A Longitudinal Study of Craniomandibular Disorders in Finnish Adolescents

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Longitudinal variations of subjective symptoms and clinical signs of craniomandibular disorders, orofacial parafunctions, and occlusal conditions were examined in 131 Finnish adolescents. Patients were interviewed and clinically examined at the ages of 14, 15, and 18 years. Signs and symptoms of craniomandibular disorders were common, although usually mild. Reported and recorded temporomandibular clicking sounds were the most frequent findings and increased with age. They showed, however, no predictable pattern, and only a few patients consistently reported clicking sounds or had them recorded. Although the frequency of craniomandibular disorders according to Helkimo's clinical dysfunction index was high at each examination, there also was great intraindividual fluctuation longitudinally; impairment and improvement occurred almost equally often, showing no predictable pattern. Only 3% of those tested consistently had an index value of more than I. Thus, even longer follow-up studies are needed to understand natural longitudinal variations and evaluate the need and demand for treatment of craniomandibular disorders.
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Signs and symptoms of craniomandibular disorders (CMD) exist in children as young as 3 to 6 years of age.[1,2] According to cross-sectional studies, the frequency of signs and symptoms increases during childhood and reaches, in adolescence, a prevalence level close to that found in adults.[2–11] A number of longitudinal studies in children and adolescents have shown an increase in the incidence of CMD with age, confirming the prevalence figures obtained in cross-sectional studies of different age groups.[12–20]

In spite of the high frequency of signs and symptoms, the need and demand for treatment of CMD in children and adolescents has been considered small because of the mild and occasional character of CMD.[5,11,21] However, it has been suggested that these signs and symptoms in childhood will become more severe in adulthood.[22] As opinions about etiology of CMD also differ, there is great confusion as regards the need for and type of treatment.[4,21,23–30] Additional longitudinal studies are required to achieve a better understanding of the development, fluctuation, and importance of different signs and symptoms of CMD. Therefore, a 4-year investigation was carried out to study longitudinal variation in signs and symptoms of CMD in a series of Finnish adolescents who had been examined since birth by the same group of dentists.

Materials and Methods

A longitudinal investigation regarding dental development and oral health of children was initiated in 1967 at the Helsinki University Department of Pedodontics and Orthodontics. Altogether 382 infants were included in the first examination. They have since been examined annually concerning development of teeth, occlusion, and structures related to teeth.[31] The first stomatognathic examination was held in 1984, when 156 adolescents (mean age 14.1 years, SD 1.5) were first interviewed using standardized questions and then examined clinically.[32] The second stomatognathic examination was carried out in 1985 and the third in 1988. This study reports on the follow-up of those 131 adolescents (84% of the original study; 61 boys and 70 girls) who took part in all three stomatognathic examinations. The examinations were always undertaken during the first two weeks of January. Detailed descriptions of the design of this longitudinal investigation, the series of adolescents included, and their demographic background have appeared earlier.[31,33,34]

The adolescents were subjected to a routine stomatognathic examination to detect signs of CMD and register occlusal conditions.[35,36] Maximal mandibular movement capacity, joint noises, deviation of the mandible during opening and closing, and palpatory tenderness of the temporomandibular joints (TMJs) and masticatory muscles were recorded. Temporomandibular joint sounds, clicking, and crepitation were assessed using a stethoscope placed at the zygomatic arch. The severity of clinical signs was estimated according to Helkimo's clinical dysfunction index (D_i).[37] The occlusal examination included recordings of interferences and unilateral contacts in the retruded contact position (RCP) in accordance with Egermark-Eriksson et al.[5] Interferences were verified with a plastic foil (GHM, gebr, Hanel-Medizinal, Nürtingen, Germany). All clinical stomatognathic examinations were carried out by one dentist (MK) without knowledge of the results obtained at interview by the other members of the team. The standardized questions were modified from those used in a study by Nilner and Lassing.[7] A more detailed description of the clinical procedure is given in an earlier paper.[32]

Statistics

The significance of differences between sexes and groups were tested using the chi-square test and t test. The significance of differences between longitudinal examination data were tested using the Wilcoxon matched pairs signed-ranks test (nonparametric variables) and paired t test (parametric variables). The correlations are given by using Pearson's product-moment correlation coefficient (r).

