Journal of Orthodontics/Vol. 28/2001/53–58

Dentoskeletal Morphology in Children with Juvenile Idiopathic Arthritis Compared with Healthy Children

SOSSANI SIDIROPOULOU-CHATZIGIANNI, D.D.S., DR. MED. DENT.

MOSCHOS A. PAPADOPOULOS, D.D.S., DR. MED. DENT.

GEORGIOS KOLOKITHAS, D.D.S., DR. DENT., DR. HABIL.

Department of Orthodontics, School of Dentistry, Aristotle University of Thessaloniki, Greece

Abstract. *The aim of this study was to evaluate the dentoskeletal relationships in children with juvenile idiopathic arthritis (JIA) compared to healthy children without significant differences in relation to age and sex, by means of lateral cephalometric radiographs. Cephalometric, as well as dental panoramic radiographs were taken of 66 JIA children (27 males and 39 females; age range: 6–19 years; mean age: 11·9 years). The control group consisted of 37 healthy children unaffected by JIA seeking orthodontic treatment, with Class I occlusion (17 males and 20 females; age range: 7·5–17 years; mean age: 11·9 years). All cephalometric landmarks were identified and digitized, and calculations were performed by means of a computerized cephalometric system.*

The cephalometric findings indicated a tendency towards retrognathism with a short mandible. The lower facial height was increased and the growth pattern of the face was biased towards the vertical direction (clockwise, i.e. with a tendency to open bite) and the interincisal angle was less in the JIA children compared to the healthy children. These findings were in general more pronounced by the JIA children with polyarticular type of the disease as well as with affected condyles.

Our study indicated that the dentoskeletal morphology in children with JIA presented some special characteristics when compared to healthy children, which could be attributed to the effects of the disease.

Index words: Cephalometry, Computerized Cephalometric analysis, Dentoskeletal Morphology, Juvenile Idiopathic Arthritis.

Introduction

Juvenile idiopathic arthritis (JIA) is a chronic pediatric connective tissue disease that affects joints, influences function, and can lead to growth disturbances or disability. To confirm the diagnosis of JIA, the disease must occur before the sixteenth year of age, it must be present in one or more joints, and it should persist longer than 6 weeks (Cassidy *et al.*, 1986).

According to the type of onset of the disease and the joints affected during the first 4–6 months, JIA is classified as pauciarthritis or oligoarthritis when four or less joints are involved, and polyarthritis when five or more joints are involved. Large joints such as knees, wrists, and ankles are prominently involved in JIA. This chronic disease often involves the craniofacial complex and particularly the temporomandibular joint.

The prevalence of JIA varies from between 50 and 110 per 100,000 children. Girls are more susceptible than boys (Andersson-Gäre and Fasth, 1992). The treatment of JIA includes an attempt to control the clinical manifestations, that is suppressing the articular inflammation and pain, preserving joint mobility, and preventing deformity. When managing the disease one has to take into consideration the importance of fostering normal growth patterns (Wallace and Levinson, 1991). This is particularly important for the facial region because of the possible effects on the temporomandibular joint (Rönning *et al.*, 1974; Larheim *et al.*, 1981a,b; Karhulahti *et al.*, 1990), as well as the craniofacial morphology, and the occlusion (Lahrheim and Haanaes, 1981; Lahrheim et al., 1981c; Stabrun, 1985, 1991; Jämsäa and Rönning, 1985; Stabrun *et al.*, 1988; Kreiborg *et al.*, 1990; Rönning *et al.*, 1994). According to these studies, the JIA patients demonstrated an increased mandibular posterior rotation, a retrognathic mandible, and increased vertical growth in the anterior part of the face.

In most studies, the aberrant facial morphology has been associated with condylar destruction (Bache, 1964; Barriga *et al.*, 1974; Rönning *et al.*, 1974, Rönning and Väliaho, 1975; Lahrheim *et al.*, 1981c; Forsberg *et al.*, 1988; Stabrun *et al.*, 1988). However, the possible relationship between the effects of the types of JIA and facial morphology is, as yet, undetermined and needs further investigation.

