Early dentofacial features of Class II malocclusion: A longitudinal study from the deciduous through the mixed dentition

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A group of 25 untreated subjects with Class II malocclusion in the deciduous dentition (featuring the concomitant presence of distal step, Class II deciduous canine relationship, and excessive overjet) was compared with a control group of 22 untreated subjects with ideal occlusion (flush terminal plane, Class I deciduous canine relationship, minimal overbite, and overjet) at the same dentitional stage. The subjects were monitored during a 2½-year period in the transition from the deciduous to the mixed dentition, during which time no orthodontic treatment was provided. Occlusal analysis of the Class II group in the deciduous dentition revealed an average interarch transverse discrepancy due to a narrow maxillary arch relative to the mandible. All occlusal Class II features were maintained or became exaggerated during the transition to the mixed dentition. The skeletal pattern of Class II malocclusion in the deciduous dentition typically was characterized by significant mandibular skeletal retrusion and mandibular size deficiency. During the period examined, cephalometric changes consisted of significantly greater maxillary growth increments and smaller increments in mandibular dimensions in the Class II sample. Moreover, a greater downward and backward inclination of the condylar axis relative to the mandibular line, with consequent smaller decrements in the gonial angle, were found in the Class II group, an indication of posterior morphogenetic rotation of the mandible in patients with Class II malocclusion occurring during the period examined. The results of this study indicate that the clinical signs of Class II malocclusion are evident in the deciduous dentition and persist into the mixed dentition. Whereas treatment to correct the Class II problem can be initiated in all three planes of space (e.g., RME, extraoral traction, functional jaw orthopedics), other factors such as patient cooperation and management must also be taken into consideration before early treatment is started. (Am J Orthod Dentofac Orthop 1997;111:502-9.)

Occlusal features of the Class II malocclusion during the transition from the deciduous to the mixed dentition have been investigated by several authors in the past. For example, Fröhlich[1] reported that no improvement of Class II occlusal relationship occurs from 5 to 12 years of age. Moyers and Wainright[2] stated that a distal step in the deciduous dentition likely reflects an underlying skeletal imbalance and typically results in a Class II malocclusion occurring in the permanent dentition. Arya and coworkers[3] observed that all patients presenting with a distal-step relationship of the second deciduous molars ultimately demonstrated a Class II relationship of the permanent molars. These observations were confirmed by Bishara and colleagues[4] who concluded that Class II malocclusion, when diagnosed on the basis of the occlusal features, never is "self-correcting" in growing patients.

In contrast to the occlusal features, the skeletal characteristics of early Class II malocclusion have been examined infrequently. Varrela[5] compared cephalometric values of children at the deciduous dentition stage with Class II occlusal development with those of children at the same developmental stage with normal occlusal development. He found that children with distal occlusion had a shorter

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mandibular corpus and a larger gonial angle relative to those with normal occlusion.

Although Buschang and coworkers[6] pointed out reduced mandibular growth rates in subjects with untreated Class II malocclusion compared with normal controls from 6 to 15 years of age, the nature of growth changes in children with Class II malocclusion from the deciduous through the mixed dentition has not been described in detail. Data concerning this developmental period are of significance in that very early treatment of Class II occlusal and skeletal malrelationships is being advocated frequently. West[7] stated that intervention in patients with Class II malocclusion in the deciduous dentition generally is overlooked in terms of benefits from early treatment. Wieslander[8] has proposed to correct distocclusion in the early mixed dentition with a headgear-Herbst appliance, and Fränkel and Fränkel[9] recommend the treatment of Class II malocclusion associated with significant skeletal and neuromuscular imbalances early in the mixed dentition by means of the function regulator (FR-1 or FR-2). Bishara and coworkers[4] suggest that, in subjects with Class II occlusal features in the deciduous dentition, treatment should be started as soon as the clinician and the patient are ready for treatment to begin.

In light of the paucity of information about early Class II development, this study was designed to determine whether the craniofacial and occlusal patterns already established in the deciduous dentition of young patients with Class II malocclusions are maintained, improved, or worsen during the transition from the deciduous through the mixed dentition.