Results

Interview

Prevalence of subjective symptoms of CMD at the three examinations is shown in Table 1. At least one subjective symptom at the first, second, and third interview was reported by 36%, 28%, and 35% of the adolescents, respectively. Subjective symptoms were consistently recorded by 10% of the patients (10 girls and 3 boys). Occurrence of recurrent headache showed no significant difference longitudinally. At the third examination, girls reported more frequent headaches than did boys (14% and 2%; $P < .05$). The reported frequency of pain or tiredness in jaws when chewing decreased with age (Table 1). Figure 1 shows the distribution of reported TMJ clicking sounds at the three

Table 1 Prevalence of Subjective Symptoms in Stomatognathic System (%)

	Mean patient* age (y)				
	14		15		18
Headache	12	NS	12	NS	8
Pain in temporal region	11	NS	6	NS	8
Any other facial pain	4	NS	6	NS	1
Pain when opening wide	8	NS	3	NS	3
Pain or tiredness when chewing	9	†	4	†	0
Restricted opening	2	NS	1	NS	2
TMJ clicking	11	NS	12	††	25

*N = 131.
NS = nonsignificant; † = $P > .05$; †† = $P > .01$.

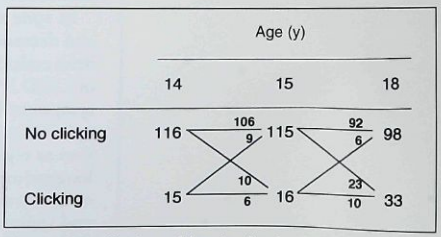

Fig 1 Distribution of longitudinal pattern of changes in reported clicking in adolescents (n = 131) during examination period.

Table 2 Prevalence of Orofacial Parafunctions (%)

	Mean patient* age (y)				
	14		15		18
Nocturnal grinding	14	NS	9	NS	11
Diurnal clenching	9	NS	5	NS	10
Biting of lips or cheek	25	†	16	NS	24
Biting of fingernails	35	†	27	NS	27
Biting of foreign objects	32	††	16	NS	23

*N = 131.
NS = nonsignificant; † = $P > .05$; †† = $P > .001$.

Table 3 Mean Values mm (SD) for Maximum Voluntary Mandibular Movements

	Mean patient* age (y)				
	14		15		18
Maximal opening	55.2 (6.9)	NS	55.8 (6.4)	†	57.0 (6.8)
Laterotrusion right	10.5 (1.6)	NS	10.3 (1.5)	NS	10.3 (1.7)
Laterotrusion left	10.5 (1.5)	NS	10.6 (1.7)	NS	10.4 (1.8)
Protrusion	10.8 (1.9)	NS	10.8 (2.4)	NS	10.4 (2.3)
Retrusion (RCP/ICP)	0.4 (0.6)	NS	0.3 (0.5)	NS	0.4 (0.5)

*N = 131. †$P > .001$.

Table 4 Distribution (%) of Clinical Signs of CMD

	Mean patient* age (y)				
Clinical findings	14		15		18
Tenderness to palpation					
Masticatory muscles	38	NS	40	NS	36
TMJ laterally	21	NS	18	NS	20
TMJ dorsally	1	NS	4	NS	4
TMJ clicking	11	NS	18	†	32
Painful movements	6	NS	7	NS	5

*N = 131. †$P > .01$.

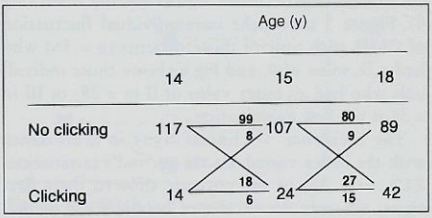

Fig 2 Distribution of longitudinal pattern of changes in recorded clicking in adolescents (n = 131) during examination period.

examinations. The cumulative incidence of reported TMJ clicking sounds for the 4-year period was 23%. Clicking was reported by 32% of the adolescents at least once during the investigation and was consistently reported by 2%. At no examination was there a significant difference between boys and girls. Forceful trauma to the jaws was reported in first, second, and third examinations by 16%, 20%, and 28% of the adolescents.

Table 2 shows the prevalence of reported orofacial parafunctions at the three examinations. At least one parafunction at the first, second, and third interview was reported by 69%, 57%, and 61% of the adolescents. At least one parafunction was reported by 35% of the adolescents at all three examinations. No significant difference was present between the examinations regarding frequency of occlusal parafunctions. Biting of lips, cheeks, fingernails, and foreign objects decreased between the first and second examinations (Table 2). There was no significant difference between boys and girls at any examination.

Clinical Examination

Maximum mandibular movement capacity at first, second, and third examinations is presented in Table 3. Maximal voluntary opening capacity increased between the second and third examinations, and at the third examination it was significantly larger in boys (58.9 mm, SD 7.5) than in girls (55.4 mm, SD 5.7) ($P < .01$).

