Scholars Journal of Dental Sciences
Abbreviated Key Title: Sch J Dent Sci
ISSN 2394-4951 (Print) | ISSN 2394-496X (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Evaluation and Correlation of Facial Asymmetry in Adults with Class I, Class II, and Class III Skeletal Relation

Abdurahman M. Alruwaili [1*], Bassant Mowafey[2], Mohammed A. Elbialy[3], Marwa A. Tawfik[4]

[1]Orthodontic Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt.
[2]Associate Professor, Diagnosis and Oral Radiology, Faculty of Dentistry, Mansoura University, Mansoura, Egypt
[3]Lecturer, Orthodontic Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt
[4]Associate Professor, Orthodontic Department, Faculty of Dentistry, Mansoura University, Mansoura, Egypt

DOI: 10.36347/sjds.2024.v11i05.001 | **Received:** 29.05.2024 | **Accepted:** 08.07.2024 | **Published:** 10.07.2024

***Corresponding author**: Abdurahman M. Alruwaili
Department of Orthodontics, Faculty of Dentistry, Mansoura University, Mansoura, Egypt

Abstract **Original Research Article**

Background: The current study with the prime objectives revolved around investigating and evaluating the differences of facial asymmetry in adults who suffer from Class I, Class II, and Class III skeletal relations, and to also evaluate the extent to which soft tissue either accentuate or mask such differences altogether. ***Material and Methods***: A total of 225 frontal photographs of adult patients who was attended and was diagnosed in orthodontic department at Al-Mansoura University and were took to evaluate facial asymmetry. The subjects were divided in three groups; namely Group I, II, and III that pertain to Class I, II, and III patients with each Group/Class appointed to 75 participants respectively. Each Group was divided into sub-groups; a and b, for each Class. Digital photos were took using a Canon 600d digital camera. ***Result***: Findings revealed that between Class I and Class III and Class II and Class III the Pronasale point was the only point that caused a statistical significance as opposed to the Labial Superior and Menton points; (p=0.03, p=0.02) respectively. Other statistically significant differences were found among Class I, II, and III groups regarding the distance between mid-facial plane point and the left exocanthus for; (p = 0.012) and regarding the distance between MFP and the left ala for; (p = 0.04). ***Conclusion*:** It was concluded that though Class I, II, and III malocclusions may have distinct skeletal differences, the appearance of the soft tissues can obscure the distinctions, creating a seemingly uniform image. Regarding the PN point, it can be concluded that patients who suffer from Class I, Class II and Class III had a wider right hemiface, and that patients who suffer from Class II and Class III had a wider right hemiface regarding both the LS and ME points respectively. Generally speaking, 56%, 52%, and 52% of the subjects had a wider right hemiface regarding the PN, LS, and ME points respectively.

Keywords: Malocclusion, Skeletal Relation, Facial Asymmetry, Facial Reference Lines.

INTRODUCTION

Being self-conscious about one's facial asymmetrical characteristics can cause diminished levels of self-confidence or failure to intersect and communicate with others in a natural manner. This is because facial asymmetry often pertains to facial unattractiveness [1]. Moreover, different levels facial asymmetry can be associated with various types of growth and skeletal malocclusion patterns [2].

The development of facial asymmetry takes place due to morphological abnormalities and deformities that affect the right or the left craniofacial structures in a manner through which one side of the face does not align with the other on vertical and/or horizontal levels [3]. These abnormalities and deformities can be caused by congenital, acquired, and developmental factors [4].

Thus, in order to evaluate these varying levels of facial asymmetry and provide accurate assessment of its characteristics and severity, skeletal classifications have been utilized by researchers, experts, and practitioners [5]. For instance, various facial landmarks and planes can help identify such sections and proportionate points on someone's face. Similarly, symmetry is always considered the hallmark of beauty since it exhibits how each portion of the face share are equally proportionate to one another. Accordingly, any

levels of misalignment between these landmarks and planes can cause the face to be asymmetrical [6].

Specifically speaking, one of the most prominent assessment and classification frameworks emerged as a standard for evaluating skeletal malocclusion for individuals who suffer from facial asymmetry, which is the Salzmann Class I, II, and III skeletal malocclusion classification framework [7].

Class I is also known as neutron-occlusion, and is characterized by the fact that (a) the maxillary first permanent molar's mesiobuccal cusp occludes naturally with the mesiobuccal groove of the mandibular first permanent molar, (b) the maxillary canine's mesial incline occludes naturally with the mandibular canine's distal incline, and(c) the maxillary canine's distal incline occludes naturally with the mandibular first premolar's mesial incline. Class II on the other hand is characterized by the fact that (a) the mandibular first molar's mesiobuccal groove is distally-positioned from the maxillary first molar's mesiobuccal cusp, (b) the maxillary canine's mesial incline anteriorly occludes with the mandibular canine's distal incline, and (c) the mandibular canine's distal surface is posterior to the maxillary canine' mesial surface. Class III is also characterized by the fact that (a) the maxillary first permanent molar's mesiobuccal cusp distally occludes to the mandibular first molar's mesiobuccal groove, and (b) the mandibular canines' distal surface is mesial to the maxillary canines' mesial surface, where mandibular incisors for a crossbite [8].

One of the most prominent methods of diagnosis regarding cases of malocclusion is represented by cephalometric analysis. This method of examination and diagnosis assists practitioners in the evaluation of cranio-axillo-facial structure of patients by locating specific facial landmarks onto an X-ray image [9]. Indeed, cephalometric analysis is considered an integral tool through which dental diagnosis, planning, surgery, and treatment procedures are implemented [10].

A homogenous analysis that uses information regarding both hard and soft tissues in a consistent and harmonious manner should always be on top of orthodontists' priority list [11]. Consequently, soft tissue thickness varies in accordance with the characteristics of each skeletal classification in a very complex manner.

To further elaborate, it can be indicated that the varying thicknesses of soft tissue do not necessarily induce corresponding changes that might be found in one skeletal structure [12]. Similarly, skeletal asymmetry might be masked by varying thickness levels of soft tissue, in the sense that some patients' faces might actually be asymmetric on a skeletal level but they appear symmetric due to the masking effect of soft tissue, or vice versa [13].

Based on the aforementioned, the current study aims to (a) investigate the different features that pertain to patients who suffer from Class I, Class II, and Class III skeletal relations in terms of their facially asymmetries, and (b) evaluate the role of soft tissue in accentuating or masking these differences; given the fact that an individual's facial structure might appear symmetrical even through he/she indeed suffers from Class I, Class II, or Class III skeletal relations.

