

PERCEPTION THRESHOLD, ESTHETIC ACCEPTABILITY, AND TREATMENT NEED OF MAXILLARY DENTAL MIDLINE DEVIATION AMONG UNDERGRADUATE DENTAL STUDENTS ACROSS DIFFERENT ACADEMIC YEARS: A CROSS-SECTIONAL QUESTIONNAIRE-BASED STUDY

Dr. Karthick Shetty¹, Dr. Aparna Khamatkar², Dr. Veera Sawant³, Dr Vishal Singh Pal⁴, Dr Pranita Jadhav⁵, Dr Vighanesh Kadam⁶, Dr Yashvi Oswal⁷

¹Professor, Working with (Name of Institution) – Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id - karthick.shetty@dypatil.edu, Mobile No - ²Reader/ Associate Professor, Working with (Name of Institution) - Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id- aparna.kamatkar@dypatil.edu, Mobile No - 9082523490

³Reader/ Associate Professor, Working with (Name of Institution) - Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id- veera.sawant@dypatil.edu, Mobile No - 9833649728

⁴1st Year Post Graduate, Working with (Name of Institution) - Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id- vishalspal2000@gmail.com, Mobile No - 9833231072

⁵Lecturer, Working with (Name of Institution) - Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id- pranita.jadhav@dypatil.edu, Mobile No - 8055557585

⁶Lecturer, Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Department- Orthodontics and Dentofacial Orthopaedics, Email Id- vighaneshkadam99@gmail.com, Mobile No - 7507723909

⁷Intern, Padmashree Dr. DY Patil University, School of Dentistry, Nerul, Navi Mumbai, Mobile No - 9422180021, Email Id- yashvivoswal@gmail.com

ABSTRACT

Introduction: The study investigates the relationship between dental midline deviation and perceived smile attractiveness among undergraduate dental students. It highlights the importance of facial symmetry in orthodontic treatment, noting that while many individuals possess some degree of facial asymmetry, the aesthetic implications of correcting dental midline discrepancies can be significant. The research aims to evaluate the perception threshold, aesthetic acceptability, and treatment needs related to maxillary dental midline deviations.

Methodology: A cross-sectional, questionnaire-based study was conducted among Bachelor of Dental Surgery (BDS) students at D.Y Patil Deemed to be University School of Dentistry, Navi Mumbai. After obtaining participants provided informed consent, a pilot study was conducted to ensure questionnaire clarity and feasibility. The final sample consisted of 152 students aged 18-25, selected through proportional sampling. Data were collected using a structured questionnaire assessing demographic information and perceptions of five standardized smile images with varying midline deviations. Statistical analyses were performed using SPSS, focusing on descriptive statistics and Chi-square tests to evaluate associations between variables.

Results: The study included 152 participants, predominantly aged 18-25, with a majority being female (70.4%). Smile attractiveness ratings showed a decline from Smile A (most attractive) to Smile E (least attractive). Recognition of smile asymmetry increased with the degree of deviation, and the perceived need for orthodontic treatment rose correspondingly. Gender differences were statistically significant for Smile A and Smile C in attractiveness ratings, but not in asymmetry recognition or treatment necessity. Previous orthodontic treatment history did not significantly affect asymmetry detection.

Conclusion: The findings indicate that increased smile asymmetry correlates with decreased attractiveness and a heightened perceived need for orthodontic treatment among young adults. While minor asymmetries are generally acceptable, larger deviations are easily recognized and often deemed in need of correction. Among the participants, all the dental students would detect asymmetry even in 1 mm deviations, whereas laypersons could detect them when the deviations were 2mm or more according to Ferreira et al. The study emphasizes the importance of considering patient aesthetics alongside clinical evaluations in orthodontic treatment planning.

KEYWORDS: Midline Shift, Orthodontic Treatment, Perception, Dental Students.

INTRODUCTION

The goal of orthodontic treatment is to improve the patient's face beauty, and one way to measure success in this area is by looking at the patient's frontal symmetry. The goal of orthodontic treatment is to bring the midlines of the upper and lower jaws closer together.[1] Nonetheless, most people have some degree of face asymmetry, and most people seldom notice it. [2] Although the benefits to the patient are questionable, modifying the maxillary

midline to attain complete frontal symmetry might involve difficult surgeries, lengthen treatment time, and cost a large amount of money. [3,4]

There is an assumed correlation between facial symmetry and attractiveness. Having said that, no two people's faces are exactly alike [5]. Since there are no objective scientific criteria to differentiate between typical and abnormal asymmetries, and because every human face is asymmetrical, this cannot be studied using only straight lines [6]. Having a beautiful smile is essential for a person's acceptance in contemporary culture, since it influences the first impression in relationships and is one of the most noticeable aspects of facial expression [7]. People who are self-conscious about their looks often seek out dentofacial esthetics treatments after being influenced by others' attractive features and smiles [8,9]. Considering that dentists formerly placed a far lower value on aesthetics than on function, structure, and biology, it is not surprising that they have recently begun to place a greater emphasis on them [10].

