

Clinical findings in the stomatognathic system for individuals with rheumatoid arthritis and osteoarthritis

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A group of 123 individuals with rheumatoid arthritis (RA group) and 28 individuals with osteoarthritis (OA group) were compared with 52 individuals without general joint symptoms (C group). The individuals in the RA and OA groups constituted 35% and 14%, respectively, of all individuals with RA and OA at the Rheumatism Hospital in Strängnäs, Sweden, during the period of investigation. All individuals answered a questionnaire concerning subjective symptoms from the stomatognathic system and general joint symptoms and were given a clinical examination comprising the temporomandibular joint (TMJ), masticatory muscles, mandibular mobility, and occlusion. Most signs of disorder in the stomatognathic system were more frequent and more severe in the RA and OA groups than in the C group. The clinical signs were of a similar character in the RA and OA groups, but the individuals in the RA and OA groups had less occlusal support, more occlusal interferences, greater distance between RP and IP, and less vertical overbite than the C group. Anterior open bite was found with higher frequency and severity in the RA and OA groups than in the C group and was correlated to clinical dysfunction score and reduced maximum mouth opening capacity. □ *Occlusion; questionnaire; temporomandibular joint; temporomandibular joint disease*

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Like other joints of the body the temporomandibular joint (TMJ) can be affected by a wide variety of diseases. The commonest of the inflammatory joint diseases is rheumatoid arthritis (RA). The extent of joint involvement and the severity of the disease can vary considerably. Involvement of the TMJ by RA was described by Garrod already in 1874 (1); he believed that this disease had an affinity for the TMJ. According to later clinical investigations, it can be expected that about every second individual with RA has clinical signs of TMJ disorder such as palpation tenderness and crepitus (2, 3). Involvement of the TMJ has frequently been reported to occur late in the course of the disease (4, 5).

The character and distribution of the clinical signs of RA in the TMJ are not entirely known. Tenderness to palpation and crepitus have been considered the most characteristic clinical signs of RA in the TMJ (3), although both are non-specific and in common with

most other organic diseases of the TMJ. Pain confined to the joint during mandibular movements has also been considered a valuable symptom, although it is dependent on the patients' subjective judgement. The clinical finding of swelling of the TMJ in RA has only been reported occasionally (6, 7) and is therefore probably uncommon. A characteristic and maybe specific occlusal feature of RA in the TMJ is anterior open bite due to bilateral destruction of the mandibular condyles (7). The frequency of and the factors determining the development of open bite and other occlusal disturbances are largely unknown at present.

Osteoarthritis (OA) is a most common organic joint disease afflicting the TMJ and is defined as a primarily non-inflammatory disease of movable joints. The clinical signs of OA in the TMJ reported hitherto are similar to those of RA—that is, tenderness to palpation and crepitus of the TMJ, reduced mobility of the TMJ, and pain on mandibular

movement. In contrast to RA, anterior open bite and other major occlusal disturbances have not been reported to be associated with OA of the TMJ.

The aims of this study were to investigate the frequency, character, and severity of the clinical signs in the stomatognathic system in individuals with RA and OA and their distribution by age and sex in comparison with individuals without general joint symptoms; to investigate the frequency, character, and severity of occlusal disturbances; and to investigate the relationship between clinical signs and occlusal disturbances.

Patients and methods

The individuals in this study were selected from a total number of 901 (401 of whom had RA and 246 OA) attending the Rheumatism Hospital in Strängnäs, Sweden, during 1982–83, in accordance with the following principles. All 901 individuals were given a screening questionnaire, to find those with previous or current pain in the TMJ region, difficulties in chewing, or difficulties in opening the mouth wide. Among the 311 individuals who responded affirmatively to any of these questions, 22 had symptoms caused by inadequate dental prostheses not located to the TMJ region, 21 had symptoms caused by pulpitis, otitis, and so forth, 4 were receiving treatment by other dentists, 32 had left the hospital just after answering the ques-

tionnaire, 20 were not willing to participate in the study, 8 delivered unreliable answers owing to senility, and 4 delivered unreliable answers owing to language difficulties. The other 200 individuals were given an extensive questionnaire and were then subjected to a clinical examination. One hundred and twenty-three of these individuals, who had RA in accordance with the American Rheumatism Association (ARA) criteria, definite or classical (8), and 28 individuals who had OA (9) were investigated in this study. They constituted the RA and OA groups. A comparison group (C group) comprising 52 individuals without general joint symptoms or disease attending the Public Dental Clinic in Strängnäs for regular dental treatment was included in the study. These individuals were selected on the basis of age and sex to match the RA and OA groups. Forty-nine individuals were excluded from the study because of other diagnoses, such as ankylosing spondylitis, psoriatic arthropathy, and fibromyalgia. In the RA group the mean age was 57 years and 80% were women; in the OA group the mean age was 61 years and 89% were women; and in the C group the mean age was 51 years and 75% were women (Table 1).

