Cephalometric characteristics of bimaxillary dentoalveolar protrusion in early mixed dentition

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The children with bimaxillary dentoalveolar protrusion in early mixed dentition were compared with the normal occlusion children. The bimaxillary dentoalveolar protrusion children had significant smaller inter-incisal angle and greater convexity, A-B plane, and ANB angles than the normal children. Maxillary and mandibular growths of the bimaxillary dentoalveolar protrusion girls were greater than those of normal girls. The direction of the mandibular growth of the bimaxillary dentoalveolar protrusion boys showed a tendency of downward and backward.
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INTRODUCTION

The efficacy and timing of the treatment of malocclusions often depends upon the pubertal growth spurt. Treatment effects may be impaired or enhanced by variations in the direction, timing, and duration of development in the facial area. Extensive knowledge of facial morphology and development is thus necessary for the successful treatment of dentofacial deformities.

Dentofacial abnormalities, such as dentoalveolar protrusion, can be distressing both socially and psychologically. Bimaxillary dentoalveolar protrusion has been viewed as one of the most severe facial deformities. It becomes remarkable from early mixed dentition stage and is characterized by dentoalveolar flaring of both the maxillary and the mandibular incisors resultant protrusion of the lips and convexity of the face. The majority of patients, who present with bimaxillary dentoalveolar protrusions, are mainly concerned with the esthetic quality of the dentition; i.e. the protruding teeth and everted lips.

The positions of the maxillary and mandibular incisors have long been recognized as useful guides in the diagnosis and treatment of malocclusion. Likewise, incisor protrusion and inclination are generally considered to influence the stability of orthodontic results and the esthetics of the lips relative to the chin and nose.

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Racial groups who have more procumbent maxillary and mandibular incisors with smaller interincisal angles include Mexican-American[1] and American Negro children[2-4] as well as groups like the Japanese[4-6] Iranian[7], North Indian[4], Chinese[4,8], and the Australian aborigines.[8]

The aim of this study is to identify the cephalometric features of bimaxillary dentoalveolar protrusion in the early mixed dentition and highlight the measurements that characterize bimaxillary dentoalveolar protrusion when compared to a normal occlusion group.

MATERIALS AND METHODS

All subjects examined in this study were Taiwanese children in Hellman's dental developmental stage IIIA. None of the subjects had congenital anomalies, significant facial asymmetries, or congenitally missing teeth. No orthodontic treatment had been rendered, and lateral cephalometric radiographs were obtained in relaxed lip posture. Those in which posterior teeth were not in occlusion were not included.

The subjects were divided into four groups. Twenty-four were boys with bimaxillary dentoalveolar protrusion, twenty-four were boys with normal occlusion, twenty-four were girls with bimaxillary dentoalveolar protrusion, and twenty-one were girls with normal occlusion. The bimaxillary dentoalveolar protrusion group was chosen to have an interincisal angle less than 120˚.

The lateral cephalometric radiographs from the selected individuals were traced, and reference points and planes were then obtained. The reference points and planes identified on each radiograph are presented in Figures 1 and 2. The midpoints of all bilateral reference points were used. From these reference points and planes 13 linear and 25 angular measurements illustrated in Figures 3 and 4 were constructed.

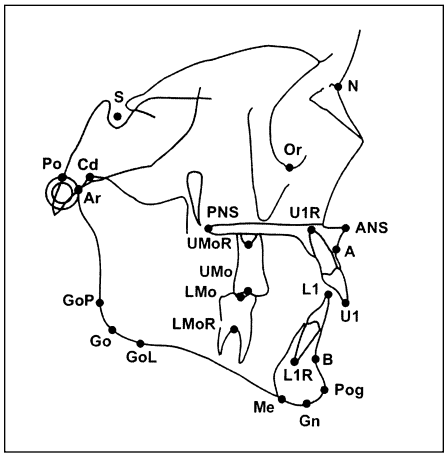

Figure 1. Reference points

S: sella turcica
N: nasion
Or: orbitale
Po: porion
ANS: anterior nasal spine
PNS: posterior nasal spine
A: subspinale
B: supramentale
Cd: condyle
Ar: articulare
GoP: posterior gonion
Go: gonion
GoL: lower gonion
Me: menton
Gn: gnathion
Pog: pogonion
U1: upper incisor edge
U1R: upper incisor root apex
UMo: upper first molar buccal groove
UMoR: furcation of upper first molar root
L1: lower incisor edge
L1R: lower incisor root apex
LMo: lower first molar buccal groove
LMoR: furcation of lower first molar root

