A Review

Cephalometeric Assessment of Sagittal Discrepancy: A Review

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Abstract

Cephalometrics play a integral role in orthodontic diagnosis and treatment planning especially for sagittal skeletal discrepancies. Most patients are concerned about anteroposterior discrepancy, hence has received maximum attention in orthodontics. Therefore, number of analyses has been proposed over the years with varying degrees of reliability and success in assessing sagittal jaw relationships. It is absolutely essential that a clinician be aware of a range of analyses to be used in different situations. This review is to discuss various cepahlometric angular and linear geometric parameters for assessment of sagittal jaw relationship

Keywords: Sagittal dysplasia, Anteroposterior discrepancy, Cephalometric analysis, Antero-posterior dysplasia, Sagittal skeletal dysplasia, Cephalometric parameters, Sagittal discrepancy

Precise diagnosis and treatment planning is the main hallmark of orthodontic treatment, and an inaccurate diagnosis may lead to unacceptable results.[1] The sagittal jaw base relationship is one of the essential criteria for orthodontic diagnosis. Initially, diagnosis in the sagittal plane was based on the first permanent molar relationship by E. H. Angle which gives only dental anteroposterior relationship.[2] It is also essential to be interpreted clinically by visual profile analysis or the two-finger method by Foster.[3] As these carry the drawback of a false diagnosis; thus a confirmation by lateral cephalometric radiograph is vital. Several cephalometric linear and angular measurements have been devised to overcome this problem, which can give accurate, reliable and reproducible results.

The purpose of this review is to discuss various cephalometric angular and linear geometric parameters for assessment of sagittal jaw relationship in chronologic order and their clinical implications in contemporary orthodontics.

There are various linear measurements and angular measurements given for assessing the sagittal skeletal jaw relationships. The first attempt to describe the anteroposterior jaw relationship was proposed by Wylie in 1947,[4] which was followed by many authors who started developing new measurements for sagittal skeletal discrepancy, this was a linear measurement. The advantage of using linear measurements is that they are more accurate, and there are less errors of measurement because they involve only two reference points, as compared to the angular measurements which include three reference points. Angular measurements have a wider range of coverage, but they are affected by jaw proclination and changes in facial height. Linear measurements are affected by inclination of the reference lines.

The first angular measurement for anteroposterior dysplasia was given by Downs (A-B plane angle)[5] in 1948. Later, several authors reported various linear and angular measurements for making better diagnosis and treatment planning of anteroposterior skeletal discrepancies. A list of linear measurements include Wylies method,[4] Jenkin's A plane,[6] AB linear distance(Taylor),[7] A-D' distance (Beatty),[8] Wit appraisal(Jacobson),[9] Quadrilateral analysis(Di Paolo),[10] maxillo-mandibular differential (Mc Namara),[11] AF BF distance (Chang),[12] APP BPP distance(Nanda, Merill),[13] overjet predictor(Zupancic),[14] Dentoskeletal overjet (AL Hammadi),[15] Yen linear (Sandeep Shetty).16 Angular measurements include AB plane angle

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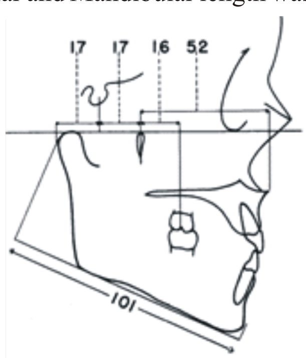
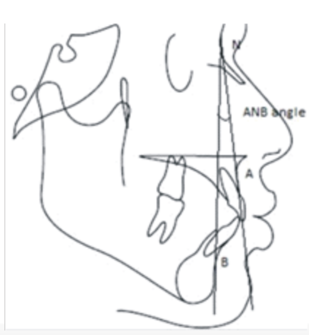
(Downs),[5] ANB angle,[17] APDI(Kim, Vietas),[18] AXB angle (Freeman),[19] JYD angle (Jarvinen),[20] FABA(Yang, Suhr),[21] β angle (Baik, Ververidou),[22] μ angle (Fattahi),[23] Yen angle(Neela et al.),[24] W angle (Badh et al.).[25] Pi analysis (Kumar et al.)[26] SAR angle(Sonahita aggarwal),[27] HBN angle (Harsh Bhagvatiprasad)[28] includes both linear and angular measurements.