MATERIAL AND METHODS

The researcher utilized the characteristics of descriptive comparative research which investigates attributes of groups or environments that already exist without changing anything. Rather than planting seeds in one area and leaving another alone, it studies the natural variations that have materialized on their own. In the case of the current thesis, descriptive comparative research assists the researcher in analyzing the extent to which soft tissue contributes to mask any discrepancies between Class I, II, and III skeletal classifications by comparing specified facial landmarks between each two Classes and between the three Classes collectively.

Moreover, the selection of the study sample is conducted in accordance with specified inclusion and exclusion criteria. Accordingly, the inclusion criteria are adult with Class I, II, and III skeletal relation, no previous orthodontic treatment and no surgery. Blurred X-ray, orthodontic treatment, facial or aesthetic surgery, and patient with congenital craniofacial anomalies or severe facial deformities including cleft lip and/or palate, severe mal-positioning of the orbits or ears, and functional shift of the mandible will be excluded.

Sample Size Calculation

A total of 225 frontal photographs of adult patients who was attended and was diagnosed in orthodontic department at AL-Mansoura University and were took to evaluate facial asymmetry. Consent forms were prepared in accordance with the guidelines of Educational Ethics Committee at Mansoura University.

Sample size calculation was based on dFW (L-R) between different skeletal classes retrieved from previous research [14]. Using G power program version 3.1.9.4 to calculate size based on expected difference of 12%, using 2-tailed test, α error = 0.05 and power = 80.0%, the total calculated sample size will be 70 in each group by adding 5% to compensate possible drop out then total sample size will be 75 in each of the three groups (total 225).

Consent forms were prepared in accordance with the guidelines of Educational Ethics Committee at Mansoura University. The digital photograph of the subjects were took using a digital Canon 600d camera. Each participant's head was positioned so that the Frankfort horizontal plane and the inter-papillary line were parallel to the surface of the floor. The camera was

fixed on the tripod stand which helped to keep them at a distance of 100 cm from each participant's face with a vertical ruler which is meant to was attached to a wall as a tool that assists the researcher in calibrating the photographs.

Trial Design

Digital photographs were cropped using Adobe Photoshop CS. Furthermore, cropped photographs were transferred to a computer equipped with a digitized software; i.e. AudaxCeph ver. 6.1.4.3951, which used to evaluate facial asymmetry. Participants' photographs then was analyzed in terms of five horizontal and three midline parameters using a digitizer once all required facial landmarks were identified.

Moreover, all lateral cephalomatric digital tracings (Gendex GX700) and frontal photographs were carried out by a single calibrated investigator. Furthermore, the examiner underwent intensive training and calibration, and reference planes can be outlined as based on the fact that Interpupillary Line (PP') is a horizontal line from left pupil to right pupil, and Mid facial plane (Mfp) is a line perpendicular to interpupillary line from nasion.

Landmarks on Frontal Facial photograph (Figure 1) included: Nasion (N'): The point in the middle line located at the nasal root, Right pupil (P'): The midpoint of the left eye pupil, Left pupil (P): Midpoint of the left eye pupil., Right endocanthus (Enr) : The point at the right inner commisure of the eye fissure, Left endocanthus (Enl): The point at the left inner commisure of the eye fissure, Right exocanthus (Exr): The point at the right outer commisure of the eye fissure, Left exocanthus (Exl): The point at the left outer commisure of the eye fissure, Pronasale (Prn): The most prominent part of the nose, Right ala of the nose (Alr): The most lateral point on right ala contour, Left Ala of the nose (All): The most lateral point on left ala contour, Labiale superius (Ls): The midpoint of the vermilion border of the upper lip, Right chelion (Chr): The lateral point to the angle of the mouth on right side, Left chelion (Chl): The lateral point to the angle of the mouth on left side, Right gonion (Gor): The most lateral point at the right angle of the mandible, Left gonion (Gol): The most lateral point at the left angle of the mandible, Menton (Me): The lowest part of the chin on the mandible in the midline.

Reference plane (Figure 2) included: Interpupillary line (PP'): A horizontal line from left pupil to right pupil, and mid-facial plane (Mfp): A line perpendicular to interpupillary line from nasion.

Horizontal Parameters (Figure 3) included Mfp-Enr: A distance from mid facial line to the right endocanthus, Mfp-Enl: A distance from mid facial line to the left endocanthus, Mfp-Exr: A distance from mid facial line to the right exocanthus, Mfp-Exl: A distance from mid facial line to the left exocanthus, Mfp-Alr: A distance from mid facial line to the right ala of the nose, Mfp-All: A distance from mid facial line to the left ala of the nose, Mfp-Chr: A distance from mid facial line to the right inters commissure, Mfp-Chl: A distance from mid facial line to the left inters commissure, Mfp-Gor: A distance from mid facial line to the right gonion, and Mfp-Gol: A distance from mid facial line to the left gonion.

Midline Parameters (Figure 4) included Mfp-Pn: A linear distance from the mid facial plane to pronasale, Mfp-Ls: A linear distance from the mid facial plane to labiale superior, and Mfp-Me: A linear distance from mid facial plane to Menton.

Statistical Analysis

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 22; given the fact that quantitative data was presented in the form of percentages and digits, while quantitative data is meant to be tested for normality by Kolmogorov–Smirnov test then described in terms of means and standard deviations for normally distributed data, medians, and ranges for non normally distributed data. The appropriate statistical test was applied according to data type with a number of suggested tests; namely Chi-Square, One Way ANOVA, and Kruskal Wallis tests.

RESULTS

In terms of PN, LS, and ME location points, discrepancies between Class I and II malocclusion indicated no significant difference regarding the location of the PN point; ($p > 0.05$), the location of the LS point; ($p > 0.05$). And the location of the ME point; ($p > 0.05$) (Table 1). Discrepancies between Class I and III indicated a significant difference for the PN point; ($p < 0.05$), but no significant difference for the LS point; ($p > 0.05$), and the ME point; ($p > 0.05$) (Table 2). Correspondingly, discrepancies between Class II and III malocclusion indicated a significant difference for the PN point; ($p < 0.05$), but no significant difference between Class II and Class III regarding the location of the LS and the ME point; ($p > 0.05$) (Table 3).P value between Class I, II, and III is 0.04, 0.712, and 0.752; indicating a significant difference for the PN point; ($p < 0.05$), but none for the LS and ME points; ($p > 0.05$). Chi-square statistic for PN is 6.60, with a p-value of 0.04 indicating a statistically significant association between PN and "Left" or "Right" at the 0.05 significance level. The chi-square statistics for LS and ME are 0.677 and 0.571, respectively, with p-values of 0.712 and 0.752, respectively. These p-values are greater than 0.05. Consequently, and according to the Null hypothesis, these p-values indicate no significance.

