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DECIDING MOST IDEAL SAGITTAL DYSPLASIA INDICATOR- A COMPARITIVE STUDY IN NORTH- KARNATAKA POPULATION

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ABSTRACT **AIMS AND OBJECTIVES:-** In orthodontic diagnosis and treatment planning, assessment of anteroposterior discrepancy is of importance to the orthodontist. Both angular and linear measurements have been incorporated into various cephalometric analysis to help the clinician diagnose anteroposterior discrepancies and establish the most appropriate treatment plan. Hence the present study is designed to compare various sagittal discrepancy indicators in North- Karnataka population.

MATERIALS AND METHODS:- The sample was screened from the old records of the Department of Orthodontics and dentofacial orthopedics, AME's Dental College and hospital, Raichur and from other colleges of North- Karnataka region. 90 pretreatment cephalometric radiographs (18 from each district) were subdivided based on ANB angle and Wits appraisal into skeletal Class I, II, III. Various sagittal dysplasia indicators included in the study are ANB Angle, Wits appraisal, APDI, Quadrilateral analysis, McNAMARA maxillomandibular angle, APP-BPP, BETA Angle, YEN angle, PI angle and W angle where in ANB ANGLE is taken as standard.

The results and statistical analysis were done to determine the more reliable sagittal dysplasia indicator.

CONCLUSION:- According to the study the order of significance is ANB angle, Pi analysis, Yen angle, W angle and Beta angle. So, more than one cephalometric analysis had to be used according to the need to quantify the results.

KEYWORDS : Sagittal dysplasia, Anterioposterior dysplasia, Cephalometric Analysis.

Introduction

With invent of cephalometric radiography in 1931 it became easy to determine jaw relationships in all three different planes i.e Anterioposterior, transverse and vertical planes which in turn helps in orthodontic treatment planning.

The sagittal relationship in orthodontics is given a major concern in diagnosis and therefore needs a critical evaluation. Previously established parameters such as ANB angle[1], Wits analysis[2], Quadrilateral analysis[3], APDI[4], Beta angle[5], Yen angle[6], W- angle[7], and recently introduced Pi- Analysis[8] have been defined and used effectively for the evaluation of A-P discrepancies affecting the apical bases of jaws.

There are obvious shortcomings for both angular and linear measurements which have been comprehensively discussed in literature[9,10]. Horizontal reference planes such as Frankfort Horizontal plane and Sella- Nasion line have been used in determination of jaw dysplasia. Extracranial reference planes have also been used. The importance of this article is to determine most ideal sagittal dysplasia indicator among 10 different indicators in North- Karnataka population.

Materials and Method:

The sample was screened from the old records of the Department of Orthodontics and dentofacial orthopedics, AME's Dental College and hospital, Raichur and from other colleges of North- Karnataka region. 90 pretreatment cephalometric radiographs (18 from each district) were subdivided based on ANB angle and Wits appraisal into skeletal Class I, II, III. Various sagittal dysplasia indicators included in the study are ANB Angle, Wits appraisal, APDI, Quadrilateral analysis, McNAMARA maxillomandibular angle, APP- BPP, BETA Angle, YEN angle, PI angle and W angle where in ANB angle is taken as standard.

Method is the classified cephalometric radiographs are subjected to various analysis used in the study and the results obtained are recorded. The obtained results are compared to the original malocclusion the subject is holding and therefore the frequency of the correct coded analysis from all the radiographs are recorded and then arranged according to the sequence of most frequent occurring analysis to the least frequent analysis. And therefore the conclusion is formulated.

Table 1

SAGITTAL DYSPLASIA INDICATORS	RANGE	MEAN VALUE
ANB ANGLE	2-4^0	2^0
WITS APPRISAL	0-1mm	1mm
APDI	77.61-85.19^0	81.40^0
QUADRILATERAL ANALYSIS		
McNamara ANGLE		Small 20mm Medium 25-27mm Large 30-33mm
APP- BPP	F 5.2 ± 2.9mm M 4.8 ± 3.6mm	
BETA ANGLE	27^0-35^0 Class I ≤27^0 Class II ≥34^0 Class III	
YEN ANGLE	117^0-123^0 Class I ≤117^0 Class II ≥123^0 Class III	
PI ANGLE	GG'M - 8.94^0 ± 3.16^0 G'M'- 8.90 ± 3.56mm	
W ANGLE	51^0-56^0- Class I ≤ 51^0 - Class II ≥ 56^0 - Class III	

Results:-

Table 2

Description	*ANB*	*WITS*	*APDI*	*QA(OR) PA*	*Mc MMD*	*APP-BPP*	*BETA*	*YEN*	*Pi-Angle*	*W-Angle*
Frequency of occurrence compared to original malocclusion	42	24	30	-	-	24	48	12	42	36

From the results obtained we can conclude that the sequence of reliable Sagittal Dysplasia Indicators mostly in all cases are:

Overall :- Beta angle > ANB angle > Pi- angle > W- angle > APDI > Wits > APP- BPP > Yen- angle.

