The temporomandibular joint in ankylosing spondylitis

Correlations between subjective, clinical, and radiographic features in the stomatognathic system and effects of treatment

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One hundred individuals with ankylosing spondylitis (AS) and a comparison group comprising 57 individuals without joint symptoms or disease were studied for correlations between subjective, clinical, and radiographic features in the stomatognathic system and the short-term effect of occlusal splint therapy. There was a correlation between radiographic findings in the temporomandibular joint (TMJ) and subjective and clinical symptoms from the stomatognathic system in individuals with AS but not in the comparison group. There were also more and stronger correlations between clinical signs of TMJ involvement and subjective and other clinical symptoms from the stomatognathic system in the individuals with AS than in the comparison group. There are thus strong indications that the subjective symptoms, the clinical signs, and the radiographic findings in the TMJ of the individuals with AS were caused mainly by this joint disease. The short-term effect of treatment with occlusal splints was investigated in seven of the individuals with AS, who had clinical dysfunction index II or more in accordance with Helkimo. No statistically significant improvement of the subjective or clinical symptoms from the stomatognathic system was found, although a reduction of clinical symptoms was noted in five of the seven individuals. □ *Human; occlusal splint therapy; pathology; questionnaires; spondylitis, ankylosing; temporomandibular joint diseases*

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Ankylosing spondylitis (AS) is a chronic inflammatory joint disease that predominantly affects the spine and sacroiliac joints and in more severe cases also peripheral joints (1). Temporomandibular joint (TMJ) involvement in AS has been reported (2–5), but the frequency of clinical and radiographic findings differs considerably between studies. This variation in frequency is probably due to differences in examination techniques and/or in the patient populations investigated. None of the previous studies have included a group of individuals without AS for comparison, and earlier reports of treatment of TMJ disorders in individuals with AS are few and deal mostly with single patients (3, 6). Occlusal splints have been tried in an uncontrolled study of four patients with improvement of the condition in three (3).

In three recent studies (7–9) the subjective, clinical, and radiographic features in the stomatognathic system of individuals with AS have been investigated. This study aims specifically to answer the following questions:

1. Is there a correlation between radiographic findings in the TMJ and subjective and clinical symptoms from the stomatognathic system in individuals with AS not found in other individuals without general joint disease?

2. Is there a correlation between clinical signs of TMJ involvement (crepitus and palpatory tenderness) and subjective and other clinical symptoms from the stomatognathic system in individuals with AS not found in other individuals without general joint disease?

3. Does short-term occlusal therapy have

any effect on subjective and/or clinical symptoms from the stomatognathic system in individuals with AS?

Patients and methods

Ankylosing spondylitis group (AS group)

One hundred individuals (72 men and 28 women) with a medical diagnosis of AS in accordance with the Rome criteria (10) were investigated for subjective and clinical symptoms from the stomatognathic system at the Dept. of Stomatognathic Physiology, University of Gothenburg. Ninety of these (71% men and 29% women) accepted referral to the Dept. of Oral Radiology and were also subjected to a panoramic radiographic examination of the TMJ. The mean age of these individuals was 43 years (range, 23–72).

Comparison group (C group)

Fifty-seven individuals (72% men and 28% women) without known general joint symptoms or disease were selected from a private dental practice. The selection was made at the individuals' annual routine dental examination and was based on age and sex to match the AS group. They were investigated for subjective and clinical symptoms from the stomatognathic system in the same manner as the AS group. Forty-four of these individuals (73% men and 27% women) accepted referral to the Dept. of Oral Radiology and were subjected to a panoramic radiographic examination of the TMJ. The mean age of these individuals was 42 years (range, 22–71).

More detailed information about the AS and C groups has been given elsewhere (7, 9).

