

The relationship of facial soft tissue a'n'b angle and facial hard tissue ANB angle in determination of skeletal relations

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ABSTRACT

Background: Cephalometric analysis used in orthodontics to inform the diagnosis, treatment planning, quantifies changes during treatment, and provides data for clinical research. It has been used for determination of Skeletal Relations using facial hard tissue ANB Angle. Points A and B on the facial hard tissue correlate closely with the positions of the corresponding points on the soft tissue. This study aims to determine the relationship between the A'N'B angle of soft tissue and the ANB angle of hard tissue in determining the class of skeletal relations

Method: The sample used in this study was 75 cephalograms, which had been selected according to the criteria. Cephalometric tracing is done manually. Inter-observer and intra-observer measurements were carried out to increase the validity and reliability of the research instrument. The Bland-Altman method is used as a statistical fit test. The results of the research data were then tested for normality with the Kolmogorov-Smirnov test. For further testing to test the significance of the correlation coefficient obtained in the Pearson test, the significance test of the t-test is used.

Result: The results of $t\text{-count} > t\text{-table}$, which means that there is a strong linear relationship between hard tissue ANB and soft tissue A'N'B with a correlation coefficient (r) > 0.05 .

Conclusion: The soft tissue A'N'B' angle can be used as an alternative in determining the class of skeletal relationships in addition to the hard tissue ANB angle.

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INTRODUCTION

Orthodontic treatment with lateral cephalometric support is necessary to determine the right treatment for the patient. Cephalometry is a scientific measurement of the head dimensions with an X-ray in relation to a specific reference point with adequate standardization to assess the growth and development of the face. Cephalometry is a technique that allows for accurate measurement and comparison of oral and craniofacial structures. The lateral cephalometric radiograph shows not only the underlying structure of the craniofacial hard tissue but also the profile of the soft tissue¹. Cephalometrics is an integral part of orthodontic diagnosis and treatment planning. It has been extensively used to study variation in human face and craniofacial growth. Cephalometrics is an established and valuable tool to assess outcome of orthodontic and orthognathic surgical procedures, follow up and relapse. Cephalometric has also been used a research instrument for huge number of investigations. Cephalometric measurement techniques have progressed over the years from a manual tracing of analogue X-Ray film over acetate tracing sheets to the modern practice of on-screen computerized cephalometric analysis on a digital two-dimensional (2-D) image².

The quality of the radiograph will affect the translation or reading of what is seen in a radiograph, where the more information that can be interpreted correctly, the goal in diagnosis can be achieved. To achieve this goal, radiograph quality is determined by several assessment protocols which are divided into several factors³. These factors are Coverage of the anatomic region of interest⁴, Contrast (the degree of difference in density between two areas on the radiograph. Contrast between various parts of the image is one of the criteria for assessing the quality of an image, where the greater the contrast, the more features

are visible)⁵, Density (the assessment of density is almost the same as contrast. Density describes the thickness and density of the tissue inside the object, while object contrast describes the density between objects and non-objects)⁶, Sharpness (refers to the ability of X-rays to produce clear outlines. Sharpness is an important factor that must be met on radiograph), Detail (the ability of radiographs to show differences from each anatomical part)⁷, Distortion (affected by improper placement and alignment of the film or X-ray angulation)⁸, Resolution (a measure of the ability to distinguish one object from another)⁵, and Brightness (the radiographic ability to increase brightness, usually related to processing, timer and Kvp exposure)⁹.

In orthodontics, it is necessary to determine the skeletal relationship in order to be able to establish a diagnosis and a plan of orthodontic treatment. One of the most used methods of determining skeletal relations with cephalometric analysis is the Steiner method, that is, through the determination of the ANB angle on the facial hard tissue to determine the abnormality of the relationship between the upper jaw and the lower jaw in the direction of the sagittal. The advantage or great use of the ANB angle is to know the tendency of malocclusion that occurs and to show the maxilla's relationship to the mandibula¹. The points A and B on the facial skeleton are closely correlated with the positions of the corresponding points on its soft tissue. Points A and B on the facial hard tissue correlate closely with the positions of the corresponding points on the soft tissue¹⁰. projection, as is the case in the calculation of the ANB angle of the hard tissue.

