https://doi.org/10.5114/for.2021.107530

Forum Ortod 2021; 17 (2): 106-13

Ocena wybranych pomiarów cefalometrycznych w płaszczyźnie strzałkowej u osób z I klasą szkieletową z różnymi typami pionowego wzrostu twarzy

Evaluation of Various Sagittal Cephalometric Measurements in Skeletal Class I Individuals with Different Vertical Facial Growth Types

Gokhan Turker [1] ABEF **(ORCID ID: 0000-0001-5295-2722)**
Taner Ozturk[1] ABCD **(ORCID ID: 0000-0003-1670-286X)**
Gokhan Coban[1] BCE **(ORCID ID: 0000-0001-6066-005X)**
Emin Isgandarov[1] BC **(ORCID ID: 0000-0002-8678-3506)**

Wkład autorów: A Plan badań B Zbieranie danych C Analiza statystyczna D Interpretacja danych E Redagowanie pracy F Wyszukiwanie piśmiennictwa

Authors' Contribution: A Study design B Data Collection C Statistical Analysis D Data Interpretation E Manuscript Preparation F Literature Search

[1] Zakład Ortodoncji, Uniwersytet Erciyes, Turcja
Orthodontics, Erciyes University, Turkey

Streszczenie

W literaturze można znaleźć wiele badań na temat stosowania różnych pomiarów i metod dotyczących położenia dolnej i górnej szczęki w płaszczyźnie przednio-tylnej i pionowej. **Cel.** Celem badania była ocena zależności pomiędzy poszczególnymi parametrami stosowanymi w określaniu przednio-tylnej relacji szczęk u osób z różnymi typami pionowego wzrostu twarzy. **Materiał i metody.** Do badania włączono cefalogramy boczne 150 pacjentów z różnymi typami pionowego wzrostu twarzy [z niskim kątem (ang. Low-Angle, LA), prawidłowym kątem (ang. Norm-Angle, NA) i wysokim kątem (ang. High-Angle, HA)] i wadami zgryzu

Abstract

There are various studies in the literature on using different measurements and methods regarding the anteroposterior and vertical positions of the lower and upper jaws. **Aim.** The aim of the study was to evaluate the relationship between different parameters used in defining the anteroposterior relationship of the jaws in individuals with different vertical facial growth types. **Material and methods.** Lateral cephalometric radiographs of 150 patients with different vertical facial growth types [Low-Angle (LA), Norm-Angle (NA) and High-Angle (HA)] and skeletal Class-I malocclusion were included in the study. The ANB, Wits

Adres do korespondencji/*Correspondence address:*
Taner Ozturk
Orthodontics, Erciyes University, 38039, Kayseri, Turkey
email: tanertr35@gmail.com

klasy I. Do określenia relacji szczęki w płaszczyźnie strzałkowej oceniano i porównano ze sobą kąty ANB, analizę Wits, A-Nperp, Pog-Nperp, Beta, W i Yen. **Wyniki.** Stwierdzono, że parametry analizy Witsa, kątów Pog-Nperp, Beta, W i Yen różniły się istotnie pomiędzy grupami (p<0,05). Parametry analizy Witsa, kątów Pog-Nperp i Yen okazały się istotnie niższe u osób typu HA niż u osób typu LA, natomiast kąt Beta okazał się istotnie wyższy u osób typu HA niż u osób typu LA (p<0,05). Kąty Beta i W były istotnie niższe u osób typu NA niż u osób typu HA (p<0,05). Stwierdzono, że kąty ANB, Beta, W i Yen wykorzystywane w ocenie relacji szczęk w płaszczyźnie strzałkowej wykazują istotną korelację niezależnie od typu pionowego wzrostu twarzy (p<0,05). **Wnioski.** W niniejszym badaniu zinterpretowano relacje pomiędzy różnymi parametrami strzałkowymi w zależności od wzorca pionowego wzrostu twarzy. Parametry strzałkowe, które można wykorzystać we wszystkich trzech grupach, to kąty ANB, Beta, W i Yen oraz analiza Wits. **(Turker G, Ozturk T, Coban G, Isgandarov E. Ocena różnych pomiarów cefalometrycznych w płaszczyźnie strzałkowej u osób z I klasą szkieletową z różnymi typami pionowego wzrostu twarzy. Forum Ortod 2021; 17 (2): 106-13).**

Nadesłano: 21.01.2021
Przyjęto do druku: 18.05.2021
https://doi.org/10.5114/for.2021.107530