Questionnaire

Subjective symptoms from the stomatognathic system were assessed by means of a questionnaire. Questions were posed concerning pain in the TMJ and cheek regions, difficulties in opening the mouth wide, stiffness/tiredness in the jaws during mandibular movements, TMJ sounds, and swelling over the TMJ. An index (S_i) was constructed by adding the above symptoms, and a score was obtained, ranging between 0 and 6 units. The extension, duration, and severity of subjective general joint symptoms were assessed in the AS group. The extension of AS was estimated by counting the number of joint regions reported to be involved by the individuals. The following joint regions were considered: hands, elbows, shoulders, neck, back, hips, knees, and feet. A score was calculated (0–8 units) by counting the number of joint regions involved. More detailed information about the assessment of subjective symptoms has been given in a previous report (7).

Clinical examination

Clinical symptoms from the stomatognathic system were recorded by routine examination procedures used at the department (11, 12). The examination included palpation of the masticatory muscles and the TMJ, maximal mandibular movement capacity, pain on movement of the mandible, and TMJ sounds. The occlusion was examined for number of occluding pairs of teeth and loss of molar support. The occlusion was also examined for unilateral premature contacts in the retruded position (RP) and for interferences between RP and the intercuspal position (IP) causing lateral displacement of the mandible by 0.5 mm or more as measured in the incisal region. Interferences on the mediotrusion side within 3 mm of IP, as measured in the incisal region, were also recorded. The severity of the clinical symptoms was estimated by means of the clinical dysfunction index (D_i) in accordance with Helkimo (13). More information about the clinical examination procedures has been given previously (8).

Radiographic examination

Panoramic radiographs were used in this study. Only the mandibular condyle was judged radiographically, since the method gives unreliable information about the temporal component of the TMJ (14). Radiographic signs of deviation in shape and changes of the cortical outline (sclerosis, erosion) of the joint surface were recorded. A radiographic index (R_i) was constructed, in-

cluding the following four radiographic signs: flattening, osteophytes, erosion, and sclerosis. The latter two findings were classified as local or extensive, giving a score of 1 or 2 units. The right and left joint were recorded separately. A total score ranging between 0 and 12 units was thus obtained for each individual. Further details of the radiographic examination and its limitations are given elsewhere (9).

Treatment

All 14 individuals (14%) in the AS group with a clinical dysfunction index value of II or more (10 men and 4 women) were randomly allocated to one of two groups of 7 individuals (Table 5). One of the groups received full-coverage maxillary acrylic occlusal splints (S group), whereas the other group received no treatment (N group). The individuals in the S group were instructed to wear the splints during night and as much as possible during the day. The splints afforded unilateral and bilateral molar support in two individuals and were adjusted to stable occlusion in RP and IP. Lateral and protrusive contact movements were made smooth and unrestricted. Mediotrusion side interferences (preventing contacts on the laterotrusion side) were not accepted on the splints, nor were single contacts on the laterotrusion side distal to the cuspids. During protrusion, contacts were made only in the incisal region. The individuals were instructed to wear the splints for 6 weeks.

The individuals in both groups were re-examined after 6 weeks. The severity of subjective symptoms was assessed by a 5-graded subjective dysfunction score (SDS) (7): 1) minimal or no discomfort; 2) slight discomfort; 3) moderate discomfort; 4) severe discomfort; and 5) very severe discomfort. The severity of the clinical symptoms was assessed by the clinical dysfunction score (CDS) (13). The duration and extension of AS, the TMJ radiographic index (R_i), the number of occluding pairs of teeth, and the subjective and clinical dysfunction scores are shown in Table 5.

Statistics

Significance tests for differences between sexes and groups were performed with Fisher's permutation test (15). Tests for age differences and correlations were performed with Pitman's test (16). Both methods are non-

Table 1. Correlations within the AS group between the variables included in the subjective index (S_i) and the radiographic index (R_i)

	R_i:	Flattening	Osteophytes	Erosion	Sclerosis
S_i:	**	**			
Pain from the TMJ area					
Pain from the cheek area					
Difficulties in opening the mouth wide	**	**		**	
Stiffness/tiredness in the jaws during mandibular movements					
Sounds from the TMJ					
Swelling over the TMJ					

Table 2. Correlations within the AS group between variables included in the clinical dysfunction index (D_i) and the radiographic index (R_i) (Neg. = negative correlation)

