Assessment of Anteroposterior Skeletal Jaw Relationship Using Maxillo-Mandibular Planes Angle Bisector (mm°) in our selected Chennai City Population

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CERTIFICATE

This is to certify that the dissertation entitled as **"ASSESSMENT OF ANTEROPOSTERIOR SKELETAL JAW RELATIONSHIP USING MAXILLO-MANDIBULAR PLANES ANGLE BISECTOR (MM°) IN OUR SELECTED CHENNAI CITY POPULATION** done by **Dr.A. EDEINTON ARUMUGAM,** Post Graduate student, M.D.S, Branch V - Orthodontics, Saveetha Dental College and Hospitals, Chennai submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfilment for the M.D.S. degree examination in February 2005, is a bonafide research work done under our guidance and supervision.

Dr. R. Rajagopal,
Professor & Head of the Department,
Department of Orthodontics,
Saveetha Dental College & Hospitals,
Chennai.

Dr. M.F. Baig,
Dean
Saveetha Dental College & Hospitals,
Chennai

Place :

Date :

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INTRODUCTION

The importance of an accurate antero – posterior measurement of jaw relationship is very critical to orthodontic diagnosis and treatment planning. The proper understanding of the skeletal pattern, its role in occlusal development and restriction posed in orthodontic management needs no emphasize.

The skeletal pattern may be analysed clinically by an overall profile view of the patient and by palpation of the anterior surfaces of the basal part of the jaws with the teeth in occlusion. The earliest attempt to study skeletal pattern in orthodontics dates back to 1899 when **E.H. Angle** first put forth the " concept of occlusion " and later formulated the classification of malocclusion based on molar relationship.

Later with the Introduction of Cephalometry in 1931 by **Broadbent and Hofrath** provided a better and more accurate method of recording, measuring and quantifying skeletal morphology.

Various methods of assessing dental base relationship have been formulated. Some focus attention on dental structures, Some embrace a comprehensive dental and skeletal assessment and others even incorporate prediction of growth change.

Downs in 1948 provided a measure of the antero-posterior relationship of the jaws using the angle between a line through points A and B to the facial plane.

Reidel in 1952 used the difference between the angle SNA and SNB to classify the antero-posterior dental base relationship.

Ballards in 1952 introduced a method that relates the lower- incisor mandibular plane angle to the Frankfort mandibular plane angle.

Not with standing the inadequacies of angular measurement in cephalometrics, **Freeman** and **later stoner in 1956** and **Taylor in 1969** demonstrated linear measurement, an evolution in the science of cephalometrics towards a method which will assimilate all diagnostic features for diagnosis and treatment planning and correlate them in a logical manner.

Jacobson in 1975 realising the limitations of point N being used in reference planes, introduced the Wits appraisal, a linear method of measuring the relationship of A point to B point along the functional occlusal plane , a plane bisecting the molar and premolar overbite excluding the incisors in the adult dentition.

However dissatisfaction had grown over the clinical usefulness of this plane. A change of cant of the plane due to growth or treatment progress can lead to a bias in the value between A and B points measured along the plane.

Also, the points used to define the FOP being at close proximity makes identification of landmarks difficult even under perfect condition.

The idea of an occlusal plane substitute was originally suggested by Jenkins, who used the bisector of Frankfort plane and mandibular plane. He related his plane to the Cranial base for subsequent measurements and so incurred inaccuracies when the cranial base was abnormally related to the dental base.

To overcome these limitations Jennifer Hall Scott derived maxillo-mandibular planes angle bisector (MMº), a plane bisecting maxillay and mandibular plane for measuring antero-posterior skeletal relationship.

This plane lies close to but at an angle and inferior to the traditional functional occlusal plane. The main features of this plane are.

1. It doesn't change with growth, even if it does it will change in harmony with dental base change and so will not distort the true relationship between A and B points.
2. As the plane is geometrically derived from the dental base planes it is highly reproducible.
3. It can be defined at all times despite obliteration of the teeth by stainless steel or amalgam.
4. Lying at an angle and inferior to the other occlusal planes, measurement to the MMº bisector is not obscured by the outline of the teeth.

REVIEW OF LITERATURE

Angle (1907)[1] provided one of the first assessments of Jaw relationship Angle classified three main groups ' based on the mesio-distal relations of the teeth., dental arches and jaws which primarily depend upon the positions assumed by the first permanent – molars on their eruption and locking. By assuming that the first permanent molar was stable he reasoned that the relationship between the upper first permanent molar and lower first permanent molar reflected the relative degree of prgnathism or retrognathism of the mandible to the maxilla.But the first permanent molar relationship is very rarely an accurate reflection of skeletal pattern.