A well-placed midline adds to the harmony and balance of tooth composition, which is one of the most essential variables in determining the attractiveness of a smile [11,12]. According to Lombardi, the dental midline is the most crucial part of a beautiful smile, even from 1973 [13]. If you want to know how to appreciate face harmony and balance, you need to make sure your facial and dental midlines are coordinated. Dentofacial esthetics might suffer greatly from large midline angulation differences, while minor shifts to accommodate facial asymmetry within accepted bounds are perfectly OK [14].

As a result, the connection between the midline of the teeth and the midline of the face is one of the aspects considered in the aesthetic evaluation [15]. So, a number of studies have been conducted to determine the maximum amount that the dental midline can tilt or diverge from the face midline before it starts to look unattractive [7,16,17,18].

While Beyer and Lindauer did not discover how misaligned midline facial structures can affect the perception of dental midline abnormalities, they did state that such structures can make assessment of the dental midline position more difficult [19].

Aesthetics of the grin are influenced by facial structures; for example, a misaligned chin or nose might detract from the smile's perceived attractiveness. Orthodontic and oral rehabilitation treatment plans should take each patient's unique facial features into consideration [20].

If a patient is going to get orthodontic treatment or oral rehabilitation for facial asymmetries, the dentist must be aware of the optimal placement of the dental midline in order to make the asymmetries less obvious and increase the patient's face attractiveness.

While there is a paucity of literature evaluating the Perception Threshold, Esthetic Acceptability, and Treatment Need of Maxillary Dental Midline Deviation Among Undergraduate Dental Students Across Different Academic Years and the understanding of the distribution across gender the need to conduct the study was felt and hence the study was planned with an aim to evaluate the perception of the Threshold, Esthetic Acceptability, and Treatment Need of Maxillary Dental Midline Deviation Among Undergraduate Dental Students

METHODOLOGY

This cross-sectional, questionnaire-based study was carried out to assess the perception and awareness of dental midline discrepancy and the need for orthodontic treatment among young adults. The study was performed among the Bachelor of Dental Surgery (BDS) undergraduate students of D.Y Patil Deemed to be University School of Dentistry, Navi Mumbai. The study was carried out in compliance with the ethical guidelines of the Declaration of Helsinki. Before carrying out the study, all participants were briefed about the objectives and methodology of the study, and informed written consent was taken from them.

In addition, a pilot test was done among 30 subjects before the actual experiment was started in order to check whether the study is feasible, check the understandability of the questionnaire and the ability of the subjects to detect midlines and check any problems with data gathering. The results of the pilot study showed that the questionnaire and the standardized smile photographs were easy to understand. The participants used in the pilot study were not considered in the final analysis in order to avoid response bias.

Sample size determination was first done using the single population proportion formula, which is $n = Z^2 P(1-P)/d^2$ where Z stands for the confidence interval level (which was 95%), P represents the expected proportion (50%) due to lack of previous prevalence estimates, and d being the absolute precision of 5%, yielding a sample size of 386. Nonetheless, owing to the limited population of dental students that were present during the research period and feasibility confirmed from pilot studies, a proportional sampling technique was used. Consequently, a sample size of 152 subjects was deemed sufficient to fulfill the research objectives.

Subjects for the research were selected through a sampling approach in a proportional manner among the BDS students in the undergraduate level. Subjects that qualified for the study and consented to be involved in it consecutively participated until the sample size of 152 subjects was reached. This study involved undergraduate BDS students who were 18–25 years old, capable of comprehending the questionnaire and giving written informed consent and were available during the process of data collection. Those students with visual problems which may hinder their evaluation of the smile, students who are unable to understand the questionnaire, those who refused to participate, those who completed the questionnaires incompletely and those that took part in the pilot study were excluded from the study.

Data collection was done using a structured questionnaire administered by self-reporting after reviewing extensively literature on smile esthetics and dental midline perception. The questionnaire was divided into two parts. In the first part, demographic data was collected, which included age, gender, academic year, previous experience with orthodontics in the form of braces and aligners, and frequency of noticing the dental elements when seeing a smiling face of someone else. The second part involved assessment of five standardized smile images (Smile A-Smile E), which included different levels of increasing dental midline deviations. Participants had to assess how attractive they found the smile image on a scale from 1 (least attractive) to 5 (most attractive). Additionally, participants had to report whether they saw any asymmetry in the smile image and whether the smile image needed orthodontics, in the affirmative or negative response.

