ORIGINAL ARTICLE

Differences in the visual perception of the upper dental midline deviation between orthodontically completely treated and untreated patients

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ABSTRACT

Introduction: A common reason for people to obtain orthodontic treatment is a misalignment between the upper dental midline and the midline of the face. The process of orthodontic treatment is considered to affect a patient's visual perception before and after the treatment, as well as their satisfaction with treatment, possibly due to the information received during treatment. This study aimed to analyze this visual perception of dental midline deviation differences between orthodontically completely treated and untreated patients. **Methods:** This was a cross-sectional survey of 90 orthodontic patients, 49 completely treated patients who had completed orthodontic treatment and 41 untreated patients who had not started treatment. Patients were asked to complete a Google Form questionnaire for evaluating 12 intraoral smiling photos with midline deviation and a Likert scale. Bivariate statistical analysis with the Mann Whitney test was carried out to see differences in visual perceptions between two groups. **Results:** Completely treated patients perceive a 0-1 mm (LCN/L photos) midline deviation of the upper teeth as attractive, while untreated patients perceive a 0-2 mm (LCN photos) and 0-3 mm (L photos) deviation as attractive. The statistical analysis revealed a significant difference in patient perception between completely treated and untreated groups, with a p-value of 0.001 ($p<0.05$) and a mean score of 36.5 and 53.0, respectively. **Conclusion:** There are differences in visual perception between orthodontically completely treated and untreated patients. The group of completely treated patients is more sensitive to detecting a midline deviation of the upper teeth.

KEYWORDS

Upper dental midline deviation, visual perception, completely treated orthodontic patients, untreated orthodontic patients

INTRODUCTION

In addition to correcting malpositions of teeth and jaw relationships, the objective of orthodontic treatment must be to create overall dento-craniofacial harmony to improve facial esthetics. Facial aesthetics is essential in orthodontic treatment because research has shown that a person's perception of his or her facial appearance can affect self-confidence and quality of life.[1-5] The aesthetic value of a person's face is determined, partly by the symmetry between the midline of the maxillary teeth and the face when smiling. The midline of the teeth in the maxilla that does not match the midline of the face is one of the asymmetry problems that patients are most aware of, with a prevalence of 20.70 %.[6] The desired outcome of orthodontic treatment is the placement of the maxillary central incisors at the midline of the face. Nevertheless, in certain circumstances, it is difficult to achieve, takes longer treatment duration, or may not be accomplished.[6-11]

The problem of difficult midline correction is a particular burden for the orthodontist, who must decide whether the dental midline correction should be carried out so that it completely fits perfectly with the midline of the face, requiring a longer treatment time, or whether to complete the treatment with a little deviation in the limits acceptable to the patient. Patients' satisfaction with orthodontic treatment results that do not reach the desired or ideal midline depends on how much deviation the patient can tolerate. This condition is affected by how sensitive the patient's impression of dental aesthetics is, as the patient's perception does not always align with that of their treating dentist. Due to the influence of social environment, culture, and an individual's own experiences on facial aesthetic opinions, perception variances between patients who had and had not obtained orthodontic treatment may exist. The patient's view may change based on the orthodontic treatment he or she has had and the information he or she has learned at each appointment.[6,9,11-14]

Numerous studies on the perception of dental and facial asymmetries have been performed. However, the standards for evaluating these differences continue to vary, owing to the subjective nature of the assessment. Several studies have produced contradictory findings about the perception of the midline of the upper teeth and the midline of the face by dentists, orthodontists, and laypersons. According to a study that compares esthetic smile perceptions among laypersons with and without orthodontic treatment experience and dentists, a group of dental specialists could detect a midline deviation of up to 3 mm, whereas a group

of average individuals could not.[9] Another particular study discovered that laypersons, general dentists, orthodontists, and maxillofacial surgeons had inconsistent abilities to determine the severity of asymmetry. However, a study on the perception of general dentists and laypersons towards altered smile aesthetics states that doctors are more sensitive than laypersons in assessing the deviation.[11,13] According to two different study findings, the deviation of the upper dental midline that laypersons and orthodontic patients can detect starts at 2 mm. Another study stated that laypersons could detect the midline deviation at 1-5 mm. The results of previous studies regarding the perception of the midline deviation from the midline of the face, as perceived by the laypersons, still need to be revised.[12,15,16-20]

Research on the visual perception of the deviation in upper dental midline among orthodontic patients in Indonesia is still quite limited. However, the fact is that this information can be helpful for orthodontists when deciding how to treat complex cases of the midline deviation. Therefore, the authors proposed a study to analyze discrepancies in orthodontic patients' visual perceptions of upper dental midline deviation between those who had completely treated and those who were untreated.