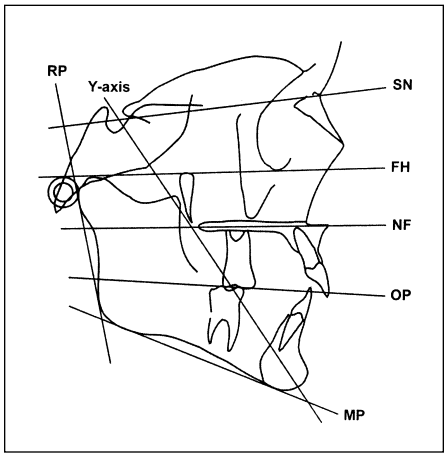

Figure 2. Reference planes

SN: S to N
FH: Po to Or
NF: ANS to PNS
OP: the midpoint of UMo and LMo to the midpoint of U1 and L1
MP: Me to GoL
RP: Ar to GoP
Y-axis: S to Gn

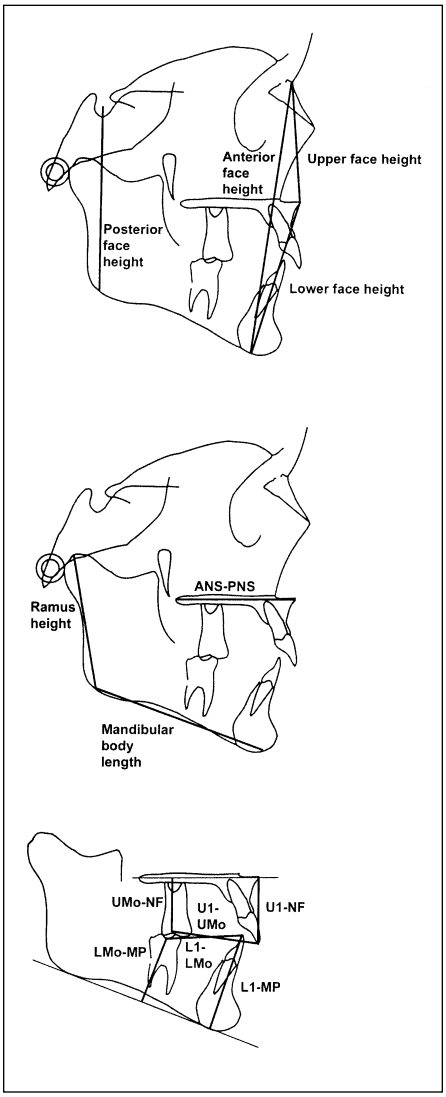

Figure 3. Linear measurements

Upper face height: N-ANS, the distance between N and ANS
Lower face height: the distance between ANS and Me
Anterior face height: N-Me, the distance between N and Me
Posterior face height: the distance between S and Go
ANS-PNS: the distance between ANS and PNS
Mandibular body length: the distance between Go and Gn
Ramus height: the distance between Cd and Go
U1-NF: the projected distance of U1 to NF plane
UMo-NF: the projected distance of UMo to NF plane
U1-UMo: the distance between U1 and UMo
L1-MP: the projected distance of L1 to MP plan
LMo-MP: the projected distance of LMo to MP plane
L1-LMo: the distance between L1 and LMo

The mean values and standard deviations for each measurement were calculated. The differences between the two groups were analyzed by means of Student's t-test (Tables 1 to 4) and facial profile polygon method (Figures 5 and 6) for both boys and girls. Where the F-ratio was significantly different, or where the data of a particular parameter was significantly

