

# Temporomandibular disorders and the need for stomatognathic treatment in orthodontically treated and untreated girls

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**SUMMARY** The aim of this investigation was to study symptoms of temporomandibular disorders (TMD) and headaches longitudinally in girls with Class II malocclusions receiving orthodontic treatment in comparison with subjects with untreated Class II malocclusions and girls with normal occlusion, and to evaluate the need and demand for stomatognathic treatment.

The frequency and location of subjective symptoms of TMD and headaches were registered by means of an interview and a questionnaire in three groups of age-matched adolescent girls. Sixty-five Class II subjects received orthodontic fixed straight-wire appliance treatment (Orthodontic group), 58 with Class II malocclusion were orthodontically untreated (Class II group) and 60 had a normal occlusion (Normal group).

Individual fluctuations of reported symptoms of TMD were found in all three groups over the 2-year period of the study. Subjects with untreated Class II malocclusions rated their overall symptoms of TMD as more severe than the Orthodontic and the Normal groups. In the Orthodontic group, the prevalence of symptoms of TMD decreased over the 2 years. The overall prevalence of symptoms of TMD was, however, lower in the Normal group than in the other two groups. The need for stomatognathic treatment in the whole sample was estimated to be 13 per cent, while the actual demand was 3 per cent. The large fluctuation of symptoms of TMD over time leads us to suggest a conservative treatment approach when stomatognathic treatment in children and adolescents is considered. The results show that orthodontic treatment did not increase the risk of TMD.

## Introduction

Temporomandibular joint (TMJ) sounds, pain from masticatory muscles, and the TMJs, feelings of fatigue in the jaws and headaches are frequently reported symptoms of temporomandibular disorders (TMD) in children and adolescents (Nilner, 1992). Longitudinal studies of these age groups have shown that symptoms of TMD and headaches fluctuate over the course of time, with both improvement and impairment in the individual (Magnusson *et al.*, 1985, 1986; Wänman and Agerberg, 1986; Heikinheimo *et al.*, 1989). An increased prevalence of headaches and TMJ clicking with age, and a higher prevalence in girls

compared with boys, have been reported (Nilner, 1986; Wänman and Agerberg 1986; Pilley *et al.*, 1992). In 1996, Wänman reported different courses for symptoms of TMD in men compared with women and that women were less likely in the long term to recover from their symptoms. They concluded that their findings could be one explanation of why more women than men seek treatment for TMD. The mentioned gender differences indicate that investigations evaluating possible contributing aetiological factors of TMD should study women and men separately.

Nilner (1992) reported, in a review, that the prevalence of symptoms of TMD varied from 12

to 58 per cent in different epidemiological studies. The mere presence of symptoms of TMD does not, however, indicate a need for stomatognathic treatment. The need for stomatognathic treatment in a population of adolescents and young adults has been suggested to be 5–27 per cent (Wänman and Agerberg, 1986; Ohno *et al.*, 1988; Magnusson *et al.*, 1991).

Trauma, anatomic, pathophysiological and psychosocial factors are generally accepted to be contributing factors in the aetiology of TMD (Okeson, 1996). The influence of occlusion in the development of TMD has been thoroughly discussed during the last two decades, and malocclusion and occlusal interferences have been considered to be contributing factors in the multifactorial theory (Mohlin, 1983; Nilner, 1985; Riolo *et al.*, 1987; Egermark-Eriksson *et al.*, 1990; Pullinger *et al.*, 1993; Henrikson *et al.*, 1997; Sonnesen *et al.*, 1998). The relative importance of occlusion in relation to other contributing factors is, however, still questioned and debated (Carlsson and Droukas, 1984; Seligman and Pullinger, 1991a,b; McNamara *et al.*, 1995; Luther, 1998b). Claims that orthodontic treatment is a risk factor for the development of TMD were not supported in a recent review by Luther (1998a).

In view of a possible increasing prevalence during adolescence, the fluctuations over time and gender differences of both symptoms and signs of TMD, several methodological problems exist when investigating the role of occlusion, orthodontic treatment and TMD. These problems have, in the past, often not been taken into account. A prospective and longitudinal study of symptoms of TMD in similar, but orthodontically treated and untreated malocclusion subjects, and in those without malocclusion, could further clarify the nature of symptoms of TMD, and also lead to a better understanding of the relationship between occlusion, orthodontic treatment, and symptoms of TMD.

