Cephalometric studies of children with long and short faces

Hung-Huey Tsai*

The purpose of this study was to investigate the facial morphologic characteristics in children with long and short faces. Lateral cephalometric radiographs of 46 children with long faces and 42 children with short faces were used. Both boys and girls with long faces exhibited upright incisors, excessive upper dentoalveolar development, shorter posterior face height, shorter ramus height and mandibular body, greater gonial angle and backward rotation of mandible when compared with those with short faces.
J Clin Pediatr Dent 25(1): 23-28, 2000

INTRODUCTION

Different terminologies have been used to describe facial types: short, average and long face types,[1] poor and good face patterns,[2] forward and backward rotators,[3,4] as well as dolichocephalic and brachycephalic types.[5] The two most common types of vertical facial dysplasia are generally defined as hyperdivergent and hypodivergent.[6] Schendel[4] described the former as "long face syndrome;" Opdebeeck[7] named the latter "short face syndrome.: The hyperdivergent "long face" is characterized by a tendency toward a relatively large face, compared with the hypodivergent "short face".

Normal vertical variations in facial relationships have been noted by many investigators as an expression of differing patterns of growth.[1-3, 5, 8-12] A number of parameters have been used to categorize vertical facial type, including the cant of the mandibular plane,[1-4,6,7,9, 13,14] can't of the palatal plane,[10] ratios of anterior and posterior facial heights,[1-3, 9, 10, 12, 13] as well as the structural morphology of the mandible.[3]

Although it seems that the vertical facial pattern is established early in life and often maintained,[1, 11, 12] there are still insufficient data concerning the basic differences between "long faces" and "short faces" patterns in early mixed dentition stage. The purpose of this study was to investigate the facial morphological characteristics in children at Hellman dental age IIIA with long and short faces.

MATERIALS AND METHODS

All subjects examined in this study were Taiwanese children. 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 and natural head position. Those in which the teeth were not in occlusion or in which lip strain was evident were not included.

Eighty-eight sets of lateral cephalometric radiographs at Hellman dental age IIIA were selected based on the following facial parameters from the records of our department: 1. the ratio of posterior facial height to anterior facial height (facial height ratio: S-Go/N-Me) and, 2. inclination of the mandibular plane relative to Frankfort horizontal plane (FH-MP angle).

The subjects exhibiting the greatest extreme values for these parameters were divided into four groups. Twenty were boys with short faces, twenty were boys with long faces, twenty-two were girls with short faces, and twenty-six were girls with long faces. The selection of these subjects was based on skeletal relationships, without reference to clinical evaluation of the occlusion. The mean values and standard deviations of these parameters for each group are displayed in Table 1.

Table 1. Mean values and standard deviations of face height ratio and FH-MP angle for each group.

		Face height ratio		FH-MP angle	
		mean	s.d.	mean	s.d.
Long face	Boys (N=20)	0.577	0.018	34.990	3.832
	Girls (N=26)	0.571	0.027	37.015	2.319
Short face	Boys (N=20)	0.711	0.024	19.690	3.784
	Girls (N=22)	0.664	0.011	24.773	3.238

* Hung-Huey Tsai, DDS, PhD, Department of Pedodontics, School of Dentistry, China Medical College, 91 Hsueh Shih Road, Taichung 404, Taiwan.

Telephone: 886-4-2055674
Fax number: 886-4-2014043
E-mail address: tasipopo@tcts.seed.net.tw