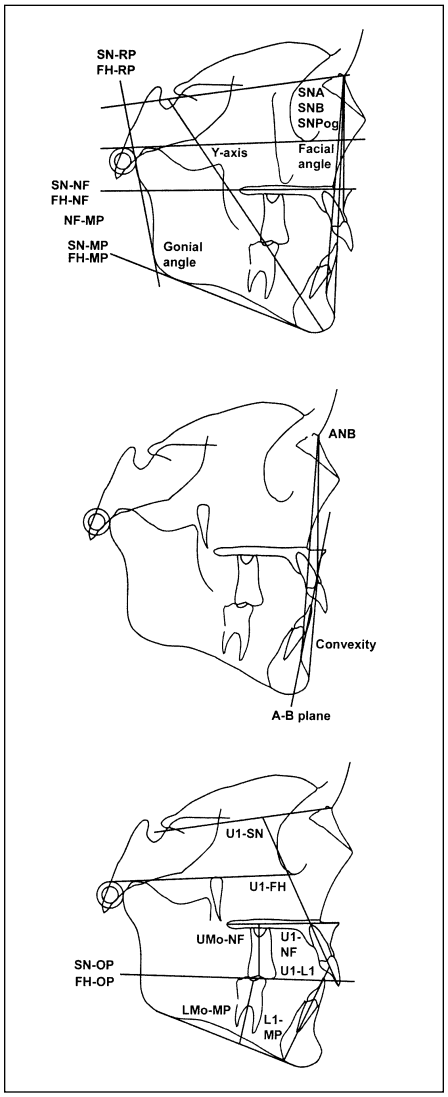

Figure 4. Angular Measurements

SNA: the angle of S-N-A (SNA)
SN-NF: the angle of ANS-PNS and S-N (SN-NF)
FH-NF: the angle of ANS-PNS and Po-Or (FH-NF)
Facial angle: the angle of Po-Or and N-Pog (FH-Npog)
Y-axis: the angle of PO-Or and S-Gn (FH-SGn)
SNB: the angle of S-N-B (SNB)
SNPog: the angle of S-N-Pog (S-N-Pog)
SN-MP: the angle of Me-GoL and S-N (SN-MP)
FH-MP: the angle of Me-GoL and Po-Or (FH-MP)
NF-MP: the angle of MeGoL and ANS-PNS (NF-MP)
SN-RP: the angle of Ar_GoP and S-N (SN-RP)
FH-RP: the angle of Ar-GoP and Po-Or (FH-RP)
Gonial angle: the angle of Ar-GoP and Me-GoL (gonial angle)
Convexity: the angle of N-A and A-Pog (N-A-Pog)
A-B plane: the angle of A-B and N-Pog (AB-Npog)
ANB: the angle of A-B and N-Pog (ANB)
U1-SN: the angle of S-N and U1-U1R (U1-SN)
U1-FH: the angle of PoOr and U1-U1R (U1-FH)
U1-NF: the angle of ANS-PNS and U1-U1R (U1-NF)
L1-MP: the angle of L1-L1R and U1-U1R (L1-MP)
U1-L1: the angle of L1-L1R and U1-U1R (U1-L1)
SN-OP: the angle of S-N and (the midpoint of UMo and LMo)-(the midpoint of U1 and L1) (SN-OP)
FH-OP: the angle of Po-Or and (the midpoint of UMo and LMo)-(the midpoint of U1 and L1) (FH-OP)
UMo-NF: the angle of UMo-UMoR and ANS-PNS (UMo-NF)
LMo-MP: the angle of LMo-LMoR and GoL-Me (LMo-MP)