Słowa kluczowe: kąt Beta, kąt ANB, kąt Yen, kąt W, typ pionowego wzrostu twarzy

appraisal, A-Nperp, Pog-Nperp, Beta, W and Yen angles were used to determine the sagittal relationship of the jaw and were evaluated in comparison with each other. **Results.** Wits appraisal, Pog-Nperp, Beta, W and Yen angle parameters were found to differ significantly between groups(p<0.05). Wits appraisal, Pog-Nperp and Yen angle parameters were found to be significantly lower in HA-individuals than LA-individuals, while the Beta angle was found to be significantly higher in HA-individuals than LA-individuals(p<0.05). Beta and W angles were significantly lower in NA-individuals than HA-individuals(p<0.05). It was determined that the ANB, Beta, W and Yen angles used in the evaluation of the sagittal relationship of the jaws showed a significant correlation regardless of the vertical growth type of the face(p<0.05). **Conclusions.** This study interprets the relationship between different sagittal parameters according to the vertical growth pattern of the face. The sagittal parameters that are usable in all three groups are ANB, Beta, W and Yen angles, and Wits appraisal. **(Turker G, Ozturk T, Coban G, Isgandarov E. Evaluation of Various Sagittal Cephalometric Measurements in Skeletal Class I Individuals with Different Vertical Facial Growth Types. Orthod Forum 2021; 17 (2): 106-13).**

Received: 21.01.2021
Accepted: 18.05.2021
https://doi.org/10.5114/for.2021.107530

Key words: Beta angle, ANB angle, Yen angle, W angle, vertical facial growth type

Introduction

The cephalometric analysis, first introduced by Wylie and based on the evaluation of various angular and linear measurements, is considered an essential step in orthodontic diagnoses and treatment planning (1). Cephalometric analysis in orthodontic treatment planning, which was introduced many years ago, continues to develop and improve via the use of new measurements (2-7). Of these measurements, the two most frequently used to evaluate the sagittal maxillomandibular skeletal relationship are the ANB angle, defined by Riedel in 1950, and the Wits appraisal, defined by Jacobson in 1975 (2,3,8). In 1984, McNamara suggested that the distance of the McNamara, A and Pogonion points from the nasion perpendicular line (A-Nperp and Pog-Nperp) could be used to determine the position of the lower and upper jaws in the sagittal dimension (7). This is possible for these measurements because unlike others they use the Frankfort horizontal plane. They are therefore more sensitive to the changes in the vertical dimension of the jaws used in a McNamara cephalometric evaluation (7). On the other hand, the use of the Beta angle, Yen angle and W angle, which are considered alternatives to the aforementioned measurements, has increased in recent years (4-6, 9-14). However, it has long been known that orthodontic malocclusions arising from the difference in the lower and upper jaw positions occur effectively in all three planes (15). Each analysis thus has several limitations, which various studies have attempted to eliminate. For example, it is known that the ANB angle is affected by the position of the nasion point, the difficulty of determining it, and the rotations of the lower jaw; while the Wits measurement is affected by the rotations of the occlusal plane (16). The Beta angle, which is designed to eliminate these disadvantages and is used in the definition of skeletal problems in the sagittal direction, was delineated by Baik and Ververidou in 2004 but is based on the A, B and Condilion points (4). The Yen angle, defined by Neela et al. in 2009, is based on the M, G and S points (5). The W angle, developed by Bhad et al. in 2013, is measured from the vertical line passing through the point M on the line connecting the S and G points to the line between the M and G points, taking the points M, G and S as references (6).

Previous studies conducted among various populations examined the relationships between the Wits measurement and the ANB, Beta, Yen and W angles, but did so using only sagittal evaluations (9-14). No study has shown the relationship between these angles according to different growth types of the face in the vertical dimension.

Aim

The aim of this study is to compare various cephalometric measurements and show the relationship between the Beta, W and Yen angles and the sagittal dimension of the maxilla and mandible in individuals with different vertical facial growth types. The sample used is from the Turkish population, whose records have recently entered the orthodontics literature.

