Image C (Protruded):** Chin digitally modified to be protruded by 3 mm in front of the E-line

Each image was randomly assigned a number to reduce bias. Each photograph was printed on A4-sized glossy paper and presented to participants in random order. Each participant was given a questionnaire to rate each photograph within 30 seconds for each, from most attractive to least attractive, on a scale of (1 to 5).

Figure 1

4. Procedure

Participants completed an online questionnaire containing:

- A demographic section (age, gender, professional status)
- The three profile images presented in randomized order
- A 5-point Likert scale (1 = very unattractive, 5 = very attractive) to rate each image's overall facial attractiveness. Participants were instructed to evaluate overall profile harmony without focusing on isolated facial features.

5. Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 27.0.

- Repeated Measures ANOVA was used to analyze the effect of image type and the interaction with participant group on attractiveness ratings.
- Mauchly's Test of Sphericity was used to test the sphericity assumption. Since the assumption was violated, results were interpreted using Wilks' Lambda from the multivariate test.
- Partial eta squared (n2) was reported to indicate effect sizes.
- A p-value < 0.05 was considered statistically significant.

6. Ethical Considerations

This study followed the ethical standards of the Declaration of Helsinki. Informed consent was obtained from all participants, and anonymity and confidentiality of data were ensured throughout the research process.

RESULTS

A repeated measures ANOVA was conducted to examine the effect of chin position profile in relation to the E-line (based on three images) on facial attractiveness ratings, and whether this effect differed between orthodontists and laypeople. (Table 1:4)

A repeated measures ANOVA was conducted to examine the effect of chin position profile in relation to the E-line (based on three images) on facial attractiveness ratings, and whether this effect differed between orthodontists and laypeople. ratings (Wilks' Lambda = 0.947, F(2, 68) = 1.936, p = .149, partial n2 = .032). (Table1)

However, there was a significant interaction between image type and participant group (Wilks' Lambda = 0.490, F (2, 68) = 32.913, p <. 001, partial n2 = .360), indicating that orthodontists and laypeople rated the images differently. (Table1)

This interaction had a large effect size, suggesting that the participant group plays a major role in the perception of facial attractiveness depending on chin position relative to the E-line.

Table 1: Multivariate Tests'

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Photo	Pillai's Trace	.032	1.936[b]	2.000	117.000	.149	.032
	Wilks' Lambda	.968	1.936[b]	2.000	117.000	.149	.032
	Hotelling's Trace	.033	1.936[b]	2.000	117.000	.149	.032
	Roy's Largest Root	.033	1.936[b]	2.000	117.000	.149	.032
photo * participation	Pillai's Trace	.360	32.913[b]	2.000	117.000	.000	.360
	Wilks' Lambda	.640	32.913[b]	2.000	117.000	.000	.360
	Hotelling's Trace	.563	32.913[b]	2.000	117.000	.000	.360
	Roy's Largest Root	.563	32.913[b]	2.000	117.000	.000	.360
a. Design: Intercept + participation Within Subjects Design: photo							
b. Exact statistic							

Table 2: Tests of Within-Subjects Effects

		Measure:					
Source		Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Photo	Sphericity Assumed	4.039	2	2.019	1.718	.182	.014
	Greenhouse-Geisser	4.039	1.969	2.051	1.718	.182	.014
	Huynh-Feldt	4.039	2.000	2.019	1.718	.182	.014
	Lower-bound	4.039	1.000	4.039	1.718	.193	.014
photo * participation	Sphericity Assumed	75.172	2	37.586	31.970	.000	.213
	Greenhouse-Geisser	75.172	1.969	38.171	31.970	.000	.213
	Huynh-Feldt	75.172	2.000	37.586	31.970	.000	.213
	Lower-bound	75.172	1.000	75.172	31.970	.000	.213
Error(photo)	Sphericity Assumed	277.456	236	1.176			
	Greenhouse-Geisser	277.456	232.383	1.194			
	Huynh-Feldt	277.456	236.000	1.176			
	Lower-bound	277.456	118.000	2.351			

Table 3: Tests of Between-Subjects Effects

Measure:						
Transformed Variable: Average						
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Intercept	3004.444	1	3004.444	2650.100	.000	.957
participation	71.111	1	71.111	62.724	.000	.347
Error	133.778	118	1.134			

Table 4: Pairwise Comparisons

Measure: MEASURE_1						
(I) photo	**(J) photo**	**Mean Difference (I-J)**	**Std. Error**	**Sig.[a]**	**95% Confidence Interval for Difference[a]**	
					Lower Bound	**Upper Bound**
1	2	-.150	.140	.287	-.428	.128
	3	.108	.147	.463	-.183	.400
2	1	.150	.140	.287	-.128	.428
	3	.258	.132	.053	-.003	.520
3	1	-.108	.147	.463	-.400	.183
	2	-.258	.132	.053	-.520	.003
Based on estimated marginal means						
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).						