Wylie et al.[4] found that there is no single entity as normal facial pattern, and dentofacial anomaly is measured by random combination of facial parts produce a condition called "dysplasia." He made an attempt to group such kinds of dysplasia by five linear measurements which helps to localize the site of dysplasia. Method of measurement- glenoid fossa to sella, sella to PTM, PTM to ANS (maxillary length), PTM to buccal groove of upper first molar and Mandibular length was measured by dropping the perpendicular from posterior point of condyle and pogonion to tangent to lower border of the mandible. It is a quantitative method for assessing sagittal dysplasia. The location of dysplasia can be easily identified, but the standard values were based on 11.5 years aged children, thus it was not adaptable for all ages

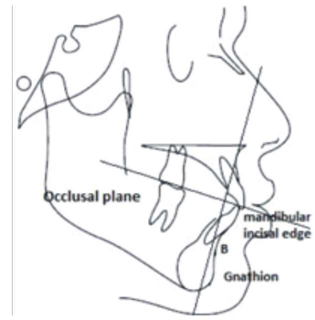


Downs[5] described the A-B plane angle in 1948 as a means to assess the anteroposterior apical dysplasia. He used points A and B to form AB plane and N-pog as facial plane and formed an angle to assess the relationship of the anterior limit of denture base to the facial profile. He used Nasion as reference point, as Nasion may alter its position vertically and horizontally during growth. It is an indicator for obtaining correct axial inclination, overjet, and overbite after orthodontic therapy.

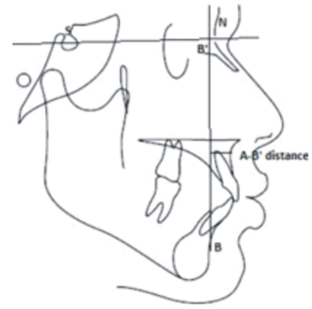
Riedel[17] in 1952 introduced ANB angle which was included as one of the skeletal parameters in Steiner's analysis. It is the angle between the lines NA and NB. It denotes the relative position of the maxilla and mandible to each other. It is highly reliable if the values are close to average values. But if the values are high, it cannot describe whether the discrepancy is in the maxilla or the mandible. It also uses nasion as a reference point which changes its position during growth.



Jenkin[6] introduced 'A' plane in 1955. According to Jenkins, the functional areas of the head are the cranial area and the masticatory area which lie between the Broadbent's Bolton plane and the occlusal plane. The fifth nerve musculature has its origin in the cranial area and attachment in the masticatory area. It is in the masticatory area where the main orthodontic deformity is manifested. The functional plane of this area is the occlusal plane. Jenkin considered the occlusal plane as the most desirable reference plane. In this, 'A' plane is drawn at a right angle to the occlusal plane on point A. Linear measurements are measured from point B, point Gnathion, and mandibular incisal edge. One disadvantage is that the occlusal plane is very difficult to define.



Taylor[7] reported the A-B' distance in 1969. He concluded that the changes in relative position of nasion to point A and B influence the ANB angle, and the ANB difference is not always the true indicator of the apical base relationship. Thus, he introduced the linear distance between point A and point B. Line B' is the line drawn perpendicular from SN plane to point B, and distance of point A from this line is measured as A-B' distance. It is used for comparing the changes in the position of point A and B before and after treatment. The A-B' distance provides a more accurate assessment of changes taking place at points A and B; but, point B is not reliable, as it changes after treatment.



