Craniofacial pattern of Class III deciduous dentition

Hong-Po Chang, DDS, DDSc; Zennosuke Kinoshita, DDS, DMSc; and Tatsuo Kawamoto, DDS, DDSc

Class III malocclusion or mandibular prognathism has long been viewed as one of the most severe facial deformities. In 1778, John Hunter, addressing this problem, stated: "It is not uncommon to find the lower jaw projecting too far forwards, so that its fore teeth pass before those of the upper jaw, when the mouth is shut; which is attended with inconvenience, and disfigures the face."[1]

While this problem has long been recognized, one area that has not received much attention is the cranio-dento-facial pattern at the time Class III malocclusion first becomes apparent. This study compared skeletal and dental relations in children with Class III deciduous dentition to Class I norms, in search of an answer to the following questions: Do young children with Class III malocclusions in the primary dentition have different cranio-dento-facial patterns than children with Class I dentitions? Are the typical skeletal and dental characteristics of Class III adults already present in growing children?

Materials and methods

Lateral cephalometric radiographs of Chinese children in Taiwan with primary dentition in Hellman's developmental stage IIA were obtained from the files of the Department of Orthodontics, School of Dentistry, Kaohsiung Medical College. The sample comprised 40 cases with normal occlusion and 40 cases with Class III malocclusion. Each occlusion group was composed of 20 boys and 20 girls. In the Class III group, the mesiobuccal cusp of the maxillary second primary molar occluded posteriorly to the buccal groove of the mandibular second primary molar. This was determined by clinical evaluation of each subject in centric relation in order to rule out functional

Abstract

The purpose of this study was to investigate the morphological characteristics of the cranio-dento-facial complex of children with deciduous dentition and Class III malocclusion. Forty Chinese children in Taiwan with normal occlusion and 40 with Class III malocclusion in deciduous dentition were selected for cephalometric analysis. Mandibular length was significantly greater and the mandible was situated farther forward in the Class III group. The maxilla was also slightly backward in this group, perhaps in association with the shorter maxillary length. The mandibular incisors were tipped lingually to compensate for the intermaxillary skeletal dysplasia and the maxillary incisors were tipped lingually by the retroinclined mandibular incisors.

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Key Words

Cephalometrics • Deciduous dentition • Normal occlusion • Class III malocclusion • Craniofacial pattern • Chinese in Taiwan

Figure 1
Cephalometric landmarks and planes

Figure 2
Cranial base relationships.
1=S-N (mm)
2=S-Ba (mm)
3=N-S-Ba
4=FH to SN

Figure 3
Maxillary skeletal relationships
5=SNA
6=FNA
7=A-NV (mm)
8=SN to PP
9=FH to PP
10=A'-Ptm' (mm)

Figure 4
Mandibular skeletal relationships
11=SNB
12=SNPog
13=FNB
14=Facial angle
15=B-NV (mm)
16=Pog-NV (mm)
17=SN to MP
18=FMA
19=Cd-Gn (mm)
20=Pog'-Go (mm)
21=Cd-Go (mm)
22=N-S-Ar
23=FH to S-Ar
24=Ramus inclination (SN)
25=Ramus inclination (FH)
26=Gonial angle