To further elaborate on this notion, it can be indicated that the p-value represents the calculated probability of making an error when rejecting the null hypothesis (H0), which posits no difference between groups. A Type I error is the predetermined likelihood of

rejecting the null hypothesis when it is actually true. In medical research, a p-value below the Type I error threshold (commonly 0.05) indicates that the null hypothesis can be safely rejected, with the risk of error being acceptably low (less than 5 percent) [15]. Therefore, there is not enough evidence to reject the null hypothesis of no association for LS and ME (Table 4).

Mid-facial plane measurements for Class I and II malocclusion indicated no statistically significant difference between MFP and the right endocanthus for Class I and II- (p = 0.911), and between MFP the left endocanthus- (p = 0.608). Moreover, no statistically significant difference between MFP and the right exocanthus for Class I and II malocclusion- (p = 0.487), and between MFP and the left exocanthus- (p = 0.441). There was no statistically significant difference between MFP and the right for Class I and II malocclusion- (p = 0.349), and between MFP and the left ala- (p = 0.145). There was no statistically significant difference between MFP and the right inters commissurein for Class I and II malocclusion- (p = 0.268), and between MFP and the left inters commissurein- (p = 0.310). There was no statistically significant difference between MFP and the right gonion for Class I and II malocclusion- (p = 0.348), and between MFP and the left gonion- (p = 0.705) (Table 5).

When it comes to the distance between MFP and the LS point between Class I and Class II malocclusion patients, it can be concluded that this distance is longer for patients who suffer from Class I malocclusion (1.05 mm) than the distance for patients who suffer from Class II malocclusion (0.919 mm), with no statistically significant difference; (p = 0.304). On the other hand, when it comes to the distance between MFP and the ME point between Class I and Class II malocclusion patients, it can be concluded that this distance is longer for patients who suffer from Class II malocclusion (1.38 mm) than the distance for patients who suffer from Class I malocclusion (1.32 mm), with no statistically significant difference; (p = 0.781) (Table 5) (Figure 5).

Mid-facial plane measurements Class I and III malocclusion patients indicated no statistically significant difference between MFP and the right endocanthus for Class I and III malocclusion- (p = 0.927), and between MFP and the left endocanthus- (p = 0.547). There was statistically significant between MFP and the right exocanthus for Class I and III malocclusion- (p = 0.02). and between MFP and the left exocanthus- (p = 0.03). There was no statistically significant difference between MFP and the right ala for Class I and III malocclusion- (p = 0.570). However, there was a statistically significant between MFP and the left ala- (p = 0.016). There was no statistically significant difference between MFP and the right inters commissure for Class I and III malocclusion- (p = 0.363), and between MFP and the left inters commissure- (p = 0.656). There was no statistically significant difference between MFP and the right gonion for Class I and III malocclusion- (p = 0.414), and between MFP and the left gonion- (p = 0.996) (Table 6)(Figure 6).

Lastly, when it comes to the distance between MFP and the PN point between Class I and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class III malocclusion (1.0 mm) is close to the distance for patients who suffer from Class I malocclusion (0.728 mm), with no statistically significant difference; (p = 0.06). When it comes to the distance between MFP and the LS point between Class I and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class I malocclusion (1.05 mm) is close to the distance for patients who suffer from Class III malocclusion (1.17 mm), with no statistically significant difference; (p = 0.397). On the other hand, when it comes to the distance between MFP and the ME point between Class I and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class III malocclusion (1.39 mm) is very close to the distance for patients who suffer from Class I malocclusion (1.32 mm), with no statistically significant difference; (p = 0.783) (Table 6).

Mid-facial plane measurements for Class II III malocclusion indicated no statistically significant difference between MFP and the right endocanthus for Class II and III malocclusion- (p = 0.846), and between MFP and the left endocanthus- (p = 0.276). There was no statistically significant difference between MFP and the right exocanthus for Class II and III malocclusion- (p = 0.116). However, there was a statistically significant difference between MFP and the left exocanthus- (p = 0.004).There was no statistically significant difference between MFP and the right ala for Class II and III malocclusion- (p = 0.741), and between MFP and the left ala- (p = 0.257).There was no statistically significant difference between MFP and the right inters commissure for Class II and III malocclusion- (p = 0.082), and between MFP and the left inters commissure- (p = 0.174) (Figure 7).There was no statistically significant difference between MFP and the right gonion for Class II and III malocclusion- (p = 0.084), and between MFP and the left gonion- (p = 0.680) (Table 7).

Lastly, when it comes to the distance between MFP and the PN point between Class II and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class III malocclusion (1.0 mm) is longer than the distance for patients who suffer from Class II malocclusion (0.693 mm), with a statistically significant difference; (p = 0.024). When it comes to the distance between MFP and the LS point between Class II and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class II malocclusion (0.919 mm) is close to the distance for patients who suffer from Class

III malocclusion (1.17 mm), with no statistically significant difference; (p = 0.09). On the other hand, when it comes to the distance between MFP and the ME point between Class II and Class III malocclusion patients, it can be concluded that this distance for patients who suffer from Class III malocclusion (1.39 mm) is very close to the distance for patients who suffer from Class II malocclusion (1.38 mm), with no statistically significant difference; (p = 0.995) (Table 7) (Figure 6).

Discrepancies between all three Classes regarding the 13 facial landmarks indicated no statistically significant difference between MFP and the left endocanthus and between MFP and the right endocanthus; (p = 0.980), and (p = 0.543) respectively. There was no statistically significant difference between MFP and the right exocanthus; (p = 0.07). On the other hand, there was a statistically significant difference between MFP and the left exocanthus; (p = 0.012). There was no statistically significant difference between MFP and the right ala; (p = 0.655). On the other hand, there was a statistically significant difference between MFP and the left ala; (p = 0.04). There was no statistically significant difference between MFP and the left inters commissure and between MFP and the right inters commissure; (p = 0.350), and (p = 0.155) respectively. There was no statistically significant difference between MFP and the left gonion and the between MFP and the right gonion; (p = 0.902), and (p = 0.215) respectively. Regarding the PN, LS, and ME points, There was no statistically significant for these parameters; (p = 0.052), (p = 0.196), and (p = 0.952) respectively (Table 8) (Figure 8).