Simon (1926)[38] developed a system of gnathostatics, which related the dental arches to the skull using a three dimensional co-ordinate system based on the median sagittal plane, the frankfort plane and the orbital plane. The validity if simon' s classification was questioned by sved (1931) who demonstrated that minor errors in locating the frankfort plane could have a major effect on the orientation of the orbital plane and an its relationship to the teeth.

The introduction of cephalometry by broad bent and hofrath in 1931 provided a method of recording, measuring and quantifying skeletal morphology and relating skeletal factors to occlusion. One of the earliest comprehensive analysis was devised by down (1948,1952,) with the aid of lateral skull radiographs related the maxillay and mandibular dentition to the cranial base Downs provided a measure of the antero - posterior relationship of the jaw using the angle subtended by a line through points A and B from the facial plan.

Ballards (1948)[3] relates the lower incisor – mandibular plane angle to the maxillay – mandibular plane angle. In this method, the maxillay and mandibular incisor are repositioned at standardized angle to the maxillay and mandibular plane. Measurement of the overjet then give the measure of the antero - posterior dental base relationship.

Reidel (1952)[31] suggested that the difference between the angle SNA and SNB was used to classify the antero – posterior dental base relationship. This method has been criticized as points A and B are points on the alveolar process rather than on the dental base. Reidel found angle ANB to have a mean value of 3.4 degree with a range of .5-7 degrees.

Jenkins (1955)[21] Elected to use functional occlusal plane as a reference base for measurements of jaw disharmony. He reasoned that all phases of dentistry traditionally use this plane as a primary plane of orientation, since all masticatory forces are focussed on this plan of intimately related to it. He argued that even Angle used this as a plane of reference for his classical classification of malocclusion. Jenkins established the a plane, drawn through point A at right angles to the occlusal plane, and the then measured from the a plane to point B, gnathion and the mandibular incisor edge. To determine the extent of antero-posterior jaw dysplasia for the different angle classifications, he formulated a range of value for each of these measurements from the plane.

Moorrees & Kean (1958)[24] suggested the registration of the head in its natural position and has the advantage that an extracranial vertical or a horizontal perpendicular to that vertical could be used as a reference plane for cephalometric analysis. Errors introduced by these are small differences and have only a minor effect on the interpretation of facial shape and facial disharmony compared to the errors introduced by the variation in the relationship of landmarks that define the intracranial reference lines.

Harvold (1963)[13] Attempted by using this functional occusal plane to predict growth patterns of the jaws. He projected points A and B onto the occlusal plane and termed the resulting measurements the A-B difference. A negative value is assigned to measurements in which point B is posterior to point A. From age 6-9 years, point B moved forward relative to point A; however, he recognized effect of the inclination of the occlusal plane on the A-B reading, which in extreme cases could change so much that the projection of point B could fall behind point A.

Taylor (1969)[40] also pointed out that the A-N_B angle did not always indicate true apical base relationship. Varied horizontal discrepancies of points A and B could give the same A-N-B measurement because variation in the vertical distance from nasion could compensate for other variation. A relative forward or backward position of nasion would likewise change the A-N-B reading, as would the forward or backward positioning of the maxilla and mandible.

Mills (1970)[22] in his Eastman analyses found variation in the antero - posterior and vertical portion of nasion will affect angle ANB, the significance of which varies according to the size of angle SNA.A method of adjustment is interpreted into the eastman analysis to compensate for variations in angle SNA for every degree SNA is greater/lesser than 81 degrees. Half of a degree is subtracted/added from to the original ANB angle.

Edward J. Beatty (1975)[4] demonstrated a revised method of establishing apical base relationship. He introduce an angular measurement and a number of linear measurement which originate from more stable landmarks. He used point D(the cross section of the symphysis of the mandible) as a reference point which was originally introduced by steiners. To overcome the inaccuracies caused by the change in position of the nasion, a geometric perpendicular was extended from point A to frankfort horizonal with "X" marking the point of intersection. A line was then extended from point B to X forming the angle AXB which provide data similar to the ANB measurement but eliminates the problem of nasion.

The ANB different is not always an accurate method of establishing the actual amount of apical base divergence. In addition to the geometric shortcomings previously pointed out, the results of this study indicate that the ANB landmarks are subject to growth and treatment mechanics which cause corresponding variations in the measurements used.

This study demonstrated conclusively that angular measurements cannot compensate for divergence of apical bases resulting from variations in vertical facial height. For this reason, a set of linear measurements was proposed which would offer an accurate method of evaluating the pre-and post-treatment change-taking place.