DISCUSSION

The present study found that while changing chin position relative to the E-line did not produce a significant main effect on attractiveness ratings across all participants, there was a significant interaction between chin position (image type) and evaluator group (orthodontists vs laypeople). That is, orthodontists and laypersons perceive the effects of chin position differently, with a large effect size for this interaction. Below is a discussion of these findings considering existing literature:

Difference Between Orthodontists and Laypersons:

The significant interaction observed indicates that orthodontists and laypeople evaluate facial aesthetics- particularly in relation to chin projection- differently. This finding is consistent with previous research showing that orthodontists are typically more sensitive to changes in craniofacial profile and more aligned with cephalometric norms, such as the E-line proposed by Ricketts (1960), compared to laypeople who rely on more holistic or culturally informed notions of attractiveness (Soh *et al.,* 2005; Rosen *et al.,* 2009).

Recent literature has reaffirmed this divide. For example, Sahu *et al.,* (2023) compared aesthetic preferences across orthodontists, dentists, and laypeople and found that professionals consistently rated profiles with idealized proportions as more attractive, whereas laypeople demonstrated greater variability in their assessments and were more tolerant of minor deviations. This aligns with the findings in the current study, where the absence of a main effect suggests that laypersons do not react strongly to subtle changes in chin projection alone.

Similarly, Alshammari *et al.,* (2023) Sign up reported that while professionals were more critical of lip position in relation to profile divergence, laypeople perceived a wider range of profiles as aesthetically acceptable. This supports the notion that orthodontic training instills a more rigid adherence to aesthetic norms, especially concerning soft tissue harmony with the E- line.

Non-significant Main Effect of Image Type:

Interestingly, the type of chin projection alone did not significantly influence attractive scores across all participants. This finding is aligned with prior studies indicating that mild deviations in profile are often not perceived as unattractive by lay observers unless the change is extreme (Nomura *et al.,* 2009; Acar *et al.,* 2022). The absence of a main effect may also suggest that chin position, while important, may not be the sole determinant of facial attractiveness. Instead, it likely interacts with other facial elements such as lip position, nasal projection, and facial type. Zorlu and Camcı (2023) highlighted the multifactorial nature of facial attractiveness perception, emphasizing that observers often evaluate faces based on overall harmony rather than isolated components. This may explain why changes in chin projection alone did not significantly affect global attractiveness ratings in the current study.

Interaction Effects and Clinical Implications:

The strong interaction effect between image type and participant group underscores the importance of considering patient perspectives during treatment planning. While an orthodontist may prioritize alignment with cephalometric norms, patients may have different expectations rooted in their social or cultural background. Discrepancies in perception between clinicians and patients can lead to dissatisfaction if not

addressed through shared decision-making (Yang *et al.,* 2021; Zhang *et al.,* 2016).

For instance, a patient might prefer a slightly retruded or protruded chin that deviates from the ideal E-line projection if it aligns with their cultural aesthetic or self-image. Recognizing these subjective factors is essential to providing patient centered care and improving treatment satisfaction.

CONCLUSION

In conclusion, while variations in chin position relative to the E-line do not significantly alter attractiveness ratings across all participants, a notable difference exists between orthodontists and laypeople in their perception of facial profiles. This suggests that professional background plays a key role in aesthetic evaluation. Recognizing these perceptual differences is essential in clinical settings to ensure effective communication and satisfaction with orthodontic treatment outcomes.

Limitations and Recommendations for Future Research:

Several limitations should be acknowledged. First, the study used digitally altered static images, which may not fully capture real-life facial dynamics. Second, only a limited range of chin modifications was tested; more extreme deviations may yield different results. Third, the study sample may not represent a wide variety of age groups, ethnicities, or cultural backgrounds, which are known to influence aesthetic preferences.

Future research should include dynamic imaging or 3D facial simulations and expand the diversity of evaluators.

Longitudinal studies could also explore how aesthetic preferences shift over time or with increased exposure to orthodontic norms.

1. Evaluate whether changes in chin position (in three digitally altered profile images) significantly affect attractiveness ratings.
2. Determine whether these effects differ between orthodontists and laypersons, thus highlighting differences in aesthetic perception.
3. Explore the interaction between image type and participant groups to identify how professional background may influence the evaluation of facial esthetics.

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