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A New Approach in Assessment of Sagittal Dysplasia

Dr (Mrs) Rinku Adwani (Nathani), P.G Diploma in orthodontics

Dr (Mrs) Shweta Kolhe (Dhope), M.D.S

Dr. Amol Verulkar, M.D.S

Dr. Twinkle Bajaj, P.G Student

Department of Orthodontics and Dentofacial orthopedics, V.Y.W.S Dental College and Hospital, Camp, Amravati, Maharashtra. 444602

Corresponding Author: Dr (Mrs) Shweta Kolhe (Dhope), M.D.S, Department of Orthodontics and Dentofacial orthopedics, V.Y.W.S Dental College and Hospital, Camp, Amravati, Maharashtra. 444602

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Abstract

Introduction: Certain cases where identification of point A is difficult because of variations in the structure of the skeleton, soft-tissue overshadows or due to the abnormal anatomy in the cleft lip and palate patients or in growing children because of the tooth germs molding the anterior contour of maxilla, to overcome such cases various alternative methods have been given by different authors. However, concerning studies are limited. Hence, the null hypothesis is that reliability of alternative points A is not affected by the different malocclusion.

Material and Methods: Lateral cephalogram of 150 patients were evaluated to locate point A exactly and consistently. Samples were divided into 3 groups: Group I, 50 cephalograms with class I skeletal pattern. Group II, 50 cephalograms with class II skeletal pattern. Group III, 50 cephalograms with class III skeletal pattern. The reliability of alternative points to point A, were evaluated while measuring angular and linear dimension in three different malocclusion groups.

Results: pearson correlation method showed very strong highly significant positive correlation of A2NB,ß2 and A2O-BO in all the three different malocclusion.

Conclusion: Situation where anterior counter of maxilla is obscured in lateral cephalograms, measurement done using point A2 can be reliable alternative.

Keywords: Cephalometry, Saggittal Dyslpasia, Point A, Point A alternative

Introduction

Cephometrics is an elixir in conjunction with other records for proper diagnosis and treatment planning. There are certain aspects of cephalometric anaylsis in orthodontics, furthermore in orthognathic surgery, maxillofacial and other cosmetic surgeries which must be understood fully, if objectivity is the goal . Broadbent introduced cephalostat (1931) as a diagnostic tool, still it has led to continued quest for precise identification of anatomical landmarks. As lateral cephalograms are 2D projection of 3D structures, so identification of these land arks in conventional cephalograms were subjected to error. Hence CBCT solved the problem of accurate identification of landmarks however a large–field–of–

view scan is required for obtaining a synthesized cephalometric image which is contraindicated for day to day practice in orthodontics.(,)Landmark definition is the biggest Achilles heel of cephalometrics. The very definition of the landmark has been criticized leading to location errors and reproducibility which should be exact and consistent. In spite of improved techniques, sometime certain landmarks are still difficult to locate because of conflicting anatomic details or conceptual judgment. One of such kind is point A or subspinale. Subspinale is defined as the deepest midline points on premaxilla between anterior nasal spine (ANS) and prosthion. There are certain cases where identification of point A is difficult, like because of variations in the structure of the skeleton, soft-tissue overshadows, or due to the abnormal anatomy as in the cleft lip and palate patients or in young children because of the tooth germs molding the anterior contour of maxilla. To overcome such cases various alternative methods have been given by different authors, to locate this point with acceptable accuracy. However, there are very few studies available in the literature on the reliability of these alternative descriptions and points. Hence, the null hypothesis is that reliability of alternative points A is not affected by the different malocclusion.For proper orthodontic diagnosis and treatment planning, there are various angular and linear measurement to assess the anteroposterior jaw relationship between maxilla and mandible. Since Wylies (1947) , was the first to attempt to describe AP jaw relationship. A number of other geometric parameter such as Downs 19488, Riedel 1952 , Wits appraisal 1975 , APDI 1978 , Moyers 1979 , AFB 1981 , AFBF 1987 , Beta 2004 , Yen 2009 , Pi analysis 2012 , W angle .

To overcome some of the deficits of the previously discussed point A and reliability to alternative to point A is evaluated and "V" analysis is develop. The aim of the present study is to assess co-relation between various parameters used for AP discrepancy analysis involving three alternative points of 'A' in relation to linear and angular measurements used.

