RESEARCH ARTICLE

FSA Angle: A Soft Tissue Approach for Assessing Sagittal Skeletal Discrepancy

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Abstract

Introduction: Lateral cephalograms are taken as a diagnostic aid for the evaluation of the anteroposterior relationships. The assessment of anteroposterior soft tissue relationships is by using skeletal points and cranial reference planes. The anteroposterior relationships are, however, clinically affected by soft tissue structures. In this pilot study, we aim to assess the anteroposterior relationships based on soft tissue landmarks.

Materials and methods: Lateral cephalograms were collected from 100 patients and evaluated on Facad software. The subject consisted of a mean age of 20 ± 7 years. Fifty-four cephalograms selected were used to perform the analysis. A new angle FSA was measured based on soft tissue landmarks. A new plane used for this analysis is the SA plane. Using this angle, we classified the cephalograms as class I, II, and III.

Results: There is a statistically significant value to differentiate the profile of patients using the FSA angle. Thus, this new angle is created to determine the anteroposterior soft tissue relationship using soft tissue landmarks on a cephalometric analysis and from our data, the value was 81 ± 7.57° for class 1 patients that is consistent with the previous studies which evaluate sagittal skeletal relationships.

Conclusion: There are various difficulties and errors in the previous analysis that is used to determine the anteroposterior jaw relations. Skeletal landmarks have been used previously and most of these points are not stable points. Thus, this new analysis that will be using soft tissue landmarks can be used to differentiate in the various profiles of patients with different malocclusions.

Keywords: Anteroposterior relation, Cephalometric study, Malocclusion, Orthodontics, Soft tissue.

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Introduction

Dentofacial balance and harmony is studied using lateral cephalograms. For treatment planning and to achieve optimum results, a good diagnostic criterion is needed. The anteroposterior skeletal relationship has been described over the years based on skeletal jaw relations defined as angles and linear distances between the various reference plane of the craniofacial complex to point A and point B.[1] Anteroposterior jaw relationships have been assessed with parameters such as the facial convexity, the ANB angle, the A–B plane angle, the angle of convexity, the APDI, and the AF–BF angle (anteroposterior dysplasia indicator).[2–6]

The disadvantage of using point A and point B are that these points are the anterior limitations on the denture bases but there can still be compensations in soft tissue that might not be reflected by using these points alone and also these points are alterable during orthodontic treatment. Anteroposterior or vertical skeletal and/or dental malrelation may present normal or near mean normal facial soft tissue contours. Analysis of proportional facial contours can identify and localize areas of disproportion and compensation.[5] Soft tissue is the penultimate compensating factor in facial contour morphology. As the facial soft tissue is the major compensating factor, a proper diagnosis and treatment planning must include a meaningful analysis of facial contour.[7] Skeletal sagittal relationships should not be the lone factor that is the guideline for deciding the treatment.

The facial soft tissue often is very essential in bringing out successful treatment outcomes, helps in function and stable treatment results; thus treatment planning should always be done keeping in mind the soft tissue adaptations.[8] What we need to remember is that patients appreciate the changes in their face, thus correction based on cephalometric alone without taking into account the soft tissue will not always give pleasing results to the face. The shift toward the soft tissue paradigm is the trend in diagnosis and treatment planning in orthodontics. Understanding the soft tissue adaptations is important to achieve esthetic harmony.[9] Profile mainly soft tissue features more often help in important decision-making, such as the need for extraction, the need for functional appliances, and so on. In this study, we have examined cephalometric measurements that will indicate an anteroposterior relationship using soft tissue points and known standard reference planes. This study aims to determine the anteroposterior relation using cephalometry with relations that can be angles and distances between the Frankfort horizontal (FH) plane and soft tissue points subnasale and chin.

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Materials and Methods

A retrospective study using cephalometric radiographs was done. Lateral cephalometric radiographs of 100 patients who reported for orthodontic treatment were randomly selected. The sample

consisted of patients between the age group 13 years and 27 years with a mean age group of 21 ± 7 years. The lateral cephalograms were all taken in the same digital cephalostat standardized to 83 kV, 10.0 mA current, and 8.0 seconds exposure with the patient in natural head position. Those patients with pathology involving the craniofacial region, facial asymmetry, and X-rays of poor quality were excluded from the study.

The cephalometric analysis was performed using FACAD digital orthodontic tracing software (ILEXIS, Sweden). The tracing was calibrated on an X-ray system ruler in comparison to real-world measurements. A new analysis was created using this software.

The parameters from the previous cephalometric analyses that assess the anteroposterior skeletal relationships were done. The specific angular and linear measurements of ANB angle of Steiner[3] and Wits appraisal[2] were done to determine the skeletal pattern as class I, class II, and class III. In case there arose any disparity in ANB, those patients were excluded from the study. The clinical profile of the patient was taken into consideration. Out of the 100 samples examined, there were 18 class III patients. To obtain a considerable statistical average; of the remaining sample 18 class II and 18 class III patients were selected randomly.

A patient was classified as class I if ANB was 2° and Wits where AO is coincident with BO in females and BO ahead of AO by 1 mm in males. The classification for the malocclusion was in class II where the ANB angle was >4°, and a profile suggesting class II profile. The patient was classified as class III when ANB angle was < or > 1°. Wits appraisal ≥ −1 mm was class II and Wits appraisal ≤ −4 mm was class III.

New Plane

SA (Subnasale to soft tissue pogonion) will be the plane.

FSA Angle

The angle formed between the SA plane and the Frankfurt horizontal plane will be the new angle that will be used to determine the anteroposterior jaw relations using a cranial reference plane and using a soft tissue reference plane.

Results

SPSS software was used for performing the statistical tests. The statistical analysis for this study was done to estimate the range for each angle, mean, median, and standard deviation and comparisons between the three groups of malocclusions were done using ANOVA.