Beatty[8] introduced AXD angle and A-D' distance in 1975. According to Beatty, Point B and Nasion point change during growth and treatment, and hence they are not reliable. He used point D- the center of bony symphysis. He introduced the AXD angle, which is the angle formed between AX and XD. Since angular measurements cannot compensate for divergence of the apical bases, a set of linear measurement (A-D' distance) was proposed which offers an accurate method of

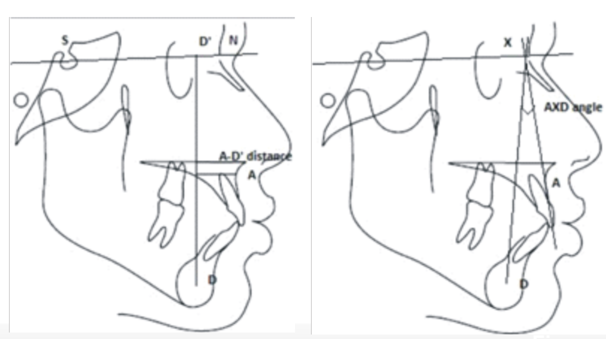
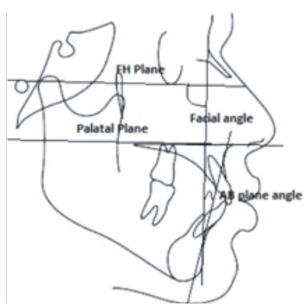


Figure-1

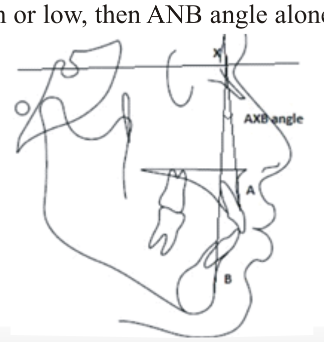
evaluating pre and post treatment changes. A-D' distance is measured in millimeters from point A to D' where D' is the line drawn perpendicular from D to SN plane. A-D' distance provides an accurate measurement of pre and post treatment changes; however, the disadvantage is that the SN plane is not a reliable reference plane as it is used.

Jacobson[9] reported Wits appraisal in 1975. It is a measurement of the extent to which jaws are related to each other anteroposteriorly. In this, perpendiculars are drawn from point A and point B onto occlusal plane through the region of maximum cuspal interdigitation and are labelled as AO and BO. In this, the reference plane common to both jaws is used so that the effects due to clockwise /anticlockwise rotation of jaws are also predicted. A low Wits appraisal reading is not considered to be correctly identified, as sometimes it is affected by the posterior vertical dimension, ramus width or occlusal plane may be not identified etc.

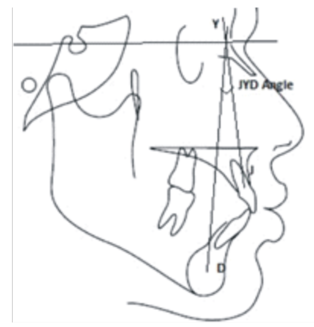
Kim and Vietas[18] in 1978 described APDI (AnteroPosterior Dysplasia Indicator). According to them, unanticipated anteroposterior interarch changes occur during and after orthodontic treatment. For example, a Class I molar relationship may shift to Class II, or Class III which cannot be attributed to the mechanics utilized; and Class II malocclusions may shift during treatment into easily treated Class I relationships. So, when related to molar displacement, a combination of cephalometric measurements may produce a higher correlation value than any singular measurement. APDI reading is obtained by a combination of the facial angle, palatal plane angle, and AB plane angle, it also provides an anteroposterior relationship of dentition rather than jaws.



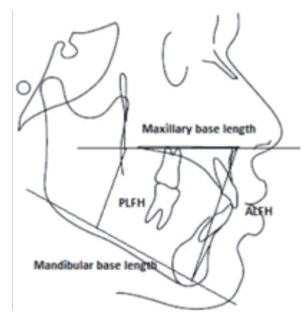
Freeman[19] reported the AXB angle in 1981. He found that the ANB angle is reliable when SNA is in normal or close to normal range, and if it is high or low, then ANB angle alone can be the very misleading. Thus, he eliminated point N and constructed point X which is formed at a line perpendicular from point A to FH plane. Lines drawn from point X to point A and point B form the AXB angle. A disadvantage is that point B which changes its position is not eliminated here.