Questionnaire

The questionnaire comprised 30 multiple-choice questions on symptoms in the stomatognathic system (pain, impaired chewing

Table 1. Age and sex distribution for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group), and without general joint symptoms (C group)

	Age, years						Total
	21–30	31–40	41–50	51–60	61–70	71–82	
RA group							
Women	3	6	11	42	28	10	100
Men	—	1	5	9	6	2	23
OA group							
Women	—	1	4	7	6	7	25
Men	—	—	1	2	—	—	3
C group							
Women	—	7	16	10	5	1	39
Men	—	1	3	5	4	—	13
Total	3	16	40	75	49	20	203

ability, TMJ swelling, TMJ sounds, TMJ locking, severity and duration of symptoms), general joint symptoms (pain, stiffness, severity and duration of symptoms), medication, dental condition, and dental care (tooth-brushing, dental visits).

Clinical examination

The clinical examination of the stomatognathic system comprised palpation for tenderness of the TMJ and masticatory muscles, assessment of TMJ for mobility, clicking, crepitus, and soft-tissue swelling, measurement of the maximum movement capacity of the mandible, assessment of pain on active mandibular movements, and deviation of the mandible (>2 mm) on mouth opening (10, 11). The clinical signs were quantified by the clinical dysfunction index (Di0-III) of Helkimo (12). The Eichner index, which counts the number of supporting zones in the premolar and molar regions, was recorded. The Eichner index includes only natural teeth and teeth in fixed bridges (13) and is divided into 10 categories (A1-A3, B1-B4, C1-C3) in accordance with number of teeth (tooth support). The presence and degree of anterior open bite was assessed visually and with occlusal foil with the mandible in intercuspal position (IP). Vertical overbite, interferences between retruded position (RP) and IP causing lateral displacement of the mandible >0.5 mm measured in the incisal region (11/41), and balancing-side interferences were also recorded. Balancing-side (mediotrusion) interference was defined as an interference that prevents occlusal contact on the functioning (laterotrusion) side. The sagittal and vertical distances between RP and IP were measured to the nearest 0.5 mm with a ruler in the right premolar region. All clinical examinations were performed by the same examiner.

Statistics

Correlations with age, sex, and clinical findings were tested for statistical significance with the Spearman rank correlation coefficient (R_s) and differences between

patient groups were tested by the Mann-Whitney U-test (14). The level of statistical significance (p value) is given when $p < 0.05$. Otherwise it is denoted NS (not significant). A stepwise regression analysis was used to investigate the relative importance of the single independent variables determining the clinical dysfunction index. Only variables meeting the 0.05 significance level were included in the regression (15).

Results

The distribution of the clinical signs and the clinical dysfunction index in the different groups is shown in Tables 2 and 3 and in Figs. 1 and 2. Both the RA and OA group showed high frequencies of TMJ crepitus, reduced translatory mobility of the TMJ, and deviation of the mandible during mouth opening. In the RA group the mandibular movements were greater in men than in women ($p = 0.001$). Translatory mobility of the TMJ was more frequently reduced among women than men in the RA group ($p = 0.001$). The value of the clinical dysfunction index was higher in the OA group (median, 2.5) than in the RA group (median, 1.9; $p = 0.011$) (Fig. 2), whereas both RA and OA groups had higher values than the C group (median, 0.7; $p = 0.001$). According to the stepwise regression analysis, most of the variance in the clinical dysfunction index could be attributed to the number of muscles tender to palpation in both the RA group (51%) and the C group (31%). Other important variables were pain on mandibular movement in the RA group (additional 25%) and TMJ crepitus in the C group (additional 11%).

The distribution of tooth support by the Eichner index is shown in Fig. 3. The Eichner index was negatively correlated to age ($R_s = -0.46$; $p = 0.001$) in the RA group. There were less support zones in the RA and OA groups (median, 5.8) than in the C group (median, 9.1; $p = 0.001$).

The distribution of anterior open bite and the influence of the Eichner index on this variable are shown in Table 4.