Material and Methods

This retrospective cross-sectional study was approved (Approval No: 2020/337) by the XXX University Clinical Research Ethics Committee. Informed consent forms were obtained from all individuals before the study. Before beginning the study, it was determined that a total of 135 cases should be divided into 3 groups according to the results of a One-Way ANOVA power analysis with 95% confidence (1-α), 95% test power (1-β) and f = 0.630 (large effect size), using G*Power software (Version 3.1.9.3; Franz Faul, Universität Kiel, Kiel, Germany) (14). In order to strengthen the legitimacy of the study, it was decided that each group would include 50 subjects. Lateral cephalometric radiographs of the 150 subjects (80 female and 70 male, whose mean age was 16.72 ±1.46 year) who presented to the XXX University Faculty of Dentistry Department of Orthodontics with requests for orthodontic treatment were included in the study. The participants were divided into 3 groups (Tab. 1): Group I, the low-angle group (n=50; 27 female, 23 male); Group II, the norm-angle group (n=50; 24 female, 26 male); and Group III, the high-angle group (n=50; 29 female, 21 male). The individuals included in the study were selected from among those who applied to the clinic for orthodontic treatment, and were selected in the order they came. Care was taken to ensure that all radiographs were taken by the same technician and on the same cephalometry device (Orthoceph OP300; Instrumentarium; Tuusula, Finland). For all radiographs, the device's head was adjusted with the same cephalostat, the Frankfort horizontal plane was rendered parallel to the ground, the participant's teeth were in centric occlusion and the participant's lips were in the resting position.

The inclusion criteria for the participants were determined as follows:

1. Skeletal Class I malocclusion (0 < ANB < 4) (17)
2. SN/GoGn angle between 26° and 32° for norm-angle; > 32° for high-angle and ≤ 26° for low-angle (18)
3. High quality of cephalometric radiography

The exclusion criteria for subjects were determined as follows:

1. Skeletal malocclusions other than skeletal Class I malocclusion
2. Any congenital malformation, syndrome or facial trauma
3. Insufficient patient-related diagnostic records
4. A history of orthodontic or orthognathic surgical treatment

The abbreviations and definitions of the cephalometric points and measurements used in the study are presented in Figure 1 and Table 2 (3-7,19). The examples were divided into three groups: low-angle, norm-angle and high-angle, according to the vertical growth pattern of the face and the inclusion and exclusion criteria listed above.

To prevent errors caused by in-observation variations, all cephalograms were evaluated digitally by a single operator using a standard Dolphin 11.0 software program (Dolphin Imaging and Management Solutions, Chatsworth, CA, USA).

Statistical Evaluation

The analysis of the data was carried out using statistical analysis software with a 95% confidence level from the Statistical Package of Social Sciences (SPSS, Ver 24.0, IBM Corp., Armonk, USA). Mean, standard deviation, median, and minimum and maximum variables were used as descriptive statistical data (Tab. 3). The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to determine the normal distribution analysis of the data. Levene's test was used to evaluate the homogeneity of the data. To evaluate the differences between the measured values for all vertical growth pattern of the face groups, the One-Way ANOVA test (in conjunction with Tukey's test for binary comparisons) and the Kruskal-Wallis H test (in conjunction with the Mann-Whitney U test

Table 1. Distribution of demographic data.

Groups	*Females*			*Males*			*Total*		
	N	*Sn/GoGnº*	*Age (year)*	*N*	*Sn/GoGnº*	*Age (year)*	*N*	*Sn/GoGnº*	*Age (year)*
LA	*27*	*24.67±2.95*	*16.29±1.18*	*23*	*24.10±2.50*	*17.10±1.75*	*50*	*24.41±3.34*	*16.66±1.51*
NA	*24*	*33.17±3.85*	*16.37±1.11*	*26*	*33.00±3.24*	*16.79±1.14*	*50*	*33.08±3.51*	*16.59±1.13*
HA	*29*	*40.44±2.96*	*16.94±2.03*	*21*	*41.43±3.69*	*16.89±1.08*	*50*	*40.84±3.27*	*16.92±1.70*
Total	*80*	*33.02±7.13*	*16.56±1.54*	*70*	*32.48±7.56*	*16.92±1.35*	*150*	*32.77±7.52*	*16.72±1.46*

Data was given Mean±SD. º: Degree. LA: Low-Angle. NA: Norm-Angle. HA: High-Angle. N: Number of subjects.

Table 2. Cephalometric points and angular-linear measurements used in the study.