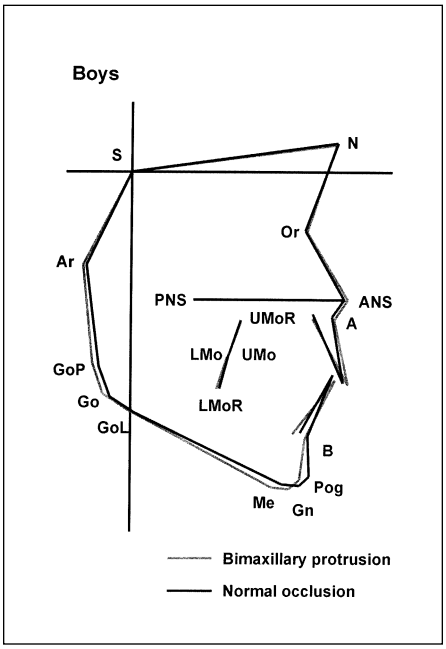

Figure 5. Mean facial polygons of bimaxillary protrusion and normal occlusion (boys).

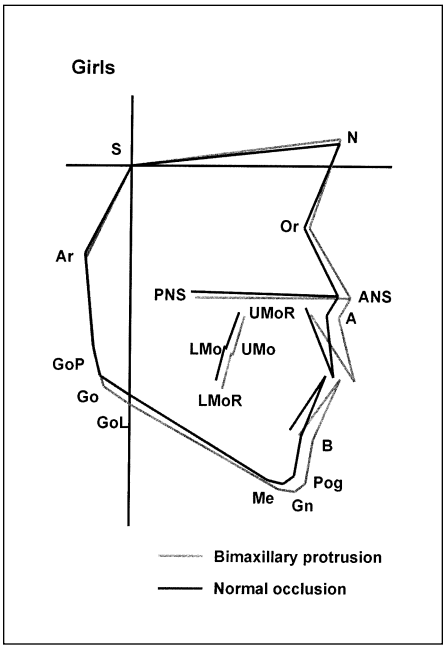

Figure 6. Mean facial polygons of bimaxillary protrusion and normal occlusion (girls).

skewed, the Mann-Whitney Rank Sum Test was then applied. Pearson Product Moment correlation tests between all angular and between all linear measurements in the bimaxillary dentoalveolar protrusion groups were also performed (Tables 5 and 6) for assessing morphological characteristics of craniofacial pattern.

Table 1. Statistical comparisons of linear measurements between bimaxillary protrusion and normal occlusion groups for boys.

Linear measurements (millimeter)	Bimaxillary protrusion (N=24) Mean	s.d.	Normal occlusion (N=24) Mean	s.d.	t-test
Face height					
Upper face height	51.000	2.529	51.283	3.601	n.s.
Lower face height	66.342	5.146	63.625	4.455	n.s.
Anterior face height	114.004	6.612	112.837	7.007	n.s.
Posterior face height	73.179	6.227	73.850	5.356	n.s.
Maxilla					
ANS-PNS	51.262	2.899	49.692	3.264	n.s.
Mandible					
Mandibular body length	68.963	5.388	69.017	4.633	n.s.
Ramus height	51.800	5.581	53.083	4.009	n.s.
Dental relationships					
U1-NF	27.825	3.616	27.167	2.850	n.s.
UMo-NF	18.913	2.393	17.850	2.039	n.s.
U1-UMo	40.579	3.365	38.650	3.285	n.s.
L1-MP	40.933	2.604	39.483	2.842	n.s.
LMo-MP	30.658	2.953	30.329	2.244	n.s.
L1-LMo	36.442	2.678	35.146	2.159	n.s.

Table 2. Statistical comparisons of linear measurements between bimaxillary protrusion and normal occlusion groups for girls.