Neither palpation tenderness of muscles and TMJ nor painful mandibular movements showed significant difference with age, whereas clinically recorded TMJ clicking sounds did increase with age (Table 4, Fig 2). The cumulative incidence of clinically recorded TMJ clicking sounds for the 4-year period was 31%. Clicking was clinically recorded at least once in the investigation by 42% of the adolescents; however, only 3% of the patients consistently had TMJ clicking sounds, and only one girl consistently had both reported and recorded clicking. Crepitation was recorded at the first, second, and third examinations in 1%, 14%, and 9% of the adolescents. The difference between the first and second examination was statistically significant ($P < .001$). Crepitation was found in 20% of the adolescents at least once during the investigation period and was found twice in 4%. No individual consistently had TMJ crepitation sound during the 4-year period.

Neither the prevalence of unilateral contacts in RCP (found in 66% to 83% of the patients) nor occlusal interference showed a significant difference with age. Occurrences of interference varied: mediotrusion in between 2% and 8% of the patients, laterotrusion in between 5% and 6%, and protrusion in between 0% and 4%.

The prevalence of signs of CMD according to Di was 57% at the first examination, 68% at the second, and 67% at the third (Fig 3), with no significant difference between the boys and girls at any examination. Figure 4 shows the longitudinal pattern of changes within the D_i in the examination group; impairment and improvement of the clinical dysfunction occurred almost equally often (Fig 4). Figure 5 shows the intraindividual fluctuation of CMD with time of those patients (n = 56) who had a D_i value of 0, and Fig 6 shows those individuals who had an index value of II (n = 28) or III (n = 3) at the first examination.

The incidence of clinical signs in accordance with the index varied. At the second examination, 21% (n = 28) of the patients showed their first signs, whereas the incidence between the second and third examinations was 18% (n = 25). The cumulative incidence of clinical signs according to Helkimo's index for the 4-year period was 33%. Thirty-one percent of the adolescents (n = 41) had clinical signs included in the Helkimo's index (value I to III) at all three examinations, but only 3% (three boys and one girl) consistently had a value of more than I. The frequency of boys who had a Helkimo index value of II or III decreased between the second and third examinations (23% and 15%; $P < .05$), whereas the corresponding number of girls increased (11% and 23%; $P < .01$).

Correlations

Table 5 shows correlations between the Helkimo index and selected variables included in the interview and clinical examinations. The number of subjective symptoms correlated significantly with D_i at the first ($r = .34$, $P < .001$) and second examinations ($r = 0.24$, $P < .01$), whereas the number of parafunctions correlated with D_i at the second ($r = .19$, $P < .05$) and third examinations ($r = .20$, $P < .05$). Reported and recorded TMJ clicking sounds correlated significantly with each other at consecutive examinations ($r = .20$, $P < .05$; $r = .28$, $P < .01$; $r = .46$, $P < .001$).

Discussion

Of the original stomatognathic group (n = 156), 131 children and adolescents took part in all three examinations, making the drop-out rate (16%) relatively low. Since an analysis of the dropouts and the original sample did not show any significant differences regarding signs and symptoms of CMD, the dropouts scarcely influenced the results. The study group is highly selected in several respects; it was an originally urban population with good oral health. Socioeconomically, middle and higher classes are overrepresented. However, this rather homoge-

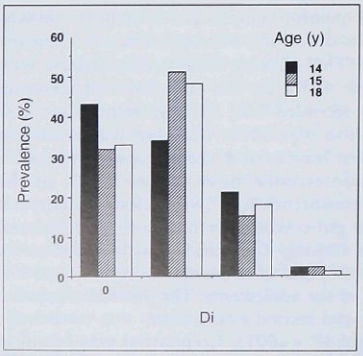

Fig 3 Percentage distribution of subjects (n = 131) by Helkimo's clinical dysfunction index at each examination.

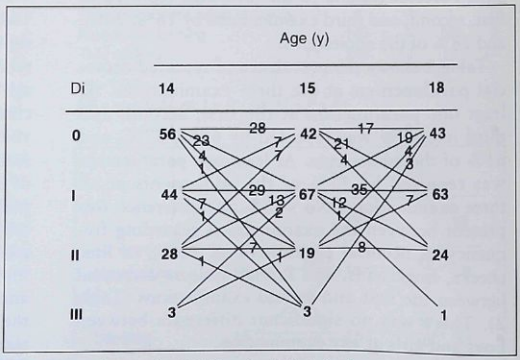

Fig 4 Distribution by Helkimo's clinical dysfunction index of longitudinal pattern of changes between examinations regarding stomatognathic functioning of subjects (n = 131).

