A Modified Method to Assess the Sagittal Jaw Relationship

Yasir R. Al-Labban[1], Zainab M. Kadhom[1], Mohammed Nahidh[1]*

1. Department of Orthodontics, College of Dentistry, University of Baghdad, Iraq.

Abstract

In orthodontics, assessment of any case is started with taking history and examining the jaws, soft tissues and dentition in different planes. The present study was conducted to modify a clinical method used to evaluate the sagittal jaw relationship and correlate it with other methods.

One hundred and five individuals were selected to participate in this study. Clinical examination and true lateral cephalometric radiograph were taken to analyze different methods for assessing sagittal jaw relationship using AutoCAD program 2017. Data collected were analyzed using independent sample t-test, one-way ANOVA followed by post hoc Tukey's test and Pearson's correlation coefficient test.

There was agreement between the two fingers method with other methods. The difference between modified method (Subspinale and Sublabiale to the Zero-Meridian line) was correlated significantly with other methods in class II sample.

A new clinical method is developed to assess the sagittal jaw relation using Zero-Meridian line.

Clinical article (J Int Dent Med Res 2019; 12(4): 1402-1408)

Keywords: ANB angle, angle of convexity, sagittal jaw relationship, Zero Meridian line.

Received date: 22 April 2019 **Accept date:** 08 June 2019

Introduction

The first step in treating any orthodontic case is the clinical diagnosis. This will be performed by the orthodontist regarding the skeletal, soft tissue and dental components in three planes of space [1]. The majority of the orthodontic textbooks started with examining the sagittal jaw relationship clinically. Most of the methods used were subjective and little was objective.

Foster [2] in 1975 developed the first method called the two fingers method. He oriented the patient with Frankfort plane parallel and the teeth in maximum intercuspation and applied the index finger on the soft tissue concavity of the upper lip below the nose and the middle finger on the soft tissue concavity of the lower lip upper to the chin. These points coincided with points A and B determined cephalometrically. When the two fingers touched at the same time, this was considered class I. When the index finger touched the soft tissue before the middle, this meant class II jaw relation and vice versa for class III. The weak points of this method were the variable fingers' length and the thickness of soft tissues that may vary according to the age and genders in addition to the problem of subjectivity in determining the cause of jaw mal-relation whether in the maxilla or in the mandible.

Mills [3] in 1987 used the same method of Foster but applied the two fingers intra-orally in direct contact with bony point A and B to cancel the effect of soft tissue thickness. Still the results were subjective in addition to the variability of the fingers' lengths between the orthodontists.

Houston [4] and Mitchell [5-7] assessed the skeletal jaw relationship by viewing the relative position of the maxilla and mandible from the side view of the patient. They concentrated on the region of the dental bases rather than the lips as their positions were influenced by proclination or retroclination of the incisors. The sagittal jaw relation was classified into:

- Class I- the mandible is 2-3 mm posterior to maxilla.
- Class II- the mandible is retruded relative to the maxilla.
- Class III- the mandible is protruded relative to the maxilla.

Corresponding author:
Mohammed Nahidh
Department of Orthodontics,
College of Dentistry, University of Baghdad,
Iraq.
E-mail: m_nahidh79@yahoo.com

The drawback of this classification was it gave only the position of the mandible and the maxilla relative to each other and does not indicate where the discrepancy lies. Furthermore, a lateral cephalometric radiograph is necessary to assess the real etiology of the skeletal pattern.

Littlewood [8], Cobourne and DiBiase [9] and Littlewood and Mitchell [10] listed three methods for evaluating the sagittal jaw relation. First, by relating the upper lip and the chin to a vertical line dropped from soft tissue nasion called Zero Meridian line. In normal condition, the upper lip should rest on or slightly in front of this line and the chin slightly behind it. This method did not take the soft tissue points A and B in consideration. Second, by palpating the anterior portion of the maxilla at A point and the mandible at B point (the same method mentioned previously by Mills) and lastly by assessing the convexity of the face by determining the angle between the middle (glabella to subnasale) and lower (subnasale to pogonion) thirds of the face in profile. The mean value of this angle was 12°± 4°.