Discussion:-

ANB Angle

When compared to available cephalometric sagittal dysplasia indicators ANB angle (Fig.1) is most widely used[12-14] and accepted due to its simplicity. But when it comes to matter of reliability the above stated reasons itself confines its usage in all cases.

Riedel[1] (1952) discovered ANB angle for evaluating anteroposterior relationship of the maxilla to the mandible. Which is actually popularized by Cecil C Steiner in 1953 in his classic article 'Cephalometrics for you and me'.

As the position of nasion is not fixed during growth [10,12,15,16] (nasion grows 1mm per year), as any deviation at nasion will directly effects ANB angle.[14] Rotation of jaws either by growth or orthodontic treatment can also change ANB angle dimensions.[2]

According to Binder[17] for every 5mm of anterior displacement of nasion ANB angle reduces by 2.5^0, a 5mm of upward displacement of Nasion decreases the ANB angle by 0.5^0 and 5mm downward displacement increases ANB angle by 1^0.

Wits appraisal of jaw disharmony

Wits appraisal (Wits stands for University of Witswatersrand, Johannesburg, South Africa.) discovered by Jacobson[2](1975) intended as a diagnostic aid measures anteroposterior jaw disharmony independent on cranial landmarks on a same lateral cephalometric head film.

According to a study done by Bishara[18] et al Wits appraisal (Fig 2) doesn't change significantly with age. The use of occlusal plane which is a dental parameter, to describe the skeletal discrepancy questions the effectiveness as Occlusal plane which can be easily altered with tooth eruption, dental development as well as by orthodontic treatment[19,20,21]. Reproducing Occlusal plane is not always easy in all cases.

Anteroposterior Dysplasia Indicator (APDI)

Kim and veta[4] (1978), proposed APDI to assess sagittal dysplasia. The APDI reading is obtained by tabulating the Facial angle (FH to NPog) ± the A-B plane angle (AB to NPog) ± the Palatal plane angle (ANS-PNS to FH plane) (Fig.3). mean value is 81.4º ± 3.79. Lesser value indicates disto-occlusion and greater indicates mesio-oocclusion.

Quadrilateral Analysis or Proportional analysis

In 1983, Rocco di Paolo proposed quadrilateral analysis[3] based on theorem in Euclidean geometry that determines the direction, extent and location of the skeletal dysplasia in millimeter measurement which is more understandable in surgical orthodontics than angular measurements. The analysis is follows concept of lower facial proportionality which states that in a balanced facial pattern there is a 1:1 proportionality that exists between the maxillary base length and mandibular base length; also that the average of the anterior lower facial height (ALFH) and posterior lower facial height (PLFH) equals these denture base lengths (Fig. 4)

Maxillary length = mandibular length = ALFH + PLFH/2.

Clinically, the biggest advantage of quadrilateral analysis is that it offers an individualized cephalometric diagnosis (not dependent on established angular or linear norms) on patients with or without skeletal dysplasias.

Mcnamara's Maxillomandibular Differential (1984)

McNamara derieved a method for cephalometric evaluation from the analysis of Rickett's and Harvold. Maxillomandibular differential was calculated by subtracting effective midfacial length from effective mandibular length. First the effective midfacial length, not the actual anatomic length of the maxilla, is determined by measuring a line from condylion (the most posterosuperior point on the outline of the mandibular condyle, to point A. Then, the effective mandibular length is derived by constructing a line from condylion to anatomic gnathion (Fig.5). A geometric relationship exists between the effective length of the midface and that of the mandible. Any given effective midfacial length corresponds to a given effective mandibular length.[30] Ideal maxillomandibular differentials are: small, 20 mm; medium, 25 to 27 mm and large, 30 to 33 mm.

From a clinical standpoint, this analysis is very useful in determining actual dimensional variations of midface/ mandible, thus giving the orthodontist an idea as to whether a skeletal Class II or III problem is positional or dimensional.