Cephalometric Points		*Cephalometric Angular and Linear Measurements*	
Abb.	***Description***	***Abb.***	***Description***
A	*A point: The point of subspinale*	*ANB º*	*The angle from point A to nasion to point B*
B	*B point: The point of supramentale*	*Wits (mm)*	*It is the distance (AO to BO) between the vertical projections of the A and B points on the occlusal plane, respectively.*
S	*Sella: The midpoint of sella turcica*	*A-Nperp (mm)*	*The perpendicular distance is measured from the A point to the nasion perpendicular*
N	*Nasion: The most anterior point of the nasofrontale suture*		
M	*Point M: midpoint of premaxilla*	*Pog-NPerp (mm)*	*The perpendicular distance is measured from the pogonion to the nasion perpendicular.*
G	*Point G: The point that is tangent to the 4 surfaces (internal-anterior-inferior-posterior) of the mandibular symphysial part and shows the center of the circle that fits best.*		
C	*Point C: The apparent axis of the Condyle*	*SN/GoGn º*	*The angle formed at the intersection of Sella-Nasion and Gonion-Gnathion lines*
Go	*Gonion: Midpoint of the angle of the mandible, found by bisecting the angle formed by the mandibular plane and a plane through articulare, posterior and along the portion of the mandibular ramus inferior to it*	*Beta º*	*The angle formed between A-B line and the perpendicular line dropped from point A and C-B line*
Gn	*Gnathion: Lowest, most anterior midline point on the symphysis of the mandible*		
Po	*Porion: Point on the upper margin of the porus acusticus externus*	*W º*	*The angle between the M-G line (M = midpoint of the premaxilla; G = the center of the mandibular symphysis) and a perpendicular line drawn from point M to the S-G line (S = Sella).*
Or	*Orbitale: The lowest point on the average of the right and left borders of the bony orbit*		
Pog	*Pogonion: The most anterior part on the contour of the bony chin, determined by a tangent through nasion*	*Yen º*	*The angle between line S-M and line M-G.*

Abb.: Abbreviation. (°): Degree. (mm): Milimeter.

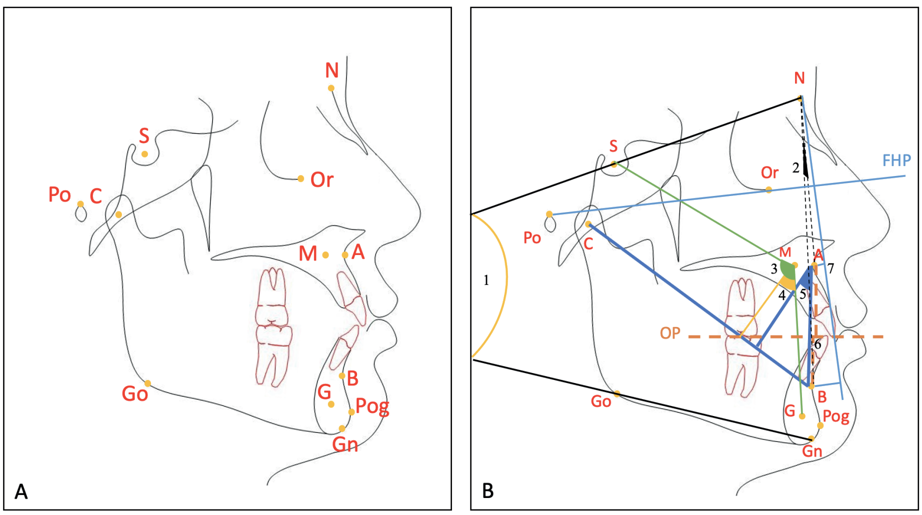

Figure 1. A) Cephalometric points. S: Sella; N: Nasion; Po: Perion; Or: Orbitale; A: A point; B: B point; Pog: Pogonion; Gn: Gnathion; Go: Gonion; M: M point; G: G point; C: C point.

B) Cephalometric measurements. OP: Occlusal plane; FHP: Frankfort horizontal plane; 1: SN/GoGn angle; 2: ANB angle; 3: Yen angle; 4: W angle; 5: Beta angle; 6. Wits appraisal; 7: A-Nperp; 8: Pog-Nperp.

Table 3. Examining the reliability between the first and second measurements.

