ORIGINAL ARTICLE POJ 2015:7(1) 8-12

The relationship between cranial base angle and various malocclusion types

Rizwan Shah[a], Maryam Mushtaq[b], Amjad Mahmood[c]

Abstract

Introduction: Scientific literature indicates that the entire craniofacial complex is influenced by the growth and displacement of the cranial base structures, exerting direct influence over them. A number of authors have suggested that there is a relationship between the degree of cranial base flexion and type of malocclusion. Nevertheless, many times this is not the case and this point is subject to controversy. Hence the aim of the present study was to assess the relationship between cranial base flexure and skeletal class.

Material and Methods: Cranial base angles (N-S-Ar and N-S-Ba) were measured on lateral cephalometric radiographs of 151 orthodontic patients with different skeletal malocclusions

Results: In this study cranial base angle did not show statistically significant difference between the four groups studied.

Conclusions: The present study did not find any differences in cranial base angle among various sagittal malocclusion types and results showed that the cranial base flexure does not play a pivotal role in determining skeletal malocclusion.

Keywords: Cephalometric analysis, Cranial base flexure, Skeletal malocclusion, Angle's classification

Introduction

Malocclusion is a developmental deformity which may be of dental or skeletal origin. Malocclusions with skeletal discrepancies in the craniofacial region are caused by abnormal forms, sizes and positions of the cranial base, maxilla and mandible. The variation in the expression of different facial patterns is a result of interplay between various factors such as heredity, environment and function. Such variable factors have an effect on the growth and development of the maxillofacial complex.[1]

The cranial base plays a pivotal role in craniofacial growth by aiding to integrate different patterns of growth in various adjoining regions of skull such as components of brain, nasal cavity, oral cavity and the pharynx, both functionally as well as spatially.[2] It has a major influence on the normal development of facial functions such as breathing, chewing, swallowing and development of skeletal malocclusion.[3]

The cranial base forms the floor of the cranial vault and extends from the foramen caecum anteriorly to the basioccipital bone posteriorly. Sella turcica lies near the center of the cranial base and divides it into anterior (sella to nasion) and posterior (sella to basion) limbs. The two limbs of the cranial base form a flexion of 130° – 135° at sella. The angle at birth is approximately 142°, but then reduces to 130° at 5 years of age. From 5 to 15 years the cranial base angle is relatively stable.[4]

Cranial base and its relationship with anteroposterior jaw position has been a topic of interest for the researchers in the recent times due to its functional and aesthetic implications. The correlation between the two entities has been investigated for many years and different theories have been proposed. One group contends that the cranial base flexure has no effect on the class of malocclusion whereas others propose vice vers.[5]

When considering the relationship between maxillofacial morphology and the cranial

[a,b] Corresponding author: BDS; Resident, Department of Orthodontics, MIHS, Rawalpindi. Email:dr_rizshah@hotmail.com

[b] BDS; Resident, Department of Orthodontics, MIHS, Rawalpindi.

[c] BDS, FDSRCS; Associate Professor and Head, Department of Orthodontics, MIHS, Rawalpindi

base, it is important to recognize that maxillary and mandibular growth might be influenced in different ways by the anterior and posterior cranial bases, with the maxilla being more closely related to the anterior cranial base and the mandible being associated more with the middle and posterior regions of the cranial base.[3] Differences in craniofacial morphology among various human populations have also been established on dry skulls as well as on the living.[1,3]

The purpose of this retrospective study was to find if there is a relationship between the cranial base angle and various malocclusion types in our population sample.

Material and Methods

The data for this study was obtained from 151 pretreatment lateral cephalometric radiographs which had been collected from the files of the patients who attended the Orthodontic Department, Margalla Institute of Health Sciences. Of the total sample, 34 were males and 117 were females. The lateral cephalometric radiographs were traced and measured by one researcher and counter checked by the other researcher in order to eliminate the intra-observer bias.

The patients were divided into 4 groups on the basis of sagittal Angle's classification and the British Standards Institute incisor classification.

Group 1: Patients with class I skeletal jaw relationship and class I dental occlusion

Group 2: Patients with class II skeletal jaw relationship and class II div 1 malocclusion

Group 3: Patients with class II skeletal jaw relationship and class II div 2 malocclusion

Group 4: Patients with class III skeletal jaw relationship and class III malocclusion

Patients with cranial base growth largely completed i.e. above the age of 8 years with complete permanent dentition , no history of previous orthodontic, orthopedic or facial and surgical treatment were included. For Class I samples; Bilateral Class I molar and canine relationships with minor crowding or spacing, ANB between 0.1 and 3.5, for class II samples; bilateral Class II molar and canine relationships with maxillary protrusion and/or mandibular retrusion, ANB>3.6, for Class III samples; Bilateral Class III molar and canine relationships with mandibular prognathism and/ or maxillary retrusion, ANB < 0.1 were included in the study.