	R_i:	Flattening	Osteophytes	Erosion	Sclerosis
D_i:	**	**		*	
Maximal mouth opening	**Neg.	**Neg.		**Neg.	*Neg.
Tenderness to palation of the masticatory muscles		*		*	
Tenderness to palpation of the TMJ	*	*		*	
Clicking from the TMJ					
Crepitus from the TMJ					
Painful mandibular movements	*	*		**	

Table 3. Relationships between radiographic changes in the TMJ and tenderness to palpation and crepitus from the TMJ in the AS group (percentage of individuals)

Radiographic changes in the TMJ	Palpatory tenderness of the TMJ (no. = 90)		Crepitus from the TMJ (no. = 90)	
	Present	Absent	Present	Absent
Present	11	14	9	16
Flattening	9	11	7	13
Osteophytes	1	3	2	2
Cortical erosion	4	2	2	4
Cortical sclerosis	4	2	2	4
Absent	19	56	14	61
Total	30	70	23	77

parametric and are thus applicable to both discrete and continuous distributions and give correction for ties. Age, sex, and number of occluding pairs of teeth have been included in the tests as confounding variables when correlated to the variables tested with a probability of $p < 0.4$. The levels of statistical significance used are denoted by $**p < 0.01$ and $*0.01 \leq p < 0.05$.

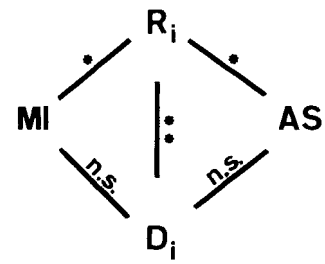

Fig. 1. Partial correlations between extension of ankylosing spondylitis (AS), mediotrusion side interferences (MI), clinical dysfunction index (D_i), and radiographic index (R_i).

Results

Correlations (AS group)

The radiographic index was positively and significantly correlated to the subjective index ($p < 0.01$; Table 1). The radiographic index was also correlated to the duration of the subjective stomatognathic symptoms (flattening and erosion; $p < 0.01$) and the previous occurrence of similar symptoms (flattening; $p < 0.05$).

The radiographic and clinical dysfunction indices were positively and significantly correlated to each other ($p < 0.01$; Table 2). Correlations between radiographic changes in the TMJ and clinical signs from the TMJ are given in Table 3.

The correlations between extension of AS and clinical dysfunction index and between mediotrusion side interferences and clinical dysfunction index (8) were mainly due to the radiographic index when partial correlations were analyzed (Fig. 1). The correlations between the radiographic index and extension of AS and mediotrusion side interferences, respectively, were due to the radiographic sign erosion ($p < 0.05$ and $p < 0.01$). The clinical dysfunction index was also significantly correlated to the subjective index ($p < 0.01$). Mediotrusion side interferences were positively and significantly correlated to unilateral RP–IP contacts ($p < 0.01$) and to interferences causing lateral gliding between RP and IP ($p < 0.05$).

Correlations between clinical signs and symptoms from the stomatognathic system are shown in Table 4.

Correlations (C group)

No statistically significant correlation could be found between the radiographic signs and single subjective or clinical symptoms from the stomatognathic system in the C group. Nor was any significant correlation found between mediotrusion side interferences and the other occlusal variables.

The clinical dysfunction index was significantly correlated to the subjective index ($p < 0.01$). Correlations between signs and symptoms from the stomatognathic system are shown in Table 4.

Table 4. Correlations between crepitus from the TMJ, tenderness to palpation of the TMJ, difficulties in opening the mouth wide, duration of symptoms, and subjective and clinical symptoms from the stomatognathic system in the AS and C groups (Neg. = negative correlation; — = not tested)