Linear measurements (millimeter)	Bimaxillary protrusion (N=24) Mean	s.d.	Normal occlusion (N=21) Mean	s.d.	t-test
Face height					
Upper face height	52.263	3.235	49.624	3.095	P=0.008
Lower face height	66.567	5.377	64.367	3.963	n.s.
Anterior face height	116.004	6.599	112.090	6.176	P=0.047
Posterior face height	72.638	5.994	68.990	4.931	P=0.033
Maxilla					
ANS-PNS	51.225	3.988	48.410	3.856	P=0.021
Mandible					
Mandibular body length	71.771	6.876	69.829	5.006	n.s.
Ramus height	52.308	4.648	48.871	3.751	P=0.010
Dental relationships					
U1-NF	27.054	3.662	26.633	2.576	n.s.
UMo-NF	19.083	1.262	18.386	1.580	n.s.
U1-UMo	41.067	3.516	36.533	4.497	P<0.001
L1-MP	41.163	2.988	38.881	3.261	P=0.018
LMo-MP	31.192	2.664	29.986	2.350	n.s.
L1-LMo	37.013	3.326	34.505	3.048	P=0.012

RESULTS

Linear measurements (Tables 1 and 2)

In comparisons of the linear measurements between bimaxillary dentoalveolar protrusion and normal occlusion children, boys and girls had different results. There were no significant differences in all linear measurements between the two groups in boys. However, the bimaxillary dentoalveolar protrusion girls had greater values in all linear measurements than the normal occlusion girls.

Angular measurements (Tables 3 and 4)

In comparisons of the angular measurements between bimaxillary dentoalveolar protrusion and normal occlusion children, boys and girls had similar results. There were no significant differences in the vertical jaw positions (SN-NF, FH-NF, SN-MP, and FH-MP angles) and in the vertical jaw relationships (NF-MP angle) between the two groups. In the anteroposterior jaw relationships, the bimaxillary dentoalveolar protrusion children had significant greater convexity, A-B

Table 3. Statistical comparisons of angular measurements between bimaxillary protrusion and normal occlusion groups for boys.

Angular measurements (degree)	Bimaxillary protrusion (N=24) Mean	s.d.	Normal occlusion (N=24) Mean	s.d.	t-test
Maxilla					
SNA	81.971	3.022	80.596	2.719	n.s.
SN-NF	7.800	2.695	8.083	3.079	n.s.
FH-NF	-0.125	3.808	-0.108	3.168	n.s.
Mandible					
Facial angle	84.038	3.555	85.433	3.601	n.s.
Y-axis	63.113	3.459	61.479	3.652	n.s.
SNB	76.529	3.105	77.263	3.197	n.s.
SNPog	76.342	3.532	77.458	3.299	n.s.
SN-MP	35.846	5.172	33.846	6.050	n.s.
FH-MP	28.171	4.302	25.879	6.321	n.s.
SN-RP	91.929	4.599	90.754	4.501	n.s.
FH-RP	84.254	4.406	82.787	3.904	n.s.
Gonial angle	123.908	4.443	123.079	6.729	n.s.
Jaw relationships					
Convexity	11.646	6.478	6.471	5.564	P=0.005
A-B plane	7.729	3.819	4.950	3.303	P=0.010
ANB	5.467	2.702	3.308	2.350	P=0.005
NF-MP	28.033	4.117	25.762	6.174	n.s.
Dental relationships					
U1-SN	110.837	5.666	105.833	7.613	P=0.013
U1-FH	118.504	5.189	113.808	7.464	P=0.015
U1-NF	118.629	6.040	113.917	7.396	P=0.020
L1-MP	99.842	4.979	94.150	5.867	P<0.001
U1-L1	113.488	4.714	126.162	2.562	P<0.001
SN-OP	19.929	4.328	20.404	4.179	n.s.
FH-OP	12.263	3.573	12.437	4.126	n.s.
UMo-NF	69.379	5.510	71.458	5.706	n.s.
LMo-MP	80.158	4.979	85.850	5.867	P<0.001

Table 4. Statistical comparisons of angular measurements between bimaxillary protrusion and normal occlusion for girls.