The landmarks and linear measurements used in the study (Figure 1) were:[6]

Ar: Articulare (the point of intersection between the shadow of the zygomatic arch and the posterior border of the mandibular ramus)

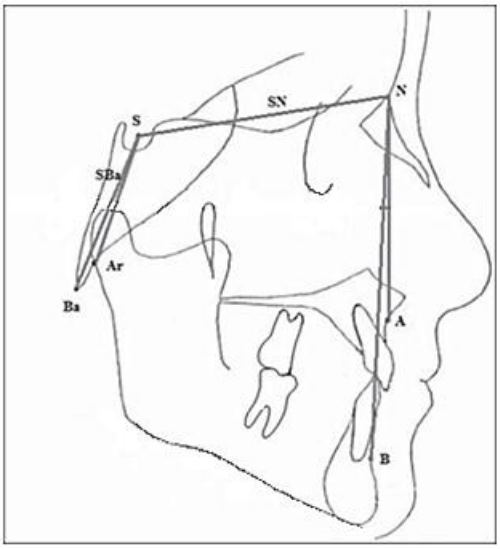

Figure 1: Bony landmarks and linear measurements used in this study

Ba: Basion (lowest point on the anterior border of foramen magnum)

NASION (N): The anterior point of the intersection between the nasal and frontal bones.

S: Sella (midpoint of the cavity of sella turcica)

ANB ANGLE: Angle formed by the intersection of lines from points A and B to nasion. (SNA angle minus SNB angle)

SNA: Angle formed between SN plane and NA line. "Norm" is 80^{o}- 84^{o}.

SNB: Angle formed between SN plane and NB line. "Norm" is 76°−80°.
POINT A: The innermost point on the contour of the premaxilla.
POINT B: The innermost point on the contour of the mandible.
SN PLANE: Horizontal plane joining points Sella and Nasion
Skeletal Class I: ANB angle ranging from 0.1° to 3.6°[7]
Skeletal Class II: ANB angle > 3.6°.
Skeletal Class III: ANB angle < 0.1°.
According to British Standards Institute incisor classification:
Class I: The lower incisor edges lie on or below the cingulum plateau on the palatal surface of the upper incisors with a normal overjet.
Class II, Division 1: The lower incisor edges lie palatal to the cingulum plateau of the upper incisors, and the upper incisors are proclined or of normal inclination with an increased overjet.
Class II, Division 2: The lower incisor edges lie palatal to the cingulum plateau of the upper incisors with the upper incisors being retroclined. The overjet is usually minimal but may be increased.
Class III: The lower incisor edges lie labial to the cingulum plateau of the upper incisors or in an edge to edge relationship with upper incisors.
All the data of the sample were subjected to computerized statistical analysis using SPSS (Statistical Packages for Social Sciences) version 21. Quantitative variables were expressed as Mean ± S.D. One way analysis (ANOVA) was used for comparison of quantitative parameters among groups followed by post hoc tuckey's test for individual comparisons. A *p* value of less than 0.05 was considered statistically significant.

Results

The distribution of the Angle classification was 19% Class I, 58% per cent Class II div I, 16% Class II div 2 and 7% percent Class III. The average age of the sample was 17.66 ± 4.3 years with maximum age of 30 years and minimum of 11 years (Table I). The mean cranial base angle with articulare was calculated to be 125.2 ±5.6 with highest angle value of 137° and lowest value of 113°. Similarly the mean cranial base angle with basion point was calculated to be 130.

Table I: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	151	11	30	17.66	4.385
S-N-Ar	151	113	137	125.2	5.633
S-N-Ba	151	120	146	130.9	5.299

Table II: Descriptives according to malocclusion

		N	Mean	Std. Deviation
Age	Class I	29	17.64	4.529
	Class II div1	87	17.16	4.128
	Class II div2	24	18.25	4.702
	Class III	11	20.36	4.739
	Total	151	17.66	4.385
S-N-Ar	Class I	29	125.31	5.149
	Class II div1	87	125.07	5.744
	Class II div2	24	126.71	5.137
	Class III	11	123.55	6.977
	Total	151	125.26	5.633
S-N-Ba	Class I	29	130.41	5.834
	Class II div1	87	131.29	5.205
	Class II div2	24	131.58	4.643
	Class III	11	128.45	5.803
	Total	151	130.96	5.299

Among various malocclusion groups, the mean value of Class II div 2 group showed the highest value for both angles i.e. S-N-Ar and S-N-Ba which was calculated to be 126.71 ± 5.1 and 131.58 ± 4.6 (Table III). The lowest value of both the cranial base angles was exhibited by class III patients i.e. S-A-Ar = 123.55 ± 6.97 and S-N-Ba = 128.45 ± 5.8.

One way analysis (ANOVA) was applied to the four groups of malocclusions used in this study, in order to compare their means. The p value calculated for malocclusion groups with S-N-Ar angle was 0.44 while for S-N-Ba, it was 0.33 both of which are considered as statistically insignificant.