The data are represented in the following tables. The maximum and minimum limits for each angle were measured. Table 1 shows comparisons between class I, II, and III of the angle FSA (formed between the FH plane and the soft tissue plane SA). There is statistical significance between these values and differences to differentiate between class I, class II, and class III. Table 2 represents the descriptive statistics of mean, standard deviation, and range of FSA angle.

Discussion

The profile of a patient is usually diagnosed by clinical examination and also analysis on the lateral cephalogram. In cephalometric analysis, ANB angle and the Wits appraisal are among the ones commonly used to evaluate anteroposterior malrelations.[1] Freeman describes a method to evaluate is A–P jaw relation to eliminating point N described a method to evaluate the A–P jaw relationship to eliminate and hence a more accurate evaluation.[10] The cephalometric evaluation commonly used in assessing the

Table 1: Multiple comparisons–ANOVA

	Dependent variable: FSA						
						95% Confidence interval	
	(I) group	*(J) group*	*Mean difference (I–J)*	*Std. error*	*Sig.*	*Lower bound*	*Upper bound*
Tukey HSD	Class I	Class II	−6.52778*	1.97914	0.005	−11.3054	−1.7502
		Class III	5.20556*	1.97914	0.030	0.4280	9.9832
	Class II	Class I	6.52778*	1.97914	0.005	1.7502	11.3054
		Class III	11.73333*	1.97914	0.000	6.9557	16.5109
	Class III	Class I	−5.20556*	1.97914	0.030	−9.9832	−0.4280
		Class II	−11.73333*	1.97914	0.000	−16.5109	−6.9557
Bonferroni	Class I	Class II	−6.52778*	1.97914	0.005	−11.4272	−1.6284
		Class III	5.20556*	1.97914	0.034	0.3062	10.1049
	Class II	Class I	6.52778*	1.97914	0.005	1.6284	11.4272
		Class III	11.73333*	1.97914	0.000	6.8340	16.6327
	Class III	Class I	−5.20556*	1.97914	0.034	−10.1049	−.3062
		Class II	−11.73333*	1.97914	0.000	−16.6327	−6.8340

*The mean difference is significant at the 0.05 level

Table 2: FSA angle report

	FSA angle					
Group	*Mean*	*N*	*Std. deviation*	*Minimum*	*Maximum*	*Range*
Class I	−81.5278	18	5.21466	−92.40	−73.60	18.80
Class II	−75.0000	18	7.52158	−85.40	−60.60	24.80
Class III	−86.7333	18	4.68954	−97.00	−81.40	15.60
Total	−81.0870	54	7.57626	−97.00	−60.60	36.40

problems in the anteroposterior relationship is the ANB angle. The alternative cephalometric analysis to the ANB angle is the Wits appraisal, but even with this analysis, there is a difficulty in identifying the occlusal plane.[11] These difficulties call for developing a new measure. The beta angle uses the points—point A, point B, and the axis of rotation in the condyle (point C). This cephalometric angle can be used to evaluate changes in growth as well as treatment changes.[12] There are various flaws in these skeletal bases and the analysis. The rotation of the jaws can result in altering the ANB angle, the SN–AB angle, A–B plane angle,[3] the angle of convexity, and the AF–BF distance.[10] Variation in the spatial positions of nasion horizontally and/or vertically, and point A or B vertically is a normal anatomic occurrence. ANB is not always an accurate indicator of the jaws and should be interpreted with care. There can be variations in point A and point B in the vertical plane and well as rotation of the occlusal plane. The Wits appraisal is influenced by the vertical dimension of the jaw and the inclination of the occlusal plane. The Wits appraisal is a measurement of the anteroposterior relationship of the teeth.[13]

The thickness of lips, chin; the thickness and length of the nose all influence the soft tissue facial profile of a patient.[14] On clinical examination of a patient, the profile and convexity are checked based on points subnasale and soft tissue pogonion. According to Kasai, the intimate between hard and soft relationship is influenced by morphology, function relationship.[7] There are several limitations to dental compensation as established by the soft tissue relations and these are exerted by the cheeks, lip, tongue, the PDL, mandibular position, and relationship to the tooth and lip.[15,16] Most of the cranial reference panes used in the cephalometric analysis are not stable. The FH plane is logical to use as a reference plane when it to study the facial profile. Several planes have been used, the one best plane meeting the requirements was the Frankfort horizontal plane.[17] The Frankfort horizontal is said to be level when a person is standing looking straight forward. FSA angle can be used as an angle that will be used to define the profile of the patient and the anteroposterior relation of the patient. The limitation of this study is that this analysis was done in a regional area which might be different for different ethnic groups. A future perspective of this study is that the same analysis can be done using profile photos of the patients taken in natural head position to determine FSA angle using the clinical FH plane of the photo and the same soft tissue points subnasale and pogonion. The Frankfort plane may be drawn on the profile photo from the superior margin of the acoustic meatus to the orbital, which is easily palpated and its location transferred to the skin.[17]

Conclusion

FSA is a statistically significant value to differentiate the class I, class II, and class III using soft tissue points. The FSA is thus a new analysis to differentiate the anteroposterior relationship. Previous measurements for assessing the sagittal jaw relationship can often be inaccurate.

Clinical Significance

The profile of the patient may be determined by skeletal basis but also a soft tissue relation is of utmost importance in the changing era. The soft tissue profile should be kept in mind and carefully evaluated before making significant changes and adopting a method of orthodontic treatment as ignorance can lead to disaster in treatment outcomes.

Ethics Approval and Consent to Participate

The study was approved by the Institute review board of Saveetha University.

Consent for Publication

Not applicable.

Availability of Data and Material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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