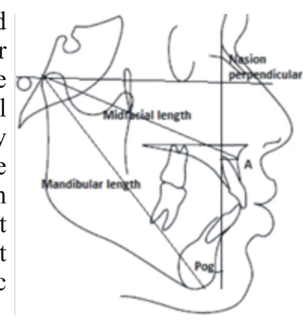
Jarvinen[20] reported the JYD angle in 1982. He used two analogous points, J and D, to determine the apical bases. Point J is the center of the cross-section of the anterior body of the maxilla, and point D is the center of the cross-section of the body of mandibular symphysis. Point Y is the point of intersection of the SN plane and is perpendicular from the SN plane through point J. The JYD angle is formed by the intersection of lines joining from points J and D to point Y. Point A and point B are eliminated, as the accuracy of the location of points is questionable, and points J and D are used. Facial prognathism cannot affect the JYD angle as nasion is not used here, but it is affected by jaw rotation and anterior facial height.



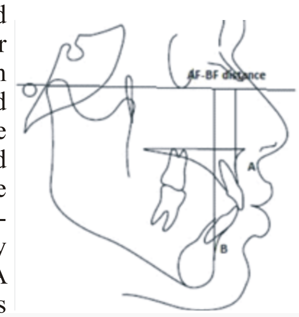
Di Paolo et al.[10] in 1983 described quadrilateral analysis. It attempts to identify skeletal dimensions in size and position in both horizontal and vertical dimensions regardless of dentoalveolar relationships. This analysis is based on the concept of lower facial proportionality which states that in a balanced facial pattern, there is 1:1 proportionality between maxillary and mandibular length, and the average of anterior lower facial height and posterior lower facial height equals these denture base lengths. It is used to detect the extent and direction of skeletal dysplasia in millimeters. It is used in planning of surgical orthodontics.



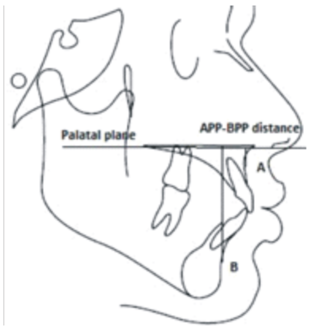
McNamara[11] in 1984 reported the maxilla-mandibular differential. He described the relationships of jaws and cranial base structures to one another by relating the maxilla and mandible to the cranial base. It is used in serial films to evaluate treatment results. It is complex and not beneficial for minor orthodontic correction procedures.



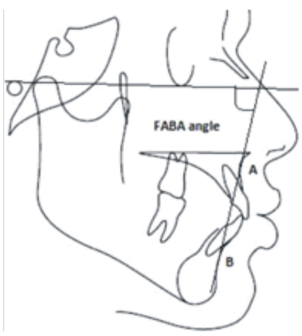
Chang[12] in 1987 described AF-BF distance. It is a linear assessment in which perpendiculars from point A and point B are drawn on the FH plane and measured. They are labelled as AF and BF points, and the distance between them is the AF-BF distance. It is not affected by vertical displacement of points A and B; but, for FH plane, Porion is very difficult to identify exactly.



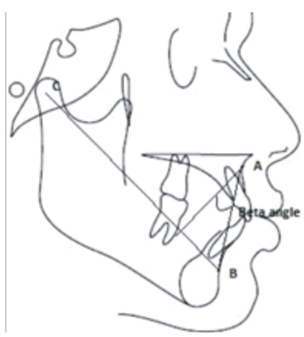
Nanda and Merill[13] in 1994 described APP-BPP distance. It is a linear distance measurement based on the palatal plane. In this, a perpendicular line is drawn from point A and point B to the palatal plane i.e., APP-BPP. Palatal plane is used here which is stable throughout the growth period, and it is in close proximity to the area under consideration. There is no significant difference in APP-BPP measurements between Class I, Class II division 2, and Class II subdivision cases.