	ICC	%95 CI Lower Bound	Upper Bound	P values*
SN-GoGn (°)	*0.994*	*0.981*	*0.998*	*0.089*
ANB (°)	0.923	*0.760*	*0.975*	*0.939*
Wits (mm)	0.986	*0.955*	*0.995*	*0.599*
A-Nperp (mm)	0.924	*0.765*	*0.976*	*0.615*
Pog-Nperp (mm)	0.960	*0.874*	*0.987*	*0.352*
Beta (°)	0.980	*0.938*	*0.994*	*0.053*
W (°)	0.967	*0.898*	*0.989*	*0.382*
Yen (°)	0.941	*0.817*	*0.981*	*0.510*

(°): Degree. (mm): Milimeter. ICC: Intra-class Correlation Coeffcient. CI: Confidence Interval. * P values obtained as a result of the Paired samples-t test. Statistical significant degree $p<0.05$.

for binary comparisons) were used. The Spearman correlation test was used to evaluate the relationship between the measurements. Finally, in order to classify the extent of the correlation, 0.30-0.50 was evaluated as a low correlation, 0.50-0.70 as moderate and over 0.70 as high (20). The statistical significance value was accepted as $p<0.05$.

Reliability Analysis

In order to evaluate the method error, 15 randomly selected cases were re-evaluated one month after the first measurements were made. For the reliability analysis, the intra-class correlation coefficient (ICC) between the first and second measurements was used. In addition, the relationship between the two measurements was evaluated using the paired samples t-test.

Table 4. Descriptive and comparative statistics among the three vertical growth pattern of face for the total sample.

Variables	Groups	Mean+SD	Median	Min	Max	P value	Binary Comparisons. p values LA-NA	LA-HA	NA-HA
ANB (°)	Low-angle	2.03±1.24	1.80	0.09	4.00	0.077 KW	0.077	0.053	0.529
	Norm-angle	2.42±1.08	2.30	0.01	4.00				
	High-angle	2.54±1.27	2.50	0.15	4.00				
	Totally	2.33±1.21	2.30	0.13	4.00				
Wits (mm)	Low-angle	1.01±3.28	1.20	-5.10	8.80	0.006 OWA	0.255	0.004	0.365
	Norm-angle	0.02±3.10	0.15	-7.40	8.50				
	High-angle	-1.03±2.99	-1.05	-9.90	5.70				
	Totally	-0.07±3.22	-0.30	-9.90	8.80				
A-Nperp (mm)	Low-angle	0.27±3.10	0.05	-6.40	8.70	0.286 KW	0.434	0.113	0.432
	Norm-angle	-0.54±3.57	-0.45	-9.50	7.00				
	High-angle	-0.89±3.47	-1.20	-13.80	4.90				
	Totally	-0.39±3.48	-0.40	-13.80	8.70				
Pog-Nperp (mm)	Low-angle	0.34±5.39	0.55	-11.20	13.60	<0.001 OWA	0.004	<0.001	0.233
	Norm-angle	-3.63±6.08	-3.35	-19.80	6.80				
	High-angle	-5.61±6.67	-5.15	-26.60	8.60				
	Totally	-2.97±6.52	-2.50	-26.60	13.60				
Beta (°)	Low-angle	29.61±4.40	29.25	18.20	37.40	<0.001 OWA	0.119	<0.001	0.003
	Norm-angle	31.22±3.30	31.55	20.30	36.90				
	High-angle	33.93±4.35	34.20	24.80	45.10				
	Totally	31.58±4.40	31.70	18.20	45.10				
W (°)	Low-angle	56.79±3.02	57.15	49.80	63.80	0.048 OWA	0.412	0.212	0.045
	Norm-angle	56.31±2.79	56.75	46.00	61.90				
	High-angle	57.76±3.18	57.90	50.40	65.60				
	Totally	56.95±3.04	57.20	46.00	65.60				
Yen (°)	Low-angle	126.97±4.19	127.70	117.30	135.40	0.001 KW	0.002	<0.001	0.576
	Norm-angle	124.65±3.79	125.40	111.20	132.10				
	High-angle	124.27±4.00	124.70	115.20	134.50				
	Totally	125.30±4.15	125.75	111.20	135.40				

(°): Degree. (mm): Milimeter. Min: Minimum. Max: Maximum. SD: Standard Deviation. LA: Low-Angle. NA: Norm-Angle. HA: High-Angle. OWA: One-Way ANOVA test was performed for parametric variables. Tukey test was performed for parametric variables for binary comparisons. KW: Kruskall-Wallis test was performed. Mann-Whitney U test was performed for non-parametric variables for binary comparisons. Statistical significance degree was accepted p<.05.

Table 5. Correlation matrix including comparison of sagittal parameters among themselves and within different groups of vertical facial growth types.

