The impact of the degree of upper and lower midline deviation on the aesthetic

By Malath Azeez Alsaadi

TYPE OF ARTICLE: Original Article

The impact of the degree of upper and lower midline deviation on the aesthetic

Zainab Mahmood Al-Jammali[1], Aoss Moez Abed –Alhussian Alyassery[2] , Anas Al-Yasiry[2], Malath Azeez Alsaadi[2]

[1]Prosthodontics Department, College of Dentistry, University of Babylon, Iraq

[2] Department of Basic Science, College of Dentistry, University of Babylon, Iraq

corresponding author

Email: malathazeez1122@gmail.com.

ABSTRACT

Background and Objectives. Patients' concerns about aesthetics have grown significantly, and the midline is the most critical area of a smile from an aesthetic standpoint. To investigate the impact of the degree of deviation of the dental midline on the patient's aesthetic for establishment of acceptable midline deviation for artificial teeth arrangement in Iraq.

Materials and Methods. 300 undergraduate students with an age range $(18-25)$ years were included to estimate of aesthetics using the Visual Analog Scale. After marking the values assigned to the esthetics of the smile on their respective scales, the researchers determine the distance between the pupils of the eyes with the aim of drawing a straight vertical line down the patient's face. Once the patient is smiling and the upper and lower teeth are in occlusion, we determine if there is a midline deviation or if the upper midline and lower midline coincide with the midface.

Results. the majority of UML (upper midline) and LML (lower midline) was to the left (61.46%) and (62.41%) respectively, the degree of deviation(1-1.5mm) with the largest percentage (55.21%), for

upper midline, furthermore, the highest mean value of Visual Analog Scale that impact esthetic was (4mm).

Conclusions. the dental midline may be precisely aligned with the mid face line or at a small deviation from the mid face line (not > 2 mm). The bulk of lower midline deviation as well as the upper midline deviation are to the left, and there is a very significant association between them

Keywords: Aesthetics, Dental midline, Denture esthetic, Facial midline, Midline deviation

Abbreviations:

FM -facial midline

UML = upper midline

LML = lower midline

VAS= Visual Analog Scale

INTRODUCTION

Patients' concerns about aesthetics in dentistry have grown significantly, and this is frequently the main reason they seek treatment. The midline is the most critical area of a smile from an aesthetic standpoint. Although perfect bilateral symmetry seldom achieved, it is crucial characteristics that determine how charming a smile is. The desired impact of balance and harmony in the dental composition is enhanced by a properly positioned midline [1].

The two maxillary central incisors will be divided by an imaginary line called (dental midline). Midline deviations or symmetry are noted as contemporaneous or non-coincidental to the face and to one another. Authors who have addressed themselves to this matter argued this subject differently. One school advocate employing landmarks like the incisive papilla and the labial frenum to establish the midline of the anterior teeth precisely in the mid face (MF). On the other hand, other researchers disagree with the above idea because doing so creates a false appearance, the dental midline (DML) virtually should not be placed exactly in the MF [2]. Omar and Duarte [3] explained that asymmetries might have either hereditary or non-genetic causes, and are typically caused by a mix of both.

The landmarks that fall in the middle of facial and skeletal images can be used and correlated with the DML (dental midlines) to find the amount of deviation, as the inter-pupillary line and other lines parallel to it as a horizontal reference line used in facial analysis. Similarly, the vertical midline established by two anatomical reference points, the nasion and the filtrum [4]. The feeling of complete congruence of the face increases as this line becomes more perpendicular to the inter-pupillary line [5]. When possible, the maxillary DML should coincide with the MF; however, if this is not possible, it should parallel to MF line [6].

A dental to facial midline difference of more than two millimeters is deemed unsatisfactory esthetically by Johnston et al [7], whereas, Coachman et al [8] revealed in their study, that differences of up to 4mm could remain unnoticed. Though, others, proposed that the precise dental midline has the potential to look artificial [9-11].

Pinho et al [12] conducted a study in which they evaluated the difference in perceptions among prosthodontists, orthodontists, and lay persons regarding the midline shift and smile esthetics. They concluded that orthodontists can appreciate even 1-mm discrepancy in the facial and dental midline, while prosthodontists can perceive a midline shift of 2.2 mm. Yet, to which extent the degree of deviation has an effect on the aesthetic still uncertain.

The aim of this study was to investigate the impact of the degree of deviation on the patient's aesthetic, with the null hypothesis that (1,2,3,4 mm) or more deviation of DML from MF will negatively impact the aesthetic after assessing the coincidence of DML with MF and the coincidence between UML and LML.