In the literature, only one study conducted by Saleh [11] in 2001 compared the palpation method with ANB angle determined by lateral cephalometric radiograph and the findings proved a 100% agreement between the two methods in diagnosing class II and III cases while 80% agreement for class I cases.

The present study was conducted to modify the Zero-Meridian line method (by relating soft tissue point A and B to this line) and to correlate this new method with others.

Materials and methods

Sample

The samples of the current study comprised of undergraduate students at the College of Dentistry, University of Baghdad and students from nursing secondary school in the medical city.

One hundred and five individuals were selected to participate in this study according to specific criteria. These criteria included individuals with class I, II and III dental and skeletal relationships determined by clinical examination and using the two fingers method of Foster [2], Iraqi Arabs in origin, aged 18-23 years, having complete set of permanent teeth with no history of orthodontic treatment, bad oral habits or craniofacial deformities.

Methods

The goals of the present study were explained to the participants and in case of agreement; a consent form was signed and brief history was taken from the participants.

The subject then asked to sit in an upright position on the dental chair and to look on the level with his/her eyes so that he/she could look straight ahead, as in this position the head will be in the natural (relaxed) position, and occluded in centric relationship to examine dental and skeletal relationships.

True lateral cephalometric radiographic was taken using Planmeca ProMax X-ray unit (Planmeca OY Company, Helsinki, Finland) in natural head position [12,13].

The collected radiographs were analyzed using AutoCAD software 2017. The linear measurements were corrected to overcome the magnification.

The points used in this study were (Figure1) [14]:

1. Point Nasion (N): The midpoint of the fronto-nasal suture.
2. Point A: The point of maximum concavity in the midline of the alveolar process of the maxilla.
3. Point B: The point of maximum concavity in the midline of the alveolar process of the mandible.
4. Point soft tissue nasion (n): The midpoint on the soft tissue contour of the base of the nasal root.
5. Point Subspinale (ss): The most posterior midpoint of the philtrum.
6. Point Sublabiale (sl): The most posterior midpoint on the labio-mental soft tissue contour that defines the border between the lower lip and the chin.
7. Point Glabella (g): The most anterior point of the frontal bone.
8. Point Subnasale (sn): The midpoint on the nasolabial soft tissue contour between the columella crest and the upper lip.
9. Point Soft tissue pogonion (pog): The most anterior midpoint of the chin.

The measurements obtained were (Figure1):

1. ANB angle [15]: The angle between NA and NB lines.

2. Angle of convexity of the face [8]: The angle between g-sn and sn-pog lines.

The liner measurements between points soft tissue subspinale and sublabiale and the Zero Meridian line (developed by the authors): It is the perpendicular distance between point soft tissue subspinale and sublabiale and Zero Meridian line. The difference between these two distances represented the sagittal jaw relationship.

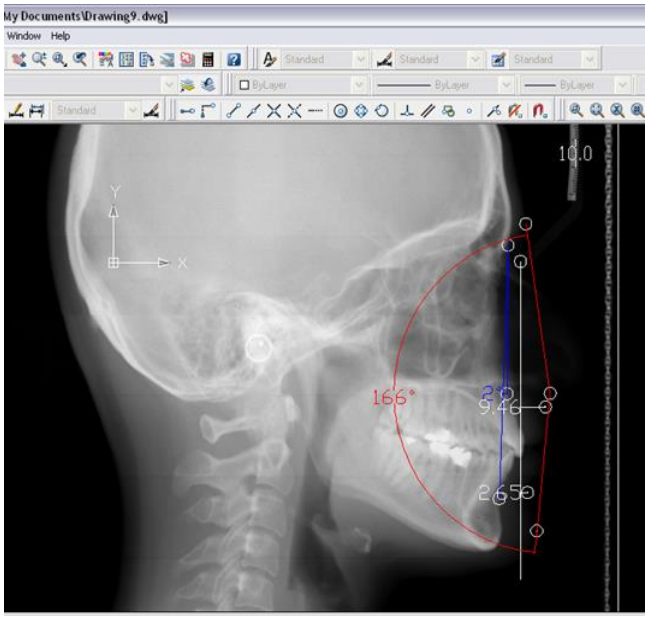

Figure 1. The measurements used in the present study.