Table 2. Distribution of mandibular movement capacity for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group), and without general joint symptoms (C group). W = women; M = men

	RA group		OA group	C group		Test of differences between groups		
	W <i>n</i> = 99	M <i>n</i> = 24	W <i>n</i> = 25	W <i>n</i> = 39	M <i>n</i> = 13	RA-OA	RA-C	OA-C
Maximum mouth opening capacity, mm								
Mean	38	45	40	52	57	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Range	24-58	29-61	23-50	39-62	50-73			
Maximum laterotrusion								
Right								
Mean	7	8	8	11	11	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Range	0-13	2-14	3-13	7-15	7-16			
Left								
Mean	8	9	8	11	12	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Range	1-13	3-14	2-14	7-17	9-14			
Maximum protrusion								
Mean	6	8	6	9	8	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Range	1-13	1-14	1-10	5-15	5-11			

The distribution of occlusal disturbances is shown in Table 5, and the relation between RP and IP and vertical overbite is presented in Table 6 and Figs. 4 and 5. The influence of tooth support according to the Eichner index is considered in the analysis. The

women in the RA and OA groups had a longer sagittal RP-IP distance than the men (*p* = 0.013 and *p* = 0.035, respectively) and the sagittal RP-IP distance was positively correlated to age in the OA group (*R*_s = 0.64; *p* = 0.001).

Table 3. Distribution of clinical signs in the stomatognathic system for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group), and without general joint symptoms (C group). W = women; M = men

	RA group		OA group	C group		Test of differences between groups		
	W <i>n</i> = 99	M <i>n</i> = 24	W <i>n</i> = 25	W <i>n</i> = 39	M <i>n</i> = 13	RA-OA	RA-C	OA-C
Reduced translatory mobility of TMJ, %	60	21	52	3	0	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Deviation of mandible during mouth opening, %	56	58	80	31	23	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Crepitus of TMJ, %	76	75	56	21	15	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
Clicking of TMJ, %	8	13	28	38	38	<i>p</i> = 0.018	<i>p</i> = 0.001	NS
Locking of TMJ, %	5	4	32	0	0	<i>p</i> = 0.001	NS	<i>p</i> = 0.001
Lateral tenderness of TMJ, %	43	25	56	3	8	<i>p</i> = 0.045	<i>p</i> = 0.001	<i>p</i> = 0.001
Posterior tenderness of TMJ, %	14	0	20	5	0	NS	NS	<i>p</i> = 0.035
Swelling of TMJ, %	1	0	0	0	0	NS	NS	NS
Painful mandibular movements, %								
1 movement	20	8	44	0	0			
>1 movement	28	38	20	3	0	NS	<i>p</i> = 0.001	<i>p</i> = 0.001
No. of tender muscle regions								
Median	4	3	7	0.5	0.2	<i>p</i> = 0.001	<i>p</i> = 0.001	<i>p</i> = 0.001
Range	10-13	0-8	0-10	0-6	0-1			

**MAXIMUM MOUTH
OPENING CAPACITY
IN MM**

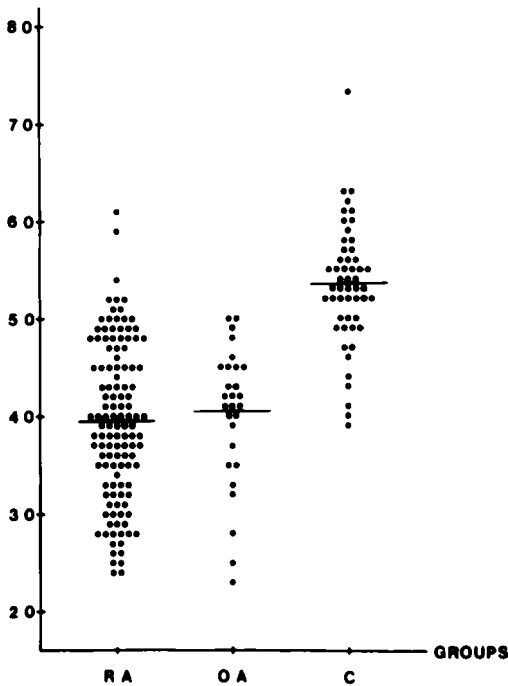


Fig. 1. Maximum mouth opening capacity (in millimeters) for individuals with rheumatoid arthritis (RA group; $n = 123$), osteoarthritis (OA group; $n = 28$), and without general joint symptoms (C group; $n = 52$). Mean values are indicated by horizontal bars.

Correlation between subjective symptoms and clinical signs

Maximum mouth opening capacity and translatory mobility of the TMJ were negatively correlated to pain in the TMJ region in the RA group ($R_s = -0.36$; $p = 0.001$ and $R_s = -0.30$; $p = 0.001$). Translatory mobility of the TMJ was negatively correlated to crepitus in the OA group ($R_s = -0.37$; $p = 0.028$). The clinical dysfunction index was positively correlated to the extension of general joint symptoms in RA ($R_s = 0.29$, $p = 0.001$) (Fig. 6). Forty-four individuals thereby received the highest score (DiIII) of the clinical dysfunction index, and 89% of these had general joint involvement in five or more joint regions.

