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To Evaluate the Association between Cranial Base Angle and Malocclusions in Saggital Plane

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Abstract: Introduction: Position of jaws is influenced by the cranial base as evidenced by literature. Various authors have suggested that displacement and growth of cranial base influences position of jaws.

Materials and methods: Lateral cephalograms of 90 patients were taken and a study was undertaken to examine the effect of a cranial base on malocclusion and the effect of different methods of sample grouping on results.

Results: Based on the first method of sample grouping, a significant relation was observed between cranial base angle and malocclusion and opposite result was observed when following the second method of sample grouping.

Conclusion: The method according to which sample is grouped is an important factor in determining the results of the study. In the present study, it had a significant influence on results of the study.

Keywords: ***Cranial base angle, Cephalometric Analysis, Malocclusion, Maxillomandibular Relation.***

1. INTRODUCTION

The sagittal relationship between the upper and lower jaw represent the basic characteristic of a human profile. It is one of the most important criteria assessed during the diagnosis of orthodontic anomalies. In orthodontic diagnosis and treatment planning, a cephalometric radiograph is considered to be a valuable tool. Three planes of discrepancies are commonly described in orthodontics namely, transverse, sagittal and vertical. Of these, the sagittal discrepancies are most commonly encountered in day to day practice. Angular and linear measurements have been incorporated into various cephalometric analyses to help the clinician for diagnosing these anteroposterior discrepancies. Assessing this sagittal relationship is a challenging issue in orthodontics [1].

Cranial base configuration and its influence on inter jaw relationship has been of interest to orthodontists, particularly in relation to facial aesthetics and function. Huxley [2] used dried skulls whereas Bjork [3] used cephalograms to demonstrate the existence of a relationship between cranial base morphology and jaw relationship. The cranial base plays a pivotal role in craniofacial growth both functionally as well as spatially[4], having a major influence on the normal development of orofacial functions such as breathing, chewing, swallowing and development of skeletal malocclusion[5].

The cranial base extends from the foramen caecum anteriorly to the basioccipital bone posteriorly with Sella turcica dividing the cranial base into anterior (sell $_{to}$ nation) and posterior (sell to basion) parts. The maxilla and mandible articulate with different limbs of the cranial base, and hence the difference in configuration of cranial base influences their position as well. The angle at birth is approximately 142^0 but then reduces to 130^0 at 5 years of age. In studies conducted by Scott[6], Melson[7], Ohtsuki *et al.*[8] it has been found that cranial base angle becomes stable between 5 and 7 years of age and does not change after that.

The correlation between two entities has been investigated and conflicting results have been obtained.Also, various studies have been conducted by first grouping the sample on basis of various skeletal parameters and then measuring the cranial base angle in these groups but fewer studies have been conducted using cranial base angle for grouping the sample and then assessing the skeletal parameters for different groups.

Thus this study was conducted to find whether any relationship existed between cranial base angle and various malocclusions following two methods of sample grouping.

MATERIAL AND METHODS

The study was carried out on the patients received in the Out-Patient Department of the Department of Orthodontics & Dentofacial Orthopaedics, Government Dental College & Hospital, and Srinagar. The sample for this study consisted of 90 subjects which included 47 males and 43 females. Those subjects between the age group of 15-35 years, who did not undergo any prior orthodontic treatment and had a full complement of permanent teeth up to 2nd molars were selected for the study. It was ensured that the subjects selected had no caries or missing teeth, periodontal problem, TMJ abnormality any associated syndrome and had not undergone any surgery. Lateral standardized cephalograms were taken by a single operator using the same X-ray device and a standardized procedure. The cephalograms were made with the mandible in the intercuspal position with an anode to midsubject distance of 5 feet.Thyroid shield and lead apron were worn by the subject to reduce radiation exposure. Lateral cephalogram was traced upon an A4 size acetate paper with a 2B or 3HB hard lead pencil over well-illuminated viewing screen. The linear measurements were recorded with a measuring scale up to a precision of 0.5 mm. The angular measurements were analysed with a protractor up to a precision of 0.5°. The reference points and measurements used and the variables measured are shown in Figure 1.