Figure 1: Landmarks on frontal facial photographs (1. Nasion, 2. Right pupil, 3. Left pupil, 4. Right endocanthus, 5. Left endocanthus, 6. Right exocanthus, 7. Left exocanthus, 8. Pronasale, 9. Right ala of the nose, 10. left ala of the nose, 11. Labiale superious, 12. Right chelion, 13. Left chelion, 14. Right gonion, 15. Left gonion, 16. menton)

Figure 2: Reference plane (1. Interpupillary line, 2. Mid facial plan)

Figure 3: Horizontal parameters (1. Mfp- Enr, 2. Mfp- Enl, 3. Mfp- Exr, 4. Mfp- Exl, 5. Mfp-Alr, 6. Mfp- All, 7. Mfp-Chr, 8. Mfp- Chl, 9.Mfp-Gor, 10. Mfp-Gol)

Figure 4: Midline Parameters (1. Mfp-Prn, 2. Mfp-Ls, 3. Mfp- Me')

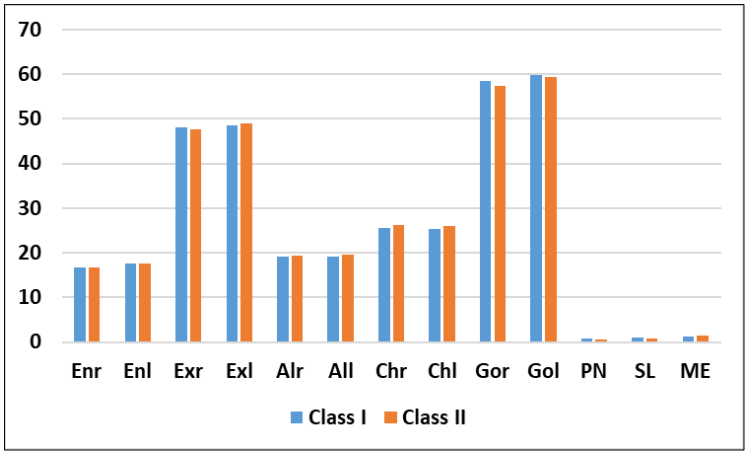

Figure 5: Comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I and Class II malocclusion patients.

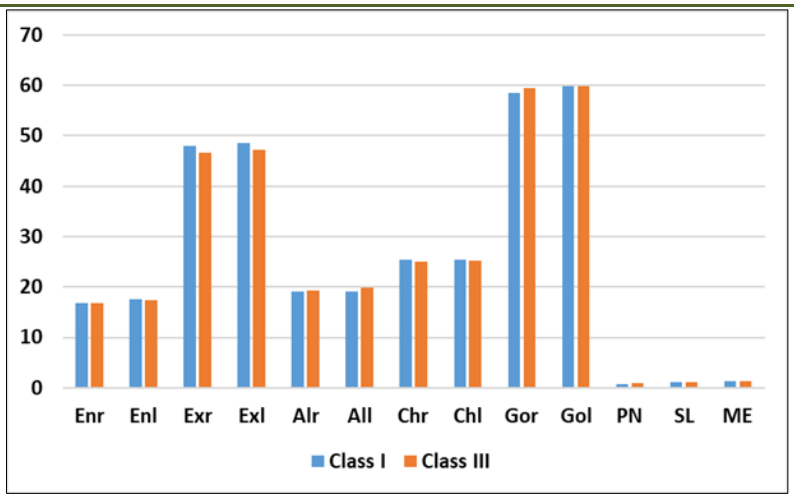

Figure 6: Comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I and Class III malocclusion patients

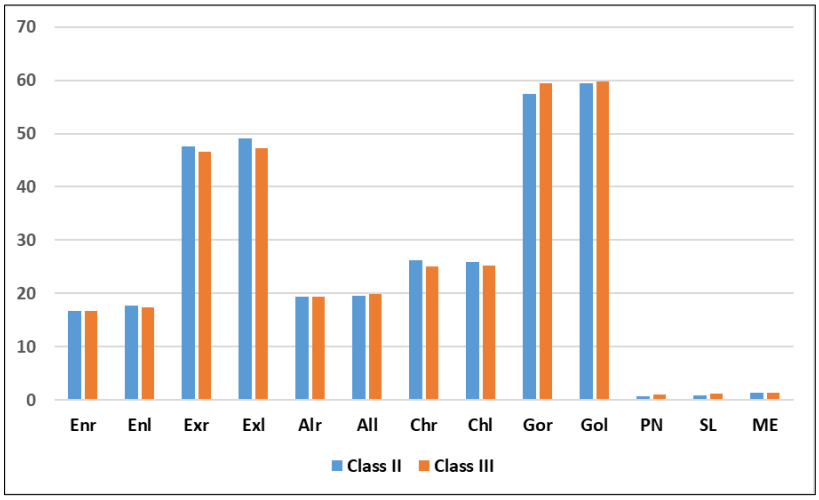

Figure 7: Comparison of the distance between MFP and different facial landmarks on the right and left sides of Class II and Class III malocclusion patients

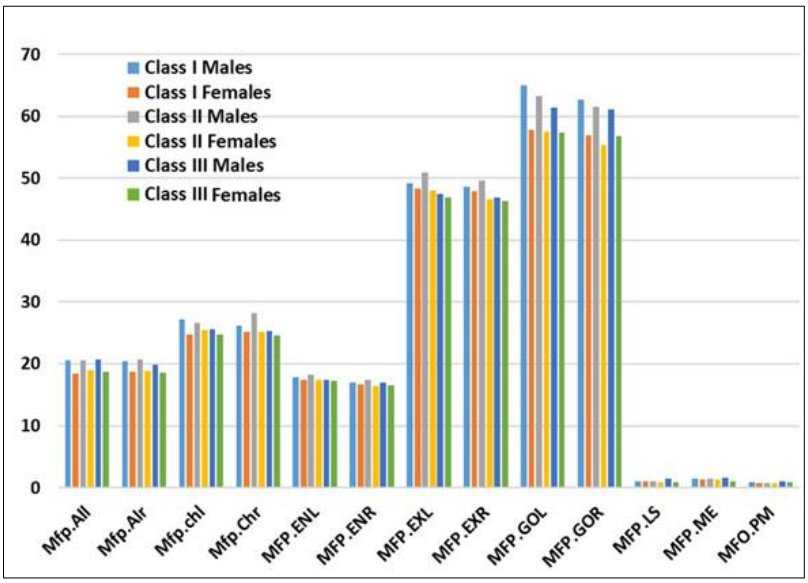

Figure 8: Comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I, Class III, and Class III malocclusion patients

Table 1: comparison of Pronasale (PN), Labial Superior (LS) and Menton (ME) between Class I and Class II