Correlations between clinical signs and occlusal status

Maximum mouth opening capacity in the RA group was positively correlated to number of own teeth ($R_s = 0.18$; $p = 0.022$) and negatively correlated to anterior open bite ($R_s = -0.21$; $p = 0.011$). Maximum mouth opening capacity was also negatively correlated to anterior open bite in the OA group ($R_s = -0.32$; $p = 0.048$).

The clinical dysfunction score in the RA

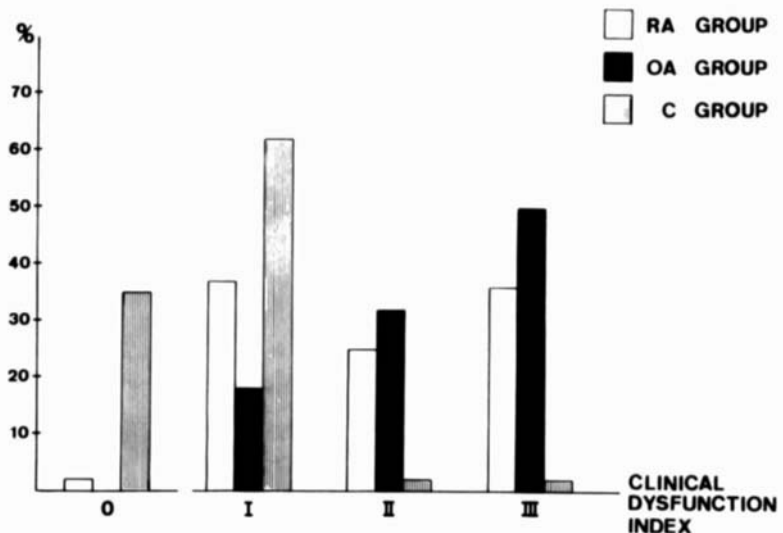


Fig. 2. Percentage distribution of clinical dysfunction index (0-III) for individuals with rheumatoid arthritis (RA group; $n = 123$), osteoarthritis (OA group; $n = 28$) and without general joint symptoms (C group; $n = 52$).

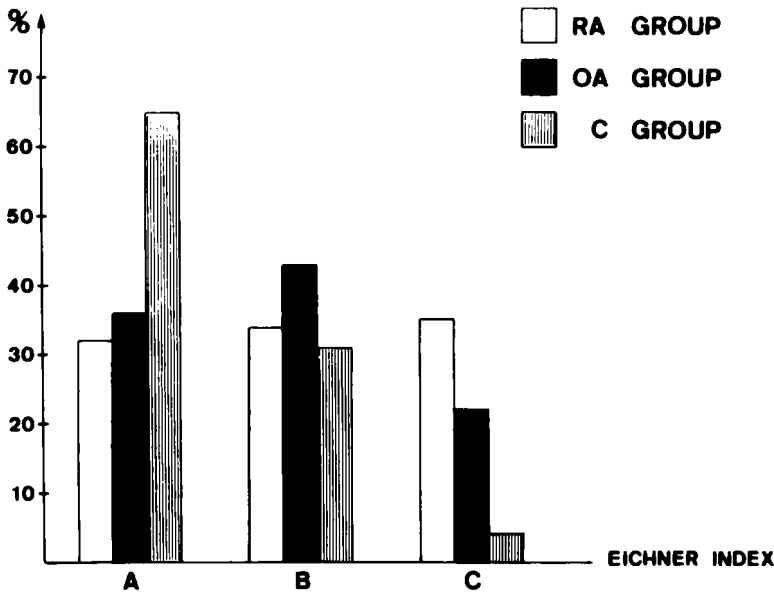


Fig. 3. Percentage distribution of the Eichner index for individuals with rheumatoid arthritis (RA group; $n = 123$), osteoarthritis (OA group; $n = 28$), and without general joint symptoms (C group; $n = 52$). A = all support zones present, B = one to four support zones missing, and C = no support zone present.

group was negatively correlated to number of own teeth ($R_S = -0.30$; $p = 0.001$) and vertical overbite ($R_S = -0.18$; $p = 0.025$) and positively correlated to anterior open bite ($R_S = 0.17$; $p = 0.032$). The clinical dysfunction score in the OA group was negatively correlated to the number of occluding molars ($R_S = -0.43$; $p = 0.012$) and in the C group was positively correlated to sagittal RP-IP distance ($R_S = 0.27$; $p = 0.027$).