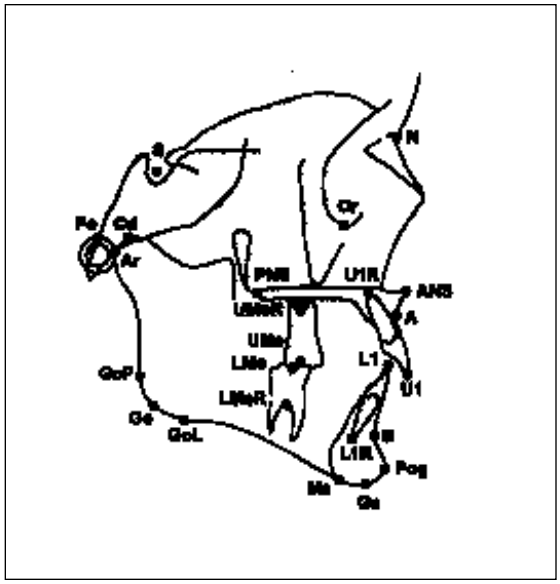

Figure 1. Reference points

S: sella turcica
N: nasion
Or: orbitale
Po: porion
ANS: anterior nasal spine
PNS: posterior nasal spine
A: subspinale
B: supramentale
Cd: condyle
Ar: articular
GoP: posterior gonion
Go: gonion
GoL: lower gonion
Me: menton
Gn: gnathion
Pog: pognion
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

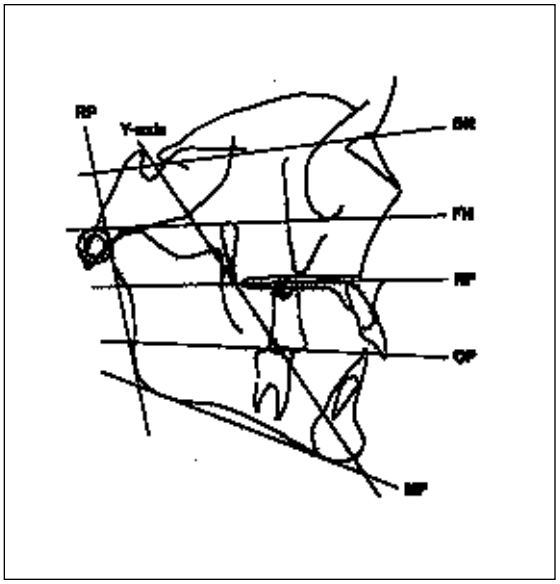

Figure 2. Reference plames

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

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 24 angular measurements illustrated in Figures 3 and 4 were constructed.

The mean values and standard deviations for each measurement were calculated. Statistical (Tables 2 to 5) and graphic (Figures 5 and 6) comparisons were made between long and short facial groups for samples from both boys and girls.

RESULTS

Linear measurements (Tables 2 and 3)

In comparisons of the linear measurements between long and short faces, boys and girls had similar results.

Facial heights

Comparisons of the mean values between long and short faces indicate that the significant differences were in the dimensions of lower facial height and posterior facial height. The children with long faces had greater lower facial height and less posterior facial height, while the children with short faces displayed the opposite characteristics. No significant differences were present between the two facial types in the dimensions of upper facial height.

Maxillary skeletal components

The ANS-PNS distance showed no significantly difference between long and short faces.

Mandibular skeletal components

The size of the ramus and body of the mandible were significantly smaller in children with long faces than children with short faces.