APP-BPP Distance

Nanda and Merrill[24] in 1994, proposed APP-BPP linear distance measurement based on claimed advantages of palatal plane (Fig. 6). This perpendicular projection of points A and B to palatal plane (APP-BPP) averaged 5.2 ± 2.9 mm in white women with normal occlusions compared with 4.8 ± 3.6 mm for white men. It increases in Class II and decreases in Class III.

The advantage of this analysis is that it is not dependent on variations of nasion point. The palatal plane is claimed to be more stable by the authors.

Beta Angle (2004)

Baik and Ververidou[5] proposed the Beta angle as a new measurement for assessing the skeletal discrepancy between the maxilla and the mandible in the sagittal plane. It uses 3 skeletal landmarks—points A, B, and the apparent axis of the condyle C—to measure an angle that indicates the severity and the type of skeletal dysplasia in the sagittal dimension (Fig.7). Beta angle between 27° and 35° have a Class I skeletal pattern; a Beta angle less than 27° indicates a Class II skeletal pattern, and a Beta angle greater than 34° indicates a Class III skeletal pattern.

Authors claim that the advantage of Beta angle over ANB and Wits appraisal is that (1) it remains relatively stable even if the jaws are rotated clockwise or counterclockwise and (2) it can be used in consecutive comparisons throughout orthodontic treatment because it reflects true changes of the sagittal relationship of the jaws, which might be due to growth or orthodontic/ orthognathic intervention.

Yen Angle (2009)

Neela et al[6] reported the Yen angle which was developed in the Department of Orthodontics and Dentofacial Ortho- paedics, Yenepoya Dental College, Mangalore, Karnataka, India, and hence its name. It uses the following three reference points: S, midpoint of the sella turcica; M, mid- point of the premaxilla; and G, center of the largest circle that is tangent to the internal inferior, anterior, and posterior surfaces of the mandibular symphysis (Fig. 8). Mean value of 117 to 123º can be considered a skeletal Class I, less than 117º for skeletal Class II, and greater than 123º as a skeletal Class III. The advantage here is that it eliminates the difficulty in locating points A and B, or the functional occlusal plane used in Wits and condyle axis in Beta angle analyses. As it is not influenced by growth changes, it can be used in mixed dentition as well. But, rotation of jaws can mask true sagittal dysplasia here also.

W-Angle

The W angle was developed by Bhad et al.[7] The points S, G and M used in Yen angle is utilised here also. Angle between a perpendicular line from point M to the S-G line and the M-G line is measured (Fig. 6B). Findings showed that a patient with a W angle between 51 and 56º has a Class I skeletal pattern. Patient with a W angle less than 51º has a skeletal Class II pattern and one with a W angle greater than 56º has a skeletal Class III pattern. In females with Class III skeletal pattern, W angle has a mean value of 57.4º, while in males, it is 60.4º and this difference was statistically significant. The authors claim that W angle reflects true sagittal dysplasia not affected by growth rotations.

Pi Analysis (2012)

Kumar S et al[8] have recently introduced the Pi analysis as a new method of assessing the AP jaw relationship. It consists of two variables, the Pi-angle and the Pi-linear and utilizes the skeletal landmarks G and M points to represent the mandible and maxilla, respectively. M point is the center of the largest circle placed at a tangent to the anterior, superior and palatal surfaces of the premaxilla.

G point is the center of the largest circle placed at a tangent to internal anterior, inferior and posterior surfaces at the mandibular symphysis. A true horizontal line is drawn perpendicular to the true vertical, through nasion. Perpendiculars are projected from both points to the true horizontal giving the Pi-angle (GG'M) and Pi-linear (G'-M') (Fig. 6C). The mean value for the Pi-angle in skeletal Class I, II and III are 3.40 (±2.04), 8.94 (±3.16) and 23.57 (±1.61) degrees respectively. Mean value for the Pi-linear (G'–M') is 3.40 (±2.20), 8.90 (±3.56) and ± (2.30) mm, respectively for Class I, II and III groups. The highest level of correlation was obtained for Pi-angle and Pi-linear (0.96).

Conclusion

Literature is filled with attempts to accurately assess antero- posterior discrepancy using different cephalometric analyses with varying degrees of success. 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. Moreover, cephalometrics is not an exact science and the various analyses based on angular and linear parameters have obvious limitations. Hence, it is imperative that a clinician be aware of a range of cephalometric analyses to be used appropriately as the need arises.

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