The smile photos in this experiment were made to reduce any potential bias in the observations. Five photos were all taken under exactly the same photographic parameters, including standard lighting, settings for the camera, background, dimensions of the photo, magnification factor, and the frontal angle of the smile. Modifications were made to the photos such that there was a known degree of malalignment of the teeth and nothing else was varied between the photos. (Table 1)

Table 1: Smiles and deviations

Smile A	0mm
Smile B	1mm
Smile C	2mm
Smile D	3mm
Smile E	4mm

Data gathering was done in a controlled environment using the google form as the setting. After obtaining consent, the participants would first answer the demographic survey before rating the five smiles in the pictures. Sufficient time was allowed to rate each photo independently, and the participants were instructed not to consult with anyone regarding their ratings to avoid observer bias. Once all surveys were completed, immediate checking of all completed surveys was done.

Outcome variables included the perception of smile attractiveness, perception of smile asymmetry, and the need for orthodontic treatment. The secondary outcome variables included comparison between males and females in their perception of smile attractiveness and symmetry and previous history of orthodontic treatment.

All data gathered were inputted in Microsoft Excel and further subjected to statistical analysis using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were done for all variables and categorical data were presented as frequency and percentage. For the association between gender and ratings of attractiveness of each smile photograph, gender and recognition of smile asymmetry and gender and the need for orthodontic treatment, the Chi-square (χ^2) test was employed. Moreover, Chi-square test was used to compare the association between history of orthodontic treatment and recognition of smile asymmetry for each smile photograph. All statistical tests were made at the significance level of $p < 0.05$. Results of this study were presented in tables and were interpreted to determine the impact of dental midline deviation on smile perception and recognition of smile asymmetry and need for orthodontic treatment.

RESULTS

Table 2: Distribution of Participants Age, Gender, Education Level History of Orthodontic Treatment and Frequency of Observation of Smile

		Frequency	Percentage
Age	Less than 18 Years	0	0.0%
	18 - 20 Years	71	46.7%
	21 - 25 Years	75	49.3%
	26 - 30 Years	4	2.6%
	30 Years and above	2	1.3%
Gender	Male	45	29.6%
	Female	107	70.4%
Education Level	I BDS	55	36.2%
	II BDS	36	23.7%
	III BDS	40	26.3%
	IV BDS	21	13.8%
Have you ever undergone orthodontic treatment or currently undergoing any orthodontic treatment? (Braces or aligners)	Yes	60	39.5%
	No	92	60.5%
	Never	0	0.0%

How often do you notice dental features when someone smiles?	Rarely	3	2.0%
	Sometime	36	23.7%
	Often	67	44.1%
	Always	46	30.3%

The number of the participants in this study was 152 with the largest number from 21–25 years old age category (49.3%) and the second most being 18–20 years (46.7%). The female gender occupied 70.4% of the sample, whereas the male gender comprised 29.6%. The largest number of participants was from the first year of BDS course (36.2%), followed by the third year (26.3%), second year (23.7%), and fourth year (13.8%). More than half of the participants (60.5%) did not have any history of orthodontic treatment, whereas the remaining 39.5% had their orthodontic treatment either in past or present. (Table 2)

Table 3: Distribution of the Rating of Smiles by the participants

Rating	SMILE A		SMILE B		SMILE C		SMILE D		SMILE E	
	N	%	N	%	N	%	N	%	N	%
1	6	3.9%	2	1.3%	4	2.6%	29	19.1%	59	38.8%
2	7	4.6%	30	19.7%	26	17.1%	43	28.3%	51	33.6%
3	31	20.4%	45	29.6%	36	23.7%	42	27.6%	24	15.8%
4	50	32.9%	38	25.0%	58	38.2%	19	12.5%	7	4.6%
5	58	38.2%	37	24.3%	28	18.4%	19	12.5%	11	7.2%

As far as the ratings for smile attractiveness were concerned, Smile A turned out to be the most attractive, being rated 5 by 38.2% of the study participants, and 4 by 32.9%. Smile C was also viewed as quite attractive, since 38.2% of the participants rated it 4. Smile B was mostly rated as quite attractive, since 29.6% of the participants gave it a score of 3. As for Smile D, it got mainly scores of 2 (28.3%) and 3 (27.6%). Finally, Smile E was the least attractive one with 38.8% and 33.6% getting 1 and 2 respectively. (Table 3)