Statistical analyses

The collected data were analyzed using SPSS software version 24. The analyses included descriptive statistics (means and standard deviations, standard errors, minimum and maximum values), while inferential statistics included independent sample t-test, one-way ANOVA test followed by post hoc Tukey's test and Pearson's correlation coefficient test. Probability value was set at 0.05.

Results

Tables 1, 2 and 3 demonstrated the descriptive statistics and gender difference of the measured variables in class I, II and III respectively. Generally, there was no significant gender difference regarding ANB angle, angle of convexity in all classes. This was also true for the new modified method representing the difference between Subspinale and Sublabiale in relation to Zero Meridian in class III but the significant difference was recorded in class I and II.

Tables 4-9 represented the relationship among different methods used in determining the sagittal jaw relationship in different classes and genders. The results in both gender of class II revealed significant correlations between the variables.

Comparing the parameters measured among different classes were shown in tables 10 and 11. Class difference was significant in all parameters used in determining the anteroposterior jaw relationship. Basically, ANB angle, angle of convexity and the new methods were higher in class II followed by class I then III.

Variables	Genders	Descriptive statistics						Comparison	
		N	Mean	S.D.	S.E.	Min.	Max.	t-test	p-value
ANB	**Males**	20	3.150	0.745	0.167	2	4	0.443	0.660
	Females	25	3.040	0.889	0.178	2	4		
Subspinale-Zero Meridian	**Males**	20	10.537	4.056	0.907	3.5	17.81	-0.621	0.538
	Females	25	11.189	2.998	0.600	6.48	16.67		
Sublabiale-Zero Meridian	**Males**	20	1.245	5.126	1.146	-9.51	9.34	-1.874	0.068
	Females	25	4.023	4.789	0.958	-5.98	12.85		
Difference	**Males**	20	9.292	2.256	0.505	4.99	13.01	3.051	0.004
	Females	25	7.166	2.372	0.474	2.55	12.57		
G'-Sn-Pog'	**Males**	20	13.600	3.952	0.884	6	19	-1.949	0.058
	Females	25	15.680	3.211	0.642	8	21		

Table 1. Descriptive statistics and gender difference for the measured variables in class I.

Variables	Genders	Descriptive statistics						Comparison	
		N	Mean	S.D.	S.E.	Min.	Max.	t-test	p-value
ANB	Males	15	5.933	1.033	0.267	5	8	-0.306	0.761
	Females	30	6.033	1.033	0.189	5	9		
Subspinale-Zero Meridian	Males	15	13.139	2.684	0.693	9.86	19.89	2.197	0.033
	Females	30	11.482	2.227	0.407	6.92	17.57		
Sublabiale-Zero Meridian	Males	15	2.333	3.548	0.916	-2.98	9.6	-0.359	0.721
	Females	30	2.728	3.431	0.626	-4.69	10.67		
Difference	Males	15	10.805	2.562	0.662	6.4	16.04	2.854	0.007
	Females	30	8.754	2.119	0.387	4.29	12.54		
G'-Sn-Pog'	Males	15	19.267	4.367	1.127	12	29	-0.856	0.397
	Females	30	20.400	4.099	0.748	13	28		

Table 2. Descriptive statistics and gender difference for the measured variables in class II.

