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Facial flow line and its effect on dental midline deviation on a female subject in an Asian population – A cross-sectional study

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Abstract

INTRODUCTION: This study aims to understand the relationship between midline deviations and the inherent asymmetry that can be observed in a human face.

MATERIALS AND METHODS: A cross-sectional study was conducted using a frontal smile photograph of a female which was altered on Adobe Photoshop software version 23.0 into eight different photographs by deviating the dental midlines by 2 mm, 4 mm, and 6 mm towards and away from the facial flow line (FFL). 4 mm of chin deviation was incorporated in all the pictures except for the first picture in which the midline and chin were kept symmetric. Orthodontic residents evaluated those photographs on an interrupted visual analogue scale (VAS) with 0 being the least attractive and 10 being the most. Simple linear regression was applied to observe factors associated with VAS score.

RESULTS: Highest score was observed for picture with midline and chin on (MLCon) with a score of 9.4 ± 0.7, followed by picture with midline on and chin deviated (MLon) 8.7 ± 0.8. The deviations towards green zone received higher scores in comparison to deviations towards red zone. Linear regression revealed highly statistically significant differences between the constant and the rest of the pictures.

CONCLUSIONS: The formation of green and red zones by the FFL influences the perception of midline deviation as judged by orthodontic residents. Midline when deviated towards the green zone, was judged to be more aesthetic than when shifted towards the red zones.

Keywords:

Facial asymmetry, facial flow line, midline, orthodontic residents

Introduction

The aim of orthofacial and cosmetic sciences has always been to attain perfect symmetry that ultimately leads to beauty.[1] Such a goal, especially in orthodontics, can be impossible to attain considering the inherent asymmetry present in the human body, more so in the facial region.[2] According to the literature, asymmetry in the general population ranges from 4.7% to 34%.[3,4] Such a prevalence supplants the idealization of symmetry and moves the focus toward finding avenues around asymmetry instead of aiming to correct it entirely.

One such avenue is the facial flow line (FFL) suggested by Silva *et al.*,[5] which can be drawn by connecting the glabella, subnasale, philtrum, and chin [Figure 1]. In the presence of asymmetry, the FFL deviates toward the affected side and divides the face into two zones.[6] The zone toward where the line deviates is termed the green zone and the other half is called the red zone. Silva *et al.*[5] postulates that deviation of the dental midline toward the green zone is less perceptible to the observer as compared to

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Figure 1: Green and red zones formed by the facial flow line (FFL)

its deviation toward the red zone. This formulates the idea that working with the asymmetry may be more beneficial then working either against it or without considering it.

Asymmetry in the dental midline and its acceptable magnitude of deviation has been well established in the literature.[7,8] This magnitude has been found to be different among groups of raters, with laypersons being more forgiving of larger midline deviations than general dentists or orthodontists.[9] This difference has been attributed to sensitivity toward facial structures and their relationships with each other. Orthodontists, or orthodontic residents (ORs), spend the majority of their practice studying faces and have a keener eye for asymmetries in the face, smile characteristics, and profile evaluation.[10] On the other hand, laypersons tend to observe the smile as a whole and have difficulties discerning deviations unless of a large magnitude.[11,12]

Previous studies on dental midline have established norms and acceptable ranges for deviations in perfectly symmetric faces.[13] The concept of FFL has not been previously investigated in the orthodontic literature, and its relationship with dental midline deviations is an avenue that can provide further insight and validation to the formation of the green and red zones in asymmetric patients. Furthermore, within these zones, a range of magnitude of midline deviations acceptable for orthodontists/ORs also needs to be established. The primary objective of this study is to determine if any differences exist in smile esthetic scores when midlines were deviated toward and away from the FFL as determined by ORs. The secondary objective is to determine if comparable smile esthetic scores were achieved in symmetric faces with centered midlines and those with asymmetric faces and midlines deviated toward the green zone.

Materials and Methods

The current cross-sectional study was conducted on 50 (N) participants in a tertiary care hospital after obtaining ethical approval from the institutional ethical review committee. (2021-5939-16676) The sample size was calculated using the findings of Thomas *et al*.,[14] who reported attractiveness scores given by orthodontists to a male subject of 1.90 ± 0.76 at 0° and 2.63 ± 1.02 at 5° of axial angulation. Keeping $\alpha = 0.05$ and a power of 80%, 24 (n) subjects were required in each group.

