

Muscle strength, endurance, and aerobic capacity in rheumatoid arthritis: a comparative study with healthy subjects

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Abstract

Isometric/isokinetic muscle strength and isokinetic endurance of the lower extremities as well as aerobic capacity were evaluated in 67 patients (43 female, 24 male; mean age 53 years, range 23-65) with classical/definite rheumatoid arthritis (RA) of functional class II. Results obtained were compared with those of a healthy reference group matched for age and sex.

Disease characteristics of the group with RA were registered and lifestyle characteristics, such as work load, exercise, diet, smoking, and alcohol habits, were reported by both groups. Generally, results showed that the group with RA had decreased functional capacity. Isometric hip and knee muscle strength of the rheumatoid group was reduced to about 75% of normal function, isokinetic knee muscle strength at the velocities of 60 and 180 degrees/s to about 65% and 75% of normal function respectively, isokinetic endurance of the knee muscle groups to about 45%, and aerobic capacity to about 80% of the results obtained for the healthy reference group.

Analyses of variance showed that the rheumatoid group, compared with the healthy group, had significantly reduced function on all isometric and isokinetic tests of the extensors and flexors of the knee. Results for isometric hip muscle strength were similar—all tests but one yielding highly significant differences. To avoid unnecessary functional deficits it seems important to include muscular training in rehabilitation programmes for patients with RA.

Impaired muscle function is a common consequence in patients with rheumatoid arthritis (RA). Results of a previous study indicated that about 80% of patients with large joints of the lower extremities affected by RA had problems related to muscle strength, endurance, and balance/coordination.¹

Earlier studies have reported that patients with RA, as compared with healthy subjects, have reduced isometric²⁻⁶ and isokinetic^{2 5-7} muscle strength. Also, decreased isometric (static) muscular endurance has been reported for patients with RA as compared with healthy subjects.⁴ In another study⁶ which considered isokinetic (dynamic) endurance, however, no significant difference was found between patients with RA and healthy controls.

It has earlier been reported that patients with RA show lower cardiorespiratory fitness than

normal subjects.² In another study, however, no significant difference in maximal oxygen consumption was found between patients with RA and healthy, very sedentary, matched controls.⁶ The latter study concluded that both rheumatoid and control groups had reduced aerobic capacity.

Our study aimed at comparing the levels of isometric (hip, knee) and isokinetic (knee) muscle strength, isokinetic endurance of the knee muscle groups, and aerobic capacity in patients with RA and in healthy controls matched for age and sex. Also, an attempt was made to investigate how the selected variables of muscle function were related to disease activity of the patients with RA and lifestyle characteristics of both groups.

Patients and methods

GROUP WITH RA

Sixty seven patients (43 female, 24 male; mean age 53.0 years (SD 10.2), range 23-65) with classical/definite RA⁸ of functional class II⁹ took part in the study. An epidemiological approach, further described elsewhere,¹⁰ was used to select the patients with RA. Table 1 gives characteristics of the patients, who all had low to moderate disease activity. Of the 67 patients with RA, 11 had been receiving no antirheumatic drugs, 16 were receiving simple analgesics or non-steroidal anti-inflammatory drugs or both, 31 were taking remission inducing drugs alone or together with corticosteroids in four cases, and five were receiving corticosteroids only.

HEALTHY REFERENCE GROUP

The patient group was compared with a group of 77 active, healthy controls (47 female, 30 male; mean age 51.0 (SD 10.4), range 24-65 years). The healthy subjects were, with a few exceptions, employed by the University Hospital in Lund and volunteered for the study.

The healthy reference group was matched with the rheumatoid group according to age and sex, but an additional 10 healthy subjects were included. These were evenly distributed according to age and sex and were included owing to the planning of a future follow up study. Of the 77 healthy subjects, four were receiving treatment with β blockers (table 1).

