Correlations among craniofacial angles and dimensions in Class I and Class II malocclusions

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A previous paper by the Authors reported a lower correlation of cranial and jaw measurements with stature in children with Angle Class II malocclusion than in those with normal and Class I occlusions[1]. The present study continues the comparison of correlations in these same Class I and Class II groups by contrasting the correlations among cranial base angles, cranial base dimensions, mandibular angles, and mandibular dimensions.

Materials and Methods

Records of a sample of 227 children from the serial records of the Burlington Growth Centre were selected for analysis. Of these, 156 had either a normal occlusion or an Angle Class I malocclusion, and 71 had a Class II malocclusion. The following measurements based on selected points (Fig. 1) were obtained from cephalometric radiographs made at 10 years of age:

Distances:

Anterior cranial base length, Sella to Nasion (S-N)
Posterior medial cranial base length, Sella to Bolton Point (S-Bo)
Posterior lateral cranial base length, Sella to Condylion (S-Co)
Mandibular ramus height, Condylion to Gonion (Co-Go)
Mandibular body length, Gonion to Menton (Go-Me)

Angles:

Medial cranial base angle, Bo-S/S-N
Lateral cranial base angle, Co-S/S-N
Mandibular ramus angle, S-Co/Co-Go
Mandibular gonial angle, Co-Go/Go-Me
Mandibular facial angle, S-N/N-Me
Stature was obtained from records taken at 10 years of age.

Pearson's correlation coefficients among variables were computed. The significance of the difference between correlation coefficients was tested using Fisher's Z_r transformation.