Midline Parameters	Class I N=75	Class II N=75	*p*
PN Left (n=126) Right(n=99)	 38(50.7) 37(49.3)	 **37(49.3** **38(50.7)**	 1.0
#	0.254	**0.124**	
LS Left (n=118) Right(n=107)	 **37(49.3)** **38(50.7)**	 42(56.0) 33(44.0)	 0.414
#	0.508	0.450	
ME Left (n=119) Right(n=106)	 **37(49.3)** **38(50.7)**	 41(54.7) 34(45.3)	 0.869
#	0.449	0.706	
#Comparison between right and left sides			

Table 2: comparison of Pronasale (PN), Labial Superior (LS) and Menton (ME) between Class I and Class III

Midline Parameters	Class I N=75	Class III N=75	*p*
PN Left (n=126) Right(n=99)	 38(50.7) 37(49.3)	 51(68.0) 24(32.0)	 0.03*
#	0.254	0.01*	
LS Left (n=118) Right(n=107)	 **37(49.3)** **38(50.7)**	 39(52.0) 36(48.0)	 0.744
#	0.508	0.924	
ME Left (n=119) Right(n=106)	 **37(49.3)** **38(50.7)**	 41(54.7) 34(45.3)	 0.869
#	0.449	0.706	
#Comparison between right and left sides			

Table 3: comparison of Pronasale (PN), Labial Superior (LS) and Menton (ME) between Class II and Class III

Midline Parameters	Class II N=75	Class III N=75	*p*
PN Left (n=126) Right(n=99)	 **37(49.3)** **38(50.7)**	 51(68.0) 24(32.0)	 0.02*
#	**0.124**	0.01*	
LS Left (n=118) Right(n=107)	 42(56.0) 33(44.0)	 39(52.0) 36(48.0)	 0.623
#	0.450	0.924	
ME Left (n=119) Right(n=106)	 41(54.7) 34(45.3)	 41(54.7) 34(45.3)	 1.0
#	0.706	0.706	
#Comparison between right and left sides			

Table 4: comparison of Pronasale (PN), Labial Superior (LS) and Menton (ME) between Class II, Class II, and Class III

Midline Parameters	Class I N=75	Class II N=75	Class III N=75	Test of significance
PN Left (n=126) Right(n=99)	 38(50.7) 37(49.3)	 **37(49.3)** **38(50.7)**	 51(68.0) 24(32.0)	 χ^2=6.60 p=0.04*

Midline Parameters	Class I N=75	Class II N=75	Class III N=75	Test of significance
#	0.254	**0.124**	0.01*	
LS Left (n=118) Right(n=107)	 **37(49.3)** **38(50.7)**	 42(56.0) 33(44.0)	 39(52.0) 36(48.0)	 χ^2=0.677 p=0.712
#	0.508	0.450	0.924	
ME Left (n=119) Right(n=106)	 **37(49.3)** **38(50.7)**	 41(54.7) 34(45.3)	 41(54.7) 34(45.3)	 χ^2=0.571 p=0.752
#	0.449	0.706	0.706	
#Comparison between right and left sides				

Table 5: comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I and Class II malocclusion patients

Points Compared with MFP	Class I	Class II	Student t test
Enr	16.77±1.69	16.74±2.09	t=0.112 p=0.911
Enl	17.52±1.80	17.68±2.0	t=0.514 p=0.608
paired t test	t=3.68 p<0.001*	t=4.52 p=0.001*	
Exr	48.05±3.66	47.62±3.80	t= 0.597 p=0.487
Exl	48.57±3.67	49.05±3.72	t=0.773 p=0.441
paired t test	t=2.06 p=0.04*	t=5.84 p=0.0001*	
Alr	19.17±1.95	19.47±1.99	t=0.939 p=0.349
All	19.05±2.07	19.52±1.85	t=1.46 p=0.145
paired t test	t=0.623 p=0.535	t=0.318 p=0.752	
Chr	25.49±2.78	26.18±4.58	t=1.11 p=0.268
Chl	25.45±2.58	25.90±2.79	t=1.02 p=0.310
paired t test	t=0.112 p=0.911	t=0.567 p=0.572	
Gor	58.54±6.61	57.48±7.15	t=0.942 p=0.348
Gol	59.76±6.18	59.39±5.58	t=0.380 p=0.705
paired t test	t=2.09 p=0.04*	t=2.66 p=0.01*	
PN	0.728±0.88	0.693±0.80	t=0.251 p=0.802
LS	1.05±0.75	0.919±0.83	t=1.03 p=0.304
ME	1.32±1.15	1.38±1.24	t=0.279 p=0.781

Table 6: comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I and Class III malocclusion patients

Points Compared with MFP	Class I	Class III	Student t test
Enr	16.77±1.69	16.80±1.85	t=0.092 p=0.927

Points Compared with MFP	Class I	Class III	Student t test
Enl	17.52±1.80	17.35±1.74	t=0.604 p=0.547
paired t test	t=3.68 p<0.001*	t=3.23 p=0.002*	
Exr	48.05±3.66	46.64±3.79	t=2.31 p=0.02*
Exl	48.57±3.67	47.29±3.69	t=2.14 p=0.03*
paired t test	t=2.06 p=0.04*	t=3.0 p=0.004*	
Alr	19.17±1.95	19.36±2.15	t=0.569 p=0.570
All	19.05±2.07	19.89±2.16	t=2.44 p=0.016*
paired t test	t=0.623 p=0.535	t=2.85 p=0.006*	
Chr	25.49±2.78	25.03±3.32	t=0.912 p=0.363
Chl	25.45±2.58	25.25±3.07	t=0.446 p=0.656
paired t test	t=0.112 p=0.911	t=0.673 p=0.503	
Gor	58.54±6.61	59.41±6.42	t=0.819 p=0.414
Gol	59.76±6.18	59.77±5.41	t=0.006 p=0.996
paired t test	t=2.09 p=0.04*	t=0.583 p=0.562	
PN	0.728±0.88	1.0±0.85	t=1.94 p=0.06
LS	1.05±0.75	1.17±0.98	t=0.850 p=0.397
ME	1.32±1.15	1.39±1.33	t=0.276 p=0.783

Table 7: comparison of the distance between MFP and different facial landmarks on the right and left sides of Class II and Class III malocclusion patients