MEASUREMENTS

Isometric muscle strength

Isometric muscle strength of the extensors, flexors, abductors, and adductors of the hip was measured in a lying position by a strain gauge

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Table 1 Characteristics of the rheumatoid and healthy control groups

Characteristic	Patients with RA*			Controls		
	Mean	SD	Range	Mean	SD	Range
Age (years)	53.0	10.2	23-65	51.0	10.4	24-65
Height (cm)						
Women	164.1	5.6	152-176	165.1	5.3	151-178
Men	177.9	6.8	164-195	177.3	8.1	153-193
Weight (kg)						
Women	66.1	11.6	44-106	62.7	9.4	50-95
Men	75.6	10.7	56-110	74.6	9.9	62-95
Duration of disease (years)	10.6	7.8	1-37	—	—	—
ESR* (mm/h)	25.0	19.0	3-125	—	—	—
CRP* (g/l)	23.5	28.0	12-137	—	—	—
Morning stiffness (min)	56.1	57.4	0-260	—	—	—
HAQ* disability index	0.9	0.6	0-2.9	—	—	—
Pain (VAS*)	1.2	0.8	0-3.0	—	—	—
Ritchie articular index	11.5	8.2	0-36	—	—	—
Index of joint mobility (%)	92.1	7.7	65-100	—	—	—
MF* index	7.7	6.5	0-25	—	—	—
			Number			Number
Sex (female/male)			43/24			47/30
Waalser-Rose test (pos/neg)			44/23			—
Rheumatoid nodules (yes/no)			24/43			—
Major joint affected (hip/knee/ankle)			16/16/35			—
Work load (light/moderate/heavy)			49/11/7			32/25/20
Leisure activities (never/sometimes/regularly/intensive)			12/13/42/0			2/12/50/13
Diet (ordinary/lactoveg/veg)			61/3/3			70/1/6
Smoking (0/1-5/6-10/>10 cig)			49/7/3/8			57/4/7/9
Alcohol (never/seldom/regularly)			26/40/1			11/63/3
Drugs (yes/no)			56/11			4/73
Disability pension (full/partial/none)			32/6/29			0/0/77

*RA=rheumatoid arthritis; ESR=erythrocyte sedimentation rate; CRP=C reactive protein; HAQ=modified Health Assessment Questionnaire¹³; VAS=visual analogue score; MF=muscle function.

dynamometer attached to the ankle. Three measurements, each with a minimum duration of three seconds, were made in each direction, the highest value obtained being selected for statistical analysis.

Isometric muscle strength of the extensors and flexors of the knee was measured with a Cybex II isokinetic dynamometer¹¹ connected to a personal computer, with the patient in a fixed sitting position (hip in 90 degrees and knee in 60 degrees of flexion), the hold duration being three seconds. The sampling frequency was 60 Hz, a mean value being calculated for a two second period, beginning one second after start. The highest mean value obtained on three tests was used in statistical calculations. Torque due to the weight of the lower leg was corrected for by the computer. Vocal instructions for the tests were standardised.

Isokinetic muscle strength and endurance

Isokinetic muscle strength of the extensors and flexors of the knee was measured with a Cybex II isokinetic dynamometer (corrected for torque, see above) at velocities of 60 and 180 degrees/s, sampling frequencies being 120 Hz and 360 Hz respectively. Standardised vocal instructions were given. The patients performed three trials at 60 degrees/s and as many as they were able to (with a maximum of 40) at 180 degrees/s. The highest of the mean values obtained, sampled in the interval 75-25 degrees of flexion of the knee joint, was used in the further analyses.

Isokinetic endurance, defined here as maximum work capacity (sum of the mean values in newton metres of the contractions carried out), was measured for the extensors and flexors of the knee at 180 degrees/s.¹⁰

The patients were asked to rate their perceived exertion, as described by Borg,¹² immediately after the muscle testing procedure.