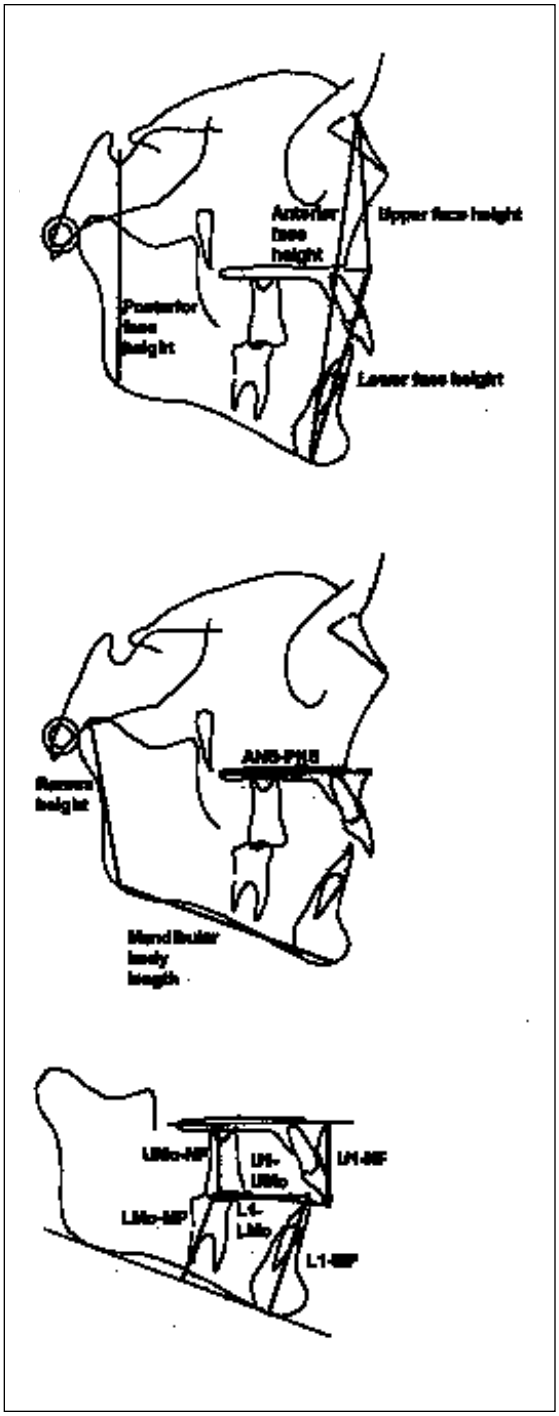

Figure 3. Linear measurements

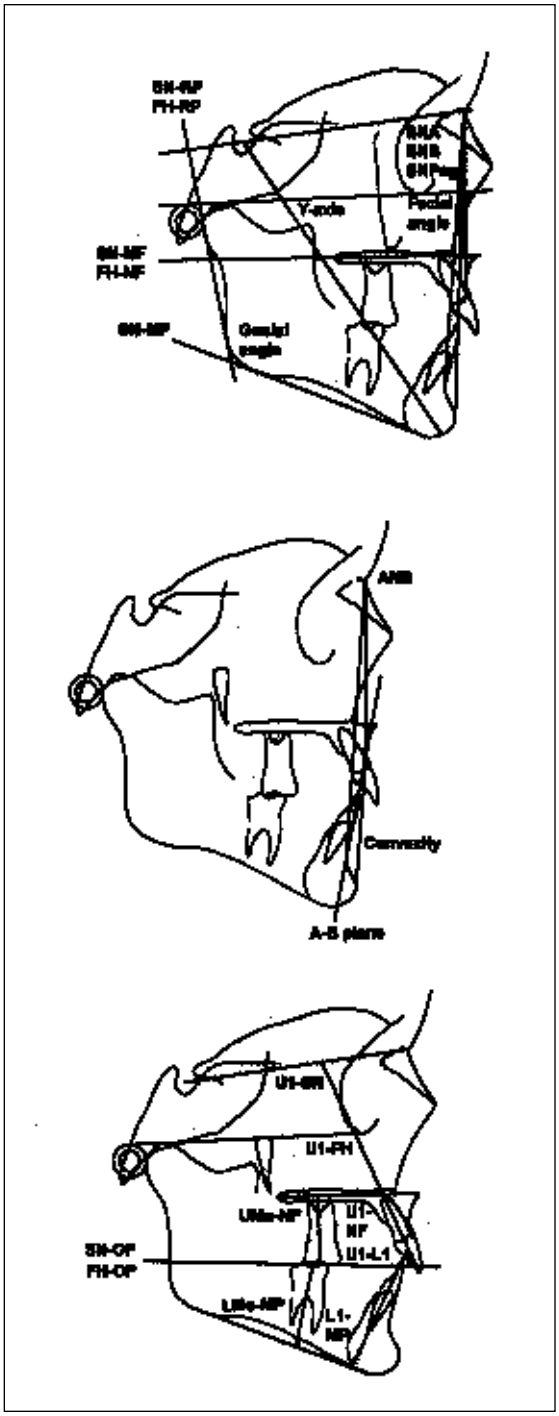

Figure 4. Angular measurements

Dental relationships

The children with long faces had significantly greater upper dentoalveolar height than children with short faces. Angular measurements are in Tables 4 and 5.

Maxillary relationships

The long face girls had significantly smaller SNA angles than the short face girls did. The long face boys had significantly greater SN-NF angles than the short face boys did.

Mandibular relationships

Differences in mean Y-axis, SN-MP and gonial angle were clearly evident between the two facial types, irrespective of sex. The children with long faces of both sexes had larger angles, with the values for the boys actually exceeding those for the girls.