Table III: ANOVA applied for S-N-Ar AND S-N-Ba angles

		Sum of Squares	df	Mean Square	F	*p*
S-N-Ar	Between Groups	85.925	3	28.64	0.901	0.442
	Within Groups	4673.479	147	31.79		
	Total	4759.404	150			
S-N-Ba	Between Groups	96.350	3	32.11	1.147	0.332
	Within Groups	4115.411	147	27.99		
	Total	4211.762	150			

± 5.2 with highest angle value of 146° and lowest value of 120°.

Discussion

In the assessment of orthodontic problems involving antero-posterior mal-relationships of the jaws, the problem is usually the result of various factors i.e. size, form and positions of the jaw other factors like head posture, breathing mode and cranial base flexion have been attributed to the development of skeletal malocclusion.

Many authors have investigated the cranial base flexion relationship with skeletal malocclusion with positive findings.[5,8-11] Proffit et al.[5] reported reduction in the cranial base angle associated with class III malocclusion.

Similar results were seen in research conducted by Bjork [8] and hopkin et al.[9] It has also been demonstrated that a linear relationship exists between the cranial base angle and skeletal malocclusion associated with the angle systematically reducing from class II, via Class I, to Class III individuals.[9-14]

Hence, the aim of our study was to determine whether this positive relationship existed between the cranial base flexion and skeletal malocclusion in our population sample. However, our study did not find any significant differences in the cranial base angles among different malocclusion groups. These results were consistent with the findings of various authors.[15-17]

In conclusion, the cranial base angle is not the only factor involved in malocclusion and other factors may influence the static jaw position and the degree of prognathism in individual cases.

Conclusions

Cranial base angles (S-N-Ar and S-N-Ba) did not demonstrate any statistically significant differences among the four malocclusion groups i.e. Class I, Class II div 1, Class II div 2 and Class III. Hence our study depicts that cranial base angle might not be an influential factor in determining a skeletal malocclusion in this population sample.

References

1. Kuroe K, Rosas A, Molleson T. Variation in the cranial base orientation and facial skeleton in dry skulls sampled from three major populations. Eur J Orthod 2004;26(2):201-7.
2. Khoshy SF, Jamil AK. The relationship between cranial base angle and malocclusion among Kurdish adults in Sulaimani city: A lateral cephalometric study. J Bagh Coll Dentistry 2010;22(3):105-10.
3. Mangano A, Mangano A. Cranial base angulation as determinant of malocclusion: a review (FU). The orthodontic CYBER journal; 2010:(7):1-8.

4. Dhopatkar A, Bhatia S, Rock P. An investigation into the relationship between the cranial base angle and malocclusion. Angle Orthod 2002;72:456-63.
5. Proff P, Will F, Bokan I, Fanghanel J, Gedrange t. Cranial base features in skeletal class III patients. Angle Orthod 2008;78(3):433-9.
6. Proffit WR, Sarver DM, Ackerman JL. Orthodontic Diagnosis: The Problem-Oriented Approach. In Fields HW, Sarver DM, (edi) Contemporary orthodontics. 5th ed. St.Louis: Mosby 2013:150-219.
7. Erum G, Fida M. A comparison of cephalometric analyses for assessing sagittal jaw relationship. J Coll Physicians Surg Pak 2008;18(11):679-83.
8. Bjork A. Cranial base development. Am J Orthod 1955;41:198-225.
9. Hopkin GB, Houston WJ, James GA. The cranial base as an aetiological factor in malocclusion. Angle Orthod 1968;38:250-5.
10. Alves PV, Mazzuchelli J et al. Cranial base angulation in Brazilian patients seeking orthodontic treatment. J Craniofac. Surg. 2008;19(2):334-8.
11. Kerr WJS, Adams CP. Cranial base and jaw relationship. Am J Phys Anthropol 1988; 77:213-20.
12. Kasai K, Moro T, Kanazawa E, Iwasawa T. Relationship between cranial base and maxillofacial morphology. Eur J Orthod 1995;17(5):403-10.
13. Bacon W, Eiller V, Hildwein M, Dubois G. The cranial base in subjects with dental and skeletal Class II. Eur J Orthod 1992;14:224–8.
14. Bhattacharya A, Bhatia A, Patel D, Mehta N, Parekh H, Trivedi R. Evaluation of relationship between cranial base angle and maxillofacial morphology in Indian population: A cephalometric study. J Orthod Sci 2014; 3(3): 74–80.
15. Menezes DM. Comparison of craniofacial features of English children with Angle class II division 1 and Angle class I occlusions. J Dent 1974; 2:250-4.
16. Wilhelm BM, Beck FM, Lidral AC, Vig KW. A comparison of cranial base growth in class I and class II skeletal patterns. Am J Orthod Dentofac Orthop 2001; 119:401-5.
17. Polat OO, Kaya B. Changes in cranial base morphology in different malocclusions. Orthod Craniofac Res 2007;10(4):216-21.