	Crepitus from the TMJ		Tenderness to palpation of the TMJ		Difficulties in opening the mouth wide		Duration of symptoms	
Symptoms	AS group	C group	AS group	C group	AS group	C group	AS group	C group
Subjective symptoms								
Pain from the TMJ area	*		**		—	—	—	—
Pain from the cheek area					—	—	—	—
Difficulties in opening the mouth wide	**		**		—	—	—	—
Stiffness/tiredness in the jaws during mandibular movements					—	—	—	—
Sounds from the TMJ	*				—	—	—	—
Swelling over the TMJ					—	—	—	—
Subjective index	**		**		—	—	—	—
Duration of symptoms	**		**		—	—	—	—
Clinical symptoms								
Maximal mouth opening	**(Neg.)	*(Neg.)	*(Neg.)		**(Neg.)	**(Neg.)	**(Neg.)	
Tenderness to palpation of the masticatory muscles			**	*	*			*
Tenderness to palpation of the TMJ	**		—	—	**		**	
Painful mandibular movements	**		**		**		**	
Clicking from the TMJ		*(Neg.)			*(Neg.)		*(Neg.)	**
Crepitus from the TMJ	—	—	**		**		**	

Treatment

The subjective and clinical dysfunction scores before and after treatment are shown in Table 5 and Figs. 2 and 3. No statistically significant changes occurred in the SDS or CDS after treatment. The mean of the CDS in the S group decreased from 8.3 (median, 8) to 5.0 (median, 4). This decrease was caused mainly by a reduced tenderness of masticatory muscles. The other variables included in the CDS showed only minor changes after treatment. In the N group the CDS was similar before and after treatment with a mean of 7.0 (median, 7) and 6.7 (median, 7), respectively.

Discussion

Difficulties in opening the mouth wide were frequently reported in the AS group, and a reduced mandibular mobility could also frequently be found on clinical examination in this group compared with the C group (7, 8). In this study, it could also be shown that difficulties in opening the mouth wide were correlated to most other clinical symptoms from the stomatognathic system but especially to tenderness and crepitus of the TMJ and pain on mandibular movement. Both the subjective symptom and the clinical sign of impaired mobility of the mandible in the individuals of the AS group were correlated to radiographic signs of TMJ disease—that is, flattening, erosion, and sclerosis of the mandibular condyle. Erosion is generally considered to be a sign of inflammatory joint disease (17, 18) and flattening and sclerosis signs of joint remodeling (19), the latter two being caused either by physiological aging of the joint or joint disease (20, 21).

Table 5. Distribution by sex, age, duration and extension of AS, radiographic changes of the TMJ, number of occluding pairs of teeth, and the subjective and clinical dysfunction score (before (I) and after (II) treatment) of seven patients treated by occlusal splints and seven not treated patients

Sex		Age (years)		Duration of AS (years)		Extension of AS (no. of joint regions affected)		Radiographic changes (R_i)		No. of occluding pairs of teeth		Subjective dysfunction score				Clinical dysfunction score			
												S		N		S		N	
S	N	S	N	S	N	S	N	S	N	S	N	I	II	I	II	I	II	I	II
M	M	27	36	9	17	3	3	4	MD*	10	13	2	2	1	1	13	4	9	8
M	M	34	60	12	18	4	7	2	0	10	0	2	2	2	1	7	3	8	8
M	M	35	63	14	33	4	8	0	MD*	10	7	2	2	2	2	8	8	7	6
M	M	43	66	17	42	5	8	4	MD*	9	10	2	2	2	2	8	8	6	7
M	F	47	33	5	10	8	3	0	0	13	14	2	1	1	1	7	2	5	1
M	F	47	47	10	11	8	6	4	0	7	9	4	3	1	1	8	7	5	5
F	F	55	54	20	20	8	3	0	1	14	8	4	1	3	3	7	3	9	13
Means		41	51	12	22	6	5	57%	14% (57%)†	10	9	2.6	1.9	2.0	1.7	8.3	5.0	7.0	6.7

S = splint therapy; N = no treatment; M = male; F = female.
* MD = missing data from orthopantomography.
† Radiographic changes later detected by tomography.