MATERIALS AND METHODS

Sample

The study was conducted on 300 students from the College of Pharmacy, 196 male and 104 female. They ranged in age from 18 to 25 years. The inclusion criteria: full dentition, no history of orthodontic issues (crowding or spacing, etc.), no missing teeth, and no jaw surgery for cosmetic reasons, no visible asymmetry or abnormality on the face or dental arch, history of genetic diseases or injuries that may have affected facial form and look, and a person with a squint eye should also be avoided.

Method:

First, tell the patient to sit up straight in a dental chair, to look at something in front of him, and to smile a little, the scores are then marked by the dental undergraduate students using a Visual Analog Scale (VAS) [13] that ranges from zero to ten, score zero representing the greatest aesthetic effect of shifting in midline and score 10 representing the least aesthetic effect, the time limit for evaluating the esthetic of smile was 20 seconds in order to enable the evaluators to assign a score to the smile on the VAS.

After marking the values assigned to the esthetics of the smile on their respective scales, the researchers determine the distance between the pupil of the eyes with a Digital vernier caliper for the aim of drawing a straight vertical line down the patient's face and a point that is fixed with an indelible pencil between the eyebrows, and the DML can be demonstrated in relation to the MF (Figure 1).

Once the patient is smiling somewhat and the upper and lower teeth are in occlusion, the upper dental midline (UML) noticed, after that we determine if there is a midline deviation or if the UML coincide with the MF. If there is a difference between the UML and the MF, we measure the magnitude of the difference with a periodontal probe and note whether it is to the left or to the right.

Accordingly , we determine whether the LML coincides with the MF or there is a midline shift, fig.(1). Finally, the congruence of UML with LML was evaluated.

Ethical approval:

This study was given approval by the Institutional Review Board Committee 5487 (in 12/06/2023). Every subject gave their informed consent. All procedures were carried out in conformity with the applicable rules and regulations. "We undersign and certificate that we have obtained the written consent of the identified persons or their legal guardians for the presentation of the cases within the present scientific paper."

Statistical Analysis:

The Statistical Package for Social Science: Software, version 21.0 (IBM Corp., Armonk, USA) is used to gather and analyze the data for this study. The variables were expressed using percentages and frequencies. Chi-Square tests were employed to analyze the relationship between the variables, and a result of $p < 0.05$ was regarded as statistically significant.

RESULTS

The study found that the majority of the participants 65.3% was men, (table 1).

68% of the observed individuals showed no congruence between upper midline(UML) and mid face line ,while 55.7% of the sample revealed incongruence of lower midline(LML) and mid face line.(Table 2, Figure 1)

demonstrates that

The majority of UML deviation was to the left (61.46%) ,as well as the majority of LML deviation was to the left (62.41%) (Table 3).

The highest degree of deviation recorded was (1 -1.5 mm) in about (55.21%) and (55.64%) for the UML and LML respectively. Whereas, (4mm) degree of deviation was the lowest (3.12%) and (0.76%) for the UML and LML respectively.

According to VAS sore evaluation the greatest effect of midline shifting on esthetic was at (4mm) degree for the UML and LML from the MF line, while the lowest degree of midline shifting effect of esthetic was at (1-1.5mm) (Table 3)

For the current sample, a highly significant association between the UML and LML at $p < 0.05$ was observed in regard of shifting or congruency (Table 4).

When the data of current study was correlated, a significant correlation p<0.05 found between gender and the overall assessment of the congruence between the MF and the UML, as well as MF and the LML (Table 5). Males showed more incongruence between facial midline and dental midlines than females.

DISCUSSION

The positioning of the maxillary and mandibular central incisors affect the symmetry and aesthetics of dentures and it is crucial in establishing adequate prosthetic occlusion. Patients have high expectations for the aesthetics from the anterior teeth [9]. As a result, the goal of the current study was set to determine the degree of deviation and its effect on aesthetic in normal individual to establish acceptable degree of deviation during the arrangement of artificial teeth.

In the current study inter-pupillary distance was used to determine facial midline. This could be explained that although the face midline has been identified using a variety of anatomical landmarks; however, the soft tissue landmarks around the mouth are influenced by the quantity of tissue, making the measure of the correct inter-pupillary distance more accurate. Furthermore, a person's overall body mass index and muscle tone as well as age alterations might alter the dynamic relationship of soft tissue landmarks [5,14,15].