Table 4: Distribution of the Patients Response towards the asymmetry of the smile

	SMILE A		SMILE B		SMILE C		SMILE D		SMILE E	
	N	%	N	%	N	%	N	%	N	%
Yes	39	25.7%	66	43.4%	66	43.4%	113	74.3%	121	79.6%
No	113	74.3%	86	56.6%	86	56.6%	39	25.7%	31	20.4%

The frequency of smile asymmetry recognition among participants increased with the degree of the smile asymmetry. It is observed that only 25.7% of the participants recognized asymmetry in Smile A, but 43.4% of participants recognized asymmetry in both Smile B and Smile C. The frequency rose sharply to 74.3% for Smile D and further rose to 79.6% for Smile E. (Table 4)

Table 5: Distribution of the Patients Response to evaluate the necessity for orthodontic treatment for the smile

	SMILE A		SMILE B		SMILE C		SMILE D		SMILE E	
	N	%	N	%	N	%	N	%	N	%
Yes	22	14.5%	65	42.8%	65	42.8%	113	74.3%	134	88.2%
No	130	85.5%	87	57.2%	87	57.2%	39	25.7%	18	11.8%

The perceived need for orthodontic treatment was found to increase with increasing smile asymmetry. Smile A needed orthodontic treatment according to only 14.5% of the participants, while Smile B and Smile C were considered to require orthodontic treatment by 42.8% of the participants. For Smile D and Smile E, the percentages were 74.3% and 88.2%, respectively. (Table 5)

Table 6: Comparison between How attractive do you find this smile and Gender

How attractive do you find this smile?		Gender				p Value
		Male		Female		
		n	%	n	%	
SMILE A	1	0	0.0%	6	5.6%	<0.05*
	2	3	6.7%	4	3.7%	
	3	2	4.4%	29	27.1%	

	4	17	37.8%	33	30.8%	
	5	23	51.1%	35	32.7%	
SMILE B	1	0	0.0%	2	1.9%	0.958
	2	11	24.4%	19	17.8%	
	3	14	31.1%	31	29.0%	
	4	5	11.1%	33	30.8%	
	5	15	33.3%	22	20.6%	
SMILE C	1	1	2.2%	3	2.8%	0.022*
	2	3	6.7%	23	21.5%	
	3	7	15.6%	29	27.1%	
	4	26	57.8%	32	29.9%	
	5	8	17.8%	20	18.7%	
SMILE D	1	4	8.9%	25	23.4%	0.076
	2	14	31.1%	29	27.1%	
	3	12	26.7%	30	28.0%	
	4	9	20.0%	10	9.3%	
	5	6	13.3%	13	12.1%	
SMILE E	1	17	37.8%	42	39.3%	0.686
	2	14	31.1%	37	34.6%	
	3	9	20.0%	15	14.0%	
	4	0	0.0%	7	6.5%	
	5	5	11.1%	6	5.6%	

A statistically significant relationship existed between gender and ratings of smile attractiveness for Smile A ($p < 0.05$) and Smile C ($p = 0.022$), where males gave ratings that were higher as compared to those by females. Nevertheless, no statistically significant gender difference was present for Smile B ($p = 0.958$), Smile D ($p = 0.076$), and Smile E ($p = 0.686$). (Table 6)

Table 7: Comparison between Do you notice any asymmetry and Gender

Do you notice any asymmetry?		Gender				p Value
		Male		Female		
		n	%	n	%	
SMILE A	Yes	12	26.7%	27	25.2%	0.854
	No	33	73.3%	80	74.8%	
SMILE B	Yes	19	42.2%	47	43.9%	0.847
	No	26	57.8%	60	56.1%	
SMILE C	Yes	20	44.4%	46	43.0%	0.869
	No	25	55.6%	61	57.0%	
SMILE D	Yes	31	68.9%	82	76.6%	0.320
	No	14	31.1%	25	23.4%	
SMILE E	Yes	37	82.2%	84	78.5%	0.605
	No	8	17.8%	23	21.5%	

There was no statistically significant relationship between gender and identification of asymmetry in smile for any of the five smiles (all $p > 0.05$). Both males and females exhibited equal ability to recognize asymmetric smiles. (Table 7)

Table 8: Comparison between Does this smile require orthodontic treatment and Gender