METHODS

The study was performed with a cross-sectional survey. The study population was orthodontic patients who had completely treated and those untreated at Rumah Sakit Gigi dan Mulut Universitas Padjadjaran (RSGM UNPAD), from 2017 to 2022. Sampling was conducted using the approach of purposive sampling to fulfill the required sample size based on the calculation, involving 40 individuals for each group.

The inclusion criteria for the group of completely treated were male and female patients who had finished their orthodontic treatment using fixed appliances, were aged 20–40 years, and were willing to be the research respondents. The inclusion criteria for the group of untreated patients were male and female patients who had never or had not yet received orthodontic treatment, were aged 20-40 years, and were willing to participate in the research. Patients who withdrew as respondents and patients with a background in dentistry or other health disciplines were excluded from this study.

Adapted from a study on maxillary dental midline deviation in the patient perspective, the study was conducted by sending patients links to Google Forms providing questions consisting of personal information, informed consent, and questionnaires to evaluate perceptions of the upper dental midline deviation.[21] The questionnaire has 12 images of a smile, six of which exhibit teeth and lips, chin, and nose (Lip, Chin, Nose/LCN) and six of which show teeth and lips only (Lip/L) with a midline deviation of 0 to 5 mm to the left. The photographs were placed randomly, and the deviation number has been eliminated. Respondents were asked to look at the photo and rate how attractive the smile was using a Likert scale with 1: very unattractive, 2: unattractive, 3: unable to tell, 4: attractive, and 5: very attractive.

Figure 1. Lip, Chin, Nose (LCN) Photos. The number indicated on each image represents the amount of deviation between the upper dental midline and the midline of the face, in millimeters (mm).[21]

Figure 2. Lip (L) photos. The number indicated on each image represents the amount of the deviation between the upper dental midline and the midline of the face, in millimeters (mm)[21]

The Spearman Coefficient of Rank Correlation test was used to evaluate the questionnaire's validity and dependability. A univariate statistical analysis of the assessment results of all respondents was carried out to

see the frequency distribution of the data obtained, and a bivariate statistical analysis with the Mann Whitney test was carried out to see differences in visual perceptions between completely treated and untreated patients. Statistical analysis was performed using the Excel Megastat version 10.4 Release 3.2.4 Mac program.

RESULTS

The validity assessment of each item in the questionnaire reveals that the r value for every photo in the questionnaire is above 0.05, indicating that every photo in the questionnaire is valid. Reliability testing results of the questionnaire using the Spearman Coefficient of Rank Correlation showed an *r value* of 0.89, meaning that the questionnaire used in the test has high reliability.

Table 1. The distribution of respondents based on gender (n=90)

Gender	Completely treated		Untreated	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Female	28	68.29	37	75.51
Male	13	31.71	12	24.49
Total	41	100	49	100

Table 1 shows the number of research subjects, along with the comparison between the group that completely treated and the group who untreated. The number of female respondents in both categories who were completely treated or untreated (68,29% and 75,51%) was greater than the percentage of male respondents (31.75% and 24.45%, respectively).

Table 2. The distribution of respondents based on age group (n=90)

Age Group	Completely treated		Untreated	
	Frequency	Percentage (%)	Frequency	Percentage (%)
20-25 years	24	58.54	36	73.47
26-30 years	8	19.51	5	10.20
31-35 years	9	21.95	6	12.24
36-40 years	0	0	2	4.08
Total	41	100	49	100

According to table 2, the age of the respondents in the completely treated group that was in the 20-25 years age is as many as 24 respondents (58.54%) and there were no respondents in the age group of 36-40 years. The untreated group consists of mostly respondents in the 20-25 age group: 36 (73.47%), and 36-40 the age group had the lowest: 2 (4.08%). The largest age group in both study groups was the 20-25 years age group, and the lowest was the 36-40 years age group.