The aim of this cephalometric study was to evaluate the dentoskeletal morphology in children with JIA, to investigate the possible effects of the type of the disease, as well as the presence of condylar affection on the facial morphology as shown in lateral cephalometric radiographs and to compare their craniofacial structure with that of healthy children.

Correspondence: Sossani Sidiropoulou-Chatzigianni, Department of Orthodontics, School of Dentistry, Aristotle University of Thessaloniki, GR-54006 Thessaloniki, Greece. Tel: + 30 31 999556. Fax: +30 31 999549.

0301-228X/01/010000+00$02.00

Materials and Methods

The study group of 66 children with juvenile idiopathic arthritis contained 27 (41 per cent) boys and 39 (59 per cent) girls. The age range was 6–19 years and the mean age 11·9 years. Thirty of them (46 per cent) suffered from the pauciarticular and 36 (54 per cent) from the polyarticular type of the disease (Table 1). These patients were first examined and diagnosed according to the criteria of the American College of Rheumatology at the Department of Pediatrics of the Hippocrates Hospital of the Aristotle University of Thessaloniki, where they were also being treated for the main disease.

Thirty-seven healthy children unaffected by JIA [19 (51 per cent) girls and 18 (49 per cent) boys] served as control group. These children presented at the clinic seeking orthodontic treatment and fulfilled the following selection criteria: (a) Angle Class I molar and canine relationship; (b) overjet and overbite between 1 and 3 mm; (c) well shaped dental arches with minor orthodontic problems; and (d) no extractions or congenital missing teeth. Their ages ranged from 7·5 to 17 years with a mean age of 11·9 years.

Lateral cephalometric radiographs were taken from both study and control group. All cephalometric landmarks were identified and digitized by one author (MP) on a Hipad digitizer (Houston Instruments Co., Houston, Texas). Calculations of a total of 24 cephalometric variables were performed by means of the computerized cephalometric system PORDIOS (Purpose On Request Digitizer Input Output System, Institute of Orthodontic Computer Sciences, Aarhus, Denmark). As part of the present project, orthopantomograms were also taken from both the JIA patients and control group in order to investigate possible alterations of the temporomandibular joint. A total of 132 dental panoramic radiographs were examined from 66 patients with JIA. Specifically, two dental panoramic radiographs were taken from each JIA patient—one in the normal position and another one with the mouth open—to examine the condyles and the possible presence of condylar destruction. The presence of radiographically detectable structural abnormalities at least at one of the condyle such as condylar flattering and erosion were registered as condylar destruction or as condylar lesion. In order to test the reproductibility of the above examination 66 panoramic radiographs of 33 patients were re-examined and a 'Wilcoxon Signed Ranks Test' was performed (P=0·317), according to which there were no significant differences between the two observations. The localization of the above abnormalities in the right or left side, uni- or bilaterally, as well as their quantitative evaluation was not taken into consideration in this study. These aspects will be the subject of a separate study.

The mean values and standard deviations were calculated for all 24 variables. The statistical analysis was performed using: (a) the Student's *t*-test in order to compare the means between the study and control group, as well as between males and females of the study group; (b) the one-way analysis of variance (ANOVA) in order to analyse the differences between the control group and the subgroups of the study group divided according to the type of JIA (polyarticular and pauciarticular), as well as to the presence of radiological findings (with or without); and (c) the univariate analysis of variance in order to investigate interactions between factors (sex, type of JIA and radiological findings).

Results

In order to compare the average ages between the two groups (JIA and control), as well as between the three groups (polyarticular, pauciarticular and control), the procedures *t*-test (P=0·978) and the one-way ANOVA (P=0·172) were used, respectively, both indicating that the two and three group means were not significantly different. Chi-square procedures were also used to test the differences of the sex ratio between the two groups (JIA and control, P=0·447), as well as between the three groups (polyarticular, pauciarticular and control, P=0·702). According to these significance values, the sex distribution was not significantly different between the above groups.