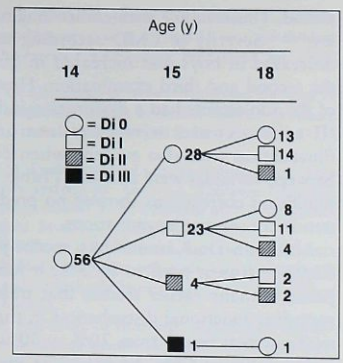

Fig 5 Distribution of adolescents (n = 56) with D_i value of 0 at first examination according to values at second and third examinations.

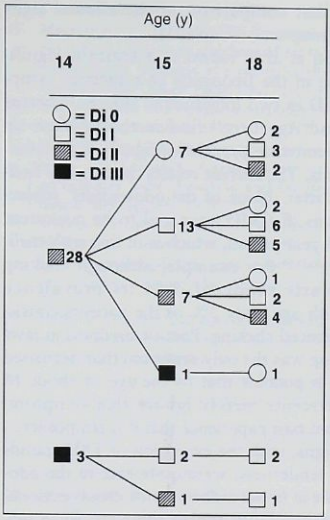

Fig 6 Distribution of adolescents with D_i value of II (n = 28) or III (n = 3) at first examination according to the index values at second and third examinations.

Table 5 Significant Correlations (*r*) Between Sum of Reported Subjective Symptoms of CMD, Helkimo's Clinical Dysfunction Score, and Selected Variables

	Sum of reported symptoms			Helkimo's clinical dysfunction score		
	Mean patient age (y)			Mean patient age (y)		
	14	15	18	14	15	18
Reported symptoms/habits						
Facial pain				0.29***		
Pain/tiredness when chewing				0.30***		
Restricted opening				0.41***		0.38***
Nocturnal grinding		0.29***				0.25**
Biting of lips						0.23**
Clinical findings						
MTR interference < 3 mm from ICP				0.18*		
TMJ clicking sound		0.33***	0.49***			
TMJ crepitation sound			0.23**			
Painful mandibular movements	0.41***		0.26**			

*$P \leq .05$; **$P \leq .01$; ***$P \leq .001$

neous group can be even more useful in evaluating the natural history of CMD than a random sample drawn from the whole population.[29]

The methods used are routine and tested procedures in stomatognathic research.[5,35,36,38,39] Some clinical signs of CMD, eg, tenderness to palpation of the TMJ and masticatory muscles, usually show interobserver differences depending on the pressure applied to the tissues. Since all the adolescents were clinically examined by one trained observer,

it is likely that comparison of the clinical signs within the group was reliable.[33,39]

Magnusson et al[13,14] report a statistically significant increase in the frequency of subjective symptoms of CMD in two longitudinal studies, whereas Wanman and Agerberg[15] find in their follow-up study quite constant prevalence figures for subjective symptoms. The current results confirm the findings of the latter. None of the adolescents' subjective symptoms of CMD appeared to be consistent during the 4-year period, which is in line with earlier reports.[11,12,15,40] For example, although clicking was frequently reported, and its prevalence increased with age, only 2% of the patients consistently experienced clicking. Pain or tiredness in jaws when chewing was the only symptom that decreased with age. It is possible that by the age of about 18 years, adolescents merely ignore this symptom, knowing from past experience that it is temporary.

Clinical signs, with the exception of TMJ sounds and muscle tenderness, were quite rare in the adolescents. This is in accordance with cross-sectional studies on children and adolescents.[5,6,10,11] As in several other studies, recorded TMJ clicking sound was the most frequent clinical sign of CMD. The great variation in frequency of recorded TMJ sounds, especially crepitation, found in several studies is mostly dependent on recording techniques.[41,42] Like reported clicking, recorded clicking also fluctuated longitudinally, with only 3% of the adolescents consistently having clicking. Some authors suggest that TMJ clicking is progressive,[43,44] whereas others emphasize that it is adaptive in nature.[45–47] Our findings, in line with those of Egermark and Thilander,[19] and Wanman and Agerberg,[48] show a considerable variation over time, and in none of the adolescents did clicking develop into locking of the TMJ. Thus, although the prevalence of TMJ clicking sounds in adolescents increases with age,[2,5,6,37,49–51] caution is suggested regarding treatment considerations. The increase in crepitation between the first and second examination is due to the inclusion of "soft" crepitation sound in the recordings at the second and third examinations. Crepitation sound is clinically a more significant TMJ sound than clicking, because it is often associated with joint pathosis.[52–54] However, crepitation sound also showed marked fluctuation over time, and was not found consistently in any of the adolescents.