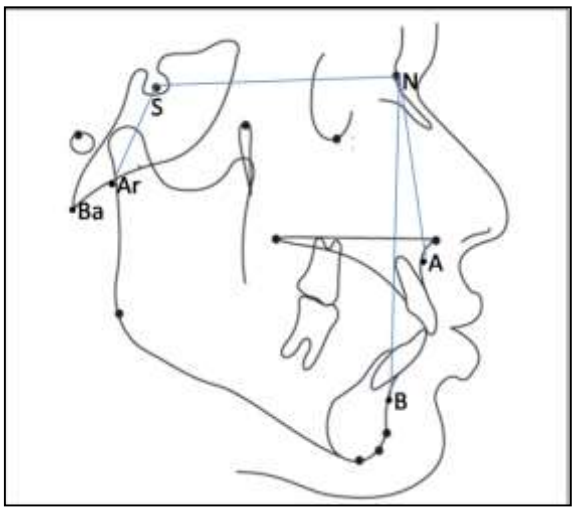

Figure 1- Cephalometric Landmarks and Reference Points

Various landmarks and measurements used in the study are as follows:

Articulare (Ar): It is the point of intersection of the images of the posterior border of the mandible and the inferior border of the basilar part of occipital bone.

Sella (S): The center of the shadow of the pituitary fossa (sella turcica).

Nasion (N): The deepest point of the frontonasal suture.

Subspinale or Point A: The deepest midline point on the pre maxilla between the anterior nasal spine and the crest of the maxillary alveolar process.

Supramental or Point B: The deepest midline point on the mandible between the pogonion and the crest of the mandibular alveolar process.

Basion: lowest point on the anterior border of the foramen magnum.

ANB angle: Angle formed by the intersection of lines from points A and B to nasion.

NSAr angle (saddle angle): Is the angle formed between nasion, sella, and articulare. It represents the crania base flexure.

According to a study by Bhatia and Leighton [9], it was concluded that growth patterns studied by use of Basion or Articulare, are very similar.

The sample was grouped as per ANB as:

Group 1: ANB 0-4(17)

Group 2: ANB >4(66)

Group 3: ANB<0 (7)

and then as per cranial base angle as:

Group 1: >135 (27)

Group 2: 130-135(25)

Group 3: <130(38)

Statistical Analysis: The statistical analysis of data was carried with the help of means, ranges and standard deviations. Karl Pearson's correlation coefficient was used to find out the correlation between dent alveolar and skeletal variables. A P-value of less than 0.05 was considered statistically significant. The statistical package SPSS (Version 16.0) was used to carry out the statistical analysis of data. One way analysis (ANOVA) was used for comparison of quantitative parameters among groups.

RESULTS

Table 1: Mean and standard deviation in three groups based on the first method of grouping of sample

Variables	GroupI ($>135^0$)		GroupII (130^0 -135^0)		Group III ($<130^0$)	
	Mean	SD	Mean	SD	Mean	SD
NSAr (^{0})	140.8	4.59	132.69	2.1	126.5	2.9
ANB (^{0})	5.15	2.07	3.15	1.96	0.26	3.85

Table 2: Correlation coefficient and p-value between cranial base angle and ANB when the sample was grouped on the basis of the first method:

Mean NSA (^{0})	Mean ANB (^{0})	P - Value	Correlation Coefficient
133.33	2.85	< 0.001	- 0.53

Table 2 reveals the highly significant negative correlation of ANB with a cranial base angle (NSAr)for the overall sample.

Table 3: Group wise correlation between cranial base angle and ANB in three groups based on the first method of sample grouping:

NSAr	ANB	
	Corelation coefficient (r)	P – value
Group I	0.02039	0.131
Group II	0.041	0.004
Group III	-0.02163	0.335

This table shows a positive and significant correlation between cranial base angle and ANB in Group II only. The relation is Non-significant but positive and negative in Group I and Group III respectively.