Points Compared with MFP	Class II	Class III	Student t test
Enr	16.74±2.09	16.80±1.85	t=0.19 p=0.849
Enl	17.68±2.0	17.35±1.74	t=1.09 p=0.276
paired t test	t=4.52 p=0.001*	t=3.23 p=0.002*	
Exr	47.62±3.80	46.64±3.79	t=1.58 p=0.116
Exl	49.05±3.72	47.29±3.69	t=2.90 p=0.004*
paired t test	t=5.84 p=0.0001*	t=3.0 p=0.004*	
Alr	19.47±1.99	19.36±2.15	t=0.331 p=0.741
All	19.52±1.85	19.89±2.16	t=1.14 p=0.257
paired t test	t=0.318 p=0.752	t=2.85 p=0.006*	
Chr	26.18±4.58	25.03±3.32	t=1.75

Points Compared with MFP	Class II	Class III	Student t test
			p=0.082
Chl	25.90±2.79	25.25±3.07	t=1.36 p=0.174
paired t test	t=0.567 p=0.572	t=0.673 p=0.503	
Gor	57.48±7.15	59.41±6.42	t=1.74 p=0.084
Gol	59.39±5.58	59.77±5.41	t=0.413 p=0.680
paired t test	t=2.66 p=0.01*	t=0.583 p=0.562	
PN	0.693±0.80	1.0±0.85	t=2.28 p=0.024*
LS	0.919±0.83	1.17±0.98	t=1.71 p=0.09
ME	1.38±1.24	1.39±1.33	t=0.006 p=0.995

Table 8: comparison of the distance between MFP and different facial landmarks on the right and left sides of Class I, Class III, and Class III malocclusion patients

Points Compared with MFP	Class I	Class II	Class III	One Way ANOVA test
Enr	16.77±1.69	16.74±2.09	16.80±1.85	F=0.02 P= 0.980
Enl	17.52±1.80	17.68±2.0	17.35±1.74	F=0.613 P=0.543
paired t test	t=3.68 p<0.001*	t=4.52 p=0.001*	t=3.23 p=0.002*	
Exr	48.05±3.66	47.62±3.80	46.64±3.79	F=2.76 P=0.07
Exl	48.57±3.67	49.05±3.72	47.29±3.69	F=4.53 P=0.012*
paired t test	t=2.06 p=0.04*	t=5.84 p=0.0001*	t=3.0 p=0.004*	
Alr	19.17±1.95	19.47±1.99	19.36±2.15	F=0.424 P=0.655
All	19.05±2.07	19.52±1.85	19.89±2.16	F=3.24 P=0.04*
paired t test	t=0.623 p=0.535	t=0.318 p=0.752	t=2.85 p=0.006*	
Chr	25.49±2.78	26.18±4.58	25.03±3.32	F=1.88 P=0.155
Chl	25.45±2.58	25.90±2.79	25.25±3.07	F=1.05 P=0.350
paired t test	t=0.112 p=0.911	t=0.567 p=0.572	t=0.673 p=0.503	
Gor	58.54±6.61	57.48±7.15	59.41±6.42	F=1.55 P=0.215
Gol	59.76±6.18	59.39±5.58	59.77±5.41	F=0.103 P=0.902
paired t test	t=2.09 p=0.04*	t=2.66 p=0.01*	t=0.583 p=0.562	
PN	0.728±0.88	0.693±0.80	1.0±0.85	F=2.99 P=0.052
LS	1.05±0.75	0.919±0.83	1.17±0.98	F=1.64 P=0.196
ME	1.32±1.15	1.38±1.24	1.39±1.33	F=0.05 P=0.952

DISCUSSION

Upon finalizing the methodological aspect of the current study, accompanied by the literature review that had been conducted previously, it can be stated that the study was capable of achieving the research objective by evaluating the state of facial asymmetry as it correlates to Class I, II, and III skeletal relations in a sample of adult patient. Firstly, it is concluded that patients' gender did not contribute in any way, shape, or form in the emergence of any discrepancies between Class I, II, and III malocclusion, and that sex, including male or female, did not dictate the manner through which facial landmarks are distributed on their faces nor did it induce any asymmetries or skeletal defects when they were subject to, photographing, examination, and analysis.

This was confirmed by [16, 17], who concluded that gender neither has an effect on the severity of any malocclusion classes and the skeletal parameters of patients nor the treatment outcome on male or female patients who suffer from skeletal relations. As a result, gender should not be thought of as a factor in the diagnosis or treatment planning of malocclusions. Recognizing that gender is not associated with these dental misalignments is vital for healthcare providers to avoid biases in care and to promote a thorough understanding of malocclusion causes.

Secondly, it is also concluded that soft tissues, in accordance with the previously measured facial landmarks and midpoint parameters, can mask the levels of malocclusion and hide any defects that would be obvious characteristics of Class I, II, or II skeletal malocclusion for patients. This was confirmed by [18], and [19], who concluded that the nature of soft tissue and the interplay between soft and hard tissues can give a normal appearance and not indicate any malocclusions or asymmetries. Moreover, the thickness and location of these soft tissues, around the nose, lips, and chin area, can often serve as natural cover-ups for the usual biological determinants and skeletal indicators for the prevalence of Class I, II, or II skeletal malocclusion for patients.

This can influence orthodontic treatment planning, as the orthodontist must take into account not just dental alignment but also the patient's soft tissue profile when deciding on interventions. Grasping the interplay between the hard and soft tissues is vital for achieving the best possible aesthetic and functional results from orthodontic treatment. For instance, Class I skeletal malocclusion involves normal positioning of the molars but misalignment or spacing problems with individual teeth. While the skeletal relationship between the upper and lower jaws is usually normal, the dental crowding or irregularities can be significant. However, characteristics of the lips, especially, can hide these issues. This was confirmed by [20], who indicated that in case of Class I and II malocclusions, patients' soft tissue can adapt to the skeletal chin positioning which might give a normal appearance and mask the asymmetrical features of their faces.

The lower face muscles can often disguise the seriousness of a Class II malocclusion. Strong jaw and chin muscles may make up for a small jaw, giving a more balanced side view of the face. Also, the position of the lips can adjust to differences in the teeth and bones. The lower lip sometimes turns up to meet the upper lip, making the front teeth seem less protruded. This was confirmed by [21], who indicated that Soft tissue analysis can be utilized to evaluate skeletal imbalances, but it does not consistently reveal the accurate type of malocclusion. Another study [22], also concluded that soft tissue thickness must always be taken into consideration when analyzing malocclusion cases for patients; due to the fact that it can affect the appearance of such cases and mask their true trajectories.