Yang and Suhr[21] in 1995 reported FABA. According to them, the skeletal sagittal aspect can be described more adequately by the angles between the craniofacial reference planes and the AB plane which are supplemented by consideration of both horizontal and vertical distances between points A and B concurrently. The vertical relationship between points A and B seems to affect anteroposterior jaw dysplasia as well as the facial profile. In this, a line is drawn to the FH plane by joining points A and B, and the inner angle formed is FABA. As more than two points are taken into account, it may be affected by change in position of one point.



Baik and Ververidou[22] in 2004 introduced the beta angle (β). It does not depend on any cranial landmarks or dental occlusion. It uses three skeletal landmarks: point A, point B, and point C (apparent axis of the condyle). The β angle is formed by the angle between the line from point A perpendicular to C-B line and A-B line. It is unaffected by rotation of the jaws and is used in serial evaluation of the orthodontic treatment plan and changes in sagittal relationship during treatment. Disadvantage related to this angle are that point A is affected by tooth movement, and point C is very difficult to mark in a lateral cephalogram.



Fattahiet al.[23] in 2006 described the μ angle. It uses three skeletal landmarks: point A, point B, and a perpendicular line from point A to the mandibular plane. This angle is formed between the AB line and the perpendicular line from point A to the mandibular plane. It is more sensitive and specific than the beta (β) angle. Determination of the mandibular plane is easier, and the quality of the radiograph does not influence this plane; however, points A and B are affected by tooth movement.

Overjet as a predictor of skeletal dysplasia was reported by Zupancic et al.[14] in 2008. Overjet is one of the most common and essential measurements in the study of cast analysis. It is used to find the sagittal relationship of the upper and lower dental arches. The cause of large or small overjet can be skeletal, dental, or a combination of both. They showed the correlation of overjet with the skeletal sagittal relationship of the jaws by measuring the distance between the incisal edges of the upper and lower anteriors. It is the best predictor in assessing only Class II division 1 malocclusion and not for Class I, Class II division 2 malocclusions and Class III.

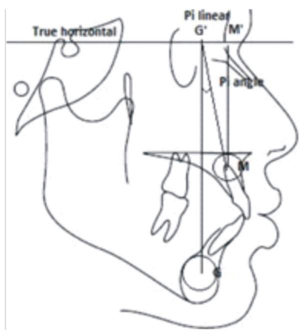
Neela et al.[24] in 2009 developed the Yen angle. Three landmarks used for this angle are points G, S, and M instead of points A and B. It uses more stable points M and G as compared to points A and B. It avoids the use of the functional occlusal plane. The results are highly correlated with ANB angle and Wits appraisal.

Al Hammadi[15] in 2011 reported the dentoskeletal overjet for determining the sagittal jaw relationship. It depends on two basic principles: 1. Dentoalveolar compensation for underlying skeletal base relation 2. Overjet that remains due to incomplete dentoalveolar compensation as a result of large skeletal discrepancy. In this, two points such as incisolabial and incisopalatal line angles and NA and NB lines are used. The main advantage is that the inclination in the functional occlusal plane does not affect the final reading.

Bhad et al.[25] in 2011 introduced the W angle. It uses three landmarks points G, S, and M which are used in the Yen angle measurement. The angle formed between the perpendicular line drawn from point M to SG line and MG line is W angle. It is used in the evaluation of treatment results. In Class II and

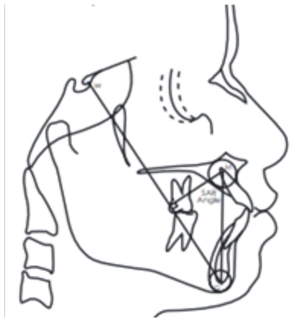
Class III cases, it cannot determine which jaw is prognathic/retrognathic, i.e. whether it is the maxilla or mandible.