After obtaining consent, frontal smile photographs of a female subject were captured using a digital camera, Sony DSC-WX200, (Tokyo, Japan). This picture was then modified by the principal investigator on the Photoshop software (Adobe Systems, San Jose, Calif). The first picture was kept with the midline and chin symmetric (MLCon) with the patient's face, which would serve as a control. For the second picture, the chin was deviated toward the left, but the midline was kept centered on the face. (MLon) The FFL concept was used for the editing of the rest of the pictures. The chin was deviated 4 mm toward the left side as with MLon, and the face was divided using a curve that connected the glabella, subnasale, philtrum, and deviated chin position. This made the left side of the face the green zone and the right side of the face the red zone. Six pictures were then further modified with the midline deviated 2, 4, and 6 mm toward the left (green zone) (GZ-2, GZ-4 and GZ-6) and the right. (red zone) (RZ-2, RZ-4 and RZ-6) [Figure 2].

These pictures were then compiled in random order and presented to the ORs in a PowerPoint presentation. Full-face pictures were utilized for these ratings except for a black strip placed over the eyes to maintain anonymity. The raters were asked to score the pictures on an interrupted visual analogue scale (VAS), with 0 being the least attractive and 10 being the most. The raters were advised to look at each picture for not more than 30 seconds before providing their assessment. The ORs included in our study had a minimum of 3 years of clinical training in orthodontics and were recruited via email from various post-graduate training centers around the country. To observe intra-examiner reliability, 10 raters were requested to repeat their assessment after 2 weeks.

Statistical analysis

Data were analyzed using SPSS (version 23.0) and STATA (version 17.0). Shapiro–Wilk test was used to determine the normality of the data, which showed a normal distribution. Frequencies were reported for categorical variables such as gender. Descriptive statistics and mean and standard deviation were reported for age and scores. Simple linear regression was applied

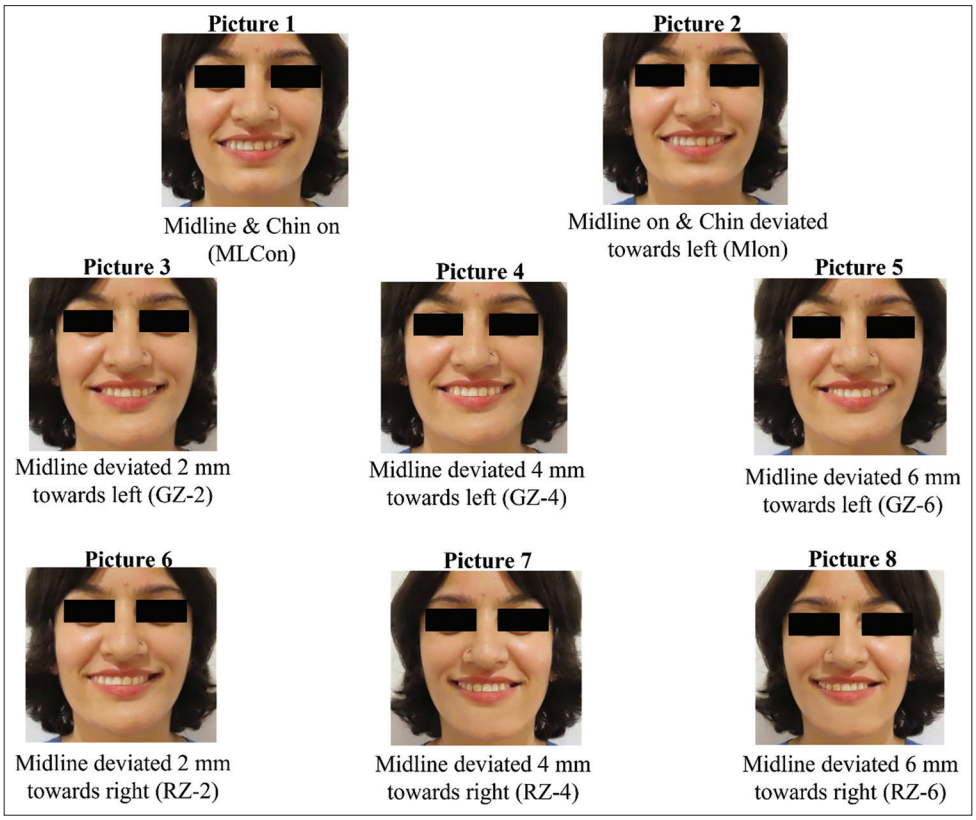

Figure 2: Original picture and modifications

to observe the positive and negative factors associated with the VAS score. Intraclass correlations (ICC) were applied to determine the intra-examiner reliability. A *P* value ≤0.05 was considered statistically significant.