Table 3. The perception of upper dental midline deviation among completely treated respondents. (Lip Chin Nose photo assessment) (n=41)

Questionnaire	Number of respondents based on the question categories (%)				
	Very unattractive (%)	Unattractive (%)	Unable to tell (%)	Attractive (%)	Very attractive (%)
LCN 0 mm	0	2.44	2.44	58.54	36.59
LCN 1 mm	2.44	21.95	14.63	56.10	4.88
LCN 2 mm	2.44	43.90	17.07	36.59	0
LCN 3 mm	0	48.78	21.95	24.39	4.88
LCN 4 mm	17.07	53.66	9.76	19.51	0
LCN 5 mm	34.15	41.46	9.76	14.63	0

*LCN = Lip Chin Nose

According to table 3, the perception of the completely treated respondents about the LCN photo without any deviation found the smile to be attractive (58.54%); on the LCN photo with a 1 mm midline deviation, most respondents (56.10%) also thought the smile was attractive, while with a 2 mm deviation (43.90%), as well as with the deviations of 3 mm, 4 mm, and 5 mm, most respondents considered the smile to be unattractive (48.78%, 53.66%, 41.46%, respectively). The completely treated respondents evaluated the

Lip, Chin, and Nose (LCN) photos and thought a smile with a midline deviation of 1 mm was still attractive. However, they thought a smile with a midline deviation of 2 mm or more was unattractive.

Table 4. The perception of upper dental midline deviation among completely treated respondents. (*Lip* photo assessment) (n=41)

Questionnaire	Number of respondents based on the question categories (%)				
	Very unattractive (%)	Unattractive (%)	Unable to tell (%)	Attractive (%)	Very attractive (%)
L 0 mm	2.44	7.32	4.88	65.85	19.51
L 1 mm	4.88	21.95	12.20	56.10	4.88
L 2 mm	4.88	41.46	24.39	29.27	0
L 3 mm	7.32	65.85	14.63	12.20	0
L 4 mm	24.39	56.10	7.32	12.20	0
L 5 mm	51.22	31.71	9.76	7.32	0

*L = *Lip*

Table 4 reveals that most of the respondents (65.85% and 56.10%, respectively) considered the lip (L) photos of a smile, both with no deviation and with a 1 mm deviation, to be attractive. However, of the L photos showing 2, 3, 4 mm deviation, both were considered unattractive by most respondents (41.4, 65.85 and 56.10%, respectively), and 51.22% of the respondents found the photo with a 5 mm deviation to be very unattractive. The L-photo evaluation conducted by the completely treated group determined that a smile with midline deviation up to 1 mm was still attractive. However, a smile with a midline deviation of 2 mm or more was considered unattractive.

Table 5. The perception of upper dental midline deviation among untreated respondents. (Lip Chin Nose photo assessment) (n=49)

Questionnaire	Number of respondents based on the question categories (%)				
	Very unattractive (%)	Unattractive (%)	Unable to tell (%)	Attractive (%)	Very attractive (%)
LCN 0 mm	0	0	0	59.18	40.82
LCN 1 mm	0	14.29	6.12	69.39	10.20
LCN 2 mm	0	28.57	16.33	53.06	2.04
LCN 3 mm	0	32.65	6.12	61.22	0
LCN 4 mm	14.29	40.82	18.37	26.53	0
LCN 5 mm	32.65	36.73	6.12	24.49	0

*LCN = Lip Chin Nose

Table 6. The perception of upper dental midline deviation among untreated respondents. (Lip photo assessment) (n=49)

Questionnaire	Number of respondents based on the question categories (%)				
	Very unattractive (%)	Unattractive (%)	Unable to tell (%)	Attractive (%)	Very attractive (%)
L 0 mm	0	6.12	2.04	59.18	32.65
L 1 mm	2,04	18.37	14.29	57.14	8.16
L 2 mm	0	49.64	4.08	49.98	0
L 3 mm	8.16	55.10	4.08	32.65	0
L 4 mm	24.49	44.90	8.16	20.41	2.04
L 5 mm	36.73	40.82	6.12	16.33	0

* L = Lip

Table 5 demonstrates the perception of the untreated group respondents on the Lip, Chin, and Nose (LCN) photo with no deviation; the majority assumed the smile was attractive (59.18%), on the LCN photo with a deviation of 1 mm, the respondents considered the smile was attractive (69.39%), as well as with the deviation of 2 mm and 3 mm (53.06%, 61.22%, respectively), yet on the LCN photo with a deviation of 4 mm and 5 mm, they considered the smile was unattractive (40.82% and 36.73%). The majority of untreated

group respondents in the assessment for Lip, Chin, and Nose photographs considered a smile with a midline deviation of 3 mm to be attractive, whereas a smile with a deviation beginning at 4 mm was found unattractive.