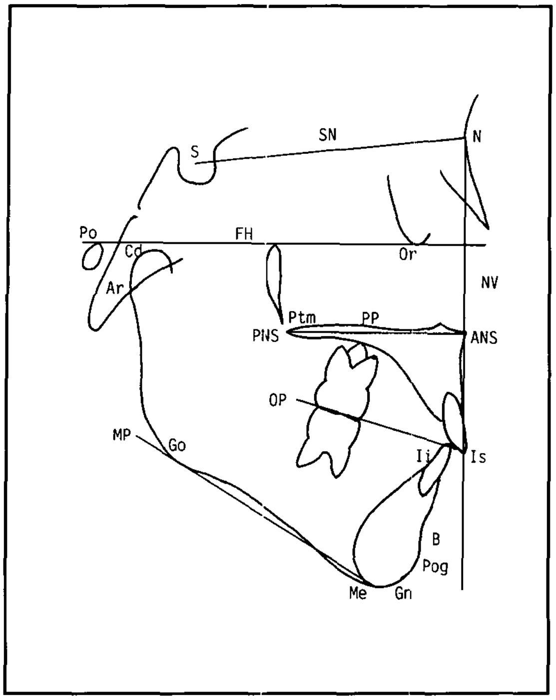

Figure 1

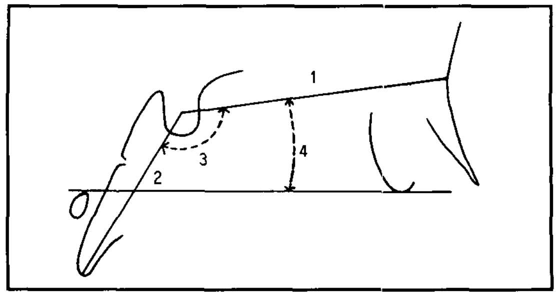

Figure 2

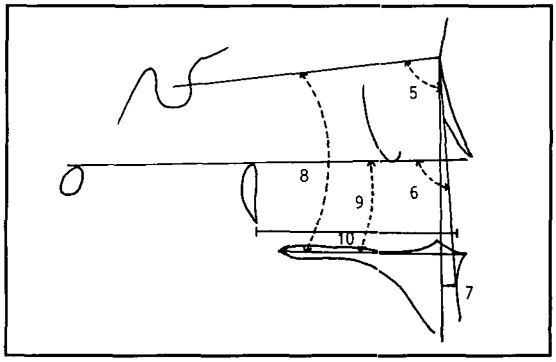

Figure 3

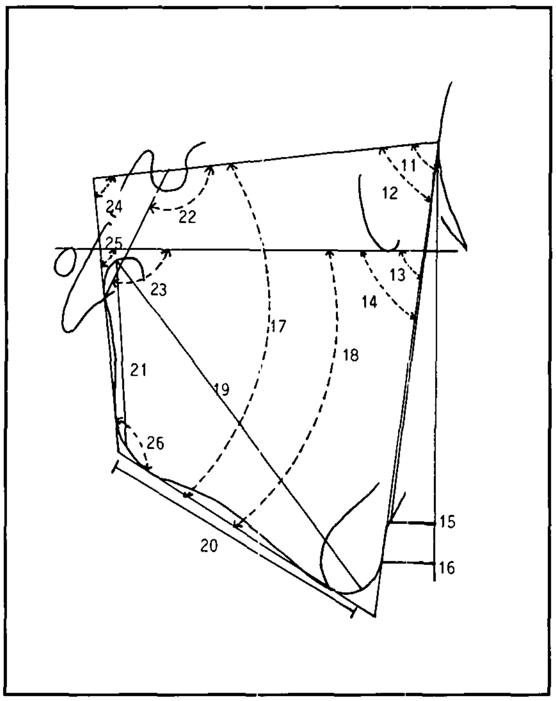

Figure 4

Class III malocclusions.

Each film was traced and cephalometric landmarks were determined (Figure 1). They were then digitized into an X-Y coordinate system. Cephalometric measurements used (Figures 2 to 9) were the common measures adopted from the analyses of Björk,[2-3] Chang,[4,5] Downs,[6-8] Jacobson,[9-10] Steiner,[11-14] Tweed[15-16] and the dimensional linear method of Sakamoto and Iizuka[17] and Sakamoto, Miura and Iizuka.[18]

The significance of the mean differences between the two groups was subjected to the Student t-test.

Results (Table 1)

Cranial base relationships (Figure 2)

There were no significant differences in the anterior cranial base length (S-N), the posterior cranial base length (S-Ba), or the cranial base angle (N-S-Ba) between the two groups. The angle between S-N and the Frankfort horizontal plane was significantly smaller in the Class III group ($p<0.01$).