The prevalence of condylar affection in the JIA group according to the type of disease is presented in Table 1. Thirty-three (50 per cent) of the JIA patients showed some form of condylar destruction. In the polyarticular type of the disease 27 (75 per cent) of the patients were found to have the condyles affected. On the other hand, the prevalence of the affected condyles in the pauciarticular type of JIA was only 20 per cent (six patients).

A total of 103 cephalometric radiographs were evaluated, 66 from patients with JIA (study group) and 37 from subjects of the control group. The means and standard deviations of all cephalometric variables, as well as the result of the *t*-test comparison of means between the study and control groups are presented in Table 2. To study the influence of the type of the disease on the craniofacial structure, the group of JIA children was divided into two groups of children with pauciarticular (oligoarticular) and polyarticular type of JIA. The craniofacial structure of these two groups of JIA children was then compared between them

TABLE 1 *Distribution of the study and control groups*

		Sex		Age (in years)			Radiological findings	
	Sum	Girls	Boys	Mean	Min.	Max.	With	Without
JIA	66	39 (59%)	27 (41%)	11·9	6	19	33 (50%)	33 (50%)
Polyarticular	36 (54%)	22 (61%)	14 (39%)	11·3	6	17	27 (75%)	9 (25%)
Pauciarticular	30 (46%)	17 (57%)	13 (43%)	12·6	6·5	19	6 (20%)	24 (80%)
Control	37	19 (51%)	18 (49%)	11·9	7·5	17		37

TABLE 2 *Results of Student's* t-*test of the cephalometric variables used in the study for the comparison between study (JIA) and control group, and of one-way ANOVA and the following* post-hoc *comparisons of means (LSD test) for the comparison between the polyarticular (poly) and pauciarticular (oligo) types of JIA and the control group*

t-test(#) and one way ANOVA (##)

Variable	JIA		poly		oligo		control		JIA/control #		poly/oligo/control ##	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P*	Significance	*P*	Significance
S–N–A	80·71	3·85	80·86	3·7	80·52	4·09	81·66	3·14	0·203		0·415	
S–N–B	76·61	3·27	76·24	3·16	77·05	3·4	77·95	2·86	0·040	*	0·071	
S–N–Pg	77·4	3·3	76·81	3·22	78·11	3·3	78·61	3·01	0·067		0·049	*
A–N–B	4·1	2·31	4·62	2·24	3·47	2·27	3·71	1·72	0·371		0·058	
A–N–Pg	3·51	2·73	4·05	2·7	2·82	2·65	3·04	2·09	0·368		0·098	
Witt sagittal relation	−1·14	2·85	−1·38	2·63	−0·85	3·13	−0·24	2·34	0·109		0·206	
N–Pg/FH	87·15	3·58	86·07	3·59	88·43	3·17	88·77	3·05	0·022	*	0·001	***
N–A/Pg–A	7·4	5·65	8·55	5·56	5·93	5·52	6·53	4·45	0·422		0·099	
N–Pg on FH	−5·34	6·86	−7·36	6·67	−2·93	6·37	−2·37	5·61	0·027	*	0·002	**
NL/ML	27·14	5·51	28·38	6·12	25·64	4·31	26·51	4·26	0·551		0·076	
NSL/NL	7·98	3·2	7·76	3·21	8·24	3·23	7·72	3·11	0·689		0·768	
NSL/ML	34·98	5·52	35·9	6·21	33·88	4·41	34·23	5·27	0·502		0·259	
ML/FH (MPL angle)	25·24	5·36	26·63	5·84	23·56	4·23	24·07	5·01	0·281		0·031	*
S–Gn/FH (Gamma axis)	59·13	3·78	59·89	3·93	58·22	3·44	57·3	3·38	0·017	*	0·010	**
S–Ar–Go angle	142·04	6·7	143·44	7·17	140·37	5·75	138·1	6·38	0·004	**	0·308	
S–Ar–Go–N upper Go-angle	53·99	4·06	53·88	3·84	54·12	4·37	56·4	3·69	0·004	**	0·014	*
Lower facial height	44	3·43	44·54	3·53	43·36	3·25	41·67	3·36	0·001	***	0·002	**
IIs/NL	109·57	7·68	109·14	7·42	110·09	8·07	108·34	4·58	0·377		0·576	
IIi/ML	94·18	6·85	95·6	7·29	92·4	5·93	92·23	5	0·134		0·041	*
Inter-incisal angle	128·59	10·49	126·06	10·12	131·76	10·24	142·92	6·8	0.027	*	0·004	**
Ar–Go abs. length	44·85	6·71	43·22	5·97	46·8	7·13	44·75	3·49	0·935		0·040	*
Go–Pog length on ML	70·85	6·84	68·7	5·7	73·44	7·27	69·16	4·33	0·176		0·002	**
Ar–Pg abs. length	101·6	8·31	99·28	7·6	104·59	8·35	101·55	3·89	0·971		0·009	**
Gn to Cd length	114·95	10·44	111·31	9·3	119·32	10·19	115·53	4·66	0·752		0·001	***