Moreover, individuals with Class III malocclusion have a lower jaw positioned in front of the upper jaw. This can lead to a protruding chin. However, the soft tissues of the face can significantly change the appearance of the profile. Someone with thicker soft tissue and fuller lips may have a less obvious protruding chin, giving a softer facial profile. This was confirmed by [23, 24], who concluded that maxillary retrusion can be compensated in patients who suffer from Class III malocclusion due to a prominent upper lip volume; which makes their profile appear more normal. Thus, even if the upper lip is further back than the lower lip due to the jaw discrepancy, there can still be a balanced look if there is ample, evenly distributed soft tissue. Facial expressions are adaptable as well, with the soft tissues moving during different expressions to hide some of the malocclusion and make it seem less severe.

Additionally, regarding the PN point, it can be concluded that patients who suffer from Class I, Class II and Class III had a wider right hemiface, and that patients who suffer from Class II and Class III had a wider right hemiface regarding both the LS and ME points respectively. Generally speaking, 56%, 52%, and 52% of the subjects had a wider right hemiface regarding the PN, LS, and ME points respectively. This was confirmed by [25], who indicated that, through analyzing a sample of patients who suffered from Class I and Class II skeletal malocclusion had a wider right-side hemiface than the left side. However, Class II patients had the same problem of a wider right-side hemiface due to asymmetries caused by menton (ME) deviation [26], also concluded that Class I and Class II both had facial asymmetry that was characterized by a wider right-side hemiface, with a laterality of facial asymmetry that was seen on the left side in both Classes.

Similarly [27], confirmed this notion by concluding that the right-side hemiface grows wider than its left counterpart for patients who suffer from Class I, II, and III skeletal malfunction. However, the authors indicated that such deviation that causes facial asymmetry can be attributed to postnatal factors such as more use of a habitually preferred chewing side. Another study conducted by [28], also concluded that there was a common, albeit mild, prevalence of skeletal asymmetry. Although soft tissue compensation appears to mask the skeletal discrepancy in an attempt to maintain aesthetic proportions, it is imperfect. The hard tissue deviation favors the left side, while the soft tissue overcompensates on the right side.

It should be noted as well, that the dominance of the right-side hemiface did not have any correlation with the patients' sex and also did not cohere with nor was it attributed to any skeletal jaw relationships. Chi-square tests for patients who suffer from Class I, Class II, and Class III 6.60 for the PN point, 0.677 for the SL point, and 0.677 for the ME point. Therefore, it can be concluded that though Class I, II, and III malocclusions may have distinct skeletal differences, the appearance of the soft tissues can obscure the distinctions, creating a seemingly uniform image. This misleading facade highlights the need for professional dental assessment, since depending solely on visual hints can result in misdiagnosis and lost chances for early treatment. Keep in mind, the real nature of malocclusion frequently lies below the exterior, waiting to be uncovered through thorough evaluation and expert interpretation.

While Class I malocclusions technically have misaligned jaws, they often look surprisingly normal. The teeth may be crowded or tilted, but the overall facial profile and bite can appear balanced. Features like full lips and rounded cheeks cleverly hide the underlying skeletal problem, creating an illusion of harmony. Slight protrusion of the upper lip, a flattened chin, or a sunken profile might hint at the jaw misalignment. However, even then, the masking ability of soft tissues can still be remarkable, potentially obscuring the full extent of the skeletal issue. The lower jaw sticking out is often obvious, causing a characteristic "under-bite." Yet even then, the soft tissues can work their magic. An especially full lower lip or rounded chin can lessen the severity of the profile, making the skeletal imbalance less noticeable.

Having said that, further research is required to be conducted about the acquired injuries that play a role in the state of facial asymmetry and skeletal disruption; which could lead to cases of Class I, II, and III malocclusion, for adult patients and children alike. Moreover, other demographic and genetic variables must also be addressed; in order to examine their correlation with the emergence of Class I, II, and III skeletal relations. Additionally, grasping the underlying reasons for right-side facial asymmetry in malocclusion has important clinical consequences. Unpacking the complex interplay of contributing elements could enable customized treatment approaches. By identifying the particular processes causing the asymmetry for each patient and taking into account their malocclusion type, dentists could tailor interventions to accomplish a more balanced and successful result. This could address not just the functional issues of malocclusion but also the possible aesthetic and psychological effects of facial asymmetry.

As such, investigating the underlying reasons for right-side facial dominance in malocclusion patients is more than just an academic exercise. It's a mission to uncover the mysteries behind facial asymmetry, opening the door for enhanced diagnosis, therapy, and most importantly, a more symmetrical and self-assured smile for people with malocclusion. The path ahead for research welcomes us to examine the concealed complexities of this fascinating occurrence and reconstruct the story of facial asymmetry, one methodical finding at a time.

CONCLUSION

The study, encompassing methodological considerations and prior literature review, effectively achieved its objective by examining facial asymmetry in correlation with Class I, II, and III skeletal relations in adult patients. Gender was found to have no bearing on the emergence of malocclusions, with orthodontic studies supporting this understanding. Soft tissues play a crucial role in masking malocclusions, particularly in the nose, lips, and chin areas, affecting treatment planning.

The analysis of discrepancies between Class I, II, and III malocclusions shows significant differences primarily at the PN point. For Class I vs. II, no significant differences were found at the PN ($p>0.05$), LS ($p>0.05$), and ME points ($p>0.05$). For Class I vs. III, a significant difference was observed at the PN point ($p<0.05$), but not at the LS ($p>0.05$) or ME points ($p>0.05$).

Similarly, Class II vs. III showed a significant difference at the PN point ($p<0.05$), but not at the LS ($p>0.05$) or ME points ($p>0.05$). Chi-square analysis for the PN point showed a significant association ($p=0.04$), but not for LS ($p=0.712$) or ME ($p=0.752$).

Mid-facial plane (MFP) measurements indicated no significant differences in various facial landmarks between Class I and II or Class I and III, except for the right exocanthus ($p=0.02$) and left exocanthus ($p=0.03$) in Class I vs. III, and the left exocanthus ($p=0.004$) and left ala ($p=0.04$) in Class II vs. III. The distance between MFP and PN, LS, and ME points generally showed no significant differences across all classes, except for PN between Class II and III ($p=0.024$).

Despite the skeletal differences between malocclusion classes, soft tissue appearance can obscure these distinctions, emphasizing the need for professional dental assessment. Class I malocclusions may appear normal due to soft tissue masking, while Class II and III malocclusions exhibit more obvious skeletal deviations, albeit still influenced by soft tissue camouflage.