Table 2. Statistical comparisons of linear measurements between long and short faces for girls.

Linear measurements (mm)	Long face (N=26)		Short face (N=22)		
	Mean	s.d.	Mean	s.d.	*t*-test
Face height					
Upper face height	51.054	2.283	52.600	3.575	n.s.
Lower face height	67.938	3.639	63.909	4.236	p<0.001
Anterior face height	116.531	5.024	114.245	7.371	n.s.
Posterior face height	66.615	5.090	75.873	5.830	p<0.001
Maxilla					
ANS-PNS	49.338	4.051	50.345	3.953	n.s.
Mandible					
Mandibular body length	68.323	4.790	74.360	7.251	P=0.003
Ramus height	49.515	3.608	53.327	5.129	P=0.004
Dental relationships					
U1-NF	28.500	3.174	26.318	2.683	p=0.014
UMo-NF	19.391	1.528	18.277	1.799	p=0.015
U1-UMo	38.977	4.225	38.455	4.724	n.s.
L1-MP	40.569	3.066	39.455	3.332	n.s.
LMo-MP	30.246	2.297	31.427	2.619	n.s.
L1-LMo	35.277	3.709	35.464	3.490	n.s.

Table 3. Statistical comparisons of linear measurements between long and short faces for boys.

Linear measurements (mm)	Long face (N=20)		Short face (N=20)		
	Mean	s.d.	Mean	s.d.	*t*-test
Face height					
Upper face height	50.740	3.998	49.920	3.757	n.s.
Lower face height	68.760	4.525	60.790	4.024	p<0.001
Anterior face height	115.830	7.654	108.720	6.783	p=0.010
Posterior face height	66.810	5.044	77.290	4.676	p<0.001
Maxill66.170a					
ANS-PNS	51.730	6.809	50.270	3.441	n.s.
Mandible					
Mandibular body length	66.170	5.687	71.190	4.571	p=0.003
Ramus height	49.920	3.502	54.960	3.649	p<0.001
Dental relationships					
U1-NF	29.790	3.105	25.320	2.550	p<0.001
UMo-NF	19.240	1.861	18.000	1.067	p=0.021
U1-UMo	38.780	4.491	40.040	4.628	n.s.
L1-MP	41.850	3.393	38.310	2.180	p<0.001
LMo-MP	29.690	1.921	30.880	2.488	n.s.
L1-LMo	35.370	2.141	34.940	2.517	n.s.

Jaw relationships

In the vertical jaw relationships, the children with long faces had significantly greater NF-MP angles than the children with long faces. There were no significant differences in the anteroposterior jaw relationships between the two facial types for girls, however the boys with long faces had disharmony of anteroposterior jaw relationships when compared with boys with short faces.

Dental relationships

The mean values for the upper incisal angles and occlusal plane angles revealed significant differences between the two facial types in both sexes. The children with long faces had upright upper incisors and significant greater occlusal plane angles than the children with short faces.

DISCUSSION

The skeletal differences that lead to disproportionate facial height in long and short faces were related to the mandibular morphology. The length of the body and ramus of the mandible in children with long faces was smaller, but the gonial angle was greater. On the other hand, increased posterior ramus height, increased

Table 4. Statistical comparisons of angular measurements between long and short faces for girls.