In our investigation, the majority of the sample had incongruence between UML and MF, that consistent with Eskelsen et al's work, who discovered that the inter-pupillary midline did not coincide with the UML in 38% of the subjects [16], while it differs with Nold et al.'s finding that 85% of people had coincided MF and DML [17]. Similar findings were observed in a study conducted in Saudi Arabia [18], where 88.10% of the participants had UML coincided with MF, as well as the outcomes attained by Miller trial [19]. An explanation for that variation could be the sample size included in this study.

(55.7%) of the individuals included in the recent study had non-coincided lower DML with MF and this is in a consistent with a study by Bhateja et al. [20], which discovered a greater value deviation of 68.3% between the LML and the MF, this may be because the mandible or maxilla be positioned improperly in relation to the facial bones leading to skeletal asymmetries, or as a result of activities like thumb sucking, early loss of deciduous teeth, displacement or deformation of the maxillary or mandibular dental arches, which can cause dental asymmetry.

In the current study most of the deviation observed to the left. This finding concur with those of Mehwish Khan in that the majority of UML and LML deviations were to the left [21], also agree with Eskelsen et al [16], who reported that the left side is the most common direction in which the UML deviates.

About the degree of deviation, (1 -1.5 mm) was significantly higher than other degrees and (4mm) deviation was the lowest for the UML and LML, that agree with other studies conclusions that the largest mean of VAS score to evaluate the effect of shifting on esthetic was (4mm) followed by (3mm) for UML deviation and the lowest effect on esthetic was (1-1.5mm) [20,22].

Nevertheless, the deviation in LML, even at 4mm degree found to have lower impact (high VAS score) on the esthetic. This result can be explained by the fact that the maxillary anterior teeth are mainly visible during function and grin, and that the UML and MF alignment is more crucial for better aesthetic results than the LML and MF congruency [14].

Additionally, at p<0.05, there is a strong correlation between the gender and the degree of congruence of the MF and dental midlines, and this finding goes with Miller et al [5]. Inversely, the current finding disagree with Melo et al [24] , who found insignificant difference between Caucasian male and female regarding the deviation in dental and facial midlines. This disagreement may be explained by the difference in ethnic group involved in the current study.

The findings above may have a significant impact on the arrangement and choice of teeth in complete and removable partial dentures for male and female patients in our country according to our study aim [23,25].

CONCLUSION

When placing artificial teeth, the DML may be precisely aligned with the MF line or at a small deviation from the MF line (not > 2 mm). A large portion of the sample had neither an upper nor a lower dental midline and facial midline congruence. The most of the lower ML deviation as well as the upper ML deviation were to the left. There is a significant correlation between the sex and the overall evaluation of the coinciding between the MF line and UML as well as between the MF line and LML.

CONFLICT OF INTEREST

"We undersign and certificate that we do not have any financial or personal relationships that might bias the content of this work."

AUTHOR'S CONTRIBUTIONS

Conceptualization, Z.A. and A.A.; methodology, Z.A.; software, M.A.; validation, Z.A., A.A., A.Alyasiry; M.A.; formal analysis, M.A.; investigation, A.A.; resources, A.Alyasiry.; writing—original draft preparation, z.A.; writing—review and editing, M.A.; visualization, A.A. All authors have read and agreed to the published version of the manuscript.

ACKNOWLEDGEMENTS

REFERENCES

1. Thomas JL, Hayes C, Zawaideh S. The effect of axial midline angulation on dental esthetics. Angle Orthod. 2003 Aug;73(4):359-64. doi: 10.1043/0003-3219(2003)073<0359:TEOAMA>2.0.CO;2. PMID: 12940555.

2. Sharma, P. K. and Sharma, P. Dental Smile Esthetics: The Assessment and Creation of the Ideal Smile. Seminars in Orthodontics.2012;18(3): 193–201.

3. Chaaban M, AlSulaiman A, Kantarci A, Stashenko P, Will LA, Motro M. Longitudinal changes in the dental arch width and symmetry in identical and fraternal twins. Am J Orthod Dentofacial Orthop. 2022 Sep;19:S0889-5406(22)00468-1. doi: 10.1016/j.ajodo.2021.06.026.

4. Omar D, Duarte C. The application of parameters for comprehensive smile esthetics by digital smile design programs: A review of literature. The Saudi dental journal. 2018 Jan 1;30(1):7-12.