Results

The mean age of the female subject was 29.9 years. Fifty ORs rated the pictures and had a mean age of 30.7 ± 3.2 with an equal distribution of male and female raters [Table 1]. ICC showed an excellent agreement between the two readings obtained from the raters (0.83).

A numerical comparison showed that MLCon received the highest score (9.4 ± 0.7) by the ORs, followed by MLon. (8.7 ± 0.8) [Table 2]. When comparing GZ pictures with RZ, GZ received higher scores for all midline deviations than RZ [Table 3]. GZ-4 and RZ-2 had similar scores, which show that a severe midline discrepancy toward the FFL scores is the same as a mild midline discrepancy away from the FFL.

Linear regression analysis was performed on the data with MLCon and MLon kept as the constants [Table 4]. The model revealed highly statistically significant differences between the constants and the rest of the pictures. A similar trend of numerical values was observed with the regression analysis as midlines toward the FFL had a smaller difference from the constants and a smaller decrease in esthetic scores was predicted.

Table 1: Demographics

Group	Gender	Age (Mean±SD)
Orthodontic Residents	Male (*n*=25)	31.09±3.66
	Female (*n*=25)	30.32±2.75

n=50. SD=Standard Deviation

Table 2: Means and standard deviations for the rating of pictures

Variable	DML Deviations	Mean Scores±SD
Picture 1 (MLCon)	0 mm	9.42±0.61
Picture 2 (MLon)	0 mm	8.72±0.78
Picture 3 GZ – 2	2 mm	7.56±1.05
Picture 4 GZ – 4	4 mm	6.70±0.93
Picture 5 GZ – 6	6 mm	5.08±0.83
Picture 6 RZ – 2	2 mm	6.76±0.96
Picture 7 RZ – 4	4 mm	4.72±0.88
Picture 8 RZ – 6	6 mm	2.20±1.11

n=50, SD=Standard Deviation, GZ=Green zone, RZ=Red zone, DML=Dental midline

Discussion

Orthodontic finishing relies on ideal relations according to the treatment plan that has been followed. In a dentition with insignificant tooth material excess in either arch, relations such as the molar and canine

Table 3: Comparison of esthetic scores between green and red zone pictures

Variable	*n*	95% Confidence Interval	
		Lower	Upper
MLCon Vs. GZ - 2	<0.001**	-2.01	-1.52
MLon Vs. GZ – 2	<0.001**	-1.53	-0.79
GZ – 2 Vs. RZ – 2	<0.001**	0.40	1.19
GZ – 4 Vs. RZ – 4	<0.001**	1.62	2.34
GZ – 6 Vs. RZ – 6	<0.001**	2.43	3.17
GZ – 4 Vs. RZ – 2	0.752	-0.44	0.32

n=50, SD=Standard Deviation, MLCon=Midline and chin on, MLon=Midline on, GZ=Green zone, RZ=Red zone. Independent *t*-test, $P \leq 0.001$**

Table 4: Simple linear regression to assess the factors associated with the VAS score

Variable	Beta Coefficient	95% CI	*P*
Picture 1 (MLCon)			
Picture 2 (MLon)	-0.7	-1.05, -0.35	<0.001**
Picture 3 GZ - 2	-1.86	-2.21, -1.51	<0.001**
Picture 4 GZ - 4	-2.72	-3.07, -2.67	<0.001**
Picture 5 GZ – 6	-4.34	-4.69, -3.99	<0.001**
Picture 6 RZ – 2	-2.66	-3.01, -2.31	<0.001**
Picture 7 RZ – 4	-4.70	-5.05, -4.35	<0.001**
Picture 8 RZ - 6	-7.14	-7.49, -6.79	<0.001**
Picture 2 (MLon)			
Picture 1 (MLCon)	0.7	0.35, 1.05	<0.001**
Picture 3 GZ - 2	-1.16	-1.51, -0.81	<0.001**
Picture 4 GZ - 4	-2.02	-2.37, -1.67	<0.001**
Picture 5 GZ – 6	-3.64	-3.99, -3.28	<0.001**
Picture 6 RZ – 2	-1.96	-2.31, -1.61	<0.001**
Picture 7 RZ – 4	-4.00	-4.35, -3.65	<0.001**
Picture 8 RZ - 6	-6.44	-6.79, -6.09	<0.001**