Linear measurements (°)	Long face (N=26)		Short face (N=22)		
	Mean	s.d.	Mean	s.d.	*t*-test
Maxilla					
SNA	78.300	2.399	81.727	3.869	p=0.002
SN-NF	8.138	3.264	8.645	2.524	n.s.
FH-NF	-2.362	2.732	-1.173	3.342	n.s.
Mandible					
Facial angle	79.285	3.083	85.482	2.850	p<0.001
Y-axis	66.792	2.190	61.636	2.238	p<0.001
SNB	74.085	3.344	78.182	2.964	p<0.001
SNPog	73.508	3.558	78.009	3.023	p<0.001
SN-MP	42.792	3.112	32.282	1.614	p<0.001
SN-RP	92.500	5.548	93.373	5.456	n.s.
FH-RP	86.715	4.947	85.891	5.777	n.s.
Gonial angle	130.300	5.494	118.900	6.374	p<0.001
Jaw relationships					
NF-MP	34.669	2.074	23.618	2.116	p<0.001
Convexity	9.738	6.077	8.018	6.121	n.s.
A-B plane	-5.169	3.391	-5.400	4.455	n.s.
ANB	4.208	2.625	3.527	2.653	n.s.
Dental relationships					
U1-SN	105.231	4.073	109.727	9.475	p<0.002
U1-FH	111.000	3.648	117.236	9.414	p<0.001
U1-NF	113.346	3.512	118.382	9.728	p=0.004
L1-MP	89.085	8.343	96.509	6.109	p<0.001
U1-L1	122.908	9.407	121.473	11.627	n.s.
SN-OP	24.362	3.743	19.182	2.665	p<0.001
FH-OP	18.569	3.355	11.691	3.133	p<0.001
UMo-NF	70.723	6.524	74.600	4.973	p=0.007
LMo-MP	90.915	8.343	83.491	6.109	p<0.001

Table 5. Statistical comparisons of angular measurements between long and short faces for boys.

Linear measurements (°)	Long face (N=20)		Short face (N=20)		
	Mean	s.d.	Mean	s.d.	*t*-test
Maxilla					
SNA	81.030	3.046	82.860	2.744	n.s.
SN-NF	9.190	2.429	6.160	3.078	p=0.001
FH-NF	-0.610	3.549	0.740	3.951	n.s.
Mandible					
Facial angle	81.880	3.446	87.580	3.706	p<0.001
Y-axis	65.010	3.399	58.500	3.272	p<0.001
SNB	74.030	2.309	79.730	2.928	p<0.001
SNPog	73.300	2.373	80.660	2.731	p<0.001
SN-MP	43.570	2.803	26.600	2.520	p<0.001
SN-RP	94.240	4.473	89.020	6.618	p<0.006
FH-RP	85.660	4.217	82.120	5.804	n.s.
Gonial angle	129.310	4.155	117.570	6.144	p<0.001
Jaw relationships					
NF-MP	34.380	2.283	20.440	2.223	p<0.001
Convexity	15.380	6.008	4.600	3.984	p<0.001
A-B plane	-8.580	3.866	-5.590	3.091	p=0.021
ANB	7.000	2.902	3.120	1.985	p<0.001
Dental relationships					
U1-SN	102.150	6.823	113.330	8.784	p<0.001
U1-FH	110.710	7.738	120.250	6.880	p<0.001
U1-NF	111.340	7.929	119.500	8.655	p=0.004
L1-MP	93.420	4.644	96.630	8.039	n.s.
U1-L1	120.870	9.320	123.440	6.934	n.s.
SN-OP	24.230	2.066	15.490	3.202	p<0.001
FH-OP	15.670	3.043	8.560	2.762	p<0.001
UMo-NF	69.870	6.255	72.510	5.808	n.s.
LMo-MP	86.580	4.644	83.370	8.039	n.s.

mandibular body length, and prominent pogonion were characteristic features of the children with short faces.

The horizontal facial planes were steeper in the children with long faces than in the children with short faces whose facial planes were more parallel. Previously reported studies[15] found that anteroposterior inclination of the palatal plane is stable and that it is established at an early age. There were no differences in the orientation of the nasal floor to the FH plane and in the dimensions of upper facial height between the two facial types in this study. These findings indicated that the area of significant difference among the two groups were located below the palatal plane.

Since the magnitude of the mandibular plane angle is often assumed to be a determinant in the rotation pattern observed during facial growth[4,7,16-23], the increased angle of the mandibular plane found in persons with long faces was associated with a backward rotational growth pattern, which can affect the vertical proportions of the anterior component of the face.

With regard to the dentoalveolar length, the upper first molar tends to be extruded downward in children with long faces, carrying the mandible backward and, consequently, the lower anterior face height and the palatomandibular angle increase. Downward and backward rotation of the mandible in long face children may be precommitted in response to dentoalveolar compensatory changes. The boys and girls with long faces exhibited upright and extruded incisors when compared with those with short faces. These differences are believed to be compensatory mechanisms in children with long faces, which may attempt to mask the vertical dysplasia, thereby producing a more normal facial profile. The molars are the first teeth to come in contact with each other and, as a result, the remaining anterior teeth erupt vertically to maintain contact with the opposing teeth, thus contributing to the change in the dentoalveolar length.