The sagittal RP-IP distance in the RA group was negatively correlated to vertical overbite ($R_S = -0.18$; $p = 0.022$), whereas the sagittal RP-IP distance in the OA group was negatively correlated to the Eichner index ($R_S = -0.51$; $p = 0.003$), positively correlated to duration of general joint symptoms ($R_S = 0.36$; $p = 0.033$), and negatively correlated to number of occluding molars ($R_S = -0.36$; $p = 0.029$).

Discussion

The RA and OA groups were similar with regard to age, sex, and occlusal stability and were therefore comparable without consideration of these factors. The C group was comparable to the other two groups with regard to age and sex.

Maximum mouth opening capacity was considered restricted when it was less than 40 mm (16). It was restricted in about half of the individuals of the RA group and in slightly less than half of the OA group, whereas only one individual in the C group had restricted mouth opening. The other mandibular movements—laterotrusion and protrusion—were also restricted in many of the individuals of the RA and OA groups. No one in any of the groups, however, had such a severe reduction (less than about 10 mm) in mouth opening capacity as to indicate TMJ ankylosis. The translatory movement of the condyle, on the other hand, was restricted in most individuals in both the RA and OA groups. This finding is in agreement with the difficulties in opening the mouth reported by these same individuals (17). Larheim et al. (18) found that condylar rotation still could exist in patients with complete destruction of the mandibular condyle and almost complete restriction of translatory motion, and they therefore suggested that maximum mouth opening capacity may give a false impression of joint mobility in individuals with RA. Reduced translatory mobility of the TMJ in our study was correlated to pain in the RA group, whereas reduced translatory mobility was correlated

Table 4. Percentage distribution of extension of anterior open bite for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group), and without general joint symptoms (C group) according to the Eichner index (A = all tooth support zones present, B = one to four support zones missing and C = no support zone present). There was a statistically significant difference between the RA and C groups ($p = 0.001$) and between the OA and C groups ($p = 0.035$)

	RA group			OA group			C group		
	A <i>n</i> = 39	B <i>n</i> = 41	C <i>n</i> = 42	A <i>n</i> = 10	B <i>n</i> = 12	C <i>n</i> = 6	A <i>n</i> = 34	B <i>n</i> = 16	C <i>n</i> = 2
Degree of open bite									
Occlusal contacts between all teeth	62	83	57	50	92	67	91	94	50
Occlusal contacts missing between incisors and cuspids	20	12	21	50	8	34	6	6	50
Occlusal contacts missing anterior to the second premolar	16	2	7	0	0	0	3	0	—
Occlusal contacts missing anterior to the first molar	3	—	2	—	—	—	—	—	—
Occlusal contacts missing anterior to the second molar	—	2	12	—	—	—	—	—	—

Table 5. Percentage distribution of occlusal interferences causing lateral displacement of the mandible >0.5 mm between retruded position (RP) and intercuspal position (IP) and interferences on the balancing side (both within and beyond 3 mm laterotrusion) for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group) and without general joint symptoms (C group)

Occlusal variables	RA group <i>n</i> = 123			OA group <i>n</i> = 28			C group <i>n</i> = 52			Test of differences between groups
	R	L	R/L	R	L	R/L	R	L	R/L	
Interference RP-IP	14	21	35	25	7	32	0	2	2	$p = 0.001$
Balancing interference <3 mm lat.tr.	9	16	21	7	4	7	13	13	21	NS
>3 mm lat.tr.	17	20	29	7	11	14	19	23	31	NS
							RA-OA	RA-C	OA-C	NS

Table 6. The sagittal and vertical distances between retruded position (RP) and intercuspal position (IP) and vertical overbite measured to the nearest 0.5 mm (mean) for individuals with rheumatoid arthritis (RA group), osteoarthritis (OA group), and without general joint symptoms (C group). Distribution according to the Eichner index of tooth support (A = all support zones present, B = 1-4 support zones missing and C = no support zone present). The differences between groups RA-C and OA-C are statistically significant (sagittal and vertical distance RP-IP: $p = 0.001$; and vertical overbite: $p = 0.001$)