n=50, SD=Standard Deviation, MLCon=Midline and chin on, MLon=Midline on, GZ=Green zone, RZ=Red zone, Simple linear regression, $P \leq 0.05$*, $P \leq 0.001$**

relationship, overjet, and overbite, along with the dental midlines, should fall under the ideal ranges.[15] Deviation in the upper dental midline tends to be the most readily identifiable relationship that may cause a negative impact on the smile esthetics of the subject, making it an important cause of concern for orthodontic patients.[16] The current study hypothesized that similar esthetic scores will be received when the midline is deviated toward the FFL when compared with a coincident midline in a face with chin asymmetry as judged by OR. We rejected our alternate hypothesis as a statistically significant difference was observed between the esthetic scores for a non-deviated midline and a deviated midline toward the green zone.

Residency programs tend to build a professional's eye over the ears for the specialty that they practice. ORs work with facial esthetics and the interplay between the positioning of the teeth with the oral soft tissues. This makes them key assessors for deviations in facial profiles, occlusal, and dental relationships.[14] In our study, we included residents with a minimum of 3 years of training completed in a residency program, which allowed our sample to be limited to experienced professionals in the orthodontic specialty. Olivares *et al*.[17] reported that orthodontists were more unforgiving of asymmetry as compared to laypersons and had a unanimous perception of occlusal canting in their study. Another study, conducted by Beyer and Lindauer,[7] reported that orthodontists are more critical about their evaluation of midlines and can tolerate a discrepancy of up to 1.68 ± 0.77 mm in females, whereas general dentists could tolerate deviations up to 1.82 ± 0.72. It is valid to assume that the tolerance of fourth-year ORs resides somewhere between these two values.

Silva *et al*.[5] expressed that human beings have irregular faces, which means that the establishment of a standard midline for all faces is nearly impossible. Customized landmarks can be proposed for the evaluation of midline in patients that suit their face and its inherent asymmetry. The FFL concept arose from this necessity for an evaluation method that is not a rigid line but follows the curve of the face. It accounts for the asymmetry that is present in all faces and divides the face into two zones, out of which the green zone has been hypothesized to allow some degree of asymmetry in the midline structures. The red zone, in turn, creates a visual tension that detracts from the facial and smile esthetics of the patient. In the current study, we consistently found lower scores when the midline was deviated toward the red zone as compared to the green zone. These readings corroborate with the literature present on the FFL with regard to the creation of visual tension when deviating the midline toward the red zone.[6,18]

The magnitude of chin deviation in our study was kept constant at 4 mm to the left, which allowed the observation of changing esthetic scores due to the midline alone. However, the visualization of the magnitude of tolerable midline deviation in relation with the extent of chin asymmetry would be an interesting avenue for further research. It can be postulated that as chin asymmetry increases, the curve of the FFL will deepen and may allow further tolerance in the midline deviation that can be kept at the end of treatment. This can help solve occlusal problems in patients with severe asymmetries such as those suffering from syndromes like cleft lip and palate or hemi facial microsomia.[19]

The results of our study pertaining toward our primary objective showed that symmetric faces with a midline centered with the facial midline score the highest on esthetic evaluation by ORs. In the next picture, when a deviation in facial symmetry was engineered, it resulted in a drop in esthetic scores. Further deviations were made in the dental midline toward the green zone, which followed a steady decreasing trend as the midline was deviated up to 6 mm. The first increment

of deviation was a midline shift of 2 mm toward the green zone, which scored a mean difference in esthetic scores of -1.16 (95% Confidence interval: -1.51, -0.81). This shows that a deviation of 2 mm, judged intolerant in the literature by orthodontists, scored only 1.16 points less than having the midline centered on an asymmetric patient.[9] It can be hypothesized with these results that an even smaller decrease in esthetic scores would be seen in minor midline deviations of up to 1 mm, which could render such a decrease as clinically insignificant.[20] These results can be translated clinically by understanding the camouflaging effect of the FFL. A minor dental midline deviation up to 2 mm should not cause a major decrease in esthetic scores if the dental midline deviation is toward the side of facial asymmetry. Concurrently, a minor deviation away from the flow of facial asymmetry may cause a major drop in esthetic scores.