The "V" Analysis:

The V-analysis was developed in department of Orthodontics and Dentofacial orthopedics, **V**idharabha Youth Welfare Society's Dental College and Hospital, Amravati, Maharashtra, India, hence its name.

Materials and Methods

Source of data

Study was done on patients visiting the Department of orthodontics and Dentofacial Orthodontics, **V**YWS Dental College, Amravati, Maharashtra, India. Total 150 cephalograms was selected from available patient's records. The sample was divided into three groups based on the ANB angle, Wits appraisal, Beta angle and profile.

Inclusion Criteria

Group I: - Comprising 50 cephalograms with class I skeletal pattern.

1. Wherein ANB angle was 1-3 degree
2. Wits appraisal was 0-3 mm
3. An pleasant facial profile
4. Permanent dentition with no missing teeth
5. Patients with age group between 15 and 19 years.

Group II: - Comprising 50 cephalograms with class II skeletal pattern.

1. Wherein ANB angle was >4 degree
2. Wits appraisal was >1 mm
3. Convex or class II facial profile
4. Permanent dentition with no missing teeth
5. Patients with age group between 15 and 19 years.

Group III: - Comprising 50 cephalograms with class III skeletal pattern.

1. Wherein ANB angle was </=1 degree
2. Wits appraisal was </=-4mm

3. Concave or class III facial profile
4. Permanent dentition with no missing teeth
5. Patients with age group between 15 and 19 years.

Exclusion Criteria

- Patient who had undergone orthodontic and/or Orthognathic surgical treatment.
- Patients with congenital defects & any marked facial deformity.
- Medically compromised patients.
- Poor quality of cephalograms.

Measurement

All lateral head films were viewed under standardized conditions and traced on acetate overlays with 0.3 mm HB lead pencil by one observer (manually).

Landmarks used and their definition and the variable measured in the study are listed in the Tables 1 and 2 respectively.

Methodology

To test the efficacy of alternative points to point A, while measuring anteroposterior jaw relationship, total samples were divided into three groups based on the skeletal malocclusion.

Group I consisted of 50 participants with class I skeletal pattern.

Group II consisted of 50 participants with class II skeletal pattern.

Group III consisted of 50 participants with class III skeletal pattern.

Three alternative methods for estimation of point A suggested in the literature (,11,9) were used for evaluation of anteroposterior jaw relationship in different malocclusion groups in present study.

A1- (Jacobson and Jacobson25)A point 3 mm labial to a point between the upper-third and lower two-thirds of the long axis of the root of the maxillary central incisor (estimated point A), to be suitable to draw the NAe line, which most closely approximates the true NA plane. (Figure 1)

A2- (Tindlund et al11)A point formed by the intersection of a line parallel to the palatal plane, 7 mm below and the anterior contour of the maxilla as an alternative for point A. (Figure 2).

A3- (Bonngarts et al9)point at the intersection of point prosthion on a line parallel to the palatal plane, 7 mm below the palatal plane which is taken as point A3 in this study(figure 3).The reliability of alternative points to point A, were evaluated while measuring angular and linear dimension in three different malocclusion groups.

Table 1 : Landmarks used in the study and their definition

Abbreviation	Landmark	Description
N	Nasion	The most anterior limits of the frontonasal suture
S	Sella	The geometric center of the sella turcica
Or	Orbitale	Lowest points on the inferior rim of the orbit
Po	Porion	Most superiorly positioned points of external auditory meatus
ANS	Anterior nasal spine	The tip of the bony anterior nasal spine
PNS	Posterior nasal spine	The posterior end of the hard palate if visible. Otherwise at the point of intersection of the dorsal maxillary contour and the soft palate contour (Hotz and Gnoinski, 1976)[24]
Pr	Prosthion	The points of the maxillary alveolar process in the midline that projects most anteriorly
A	Points A	The deepest point on the contour of the alveolar projection between the spinal points and prosthion
A1	Points A alternative 1	A point plotted 3 mm labial to a point between the upper-third and lower two-thirds of the long axis of the root of the maxillaruy central incisor (Jacobson and jacobson)[25]
A2	Points A alternative 2	Intersection between a line parallel to the palatal plane , 7 mm below , and the anterior contour of the maxilla (Tindlund et al)[11]
A3	Points A alternative 3	The projection of point Pr on a line parallel to the palatal plane, 7 mm below the palatal plane (Bongaarts et al)[9]