The aim of this investigation was to study symptoms of TMD, headaches, and TMD diagnoses prospectively and longitudinally in girls with Class II malocclusions receiving orthodontic treatment, and compare them with girls with untreated Class II malocclusions and with normal occlusion. A further aim was to

evaluate the need and demand for stomatognathic treatment.

## Subjects

One-hundred-and-eighty-three girls, aged 11–15 years at the start of the study, were included. Sixty-five subjects with a Class II malocclusion received orthodontic treatment (Orthodontic group), 58 subjects with a Class II malocclusion were without orthodontic intervention (Class II group), and 60 subjects had a normal occlusion (Normal group). The subjects in the Normal and the Class II groups were selected by screening school classes attending clinics of the Public Dental Service in the Malmö region (Sweden), while the subjects in the Orthodontic group were consecutively selected from those on the waiting-list for orthodontic specialist treatment in the Public Dental Service of Malmö.

### *Orthodontic group*

Sixty-five girls (mean age at start 12.8 years, SD 1.1) were included. One subject discontinued orthodontic treatment and did not want to participate in the re-examination. Subjects with an earlier history of orthodontic treatment were excluded. The inclusion criteria was a bilateral or unilateral Class II relationship of at least half a cusp (Angle, 1899). The Angle classification was judged at the canines and molars with due consideration to the effect of tooth migration (if present).

### *Class II group*

Fifty-eight girls with Class II malocclusions (mean age at start 12.9 years, SD 1.0) were included in this group. One subject moved away from the region and was unable to participate in the second examination. The inclusion and exclusion criteria were the same as for the Orthodontic group, but without any planned orthodontic treatment.

### *Normal group*

Sixty subjects with normal occlusion (mean age at start 12.7 years, SD 0.7) were included in this

group. The inclusion criteria for the Normal group were a bilateral neutral sagittal relationship for molars, premolars and canines and a normal transverse relationship. The overjet and overbite was to be between 1 and 4 mm. Less than 2 mm of crowding or spacing in each jaw, and midline discrepancies less than 2 mm were accepted. Subjects with aplasia of teeth were excluded, as were those with an earlier history of orthodontic treatment.

The occlusal characteristics of the three groups have been described previously (Henrikson *et al.*, 1998, 2000).

## Methods

### *Symptoms of TMD and headaches*

Symptoms of TMD were registered in all subjects at the start of the study and 2 years later. All subjects in the Orthodontic group were out of active treatment at the 2-year examination. General health, the frequency and location of subjective symptoms of TMD and headaches, as well as awareness of oral parafunction were registered by means of an interview and a standardized questionnaire. The reported frequencies of headaches and TMD related symptoms were grouped as: (a) less than once a week or (b) once a week or more often. 'Once a week or more often' are referred to as 'weekly'. During the interview, the subjects assessed the severity of their symptoms of TMD and headaches on a verbal scale including the following 5 grades: 0 = no or minimal discomfort, 1 = slight discomfort, 2 = moderate discomfort, 3 = severe discomfort, and 4 = very severe discomfort. To avoid any misunderstandings, the questionnaire was reviewed by one of the authors and the subjects also had the opportunity to ask questions.

### *Diagnosis of TMD and headaches*

Those subjects who rated their symptoms as moderate, severe or very severe were given a diagnosis/diagnoses of their TMD and/or headaches. TMD was diagnosed parallel to tension-type headaches since they often co-exist.

The diagnoses for TMD as proposed by Dworkin (1992) were used. These are non-hierarchical and allow for the possibility of multiple diagnoses for a given subject. The diagnoses of TMD were divided into the following groups:

1. Muscle disorders: (a) myofascial pain; (b) myofascial pain with limited opening (<40 mm).
2. Disc displacements: (a) disc displacement with reduction, (b) disc displacement without reduction, with limited opening; (c) disc displacement without reduction, without limited opening.
3. Arthralgia, arthritis, arthrosis: (a) arthralgia, (b) osteoarthritis of the TMJ, (c) osteoarthritis of the TMJ.

Tension-type headache was diagnosed when headaches were reported once a week or more often, in subjects without a migraine diagnosis from a physician.

The need for stomatognathic treatment was assessed by two specialists in stomatognathic physiology and based on subjective reports of symptoms of TMD as reported in this paper and clinical signs presented by Henrikson *et al.* (2000). The treatment demand was based on the opinions of the investigated subjects.