Maxillary skeletal relationships (Figure 3)

The anteroposterior position of the maxilla relative to the cranial base and the cranial structures, as indicated by the FNA angle and the A-NV distance, was significantly smaller in the Class III group. However, the SNA angle was similar for the two groups. There were no significant differences in the maxillary or palatal plane angles between the two groups in both cranial planes of orientation (SN to PP and FH to PP). The maxillary length (A'-Ptm') was significantly smaller in the Class III group ($p<0.01$).

Mandibular skeletal relationships (Figure 4)

Six measurements used to determine the anteroposterior position of the mandible relative to upper craniofacial structures (SNB, SNPog, FNB, facial angle, B-NV, and Pog-NV) were significantly greater in the Class III group, indicating a more forward positioning of the entire mandible ($p<0.001$). The mandibular plane angles showed different results with different cranial planes of orientation. The SN to MP angle was

Table 1
Cranio-dento-facial measurements of Chinese children in Taiwan with normal occlusion and with Class III malocclusion in the deciduous dentition

	Normal Occlusion		Class III malocclusion		t-test	
	Mean	S.D	Mean	SD	(Probability)	
Cranial base						
S-N (mm)	62.80	3.08	61.73	3.06	1.55	N.S.
S-Ba (mm)	39.65	2.08	39.92	2.24	0.55	N.S.
N-S-Ba	130.72	4.64	129.10	4.44	1.59	N.S.
FH to SN	8.07	2.14	6.76	1.87	2.91	**
Maxillary Skeletal						
SNA	81.88	3.43	81.72	3.88	0.19	N.S.
FNA	89.96	2.38	88.49	3.22	2.32	*
A-NV (mm)	-0.11	2.17	-1.35	2.82	2.20	*
SN to PP	7.44	3.31	6.84	2.92	0.85	N.S.
FH to PP	-0.64	2.33	0.07	2.54	1.30	N.S.
A'-Ptm' (mm)	42.89	1.81	41.70	1.90	2.86	**
Mandibular skeletal						
SNB	77.32	3.00	80.79	2.89	5.26	***
SNPog	76.40	3.09	79.87	2.81	5.25	***
FNB	85.40	2.12	87.56	2.37	4.29	***
Facial angle	84.48	2.34	86.64	2.38	4.09	***
B-NV (mm)	-6.82	3.34	-3.62	3.55	4.15	***
Pog-NV (mm)	-9.27	4.21	-5.54	3.96	4.08	***
FMA	27.76	3.81	27.27	3.41	0.60	N.S.
SN to MP	35.83	3.96	34.03	3.63	2.11	*
Cd-Gn (mm)	94.45	4.18	96.45	4.18	2.13	*
Pog'-Go (mm)	61.98	2.72	62.59	3.53	0.86	N.S.
Cd-Go (mm)	45.74	2.66	45.85	3.19	0.16	N.S.
N-S-Ar	122.36	4.38	121.43	5.02	0.88	N.S.
FH to S-Ar	114.28	3.72	114.67	4.34	0.43	N.S.
Gonial angle	125.44	4.82	128.16	4.29	2.66	**
Ramus incl. (FH)	82.31	3.57	79.10	4.01	3.78	***
Ramus incl. (SN)	90.39	3.89	85.86	4.14	5.04	***
Intermaxillary skeletal						
ANB	4.56	1.53	0.92	1.73	9.96	***
Angle of convexity	11.60	3.91	3.87	4.29	8.42	***
AO-BO (mm)	-1.56	1.63	-4.93	1.72	8.99	***
AF-BF (mm)	6.71	2.08	2.48	2.11	9.02	***
PP to MP	28.39	3.79	27.18	3.14	1.55	N.S.
Maxillary dental						
UI to SN	91.58	5.28	88.22	4.81	2.97	**
UI to FH	99.66	5.05	94.99	4.87	4.20	***
Mandibular dental						
IMPA	86.81	6.21	81.21	5.75	4.18	***
FMIA	65.42	7.06	71.51	5.65	4.25	***
Intermaxillary dental						
Interincisal	145.75	9.26	156.52	7.78	5.63	***
SN to OP	22.10	3.30	18.50	2.96	5.13	***
FH to OP	14.02	2.86	11.73	2.68	3.69	***
Overbite	1.41	0.79	2.46	1.47	3.97	***
Overjet	2.52	0.74	-2.03	0.59	30.40	***
Facial heights						
N-Me (mm)	101.46	4.99	100.18	4.20	1.24	N.S.
N-ANS (mm)	44.54	3.30	43.95	2.21	0.93	N.S.
ANS-Me (mm)	58.95	3.05	57.38	3.33	2.19	*