Variables	Genders	Descriptive statistics						Comparison	
		N	Mean	S.D.	S.E.	Min.	Max.	t-test	p-value
ANB	Males	8	-0.125	0.835	0.295	-1	1	1.484	0.162
	Females	7	-1.000	1.414	0.535	-3	1		
Subspinale-Zero Meridian	Males	8	9.546	3.548	1.254	5.72	16.3	-0.050	0.961
	Females	7	9.621	1.966	0.743	6.76	12.1		
Sublabiale-Zero Meridian	Males	8	9.731	2.884	1.019	5.98	14.03	-0.732	0.477
	Females	7	10.633	1.599	0.604	8.41	12.81		
Difference	Males	8	-0.185	3.666	1.296	-4.78	5.23	0.492	0.631
	Females	7	-1.011	2.672	1.010	-4.19	3.69		
G'-Sn-Pog'	Males	8	2.750	1.909	0.675	0	5	-0.124	0.903
	Females	7	2.857	1.345	0.508	1	5		

Table 3. Descriptive statistics and gender difference for the measured variables in class III.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.432	0.379
	p-value	0.057	0.099
Difference	r	0.386	
	p-value	0.093	

Table 4. Relation between the variables in class I male group.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.545	0.395
	p-value	0.005	0.051
Difference	r	0.324	
	p-value	0.114	

Table 5. Relation between the variables in class I female group.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.654	0.731
	p-value	0.008	0.002
Difference	r	0.448	
	p-value	0.094	

Table 6. Relation between the variables in class II male group.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.534	0.538
	p-value	0.002	0.002
Difference	r	0.338	
	p-value	0.068	

Table 7. Relation between the variables in class II female group.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.785	-0.041
	p-value	0.021	0.923
Difference	r	0.140	
	p-value	0.740	

Table 8. Relation between the variables in class III male group.

Variables		G'-Sn-Pog'	Difference
ANB	r	0.350	0.555
	p-value	0.441	0.196
Difference	r	0.354	
	p-value	0.436	

Table 9. Relation between the variables in class III female group.

Variables	Groups	Descriptive statistics						Comparison ANOVA test		Tukey HSD	
		N	Mean	S.D.	S.E.	Min.	Max.	F-test	p-value	Groups	p-value
ANB	I	20	3.150	0.745	0.167	2	4	129.379	0.000	I-II	0.000
	II	15	5.933	1.033	0.267	5	8			I-III	0.000
	III	8	-0.125	0.835	0.295	-1	1			II-III	0.000
Subspinale-Zero Meridian	I	20	10.537	4.056	0.907	3.5	17.81	3.466	0.041	I-II	0.092
	II	15	13.139	2.684	0.693	9.86	19.89			I-III	0.783
	III	8	9.546	3.548	1.254	5.72	16.3			II-III	0.048
Sublabiale-Zero Meridian	I	20	1.245	5.126	1.146	-9.51	9.34	11.695	0.000	I-II	0.739
	II	15	2.333	3.548	0.916	-2.98	9.6			I-III	0.000
	III	8	9.731	2.884	1.019	5.98	14.03			II-III	0.001
Difference	I	20	9.292	2.256	0.505	4.99	13.01	48.619	0.000	I-II	0.049
	II	15	10.805	2.562	0.662	6.4	16.04			I-III	0.000
	III	8	-0.185	3.666	1.296	-4.78	5.23			II-III	0.000
G'-Sn-Pog'	I	20	13.600	3.952	0.884	6	19	48.313	0.000	I-II	0.000
	II	15	19.267	4.367	1.127	12	29			I-III	0.000
	III	8	2.750	1.909	0.675	0	5			II-III	0.000

Table 10. Descriptive statistics and class difference for the measured variables in male group.

Variables	Groups	Descriptive statistics						Comparison ANOVA test		Tukey HSD	
		N	Mean	S.D.	S.E.	Min.	Max.	F-test	p-value	Groups	p-value
ANB	I	25	3.040	0.889	0.178	2	4	153.395	0.000	I-II	0.000
	II	30	6.033	1.033	0.189	5	9			I-III	0.000
	III	7	-1	1.414	0.535	-3	1			II-III	0.000
Subspinale-Zero Meridian	I	25	11.189	2.998	0.600	6.48	16.67	1.518	0.228	I-II	0.906
	II	30	11.482	2.227	0.407	6.92	17.57			I-III	0.328
	III	7	9.621	1.966	0.743	6.76	12.1			II-III	0.199
Sublabiale-Zero Meridian	I	25	4.023	4.789	0.958	-5.98	12.85	11.554	0.000	I-II	0.446
	II	30	2.728	3.431	0.626	-4.69	10.67			I-III	0.001
	III	7	10.633	1.599	0.604	8.41	12.81			II-III	0.000
Difference	I	25	7.166	2.372	0.474	2.55	12.57	51.922	0.000	I-II	0.034
	II	30	8.754	2.119	0.387	4.29	12.54			I-III	0.000
	III	7	-1.011	2.672	1.010	-4.19	3.69			II-III	0.000
G'-Sn-Pog'	I	25	15.680	3.211	0.642	8	21	70.277	0.000	I-II	0.000
	II	30	20.400	4.099	0.748	13	28			I-III	0.000
	III	7	2.857	1.345	0.508	1	5			II-III	0.000