Post-hoc *comparisons of means (LSD test)*

Variable	poly v. control		poly v. oligo		oligo v. control	
	P	significance	*P*	significance	*P*	significance
S–N–Pg	0·017	*	0·101		0·517	
N–Pg/FH	0·001	***	0·004	**	0·674	
N–Pg on FH	0·001	***	0·004	**	0·674	
ML/FH (MPL angle)	0·035	*	0·017	*	0·685	
S–Gn/FH (Gamma axis)	0·003	**	0·064		0·305	
Ar–Go–N upper Go-angle	0·008	**	0·804		0·021	*
Lower facial height	0·000	***	0·163		0·046	*
IIi/ML	0·022	*	0·042	*	0·911	
Interincisal angle	0·002	**	0·015	*	0·612	
Ar–Go abs. length	0·248		0·012	*	0·141	
Go–Pog length on ML	0·736		0·001	***	0·003	**
Ar–Pg abs. length	0·153		0·002	**	0·075	
Gn to Cd length	0·032	*	0·000	***	·064	

$*P < 0{\cdot}05$; $**P < 0{\cdot}01$; $***P < 0{\cdot}001$.

and to that of the control group of healthy children (Table 2). This statistical elaboration indicated that the children with JIA presented significantly more retrognathic mandibles compared to the healthy children. The mandible was also found to be retrognathic and shorter in the children with the polyarticular type of the disease in comparison to the children with the pauciarticular type. The children with JIA also presented a significantly more expressed vertical (clockwise) growth pattern of the craniofacial structures and a posterior rotation of the mandible in comparison with the healthy children. The same vertical growth pattern and posterior rotation of the mandible were also found in the children with the polyarticular type of the disease compared to the children with the pauciarticular type. Regarding the inclination of the lower incisors to the mandibular plane, this was significantly greater in the children with the polyarticular type of the disease when compared to the healthy children. On the other hand, the interincisal angle was less in the children with JIA when compared to the healthy children, as well as less in the children with the polyarticular type of the disease compared to children with the pauciarticular type or compared to healthy children.

To study the influence of condylar lesions on the craniofacial structure, the group of JIA children was also divided into two groups of children with and without detectable condylar lesions as assessed by the panoramic radiographs. The craniofacial structure of these two groups of children was then compared among them and to that of the control group of healthy children (Table 3). This comparison of the means showed that, the mandible was more retrognathic in the JIA children with condylar lesions compared with healthy children. These children presented also a more pronounced vertical growth pattern of the craniofacial complex and a posterior rotation of the mandible. With regard to the inclination of the upper and lower incisors, it was found that the inclination of the lower incisors to the mandibular plane was increased, and the interincisal angle was decreased in the JIA children with condylar lesions compared to healthy children. Almost the same differences were also found in the group of JIA children with condylar lesions compared to JIA children without condylar lesions, but no significant differences were found by the comparison between the control group of healthy children and JIA children without condylar lesions.