Spearman correlation coefficient (r)		*ANB (º)*	*Wits (mm)*	*A-Nperp (mm)*	*Pog-Nperp (mm)*	*Beta (º)*	*W (º)*
Low-Angle	*Wits (mm)*	*0.636***					
	A-Nperp (mm)	*0.275*	*0.051*				
	Pog-Nperp (mm)	*-0.207*	*-0.195*	*0.735***			
	Beta (º)	*-0.600***	*-0.649***	*0.212*	*0.335*		
	W (º)	*-0.604***	*-0.477***	*-0.277*	*0.055*	*0.582***	
	Yen (º)	*-0.672***	*-0.417***	*-0.285**	*0.127*	*0.482***	*0.875***
Norm-Angle	*Wits (mm)*	*0.386***					
	A-Nperp (mm)	*0.270*	*-0.144*				
	Pog-Nperp (mm)	*-0.157*	*-0.250*	*0.804***			
	Beta (º)	*-0.464***	*-0.568***	*0.198*	*0.405***		
	W (º)	*-0.479***	*-0.240**	*-0.090*	*0.225*	*0.472***	
	Yen (º)	*-0.477***	*-0.385***	*0.018**	*0.347**	*0.523***	*0.890***
High-Angle	*Wits (mm)*	*0.249*					
	A-Nperp (mm)	*0.371***	*-0.081*				
	Pog-Nperp (mm)	*-0.017*	*-0.178*	*0.871***			
	Beta (º)	*-0.331**	*-0.525***	*0.168*	*0.303**		
	W (º)	*-0.465***	*-0.304**	*0.044*	*0.311**	*0.628***	
	Yen (º)	*-0.501***	*-0.380***	*0.133*	*0.415***	*0.634***	*0.919***
Totally	*Wits (mm)*	*0.368***					
	A-Nperp (mm)	*0.303***	*-0.023*				
	Pog-Nperp (mm)	*-0.171**	*-0.094*	*0.789***			
	Beta (º)	*-0.349***	*-0.622***	*0.130*	*0.150*		
	W (º)	*-0.507***	*-0.368***	*-0.110*	*0.166**	*0.576***	
	Yen (º)	*-0.570***	*-0.279***	*0.007*	*0.408***	*0.360***	*0.812***

Statistical significance degree was accepted * p<.05 ** p<.01 (2-tailed).

Results

It was determined that the ICC results obtained as a result of the reliability analysis using the first and last measurements ranged between 0.923 and 0.984, and there was no statistically significant difference (p>0.05) between the two measurement values (Tab. 3).

It was found that there was no statistically significant difference between the groups in the ANB and A-Nperp parameters according to the vertical growth type of the face (Tab. 4, p>0.05). However, the Wits parameter was found to differ significantly between groups (Table 4, p<0.05), with the Wits parameter of individuals in the low-angle group being higher than that of the high-angle group. The Pog-Nperp parameter was also found to differ significantly between groups (Table 4, p<0.05), being higher in individuals of the low-angle group than either the norm-angle or high-angle groups. The Beta angle parameter was found to differ significantly between groups (Tab. 4, p<.05) and was higher in individuals in the high-angle group than in the low-angle or norm-angle group. Finally, the Yen angle parameter was found to differ significantly between groups (Tab. 4, p<0.05). For individuals in the low-angle group, the Yen angle parameter was higher than for individuals in the norm-angle and high-angle groups.

The results of the correlation analysis in which the relationship between parameters was evaluated are given in Table 5. Especially in low-angle cases, it has been determined that there are moderate correlations greater than 0.6 between ANB and the measurements of Beta (r = -0.600), W (r = -0.604) and Yen (r = -0.672, p<0.05). In all cases, it was determined that there is a negative correlation between the Wits measurement and the Beta measurement; however, the correlation coefficient of low-angle cases is above 0.6 (r=-0.649, p<0.05). Finally, in all subgroups, significant positive correlations were found between the Beta, W and Yen angles (Tab. 5, p<0.05).

Discussion

The cephalometric analysis procedure, which is key to orthodontic diagnosis and treatment planning, is used to determine sagittal and vertical jaw problems and to define malocclusions (15). For this analysis, numerous cephalometric points, angular and linear measurements, and various analyses have been used (2-7,14). Due to the large number of existing analytic methods, the same problem can be defined with different values (21). In our study, we aimed to evaluate the relationship between individuals with different vertical facial growth types in order to interpret the various parameters used in the definition of malocclusions in the sagittal dimension.