Even though the frequency of CMD according to Helkimo's clinical dysfunction index was high at every examination, there also was great intraindividual longitudinal fluctuation and no significant increase for the whole group during the 4-year period. This is in line with earlier longitudinal studies.[11,14,16] Severity of CMD according to the index decreased in boys and increased in girls between the second and third examination. However, none of the adolescents had a dysfunction index value of III at two consecutive examinations (Fig 4). Fluctuation was also evident when correlations between variables were analyzed (Table 5). The few significant correlations showed no predictable pattern at consecutive examinations.

Although De Kanter[55] has recently estimated CMD treatment need to be 5%, it has been proposed in many earlier studies that treatment need regarding functional disturbances in the stomatognathic system ranges from 20% to 30% in the general population.[4,50,56,57] Even among young adults, Magnusson and coworkers[21] estimate the treatment need to be 27%, although treatment was considered to be time-consuming in only 4% and the demand for treatment was also only 4%. Based on the present and earlier[15,16] results, it is likely that those adolescents who consistently have signs and symptoms form a high-risk group in whom subjective and objective need may develop into demand for treatment. Further, during the sensitive period of psychic and physical development in adolescence, overtreatment should be avoided. As the development and fluctuation of CMD either regarding single signs and symptoms or Helkimo's clinical dysfunction index demonstrate no predictable pattern, conservative treatment measures are advised.

Conclusion

Signs and symptoms of CMD in adolescents show great intraindividual fluctuation longitudinally and no predictable pattern, only a few adolescents consistently having signs and symptoms. Thus, additional and even longer follow-up studies are needed to understand the natural longitudinal variations in CMD essential for evaluation of the need and demand for treatment.

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Resumen

Estudio Longitudinal Sobre los Desórdenes Craneomandibulares en una Serie de Adolescentes Finlandeses

Se examinaron las variaciones longitudinales de los síntomas subjectivos y los signos clínicos de los desórdenes craneomandibulares, las parafunciones orofaciales y las condiciones oclusales en 131 adolescentes finlandeses. Los pacientes fueron entrevistados a las edades de 14, 15 y 18 años y luego fueron examinados clínicamente. Los signos y síntomas de los desórdenes craneomandibulares (DCM) fueron comunes, aunque leves usualmente. Los hallazgos mas frecuentes que fueron reportados y registrados fueron los sonidos de click en la articulación temporomandibular, y éstos aumentaron con la edad. Sin embargo, éstos no mostraron un patron predecible y sólo pocos pacientes reportaron los clicks consistentemente, o los hicieron registrar. Aunque la frecuencia de los DCM de acuerdo al índice de disfunción clínica de Helkimo fue alta en cada examen, también hubo gran fluctuación intraiindividual longitudinalmente; el deterioro de los pacientes ocurrió casi con la misma frecuencia como ocurrió la mejoría de los mismos, sin haber un patron predecible. El valor del índice en el 3% de los adolescentes fue mayor de 1, consistentemente. Por lo tanto, se necesitan aún estudios de seguimiento mas largos, para entender las variaciones longitudinales naturales y evaluar la necesidad y la demanda relacionada a los tratamientos de los DCM.

Zusammenfassung

Myoarthropathien des Kausystems in einer Gruppe von Finnischen Erwachsenen: Eine Longitudinalstudie

Veränderungen subjektiver Symptome und klinischer Zeichen von Myoarthropathien des Kausystems (MAP), orofacialer Parafunktion und der okklusalen Situation wurden in einer Gruppe von Finnischen Erwachsenen (n = 131) longitudinal verfolgt. Im Alter von 14, 15 und 18 Jahren wurden die Probanden nach einem standardisierten Fragebogen befragt und anschliessend untersucht. Symptome von MAP waren nicht selten, jedoch meist schwach. Kiefergelenkknacken war das anamnestisch und klinisch am häufigsten festgestellte Symptom, es nahm mit dem Alter von anfänglich 11% auf 25% resp. von 11% auf 32% zu. Ein vorhersagbares Muster für das Auftreten des Knackens konnte nicht gefunden werden, nur bei 2% resp. 3% trat es zu allen 3 Zeitpunkten auf. Die Häufigkeit von MAP-Symptomen gemäss dem Dysfunktionsindex nach Helkimo war bei jeder Untersuchung gross (58%–68%), longitudinal bestand eine erhebliche intraindividuelle Veränderung der Symptomatik, Verbesserungen und Verschlechterungen traten etwa gleich oft auf und liessen keine zuverlässige Prognose zu. Nur 3% hatten bei allen drei Untersuchungen einen Index von mehr als 1. Für das Verständnis der natürlichen longitudinalen Veränderungen der MAP-Symptome sind Untersuchungen über noch längere Zeiträume erforderlich.