Angular measurements (degree)	Bimaxillary protrusion (N=24) Mean	s.d.	Normal occlusion (N=21) Mean	s.d.	t-test
Maxilla					
SNA	82.271	3.719	79.905	3.815	P=0.041
SN-NF	7.908	4.331	7.543	2.739	n.s.
FH-NF	-0.246	3.589	-1.362	2.920	n.s.
Mandible					
Facial angle	84.579	2.607	82.519	3.488	n.s.
Y-axis	62.733	2.886	63.886	2.900	n.s.
SNB	77.604	3.322	76.662	3.817	n.s.
SNPog	76.929	3.350	76.324	3.883	n.s.
SN-MP	37.008	3.769	37.648	5.006	n.s.
FH-MP	29.350	4.741	31.448	5.022	n.s.
SN-RP	92.263	5.185	90.767	4.667	n.s.
FH-RP	84.608	5.643	84.576	4.756	n.s.
Gonial angle	124.742	6.877	126.871	5.737	n.s.
Jaw relationships					
Convexity	11.104	4.643	7.343	4.294	P=0.007
A-B plane	6.138	3.028	4.200	3.227	P=0.044
ANB	4.662	1.990	3.243	1.946	P=0.020
NF-MP	29.100	4.198	30.090	4.020	n.s.
Dental relationships					
U1-SN	116.229	5.538	105.576	4.335	P<0.001
U1-FH	123.883	6.483	111.781	4.422	P<0.001
U1-NF	124.129	6.046	113.124	3.998	P<0.001
L1-MP	97.408	3.883	91.995	4.981	P<0.001
U1-L1	109.367	6.052	124.781	3.233	P<0.001
SN-OP	20.108	3.362	21.505	4.235	n.s.
FH-OP	12.454	4.151	15.290	3.642	P=0.020
UMo-NF	74.121	5.834	72.367	5.721	n.s.
LMo-MP	82.592	3.883	88.005	4.981	P<0.001

Table 5. Pearson Product Moment correlation analysis (Linear measurements)

Girls

Boys	Upper face	Lower face	Ant. face	U1-NF	UMo-NF	U1-UMo	Ramus height	L1-MP	LMo-MP	L1-LMo	Post. face	ANS-PNS	Mand. body
Upper face		n.s.	+++	n.s.	n.s.	n.s.	++	n.s.	+	n.s.	++	n.s.	n.s.
Lower face	+		+++	+++	n.s.	++	+++	+++	+++	++	+++	+++	++
Ant. face	+++	+++		++	+	++	+++	+++	+++	++	+++	+++	+++
U1-NF	n.s.	+++	+++		+	++	+	+++	++	++	++	+	++
UMo-NF	+	+++	+++	++		n.s.	+	+	++	n.s.	+	n.s.	++
U1-UMo	n.s.	n.s.	n.s.	++	n.s.		+	++	n.s.	+++	++	+++	++
Ramus height	n.s.	++	++	n.s.	++	n.s.		++	+++	++	+++	++	+
L1-MP	+	+++	+++	+++	++	n.s.	+		+++	++	+++	+++	+++
LMo-MP	n.s.	+++	+++	+	+	n.s.	+++	+++		n.s.	+++	+	++
L1-LMo	n.s.	++	+++	+	++	n.s.	++	+	n.s.		+++	++	+
Post. face	++	+++	+++	+	+++	n.s.	+++	++	+++	+++		+++	++
ANS-PNS	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	n.s.	n.s.		++
Mand. body	+	n.s.	+	n.s.	+	n.s.	n.s.	n.s.	n.s.	++	+	n.s.	

Linear measurements
Upper face: Upper face height, Lower face: Lower face height, Ant. face: Anterior face height, Ramus height: Ramus height, Post. face: Posterior face height, Mand. body: Mandibular body length

n.s.: not significant
-: P<0.05, --: P<0.01, ---: P<0.001 (Negative correlation)
+: P<0.05, ++: P<0.01, +++: P<0.001 (Positive correlation)

plane, and ANB angles than the normal occlusion children. The mean values for the incisal and mandibular molar angles also revealed significant differences between the two groups. The bimaxillary dentoalveolar protrusion children had flare out incisors and distal tipping mandibular molar compare to the normal occlusion children.