### *Orthodontic treatment*

The orthodontic treatment goal was to normalize the sagittal, vertical and transversal dental relationships, and to eliminate crowding or spacing. This was achieved in most treated subjects (Henrikson *et al.*, 2000). All the patients in the Orthodontic group were treated with fixed appliances, modified straight-wire technique. Fifty-three subjects wore Class II elastics and nine subjects used extra-oral traction to enforce the anchorage and/or to correct the sagittal relationships. Eight subjects were, in addition, treated with an activator. Thirty subjects (46 per cent) were treated without any tooth extractions, while 35 subjects (54 per cent) were treated with extraction of two maxillary or four premolars. The active treatment period varied between 14 and 23 months.

### Statistical methods

Differences within the groups between the first and second measurement were calculated with McNemar's test, and differences between the groups with Pearson's Chi square test with Yates correction for continuity. If the expected cell value in a  $2 \times 2$  table was less than 5, Fisher's exact test was used instead of the Chi square test. *P* values below 0.05 were required to accept the differences as statistically significant. The actual *P* values are quoted in the text.

## Results

### General health

No general joint or muscle disease was reported by any subject. In the Orthodontic group, 14 per cent took medication occasionally for headaches and pain in the orofacial region. Two years later the number was 11 per cent. The corresponding figures for the Class II group was 20 per cent both at the start and at follow-up, while the figures for the Normal group were 10 per cent at the start and 12 per cent at follow-up. The type of analgesic most often used had paracetamol as the active ingredient.

### Symptoms of TMD and reported headaches

The prevalences of reported symptoms of TMD and headaches are presented in Table 1. The overall longitudinal trend, over the 2 years, was a slight increase of symptoms of TMD in the Class II and the Normal groups, and a slight decrease in the Orthodontic group. These longitudinal changes within the groups were not significant.

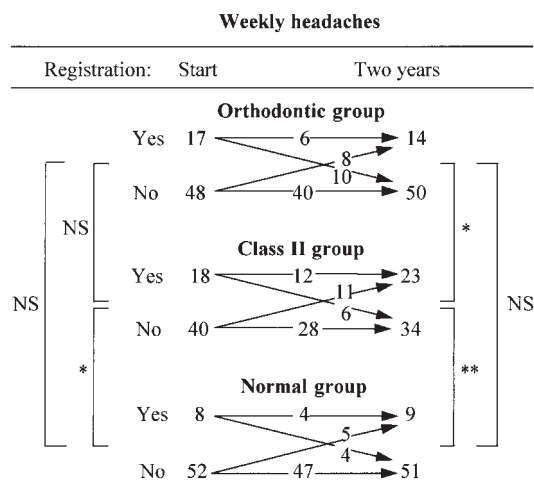
Individual fluctuations of reported weekly headaches were found in all three groups over the 2 years. This is shown in Figure 1, where differences between the groups are also presented. At the first registration, the Normal group reported a lower prevalence of weekly headaches than the Class II ( $P = 0.036$ ) and the Orthodontic groups ( $P = 0.073$ ). After 2 years, the Class II group reported a higher prevalence of weekly headaches than both the Orthodontic ( $P = 0.045$ ) and Normal groups ( $P = 0.004$ ), while no significant difference was found between the Orthodontic and the Normal groups.

At the first registration the Normal group had a lower prevalence of reported weekly TMJ clicking than in the Orthodontic group ( $P = 0.003$ ), but 2 years later there were no significant changes within or between any of the groups.

**Table 1** Prevalence of reported headaches and symptoms of TMD as a percentage of the three groups at the start and 2 years later.

Symptoms of TMD	Class II Orthodontic group %		Class II group %		Normal group %	
	Start	2 years	Start	2 years	Start	2 years
Headaches						
weekly	26	22	31	40	13	15
TMJ clicking						
weekly	20	14	10	18	2	7
Pain from the TMJs and/or the masticatory muscles at:						
rest*	8	5	7	9	2	5
wide opening*	14	9	9	14	2	8
chewing*	17	16	24	26	13	20
Pain from the TMJs and/or the masticatory muscles						
weekly	14	6	7	16	7	5
Feeling of fatigue in the jaws						
weekly	7	3	10	11	0	3

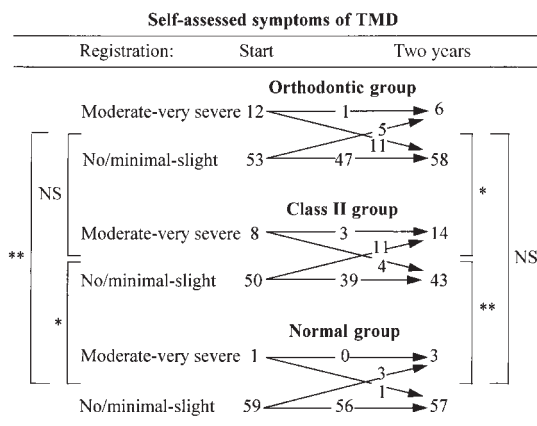
\*These questions were designed to give dichotomized, yes/no answers, while the remaining anamnestic questions were designed to evaluate the symptom frequency.