To study the possible influence of sex on the craniofacial structure in the JIA group of children, a comparison between males and females was performed (Table 4). This comparison of the means showed that females with JIA presented a more pronounced vertical growth pattern and a shorter mandible.

In order to investigate interactions between the above discussed factors (type of JIA, radiological findings, and sex) in the JIA group of children the univariate analysis of variance was used. This statistical investigation showed that, the retrognathic position of the mandible was more pronounced in females with radiological findings than in males with same findings. Concerning the ramus height, as well as the length of the total body of the mandible, the two measurements were significantly shorter by the females than in males, both with polyarticular, as well as pauciarticular type of the disease.

Discussion

The present study confirms earlier findings that the JIA patients present a characteristic craniofacial structure (Larheim *et al.*, 1981c; Jamsä and Ronning, 1985; Stabrun 1985; Kreiborg *et al.*, 1990; Kjellberg *et al.*, 1995).

According to this study, 50 per cent of the JIA patients showed some form of condylar lesions. This finding is within the limits of previous studies that have reported condylar lesions in 29–63 per cent of the affected children (Rönning *et al.*, 1974; Larheim *et al.*, 1981a; Kjellberg *et al.*, 1995; Pearson *et al.*, 1996). A further investigation confirmed a high prevalence of condylar lesions (75 per cent) in the polyarticular type of the disease, which in the pauciarticular type the prevalence was only 20 per cent. This could explain the differences in the affected condyles in the various studies, where the sample was not categorized according to the type of the disease.

In this study the control group used for the comparison of the craniofacial structure of children with JIA was selected, and tested according to their sex and age.

Cephalometric values indicating mandibular retroposition, posterior rotation and increased anterior facial height, as well as smaller mandibular dimensions, varied greatly according to the type of the disease. The most extreme craniofacial changes, particularly in the mandibular structure, were associated with the polyarticular type of the disease.

The strong relation that was found between condylar

TABLE 3 *Results of one-way ANOVA and the following* post-hoc *comparisons of means of the cephalometric variables used in the study for the comparison between the JIA children with (RF) and without (NRF) radiological findings of temporomandibular joint, and the control group (C)*

	Control			NRF			RF			ANONA C-NRF-RF		*Post hoc*		
Variable	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*P*	Significance	C v. NRF	C v. RF	NRF v. RF
S–N–A	37	81m66	3·14	33	80·51	4·02	33	80·90	3·73	0·405				
S–N–B	37	77·95	2·86	33	77·09	3·38	33	76·13	3·14	0·056				
S–N–Pg	37	78·61	3·01	33	78·05	3·24	33	76·75	3·27	0·048	*		*	
A–N–B	37	3·71	1·72	33	3·42	2·18	33	4·78	2·27	0·021	*		*	**
A–N–Pg	37	3·04	2·09	32	2·62	2·55	32	4·41	2·64	0·010	**		*	**
Witt sagittal relation	37	−0·24	2·34	31	−0·83	3·10	32	−1·44	2·61	0·187				
N–Pg/FH	37	88·77	3·05	33	88·21	3·35	33	86·08	3·53	0·003	**		***	*
m–a/pG–a	37	6·53	4·45	32	5·48	5·32	32	9·33	5·39	0·009	**		*	**
N–Pg on FH	37	−3·27	5·61	33	−3·39	6·67	33	−7·30	6·57	0·004	**		***	*
NL/ML	37	26·51	4·26	33	25·21	4·12	33	29·06	6·08	0·025	*			*
NSL/NL	37	7·72	3·11	33	8·29	3·40	32	7·67	3·02	0·678				
NSL/ML	37	34·23	5·27	33	33·50	4·23	33	36·46	6·29	0·066				
ML/FH (MPL angle)	37	24·07	5·01	33	23·34	4·07	33	27·13	5·86	0m007	**		*	**
S–Gn/FH (Gamma axis)	37	57·30	3·38	33	58·38	3·65	33	59·88	3·83	0·014	*		**	
S–Ar–Go angle	37	138·10	6·38	33	140·70	5·84	33	143·39	7·30	0·004	**		***	
Ar–Go–N upper Go-angle	37	56·40	3·69	33	53·95	4·39	33	54·04	3·76	0·015	*	*	*	
Lower facial height	37	41·67	3·36	33	43·23	2·79	33	44·77	3·85	0·001	***		***	
IIs/NL	37	108·34	4·58	33	110·58	7·40	33	108·56	7·92	0·416				
IIi/ML	37	92·23	5·00	31	92·55	5·49	32	95·76	7·72	0·040	*		*	*
Interincisal angle	37	132·92	6·80	31	131·56	9·00	32	125·72	11·15	0·002	**		***	*
Ar–Go abs. length	37	44·75	3·49	33	46·48	6·89	33	43·22	6·22	0·114				
Go–Pog length on ML	37	69·16	4·33	323	72·34	7·17	33	69·37	6·24	0·126				
Ar–Pg abs. length	37	101·55	3·89	31	103·22	8·06	33	100·08	8·36	0·261				
Gn to Cd length	37	115·53	4·66	33	117·55	10·41	33	112·35	9·96	0·149				