Results

The lateral cranial base angle correlated strongly

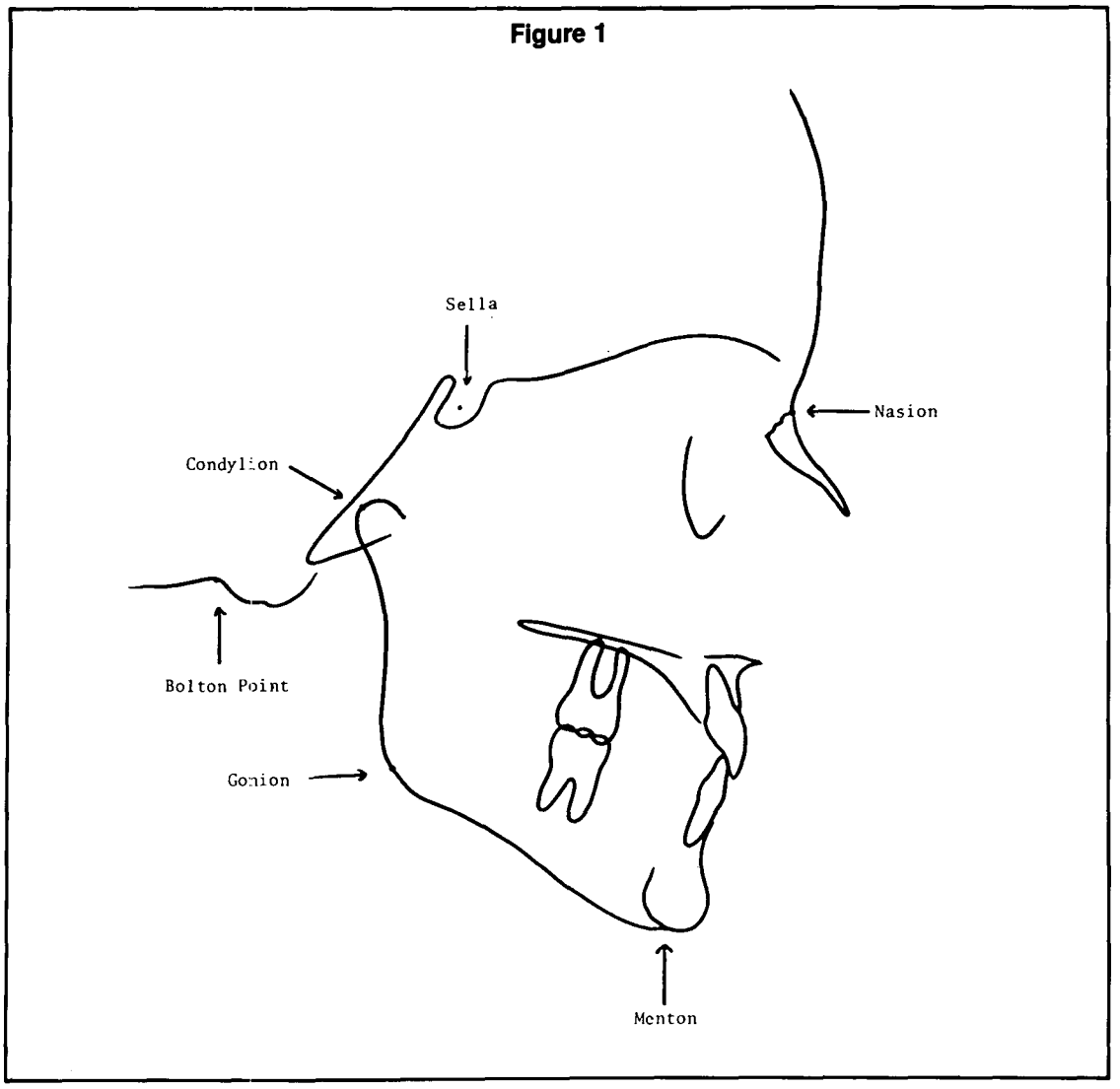
Abstract

In normal and Class I malocclusions, ramus and mandibular angles are found to correlate most strongly with cranial base dimensions rather than angles, whereas in Class II malocclusions these angles tend to relate more closely to the cranial base angles.

Key Words

Cephalometrics • Cranial base • Mandible

Figure 1



with the medial cranial base angle (r=0.73). The lateral posterior cranial base length correlated significantly, but less strongly with the medial posterior cranial base length (r=0.52).

On contrasting the normal and Class I group with the Class II, the correlations between angles was consistently higher for the Class II group (Table 1).

Differences between Class I and II

Differences between Class I and Class II correlation coefficients were statistically significant for the correlations between lateral cranial base angle (Co-S/S-N) and ramus angle (S-Co/Co-Go), between ramus angle and facial angle (S-N/N-Me), and between facial angle and gonial angle (Co-Go/Go-Me).

For the Class I group, correlations between gonial angle and the cranial base angles, and between ramus angle and facial angle, were weak or insignificant. Other correlations were highly significant.

In contrast to the correlations between angles, the correlations between angles and distances were higher for the Class I subjects (Table 2).

Significant differences between coefficients for the Class I and II groups were found for the correlation of posterior medial cranial base length with mandibular facial angle, and for the correlation of posterior lateral cranial base length with mandibular gonial angle.

Cranial base angles and mandibular angles did not correlate significantly with anterior cranial base length in either Class I or II groups; nor did mandibular ramus angle correlate significantly with any cranial base dimension or stature.

Cranial base angles correlated significantly with posterior cranial base lengths only in the Class I group. Mandibular prognathism, as measured by the mandibular facial angle, correlated significantly at the 0.001 level with posterior cranial base lengths and body stature in the Class I group only. Also, only in the Class I group did cranial base angles correlate significantly with stature.

		Angles			
		Cranial Base Lateral Co-S/S-N	Ramus S-Co/Co-Go	Mandible Gonial Co-Go/Go-Me	Facial S-N/N-Me
Angles	**Class**				
Cranial Base					
Medial, Bo-S/S-N	I	.69***	-.53***	.09	-.47***
	II	.78***	-.62***	.10	-.59***
Lateral, Co-S/S-N	I		-.79***	.09	-.54***
	II		-.90***	.25*	-.63***
Mandible					
Ramus, S-Co/Co-Go	I			-.27***	.16*
	II			-.41***	.51***
Gonial, Co-Go/Go-Me	I				-.32***
	II				-.55***

Significance Levels: .05*, .01**, .001***

Table 1
Correlation of cranial base angles and mandibular angles

Similarities between Class I and II

Correlation coefficients were similar for Class I and II groups for correlations of mandibular dimensions with cranial and mandibular angles, and with cranial base lengths (Table 3).

In both groups, mandibular dimensions related weakly to mandibular ramus angle, but strongly to gonial and facial angles. Mandibular dimensions correlated significantly with cranial base lengths, but not with cranial base angles.

From the three tables, mandibular angles were seen to relate differently. Ramus angle correlated with cranial base angles, but not with cranial base dimensions, mandibular dimension, or stature. Gonial angle correlated negatively with mandibular dimensions, negatively with posterior lateral cranial base length in the Class I group, and positively with lateral cranial base angle in the Class II group.

Facial angle correlated with cranial base angles and mandibular dimension, and with posterior cranial base lengths and stature in the Class I group.

Children with small cranial base angles at least one standard deviation below the mean, and children with large cranial base angles at least one standard deviation above the mean, may have normal, Class I or Class II occlusions. In both occlusion groups the children with large cranial base angles had small ramus angles, which tend to compensate and almost maintain the angle of the ramus of the mandible to the anterior cranial base (Table 4).