SUBJECTS AND METHODS

Subjects

Two groups of untreated persons were considered. The first group was comprised of 25 persons diagnosed as having Class II malocclusions in the deciduous dentition. The records on these untreated subjects were obtained from two sources: 17 subjects from the University of Michigan Elementary and Secondary School Growth Study[10,11] and 8 subjects from the Department of Orthodontics at the University of Florence. The selection of subjects was dependent in part on the availability of cephalograms and dental casts at the appropriate time intervals.

The identification of the Class II sample was based on the presence of three concomitant occlusal features in the deciduous dentition: a distal-step relationship of the second deciduous molars, Class II deciduous canines relationship, and excessive overjet. The sample was comprised of 13 boys and 12 girls. The mean age at the first observation during the deciduous dentition (T_1) was 5 years and 8 months ± 9 months. At the second observation (during the mixed dentition; T_2), the mean age was 8 years and 1 month (±1 year, 2 months). All the subjects did not undergo any orthodontic treatment during the observation period. The interval considered averaged 2 years and 6 months ± 9 months in duration (Fig. 1).

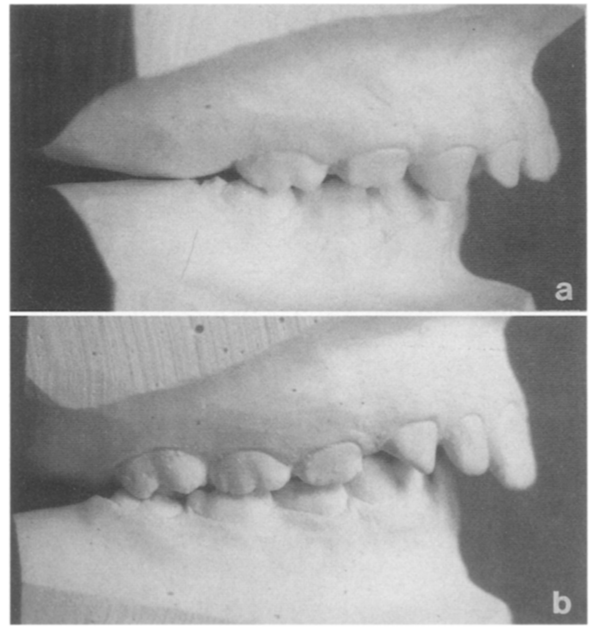

Fig. 1. Progression of Class II occlusal features from deciduous dentition **(a)** through mixed dentition **(b)**.

The second group was comprised of 22 untreated subjects (16 subjects from the University of Michigan Growth Study and 6 subjects from the University of Florence) with ideal occlusion[12] in the deciduous dentition (i.e., flush terminal plane, Class I deciduous canine relationship, minimal overbite, and overjet). The sample consisted of 9 boys and 13 girls. The mean age at first observation (T_1) was 5 years and 5 months ± 6 months; the mean age at second observation (T_2) was 7 years and 8 months ± 9 months; the total observation period was 2 years and 4 months ± 8 months in length.

Additional criteria for subject selection in both Class II and Class I groups included an absence of caries, of posterior and anterior crossbites, of congenitally missing or supernumerary deciduous or permanent teeth, and of cleft lip or cleft palate, and other syndromes.

Cast Analysis

The following measurements were performed on the dental casts of the subjects of both Class II and control groups at T_1 and T_2:

Overjet: The distance from the labial surface of the lower central incisors to the incisal edge of the upper central incisors.

Transverse relationships in the deciduous dentition (T_1):

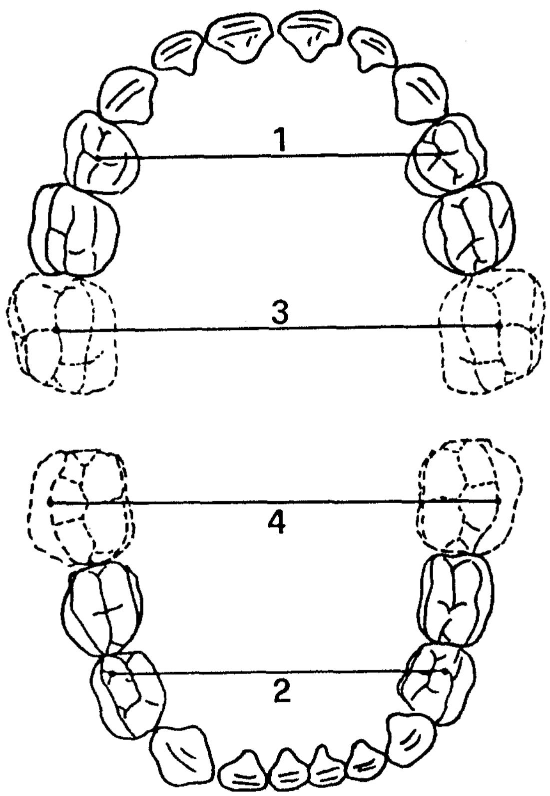

Fig. 2. Transverse measurements on dental casts (see text for explanations).