We sought to determine whether the different measurements used to evaluate the skeletal anteroposterior position of the jaws are affected by the vertical growth pattern of the face. Since the most common type of sagittal malocclusion in the world is a Class I relationship and only the relationship between different facial growth type groups was examined, individuals with skeletal Class I malocclusion were included in the study (15, 22). Four angular measurements (ANB, Beta, Yen and W) and three linear measurements (Wits appraisal, A-Nperp and Pog-Nperp) were used to evaluate the sagittal relationship of the jaws in participants with different vertical facial growth types. In previous studies, the relationship between these measurements was evaluated according only to the sagittal malocclusion classes (4-6, 9-14). Qamaruddin et al. reported that the Beta, W and Yen angles showed significant changes in different sagittal malocclusion groups in which the anteroposterior relationship of the jaws was defined (10). In this study, the lowest values were obtained in the Class II malocclusion group, while the highest values were obtained in the Class III malocclusion group, and we observed that there was only a difference in the Wits appraisal, Pog-Nperp, Beta, W and Yen angle values in individuals with different vertical facial growth types (10). Both the Beta and W angles referring from the Co and B points were found to have higher values in the HA group. It has been predicted that this finding may be due to changes in the Co and B points, which are affected by the posterior rotation of the mandible in HA cases (23). In addition, Sundareswaran and Kumar's study evaluating the differences in the Beta angle between different malocclusion groups also reported that the Beta angle had higher values in HA cases, a finding that supports the results of our study (24). Similar to previous studies (9, 21), it was determined that there are significant negative correlations between the ANB angle and Beta, W and Yen angles in both the total sample and each vertical face type. In a study conducted by Alhammadi et al., the Beta angle does not differ in individuals with Class I malocclusion and different vertical facial types (12). However, in that study, cone-beam computed tomography (CBCT) images were used and the sample distribution between the groups was not homogeneous. In contrast, we used lateral cephalometric radiographs, which expose the participants to less radiation than CBCT imaging does (an important point for the ALARA principle), are easier to examine, are more cost-effective and are usually taken for initial evaluations (15, 25, 26). Our study was the first to examine the relationship between the A-Nperp and Pog-Nperp measurements and the Beta, W and Yen angles. Although we found no significant correlation between these variables in the entire sample group with Class I malocclusion, we observed a significant correlation between the Pog-Nperp and the Beta, W and Yen angles in HA cases only. In addition, a significant correlation between the A-Nperp and the Yen angle was found only in LA cases.

The cranial base length is affected by the position of the nasion point and may sometimes camouflage, affecting the true skeletal malocclusion character (13). In this context, the reliability of the ANB angle referenced from the nasion point is questionable. W, Yen and Beta angles that are independent of the nasion point become more usable and the correlations between these measurements become important. In our study, we found that there are various degrees of correlation between these measurements. For this reason, we predict that it can be used even in individuals with different facial growth patterns. Although the limitations of this study suggest a reliability problem in terms of nasion point, and we predict that there may be errors in the geometric determination of the points used in determining the W, Yen and Beta angles (9, 10, 13, 14, 24), evaluating these measurements together will be useful in overcoming these problems. In addition, in order to evaluate the relationship between these measurements more clearly and in detail, we examined the differences in different sagittal and vertical malocclusion groups.

Conclusion

In individuals with different facial vertical growth types, the Wits measurement, ANB angle, Beta angle, W angle and Yen angle have different correlations. All measurements performed as a result of the study show the same diagnostic significance; in consequence, one analysis can be used as a replacement for another when certain factors make the use of the latter analysis difficult.