Discussion

Condyle-Sella/Sella-Nasion angle has previously been used to measure cranial base flexure[2,3] This represents the lateral region of the cranial base, while Bolton Point is medially related. The correlation between Condyle-Sella/Sella-Nasion and Bolton-Sella/Sella-Nasion angles in the present study was high, as it was in those studies. The use of the condyle as the posterior landmark for cranial base angle and length is an advantage because it is an integral part of a

		Angles				
		Cranial Base		Mandible		
		Medial Bo-S/S-N	Lateral Co-S/S-N	Ramus S-Co/Co-Go	Gonial Co-Go/Go-Me	Facial S-N/N-Me
Distances	**Class**					
Cranial Base						
	I	.00	-.13	-.01	.00	-.04
Anterior S-N						
	II	.04	-.20	.13	-.05	-.06
Posterior						
	I	-.16*	-.26***	.08	-.08	.38***
Medial, S-Bo						| *
	II	.01	.01	-.10	.01	.11
	I	-.20*	-.14	-.03	-.28***	.32***
Lateral, S-Co					| *	
	II	-.06	.00	-.18	.00	.16
Stature						
	I	-.25***	-.15*	.04	-.10	.31***
	II	-.00	.03	-.11	.02	.09

Significance Levels: .05*, .01**, .001***

Table 2
Correlation of cranial base angles and mandibular angles with cranial base dimensions and stature.

polygon that includes the face, permitting study of angles and distances within a closed system.

A previous study[1] investigated correlations among dimensions; cranial, cranial to jaw, and stature. The present study continues the investigation into the same sample, studying relations among angles, and among angles and dimensions of the cranial base and mandible.

Findings indicate that where cranial base angles and mandibular angles correlate with posterior cranial base length and body height, the occlusion tends to be normal or Class I. However, when cranial base angles and mandibular angles correlate more with each other, the occlusion tends to be Class II. Thus, occlusal harmony is better when craniofacial shape is consistent with size, rather than with shape.

Enlow[4] states that with a more open cranial base flexure the mandible tends to be rotated more downward and backward, and is thereby placed in a retrusive position which favours Class II malocclusion. His diagrams indicate that the angle between the posterior cranial base and the ramus of the mandible remains constant. Our results indicate that the angle between the posterior cranial base and the ramus closes in a highly correlated compensation for opening of the cranial base flexure.

This correlation is even higher among the Class II subjects than among the normal and Class I, and tends to maintain the angle between the ramus and the anterior cranial base (Sella-Nasion). However, with a more open cranial base flexure, the condyles of the mandible tend to be positioned farther back,[5] and because of this an open cranial base flexure is associated with Class II malocclusion.[4-13] Hence, with a more open cranial base flexure the mandible "swings" only slightly downward and backward.

Summary

From the Burlington Growth Centre serial sample at 10 years of age, 156 children with normal and Class I occlusions were contrasted with 71 children with Class II for correlation of

	Mandibular Distances			
	Ramus Co-Go		Body Go-Me	
Class	I	II	I	II
Angles				
Mandible				
Ramus, S-Co/Co-Go	-.16*	.11	.01	.17
Gonial, Co-Go/Go-Me	-.33***	-.39***	-.33***	-.55***
Facial, S-N/N-Me	.41***	.43***	.43***	.45***
Cranial Base				
Medial, Bo-S/S-N	-.12	-.11	.03	.11
Lateral, Co-S/S-N	.02	-.17	.04	-.05
Distances				
Cranial Base				
Anterior, S-N	.19*	.24*	.30***	.33***
Posterior				
Medial, S-Bo	.37***	.45***	.33***	.28*
Lateral, S-Co	.34***	.41***	.25***	.24*

Significance Levels: .05*, .01**, .001***

Table 3
Correlation of mandibular dimensions with mandibular angles and with cranial angles and dimensions.

cranial base angles and distances, mandibular angles and distances, and body height (stature).

The interrelation of cranial base angles and mandibular angles was stronger in the Class II group, whereas, the correlation of these angles with cranial base dimensions and stature was stronger in the Class I group. Correlations of mandibular dimensions with mandibular angles, and with cranial base angles and dimensions, were similar in Class I and II groups.

Thus, when cranial base and mandibular angles correlate with posterior cranial base length and stature, the occlusion tends to be normal or Class I, but when the angles correlate more with each other, the occlusion tends toward class II. It is more important that shape relate to size than to shape.

For more open cranial base flexure, the angle between the ramus and the posterior cranial base is more closed, thereby maintaining to high degree the angle between the ramus and the anterior cranial base. Short ramus and short mandibular corpus are associated with large gonial angles.

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				Angle of Mandibular Ramus with	
				Posterior Cranial Base Co-Go with S-Co degrees	Anterior Cranial Base Co-Go with S-N degrees
Cranial Base Angle					
Group	Class	n	Mean		
Small ⩽ - 1 S.D.	I	25	125.5°	138.2	83.6
	II	14	125.3°	139.8	85.1
Large ⩾ + 1 S.D.	I	24	143.2°	125.7	88.9
	II	15	145.9°	121.5	87.4

Table 4.
Angles between mandibular ramus and anterior and posterior cranial bases in children with small and large cranial base angles.

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