Tables 2 : Variables measured in the study

Angular measurements	
ANB	Angle is formed by the intersection of lines joining nasion to point A and nasion to points B.
A1NB	Angle is formed by the intersection of lines joining nasion to point A1 and nasion to points B.
A2NB	Angle is formed by the intersection of lines joining nasion to point A2 and nasion to points B.
A3NB	Angle is formed by the intersection of lines joining nasion to point A3 and nasion to points B.
ß-angle	Angle between the last perpendicular line from point A on C-B line and the A-B line.
ß1-angle	Angle between the last perpendicular line from point A1 on C-B line and the A-B line.
ß2-angle	Angle between the last perpendicular line from point A2 on C-B line and the A-B line.
ß3-angle	Angle between the last perpendicular line from point A3 on C-B line and the A-B line.
Linear measurements	
AO-BO	Distance between the points of intersection of AO and BO (perpendicular lines from points A and B to the functional occlusal plane)
A1O-BO	Distance between the points of intersection of A1O and BO (perpendicular lines from points A and B to the functional occlusal plane)
A2O-BO	Distance between the points of intersection of A2O and BO (perpendicular lines from points A and B to the functional occlusal plane)
A3O-BO	Distance between the points of intersection of A3O and BO (perpendicular lines from points A and B to the functional occlusal plane)

Statistical analysis

For Group I, II and III mean, standard deviation and mean difference were calculated for each of the variables (Table

1,2,3). Pearson's correlation coefficient was used to assess the strength of association of the alternative points A1, A2 and A3 to point A in three groups (Table 4). Level of significance was set at P<= 0.05.

Results

Mean, standard deviation and mean difference for each parameter in groups I, II and III are presented in Table 1, 2 and 3 respectively. Compare mean of all angular and linear parameter with their respected standard. In Group I, shows significant result with A3NB, ß3 angular and A3O-BO linear and non-significant results with A1NB, A2NB, ß1, ß2 angular and A1O-BO, A2O-BO linear. Comparison of mean of all angular and linear parameter with their respected standard using Independent t test; indicates significant at p≤0.05.In Group I, shows significant result with A3NB, ß3 angular and A3O-BO linear and non-significant results with A1NB, A2NB, ß1, ß2 angular and A1O-BO, A2O-BO linear similar result obtained for group II. Non-significant result obtained while Comparing mean of all angular and linear parameter with their respected standard in Group III. To further determine comparison of correlation matrix between variables pearson correlation method used in table 4 showed very strong highly significant positive correlation of A2NB,ß2 and A2O-BO in all the three different malocclusion.

Table 3: Comparison in Class I

Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
ANB	50	2.350	1.0363	0.09	0.485	0.629
A1NB	50	2.260	.8033			
ANB	50	2.350	1.0363	-0.05	-0.247	0.806
A2NB	50	2.400	.9897			
ANB	50	2.350	1.0363	-1.57	-6.381	0.001*
A3NB	50	3.920	1.3974			
AO-BO	50	1.790	1.2417	-0.14	-0.572	0.568
A1O-BO	50	1.930	1.2038			
AO-BO	50	1.790	1.2417	-0.04	-0.167	0.868
A2O-BO	50	1.830	1.1500			
AO-BO	50	1.790	1.2417	-2.15	-7.372	0.001*
A3O-BO	50	3.940	1.6464			
B	50	31.80	3.785	0.28	0.371	0.712
B1	50	31.52	3.770			
B	50	31.80	3.785	0.00	0.000	1.000
B2	50	31.80	3.785			
B	50	31.80	3.785	-2.50	-3.276	0.001*
B3	50	34.30	3.845			

Independent t test; * indicates significant at p≤0.05.