Aerobic capacity

Åstrand's method¹³ was used to calculate the maximum oxygen uptake (VO₂ max in ml/kg.min) during a submaximal work load provided by a bicycle ergometer. Immediately after the testing the rate of perceived exertion was scored by the patient. Subjects receiving β blockers were excluded from this test.

Index of muscle function

A battery of functional tests for muscle strength, endurance, and balance/coordination of the lower extremities¹ was used (muscle function indices). A patient's performance on the various tests was assessed by an observer using a three point scale (0-2), the maximum scores on the three separate indices being 14, 10, 10, respectively (muscle function index=34); a high score represented severe disability.

Disease activity

Estimated disease activity of the patients with RA was based on several measurements. Activities of daily living and pain intensity experienced during the past week were scored by the patients using a modified version¹⁴ of the Stanford Health Assessment Questionnaire—the disability index.¹⁵ An index of joint mobility was calculated, based on measurement (with a goniometer) of range of motion for all large joints of the lower extremities—100% representing normal joint mobility.¹⁴ Ritchie articular index was calculated,¹⁶ and erythrocyte sedimentation rate and C reactive protein were determined. Patients' reports of morning stiffness were noted in minutes.

Sociodemographic and lifestyle characteristics

Sociodemographic data were obtained by a

structured interview. The variable of physical work load in daily living was based on a modified version of a test described by Meenan *et al.*,¹⁷ and included the following categories: 1=light physical work, mainly sitting; 2=moderately heavy physical work involving frequent movements; 3=heavy physical work. The categories refer to the actual work load.

Inquiries about leisure activities, representing exercise habits (never/sometimes/regularly/intensive), and disability pension (full/partial/none) were made. In addition, lifestyle variables, such as diet, smoking, and alcohol consumption, were reported by all the subjects, who answered a structured questionnaire (table 1). Attitudes towards physical training were also scored by the patient on a 100 point truth value scale,¹⁸—100 representing total agreement and 0 complete disagreement with the statement given. The following items were included: 'I think physical training is important for me' and 'I think physical training is fun'.

STATISTICS

Analyses of variance on differences between groups were carried out with the SAS statistical package.¹⁹ In addition, correlation analyses according to Spearman were performed. A significance level of $p=0.05$ was selected.

Results

No significant differences between the rheumatoid and the healthy group were found for age, sex, height, and weight (analysis of variance, χ^2 test). Tables 2 and 3 show the means and standard deviations for isometric and isokinetic

muscle strength, isokinetic endurance, aerobic capacity, index of muscle function, and rate of perceived exertion for the rheumatoid and the matched healthy controls grouped according to age and sex.

Results obtained indicated decreased function for the rheumatoid group compared with the healthy group for all the variables of isometric and isokinetic muscle strength, isokinetic endurance, aerobic capacity, and muscle function index.

Isometric hip (extensors, flexors, abductors, adductors) and knee (extensors, flexors) muscle strength of the rheumatoid patients was reduced to about 75% of normal function and isokinetic muscle strength of the knee extensors and flexors at 60 and 180 degrees/s to about 75% and 65% of normal function respectively.

The isokinetic endurance of the patients with RA was about 45% of normal. It was found that older rheumatoid men (>54 years) showed least functional decrease (about 45%) and younger rheumatoid men (≤ 54 years) most functional decrease (about 60%) as compared with healthy controls in the corresponding age group. No such pattern was found for the rheumatoid women (about 45% decrease in both groups).