Proffit and Fields[24] reported that occlusal forces in children with long faces are not different from those in normal children. Since morphologic differences in children can be detected before functional alterations are obvious, it seems unlikely that weak masticatory muscles can be the major cause of the long facial pattern in these children.

REFERENCES

1. Bishara SE, Jakobsen JR. Longitudinal changes in three normal facial types. Am J Orthod 88: 466-502, 1985.
2. Wylie WL, Johnson EL. Rapid evaluation of facial hyperplasia in the vertical plane. Angle Orthod 22: 165-182, 1952.
3. Skieller V, Bjork A, Linde-Hansen T. Prediction of mandibular growth rotation evaluated from a longitudinal implant sample. Am J Orthod 86: 359-370, 1984.
4. Schendel SA, Eisenfeld J, Bell WH, Epker BN, Mishelevich DJ. The long face syndrome: vertical maxillary excess. Am J Orthod 70: 398-408, 1976.
5. Lavelle CL. A study of craniofacial form. Am J Orthod 49: 65-72, 1979.
6. Schudy FF. Vertical growth versus anteroposterior growth as related to function and treatment. Angle Orthod 34: 75-93, 1964.
7. Opdebeeck H, Bell WH. The short face syndrome. Am J Orthod 73: 499-511, 1978.
8. Bjork A. Prediction of mandibular growth rotation. Am J Orthod 55: 585-599, 1969.
9. Isaacson JR, Isaacson RJ, Speidel TM, Worms FW. Extreme variation in vertical facial growth and associated variation in skeletal and dental relations. Angle Orthod 41: 219-229, 1971.
10. Ghafari J, Brin I, Kelley MB. Mandibular rotation and lower face height indicators. Angle Orthod 59: 31-36, 1989.
11. Cleall JF, BeGole EA, Chebib FS. Craniofacial morphology: A principal component analysis. Am J Orthod 75: 650-666, 1979.
12. Nanda SK. Patterns of vertical growth in the face. Am J Orthod Dentofac Orthop 93: 103-116, 1988.
13. Bittner C, Pancherz H. Facial morphology and malocclusions. Am J Orthod Dentofac Orthop 97: 308-315, 1990.
14. Enlow DH, Pfister C, Richardson E, Kuroda T. An analysis of Black and Caucasian craniofacial patterns. Angle Orthod 52: 279-287, 1982.
15. Bjork A, Skieller V. Facial development and tooth eruption: an implant study at the age of puberty. Am J Orthod 62: 339-383, 1972.
16. Nahoum HI. Vertical proportions and the palatal plane in anterior open-bite. Am J Orthod 59: 273-282, 1971.
17. Nahoum HI. Anterior open-bite: a cephalometric analysis and suggested treatment procedures. Am J Orthod 67: 513-521, 1975.
18. Epker BN, Fish LC. Surgical-orthodontic correction of open-bite deformity. Am J Orthod 71: 278-299, 1977.
19. Fish LC, Wolford LM, Epker BN. Surgical-orthodontic correction of vertical maxillary excess. Am J Orthod 73: 241-257, 1978.
20. Trouten JC, Enlow DH, Rabine M, Phelps AE, Swedlow D. Morphologic factors in open-bite and deep-bite. Angle Orthod 53: 192-211, 1983.
21. Cangialosi TJ. Skeletal morphologic features of anterior open bite. Am J Orthod 85: 28-36, 1984.
22. Fields HW, Proffit WR, Nixon WL, Phillips C, Stanek E. Facial pattern differences in long-faced children and adults. Am J Orthod 85: 217-223, 1984.
23. Siriwat PP, Jarabak JR. Malocclusion and facial morphology: is there a relationship? An epidemiologic study. Angle Orthod 55: 127-138, 1985.
24. Proffit WR, Fields HW. Occlusal forces in normal- and long-face children. J Dent Res 62: 571-574, 1983.