5. Blatz MB, Chiche G, Bahat O, Roblee R, Coachman C, Heymann HO. Evolution of aesthetic dentistry. Journal of dental research. 2019 Nov;98(12):1294-304.

6. Delli K, Livas C, Sculean A, Katsaros C, Bornstein MM. Facts and myths regarding the maxillary midline frenum and its treatment: a systematic review of the literature. Quintessence Int. 2013 Feb;44(2):177-87. doi: 10.3290/j.qi.a28925.

7. Johnston CD, Burden DJ, Stevenson MR. The influence of dental to facial midline discrepancies on dental attractiveness ratings. Eur J Orthod, 1999; 21:517-22.

8. Coachman C, Calamita MA, Sesma N. Dynamic documentation of the smile and the 2D/3D digital smile design process. Int J Periodontics Restorative Dent. 2017 Mar 1;37(2):183-93.

9. Al-Jammali ZM, Hameed HA, Alam MK. The Effect of Several Factors on the Patient's Satisfaction with the Complete Dentures and the Correlation with the Adaptation Period. J Contemp Dent Pract. 2022 Sep 1;23(9):889-894. doi: 10.5005/jp-journals-10024-3411.

10. Silva BP, Jiménez-Castellanos E, Stanley K, Mahn E, Coachman C, Finkel S. Layperson's perception of axial midline angulation in asymmetric faces. Journal of Esthetic and Restorative Dentistry. 2018 Mar;30(2):119-25.

11. Jung JH, Oh SC. Perception assessment of esthetics of upper anterior teeth. The Journal of Korean Academy of Prosthodontics. 2003:640-55.

12. Pinho S, Ciriaco C, Faber J, Lenza MA. Impact of dental asymmetries on the perception of smile esthetics. Am J Orthod Dentofacial Orthop 2007; 132:748-53.

13. Zhang YF, Xiao L, Li J, Peng YR, Zhao Z. Young people's esthetic perception of dental midline deviation. Angle Orthod.2010;80:515-20.

14. Samorodnitzky-Naveh GR, Geiger SB, Levin L. Patients' satisfaction with dental esthetics. The Journal of the American Dental Association. 2007 Jun 1;138(6):805-8.

15. Plooij JM, Maal TJ, Haers P, Borstlap WA, Kuijpers-Jagtman AM, Bergé SJ. Digital three-dimensional image fusion processes for planning and evaluating orthodontics and orthognathic surgery. A systematic review. International journal of oral and maxillofacial surgery. 2011 Apr 1;40(4):341-52.

16. Eskelsen E, Fernandes CB, Pelogia F, Cunha LG, Pallos D, Neisser MP, et al. Concurrence between the maxillary midline and bisector to the interpupillary line. J Esthet Restor Dent 2009; 21:37-41.

17. Nold SL, Horvath SD, Stampf S, Blatz MB. Analysis of select facial and dental esthetic parameters. Int J Periodontics Restorative Dent 2014; 34:623-9.

18. Rhodes G. The evolutionary psychology of facial beauty. Annu rev psychol2006; 57: 199-226.

19. Shyagali TR, Chandralekha B, Bhayya DP, Kumar S,Balasubramanyam G. Are ratings of dentofacial attractiveness influenced by dentofacial midline discrepancies? AustOrthod J 2008; 24(2): 91-5.

20. Bhateja N, Fida M, Shaikh A. Frequency of dentofacial asymmetries: A cross-sectional study on orthodontic patients. J Ayub Med Coll Abbottabad 2014; 26:129-33.

21. Mehwish K, Syed M, Raza K. Coincidence of Dental Midline with Facial Midline in a Sample of Pakistani Population. Journal of the College of Physicians and Surgeons Pakistan 2019, Vol. 29 (3): 210-213.

22. Silva BP, Jiménez-Castellanos E, Martinez-de-Fuentes R, Greenberg JR, Chu S. Laypersons' perception of facial and dental asymmetries. Int J Periodontics Restorative Dent. 2013;33:e162–71.

23. Kokich VO, Kokich VG, Kiyak HA. Perceptions of dental professionals and laypersons to altered dental esthetics: asymmetric and symmetric situations. American Journal of Orthodontics and Dentofacial Orthopedics. 2006 Aug 1;130(2):141-51.

24. Melo, M., Ata-Ali, J., Ata-Ali, F. *et al*. Evaluation of the maxillary midline, curve of the upper lip, smile line and tooth shape: a prospective study of 140 Caucasian patients. *BMC Oral Health* 2020;**20**: 42.https://doi.org/10.1186/s12903-020-1031-y

25. Ward DH. Proportional smile design: using the recurring esthetic dental proportion to correlate the widths and lengths of the maxillary anterior teeth with the size of the face. Dental Clinics. 2015 Jul 1;59(3):623-38.