Does this smile require orthodontic treatment?		Gender				p Value
		Male		Female		
		n	%	n	%	
SMILE A	Yes	10	22.2%	12	11.2%	0.079
	No	35	77.8%	95	88.8%	
SMILE B	Yes	24	53.3%	41	38.3%	0.089
	No	21	46.7%	66	61.7%	
SMILE C	Yes	21	46.7%	44	41.1%	0.530
	No	24	53.3%	63	58.9%	

SMILE D	Yes	34	75.6%	73	68.2%	0.368
	No	11	24.4%	34	31.8%	
SMILE E	Yes	40	88.9%	94	87.9%	0.857
	No	5	11.1%	13	12.1%	

There was no statistically significant difference in perceived need for orthodontic treatment among men and women based on any of the smile images presented to the participants ($p > 0.05$). (Table 8)

Table 9: Comparison between do you notice any asymmetry and previous history of orthodontic treatment

Do you notice any asymmetry?		Previous History of orthodontic treatment? (braces or aligners)				p Value
		Yes		No		
		n	%	n	%	
SMILE A	Yes	20	33.3%	19	20.7%	0.081
	No	40	66.7%	73	79.3%	
SMILE B	Yes	27	45.0%	39	42.4%	0.752
	No	33	55.0%	53	57.6%	
SMILE C	Yes	23	38.3%	43	46.7%	0.308
	No	37	61.7%	49	53.3%	
SMILE D	Yes	43	71.7%	70	76.1%	0.543
	No	17	28.3%	22	23.9%	
SMILE E	Yes	46	76.7%	75	81.5%	0.469
	No	14	23.3%	17	18.5%	

There was no statistically significant difference in ability to recognize asymmetry in the smile pictures for those who had received orthodontic treatment previously and those who did not. All p-values were greater than 0.05. (Table 9)

DISCUSSION

Smile esthetics have great significance in determining one's facial beauty, confidence, and interpersonal relationships. Of all the variables affecting smile esthetics, the position of the dental midline has been shown to be one of the most significant variables affecting smile harmony and esthetics [1,2]. This study showed that as smile asymmetry was increased, subjects rated it as less attractive, detected smile asymmetry more often, and recommended orthodontic treatment more often. This study confirms the observations that smile attractiveness has been found to be affected by the degree of dental midline deviation [21–24].

It was seen from the demographic data of the current study that the majority of subjects belonged to the targeted age group of 18-25 years and were female subjects. It was noted that more than two-thirds of the subjects observed dental features while communicating with people, which indicated high awareness concerning smile aesthetics. This trend is also common amongst young adults due to their increased interactions on various social media platforms and other social gatherings [21,24].

Attractiveness scores achieved through the current research showed a gradual decline in attractiveness from Smile A to Smile E. The highest attractiveness scores were awarded to Smile A, while Smile E always scored the lowest attractiveness score. These results are consistent with the findings of Harshini et al., which stated that smiles with minimum midline deviations and the most optimal gingival display were rated as the most attractive smiles, with any increases in deviations significantly reducing attractiveness scores. Professional opinions were stricter in their evaluations than laypeople, but there was a common trend in decreased attractiveness with increased asymmetry [21].

Hodali and Massad showed that laypeople viewed smiles with the smallest dental midline deviations as significantly more attractive than those with greater deviations. According to their findings, dental midline deviations of greater than approximately 3 mm resulted in greatly reduced attractiveness scores, which can be considered analogous with the current study, where Smile D and Smile E scored the lowest attractiveness scores [22].

Detection of asymmetry in the smiles also gradually improved from Smile A to Smile E. Only 25% could recognize smile asymmetry in Smile A while more than 75% detected asymmetry in Smile E. This proves that detection of smile asymmetry improves in direct proportion to the degree of asymmetry. Likewise, comparative studies done on smile esthetics for orthodontists, dentists, and laypeople have found that midline deviations improved the chances of detection regardless of the group of observers [23].

One of the main findings from the current research was the increasing tendency to the perception of the necessity for orthodontic treatment as the level of smile asymmetry increased. While a relatively low percentage of participants thought that Smile A required treatment, almost nine in ten participants suggested orthodontic correction of Smile E. Similar results were obtained in the study conducted by Harshini et al., in which the

preference of participants toward orthodontic correction was found to be dependent on the degree of the upper dental midline deviation and gingival display [21].

Gender comparison in the current investigation showed statistical significance only with respect to the ratings of Smile A and Smile C for attractiveness, with asymmetry recognition and treatment recommendation not being significantly different between men and women. The same was noted in the findings of Hodali and Massad, wherein they found out that there is no gender influence on the perception of smile attractiveness and the threshold for asymmetry detection of the teeth [22].