Table 4: Mean and standard deviation in three groups based on the second method of grouping of sample

Group	Mean Cranial Base Angle (^{0})	SD
Class I (ANB 0-4^0)	135.3	5.2
Class II (ANB $>4^0$)	136.07	5.44
Class III (ANB $<0^0$)	133.55	6.97

This table shows that among various malocclusion groups, the mean value of Class II group showed the highest value for angle S-N-Ar which was calculated to be $136.07^0 \pm 5.44^0$. The lowest value the cranial base angle was exhibited by class III patients i.e. S-A-Ar which was calculated to be $133.55^0 \pm 6.97^0$.

Table 5: One way ANOVA applied for SNAr for comparison of means of groups based on the second method of sample grouping

SNAr (^{0})	Sum of squares	Degrees of freedom	Mean square	Variance ratio (F)	Probability (p-value)
Between groups	85.93	3	28.66	0.902	0.443
Within groups	4673.5	147	31.8		

One way analysis (ANOVA) was applied to the three groups of malocclusion used in this study, in order to compare their means. The p-value calculated for malocclusion groups with S-N-Ar angle was 0.443which is considered as statistically insignificant.

DISCUSSION

According to allow [15], the growth of cranial base is affected by the growth of brain which in turn influences the spatial orientation of jaw bases. The maxilla is affected more than mandible as mandible is farther from cranial base.But articulation of mandible with the cranial base at the temporomandibular joint does pave the way for the potential influence of growth of cranial base on the position of the mandible as well.

In the present study, lateral cephalograms of 90 subjects were divided into three categories according to the values of angle NSAr and ANB to see whether any relation exists between cranial base angle and malocclusion.Also, two methods of sample grouping were followed to see whether it exerts any influence on the results. When the sample was grouped based on the cranial base angle it was observed that a significant and negative relation exists between cranial base angle and ANB. This means that as the cranial base angle increases malocclusion changes from Class III to Class II. This is in agreement with various studies conducted by Bjork A[3], Proffit et al.[10] , Hopkin GB[11] , Alves PV[12] , Kerr WJS[13].Also Proffit et al.[10] reported that cranial base angle reduces in Class III malocclusion. This supports the findings of Enlow [15] but contradicts the findings of Anderson and Popovich[21] According to Anderson and Popovich[21] Class-III occlusion in subjects do not have the most closed cranial base angles.

Some studies like that of Bjork[3] , Hopkin et al[11] advocate the use of articulare to define the posterior limit of cranial base as it is easy to identify.But some studies like that of Varjanne and Koski[14] don't advocate the use of articulare because it is far from cranial base and has advocated the use of Basion as it is anatomically significant but difficult to identify.According to a study by Bhatia and Leighton[9,] it was concluded that growth patterns studied by use of Basion or Articulare, are very similar.Hence in this study articulare was chosen as a reference point to define the posterior limit of cranial base as it is easier to identify and the chances of error are minimized.

Now when the sample was grouped according to the second method, that is according to ANB, it was observed that difference between the cranial base angle between different malocclusions was not significant.This is in agreement with various studies like that of Menezes DM.[16], Wilhelm BM [17], Polat OO, Kaya B.[18].

The anatomically temporomandibular joint is positioned away from mid saggital plane.This leads to the fact that that variation in cranial base growth might not get translated to the mandible.As most of the cephalometric analyses are based on medial saggital plane changes in mandibular position due to changes in cranial base might not be observed.The observations in the present study support this assumption and are in agreement with studies reported by other authors[19,20]. This suggests that there is no direct relationship between the cranial base and class of malocclusion.

CONCLUSION

From the present study the following conclusions may be drawn:

1. The method according to which sample is grouped is an important factor in determining the results of the study. In the present study, it had a significant influence on results of the study.
2. Accordingly, when the sample is grouped according to cranial base angle, it was concluded that cranial base angle does have a significant influence on jaw positioning and with a progressive increase in cranial base angle saggital relation of jaws changes from Class III to Class II.
3. Cranial base angle (S-N-Ar) did not demonstrate any statistically significant difference among the three malocclusion groups i.e. Class I, Class II and Class III. Therefore the present study depicts that cranial base angle is an important factor in determining a skeletal malocclusion when the sample is grouped according to ANB.
4. This study leads us to the fact that a different method of sample grouping should be found and applied to get more consistent results.

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