Jacobson (1975, 1976)[15] He found out relating the jaws anteroposteriorly to the cranial reference plane presents inherent inconsistencies because of variations in craniofacial physiognomy. The rotational effect and the anteroposterior positions of the jaws relative to the anterior cranial base will effect the true dental base relationship. In an attempt to eliminate the inherent variations and problems associated with relying on A-N-B, the author suggested an alternative method of assessing sagittal or A-P jaw relationship which is independent of apical base relationships to cranial landmarks.

The method entails projecting Points A and B perpendicularly onto the functional occlusal plane. The points projected onto the occlusal plane are identified as AO and BO respectively. The measured distance between these points on the occlusal plane is termed the Wits appraisal. In the original study on Caucasian adults with excellent occlusions, points AO and BO in females coincided, the reading consequently being zero. In male subjects points BO is approximately 1 millimeter anterior to point AO, the Wits reading thus being –1 millimeter.

In Class I type malocclusions, points AO and BO generally tend to coincide on average; in class 11 type skeletal dysplasia, point Bo is posterior to point AO (positive value in millimeters); and in class 111 skeletal disharmoneies, point BO is forward of point AO (negative Wits reading).

Jacobson (1976)16 States that traditionally, the occlusal plane is extended from the cuspal image overlap of the first molars to the middle of the incisor overlap. However, because of the possible incisor supra or infra eruption in malocclusions, a more appropriate plane would be a representative functional occlusal plane drawn through the cuspal overlap of the maxillary first molars and first bicuspids. In the event of a vertical discrepancy between the left and right side of the posterior teeth, a plane is drawn midway between the two posterior segments. In the mixed Dentition, a horizontal plane can usually be drawn through the overlap of the cusps of both deciduous molars and the permanent first molars.

Guido Ferrazzini (1976)[11] determined what other factors depended on the form and structure of the cranium, influenze the ANB angle, besides the antero – posterior distance of the apical base that the ANB angle must measure. He demonstrated both in an empirical manner and in a geometric – mathematical manner and stated that the ANB angle depends not only on the antero posterior relationship of the jaw bones but also on the maxillary inclination and maxillary pragnatism and slightly on the facial dimensions. Faces having the same antero posterior value for the jawbones can have very different ANB angles and vice versa.

He stressed in clinical practice too much importance should not be given to the ANB Angle nor should it be considered the absolute measurement of the antero posterior relationship of the jaws rather it should be judged always in respect to the other variables which have been cited.

Samir E. Bishara, MS Julie, Large Peterson (1983)[5], evaluated the changes in the ANB angle and the Wits appraisal between the ages of 5 and 25 years in twenty male and fifteen female subjects, who had clinically acceptable occlusions and none had undergone orthodontic therapy. The conclusion derived from the investigation are as follows: (1). No significant differences were observed in the changes between male and female subjects for either ANB or Wits between age 5 and adulthood (2) The ANB angle changes significantly with age, while the Wits appraisal indicates that the relationship between points A and B does not change significantly with age.

These findings explain the discrepancies that are present in some cases between the measured values are relatively low.

These findings explain the discrepancies that are present in some cases between the measured values of the ANB angle and the clinical judgment of the orthodontist. For a more accurate diagnosis of the anteroposterior apical base relationship, both the ANB angle and Wits appraisal should be used.

Houston W.J.B. (1983)[14] analysed errors in orthodontic measurements. The sources of error in cephalometric measurement and their analysis were discussed. Random errors are important in the evaluation of individual radiographs and a measurement that has a high error in relation to its total variability will be of little value in clinical assessment. Judicious replication of measurements can be important in the control of random errors.

Without adequate error evaluation, the results will be of limited value because it will not be possible to distinguish the apparent effect or the biased measurement.

Showfety K.J. et al (1983)[37] devised a simple method for taking natural-head position cephalograms. It was concluded that sella-nasion to vertical angulation, which is a reflection of natural-head posture, can be reliably determined and recorded with cephalometric radiography combined with a simple fluid level device and standardized technique

Wolform Hussles, Ram’s Nanda (1984)[26] have found out cephalometric analysis based on angular and linear measurements have obvious fallacies but the clinical application of such an analysis by the orthodontic profession in treatment planning is widely accepted.

In his analysis of factors affecting angle ANB, in class I relation (Wits = 0) a mathematical formula has been developed which enables the authors to study the geometric influence of angle ANB caused by following four effects.

1. Rotation of the jaws and or occlusal plane relative to the anterior cranial base.
2. Anteroposterior position of N relative to point B.
3. Vertical growth (distance N to B).
4. Increase in dental height (distance A to B).