COMPARISONS BETWEEN THE GROUP WITH RA AND THE HEALTHY GROUP

Isometric muscle strength

Significant differences ($p<0.001$) between the rheumatoid and healthy groups were found for isometric strength of the extensors and flexors of the knee, with the rheumatoid group showing decreased muscular function. Furthermore, significant differences according to age

Table 2 Means and standard deviations for the female patients with rheumatoid arthritis and healthy control women of the tests for isometric/isokinetic muscle strength, isokinetic endurance, aerobic capacity, and rate of perceived exertion

Test	Women with RA				Healthy control women			
	(n=23) ≤ 54 years Mean	SD	(n=20) >54 years Mean	SD	(n=30) ≤ 54 years Mean	SD	(n=17) >54 years Mean	SD
Isometric strength (Nm)								
Knee ext* right	87.8	26.6	74.2	26.1	112.8	29.3	90.5	25.3
ext left	96.1	26.8	76.6	26.4	119.2	32.3	96.6	26.3
flex* right	35.3	9.4	29.8	10.2	54.8	17.1	41.0	11.8
flex left	43.7	13.9	34.5	12.6	59.7	19.1	43.8	11.9
Hip ext right (N)	83.1	23.3	72.0	16.7	96.6	26.3	83.5	23.0
ext left	77.5	29.5	70.8	15.5	97.5	24.4	82.5	18.0
flex right	58.1	15.9	48.1	13.0	61.7	17.5	54.2	19.3
flex left	53.0	18.4	44.3	13.1	65.6	20.1	56.1	15.9
abd* right	64.2	32.5	48.0	17.7	104.9	32.8	101.6	29.6
abd left	63.4	24.6	45.6	20.0	119.0	36.2	99.6	22.0
add* right	109.3	36.0	83.0	22.9	128.5	49.9	95.7	33.1
add left	103.5	37.4	78.1	23.9	129.9	40.4	107.4	42.4
Isokinetic strength (Nm)								
Knee ext right 60°/s	64.4	18.0	58.4	19.0	90.1	17.7	81.1	16.3
ext left	75.1	18.9	61.1	18.5	94.6	19.7	80.4	15.5
flex right	27.5	9.5	25.4	8.2	48.0	12.2	39.2	10.0
flex left	38.8	12.6	32.5	11.3	54.1	11.1	43.6	9.1
Knee ext right 180°/s	50.6	12.1	41.2	9.7	67.5	12.4	56.6	9.1
ext left	54.0	13.2	39.2	10.0	69.6	11.5	53.2	11.6
flex right	21.0	8.2	14.4	8.1	40.7	12.3	29.8	9.0
flex left	27.2	9.4	20.3	11.1	42.4	13.0	32.9	9.8
Isokinetic endurance (Nm)								
Knee ext right 180°/s	1083.1	500.0	840.1	474.9	1984.8	354.1	1598.0	308.3
ext left	960.9	562.6	781.5	410.5	2064.5	374.7	1438.5	464.3
flex right	337.2	248.0	232.0	160.3	1110.0	370.8	780.5	359.4
flex left	478.9	321.0	363.0	260.4	1193.8	383.7	810.8	387.8
Aerobic capacity								
VO ₂ max (ml/kg.min)	22.3	6.8	18.7	3.5	31.7	12.1	21.9	5.3
RPE†								
Muscle tests	12.1	1.8	12.4	2.9	13.5	2.2	12.1	2.4
Ergometer cycle	13.5	2.2	12.9	2.4	13.0	2.3	11.7	2.5

*ext=extensor; flex=flexor; abd=abductor; add=adductor.
†RPE=rate of perceived exertion.

Table 3 Means and standard deviations for the male patients with rheumatoid arthritis and healthy control men of the tests for isometric/isokinetic muscle strength, isokinetic endurance, aerobic capacity, and rate of perceived exertion