Occlusal variables	RA group			OA group			C group		
	A <i>n</i> = 39	B <i>n</i> = 41	C <i>n</i> = 43	A <i>n</i> = 10	B <i>n</i> = 12	C <i>n</i> = 6	A <i>n</i> = 34	B <i>n</i> = 16	C <i>n</i> = 2
Sagittal distance RP-IP	1.5	1.2	1.9	1.0	1.6	2.0	0.3	0.3	0.3
Women	1.5	1.2	2.1	1.1	1.6	2.3	0.3	0.2	0.5
Men	1.4	0.9	1.2	0.5	—	0.5	0.5	0.3	0.0
Vertical distance RP-IP	1.0	0.8	0.8	0.6	0.9	0.8	0.2	0.3	0.3
Vertical overbite	2.6	4.0	1.5	3.1	2.3	1.5	3.8	3.6	4.0

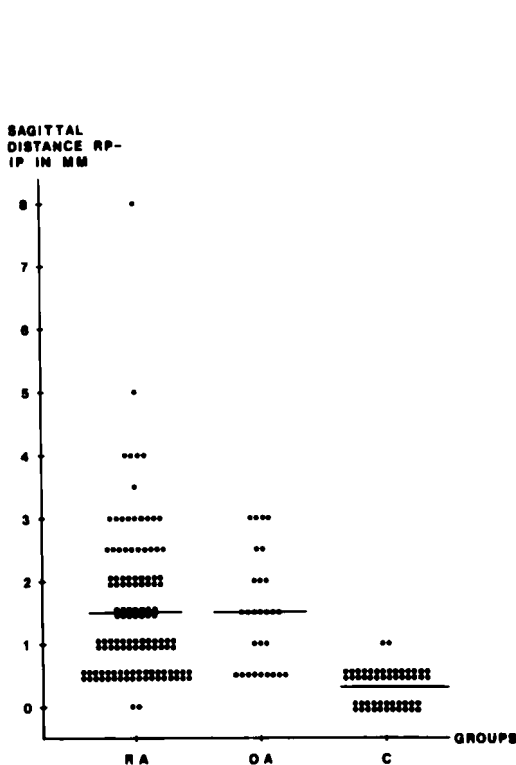


Fig. 4. Sagittal distance (in millimeters) between retruded position (RP) and intercuspal position (IP) for individuals with rheumatoid arthritis (RA group; $n = 123$), osteoarthritis (OA group; $n = 28$), and without general joint symptoms (C group; $n = 52$). Mean values are indicated by horizontal bars. Statistically significant differences exist between the RA and C groups ($p = 0.001$) and between the OA and C groups ($p = 0.001$).

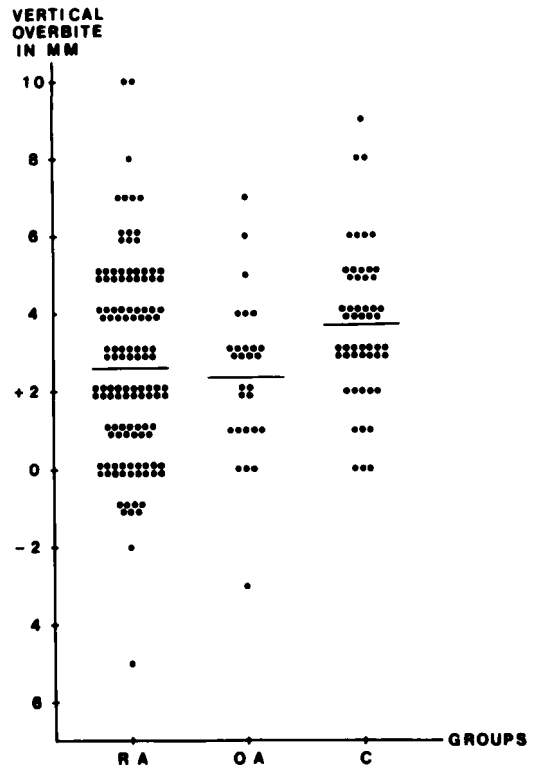


Fig. 5. Vertical overbite (in millimeters), measured in the incisal region (11/41) in individuals with rheumatoid arthritis (RA group; $n = 123$), osteoarthritis (OA group; $n = 28$), and without general joint symptoms (C group; $n = 52$). Mean values are indicated by horizontal bars. Statistically significant differences were found between the RA and C groups ($p = 0.009$) and between the OA and C groups ($p = 0.005$).