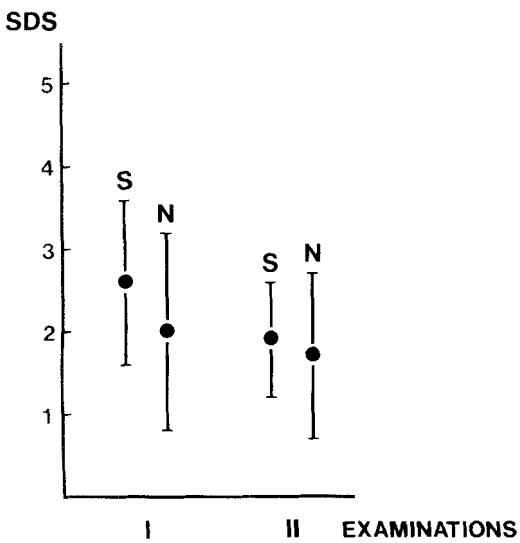

Fig. 2. Subjective dysfunction score (SDS) before (I) and after (II) treatment. Mean values ±1 standard deviation. S = splint therapy; N = no treatment.

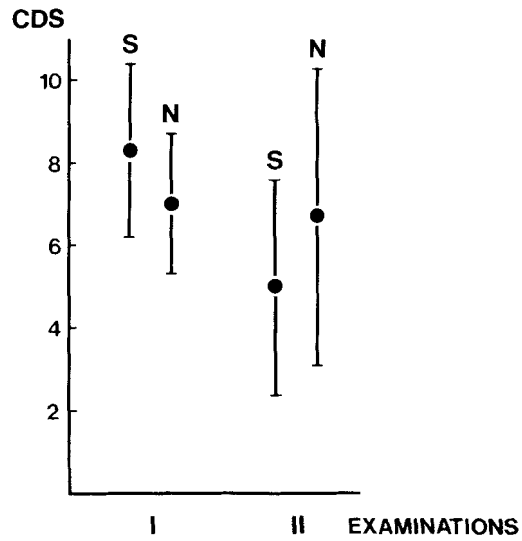

Fig. 3. Clinical dysfunction score (CDS) before (I) and after (II) treatment. Mean values ±1 standard deviation. S = splint therapy; N = no treatment.

In general, both the subjective symptoms and the clinical signs from the stomatognathic system of the individuals in the AS group were correlated both to each other and to radiographic changes in the TMJ condyle, especially flattening and erosion, strongly suggesting that AS is the common cause. Tenderness to palpation of both the TMJ and masticatory muscles was correlated to flattening and erosion of the condyle and, as expected, to painful manidbular movements.

Flattening and erosion of the condyle were also positively correlated to duration of symptoms, which indicates that these radiographic changes develop rather late and are signs of chronic TMJ disease rather than early

diagnostic signs (17). Previous occurrence of similar symptoms was also more frequent among individuals with these radiographic changes, especially flattening, which corroborates this view. It has been shown earlier that the symptoms from the stomatognathic system started on average 8 years after the onset of AS (7).

The most probable cause of both symptoms and signs from the stomatognathic system of the individuals in the AS group is, as has already been suggested, AS. Two variables were previously found to be correlated to, and therefore suggested to explain part of, the variation in the clinical dysfunction index: mediotrusion side interferences and extension of AS (8). Both of them were also correlated to erosive radiographic changes in the TMJ condyle (9). Neither the mediotrusion side interferences nor the extension of the AS, however, was found to correlate independently to the clinical dysfunction index when the radiographic index was taken into consideration; that is, the pathological process in the TMJ condyle, radiographically observed as an erosion, was probably the cause of both the clinical dysfunction in the stomatognathic system and the mediotrusion side interferences. The mediotrusion side interferences could thus not be ascribed an independent etiological role with respect to the pain and dysfunction in the stomatognathic system of the individuals with AS. Further support for this hypothesis is provided by a previous study, in which both the vertical and the sagittal distance between RP and IP were shown to be significantly greater in the AS group than in the C group. These findings are probably also the result of erosive changes of the condyles in AS (8). Mediotrusion side interferences were also positively correlated to interferences between RP and IP in the AS group.