He also concluded the cant of the occlusal plane is subjected to growth changes independent of the forward or backward jaw rotations.

Seppo Jarvinen Dr. Odont. (1985)[19] conducted a study in 138 Orthodontically untreated children from 7 to 15 years of age with Class I, Class II, or Class III (angle) malocclusion. The result revealed that a part of the variation of the ANB angle could be attributed to factors other than the actual apical base difference, among these factors being the rotation of the S-N Plane, the relative length of the S-N plane, and the rotation of the jaws. Because the ANB angle can vary without any marked abnormalities in the sagittal jaw relationship, the use of the so-called normal limits for the ANB angle is not justified. It would be better to replace the ANB angle with a more accurate indicator.

Seppo Jarvinen (1986)[20] studied that if the ANB angle is used in cephalometric analysis, its individual nature should be recognized. He find out approximately 63% of the variation of the ANB angle could be explained by the variation of the SNA and NSL/NIL angles. In his regression analysis he produced a list of floating norms of the ANB angle for different facial types.

Savage A.W. et al (1987)[35] compared cephalometric landmarks directly determined visually from bony anatomy on lateral cephalometric radiographs and compared with geometrically constructed cephalometric landmarks for repeated measures of reliability of identification. The level of observer experience and the quality of cephalogram were statistically unrelated to landmark variability on replicate examination. The geometrically constructed landmarks were not statistically different.

Hong-Po Chang et al (1987)[8] have found out that both angular and linear measurements have been proposed in the assessment of sagittal jaw relationship. Many distorting factors may influence the validity of evaluating this relationship. He concluded that many distorting factors affect the validity of the ANB. The Vertical position of point A or B in relation to nasion also affects the ANB angle value, variation in the spatial positions of nasion horizontally and or vertically is a normal anatomic occurrence.Thus the anterior posterior relationship of the jaws is not always accurately indicated by the ANB angle reading.

P.J Sandler (1988)[34] Evaluated the errors involved in taking linear and angular measurement using three different methods; Hand instruments on tracings, digitization of tracings, and direct digitization of the radiographs. Traditional methods of measurement using a ruler and protractor compared well with computer based methods involving the digitizer. it was concluded that hand measurement, if done carefully, compare reasonably well with methods involving the digitizer, and there is no reason why results using traditional methods should be considered any less valid.

Direct digitization was notably unreliable with linear measurements involving bilateral structures such as Gonion and Articulare. When using this point for linear measurements construction of tracing is the method recommended.

Todd A. Thayer, DDS (1990)[41] Studied the effects of functional versus bisected occlusal plane on the Wits appraisal in lateral cephalometric radiographs of 35 males between the ages of 11 years and 24 years. From the results of this experiment he concluded as follows.

1. Either occlusal plane can be used in the calculation of the Wits appraisal to aid in the diagnosis of the severity or degree of anteroposterior jaw disharmony.
2. The bisected occlusal plane Wits appraisal value showed a higher relationship to dental measures than the functional occlusal plane Wits appraisal value. The functional occlusal plane Wits value shared slightly more variance with skeletal measures. (i.e., angle ANB)

Anthony D. Viazis (1991)[2] developed a cephalometric analysis based on natural head position. This analysis defines the antero-posterior and vertical position of the maxilla and mandible relative to true horizontal plane than relates the position of the dentition to its skeletal substrate only two soft tissue measurements are used.

D. Millett, J.E, Gravely, (1991)[25] evaluated the reliability and validity of four methods of assessing skeletal pattern (Reidels Method, Eastmans Correction, Ballard's method, and 'Wits' analysis) from cephalometric tracings have been examined, and the levels of agreement between them investigated. There is a strong correlation between the four methods of assessing skeletal pattern considered: The correlation being significant at the 0.1 percent level of probability, suggesting that the four analyses are intimately related. The simplest method of assessing the anteroposterior dental base relationship is Reidel's method.

The two linear analysis (Ballard's method and Wits analysis) correlate very closely with each other, but both correlate poorly with the East man analysis. The Wits analysis is reputedly unreliable due to the unreliability of identifying the occlusal plane.

Riccarda Rush ton, Alec M. Gohen Alfred D. Linney (1991)[33] Analysed the errors and variations in the Wits analysis and the angle ANB using computer simulation. It is noted in the study that the largest errors in landmark location was in functional occlusal plane (FOP) despite guidelines laid down by jacabson as much as plus or minus 5 errors occurred in the angulation of this plane. This was the cause of large variation in the Wits value with a magnitude of I m or more. They conluded that small errors in location of FOP have very much greater effect on the Wits value than small errors in A, B or N on angle ANB. Both angle ANB and Wits in functional occludes plane much be viewed and assessed with caution.