Table 2: Comparison in Class II

Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
ANB	50	6.150	1.3142	0.05	0.197	0.844
A1NB	50	6.100	1.2164			
ANB	50	6.150	1.3142	-0.03	-0.119	0.906
A2NB	50	6.180	1.2070			
ANB	50	6.150	1.3142	-2.09	-7.987	0.001*
A3NB	50	8.240	1.3024			
AO-BO	50	5.370	1.8093	-0.19	-0.546	0.685
A1O-BO	50	5.560	1.6679			
AO-BO	50	5.370	1.8093	-0.01	-0.028	0.977
A2O-BO	50	5.380	1.7248			
AO-BO	50	5.370	1.8093	-2.11	-5.759	0.001*
A3O-BO	50	7.480	1.8543			
B	50	21.82	2.974	-0.240	-0.423	0.674
B1	50	22.06	2.699			
B	50	21.82	2.974	0.00	0.00	1.000
B2	50	21.82	2.974			
B	50	21.82	2.974	0.86	1.329	0.187
B3	50	20.96	3.476			

Independent t test; * indicates significant at p≤0.05

Table 3: Comparison in Class III

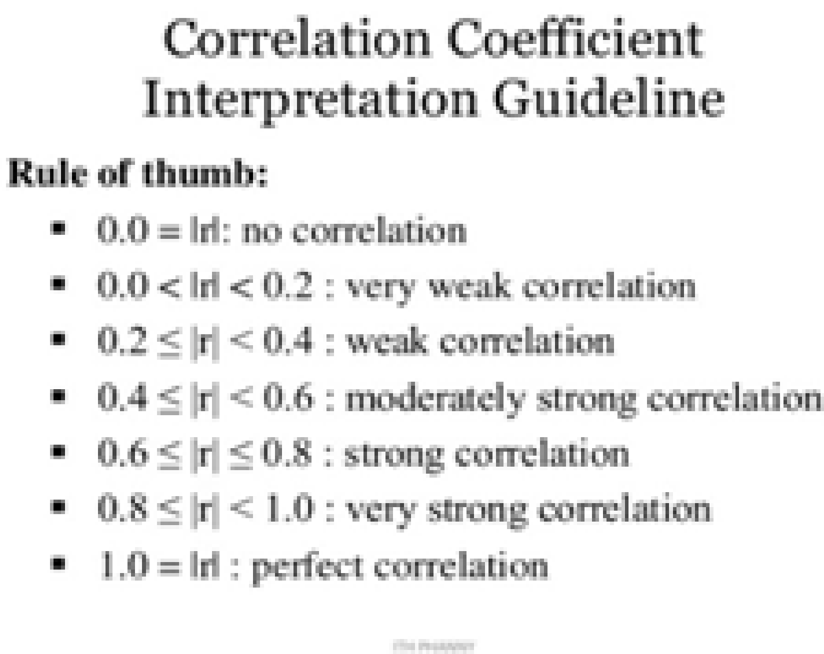
Groups	N	Mean	Std. Deviation	Mean Difference	t value	p value
ANB	50	-4.12	2.446	-0.36	-0.714	0.477
A1NB	50	-3.76	2.592			
ANB	50	-4.12	2.446	-0.04	-0.081	0.935
A2NB	50	-4.08	2.473			
ANB	50	-4.12	2.446	0.24	0.381	0.704
A3NB	50	-4.36	3.724			
AO-BO	50	-4.200	2.2177	-0.44	-0.935	0.352
A1O-BO	50	-3.760	2.4790			
AO-BO	50	-4.200	2.2177	-0.02	-0.045	0.964
A2O-BO	50	-4.180	2.2446			
AO-BO	50	-4.200	2.2177	-0.12	0.210	0.834
A3O-BO	50	-4.080	3.3797			
B	50	39.88	4.801	-0.12	-0.128	0.898
B1	50	40.00	4.545			
B	50	39.88	4.801	0.08	0.084	0.933
B2	50	39.80	4.738			
B	50	39.88	4.801	-1.20	-1.39	0.168
B3	50	41.08	3.768			