1. Maxillary deciduous intermolar width, the distance between the central fossae of right and left first maxillary deciduous molars (measurement 1 in Fig. 2).
2. Mandibular deciduous intermolar width, intended as the distance between the tips of the distobuccal cusps of right and left first mandibular deciduous molars (measurement 2 in Fig. 2).
3. Transverse Discrepancy (TD): The difference between maxillary and mandibular deciduous intermolar widths (measurement 1 subtracted from measurement 2 in Fig. 2).

In subjects with ideal occlusion in the deciduous dentition, the tips of the distobuccal cusps of mandibular deciduous molars occlude in the central fossae of the maxillary first deciduous molars.[13]

Transverse relationships in the mixed dentition (T_2):

1. Maxillary intermolar width, measured as the distance between the central fossae of right and left first maxillary permanent molars (measurement 3 in Fig. 2);
2. Mandibular intermolar width measured as the distance between the tips of the distobuccal cusps of right and left first mandibular permanent molars (measurement 4 in Fig. 2);

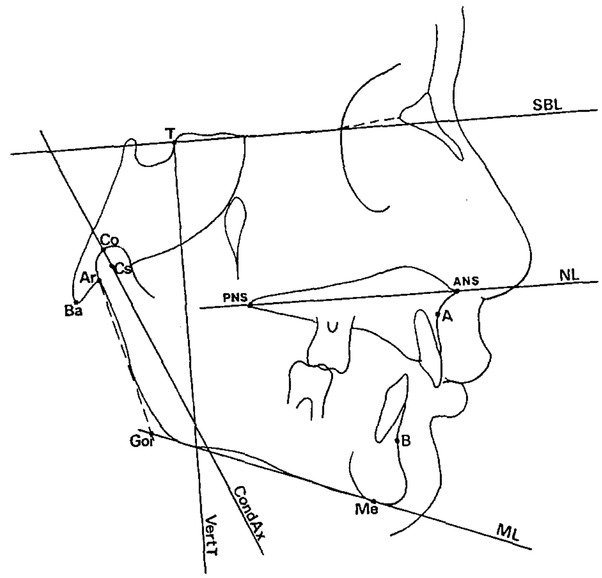

Fig. 3. Landmarks and planes used for cephalometric analysis.

3. Transverse Discrepancy (TD): difference between maxillary and mandibular intermolar widths (measurement 3 subtracted from measurement 4 in Fig. 2).

In Class I molar relationship, the distobuccal cusp of the first mandibular molar occludes with the central fossa of the first maxillary molar.[14]

All the measurements were carried out with a dial caliper to the nearest 0.01 mm. Method error for dental cast measurements, assessed by means of the Dahlberg's formula[15] on 30 repeated measurements that were selected randomly from the total of the observations, was 0.16 mm.

Cephalometric Analysis

Computer-assisted analysis of the serial lateral cephalograms of the two groups was carried out with a digitizer (Numonics 2210, Numonics) and digitizing software (Viewbox, ver. 1.8, as described by Halazonetis[16]). This software program allowed magnification standardization of the cephalograms from the two university sources. In addition, each landmark was digitized twice to reduce method error, as the average location of each cephalometric point was computed and used.