Table 6 demonstrates the perception of untreated respondents' evaluation of the lip (L) photo without any deviation. Most respondents found the smile attractive with 1 mm and 2 mm deviations (59.18, 57.14, and 49.98%). Meanwhile, most of the respondents (55.10, 44.90, and 40.82%, respectively) who assessed the deviations of 3 mm, 4 mm, and 5 mm found the smile was unattractive. The untreated group mostly thought the smile with a 2 mm midline deviation was still attractive, whereas they discovered it was unattractive starting at a 3 mm deviation.

Table 7. Mann-Whitney Test for the difference in the perception of upper dental midline deviation between respondents who completely treated and those who untreated the orthodontic treatment. (n=90)

Respondents group	Frequency	Overall mean score	*p-value*
Completely treated	41	36.5	0.001*
Untreated	49	53.0	
Total	90		

*Mann-WhitneyTest, p <0,05

According to table 7, the *Mann-Whitney* test of 90 samples of two research groups reveals that the group of untreated respondents show a higher overall mean score (53.0) than those completely treated (36.5). Moreover, there is a statistically significant difference in the perception of the deviation in the upper dental midline between those who had completely treated and untreated (p = 0.001).

DISCUSSION

Table 1 shows that the number of female respondents in both completely treated or untreated groups was greater than male respondents. Table 2 shows the largest age group in both study groups was the age group of 20-25 years, and the smallest was the age group of 36-40 years. Thus it can be concluded that the female in the age group of 20-25 is the group of people that is more aware of facial aesthetics than other groups of gender or age, and is actively seeking orthodontic treatments.

Tables 3 and 4 show the smile assessment on the questionnaire by respondents in the completely treated group. The majority of respondents classified LCN and L photos without a deviation as attractive smiles; LCN and L photos with a 1 mm deviation as attractive smiles; LCN and L photos with a 2 mm deviation as unattractive smiles; photos with a 3 mm deviation as unattractive smiles; photos with a 4 mm deviation as unattractive smiles; LCN photos with a 5 mm midline deviation as an unattractive smile; and L photos with a 5 mm midline deviation as a very unattractive smile. The assessment results by the two groups showed differences, starting with the deviation by what range was considered an unattractive smile. In the untreated group, most respondents began to consider a smile as unattractive if it had a deviation of 4 mm in photos involving the chin and nose and a 3 mm deviation in photos where only the lips were shown.

Tables 5 and 6 show the assessments of the LCN (Lip Chin Nose) and L (Lip) photos by the group of untreated respondents. Most respondents considered that photos with no deviation in the upper dental midline had an attractive smile. The photos with 1 mm to 2 mm deviations were also considered attractive. The smile in L photos with a 3 mm deviation was considered unattractive, but for LCN photos, it was still considered attractive. Photos with deviations of 4 mm and 5 mm on both LCN and L photos were considered to have an unattractive smile.

Respondents in the completely treated group began to classify smiles as unattractive when there was a 2 mm deviation of the upper dental midline in both the LCN and L photos. These results indicate a difference in visual perception between subjects who had not been treated and those who had been completely treated. Respondents receiving treatment were more sensitive to a deviation in the upper dental midline than those not. These results align with the research which showed that orthodontic treatment affected respondents' perceptions, with an increase in aesthetic perception compared to the group that had not received treatment.[17,18] This situation can arise because, during the prolonged orthodontic treatment duration, which necessitates regular meetings between the orthodontist and the patient, the orthodontist always explain each stage of treatment progress and the conditions that result in an ideal occlusion that cannot be attained with alternative treatments. The orthodontist's explanation must satisfy the patient's expectations until the patient completely understands and accepts the limits that occur. A suitable communication procedure between the patient and the doctor will favorably impact on both the patient's perception and the smooth running of the treatment.[19]

The positive impact of the interaction between patients and dentists participating in RSGM UNPAD and orthodontists as consultant lecturers are also seen in the results of this study, where completely treated respondents are more sensitive to a midline deviation because they could assess a smile with the midline deviation starting at 2 mm as an unattractive smile on both the LCN and L photos, compared to untreated respondents group, where they could rate an unattractive smile starting at 3 mm deviation on the L photo and 4 mm on the LCN photos.