**Figure 1** Individual longitudinal changes of reported weekly headaches (weekly = once a week or more). The figures indicate the number of girls. One girl from the orthodontic group and one from the untreated Class II group did not take part at the second registration. The vertical bars show significant differences between the groups at the first registration and after 2 years. NS,  $P > 0.05$ ; \* $P < 0.05$ ; \*\* $P < 0.01$ .

### Self-rating of overall symptoms of TMD

The self-rating of overall symptoms of TMD on a verbal scale is presented in Table 2. The variable was categorized into a dichotomous variable; no/minimal and slight on the one hand and moderate, severe and very severe on the other. Individual longitudinal changes over the 2 years, and differences between the three groups concerning the self-rating of symptoms of TMD are presented in Figure 2. No significant changes



**Figure 2** Individual longitudinal changes of the self-rating of overall symptoms of TMD on a verbal scale. The figures indicate the number of girls. One girl from the orthodontic group and one from the untreated Class II group did not take part at the second registration. The vertical bars show significant differences between the groups at the first registration and after 2 years. NS,  $P > 0.05$ ; \* $P < 0.05$ ; \*\* $P < 0.01$ .

were found within the groups over the 2 years. When comparisons were made between the groups at the first registration, the Normal group rated their symptoms as less severe than both the Orthodontic ( $P = 0.005$ ) and the Class II groups ( $P = 0.016$ ), while there was no significant difference between the Orthodontic and the Class II group ( $P = 0.648$ ). At the second registration the Class II group rated their symptoms as more severe than the Orthodontic ( $P = 0.045$ ) and Normal groups ( $P = 0.006$ ), while no significant difference was found between the Orthodontic and Normal groups ( $P = 0.554$ ).

**Table 2** Self-rating of overall symptoms of TMD on a verbal scale, as a percentage of the three groups, at the start of the study and 2 years later.

Self-rating of symptoms of TMD	Class II Orthodontic group %		Class II group %		Normal group %	
	Start	2 years	Start	2 years	Start	2 years
None or minimal	75	78	74	61	90	82
Slight	6	13	12	14	8	13
Moderate	14	9	10	12	2	3
Severe	3	0	2	11	0	2
Very severe	2	0	2	2	0	0

### Oral parafunctions

Table 3 shows an overall decreased prevalence of reported tooth grinding in all three groups over the 2 years. Reported tooth clenching increased in the Class II and the Normal groups between the two registrations, while a slight decrease was reported in the Orthodontic group. Comparing the groups at the first registration, the Normal group had a significantly lower prevalence of reported clenching than the Orthodontic ( $P = 0.002$ ) and the Class II groups ( $P = 0.017$ ). After 2 years, there were no significant differences of either clenching or grinding between any of the groups.

### Need of and demand for stomatognathic treatment

A total of 21 subjects at the first registration and 23 subjects after 2 years rated their overall

symptoms of TMD as moderate, severe or very severe and were judged to be in need of some treatment of their TMD. These subjects were given a diagnosis/diagnoses of TMD and headaches as presented in Table 4. Only the diagnoses presented in Table 4 were present, since no subject had limited mouth opening or a coarse crepitus in the joint. Except for the subjects with only myofascial pain, most had several TMD diagnoses. In the majority of subjects, tension headache co-existed with the TMD diagnoses. Among the 21 subjects with TMD diagnoses at the first registration, only four subjects estimated their symptoms as moderate–very severe 2 years later. Three out of these four subjects had unchanged TMD diagnoses.

Subjects from the Normal and the Class II groups who were in need of and demanded stomatognathic treatment were given this after

**Table 3** Prevalence of reported oral parafunctions as a percentage of the three groups at the start of the study and 2 years later.

Awareness of oral parafunctions	Class II Orthodontic group %		Class II group %		Normal group %	
	Start	2 years	Start	2 years	Start	2 years
Tooth grinding	23	11	22	15	9	7
Tooth clenching	25	18	19	27	3	15

**Table 4** Individual diagnoses of TMD at the first registration and after 2 years. Twenty-one subjects at the first and 23 subjects at the second registration who rated their symptoms as moderate, severe, or very severe were given a diagnosis/diagnoses of their TMD. The diagnostic system allows for single or multiple diagnoses for a given subject. In addition, tension headache was diagnosed in subjects with weekly headaches.