TABLES

Table1: Study sample distribution based on demographic information (N =300), frequency (F) and Percentage (%)

Demographical data	Ranking And Intervals	F	%
Sex	Male	196	65.3
	Female	104	34.7
	Total	300	100

Table 2: Overall Evaluation of congruence between MF(mid face line) with UML(upper dental midline) and LML(lower dental midline)

Overall evaluation of coincidence	Non-coincide		Coincide	
	F.	%	F.	%
UMLwith MF	204	68	96	32
LML with MF	167	55.7	133	44.3
Total	300	100	300	100

Table 3: Distribution of the Study Sample by UML(upper dental midline) and LML(lower dental midline) with MF(mid face line) regarding to (Deviation left and right side) with VAS scores.

Deviation Degree	Dev. Left		Dev. Right		Total		VAS
UML with MF	F	%	F	%	F	%	mean±SD
Dev. 1 -1.5 mm	38	39.59	15	15.62	53	55.21	9.1±1.2
Dev. 2 -2.5 mm	13	13.54	20	20.84	33	34.38	7.2±0.9
Dev. 3 mm	7	7.29	0	0	7	7.29	3.4±1.9
Dev. 4 mm	1	1.04	2	2.08	3	3.12	2.8±0.7
Total	59	61.46	37	38.54	96	100	
Deviation Degree	Dev. Left		Dev. Right		Total		VAS
LML with MF	F	%	F	%	F	%	mean±SD
Dev. 1 -1.5 mm	47	35.34	27	20.30	74	55.64	9.8±1.1
Dev. 2 -2.5 mm	31	23.31	20	15.03	51	38.34	9.3±1.9
Dev. 3 mm	4	3	3	2.26	7	5.26	9.1±1.2
Dev. 4 mm	1	0.76	0	0	1	0.76	7.9±1.3
Total	83	62.41	50	37.59	133	100	

**Table 4: Relationship between UML and LML for the study sample**

Paired Differences				T	df	Sig.(2-tailed)
Variables	Mean	Std.Dev	Std. Err.			
Upper ML with MF	-1.432	1.214	0.200	-7.176	299	.000
Lower ML with MF	-0.980	1.020	0.144	-6.794	299	.000

Table 5: Relationship between Overall Evaluation of Coincidence between MF with UML and LML , study sample (sex)

Coincide between MF with UML

Rating& intervals	Chi-Square Tests					
Sex	Non-coincide	Coincide	X^2	D.F	P value	Assessment
Male	160	36	4.42	1	0.043	Sig.
Female	61	43				
Total	221	79	300			
Coincidence between MF with LML						
Sex	Non-coincide	Coincide	X^2	D.F	P value	Assessment
Male	119	77	3.61	1	0.04	Sig.
Female	68	36				
Total	187	113	300			

FIGURES
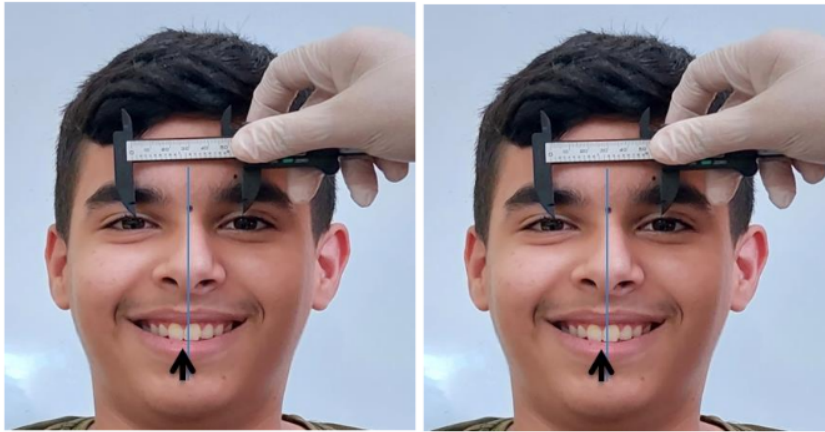
<div align="center">A   B</div>

Figure 2. (A) point the mid of inter pupillary line, (B)-a vertical line that runs straight down the MF dissecting the inter pupillary line and its coincidence with UML.