Table 11. Descriptive statistics and class difference for the measured variables in female group.

Discussion

Many clinical methods were developed to estimate the sagittal jaw relationships over forty years ago [2-10]. Some depended on the middle and index fingers which may differ from person to person, other on direct vision of patient's profile which is subjective or by using Zero-Meridian line. This line was developed by Mexican plastic surgeon called Mario Gonzalez-Ulloa in 1962 [16]. At that time, its name was the facial plane, but in 1968, Gonzalez-Ulloare re-named it as true Meridian 0 of the face [17]. Naini [18] summarized the advantages of this line by its ease of use and came in accordance with the idealized profiles of classical, Renaissance and neoclassical artistic canons.

Littlewood [8], Cobourne and DiBiase [9] and Littlewood and Mitchell [10] utilized this line in determining the sagittal jaw relationship, but still their descriptions were subjective and did not establish any value for comparison also depended on the upper lip and soft tissue pogonion to develop their method which may be little far from the selected points.

In this study, AutoCAD software was used for getting measurements because of its simplicity and reliability in cephalometric analyses [19]. Accurate measurements could be obtained from this program when orthodontist located the landmarks precisely. Pratiwi et al. [20] reached to a conclusion that the accuracy of orthodontists in measuring distances and angles on 2D and 3D radiographs was not different.

Previously, Nahidh and Al-Mashhadany [21] determined the sagittal jaw relation using Beta angle on Iraqi samples. In the current study, two linear measurements were developed from points Subspinale and Sublabiale, which were equivalent to the same point utilized by Foster [2],

to the Zero-Meridian line. The difference between the two distances represented the sagittal jaw relationship.

The findings from the present study indicated that the mean values of the angle of convexity and ANB angle were near to that reported by Littlewood [8], Cobourne and DiBiase [9], Littlewood and Mitchell [10] and Riedel [15] respectively. Whenever the angle of convexity and ANB angle increased, the case directed towards class II and vice versa. This comes in coincidence with the two fingers method of Foster [2].

There is no study to compare with regarding the new modified measurements developed in this study but this method followed the two previous ones i.e. significantly increased in class II and decreased in class III in comparison with class I. This related to the bony bases bearing the soft tissue and the inclination of the incisors supporting the lips. In class II, the point Subspinale was anterior to that in class I. On the other hand, point Sublabiale was posterior to that in class I.

Previous Iraqi studies proved that the maxillary and mandibular incisors tend to proclined in class I subjects [22,23]. In class II, upper lip tend to be short and thin with straight to acute naso-labial angle depending on the relationship of maxillary bony base with the cranium, the inclination of maxillary and mandibular incisors, amount of overjet and overbite in addition to direction of the mandibular growth, severity of sagittal jaw relation and the effect of lower lip on the maxillary incisors [2,7].

The relation among the variables revealed significant correlation in both genders of class II. In other classes the relation was non-significant and weak. This may be explained by the thickness of the soft tissue, effect of the underlying basal bone and anterior teeth.

The main advantage of the current study is cancelling the variation of fingers' length, but the problem of soft tissue thickness is still present. Further study is required to include larger sample with different malocclusions to establish the normal values for this measurement in different ages and population, moreover the effect of facial types, soft tissue thickness and incisor inclinations on this method should be addressed.