Orthodontic treatment experience in the past also failed to have any significant effect on detection of smile asymmetry in the current research. Even though subjects who had prior orthodontic treatment exhibited better ability to detect asymmetry in some smiles, the difference was not statistically significant. This means that individual orthodontic experience does not play an important role in enhancing aesthetic perception skills. This has also been confirmed by other research comparing perception of smiles by orthodontists, dentists, and laymen, where professional training played a major role in smile perception [21,23].

Although there is general agreement between the current results and those of previous research, some discrepancies have been noted. Hodali and Massad noted that individuals who do not practice dentistry usually find that dental midline displacement up to 3 mm to be esthetically pleasing [22]; however, the results from the current study revealed that greater levels of asymmetry led to lower levels of attractiveness and higher treatment needs. Differences could be due to the methodological discrepancies in image manipulation. In this study the authors assessed male and female laypersons separately and concluded that there was no statistically significant difference between them for detecting midline deviations. Both the groups stated that deviations up to 3mm could be considered aesthetic.

Another recent comparison study conducted by Ravichandra et al. found out that orthodontists are much more sensitive in recognizing dental midline discrepancy in the upper jaw, gingival show, canting of the maxilla, asymmetrical lip lift, and chin deviation compared to general dentists and nonprofessionals. However, the current study focused on the perception of young adults [23].

It was also proved by Johnston et al. that an increase in dental-to-facial midline discrepancy had a significant negative effect on the attractiveness of smiles for both groups of orthodontists and young laypeople. It was shown in the study that orthodontists had higher sensitivity to minor deviations than laypeople, which means that the skill of the observer influences the assessment of dental midline discrepancies. In this study the laypeople were able to detect deviations when there was a discrepancy of 2mm. The study also showed consistent higher probability for orthodontists in detecting facial midline discrepancy for 0-8mm range. [25]

Ferreira et al. showed some critical findings regarding the visibility of small maxillary midline deviations by laypersons. This study involved 95 laypersons and used images with deviations of 1 to 5 mm. The research found that laypersons could detect even 1-mm midline deviations in teeth when the lips, chin, and two-thirds of the nose were shown. In cases where only the lips were shown, midline deviations of 2 mm and above could be detected. The research, therefore, showed how facial structures may affect the detection of small dental midline deviations. [26]

The current results also show that as the deviation becomes more obvious, they are more easily detected and more likely to require orthodontic intervention. The results from the two studies above are also applicable to the current study although the current one focuses on the differences in detection among students of different years of study. This is because the current participants had more exposure to dentistry vocabulary, tooth anatomy, occlusion, and aesthetics than the general public participants in the study by Ferreira et al. [26]

However, it needs to be noted that not all undergraduate dental students involved in the current study can be regarded as being similar in terms of their level of dental knowledge and clinical experience since they are at different stages of education. Hence, they are more likely to be closer to the laypersons in terms of their results rather than their senior colleagues. Thus, the current study can give an intermediate viewpoint between studies conducted with laypeople and dental practitioners.

The methodological differences among three studies, by Hodali et al. [22], Johnston et al [25] and Ferreira et al. [26], further emphasize the importance of the photographic context when interpreting midline perception. The present study used standardized smile photographs in which the photographic parameters were kept constant and the dental midline deviation was altered while other features were maintained. This standardization strengthens the internal consistency of the comparisons between the five smile conditions.

It would seem that there is a notable difference between the perception of dental midline shift in the maxillary arch compared to the mandibular arch. In their work, Sayahpour et al. [27] showed that the impact of upper dental midline shift on perceived facial attractiveness was highly significant, with dentists identifying the impact at a 1 mm shift and laypeople at a 2 mm shift while lower dental midline shift did not have any significant impact on perceived attractiveness. This study clearly illustrates the aesthetic importance of the upper dental midline and can serve as an explanation of why an increase in the maxillary midline deviation decreases attractiveness.

In the present study the frequency of smile asymmetry recognition among participants increased with the degree of the smile asymmetry. More than 70% of participants could recognise the asymmetry of the smile when deviation was of 4mm. Whereas, 43.4% recognised the asymmetry with the deviation of 1 or 2mm. And 74.3% recognised symmetry in a 0mm deviated smile. As such, the results from the current research are consistent with the accumulating literature on the acceptability of mild dental midline asymmetries in young adults, and how more

pronounced asymmetries can negatively affect smile attractiveness, increase perception of asymmetry, and the need for orthodontic intervention. This clearly highlights the need to consider patients' perception along with their clinical evaluation in orthodontic assessment and treatment [21–24].