The current study aimed to understand the relationship between midline deviations and the inherent asymmetry that can be observed in a human face. It has certain limitations that can restrict the generalizability of our findings. Firstly, the study was performed in an Asian problem, limited to the southern metropolitan, in a tertiary care hospital. Secondly, only one female subject was used for picture acquisition, which negates investigation into the effect of gender on the masking properties of FFL. The study finds its strength in its robust sample size of ORs, which allows for a meticulous examination of the effect. Further avenues that present themselves are the inclusion of a male subject with varying degrees of asymmetry of the chin. Furthermore, an investigation into the vertical component of FFL, along with vertical asymmetries of the dentition, should also be assessed.

Conclusions

Under the light of evidence presented by the current study, we can conclude that the formation of green and red zones by the FFL influences the perception of midline deviation as judged by ORs. Midline, when deviated toward the green zone, was judged to be more esthetic than when shifted toward the red zones.

Authors' contributions

Author Muhammad Maaz and author Kanza Tahir have given substantial contributions to the conception, acquisition of data, and design of the manuscript. Author Mubassar Fida provided their supervision and resources and critically analyzed the manuscript. Author Rashna H. Sukhia performed the analysis and interpretation of the data. All authors have participated to drafting the manuscript. All authors read and approved the final version of the manuscript. All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

References

1. Devgan L, Singh P, Durairaj K. Minimally invasive facial cosmetic procedures. Otolaryngol Clin North Am 2019;52:443-59.
2. Haraguchi S, Iguchi Y, Takada K. Asymmetry of the face in orthodontic patients. Angle Orthod 2008;78:421-6.
3. Anistoroaei D, Golovcencu L, Saveanu IC, Zegan G. The prevalence of facial asymmetry in preorthodontic treatment. Int J Med Dent 2014;4:210-5.
4. Severt TR, Proffit WR. The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. Int J Adult Orthodon Orthognath Surg 1997;12:171-6.
5. Silva BP, Mahn E, Stanley K, Coachman C. The facial flow concept: An organic orofacial analysis—The vertical component. J Prosthet Dent 2019;121:189-94.
6. Koseoglu M, Bayindir F. Effect of variations in facial flow curves on the perceptions of smile esthetics by laypeople. J Prosthet Dent 2021;1:1-8.
7. Beyer JW, Lindauer SJ. Evaluation of dental midline position. Semin Orthod 1998;4:146-52.
8. Williams RP, Rinchuse DJ, Zullo TG. Perceptions of midline deviations among different facial types. Am J Orthod Dentofac Orthop 2014;145:249-55.
9. 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.
10. Shyagali TR, Chandralekha B, Bhayya DP, Kumar S, Balasubramanyam G. Are ratings of dentofacial attractiveness influenced by dentofacial midline discrepancies? Aust Orthod J 2008;24:91-5.
11. Abu Alhaija ES, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. Eur J Orthod 2011;33:450-6.
12. Kokich VO Jr, Asuman Kiyak H, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. J Esthet Restor Dent 1999;11:311-24.
13. Janson G, Branco NC, Fernandes TM, Sathler R, Garib D, Lauris JR. Influence of orthodontic treatment, midline position, buccal corridor and smile arc on smile attractiveness: A systematic review. Angle Orthod 2011;81:153-61.
14. Thomas JL, Hayes C, Zawaideh S. The effect of axial midline angulation on dental esthetics. Angle Orthod 2003;73:359-64.
15. Seehra J, Fleming PS, DiBiase AT. Orthodontics and the ideal occlusion–A review. Orthod Update 2009;2:45-9.
16. Ferreira JB, Silva LE, Caetano MT, Motta AF, Cury-Saramago AD, Mucha JN. Perception of midline deviations in smile esthetics by laypersons. Dent Press J Orthod 2016;21:51-7.
17. Olivares A, Vicente A, Jacobo C, Molina SM, Rodríguez A, Bravo LA. Canting of the occlusal plane: Perceptions of dental professionals and laypersons. Med Oral Patol Oral Cir Bucal 2013;18:e516-20.
18. Erum GE, Fida M. Changes in smile parameters as perceived by orthodontists, dentists, artists, and laypeople. World J Orthod 2008;9:132-40.
19. Thiesen G, Gribel BF, Freitas MP. Facial asymmetry: A current review. Dental Press J Orthod 2015;20:110-25.
20. Sadrhaghighi H, Zarghami A, Sadrhaghighi S, Eskandarinezhad M. Esthetic perception of smile components by orthodontists, general dentists, dental students, artists, and laypersons. J Investig Clin Dent 2017;8:e12235.