Research on the relationship between the A'N'B' angle of a facial soft tissue and the ANB angle of the facial hard tissue in the determination of the skeletal relationship class is still very limited. It is encouraging researchers to conduct research

on the connection between the A'N'B angle and ANB angle in determining the skeletal relationship.

RESEARCH METHOD

Research is carried out after obtaining ethical approval (No. 274/B.1-KEPK/SA-FKG/II/2021) from KEPK FKG UNISSULA. The sample of the research is cephalograms in the Department of Oral and Maxillofacial Radiology of the Islamic Sultan Agung Dental Hospital Semarang, totalling 75 cephalograms. The samples used in this study have met the following inclusion criteria:

1. Standardized Cephalograms (excellent or diagnostically acceptable quality).
2. never having or currently not undergoing any orthodontic treatment,
3. never having orthognathic surgery,
4. never having a permanent tooth extracted except third molars,
5. class I molar,
6. not wearing dental prostheses,
7. not having tooth malposition, malrelation, and facial hard tissue abnormalities

8. The minimum age of the patient is 18 years.

9. Patient with complete permanent teeth.

A consent letter was obtained from all the participants after explaining the purpose of the research. All lateral cephalometric radiographs were taken in centric occlusion with the lips in repose position and the Frankfort horizontal plane (FHP) oriented horizontally according to the natural head position. The ear-rods of the Cephalostat machine were placed in the external auditory meatus to stabilize the head. Tracing of the cephalometric radiographs were made by hand using a sharp 2H pencil on acetate tracing paper and illuminator. Eraser was avoided as much as possible.

Tracing and angle measurements were done manually. The cephalometric landmarks used (Figure 1a) are the hard-tissue (N) Nation point, the hard-tissue (A) subspinal point, the hard-tissue (B) supramental point, the soft-tissue (N') nation point, the soft-tissue (A') subspinal point, and the soft-tissue (B') supramental point. The angles measured (Figure 1b) are the angles of the ANB (facial hard tissue) and A'N'B' (facial soft tissue),

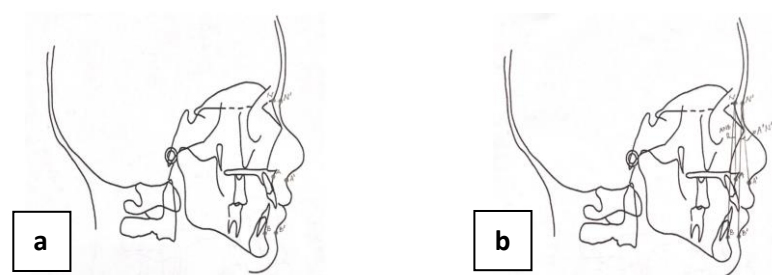


Figure 1. a. The cephalometric landmarks (points) b. The cephalometric Angles (ANB & A'N'B)

Tracing and measurements of these angles were carried out by several researchers to ensure that the measurement results were valid and reliable. Measurements were carried out by two researchers to determine the validity of inter-observer measurements. The first researcher is the

primary researcher, and the second is the researcher who has experience performing lateral cephalometric analysis as a gold standard. To determine the reliability of the intra-observer measurement, the primary researcher measured it twice on different days and the results were

statistically tested by using the Bland-Altman method.

The Kolmogorov-Smirnov test was used for normality test. If the data was distributed normally, the Pearson correlation hypothesis was then performed. Advanced testing to determine the significance of the correlation coefficient obtained in the Pearson test, then used the t-test. The resulting r (correlation coefficient) value is used to determine the t-count using the following formula: $t\text{-count} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$. The result of t-count value was then compared with the t-table's value at 95% confidence. If t-counts value $>$ t-table's value, it means statistically significant.

RESULTS

The research was conducted at the Department of Oral and Maxillofacial Radiology of the Islamic Sultan Agung Dental Hospital Semarang in June 2021. The total patient population over 18 years in 2020-2021 was 301 people. Then using a random sampling technique, 75 respondents were found to fulfil inclusion criteria. The measurements were carried out by two researchers to obtain the validity of the inter-observer measurements. The first researcher is the main researcher, and the second researcher is a researcher who has experience in conducting cephalometric analysis. The research instrument is concluded valid if the significance of $p > 0.05$. The table 1 below shows the results of the validity test.