*N.S. = not significant (p>0.05); *p<0.05 **p<0.01; ***p<0.001*

Figure 5
Intermaxillary skeletal relationships
27=ANB
28=Angle of convexity
29=AO-BO (mm)
30=AF-BF (mm)
31=PP to MP

Figure 6
Maxillary dental relationships
32=UI to SN
33=UI to FH

Figure 7
Mandibular dental relationships
34=IMPA
35=FMIA

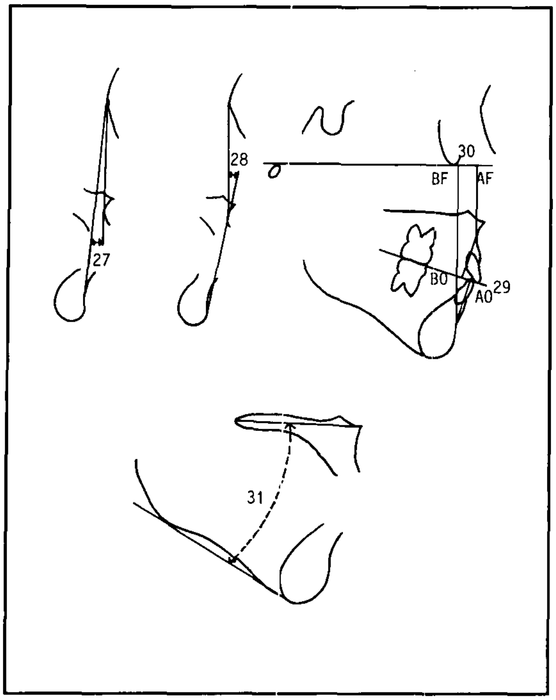

Figure 5

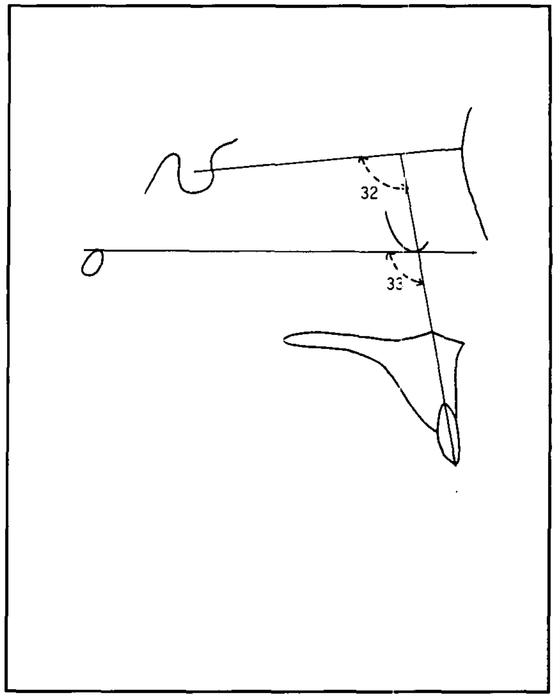

Figure 6

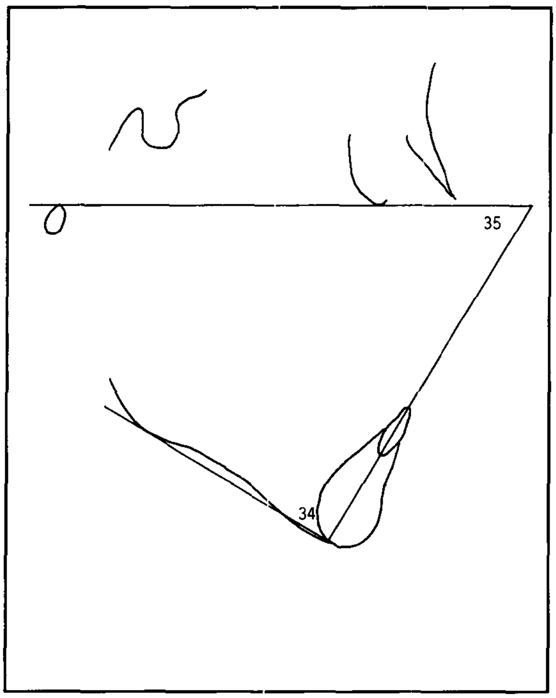

Figure 7

significantly smaller in the Class III group, whereas the Frankfört mandibular plane angle (FMA) did not differ significantly.

Mandibular body length (Pog'-Go) and ramus height (Cd-Go) showed similar mean values. Mandibular length (Cd-Gn) was significantly greater in the Class III group.

Saddle angle (N-S-Ar) and the angle from FH to S-Ar were similar in the two groups, indicating similar anteroposterior positions of the temporomandibular joints. The angles between the posterior border of the mandibular ramus and SN plane, and between the ramus and the FH plane, were significantly smaller in the Class III group, indicating a more forward position of the gonion. The mean gonial angle in the Class III group was about 2.7 degrees greater than in the controls ($p<0.01$).

Intermaxillary skeletal relationships (Figure 5)

All four measures of relative maxillary and mandibular horizontal positions (ANB angle, angle of convexity, Wits appraisal, and AF-BF distance) showed highly significant differences between the normal occlusion and Class III groups ($p<0.001$). The angle between the maxillary or palatal plane and the mandibular plane (PP to MP) was not significantly different between the two groups.

Maxillary dental relationships (Figure 6)

Two measures of maxillary incisor anteroposterior position (UI to SN and UI to FH) were used in this study. Compared with the controls, the Class III group showed significant maxillary incisor retrusion.

Mandibular dental relationships (Figure 7)

Two measures of mandibular incisor horizontal position (IMPA and FMIA) showed significant mandibular incisor retrusion in the Class III group.

Intermaxillary dental relationships (Figure 8)

The interincisal angle was significantly greater in the Class III group ($p<0.001$). The occlusal plane angles (SN to OP and FH to OP) were significantly smaller for the Class III sample.