Piśmiennictwo / References

1. Wylie WL. The assessment of anteroposterior dysplasia. Angle Orthod 1947; 17: 97-109.
2. Riedel RA. Esthetics and its relation to orthodontic therapy. Angle Orthod 1950; 20: 168-78.
3. Jacobson A. The “Wits” appraisal of jaw disharmony. Am J Orthod Dentofacial Orthop 1975; 67: 125-38.
4. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: the Beta angle. Am J Orthod Dentofacial Orthop 2004; 126: 100-5.
5. Neela PK, Mascarenhas R, Husain A. A new sagittal dysplasia indicator: the YEN angle. World J Orthod 2009; 10: 147-51.
6. Bhad WA, Nayak S, Doshi UH. A new approach of assessing sagittal dysplasia: the W angle. Eur J Orthod 2013; 35: 66-7.
7. McNamara Jr JA. A method of cephalometric evaluation. Am J Orthod Dentofacial Orthop 1984; 86: 449-69.
8. Bishara SE, Fahl JA, Peterson LC. Longitudinal changes in the ANB angle and Wits appraisal: Clinical implications. Am J Orthod Dentofacial Orthop 1983; 84: 133-9.
9. Ahmed M, Shaikh A, Fida M. Diagnostic validity of different cephalometric analyses for assessment of the sagittal skeletal pattern. Dent Press J Orthod 2018; 23: 75-81.
10. Qamaruddin I, Alam MK, Shahid F, Tanveer S, Umer M, Amin E. Comparison of popular sagittal cephalometric analyses for validity and reliability. Saudi Dent J 2018; 30: 43-6.
11. Roy P, Nambiar S, Unnikrishnan B, Desai A, Suresh C. Assessment of Sagittal Skeletal Base Relationship of Maxilla and Mandible by Horizontal Appraisal Method – A Comparative and Reliability Study. J Orofac Sci 2018; 10: 80-5.
12. Alhammadi MS, Almaqrami BS, Cao B. Reliability of Beta-angle in different anteroposterior and vertical combinations of malocclusions. Orthod Waves 2019; 78: 111-7.
13. Maharjan S, Lili C. Comparison of ANB Angle, Yen Angle and W Angle in Chinese Population. Orthod J Nepal 2019; 9: 35-9.
14. Bohra S, Udeshi PS, Sinha SP, Saidath K, Shetty KP, Nayak UK. Predictability of pi angle and comparison with anb angle, w angle, yen angle, and beta angle in South Indian Population. J Indian Orthod Soc 2018; 52: 22-8.
15. Proffit WR, Sarver DM, Ackerman JL. Orthodontic Diagnosis: The Problem-Oriented Approach. In: Proffit WR, Fields Jr HW, Sarver DM, editors. Contemporary Orthodontics, 5e. Elsevier India 2014: 150-219.
16. Hussels W, Nanda RS. Analysis of factors affecting angle ANB. Am J Orthod Dentofacial Orthop 1984; 85: 411-23.
17. Basciftci FA, Uysal T, Buyukerkmen A. Craniofacial structure of Anatolian Turkish adults with normal occlusions and well-balanced faces. Am J Orthod Dentofacial Orthop 2004; 125: 366-72.
18. Celikoglu M, Bayram M, Sekerci AE, Buyuk SK, Toy E. Comparison of pharyngeal airway volume among different vertical skeletal patterns: a cone-beam computed tomography study. Angle Orthod 2014; 84: 782-7.
19. Kula K, Ghoneima A. Skeletal Landmarks and Measures. In: Cephalometry in Orthodontics: 2D and 3D, Kula K, Ghoneima A, editors. Batavia, IL: Quintessence Publishing 2018: 17-47.
20. Mukaka MM. Statistics corner: A guide to appropriate use of correlation coefficient in medical research. Malawi Med J 2012; 24: 69-71.
21. Kapadia RM, Diyora SD, Shah RB, BN M. Comparative Evaluation of Yen Angle and W Angle with ANB Angle, Wits Appraisal, and Beta Angle for Predicting Sagittal Jaw Dysplasia: A Cephalometric Study. Int J Clin Dent Res 2017; 1: 26-31.
22. Lombardo G, Vena F, Negri P, Pagano S, Barilotti C, Paglia L, Colombo S, Orso M, Cianetti S. Worldwide prevalence of malocclusion in the different stages of dentition: A systematic review and meta-analysis. Eur J Paediatr Dent 2020; 21: 115-22.
23. Rijpstra C, Lisson JA. Etiology of anterior open bite: a review. J Orofac Orthop 2016; 77: 281-6.
24. Sundareswaran S, Kumar V. Reliability of Beta angle in assessing true anteroposterior apical base discrepancy in different growth patterns. J Nat Sci Biol Med 2015; 6: 125-33.
25. Farman AG. ALARA still applies. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005; 4: 395-7.
26. Pittayapat P, Willems G, Alqerban A, Coucke W, Ribeiro-Rotta RF, Souza PC, Westphalen FH, Jacobs R. Agreement between cone beam computed tomography images and panoramic radiographs for initial orthodontic evaluation. Oral Surg Oral Med Oral Pathol Oral Radiol 2014; 117: 111-9.