Table 1. The result of Validity Test of the inter-observer measurement

Groups		N	Mean	Standard Deviation	p-value
ANB Angle of Hard tissue	Main Researcher	75	4,2933	1,84371	0,755
	Expert Researcher	75	4,3867	1,81505	
A'N'B Angle of Soft Tissue	Main Researcher	75	5,8267	1,71538	0,704
	Expert Researcher	75	5,7200	1,71291	

The table 1 shows that the $p\text{-value} > 0.05$, which is concluded that the measurement results are valid or able to carry out the measuring function correctly and the results are appropriate, with a high accuracy. Reliability test could be done after a research instrument has confirmed its

validity. Measurements were carried out by the main researcher twice on different days to determine the reliability of intra-observer measurements of 75 cephalograms using the Bland-Altman method in SPSS. Measurements were concluded reliable if the $p > 0.05$

Table 2. The result of Reliability Test of the intra-observer measurement

Groups		N	Mean	Standard Deviation	p-value
ANB Angle of Hard tissue	Main Researcher	75	4,2667	1,86962	0,860
	Expert Researcher	75	4,3200	1,83185	
A'N'B Angle of Soft Tissue	Main Researcher	75	5,8533	1,72966	0,850
	Expert Researcher	75	5,8000	1,71638	

The table 2 shows that the $p\text{-value} > 0.05$, which is concluded that the measurement results are reliable. To test the research hypothesis,

previously a normality test was carried out on all variables (soft tissue A'N'B' and hard tissue ANB).

Table 3. The result of Normality Test

Groups	Kolmogorov-Smirnov ^a		
	Statistic	Df	Sig.
ANB Angle of Hard tissue	,129	75	,125
A'N'B Angle of Soft Tissue	,153	75	,177

The normality test used is the Kolmogorov-Smirnov because the number of samples is more than 50 samples. The significance value is $p > 0.05$. Table 3 above shows that the significance value for hard tissue ANB is 0.125 (normal) so that a p-value > 0.05 is obtained and Sig. for soft tissue A'N'B' of 0.177 (normal) so that a p-value > 0.05 is obtained. It can be concluded that the data is normally

distributed, thus, hypothesis testing is carried out using the Pearson correlation test. The Pearson Test was carried out to prove the existence of a correlation between the hard tissue ANB and soft tissue A'N'B' groups in determining the class of skeletal relationships. The results of testing with the Pearson correlation test are presented in the table below.

Table 4. The result of Hypothesis Test using Pearson Correlation Test

		Hard Tissue	Soft Tissue
ANB Angle of Hard tissue	Pearson Correlation	1	,611**
	Sig. (2-tailed)		,000
	N	75	75
A'N'B Angle of Soft Tissue	Pearson Correlation	,611**	1
	Sig. (2-tailed)	,000	
	N	75	75

The results of the Pearson test above (Table 4), p-value of 0.0000 indicates $p < 0.05$, and concluded that the hypothesis of this research is accepted. Accepting the hypothesis implies that there is a significant correlation between the hard tissue ANB angle and the soft tissue A'N'B' angle in determining the skeletal relation. The value of r (Pearson correlation) was obtained with value 0/611 which means that the correlation between hard tissue ANB and soft tissue ANB in determining the class of skeletal relations has strong strength. A positive value on the Pearson correlation indicates that the direction of the correlation is unidirectional.

DISCUSSION

Normal Occlusion achieved if the arrangement of the teeth in a regular arch is align and there is a

harmonious relationship between the upper and lower teeth. Malocclusion is not a disease but if left untreated it could cause disturbances in the function of mastication, swallowing, speech, and facial harmony, which results in physical and mental disorders. Skeletal relations class is divided into 3, namely class I, class II and class III.

Class I Skeletal if the ANB angle is 0-4 degrees, Class II skeletal if the ANB angle is more than 4 degrees, and Class III skeletal if the ANB angle is less than 0 degrees¹.