Pearson Product Moment Correlation Analysis (Tables 5 and 6)

Many significant correlations were assessed both in linear and angular measurements for both boys and girls. The analysis of the correlation coefficients of boys compared to girls indicates several similarities and several differences. In linear measurements, anterior and posterior face height had correlation with the other linear measurements, for both boys and girls. Correlation between maxillary horizontal measurements (U1-UMo and ANS-PNS) and other linear measurements was intimate in girls. In angular measurements, the correlation coefficient between NF-MP and SN-RP angle was significantly different in boys and girls; girls showed negative correlation and boys showed positive correlation.

DISCUSSION

An interincisal angle of 120.3 degrees represented the mean for normal occlusion in Japanese.[9] In the normal occlusion material of Humerfelt and Slagsvold,[10] the interincisal angle increased an average of 4 degrees from 130 to 131 degrees at age 11 to 135 to 136 degrees at age 25. In normal occlusion children of this study, the interincisal angle was 126.16 and 124.78 degrees for boys and girls respectively; those were the values between Japanese and Caucasian.

A conspicuous developmental change in oral structures is often remarkable in the early mixed dentition because the transition of anterior teeth from primary to permanent teeth. Previous study indicated that the etiology of bimaxillary dentoalveolar protrusion was complex, involving environmental factors, soft-tissue function, and habit.[11] The results of this study indicated that maxillary and mandibular forward growth of the bimaxillary dentoalveolar protrusion girls was greater than that of normal occlusion girls. The direction of the mandibular growth of the bimaxillary dentoalveolar protrusion boys showed a tendency of downward and backward when compared with normal occlusion boys. It is found that there was a low correlation in boys, but an intimate correlation in girls between maxillary components and other linear measurements in the bimaxillary dentoalveolar protrusion children. It is suggested that maxillary component is not a factor that shows the morphological characteris-

Table 6. Pearson Product Moment correlation analysis (Angular measurements)