*$P < 0·05$; **$P < 0·01$; ***$P < 0·001$.

TABLE 4 *Reslts of Student's* t-*test of the cephalometric variables used in the study for the comparison between males and females of the JIA group of children*

Variable	Males			Females			*t*-test	
	n	Mean	SD	*n*	Mean	SD	*P*	Significance
S–N–A	27	80·67	4·16	39	80·73	3·68	0·949	
S–N–B	27	76·85	3·21	39	76·45	3·34	0·628	
S–N–Pg	27	77·90	3·00	39	77·05	3·49	0·311	
A–N–B	27	3·82	2·56	39	4·29	2·14	0·429	
A–N–Pg	25	3·26	2·81	39	3·68	2·70	0·555	
Witt sagittal relation	27	−1·89	2·99	36	−0·58	2·65	0·071	
N–Pg/FH (*)	27	87·89	3·43	39	86·63	3·64	0·238	
N–A/Pg–A	25	6·94	5·92	39	7·70	5·53	0·605	
N–Pg on FH	27	−4·07	6·86	39	−6·23	6·80	0·211	
NL/ML	27	25·63	4·79	39	28·18	5·78	0·063	
NSL/NL	27	7·97	3·54	38	8·00	2·99	0·972	
NSL/ML	27	33·59	4·61	39	35·94	5·94	0·089	
ML/FH (MPL angle)	27	23·60	4·45	39	26·37	5·69	0·038	*
S–Gn/FH (Gamma axis)	27	58·62	3·61	39	59·48	3·91	0·365	
S–Ar–Go angle	27	140·35	6·60	39	143·21	6·59	0·088	
Ar–Go–N angle Go-angle	27	54·05	4·73	39	53·95	3·59	0·925	
Lower facial height	27	43·53	3·23	39	44·32	3·56	0·363	
IIs/NL	27	109·40	5·55	39	109·69	8·92	0·880	
IIi/ML	27	94·44	7·68	36	93·98	6·27	0·794	
Interincisal angle	27	130·54	10·40	36	127·14	10·46	0·206	
Ar–Go abs. length	27	49·41	6·32	39	41·69	4·97	0·000	***
Go–Pog length on ML	27	72·59	7·05	39	69·65	6·51	0·086	
Ar–Pg abs. length	25	105·96	8·19	39	98·81	7·17	0·000	***
Gn to Cd length	27	120·86	10·83	39	110·86	8·02	0·000	***

*$P < 0{\cdot}05$; **$P < 0{\cdot}01$; ***$P < 0{\cdot}001$.

lesions and altered craniofacial structures, such as mandibular retroposition and posterior rotation of the mandible is in agreement with previous studies (Larheim *et al*., 1981c; Stabrun *et al*., 1988; Kjellberg *et al*., 1995) that have reported similar findings. Stabrun *et al*., (1988) demonstrated a clear correlation between mandibular growth and TMJ involvement, when a unilateral condyle lesion and abnormality resulted in asymmetrical growth with underdevelopment of the affected side. However, children with severe radiographic destruction of the TMJ may present normal facial growth (Pearson *et al*., 1996).