This study has various strengths that contribute to the reliability and application of the results in clinical practice. First, the study was carried out in a sample of young adults between the ages of 18 and 25, whose focus is usually more on the appearance of their faces and smile. Therefore, the results of this study can be applied to orthodontic patients of this age group. Standardized smile photographs were used in this study, which ensures a consistent presentation of smile images and reduces observer biases. Besides evaluating the attractiveness of the smile, the study considered three major aspects of the perception of smiles, which include ratings of smile attractiveness, smile asymmetry, and orthodontic treatment needs. The authors of the present research exclusively studied the maxillary midline deviation. This enables one to have a comprehensive evaluation of the aesthetic judgment of participants. Moreover, this study included participants with previous experience of orthodontic treatments as well as those who did not undergo orthodontic treatment before, thus allowing the evaluation of the effect of previous orthodontic experiences on the perception of smiles. Statistical analysis was appropriately done in order to compare different responses based on gender and experience of orthodontic treatments.

Despite the numerous merits of the study, there are some aspects of its design that need to be taken into consideration when discussing the results. Firstly, the research has been carried out in one single dental institution, which may limit the generalization of the results for the populations with various educational, cultural, and socioeconomic backgrounds. Moreover, the sample of the study included a large number of female respondents, which could impact the total perception of smile aesthetics although no gender differences have been revealed in most study variables. Since the respondents were mostly dental students, they might have had higher knowledge about dental aesthetics compared to the general population, which limits extrapolation of the results. The aesthetic evaluation was done using two-dimensional static photographs; thus, it does not fully imitate the dynamic aspect of smiling during social interaction. Finally, the study evaluated smile asymmetry due to dental midline deviation but did not take into account the other important factors of smile aesthetics, such as smile arc, buccal corridor, tooth shape, tooth color, gingival show, facial symmetry, and lip morphology, which could also impact smile perception. Furthermore, a cross-sectional design cannot allow evaluating the change in aesthetic perception over time or after orthodontic treatment. The future multicenter studies with larger and more diverse samples, evaluation of dynamic smile, and comparison of smile perception between laypeople, dental professionals, and orthodontists are needed.

CONCLUSION

The current study found out that increased smile asymmetry led to decreased smile attractiveness, increased perception of malocclusion, and increased need for orthodontic intervention among young adults. Small asymmetries were aesthetically acceptable while large ones could be easily identified and needed orthodontic intervention. Among the participants, all the dental students would detect asymmetry even in 1 mm deviations, whereas laypersons could detect them when the deviations were 2mm or more according to Ferreira et al. Gender and history of orthodontics had little impact on asymmetry perception and orthodontic treatment. This study underscores the need for taking into consideration patient aesthetics along with clinical considerations in orthodontic diagnosis and treatment planning

REFERENCES

1. Arnett W. G, Bergman R. T. Facial keys to orthodontic diagnosis and treatment planning—Part II. *Am J Orthod Dentofacial Orthop.* 1990;103:395–411. doi: 10.1016/s0889-5406(05)81791-3.
2. Bishara S. E, Burkey P. S, Kharouf J. G. Dental and facial asymmetries: a review. *Angle Orthod.* 1994;64:89–97. doi: 10.1043/0003-3219(1994)064<0089:DAFAAR>2.0.CO;2.
3. Nanda R, Margolis M. J. Treatment strategies for midline discrepancies. *Semin Orthod.* 1996;2:84–89. doi: 10.1016/s1073-8746(96)80046-6.
4. Prokopakis E., Vlastos I., Picavet V., Trenite G.N., Thomas R., Cingi C., Hellings P. The golden ratio in facial symmetry. *Rhinol. J.* 2013;51:18–21. doi: 10.4193/Rhino12.111.
5. Wang B.T.T., Wessels L., Hussain M.G., Merten M.S. Discriminative Thresholds in Facial Asymmetry: A Review of the Literature. *Aesthetic Surg. J.* 2017;37:375–385. doi: 10.1093/asj/sjw271.
6. Silva B.P., Mahn E., Stanley K., Coachman C. The facial flow concept: An organic orofacial analysis—The vertical component. *J. Prosthet. Dent.* 2019;121:189–194. doi: 10.1016/j.prosdent.2018.03.023.
7. Thomas J.L., Hayes C., Zawaideh S. The effect of axial midline angulation on dental esthetics. *Angle Orthod.* 2003;73:12940555. doi: 10.1043/0003-3219(2003)0732.0.CO;2.
8. Machado A.W. 10 commandments of smile esthetics. *Dent. Press J. Orthod.* 2014;19:136–157. doi: 10.1590/2176-9451.19.4.136-157.sar.
9. Campos L., Costa M.A., Bonafé F.S.S., Marôco J., Campos J.A.D.B. Psychosocial impact of dental aesthetics on dental patients. *Int. Dent. J.* 2020;70:321–327. doi: 10.1111/idj.12574.
10. Samorodnitzky-Naveh G., Geiger S.B., Levin L. Patients' satisfaction with dental esthetics. *J. Am. Dent. Assoc.* 2007;138:805–808. doi: 10.14219/jada.archive.2007.0269.