Kumar et al.[26] in 2012 introduced pi analysis which includes pi linear and pi angle measurements. He uses the skeletal landmarks M and G, where M is representative of the maxilla, and G is representative of the mandible. A true horizontal line was drawn perpendicular to the true vertical through point Nasion. The true vertical line was the vertical line obtained at the natural head position. Perpendiculars were drawn from points M and G to the true horizontal line which were marked as M' and G.' By connecting the points G'G and G'M, pi angle is obtained which is GG'M. Pi linear is the distance between points G' and M'. The true horizontal plane obtained from a natural head position is more advantageous, as it is more reliable than other reference planes. In Class II and Class III cases, it can determine the problem specifically, i.e., whether in the maxilla or mandible. Pi angle is affected minimally by vertical movement of Nasion.

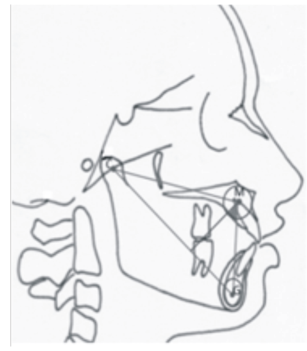


Sandeep Shetty et al.[16] developed the Yen linear in 2013, based on the landmarks used for the Yen angle. In this, the functional occlusal plane is used as the reference plane. The functional occlusal plane is the line passing through the molar and premolar overbite excluding the incisors in the adult dentition. The perpendiculars are drawn from points M and G on the functional occlusal plane and marked as MO and GO. The distance between MO and GO forms the Yen linear values. It does not localize the problem as to whether it is in the maxilla or mandible.

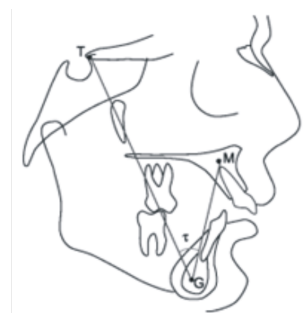
SAR Angle introduced by Sonahita Agrawal et al.[27] (2014) SAR angle is measured between the perpendicular line from point M to W-G line and the M-G line. Mean value was Class I skeletal: 55.98° (SD 2.24), Class II: 50.18° (SD 2.70), Class III: 63.65° (SD 2.25). Advantage was that the Walkers point was found to be stable after the age of five. W-SE remains unchanged in all periods of pubertal growth. The SAR angle is not influenced by growth, jaw rotations, orthodontic treatment or any other factor previously associated with other angles.



HBN angle introduced by Harsh Bhagvatiprasad Dave[28] (2015) It is the angle between line perpendicular from point M to CG and MG. Mean value was Class I skeletal: 39°-46°; Class II: < 39°, Class III: > 46°Advantagewas that the HBN angle does not depend on cranial landmarks or functional occlusion plane and Point A and B. Remain relatively stable even when the jaws are rotated.



Prateek Gupta et al[30](2020) introduced Tau angle for assessment of true sagittal relationship, The Tau angle is constructed by marking three cephalometric landmarks: Point T: Uppermost point at the junction of the frontal wall of pituitary fossa and tuberculum sellae; Point M: Constructed point representing the center of the biggest circle that is tangent to the frontal, upper, and palatal surfaces of the maxilla; Point G: Focal point of the biggest circle that is tangent to the inner frontal, posterior, and lower edge of the mandibular symphysis. Tau angle lies between the two lines connecting T and G points and M and G points. The Tau angle between 28° and 34° suggests a skeletal class I malocclusion; values below 28° show a class III skeletal pattern and above 34° suggest skeletal class II pattern. Tau angle gives a true sagittal skeletal relationship, which depends on stable landmarks and is unaffected by rotation of jaws in vertical dimension due to growth or orthodontic therapy. The T point is one of the most clearly defined structure and stable (100%) landmarks located in the middle cranial base of the skull, yet it requires the assistance of other cephalometric measurements to discern which jaw is at fault.