Further research is warranted to explore acquired injuries and demographic variables' correlation with malocclusions, aiming for customized treatment approaches. Investigating the underlying reasons for facial asymmetry in malocclusion patients is essential for tailored interventions, not only addressing functional issues but also aesthetic and psychological effects. Thus, unraveling the complexities of facial asymmetry promises more balanced outcomes and enhanced confidence for individuals with malocclusion.

REFERENCES

1. Ferrera, A., Villanuev, M., Quinto-Sánchez, M., González-José, R. (2015). The relationship between facial shape asymmetry and attractiveness in Mexican students. *Am J Hum Bio*, *27*(3), 387-396.
2. Naveed, N., Felicita, A. S., & Sabapathy, K. (2019). Assessment of Facial Asymmetry in Patients Reporting for Orthodontic Treatment. *Indian Journal of Public Health Research & Development*, *10*(12).
3. Han, S., Shin, S. M., Choi, Y. S., Kim, K. B., Yamaguchi, T., Maki, K., ... & Kim, Y. I. (2019). Comparison of temporomandibular joint shape and size in patients with facial asymmetry. *Oral Radiology*, *35*, 251-259.
4. Thiesen, G., Gribel, B. F., & Freitas, M. P. M. (2015). Facial asymmetry: a current review. *Dental press journal of orthodontics*, *20*(6), 110-125.
5. Reddy Admala, N., & Gopinath, A. (2013). Facial Symmetry: An Illusion? *J Indian Orthod Soc*, 335-338.
6. Kaipainen, A. E., Sieber, K. R., Nada, R. M., Maal, T. J., Katsaros, C., & Fudalej, P. S. (2016). Regional facial asymmetries and attractiveness of the face. *European journal of orthodontics*, *38*(6), 602-608.
7. Mageet1a, A. O. (2016). Classification of skeletal and dental malocclusion: revisited. *CH PRA*, 205.
8. Lalitha, P. (2017). Application of graph theory in diagnosis of malocclusion. *Journal of Management and Science*, *7*(1), 126-134.
9. Nishimoto, S., Kawai, K., Fujiwara, T., Ishise, H., & Kakibuchi, M. (2020). Locating cephalometric landmarks with multi-phase deep learning. *MedRxiv*, 2020-07.
10. Drevický, D., & Kodym, O. (2020). Evaluating Deep Learning Uncertainty Measures in Cephalometric Landmark Localization. In *BIOIMAGING* (pp. 213-220).
11. Tiwari, A., Jain, R. K., & Varghese, R. M. (2020). Comparative evaluation of soft-tissue chin compensation in skeletal Class I and Class III malocclusion. *European Journal of Molecular & Clinical Medicine*, *7*(01), 2020.
12. Shetty, S. K. (2021). Paradigm shift in orthodontics. *Sch. J. Dent. Sci*, *1*, 4-13.
13. Akhil, G., Kumar, K. P. S., Raja, S., & Janardhanan, K. (2015). Three-dimensional assessment of facial asymmetry: A systematic review. *Journal of pharmacy & bioallied sciences*, *7*(Suppl 2), S433-S437.
14. Reddy Admala, N., & Gopinath, A. (2013). Facial Symmetry: An Illusion? *J Indian Orthod Soc*, 335-338.
15. Eden, A. B., & Inan, N. G. (2022 July 28-30). Common Misconceptions and Misunderstandings in Magic Cut-Off for Significance: P-Value. *Proceedings of the 4th International Conference on Statistics: Theory and Applications.*Prague, Czech Republic, 1-4.
16. Elkordy, E. R., Nasef, E. M., & El Sharaby, F. A. (2021). Influence of Orthodontist's Gender and Experience on the Perception of Dentoskeletal Parameters Using Cephalometric Radiographs: A Questionnaire Study. *Open Access Macedonian Journal of Medical Sciences*, *9*(D), 270-278.
17. Mheissen, S., & Khan, H. (2023). *Orthodontic Evidence: A Q&A Handbook*. 1st Ed., Cham, Springer.
18. Ardani, I. G. A. W., Nugraha, A. P., Vitamamy, D. G., Gautama, S., Alida, R. D., Hariati, I. V. D., & Hassan, R. (2023). Correlation of malocclusion with facial profile in Javanese population: A cephalometric analysis. *J Int Dent Med Res*, *16*(2), 756-65.
19. Perović, T. M., Blažej, M., & Jovanović, I. (2022). The influence of mandibular divergence on facial soft tissue thickness in class I patients: a cephalometric study. *Folia Morphologica*, *81*(2), 472-480.
20. Shinde, N., Jethe, S., Agarkar, S., Deshmukh, S., Kharche, A., & Rahalkar, J. (2019). Comparative evaluation of soft tissue chin thickness in skeletal class i and class II adults with three mandibular divergence: a cephalometric study. *J Adv Med Dent Scie Res*, *7*(2), 33-40.
21. Ahsan, T. (2020). Comparison of soft tissue cephalometric parameters distinguishing skeletal class I, II and III malocclusion. *JPDA*, *29*(01), 14-18.
22. Kunnath, J. T., Subrahmanya, R. M., & Dhillon, H. (2020). Assessment of facial soft tissue thickness in individuals having skeletal class II malocclusion. *World Journal of Dentistry*, *11*(3), 179-184.
23. Modarai, F., Donaldson, J. C., & Naini, F. B. (2013). The influence of lower lip position on the perceived attractiveness of chin prominence. *The Angle Orthodontist*, *83*(5), 795-800.
24. Fastuca, R., Beccarini, T., Rossi, O., Zecca, P. A., & Caprioglio, A. (2022). Influence of facial

components in class III malocclusion esthetic perception of orthodontists, patients, and laypersons. *Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie*, *83*(1), 48-58.

25. Maurya, R., & Singh, H. A. M. H. (2018). Reliability and Accuracy of Menton Point in Determination of Facial Asymmetry and Mandibular Laterality. *Modern Research in Dentistry*, *2*(5), 1-6.
26. Agarwal, A., Tikku, T., Maurya, R. P., Srivastava, K., Khanna, R., Verma, S. L., & Srivastava, A. (2018). Scholars Journal of Dental Sciences (SJDS) ISSN 2394-4951 (Print). *Scholars Journal of Dental Sciences (SJDS)* 5(5), 315-321.
27. Missier, M. S., & George, A. M. (2021). Estimating the Prevalance of Facial Asymmetry in the South Indian Population. *Sch J Dent Sci*, *1*, 14-18.
28. Pan, P. H. 3-Dimensional Comparison Of Hard And Soft Tissue Asymmetry In Adult Chinese Skeletal Class III Malocclusions. Unpublished Master's Thesis 2014, University of Alabama at Birmingham, USA.