Diagnoses	Class II Orthodontic group		Class II group		Normal group	
	Start	2 years	Start	2 years	Start	2 years
TMD						
Myofascial pain	5	3	6	5	1	1
Myofascial pain and disc displacement with reduction	–	1	1	1	–	–
Myofascial pain and arthralgia	5	–	1	6	–	2
Disc displacement with reduction	1	–	–	–	–	–
Disc displacement with reduction and arthralgia	–	1	–	–	–	–
Tension headaches	7 (1)	4 (1)	8 (0)	13 (2)	1 (0)	3 (0)
Total number of subjects	12	6	8	14	1	3

Figures within the parentheses indicate the number of patients diagnosed only as having tension headaches, as diagnoses of TMD were absent in these subjects.



the second registration. One subject from the Normal and three subjects from the Class II group were treated with information, counselling, and occlusal splint therapy. Except for information and counselling, no stomatognathic treatment was given to any subject in the Orthodontic group, since their occlusions were still settling after orthodontic treatment. Following a further 12-month period, the need and demand for stomatognathic treatment was re-evaluated in the Orthodontic group and two subjects were treated with information, counselling, and occlusal splint therapy.

## Discussion

Individual fluctuations of reported symptoms of TMD were found in all three groups during the 2-year period. Subjects with untreated Class II malocclusions rated their overall symptoms of TMD as more severe than the orthodontically treated Class II group and the Normal occlusion group. In the Orthodontic group, the prevalence of symptoms of TMD decreased over the 2 years. The overall prevalence of symptoms of TMD was, however, lower in the Normal group than in the other two groups.

When evaluating the influence of occlusion and orthodontic treatment on the prevalence of TMD in children and adolescents, it is important to also examine the prevalence of TMD in a non-patient population (Luther, 1998a). In this study, the Orthodontic group was compared with age-matched control subjects with similar, but untreated Class II malocclusions, as well as age-matched subjects with normal occlusion. The possible influence of occlusal factors, orthodontic treatment and age on symptoms of TMD was thereby controlled when comparing the three groups. No other study has presented comparisons with two different non-patient groups in a prospective investigation.

In an attempt to include different socioeconomic populations in the Malmö region, the control subjects were selected from five clinics of the Public Dental Service from different socioeconomic areas. The subjects in the Orthodontic group were consecutively selected among those on the Malmö community's waiting list for

orthodontic specialist treatment. The mean age of the three groups was similar, without significant difference. The age distribution at the start of the study in the Class II and the Normal occlusion groups was centred around 12–13 years of age, while the Orthodontic group had a slightly more equal distribution over all ages, 11–15 years. The comparison of the three groups can be considered valid since age differences between the groups were minor. Furthermore, age was included as a influencing variable in a multivariate analysis when the dependence between symptoms and signs of TMD and all registered variables was calculated in the same material (Henrikson *et al.*, 1997). The result showed that age was not the explanation for the differences between the three groups.

Data concerning the frequency and location of subjective symptoms of TMD and headaches were collected by means of an interview and a questionnaire. The validity of these recordings in relation to age has been discussed (Nilner and Lassing, 1981) and the age of 7–10 years has been proposed to be the minimum age for a reliable TMD interview. The subjects in this longitudinal study were between 11 and 15 years of age at the start of the investigation, so that the collection of anamnestic data may be considered valid. The time-frame, 'once a week or more', used in this study when assessing TMD-related symptoms and headaches has been suggested to improve the reliability and give a better clinical relevance (Nydell *et al.*, 1994; Unruh, 1996).

The self-rating of overall symptoms of TMD was carried out on a five-grade verbal scale. Five different scales for assessing pain and discomfort were evaluated by Magnusson *et al.* (1995). They found a good precision, sensitivity, and memory with acceptable kappa-values for the verbal and the behaviour rating scales. They concluded, however, that the behaviour rating scale was easier to understand for the patient the first time it was presented. The self-rating of overall symptoms of TMD in this study by means of the verbal scale was performed during the interview and was carefully explained to each subject to avoid any misunderstandings.