Husamettin Oktay, (1991)[29] studied the relationship among ANB, Wits, AF-BF and APDI measurements used in the assessment of the anteroposterior jaw relationship on cephalometric radiograph of 63 male and 82 female subject and he found high correlations were found among them.

Tony T.H. Tng, C.K. Chan, Michael S. Cooke Urban Hoyg, (1993)[42] conducted a study to quantify the effect of head posture changes in the commonly used sagittal angular measures SNA, SNB and SNP pogonion. They Conclude.

1. Changes in head posture effect the measurements of the angles SNA, SNB and SNPg.

2. Overall, upward and downward rotation of the head produce under estimations of these angles by approximately 1°.
3. For the SNB and the SNPg angles these differences have both statistical and clinical significance, whereas for the SNA angle the difference
4. Head posture needs to be standardized during cephalometry.

M.S. Farina (1994)[10] investigated the effect of mandibular plane angulations on ANB and Wits measurement. The study was based on pretreatment orthodontic records of 37 females and 23 males white subjects between the ages of 11 and 16 years. They conducted this study on three groups. Group I I high angle (SN – GoGn grater than 38); group II; average angle (SN – GoGn 28 to 38); group III low angle (SN – GoGn less than 28).

He concluded that the ANB measurements were significantly effected by the mandibular plane angle specifically in the high angle group the Wits measurements however were consistent in all the three groups and not significantly effected by mandibular plane angulations

S.B. Murugesh et al (1995)[23] studied the variations in the inclination of sella-nasion and Frankfort horizontal plane to true vertical in natural head position cephalograms of ideal subjects. It was concluded that both intra cranial reference planes (SN and FM) showed high degree of individual variability while the true horizontal plane was found to be least variant. According to them true horizontal in NHP is probably the ideal reference plane for assessing a subjects face.

Timothy f. Foley, David L. Stirling, Jennifer Hall-Scott, (1997)[12]**,** evaluated the reliability and validity of three anteroposterior skeletal measurements using the maxillary-mandibular (MM°) Bisector, the functional occlusal plane (FOP), and the bisected occlusal plane (BOP) as reference planes in the assessment of antero-posterior discrepancies.

The conclusions derived form this investigation are as follows :

1. The MM° Bisector is a more reproducible reference plane, compared with the BOP or FOP.
2. The MM° Bisector provides a stable reference plane that shows no significant change during growth and treatment, compared with the BOP and FOP.
3. The validity of the MM° Bisector A-P measure is supported by the fact that is reflects growth and treatment changes described by the ANB angle. The stronger correlations seen between the ANB angle and the MM° Bisector, compared with the BOP or FOP Wits measures, reinforce its validity.
4. The MM° Bisector A-P measure, when used in association with the ANB angle, provides a more reliable and valid indicator of the skeletal antero posterior relationships of the jaws, especially during treatment, than the Wits appraisals made with either the FOP or BOP

Biljana Trpkova; Paul Major, Narashima Prasad, Brich Nebbe, (1997)[30] assessed the magnitude of cephalometric landmarks identification error through meta analysis on six pertinent studies. In this analysis they concluded the mean errors and 95% confidence intervals for total error of 15 cephalometric landmarks are presented. The landmarks B, A Ptm, S, and Go on the x coordinate, and Ptm, A and S on the y coordinate presented with insignificant mean error and small value for total error.

Therefore these landmarks may be considered to be reliable for cephalometric analysis of lateral head films. The results of this investigation emphasize the importance of critical interpretation of cephalometric measurements and careful selection of landmarks for cephalometric analysis.

Sleeva Raju et al (2001)[39] Presented a modified approach to capture the true vertical reference line on the patient's face itself in NHP which is then transferred to the conventional lateral cephalogram.

SUMMARY AND CONCLUSION

From the Study Conducted it can be concluded that,

- The MM^0 bisector is easier to define, and the measurements made to it is more accurate and less varied than that of functional occlusal plane.
- It can be defined at all times despite obliteration of the teeth by stainless steel or amalgam
- The wits appraisal measured to MM^0 bisector when used in association with the ANB angle, provides a more reliable and valid indicator of the skeletal antero–postesior relationship of the jaws than the wits appraisal made with FOP.
- Mean Values for the wits assessment made to the MM^0 bisector were found to be approximately - 3.8 mm (-4mm for male -3.5 mm for female) for our selected Chennai city population.
- The observed mean value for wits appraisal on MM^0 bisector in our selected Chennai city population is concurrent with the existing norms derived by Jenniffer Hall Scott in Caucasian population.

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