Conclusions

A new clinical method is developed to assess the sagittal jaw relation using Zero-Meridian line and correlated with other methods.

Declaration of Interest

The authors report no conflict of interest.

References

1. Proffit WR, Ackerman JL. Diagnosis and treatment planning in orthodontics. In: Graber TM, Swain BF, eds. Orthodontics current principles and techniques. 1st ed. St. Louis: The C.V. Mosby Co.; 1985. 3-100.
2. Foster TD. A textbook of orthodontics. 1st ed. Oxford: J.B. Lippincott; 1975. 75-101.
3. Mills JRE. Principles and practice of orthodontics. 2nd ed. London: Churchill Livingstone; 1987. 61-74.
4. Houston WJB. Orthodontic diagnosis. 1st ed. Bristol: John Wright & Sons Ltd; 1975. 31-39.
5. Mitchell L. An introduction to orthodontics.1st ed. Oxford: Oxford university press; 1996. 42-54.
6. Mitchell L. An introduction to orthodontics. 2nd ed. Oxford: Oxford university press; 2001. 43-54.
7. Mitchell L. An introduction to orthodontics. 3rd ed. Oxford: Oxford university press; 2007. 49-60.
8. Littlewood SJ. Orthodontic assessment. In Mitchell L, ed. An introduction to orthodontics. 4th ed. Oxford: Oxford university press; 2013. 53-72.
9. Cobourne MT, DiBiase AT. Handbook of orthodontics. 2nd ed. Edinburgh: Elsevier; 2016. 163-226.
10. Littlewood SJ, Mitchell L. An introduction to orthodontics. 5th ed. Oxford: Oxford university press; 2019. 51-70.
11. Saleh SF. The reliability of palpation method in determining the anteroposterior jaw relationship by comparison to cephalometric analysis. A master thesis, Department of POP, College of Dentistry, University of Baghdad, Iraq, 2001.
12. Solow B, Tallghen A. Natural head position in standing subjects. Acta Odontol Scand 1971; 29(5): 591-607.
13. Kadhom ZM, Al-Janabi MF. Soft-tissue cephalometric norms for a sample of Iraqi adults with class I normal occlusion in natural head position. J Bagh Coll Dentistry 2011; 23(3): 160-6.
14. Swennen GRJ, Schutyser F, Hausamen J-E. Three-dimensional cephalometry. A color atlas and manual. 1st ed. New York: Springer-Verlag Berlin Heidelberg; 2006. 113-226.
15. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. Angle Orthod 1952; 22(3): 142-5.
16. Gonzalez-Ulloa M. Quantitative principles in cosmetic surgery of the face (profiloplasty). Plast Reconstr Surg 1962; 29(2): 187-98.
17. Gonzalez-Ulloa M, Stevens E. The role of chin correction in profiloplasty. Plast Reconstr Surg 1968; 41(5): 477-86.
18. Naini FB. Facial aesthetics: Concepts and clinical diagnosis. 1st ed. Oxford: Wiley-Blackwell; 2011. 71-85.
19. Nahidh M, Al-Jarad AF, Aziz ZH. The reliability of AutoCAD program in cephalometric analysis in comparison with pre-programmed cephalometric analysis software. Iraqi Dent J 2012; 34(1): 35-40.
20. Pratii D, Soegiharto B, Krisnawati, Kiswanjaya B. Orthodontists reproducibility and accuracy in linear and angular measurement on 2D digital and 3D CBCT radiographic examination. J Inter Dent Medical Res 2017; 10(3): 997-1004.

21. Nahidh M, Al-Mashhadany SMJ. Beta angle in a sample of Iraqi adults with Class I skeletal and dental relations and its correlation with other craniofacial measurements. J Bagh Coll Dentistry 2013; 25(4): 145-50.
22. Al-Daggistany MS. A study of cephalometric measurements in Iraqi sample compared to Downs' and Steiner's analyses. Iraqi Orthod J 2009; 5(1): 25-7.
23. Nahidh M. Iraqi cephalometric norms using McNamara's analysis. J Bagh Coll Dentistry 2010; 22(3): 123-7.