Independent t test; * indicates significant at p≤0.05

Table 4: Comparison of Correlation matrix between variables

Variables	Class I	Class II	Class III
ANB VS A1NB	0.677	0.675	0.970
ANB VS A2NB	0.981	0.967	0.994
ANB VS A3NB	0.305	0.867	0.864
AO-BO VS A1O-BO	0.769	0.851	0.909
AO-BO VS A2O-BO	0.956	0.980	0.996
AO-BO VS A3O-BO	0.472	0.856	0.865
B VS B1	0.977	0.932	0.977
B VS B2	1.000	1.000	0.991
B VS B3	0.963	0.550	0.804

Pearson Correlation Method



Discussion

Great importance has been attached to the evaluation of the sagittal apical base relationship in orthodontic diagnosis and treatment planning .(15, ,)not only does the skeletal pattern play a great part in occclusal development, but it also imposes limits to the amount of anteroposterior movement of the incisor teeth during treatment .(, ,)A pioneering step in the description in the sagittal jaw relationship in orthdontics was the introduction of point A, point B and A-B plane angle to cephalometrics (1948)by Downs14 The most popular parameter for assessing the saggital dyaplasia remains the ANB angle, popular alternative is Wits appraisal. New measurement developed is Beta angle, distinguish between true skeletal class I, II and III pattern and help the clinician to decide whether orthodontic camouflage or surgery would be more appropriate.21 ANB angle, Wits appraisal and Beta angle uses point A as reference point for determining sagittal apical base relationship. All AP parameters introduced over the year are affected by at least one of the factors, namely patient's age, jaw rotations, poor reproducibility of landmarks, growth changes in reference planes and changes due to orthodontic treatment. Regardless of point A, difficult to locate when anterior anatomy of maxilla is obscured in lateral cephalometric radiographs due to various reasons as already mentioned. For such situation an alternative method for point A location have been described in by various authors in literature, reliability of which need to be thoroughly evaluated. The reliability includes judging location of these alternative points in angular and linear dimensions and relates it to actual location of point A.Thus, in the present study, an attempt has been made to check the reliability of three alternative points to point A used in AP analysis in different malocclusion. In present study, reliability of popularly used to angular parameter for AP relationship ANB and Beta (A1NB, A2NB, A3NB, ß1, ß2 and ß3) and liner parameter Wits appraisal (A1O-BO, A2O-BO, A3O-BO) checked.

To check this, the sample was divided into three group based on skeletal malocclusion-

Group I - Comprising 50 cephalograms with class I skeletal pattern,

Group II – Comprising 50 cephalograms with class II skeletal pattern and

Group III - Comprising 50 cephalograms with class III skeletal pattern. To reduce magnification error, all the radiograph were taken from same X-ray machine.

Reliability correlation matrix between variables

Evaluation in angular parameter

In this study, angle A3NB, ß3 was found to be least reliable in all three Group I, II and III (Table 4). Reason being, the authors27 have used prosthion point to determine the position of point A. A1 and A2 can be used an alternative but among two, point A2 can be consider more reliable as correlation matrix was found to be showing very strong correlation in three groups using pearson correlation method (Table 4).

Evaluation in linear parameter

In Wits appraisal (AO-BO), all three Groups with point A2 (A2O-BO) was found to be perfect correlation while other showing weak (A3O-BO for Class I) modernly strong (A1O-BO for Class I), strong correlation (A1O-BO, A3O-BO for Class II, A3O-BO for Class III) and very strong correlation (A1O-BO for Class III) in three Groups.Study done by Sing S JIOS 20182, point A2 was found to be most reliable alternative to point A. Similarly in present study angular and linear parameter used for evaluation if anteroposterior jaw base relationship using point A2 as an alternative to point A shows perfect correlation for linear parameter and very strong correlation with angular parameter in three Groups. Thus, it can be summarized that determination of sagittal jaw relationship using point A2 will approximate more closely to actual value. However, further studies need to be done with larger sample size and digitizes recording devise.

Conclusions

1. A new V-analysis, enrich clinician as better diagnostic tool for evaluating jaw dysplasia with focused maxillary anatomy.
2. Angular and linear parameter used for AP relationship with point A2, most predictable for class I, II and III

3. Situation where anterior counter of maxilla is obscured in lateral cephalograms, measurement done using point A2 can be reliable alternative.

4. Point A3 is the least reliable alternative to point A in all groups for determining sagittal jaw relationship.

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