Crepitus of the TMJ, which is considered an important sign of structural damage to the joint (21–23), was in the AS group correlated to both subjective symptoms and clinical signs such as pain and tenderness of the TMJ, difficulties in opening the mouth wide, reduced mouth opening, and pain during mandibular movements. Crepitus, however, is a late sign of organic joint lesions and will probably appear first after some years disease with periods of more unspecific pain and tenderness of the TMJ. The lack of correlation between crepitus and radiographic changes seems puzzling, but one explanation may be that rotational panoramic radiography does not give full information about the condition of the joint. This has recently been demonstrated in a study in which remodeling of the mandibular condyle, as registered by transpharyngeal radiographs, was found only in 62% by means of panoramic radiography (24).

Tenderness of the TMJ was correlated to tenderness of the masticatory muscles in both the AS and the C group; that is, muscle tenderness is usually also found in individuals with TMJ disorders, as has been shown previously (25). For AS this association probably has special significance, since this disease may involve the cervical spine and thereby influence the postural position and muscle function of the head, leading to overloading of the muscles (3).

The clinical dysfunction index was correlated to the subjective index in both the AS and the C group, which demonstrates an agreement between these indices.

The two groups subjected to the treatment trial differed with respect to sex, age, and duration of AS in spite of random allocation. There were more women in the N group, and the individuals in this group were also approximately 10 years older than those in the S group and consequently also had a longer duration of their AS. The extension of AS, on the other hand, was similar in both groups. Three of the individuals in the N group could not be examined by the panoramic technique because of severe deformation of the spine. These individuals were later examined by a tomographic technique, and all of them showed changes in the bony components of the TMJ. Since the individuals in the two groups had a similar extension of AS and a similar frequency of radiographic TMJ changes, the groups can be considered comparable in spite of the differences in sex, age, and duration of AS. The reason for this conclusion is that the extension of AS and the TMJ changes reflect the *severity* of the general disease and the TMJ involvement, respectively.

The subjective dysfunction score was similar in both groups before and after treatment, demonstrating a relatively low grade of subjective symptoms. This is understandable, since none of these individuals had requested treatment, and the selection for treatment was made on a clinical basis only.

The clinical dysfunction score, however, showed a marked reduction in the S group compared with the N group, although not statistically significant. This result is interesting from a clinical point of view, although the patient groups were too small to show a statistically significant difference, and merits further study. The reduction of the CDS was mainly due to decreased tenderness in the masticatory muscles, whereas tenderness to palpation of the TMJ remained unchanged.

Occlusal splint therapy is often used in patients with disorders in the stomatognathic system of different etiological backgrounds and has been shown to be efficient in reducing muscular hyperactivity (26). The poor effect of the treatment in this study on tenderness of the TMJ may be due to a local inflammatory involvement of the TMJ in AS. A splint may, on the other hand, reduce the symptoms from the masticatory muscles caused by altered postural position of the head.

Treatment of stomatognathic disorders in AS has been described in few studies previously (3, 6). Most of these have dealt with single patients often with a severe form of the disease. The treatment in these cases has almost exclusively been surgical and included condylectomy and artificial replacement of the condyle (6).

Crum & Loiselle (3) treated four patients with AS, who had subjective symptoms from the TMJ and a restricted mouth opening capacity. These patients were treated with acrylic occlusal splints during 4 months. Three of the patients received complete relief of symptoms and a normalized movement capacity of the mandible. These authors ascribed the positive effect to a reduction of 'spasm' in the masticatory muscles, which they assumed was caused by the altered postural position of the head. No radiographic changes were found in the TMJ in their study.

In the present study, however, 57% of the individuals treated had radiographic changes in the TMJ, which are assumed to be a negative factor for treatment by acrylic splints (25).

It can be concluded from the present results that there is a correlation between radiographic changes in the TMJ and both subjective and clinical symptoms from the stomatognathic system in individuals with AS as compared with other individuals. It can also be concluded that there is a relationship between clinical signs of TMJ involvement and subjective and clinical symptoms from the stomatognathic system. There are also strong indications that the subjective symptoms, the clinical signs, and the radiographic changes of the TMJ in the individuals with AS were caused by this disease.

Treatment with occlusal splints showed no statistically significant short-term reduction of subjective and clinical symptoms from the stomatognathic system in individuals with AS, although a reduction of clinical symptoms was found in five of seven treated individuals.

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