As stated in previous articles,[17,18] reference lines should be traced through stable craniofacial structures in longitudinal cephalometric studies on growing subjects. Consequently, such a cephalometric reference system was adopted (Fig. 3):

1. *Stable Basicranial Line* (SBL). This line is traced through the most superior point of the anterior wall of sella turcica at the junction with tuberculum

Table I. Statistical comparison of occlusal measurements between Class II and control groups

Cast measurements	Class II group (n = 25)					Control group (n = 22)					Mann-Whitney test	
	Mean	SD	Median	Max.	Min.	Mean	SD	Median	Max.	Min.	Z	p
First observation (deciduous dentition)												
Maxillary deciduous intermolar width (mm)	31.05	2.40	31.1	36.2	27.1	33.90	2.42	34	38	27.2	4.354	<0.001
Mandibular deciduous intermolar width (mm)	33.84	2.25	33.6	37.9	30.1	33.88	2.27	34	38	27.3	0.281	ns
Transverse discrepancy (mm)	−2.79	1.06	−2.6	−1.6	−6.4	−0.02	0.25	0	0.3	−0.4	5.861	<0.001
Overjet (mm)	5.84	2.32	5.4	10.1	3.1	0.93	0.27	0.9	1.5	0.4	−5.861	<0.001
Second observation (mixed dentition)												
Maxillary permanent intermolar width (mm)	42.31	2.33	42.2	46.2	38.2	45.25	2.28	44.9	49.4	41.4	3.666	<0.001
Mandibular permanent intermolar width (mm)	46.44	3.09	46	53.5	40.6	45.40	2.5	45	49	42	1.132	ns
Transverse discrepancy (mm)	−4.09	3.03	−2.7	−1.8	−13.1	−0.09	0.43	0	0.5	−0.7	5.859	<0.001
Overjet (mm)	6.73	2.45	6	13.4	3.5	2.02	0.23	2.05	2.4	1.7	−5.860	<0.001

Max., Maximum; *Min.*, minimum.

sellae (Point T[19]), and it is tangent to the lamina cribrosa of the ethmoid. These basicranial structures do not undergo remodeling from the age of 4 to 5 years.[20]

2. *Vertical T* (VertT). A line perpendicular to SBL and passing through Point T.

A cephalometric analysis based on this reference system was constructed using the following landmarks (Fig. 3): Point A (A); Point B (B); Menton (Me); gonial intersection (Goi); articulare (Ar); condylion (Co); center of the condyle (Cs), i.e., a point equidistant from the anterior, posterior, and superior borders of the condylar head; basion (Ba); anterior nasal spine (ANS); and posterior nasal spine (PNS). The definitions of these landmarks correspond to those given by Ødegaard[21]and Riolo and associates.[10]

Linear measurements for the assessment of sagittal relationships: A-VertT, B-VertT, Goi-VertT.
Linear measurements for the assessment of mandibular dimensions: Co-Pg, Co-Goi, Goi-Pg.
Angular measurements for the assessment of cranial base angulation: Ba-T-VertT, Ar-T-VertT.
Angular measurements for the assessment of vertical relationships: Mandibular line (ML)-SBL, nasal line (NL)-SBL, nasal line-mandibular line (NL-ML).
Angular measurements for the assessment of mandibular ramus and condyle inclinations: Gonial angle (Ar-Goi-Me), condylar axis (CondAx)-SBL, CondAx-ML. Condylar axis is a line passing through Point condylion and Point Cs.

Data Analysis

The data from dental cast analysis of the two groups were compared by means of a nonparametric test (Mann-Whitney U test[22,23]) for independent samples ($p < 0.05$) at T_1 and T_2. The cephalometric data of the Class II group were compared with those of Class I group with a Mann-Whitney U test at the time of the first observation.

The homogeneity between the Class II and the Class I samples as to sex, age at the first and second observations, observation period, and, as will be shown, vertical relationships and cranial base angulation at the first observation allowed a comparison of the two groups, which was based on the differences between the values between the two observations for all the cephalometric variables (Mann-Whitney U test). These differences were analyzed further with a multivariate statistical approach (discriminant analysis) to identify those cephalometric variables that reflected the most distinctive skeletal growth changes in early Class II malocclusion. A stepwise variable selection (forward selection procedure) was performed with the goal of obtaining a model with the smallest set of significant cephalometric variables (F to enter and to remove = 4). Finally, the classifying power of selected cephalometric variables was tested.

RESULTS

Occlusal Findings

Descriptive data and statistical comparison for occlusal features in Class II and Class I samples at T_1 (deciduous dentition) and at T_2 (mixed dentition) are reported in Table I.