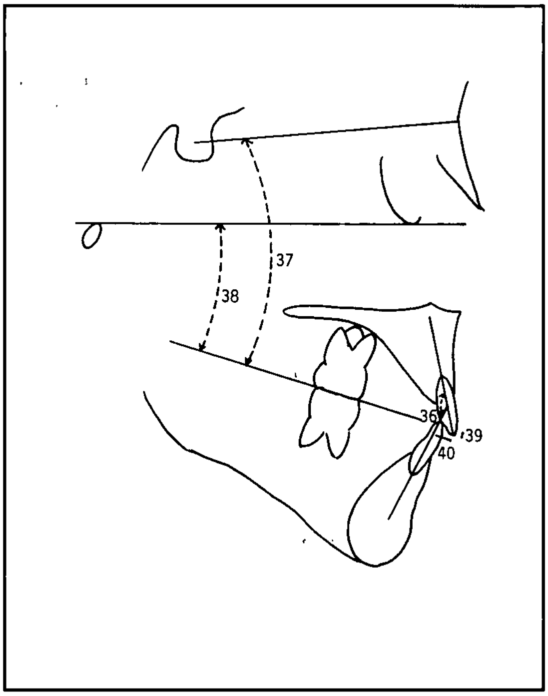

Figure 8

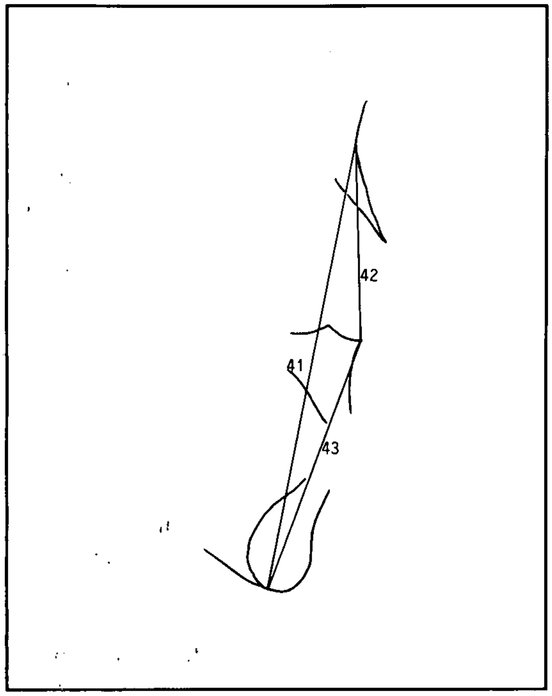

Figure 9

Figure 8
Intermaxillary dental relationships
36=Interincisal angle
37=SN to OP
38=FH to OP
39=Overbite
40=Overjet

Figure 9
Facial heights
41=N-Me (mm)
42=N-ANS (mm)
43=ANS-Me (mm)

Incisor overbite was significantly larger in the Class III group. Incisor overjet in this group, which was negative, was significantly different from the controls.

Facial Heights (Figure 9)

The anterior upper facial height (N-ANS) and the total facial height (N-Me) were similar for the two groups, whereas the anterior lower facial height (ANS-Me) was significantly different ($p<0.05$). The ANS-Me value was smaller in the Class III group.

Discussion

Skeletal differences

The most significant differences between the Class III and the normal occlusion groups in children with primary dentition were found in the anteroposterior intermaxillary skeletal relationships. The ANB angle, angle of convexity, Wits appraisal, and AF-BF distance all had significantly smaller mean values in the former group. These marked intermaxillary skeletal differences reflect a forward positioning of the mandible relative to the upper craniofacial structures. The positioning was reflected by the mean SNB, SNPog, FNB, facial angle, B-NV and Pog-NV measurements, which were significantly larger in the Class III group.

The position of the maxilla relative to the cranial base and cranial structure, as determined by measurement of the FNA angle and A-NV distance, was significantly different between the two groups. At the same time, there was also a significantly shorter maxillary length (A'-Ptm') in the Class III group. The more forward position of the gonion contributed to a more obtuse gonial angle in the Class III group.

Dental differences

Compensating for the intermaxillary skeletal dysplasia during mandibular protrusion in the Class III sample, the mandibular incisors were tipped lingually. The lower incisor retroinclination may be the result of a restraining effect of the orbicularis oris musculature on the crowns as the roots are carried forward by the protruding mandible.[19]

Likewise, the maxillary incisors were also tipped lingually in the Class III group. In contrast to the deciduous dentition in the children in the Class III group, the maxillary incisors in the adults were more proclined.[5] Compared with the controls, the maxillary incisors in the Class III children with late mixed dentition and early permanent dentition showed no significant difference in the angulation relative to the upper craniofacial structures.[20] This may be due to the dominance of mandibular growth in adults. The maxillary incisors in Class III adults may be tipped labially by the tongue while the maxillary incisors in the deciduous Class III group are tipped lingually by the retroinclined mandibular incisors.

Clinical implications

This study indicated that Class III subjects in the primary dentition have significantly longer mandibular length, primarily because of an increased gonial angle and a slightly backward and shorter maxilla. However, mandibular body length and ramus length did not differ significantly between the Class III subjects and the Class I controls.

Chin cup therapy contributes to the correction of Class III malocclusion in several ways. First, by rotating the mandible posteriorly, the ramus is placed in a more vertical orientation to the upper craniofacial structures. Second, by overcoming the changes introduced by backward mandibular rotation, the gonial angle is decreased and the mandibular plane is re-established. Finally, vertical condylar growth is inhibited.[21-23]

Because the deciduous Class III malocclusion is generally characterized by maxillary retrusion, chin cup therapy may not be the treatment of choice. The orthopedic effects of facial mask therapy, include anterior displacement of the bony maxilla and backward redirection or inhibition of mandibular growth,[24-26] both of which served to lessen the skeletal disharmony of Class III malocclusion

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