The difference in sensitivity of assessing the deviation in the upper midline teeth between those who had completely treated and those who untreated possibly occur because the group who had completely treated routinely obtained information regarding the ideal arrangement of teeth. The difference in perception

between the two groups was also stated in the study where patients without a history of treatment could not detect a deviation in the upper dental midline. In contrast, patients with a history of previous treatment could detect it if it was greater than 3 mm.[9] Several other studies on the effect of orthodontic treatment experience on patients' aesthetic perceptions, concluded that after orthodontic treatment, adult patients had a higher perception of the need for orthodontic treatment compared to patients who had never undergone treatment, and concluded that orthodontic treatment has a positive effect on patient perception, as seen from the findings of this study.[8,9,20]

Tables 5 and 6 reveal a difference in the assessment of the LCN and L images with a deviation of 3 mm by untreated respondents who have not received orthodontic treatment, with the LCN photos still rated as attractive smiles. In contrast, the L photos are categorized as unattractive smiles. This disparity in assessment is likely attributable to the fact that the LCN photograph included other facial structures, which could disturb respondents due to a deviation in the midline teeth.[5] The maxillary dental midline deviation in the patient perspective's research came to a different conclusion. It showed no obvious difference between how LCN and L photos are evaluated.[21] Furthermore, the study on perception of midline deviations in smile esthetics found that if the facial structures above the lips were visible, laypersons could detect a deviation of 1 mm or more, and if only the lips were visible, it could be noticed if it was greater than 2 mm.[12]

The process of orthodontic treatment is considered to affect patient perception positively. Naturally, individuals with a history of orthodontic treatment have a better perception of facial and dental aesthetics or at least the same perception as individuals without a history of orthodontic treatment. This statement is consistent with the study findings, as presented in Table 7, which indicate significant differences in perception between completely treated and untreated patients, as indicated by their vastly different mean questionnaire scores. The group of respondents who had completed treatment mostly gave unattractive and very unattractive values, starting with a minor deviation in the midline, leading to a low overall mean score. In contrast, the group of respondents who had not received treatment generally gave more attractive and very attractive values, leading to a higher mean score.

The study on patient satisfaction with orthodontic treatment is in line with the results of this study, which show that in the group of untreated patients who had not been received orthodontic treatment, they generally have high expectations for the results of treatment, thus encouraging patients to seek information about the types of orthodontic treatment that can be done to obtain the best possible results. The group of completely treated patients may have more realistic expectations because during treatment they receive explanations about the complicating factors and limitations of treatment, even if orthodontic treatment only sometimes gives ideal results. Routine orthodontic reviews and good relations between doctors and patients are very likely to affect treatment satisfaction. Patient options of facial aesthetics, especially regarding the deviation in upper dental midline.[22] Patient awareness regarding the results of midline treatment is in line with the study of photographic assessment of smiles. The patients who were treated orthodontically were very aware of changes that occurred in their midline teeth. Regardless of whether they were corrected, partially corrected, not corrected at all, or even if there was a deviation that did not exist previously.[23] The results of this study are also in line with research done about the relationship between orthodontic treatment outcome and patient satisfaction. It stated that patients can still feel satisfied with the results of orthodontic treatment even though not all patients have an excellent ABO-MGS score. The test is used to measure the results of orthodontic treatment.[24]

The limitations of this study are the short amount of time spent collecting the samples and the fact that questionnaires were filled out online through a Google Form, which could have led to respondents not understanding the questions. To overcome this obstacle, a written explanation was provided, and it demonstrates that the questionnaire was valid and reliable to use based on the statistical test. The potential for respondents to ask questions or even request assistance from others when filling out the questionnaire is an additional shortcoming of online completion. A further condition that can influence the outcomes of completing the questionnaire is tiredness when evaluating twelve photographs that were provided. These limitations can be utilized as a basis for future research that employs the same online questionnaire. Since this research is a *cross-sectional* study with different respondents between groups who had been completely treated and untreated; so that a longitudinal study on the same respondents is required to determine whether the orthodontic treatment process is genuinely a factor influencing differences in respondents' perceptions of facial and dental esthetics, particularly the midline deviation of the upper teeth.

CONCLUSION

There are differences in visual perception between orthodontically completely treated and untreated patients. The group of completely treated patients is more sensitive to detecting a midline deviation of the upper teeth.

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Informed Consent Statement: Respondents in this study were given a statement of consent (informed consent) and a questionnaire can only be filled out if the respondent has agreed to the informed consent page.

Data Availability Statement: The availability of research data will be given with the permission of all researchers via email correspondence with due regard to ethics in research
Conflicts of Interest: The author declares no conflict of interest in the research

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