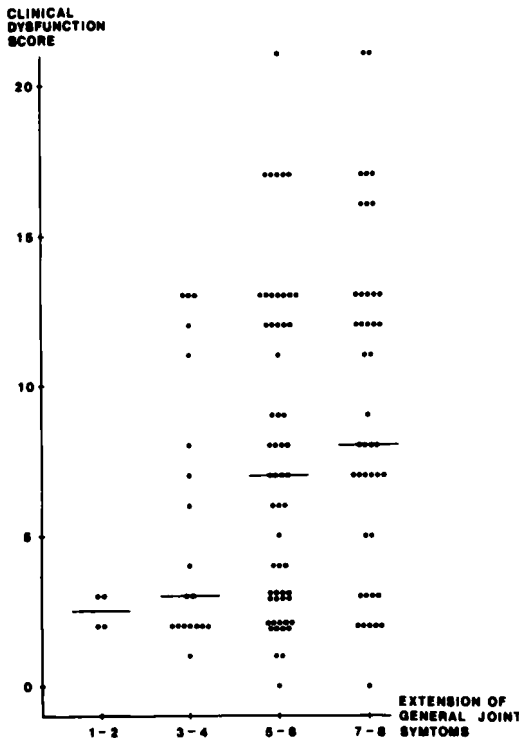


Fig. 6. Relationship between the clinical dysfunction score and extension of general joint symptoms (number of joint regions reported to be involved) for individuals with rheumatoid arthritis (RA group; $n = 123$; $R_s = 0.29$; $p = 0.001$). Median values indicated by horizontal bars.

to crepitus in the OA group. The cause of the restricted joint mobility may be locking by displaced perforated discs, fibrous adhesions, pain, or a combination of these factors. In this study, however, pain seemed to be an important factor of restricted mandibular mobility in the RA group, while crepitus and locking seemed important in the OA group.

Crepitus of the TMJ was a more frequent finding among the RA than OA individuals, which is in contrast to Zarb's view (19) that crepitus is more suggestive of OA. The frequency of crepitus in the RA group is in agreement with that presented by Franks (3) for RA patients with a history of TMJ disorder. Clicking and locking of the TMJ, on the other hand, was more frequent in the OA group in our study.

The frequency of lateral tenderness to pal-

pation of the TMJ in the RA group of our study was similar to the figure reported by Franks (3). Lateral tenderness was more frequent than posterior tenderness, as has been found previously (6), and there were no differences between the RA and OA groups with regard to frequency of either type. The individuals in the C group had a lower frequency of palpatory tenderness of the TMJ and masticatory muscles than those in the RA and OA groups, as could be expected.

This study confirms that soft-tissue swelling over the TMJ is a rare clinical finding (6, 7), since it was observed in only one woman of the RA group.

Loss of occlusal support, taking age into consideration, was positively correlated to TMJ crepitus and the clinical dysfunction score and negatively correlated to maximum mouth opening capacity in the RA group, which indicates that reduction of occlusal support results in a more severe TMJ involvement. This result is in agreement with studies by Öberg et al. (20), Kopp (21), and Larheim et al. (18). The latter reported that occurrence of radiographic signs of destructive and asymmetrical TMJ lesions were more frequent among endentulous than dentate patients.

Development of anterior open bite with progressing disease has been considered a characteristic finding in RA, but the results of this study show that this is an uncommon condition, since only 11% (right side) and 7% (left side) of the individuals in the RA group presented an open bite anterior to the second premolars, compared with 4% (right side) and 0% (left side) in the OA group and 2% (right side) and 0% (left side) in the C group. Larheim et al. (18) reported various degrees of anterior open bite for about 25% of their series of RA patients. Their figure is high compared with ours, probably because they also included missing contacts between incisors and cuspids, which are not necessarily related to TMJ disease. Our results, thus, indicate that anterior open bite is not a characteristic or specific sign of RA and raise the question whether some of the individuals with OA might have been afflicted by erosive arthritis of the TMJ, resulting in anterior open bite. There was no difference

between the RA and OA groups concerning sagittal or vertical distance between RP and IP, but the interindividual variation of the sagittal distance was much greater in the RA group. Another interesting occlusal finding was the high frequency of RP-IP interferences in the RA and OA groups compared with the C group. Interferences and vertical and sagittal distance between RP and IP as a consequence of inflammatory joint disease have been discussed previously for ankylosing spondylitis (22), and a correlation has also been reported between balancing interferences and radiographic evidence of erosion on the mandibular condyle (23).

The severity of TMJ disorder as estimated by the clinical dysfunction index was greatest in the OA group, in which 50% of the individuals had severe dysfunction (DiIII), compared with 36% in the RA group and 2% in the C group, whereas 18% of the OA group had none or slight dysfunction (Di0-I) compared with 39% in the RA group and 62% in the C group. These figures are in agreement with those of the subjectively experienced severity of TMJ symptoms in these same individuals (17).