Girls

Boys	facia	conv	AB	Y	SNA	SNB	ANB	SPog	SNN	FHN	SNM	FHM	SNR	FHR	goni	U1S	U1F	L1M	UL1	SNO	FHO	NFM	U1N	UMo	LMo
facial		n.s.	n.s.	---	n.s.	n.s.	n.s.	n.s.	n.s.	+++	n.s.	---	n.s.	n.s.	n.s.	n.s.	++	n.s.	n.s.	-	---	n.s.	n.s.	n.s.	n.s.
conv	n.s.		---	n.s.	n.s.	n.s.	+++	n.s.	n.s.	n.s.	+	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
AB	n.s.	---		n.s.	n.s.	n.s.	---	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Y	---	n.s.	n.s.		n.s.	n.s.	n.s.	n.s.	n.s.	---	n.s.	+++	n.s.	++	n.s.	n.s.	---	-	n.s.	n.s.	+++	n.s.	n.s.	n.s.	+
SNA	n.s.	n.s.	n.s.	n.s.		+++	+	+++	---	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	n.s.	n.s.	n.s.	--	n.s.	+	n.s.	-	n.s.
SNB	+	-	+	n.s.	++		n.s.	+++	---	n.s.	--	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	---	n.s.	n.s.	n.s.	n.s.	n.s.
ANB	n.s.	+++	---	n.s.	+	-		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
SPog	+	--	n.s.	n.s.	++	+++	-		---	n.s.	--	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	---	n.s.	n.s.	n.s.	n.s.	n.s.
SNN	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	--		--	+	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+++	n.s.	--	+	++	n.s.
FHN	+++	n.s.	n.s.	--	n.s.	n.s.	n.s.	n.s.	-		n.s.	--	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--	n.s.	n.s.	n.s.	n.s.
SNM	n.s.	+	n.s.	n.s.	n.s.	---	n.s.	---	++	n.s.		++	n.s.	n.s.	+++	n.s.	n.s.	-	n.s.	+++	n.s.	+	n.s.	n.s.	+
FHM	---	n.s.	n.s.	+++	n.s.	n.s.	n.s.	-	+	-	+++		n.s.	n.s.	++	n.s.	-	--	n.s.	n.s.	+++	+++	n.s.	n.s.	++
SNR	n.s.	n.s.	n.s.	n.s.	n.s.	--	n.s.	--	n.s.	n.s.	++	n.s.		+++	---	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	n.s.	n.s.
FHR	--	n.s.	n.s.	+++	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	+++		---	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
goni	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	n.s.	++	+	n.s.	--		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	++	n.s.	n.s.	n.s.
U1S	n.s.	n.s.	n.s.	n.s.	n.s.	+	n.s.	++	n.s.	n.s.	-	n.s.	n.s.	n.s.	n.s.		+++	n.s.	---	---	-	n.s.	+++	n.s.	n.s.
U1F	+	n.s.	n.s.	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+++		n.s.	---	n.s.	---	n.s.	+++	n.s.	n.s.
L1M	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-		n.s.	n.s.	n.s.	-	n.s.	n.s.	---
UL1	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	n.s.		n.s.	n.s.	n.s.	---	n.s.	n.s.
SNO	n.s.	+	n.s.	n.s.	n.s.	--	n.s.	---	++	n.s.	+++	+	++	n.s.	n.s.	---	n.s.	n.s.	n.s.		+	n.s.	n.s.	+	n.s.
FHO	--	n.s.	n.s.	+++	n.s.	n.s.	n.s.	n.s.	+	--	n.s.	+++	n.s.	+	n.s.	n.s.	--	n.s.	n.s.	++		n.s.	-	n.s.	n.s.
NFM	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	--	n.s.	+	+++	++	++	n.s.	n.s.	--	n.s.	n.s.	n.s.	++	n.s.		n.s.	n.s.	+
U1N	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	--	n.s.	n.s.	n.s.	n.s.	n.s.	+++	+++	n.s.	-	n.s.	n.s.	-		n.s.	n.s.
UMo	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	-	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.		n.s.
LMo	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	+	---	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	

Angular measurements
facia: facial angle, conv: Convexity, AB: A-B plane, Y: Y-axis, Spog: SNPog, SNN: SN-NF, FHN: FH-NF, SNM: SN-MP, FHM: FH-MP, SNR: SN-RP, FHR: FH-RP, goni: gonial angle, U1S: U1-SN, U1F: U1-FH, L1M: L1-MP, UL1: U1-L1, SNO: SN-OP, FHO-FH-OP, NFM: NF-MP, U1N: U1-NF, UMo: UMo-NF, LMo: LMo-MP

n.s.: not significant
-: P<0.05, --: P<0.01, ---: P<0.001 (Negative correlation)
+: P<0.05, ++: P<0.01, +++: P<0.001 (Positive correlation)

tics of the bimaxillary dentoalveolar protrusion in boys. The correlation coefficients between NF-MP and SN-RP angle were negative and positive in girls and boys respectively. It is suggested that in bimaxillary dentoalveolar protrusion children, when NF-MP angle is large, the gonial angle tend to be large in girls and the mandible tend to rotate downward and backward in boys.

Richardson suggested that various facial types behave differently in terms of growth and treatment response.[12] The present trend to treat bimaxillary protrusion malocclusion is extraction of the four first premolar teeth and then retraction of the maxillary and mandibular anterior teeth. This treatment would tend to retract the lips and reduce the convexity of the face. The result would simulate or approach a straight facial profile. Several investigators[13-16] observed that changes in mandibular incisor position might be influenced by the direction of mandibular growth. Bjork[17] noted that the forward rotation of the mandible present in the short facial type influences the path of eruption of the teeth and that in extreme cases, it increases the potential for deepening of the bite and enhances mandibular incisor crowding after treatment. It was found that there were differences in cephalometric characteristics of bimaxillary dentoalveolar protrusion between Taiwanese boys and girls in this study, it would be helpful in determining treatment plan for those children.

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