Pavankumar Ramshran Singh[31] (2021) introduced P angle for saggital relationship establishment. It comprises of three skeletal landmarks-point S, point Gn, point A, i.e., Point S-midpoint or center of sella turcica, Point Gn-the most anterior inferior point of the bony chin or the midpoint between pogonion and menton or the point located perpendicular on mandibular symphysis, midway between the Pogonion and Menton points, Point A (subnasale) it is the deepest midline point on the anterior outer contour of the maxillary alveolar process. The mean value for the P angle in the Class I skeletal pattern group was 53.7° with an SD of 1.86, the

mean values in the Classes II and III skeletal pattern groups were 47.92 and 58.8° with an SD of 1.51 and 1.9, respectively. Its drawbacks are It cannot determine which jaw is prognathic or retrognathic, and may not be very accurate to evaluate treatment progress as the stability of point A is questionable after orthodontic treatment.

DISCUSSION

At present, angle ANB is the most widely used parament due to its simplicity as cephalometric sagittal dysplasia indicators. But, total reliance on angle ANB cannot be recommended due to its demerits. Next is Wits appraisal of jaw disharmony, a linear parameter dependent on the occlusal plane, again has obvious limitations, as it does not cover wide range. The Maxillomandibular differential finds a definite place in cases where myofunctional therapy is contemplated as it helps us to understand whether a skeletal problem is dimensional. The quadrilateral analysis being individualized, and not dependent on established norms, would be an excellent tool in cases with underlying skeletal discrepancies. The Beta angle is claimed to reflect true changes in anteroposterior relationship of the jaws. But it can be affected by errors in locating points A and B, and clockwise rotation of the jaws. Both Yen angle and W angle have eliminated the difficulties in locating points A and B, functional occlusal plane of Wits and condyle axis of Beta angle, thus making it a useful tool in mixed dentition cases also. The Pi analysis defies ease of application and does not seem to offer significant advantages. A recent P angle for sagittal relationship establishment uses point Gn instead of point B, which is affected by remodeling. Accurate anterioposterior measurement of jaw relationship is critically important in orthodontic treatment planning. Due to the large variability in the human population, a single cephalometric analysis may not provide an accurate diagnosis. A different set of cephalometric norms for other ethnic groups should be formulated to guide the orthodontist and surgeon to optimize the treatment plan based on local norms. The best solution would be to apply at least three analyses in each individual case. A thorough knowledge of the various analyses at hand will help the ingenious clinician in choosing the most appropriate ones for each case.

CONCLUSION

Rotational effects of jaws, varying positions of points A and B, nasion, variations in cranial base length, tooth eruption, curve of Spee, etc. seem to have influenced sagittal assessment leading to the use of extracranial reference planes as well. Due to the large variability in human population, a single cephalometric analysis may not provide an accurate diagnosis. The various analyses based on angular and linear parameters have obvious limitations. Hence, it is commanding that a clinician be aware of a range of cephalometric analyses to be used appropriately as the need arises.