Test	Men with RA				Healthy control men			
	(n=12) ≤54 years		(n=12) >54 years		(n=16) ≤54 years		(n=14) >54 years	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Isometric strength (Nm)								
Knee ext* right	122.4	39.6	142.1	48.8	175.9	43.3	156.5	34.4
ext left	143.6	35.9	145.2	50.9	182.2	47.7	152.9	41.1
flex* right	45.2	15.0	52.8	20.3	83.8	27.9	63.0	12.3
flex left	68.3	20.3	64.7	22.0	91.1	26.0	70.5	15.6
Hip ext right (N)	117.3	25.6	98.6	34.9	149.4	36.6	113.2	26.6
ext left	123.7	33.2	98.7	33.1	156.1	34.8	124.5	25.4
flex right	88.4	21.8	79.9	29.8	97.5	30.7	95.5	37.4
flex left	86.1	22.8	76.7	25.2	95.5	30.6	93.1	31.1
abd* right	90.6	23.9	63.4	28.0	152.5	48.2	135.8	30.6
abd left	92.7	33.0	65.2	25.2	159.3	46.8	142.9	30.7
add* right	147.5	57.4	123.2	50.8	186.2	49.8	155.3	35.9
add left	162.2	47.8	137.5	31.0	188.3	65.2	155.3	41.5
Isokinetic strength (Nm)								
Knee ext right 60°/s	82.7	47.1	103.3	26.9	136.6	32.4	113.9	21.7
ext left	103.1	35.5	110.8	36.9	137.5	39.0	119.0	23.9
flex right	35.8	16.6	45.3	20.1	72.2	17.0	58.1	13.1
flex left	59.7	23.2	60.3	22.9	79.0	18.9	66.1	16.2
Knee ext right 180°/s	54.6	29.4	58.3	18.2	97.2	21.5	80.3	15.3
ext left	71.9	26.8	65.5	20.8	98.8	23.4	81.1	16.1
flex right	23.9	12.9	26.8	14.3	60.1	18.5	46.6	14.1
flex left	43.5	22.9	37.7	12.6	63.2	17.5	46.6	14.9
Isokinetic endurance (Nm)								
Knee ext right 180°/s	1203.7	933.1	1420.4	614.4	2871.0	626.9	2346.7	397.2
ext left	1570.3	1004.6	1620.4	662.7	2855.8	629.7	2303.4	351.2
flex right	381.8	385.0	522.6	330.3	1669.5	469.1	1319.6	482.2
flex left	579.6	326.9	674.3	322.4	1854.1	597.3	1396.5	468.8
Aerobic capacity								
Vo ₂ max (ml/kg.min)	24.0	4.3	18.7	4.1	27.6	7.4	25.1	6.1
RPE†								
Muscle tests	13.4	2.6	13.3	3.3	13.0	1.5	12.1	1.4
Ergometer cycle	12.9	2.9	15.3	3.2	11.3	2.8	12.0	2.2

*ext=extensor; flex=flexor; abd=abductor; add=adductor.
†RPE=rate of perceived exertion.

($p<0.05$) and sex ($p<0.0001$) were noted, indicating that older subjects and women had reduced function.

Results for isometric strength of the hip muscle groups showed highly significant ($p<0.001$) differences for all calculations but one ($p<0.05$)—the rheumatoid group showing decreased function. In addition, there were significant age ($p<0.05$) and sex ($p<0.0001$) differences here, showing the same pattern as for isometric knee muscle strength (tables 2 and 3).

Isokinetic muscle strength

Highly significant differences ($p<0.0001$) were obtained on all the measured subtests at both the velocities used (60 and 180 degrees/s—the patients with RA showing decreased function as compared with the healthy controls. In addition, a significant sex ($p<0.0001$) difference was found for the isokinetic variables of muscle strength (tables 2 and 3), indicating that muscular function was reduced more in women than in men. There were significant ($p<0.01$) effects of age for all the variables of isokinetic muscle strength except one ($p=0.06$), indicating that older subjects (>54 years) had reduced function.

Isokinetic muscular endurance

The tests of endurance were found to discriminate (tables 2 and 3) between the patients with RA and the healthy controls. Highly significant differences ($p<0.0001$) between the rheumatoid and healthy groups were found on all four subtests (extensors and flexors of the

right and left legs—the patients with RA showing lower capacity than the healthy subjects. Also, there were, as expected, significant ($p<0.05$) effects relating to age ($p<0.001$) and sex ($p<0.001$), with older subjects and women showing decreased function as compared with younger subjects and men respectively.