Deciduous dentition (T_1). All the subjects with Class II malocclusion in the deciduous dentition showed a negative transverse discrepancy between maxillary and mandibular deciduous intermolar widths (−2.8 ± 1.1 mm). As expected in subjects with ideal occlusion,[13] TD was very close to zero in control group. The comparison of the values for maxillary deciduous intermolar width between Class II and ideal Class I groups revealed a significantly narrower maxillary width ($p < 0.001$) in Class II children. No statistically significant difference was assessed for the mandibular deciduous intermolar width. Overjet was significantly larger ($p < 0.001$) in Class II group in comparison to controls. Mean

Table II. Descriptive statistics for cephalometric measurements in Class II group

Cephalometric measurements	Class II group (n = 25)									
	First observation					Second observation				
	Mean	SD	Median	Max.	Min.	Mean	SD	Median	Max.	Min.
A-VertT (mm)	57.57	3.75	57.93	65.37	51.38	60.73	3.86	59.45	70.67	55.50
B-VertT (mm)	46.09	4.18	47.26	53.43	37.51	48.78	4.73	48.11	58.80	38.82
Goi-VertT (mm)	9.05	5.27	9.07	24.53	−1.23	10.00	6.00	9.61	25.01	−1.36
Co-Pg (mm)	88.08	3.32	88.03	96.22	82.36	92.91	4.19	93.04	98.69	84.21
Co-Goi (mm)	42.61	3.14	42.76	48.82	37.19	45.01	3.51	44.40	52.70	38.50
Goi-Pg (mm)	59.39	4.02	59.15	68.91	51.48	63.68	4.41	63.86	73.98	55.27
Ba-T-VertT (degrees)	38.48	4.59	38.74	49.97	30.51	37.23	5.36	37.33	50.95	27.02
Ar-T-VertT (degrees)	33.47	5.39	33.69	45.36	23.58	32.49	5.89	33.32	45.48	21.28
ML-SBL (degrees)	27.64	5.41	27.66	37.91	17.49	25.73	5.45	26.06	35.74	15.47
NL-SBL (degrees)	−0.77	4.23	0.11	6.43	−9.32	−1.11	4.19	−0.55	7.20	−12.38
NL-ML (degrees)	28.17	4.01	29.04	35.09	20.08	26.85	4.03	27.21	35.44	18.39
Ar-Goi-Me (degrees)	129.98	6.30	132.04	142.02	112.11	128.36	5.34	128.29	139.69	114.09
CondAx-SBL (degrees)	69.44	7.01	68.96	82.43	51.00	68.46	5.28	68.65	79.91	58.80
CondAx-ML (degrees)	138.09	6.54	137.67	128.18	152.30	138.11	4.80	138.12	145.02	125.71

Table III. Descriptive statistics for cephalometric measurements in control group

Cephalometric measurements	Control group (n = 22)									
	First observation					Second observation				
	Mean	SD	Median	Max.	Min.	Mean	SD	Median	Max.	Min.
A-VertT (mm)	56.69	3.60	56.34	63.30	49.50	58.38	4.00	58.23	65.54	49.83
B-VertT (mm)	49.38	4.74	48.43	57.84	41.87	51.86	5.49	50.20	64.28	42.88
Goi-VertT (mm)	9.21	4.35	9.77	16.91	−0.72	11.14	4.72	12.01	21.72	0.98
Co-Pg (mm)	90.44	4.06	90.46	99.28	83.48	96.85	3.82	97.04	104.71	88.90
Co-Goi (mm)	42.95	3.07	42.63	49.54	38.04	45.99	2.71	45.66	51.92	42.22
Goi-Pg (mm)	61.00	3.96	60.78	67.16	54.84	66.79	3.63	66.41	73.26	60.64
Ba-T-VertT (degrees)	38.12	4.79	37.51	45.76	28.45	37.33	5.25	36.52	45.88	28.21
Ar-T-VertT (degrees)	33.50	5.15	34.41	40.16	21.89	33.06	5.79	33.24	41.16	21.27
ML-SBL (degrees)	29.24	3.71	29.26	30.49	20.40	27.99	4.22	28.22	34.19	16.57
NL-SBL (degrees)	0.15	3.12	0.13	5.30	−5.05	0.65	3.06	0.35	6.71	−7.12
NL-ML (degrees)	29.09	4.13	29.51	34.07	17.03	27.33	4.47	28.21	34.09	16.69
Ar-Goi-Me (degrees)	130.44	5.8	132.08	139.48	122.00	126.96	5.21	128.54	134.71	117.76
CondAx-SBL (degrees)	68.37	5.74	67.91	77.71	59.70	71.46	8.16	71.66	91.47	58.62
CondAx-ML (degrees)	140.87	5.86	142.11	149.24	125.61	136.53	6.74	137.39	146.58	120.51

overjet in Class II sample was 5.84 mm, with no subject showing a value less than 3.1 mm.