On the other hand, a steep mandibular plane and increased anterior facial height were found even in children suffering from JIA without visible TMJ involvement when compared to the control group (Kjellberg *et al*., 1995). According to some workers, the effects of JIA on facial growth is possibly because of the reduction in function due to pain and tenderness in the joints (Larheim, 1981c; Kreiborg *et al*., 1990) or because of the masseteric weakening that was found to be associated with microscopic tissue changes (Kreiborg *et al*., 1990).

The possible contribution of corticosteroid treatment to the maldevelopment of the mandible was referred by Barriga *et al*. (1974) and Stabrun *et al*. (1988); however, its effects on the condyle and growth of the mandible are equivocal (Pearson *et al*., 1996), although the general growth retarding effect of corticosteroids is well documented under specific circumstances (Ansell and Bywaters, 1974, 1978). The therapeutic regime of the JIA children was not taken into consideration in this part of the study, as the possible effects of corticosteroids to the maldevelopment of the mandible depends on many factors (age, duration, dosage, etc.), and requires an additional separate investigation.

According to the findings of this study, the group of JIA patients with the polyarticular type of disease showed significant differences when compared to those with the pauciarticular type and even greater differences compared with the control group. This could be explained by the greater tendency of the condyles to be affected in this type of the disease. A link between the type of the disease and the growth and development of the mandible has been reported by Odenrick (1976) in his thesis.

In addition, it has been demonstrated that the retrognathic position of the mandible was more pronounced in females with radiological findings than in males with same findings. Concerning the ramus height, as well as the length of the total body of the mandible, both measurements were shorter in females than in males, as well as in both types of the disease.

In conclusion, juvenile idiopathic arthritis seems to affect the craniofacial structures of children. Sometimes the quantity of this affection and further its clinical significance appears quite small by examining each variable separately. However, the total effect of the disease on the craniofacial structure of these children demonstrates clear characteristics, such as the retrognathic mandible and the vertical growth pattern, which are clinically important for orthodontic diagnosis and treatment planning. The type of disease and the presence of affected condyles seem to be contributing factors behind the altered facial structures in children with JIA.

References

Andersson-Gäre, B. and Fasth, A. (1992)
The epidemiology of juvenile chronic arthritis in South West Sweden—a five year prospective population study,
Pediatrics, **90**, 950–958.

Ansell, B. M. and Bywaters, E. G. L. (1974)
Alternate-day corticosteroid therapy in juvenile chronic polyarthritis,
Journal of Rheumatology, **1**, 176–186.

Ansell, B. M. and Bywaters, E. G. L. (1978)
Juvenile chronic polyarthritis,
In: J. T. Scott (ed.) *Copeman's Textbook of the Rheumatic Diseases*, Churchill Livingstone, Edinburgh.

Bache C. (1964)
Mandibular growth and dental occlusion in juvenile rheumatoid arthritis,
Acta Rheumatologica Scandinavica, **10**, 142–153.

Barriga, B., Lewis, T. M. and Law, D. B. (1974)
An investigation of the dental occlusion in children with juvenile rheumatoid arthritis,
Angle Orthodontist, **44**, 329–335.

Cassidy, J. T., Levinson, J. E., Bass, J. C., Baum, J., Brewer, E. J. Jr, Fink, C. W., Hanson, V., Jacobs, J. C., Masi, A. T. and Schaller, J. G. (1986)
A study of classification criteria for a diagnosis of juvenile rheumatoid arthritis,
Arthritis and Rheumatism, **29**, 274–287.

Forsberg, M., Agerberg, G. and Persson, M. (1988)
Mandibular dysfunction in patients with juvenile rheumatoid arthritis,
Journal of Craniomandibular Disorders: Facial & Oral Pain, **2**, 201–208.

Jämsa, T and Rönning, O. (1985)
The facial skeleton in children affected by rheumatoid arthritis—a roentgencephalometric study,
European Journal of Orthodontics, **7**, 48–56.