Large individual fluctuations of reported weekly headaches over the 2 years were found

in all three groups (Figure 1). Interestingly, approximately 50 per cent of the subjects who reported weekly headaches at the first registration had an unchanged frequency 2 years later. Epidemiological studies have reported the prevalence of weekly headaches in adolescent girls to be between 16 and 31 per cent (Nilner, 1986; Heikenheimo *et al.*, 1989; Pilley *et al.*, 1992). At the start of this study, 28 per cent of the subjects with Class II malocclusions (Orthodontic group 26 per cent and Class II group 31 per cent) reported weekly headaches. This prevalence was similar to that in the study of Sonnesen *et al.* (1998), who found that 27 per cent of their subjects with severe malocclusions reported weekly headaches. They investigated 104 children, aged 7–13 years, of whom 72 per cent had a Class II malocclusion. Egermark-Eriksson and Rönnerman (1995) reported a decreased prevalence of weekly headaches from 24 per cent before orthodontic treatment to 12 per cent. A minor decrease of weekly headaches in the Orthodontic group from 26 to 22 per cent and an increased prevalence from 31 to 40 per cent in the untreated Class II group was found in this study. The differences between the three groups in this investigation and the changes over the 2-year period coincide with changes of TMD of muscular origin in the same subjects (Henrikson *et al.*, 2000). A correlation between headaches and tenderness to palpation of the masticatory muscles has also been reported (Magnusson *et al.*, 1985, 1986; Nilner, 1986; Mohlin *et al.*, 1991).

An increased prevalence of clinically registered TMJ clicking in all three groups has previously been reported by Henrikson *et al.* (2000). This increase over the 2-year period was similar to the longitudinal changes of reported weekly TMJ clicking, except in the Orthodontic group, where a slight decrease was found. The reason for these diverging results in the Orthodontic group concerning clinically registered and reported TMJ clicking is not clearly understood. One explanation could be that subjects receiving orthodontic treatment with fixed appliance avoid excessive jaw movements that would normally cause clicking.

Individual fluctuations were found in all three groups regarding the self-rating of symptoms of TMD over the 2 years. Only one subject out of

12 in the Orthodontic group who rated her overall symptoms as at least moderate at the first registration had an unchanged self-rating 2 years later (Figure 2). On a group basis, after 2 years, the untreated Class II group rated their symptoms of TMD as more severe than the Orthodontic and the Normal groups. This difference in self-rating between the groups is in line with the group differences of the overall prevalence of symptoms of TMD as presented in Table 1 and muscular signs of TMD reported by Henrikson *et al.* (2000).

Since this study has shown rather large individual fluctuations of TMD over the course of time, the question arises, 'When should stomatognathic treatment be considered and on what indications?' The mere occurrence of symptoms and signs of TMD does not indicate the need for stomatognathic treatment. Subjects who rated their overall symptoms of TMD as moderate, severe, or very severe were given TMD diagnoses (Table 4) and judged to be in some need of treatment of their TMD. A treatment need of 13 per cent for the total sample in this investigation is in accordance with previous studies suggesting that 5–27 per cent of a population of adolescents and young adults would need treatment of their TMD (Wänman and Agerberg 1986; Ohno *et al.*, 1988; Magnusson *et al.*, 1991; Sonnesen *et al.*, 1998). The large fluctuation of both symptoms and signs of TMD over time would indicate a conservative treatment approach when considering stomatognathic treatment in children and adolescents. However, those children and adolescents who consistently have signs and symptoms of TMD form a risk group in whom subjective and objective need may develop into demand for stomatognathic treatment.

Subjects who both demanded and were in need of stomatognathic treatment were provided with information, counselling and occlusal splint therapy. The treatment demand in this study of about 3 per cent is well in line with List *et al.* (1999), who reported a perceived treatment need of 4 per cent in their study of 862 children and adolescents. Sonnesen *et al.* (1998) reported that 7 per cent of subjects with severe malocclusions aged 7–13, were referred for stomatognathic treatment.



## Conclusions

The subjects who received orthodontic Class II treatment reported less symptoms after treatment than before, while those with untreated Class II malocclusions reported an increased prevalence. The difference between groups may be explained by an improved dental occlusion and occlusal stability in the orthodontic group. Noteworthy is the relatively low prevalence of symptoms of TMD in the Normal occlusion group compared with the Orthodontically treated group and especially the untreated Class II group. The need and demand for stomatognathic treatment in the total sample was in line with previous studies of adolescents in Scandinavian countries.

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## Acknowledgements

This study was supported by grants from the Faculty of Odontology at Malmö University, the Swedish Dental Society, Stockholm, and Praktikertjänst AB, Stockholm.

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