Mixed dentition (T_2): All Class II subjects showed full Class II molar and canine relationships. Overjet was still significantly larger ($p < 0.001$) in Class II subjects than in controls. Mean overjet in Class II sample was 6.7 mm, with no subject showing a value lower than 3.5 mm. Moreover, the subjects maintained a negative transverse discrepancy between maxillary and mandibular intermolar widths in the mixed dentition (−4.1 ± 3.0 mm), due to a significant narrower maxillary arch width ($p < 0.001$). As shown in a previous article,[14] TD was close to zero in subjects with Class I occlusion (controls).

Craniofacial Findings

Descriptive statistics in Class II and Class I groups at T_1 (deciduous dentition) and at T_2 (mixed dentition) are reported in Tables II and III.

A significantly more retruded mandible (B-VertT), associated with a shorter mandibular total length (Co-Pg), was assessed in Class II subjects ($p < 0.05$) at T_1. No other statistically significant differences between Class II and Class I samples, including vertical relationships and cranial base angulation, were found in the deciduous dentition.

Craniofacial Changes from the Deciduous Dentition Through the Mixed Dentition

Statistical analysis of the differences between the first and the second observations for all the cephalometric variables for both groups are listed in Table IV. The Class II group showed significantly larger increments in maxillary protrusion (A-VertT; $p < 0.05$), whereas total mandibular length (Co-Pg) and the length of mandibular body (Goi-Pg) showed significantly smaller increments in Class II group ($p < 0.01$ and $p < 0.05$, respectively) in comparison

Table IV. Descriptive statistics and statistical comparison of growth changes between Class II and control groups

Cephalometric measurements	Differences second-first observations Class II group (n = 25)					Differences second-first observations control group (n = 22)					Mann-Whitney test	
	Mean	SD	Median	Max.	Min.	Mean	SD	Median	Max.	Min.	Z	p
A-VertT (mm)	3.58	2.41	3.37	9.73	−0.85	1.22	4.26	1.48	6.64	−5.38	−2.142	*
B-VertT (mm)	2.69	3.11	3.08	8.92	−2.65	2.74	5.46	3.10	14.20	−8.31	0.138	ns
Goi-VertT (mm)	0.94	2.91	0.82	7.27	−3.89	1.93	4.29	1.69	12.64	−6.83	−0.852	ns
Co-Pg (mm)	4.38	2.26	4.64	8.49	−0.09	6.91	3.90	5.91	15.38	−1.18	2.557	**
Co-Goi (mm)	2.40	2.54	2.34	9.97	−1.71	3.41	2.47	3.21	8.56	−1.57	1.353	ns
Goi-Pg (mm)	4.12	2.40	3.58	7.86	−2.51	5.79	3.06	6.11	11.19	−0.62	2.185	*
Ba-T-VertT (degrees)	−1.24	3.03	−0.73	7.09	−8.28	−0.78	5.91	−0.62	9.93	−11.33	0.394	ns
Ar-T-VertT (degrees)	−0.97	2.90	−0.62	3.59	−8.69	−0.44	6.04	−0.26	13.28	−13.43	0.479	ns
ML-SBL (degrees)	−1.99	3.77	−1.50	6.28	−12.53	−1.25	0.81	−1.24	0.02	−3.83	0.607	ns
NL-SBL (degrees)	−0.46	2.72	−0.32	5.37	−6.40	0.51	3.83	1.32	9.38	−9.17	1.012	ns
NL-ML (degrees)	−1.32	3.05	−1.15	7.43	−10.24	−1.76	3.71	−2.69	7.14	−10.54	−0.991	ns
Ar-Goi-Me (degrees)	−1.22	−1.46	−1.46	5.75	−5.43	−4.48	6.41	−4.14	4.17	−15.37	−2.036	*
CondAx-SBL (degrees)	−1.10	6.96	0.47	14.46	−12.59	3.08	6.92	1.24	18.92	−8.57	1.588	ns
CondAx-ML (degrees)	0.63	6.65	0.21	12.86	−12.99	−4.41	6.12	−2.56	5.07	−16.26	−2.185	*

$^*p < 0.05$; $^{**}p < 0.01$.

to controls. As for angular measurements for the assessment of mandibular ramus and condyle inclinations, data analysis revealed significantly smaller decrements of the gonial angle (Ar-Goi-Me; $p < 0.05$) and a more backward and downward inclination of the condylar axis in relation to the mandibular line (CondAx-ML; $p < 0.05$) in the Class II group.