Karhulahti, T., Rönning, O. and Jämsä, T. (1990)
Mandibular condyle lesions, jaw movements and occlusal status in 15-year-old children with juvenile rheumatoid arthritis,
Scandinavian Journal of Dental Research, **1**, 17–26.

Kjellberg, H. (1995)
Juvenile chronic arthritis. Dentofacial morphology, growth, mandibular function and orthodontic treatment,
Doctoral Thesis, University of Göteborg, Göteborg.

Kjellberg, H., Fasth, A., Killiaridis, S., Wenneberg, B. and Thilander, B. (1995)
Craniofacial structure in children with juvenile chronic arthritis (JCA) compared with healthy children with ideal or postnormal occlusion,
American Journal of Orthodontics and Dentofacial Orthopedics, **107**, 67–78.

Kreiborg, S., Bakke, M., Kirkeby, S., Michler, L., Vedtofte, P., Seidler, B. and Müller, E. (1990)
Facial growth and oral function in a case of juvenile rheumatoid arthritis during an 8-year period,
European Journal of Orthodontics, **12**, 119–134.

Larheim, T. A. and Haanes, H. R. (1981)
Micrognathia, temporomandibular joint changes and dental occlusion in juvenile rheumatoid arthritis of adolescents and adults,
Scandinavian Journal of Dental Research, **89**, 329–338.

Larheim, T. A., Dale, K. and Tveito, L. (1981a)
Radiographic abnormalities of the temporomandibular joint in children with juvenile rheumatoid arthritis,
Acta Radiologica. Diagnosis, **22**, 277–284.

Larheim, T. A., Haanaes, H. R. and Dale, K. (1981b)
Radiographic temporomandibular joint abnormality and juvenile rheumatoid arthritis,
Acta Radiologica. Diagnosis, **22**, 495–504.

Larheim, T. A., Haanes, H. R. and Ruud, A. F. (1981c)
Mandibular growth, temporomandibular joint changes and dental occlusion in juvenile rheumatoid arthritis,
Scandinavian Journal of Rheumatology, **10**, 225–233.

Odenrick, L. (1976)
Ansikets utveckling vid juvenil reumatoid artrit,
Thesis, Karolinska Institutet, Stockholm.

Pearson, M. H., Orth, M. and Rönning, O. (1996)
Lesions of the mandibular condyle in juvenile chronic arthritis,
British Journal of Orthodontics, **23**, 49–56.

Rönning, O. and Väliaho M-L. (1975)
Involvement of the facial skeleton in juvenile rheumatoid arthritis,
Annales de Radiologie (Paris), **18**, 347–353.

Rönning, O., Väliaho, M-L. and Laaksonen, A-L. (1974)
The involvement of the temporomandibular joint in juvenile rheumatoid arthritis,
Scandinavian Journal of Rheumatology, **3**, 89–96.

Rönning, O., Barnes, S. A. R., Pearson, M. H. and Pledger, D. H. (1994)
Juvenile chronic arthritis: a cephalometric analysis of the facial skeleton,
European Journal of Orthodontics, **16**, 53–62.

Stabrun, A. E. (1985)
Mandibular morphology and position in juvenile rheumatoid arthritis. A study on postero-anterior radiographs,
European Journal of Orthodontics, **7**, 288–298.

Stabrun, A. E. (1991)
Impaired mandibular growth and micrognathic development in children with juvenile rheumatoid arthritis. A longitudinal study of lateral cephalographs,
European Journal of Orthodontics, **13**, 423–434.

Stabrun, A. E., Larheim, T. A., Höyeraal, H. M. and Rösler, M. (1988)
Reduced mandibular dimensions and asymmetry in juvenile rheumatoid arthritis. Pathogenetic factors,
Arthritis and Rheumatism, **31**, 602–611.

Wallace, C. A. and Levinson, J. E. (1991)
Juvenile rheumatoid arthritis: outcome and treatment for the 90's,
Rheumatic Diseases Clinics of North America, **17**, 891–905.