There are several methods of cephalometric analysis to determine the condition or skeletal relationship of orthodontic patients. One of them is using Angular ANB. Angle ANB is the angle formed by the intersection of the lines N-A and N-B. There are 3 cephalometric hard tissue

points used for determining the angle, namely point A (subspinal) which is the deepest point in the anterior maxillary concavity between the anterior nasal spine and the alveolar crest, point B (supramental) which is the deepest point in the anterior mandibular concavity between the chin and alveolar crest, and point N (Nasion) which is the most anterior point in the middle of the frontonasal suture. The interpretation of the ANB angle is to determine the patient's skeletal class, namely skeletal class 1 for ANB angle values of $2-4^{\circ}$, skeletal class 2 for ANB angle values > 40 , and skeletal class 3 if ANB angle values $< 2^{\circ}$ ¹. The value of the ANB angle is influenced by four things namely mandibular rotation and/or occlusal plane to the anterior cranium base, Nasion anteroposterior position to point B, vertical growth which affects the distance Nasion to point B and increase in dental height which will affect the distance from point A to point B⁴. The ANB angle is the most valid and reliable indicator in determining the anteroposterior jaw relationship¹¹.

The soft tissue ANB angle is the angle formed by the intersection of the N'-A' and N'-B' lines (Holdaway, 1984). There are 3 soft tissue points that are used, namely point A' (subspinal soft tissue), B' (supramental soft tissue), and N' (soft tissue nasion). Point A' is the outermost point of intersection of the horizontal line point A of hard tissue. This point is in the deepest concavity above the vermilion edge of the upper lip. Point B' (soft tissue supramental) which is the outermost point of intersection of the horizontal line point B hard tissue and soft tissue. This point is in the deepest concavity beneath the vermilion edge of the lower lip. Point N' (Nasion soft tissue) which is the outermost point of intersection of the horizontal line point N hard tissue and soft tissue. This point is located where the nose and forehead meet¹².

In table 4 and the t-count results using the formula it is known that there is a significant and strong correlation between the angle of hard tissue ANB and the angle of soft tissue A'N'B' in determining the class of skeletal relationships. Similar results were also shown in studies using photometric analysis where there was a significant correlation between ANB angle and A'N'B' angle, although weak. This is probably related to the thickness of the soft tissue which varies and is influenced by many things, one of which is race¹³. Several factors will affect the facial pattern, namely skeletal pattern, tooth pattern, soft tissue thickness, ethnic and cultural origin, differences in sex and age¹⁴. However, the ANB angle and the angle of convexity of Downs analysis applied to facial soft tissue can be a preference for assessing the patient's skeletal condition¹⁵.

The results in this study are similar to the results of previous studies regarding the relationship between the degree of convexity of the hard tissue and soft tissue profiles of the face where the results of the study stated that there was a significant relationship between the degree of convexity of the skeletal profile and the profile of the facial soft tissues¹⁶. The results of this research showed that the highest value of hard tissue and soft tissue A'N'B' angle was 5° , while the lowest was 0° . Based on the results of the Pearson statistical test, it is known that the significance value is 0.000 lower than the significance value (0.05) so it can be concluded that there is a significant correlation between the angle of hard tissue ANB and the angle of soft tissue A'N'B' in determining the class of skeletal relationships. Soft tissue has a very dynamic state over time. Therefore, to be able to use soft tissue in determining orthodontic diagnoses and treatment plans certainly requires in-depth consideration¹⁷.

The structure and function of the craniofacial complex are related to the dentocraniofacial. The growth and development of the dentocraniofacial includes the growth and development of occlusion, dental arches and the maxillary and mandibular bones which are related to craniofacial growth. Facial shape is influenced by the shape of the head because it influences the structure, dimensions, angles and placement of various facial parts¹. Based on this, the results of the research are in line with the theory, where the consequences of craniofacial related to dentocraniofacial can affect the relationship between the angle of hard tissue ANB and the angle of soft tissue A'N'B'. The significant relationship between the hard tissue ANB angle and soft tissue A'N'B' angle will facilitate the determination of the skeletal relationship class.

The soft tissue is in close contact to the underlying skeletal hard tissue and takes up whatever form is dictated by the hard tissue. Yet, there exists some variations in cases of which, the soft tissue thickness varies in certain places to camouflage the skeletal deficiency¹⁸. For some variables, the structure of hard and soft tissue is closely related, but there are also those that are independent because the characteristics of soft tissue are influenced by their length, thickness, and functional aspects such as tissue tension. In this study, these variables were not considered and could be used as a suggestion for further research.

CONCLUSION

There is a strong linear relationship between hard tissue ANB and soft tissue A'N'B with a correlation coefficient (r) > 0.05. The A'N'B angle soft tissue can be used as a valuable indicator and an adjunct in diagnosis and treatment planning of orthodontic cases.

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