Stepwise variable selection identified two cephalometric variables mostly accounting for distinctive skeletal changes in Class II group: gonial angle and Co-Pg. The classifying power of the two selected variables was approximately 70%.

DISCUSSION

Class II malocclusion in the deciduous dentition is associated with occlusal signs that are typical of Class II malocclusion in the permanent dentition as well: distal molar relationship, Class II canine relationship, and excessive overjet. The investigators who have described the progress of the distal deciduous molar relation in the transition to the permanent dentition[3,4] have demonstrated the typical maintenance of a full Class II molar relationship during that time. The current study analyzed the evolution of all three concomitant Class II occlusal signs from the deciduous through the mixed dentition. As a matter of fact, in the mixed dentition (T_2) all subjects in this study maintained full Class II molar and canine relationships, and mean overjet was increased when compared with the mean overjet in the deciduous dentition (T_1).

On the basis of the results of Arya and coworkers[3] and Bishara and coworkers,[4] as well as of the current study, it may be stated that Class II occlusal relations are never self-correcting in the transition from the deciduous to the mixed dentition in the absence of treatment or a change in an existing etiologic factor (e.g., habit, airway obstruction). It also should be noted that *all* Class II children in the deciduous dentition in the current study presented with a transverse discrepancy between maxillary and mandibular deciduous intermolar widths due to a narrower upper arch. Therefore transverse deficiency in maxillary arch width deserves to be included in the distinctive occlusal pattern of Class II malocclusion in the early developmental phases. These data fully confirm previous findings by Varrela[5] on the arch widths of children with distal step deciduous molar relationship. After eruption of the first permanent molars, interarch transverse discrepancy is maintained, and it may become a feature of Class II malocclusion in the mixed dentition as well.[14]

As for the cephalometric findings, children with Class II malocclusion in the deciduous dentition already show some distinctive craniofacial characteristics when compared with Class I children. Most representative Class II skeletal signs in the deciduous dentition are related to mandibular position in relation to stable basicranial structures (e.g., significantly retruded mandible) and to mandibular dimensions (e.g., significantly shorter mandibular length).

To our knowledge, the current study is the first to analyze specifically growth changes of the craniofacial complex in children with Class II malocclusion from the deciduous to the mixed dentition.

During the transition, the upper jaw becomes more protruded, as significantly larger increments of maxillary protrusion relative to stable basicranial structures were recorded in the Class II group. However, part of the changes for A-VertT may have been influenced by movements of upper frontal teeth associated with their overjet.

In early Class II malocclusion, total mandibular length and the length of mandibular body grow at a lesser rate than in children with normal occlusion. In addition, the assessment of significantly smaller decrements of the gonial angle and of a more backward and downward inclination of the condylar axis in relation to the mandibular line in the Class II group leads to further considerations. Both these significant mandibular skeletal changes are signs of posterior morphogenetic mandibular rotation,[24,25] intended as a physiologic growth mechanism compensating for anteroposterior discrepancy between the two jaws. This mechanism, which should induce an increase in total mandibular length, though *effective*, was not *efficient* in the examined Class II group, as the increments in mandibular length actually were smaller in children with Class II malocclusion from the deciduous through the mixed dentition. The intimate connection between increases in total mandibular length and changes in the gonial angle, as well as the important role of these two variables in determining a distinctive Class II growth pattern, were confirmed through discriminant analysis.