REFERENCES

1. Barnett D.P. Variations in the soft tissue profile and their relevance to the clinical assessment of skeletal pattern. Br J Orthod, 1975;2: 235-8.
2. Angle, E.H., Malocclusion of teeth. 7th ed. Philadelphia; The S.S. White Dental Co. 1907.
3. Foster TD. A textbook of orthodontics. 2nd ed. Oxford: Blackwell Scientific Publication; 1985.
4. Wylie W. The assessment of anteroposterior dysplasia. Angle Orthod 1947;7:97-109.
5. Downs WB. Variations in facial relationship: Their significance in treatment and prognosis. Am J Orthod 1948;34;812-40.
6. Jenkins DH. Analysis of orthodontic deformity employing lateral cephalostatic radiography. Am J Orthod 1955;41;442-52.
7. Taylor CM. Changes in the relationship of Nasion, point A and point B and the effect upon ANB. Am J Orthod 1969;56;143-63.
8. Beatty EJ. A modified technique for evaluating apical base relationships. Am J Orthod 1975;68;303-15.
9. Jacobson A. The “Wits” appraisal of jaw disharmony. Am J Orthod 1975;67;125-38.
10. Di Paolo RJ, Philip C, Maganzini AL, Hirce JD. The quadrilateral analysis: An individualized skeletal assessment. Am J Orthod 1983;83;19-32.
11. McNamara JA Jr. A method of cephalometric evaluation. Am J Orthod 1984;86:449-69.
12. Chang HP. Assessment of anteroposterior jaw relationship. Am J Orthod Dentofacial Orthop 1987;92;117-22.
13. Nanda RS, Merrill RM. Cephalometric assessment of sagittal relationship between maxilla and mandible. Am J Orthod Dentofacial Orthop 1994;105;328-44.
14. Zupancic S, Pohar M,Farcnik F, Osvenik M. Overjet as a predictor of sagittal sketetal relationships. Eur J Orthod 2008;10;269-73.
15. AL-Hammadi. Dentoskeletal overjet: A new method for assessment of sagittal jaw relation. Aust J Basic Appl Sci 2011;5:1830-6.
16. Sandeep Shetty, Akhter Hussain, Parag Majithia, Suhail Uddin. YEN – linear: A sagittal cephalometric parameter. Journal of World Federation of Orthodontics, 2013;57-60..
17. Riedel RA. The relation of maxillary structures to cranium in malocclusion and in normal occlusion. Angle Orthod 1952;22;140-5.
18. Kim YH, Vietas JJ. Anteroposterior dysplasia indicator: An adjunct to cephalometric differential diagnosis. Am J Orthod 1978;73;619-33.
19. Freeman RS. Adjusting A-N-B angles to reflect the effect of maxillary position. Angle Orthod 1981;51;162-71.
20. Jarvinen S. The JYD angle. A modified method of establishing the sagittal apical base relationship. Eur J Orthod 1982;4;243-9.
21. Yang SD, Suhr CH. F-H to AB plane angle (FABA) for assessment of anteroposterior jaw relationships. Angle Orthod 1995;65(3):223-31.
22. Baik CY, Ververidou M. A new approach of assessing sagittal discrepancies: the beta angle. Am J Orthod Dentofacial Orthop 2004; 126:100-5.
23. Fattahi Hr, Pakshir HR, Molaverdi F. A new index for evaluating sagittal jaw relationship in comparison with β angle. A cephalometric study. Shiraz Univ Dent J 2006;7;81-8.
24. Neela PK, Mascarenhas R, Husain A. A new sagittal dysplasia indicator: the Yen angle. World J Orthod 2009;10:147-51.
25. Bhad WA, Nayak S, Doshi UH. A new approach of assessing sagittal dysplasia: The W angle. Eur J Orthod 2013;35:66-70.
26. Kumar S, Valiathan A, Gautam P, Chakravarthy K, Jayaswal P. An evaluation of Pi analysis in the assessment of anteroposterior jaw relationship. J Orthod 2012;39:262-9.
27. Agarwal S, Bhagchandani J, Mehrotra P, Kapoor S, Jaiswal RK: The SAR Angle: A Contemorary Sagittal Jaw Dysplasia Marker. Orthod J Nep. 2014;4(2):16-20
28. Dave HB, GlII V, Rai D, Reddy YNN. The HBN Angle. J Ind Orthod Soc. 2015;49(2):79-84.
29. Parvez H. et al. A new cephalometric tool W angle for the evaluation of anteroposterior skeletal discrepancy in orthodontic patients. Int J Dent Health Sci 2014; 1(3):299-304.
30. Gupta P, Singh N, Tripathi T, et al. Tau Angle: A New Approach for Assessment of True Sagittal Maxillomandibular Relationship. Int J Clin Pediatr Dent 2020;13(5):497–500.
31. Singh PR, Ambekar AS, Kangane SK. A novel diagnostic tool for sagittal jaw relationship: The P angle. Int J Orthod Rehabil 2021;12:58-63