It could be concluded that clinical signs of disorder in the stomatognathic system are more frequent and more severe among individuals with RA and OA than among individuals without joint disease. The clinical signs in the stomatognathic system are of similar character in RA and OA, but locking and lateral tenderness of the TMJ and tenderness of masticatory muscles seem to be more frequent in OA than in RA. The results of this study further show that individuals with RA and OA have less occlusal support, more occlusal interferences, greater distance between RP and IP, and less vertical overbite than individuals without joint disease. Anterior open bite occurs in both RA and OA with higher frequency than among individuals without joint disease and is positively correlated to the severity of disorder in the stomatognathic system.

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References

1. Garrod AB. A treatise on gout and rheumatic gout (rheumatoid arthritis). 3rd ed. London: Longmans, Green & Co. Ltd, 1874:520.
2. Ericsson S, Lundberg M. Alterations in the temporomandibular joint at various stages of rheumatoid arthritis. *Acta Rheum Scand* 1967;13:257-74.
3. Franks AST. Temporomandibular joint in adult rheumatoid arthritis. A comparative evaluation of 100 cases. *Ann Rheum Dis* 1969; 28:139-45.
4. Russel LA, Bayles TB. The temporomandibular joint in rheumatoid arthritis. *J Am Dent Assoc* 1974;28:533-9.
5. Hatch GS. Clinical and radiographic findings of the temporomandibular joint in patients with rheumatoid arthritis [Thesis]. Rochester, Minn.: Mayo Graduate School of Medicine, University of Minnesota, 1967.
6. Kopp S, Wenneberg B, Clemensson E. Clinical, microscopical and biochemical investigation of synovial fluid from temporomandibular joints. *Scand J Dent Res* 1983;91:33-41.
7. Mayne JG, Hatch GS. Arthritis of the temporomandibular joint *J Am Dent Assoc* 1969;79:125-30.
8. Kellgren JH. Diagnostic criteria for population studies. *Bull Rheum Dis* 1962;13:291-2.
9. Laine V, Sackett DL, Tzonchev VT. Report from the subcommittee on diagnostic criteria for osteoarthritis. In: Bennet PH, Wood PHN, eds. Population studies of the rheumatic diseases. Proceedings of the third international symposium. New York: Excerpta Medica Foundation, 1968. (International congress series no. 148).
10. Krogh-Poulsen WG. Management of occlusion of the teeth. Examination, diagnosis, treatment. In: Schwartz L, Chayes CM, eds. Facial pain and mandibular dysfunction. Philadelphia: WB Saunders Co, 1969;251-8.
11. Carlsson GE, Helkimo M. Funktionell undersökning av tuggapparaten. In: Holst JJ et al., eds. Nordisk klinisk odontologi 8-I. Copenhagen: A/S Forlaget for faglitteratur, 1972:1-21.
12. Helkimo M. Studies on function and dysfunction of the masticatory system. II. Index for anamnestic and clinical dysfunction and occlusal state. *Swed Dent J* 1974;67:101-21.
13. Eichner K. Über eine Gruppeneinteilung des Lückengebisses für die Prothetik. *Dtsch Zahnartztl Z* 1955;18:1831-4.
14. Siegel S. Nonparametric statistics for the behavioral sciences. New York: McGraw-Hill Book Co, 1956:116-27, 184-93, 202-13.
15. Draper NR, Smith H. Applied regression analysis. New York: John Wiley & Sons, 1966:171-2.
16. Agerberg G. Maximal mandibular movements in young men and women. *Swed Dent J* 1974;67:81-100.
17. Tegelberg Å, Kopp S. Subjective symptoms from the stomatognathic system in individuals with rheumatoid arthritis and osteoarthritis. *Swed Dent J* (in press).

18. Larheim TA, Storhaug K, Tveito L. Temporomandibular joint involvement and dental occlusion in a group of adults with rheumatoid arthritis. *Acta Odontol Scand* 1983;41:301-9.
19. Zarb GA. Non-surgical treatment of rheumatoid and degenerative arthritis of the TMJ. In: The President's conference on the examination, diagnosis and management of temporomandibular disorders. 1982:133-6.
20. Öberg T, Carlsson GE, Fajers C-M. The temporomandibular joint. A morphologic study on a human autopsy material. *Acta Odontol Scand* 1971;29:349-84.
21. Kopp S. Clinical findings in temporomandibular joint osteoarthritis. *Scand J Dent Res* 1977;85:434-43.
22. Wenneberg B, Kopp S. Clinical findings in the stomatognathic system in ankylosing spondylitis. *Scand J Dent Res* 1982;90:373-81.
23. Wenneberg B, Hollender L, Kopp S. Radiographic changes in the temporomandibular joint in ankylosing spondylitis. *Dentomaxillofac Radiol* 1983;12:25-30.

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