The findings of the current study have obvious clinical implications. The results of this study indicate that Class II occlusal and craniofacial patterns already are established in the deciduous dentition and, without intervention, are not self-correcting in the transition to the mixed dentition. Therefore, in patients presenting with concomitant Class II occlusal signs in the deciduous dentition, it is possible to start treatment at that stage of dental development. As Class II subjects in the deciduous dentition almost always present with a deficiency in maxillary arch width, an initial goal of treatment might be the early correction of interarch transverse discrepancy by means of rapid maxillary expansion (RME).[26] In patients with mild to moderate Class II problems, the use of RME followed by a palatal stabilization plate in the early mixed dentition may lead to a spontaneous correction of the Class II occlusal relationship, even though no definitive Class II therapy (e.g., extraoral traction, functional jaw orthopedics) has been provided. McNamara and Brudon[26] hypothesize that expansion of the maxillary dentition may create an "endogenous functional appliance" in that lingual cusps of the maxillary dental arch, overexpanded after RME relative to the mandibular dental arch, will encourage the growing patient to posture his or her jaw in a more protrusive position when establishing comfortable contact in maximal intercuspation, ultimately leading to a stable occlusal change.

If a spontaneous correction is not observed, and in patients with more severe skeletal and muscular problems, a functional jaw orthopedic appliance (e.g., bionator, FR-2 of Fränkel, twin block) or extraoral traction can be used after an initial phase of expansion, either immediately thereafter or in the late mixed dentition, to address the underlying anteroposterior skeletal discrepancy. Later, a final phase of fixed appliance therapy is typically necessary to align and detail the permanent dentition.

Although the rationale for intervention in children with severe distocclusion in the deciduous dentition is founded on sound biologic and clinical bases, many interactive factors must be considered before making the decision to intervene early. In support of early intervention, it should be noted that somatic and craniofacial growth rate is more intense in young juveniles (deciduous dentition) than in later developmental stages (e.g., mixed dentition) at which time generally a steady low growth rate is observed until pubertal growth spurt occurs.[27] According to Petrovic and Stutzmann,[28] the possibility of stimulating increments in condylar cartilage growth is quite effective between 5 and 7 years of age. In addition, the experimental primate studies of McNamara[29] demonstrated that the most significant experimentally induced increments in condylar growth occur in animals with full deciduous dentitions, when compared with juvenile, adolescent, or adult animals. Also, Melsen[30] has shown that the midpalatal suture is more amenable to orthopedic expansion during the juvenile age period than at later stages of development.

Other factors, however, also must be considered when making the decision to initiate treatment in the deciduous dentition, including patient (and parental) motivation and cooperation, as well as patient management considerations. The enthusiasm of the late 1970s and the early 1980s in the United States regarding the possibilities of functional appliance treatment in very young children has been tempered with time. When growth guidance protocols requiring significant patient cooperation are used indiscriminately, patient and parental "burnout" often have occurred, and practice management nightmares have been reported. Even though a second therapeutic opportunity is available at the time of the pubertal growth spurt in instances of relapse or incomplete success of very early treatment of severe Class II malocclusion, the astute clinician recognizes the possibilities of early treatment, yet chooses to intervene only in those instances in which the treatment will produce an obvious benefit to the patient within a defined time period and at a reasonable cost, financial, and otherwise.

CONCLUSIONS

The principal findings of this study may be summarized as follows:

1. In the deciduous dentition, a distinctive occlusal and skeletal pattern of Class II malocclusion exists. In addition to concomitant diagnostic dental relationships in the sagittal plane (distal step, Class II deciduous canine relationship, excessive overjet), transverse interarch discrepancy due to a narrower maxillary arch is a constant feature of early Class II malocclusion. Skeletal findings in children with Class II malocclusion typically include significant mandibular retrusion and shorter total mandibular length.
2. In the transition from the deciduous to the mixed dentition, Class II occlusal characteristics, including transverse interarch discrepancy, are maintained or even worsen. During this period, major distinctive growth changes in Class II malocclusion consist of significantly smaller increments in mandibular total and body lengths, and of significantly greater increments in maxillary protrusion. A more backward and downward inclination of the condyle relative to the mandibular body leading to smaller decrements in the gonial angle also is evident.
3. The results of this study indicate that the clinical signs of Class II malocclusion are evident in the deciduous dentition and persist into the mixed dentition. Whereas treatment to correct the Class II problem can be initiated in all three planes of space (e.g., RME, extraoral traction, functional jaw orthopedics), other factors such as patient cooperation and management must also be taken into consideration before early treatment is started.

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