11. Miller E.L., Bodden W.R., Jamison H.C. A study of the relationship of the dental midline to the facial median line. *J. Prosthet. Dent.* 1979;41:657–660. doi: 10.1016/0022-3913(79)90065-9.
12. Tjan A.H., Miller G.D., The J.G. Some esthetic factors in a smile. *J. Prosthet. Dent.* 1984;51:24–28. doi: 10.1016/S0022-3913(84)80097-9.
13. Lombardi R.E. The principles of visual perception and their clinical application to denture esthetics. *J. Prosthet. Dent.* 1973;29:358–382. doi: 10.1016/S0022-3913(73)80013-7.
14. Janson G., Branco N.C., Fernandes T., Sathler R., Garib D., Lauris J. Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness. *Angle Orthod.* 2011;81:153–161. doi: 10.2319/040710-195.1.
15. Khan M.F., Sharaz S., Shariff M., Alam M.K., Binhomran F.M., Almathami S.A. Discord Between the Facial and Maxillary Midline and Intermaxillary Midline Among the Population of Asir, Saudi Arabia. *Pesquisa Brasileira em Odontopediatria e Clínica Integrada.* 2019;19:1–8. doi: 10.4034/PBOCI.2019.191.132.
16. Kokich V.O., Ma H.A.K., Shapiro P.A. Comparing the Perception of Dentists and Lay People to Altered Dental Esthetics. *J. Esthet. Restor. Dent.* 1999;11:311–324. doi: 10.1111/j.1708-8240.1999.tb00414.x.
17. Gul-e-Erum E., Fida M. Changes in smile parameters as perceived by orthodontists, dentists, artists, and laypeople. *World J. Orthod.* 2008;9:132–140.
18. Silva B.P., 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.* 2018;30:119–125. doi: 10.1111/jerd.12347.
19. Beyer J.W., Lindauer S.J. Evaluation of dental midline position. *Semin. Orthod.* 1998;4:146–152. doi: 10.1016/S1073-8746(98)80016-9.
20. Silva B.P., Jiménez-Castellanos E., Martínez-De-Fuentes R., Greenberg J.R., Chu S. Laypersons' perception of facial and dental asymmetries. *Int. J. Periodontics Restor. Dent.* 2013;33:e162–e171. doi: 10.11607/prd.1618.
21. Harshini PR, Rajesh RNG, Kondody R, Anushree MK, Roopa K. Perception of smile attractiveness based on upper dental midline shift and gingival display among dental professionals and general population: a questionnaire-based study. *Cureus.* 2025;17(12):e99173. doi:10.7759/cureus.99173. PMCID: PMC12796864.
22. Hodali L, Massad N. The impact of midline deviation on smile attractiveness: a cross-sectional study among laypersons. *Cureus.* 2025;17(2):e79479. doi:10.7759/cureus.79479. PMCID: PMC11933446.
23. Ravichandra S, Riyaz K, Manjappa LS, Talwar A, Mogaveera NKN, Ghosh PP, et al. Comparative assessment of smile attractiveness perception and treatment need across dental professionals and laypersons. *Cureus.* 2025;17:e94037. doi:10.7759/cureus.94037. PMCID: PMC12591280.
24. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. *Am J Orthod Dentofacial Orthop.* 2003;124(2):116–127.
25. Johnston CD, Burden DJ, Stevenson MR. The influence of dental to facial midline discrepancies on dental attractiveness ratings. *The European Journal of Orthodontics.* 1999 Oct 1;21(5):517-22.
26. Ferreira JB, Silva LE, Caetano MT, Motta AF, Cury-Saramago AD, Mucha JN. Perception of midline deviations in smile esthetics by laypersons. *Dental press journal of orthodontics.* 2016;21(06):51-7.
27. Sayahpour B, Eslami S, Usherenko R, Jamilian A, Gonzalez Balut M, Plein N, Grassia V, Nucci L. Impact of dental midline shift on the perception of facial attractiveness in young adults. *Journal of clinical medicine.* 2024 Jul 5;13(13):3944 .