Rate of perceived exertion

No significant difference was found between the rheumatoid and healthy groups for the rate of perceived exertion obtained immediately after the muscle tests. For the rate of perceived exertion obtained after the bicycle ergometer test the patients with RA had a significantly ($p=0.001$) higher value than the healthy subjects.

Aerobic capacity

A significant difference ($p<0.001$) in aerobic capacity was found between the rheumatoid and the healthy groups, with the rheumatoid group showing decreased function. Also, a significant difference related to age ($p<0.001$) was found, indicating that older (>54 years) subjects, as compared with younger ones of both groups, had decreased aerobic capacity. No significant sex difference was found here.

Index of muscle function

A significant difference ($p<0.001$) was noted between the groups for the total muscle function index, indicating that patients with RA had a poorer physical performance than healthy people.

Sociodemographic and lifestyle variables

There was a significant ($p < 0.001$) difference in exercise habits, indicating that healthy subjects were more active than the rheumatoid patients. No significant differences in diet or smoking habits were found. Men of both groups, however, smoked more than the women ($p < 0.002$). Furthermore, there was a significant difference ($p < 0.001$) in alcohol consumption between the groups, indicating that healthy people drink alcohol more frequently than patients with RA. A significant sex difference ($p < 0.006$) was also found here, showing that men drink alcohol more often than women. Attitudes towards physical training indicated by the response to the statement 'physical training is important to me', were significantly different ($p < 0.05$) in the rheumatoid and the healthy groups. The rheumatoid patients agreed less with the statement than the healthy subjects did. Response to the statement 'physical training is fun' was not significantly different between the two groups.

CORRELATIONS

Muscle function and disease characteristics of the group with RA

Correlations according to Spearman were performed for the group with RA between isometric and isokinetic muscle strength, isokinetic endurance, and aerobic capacity, on the one hand, and disease duration, morning stiffness, Health Assessment Questionnaire disability index, pain, Ritchie index, joint mobility index, erythrocyte sedimentation rate, and C reactive protein on the other.

Results obtained indicated that both the joint mobility index and the Health Assessment Questionnaire disability index correlated significantly with muscle strength, endurance, and aerobic capacity. There were 25 possible correlations for each of the disease characteristics mentioned. For joint mobility, 11 and 13 significant ($p < 0.05$) correlations were found for the rheumatoid women and men respectively. For the Health Assessment Questionnaire disability index the corresponding figures were 14 and 11 ($p < 0.05$) for women and men respectively. In addition, for the rheumatoid women only, significant correlations were found for disease duration (11 significant correlations at the $p < 0.05$ level), erythrocyte sedimentation rate (18 significant correlations), C reactive protein (seven significant correlations), and pain (11 significant correlations). No such pattern was found for the rheumatoid men. For the Ritchie index and morning stiffness, no significant correlations were found for either women or men of the group with RA.

Muscle function and lifestyle characteristics

For both the rheumatoid and healthy groups, correlations between isometric/isokinetic muscle strength, isokinetic endurance, and aerobic capacity, on the one hand, and physical work load in daily life, motivation, exercise, diet, smoking, and alcohol habits, on the other, were assessed. Results indicated significant correlations between increased muscle strength/

endurance and heavy physical work load in daily life for the rheumatoid group (10 out of 25 significant correlation $p < 0.05$) and for the healthy subjects (four out of 25 $p < 0.05$).

Discussion

Physical capacity was found to be less in patients with RA than in healthy controls matched for age and sex. The results obtained in this study seemed to be in close agreement with the subjective experiences of muscular impairments, previously reported by patients with RA.¹

A decrease in muscular strength, isometric as well as isokinetic, was expected and confirms the results of other studies.²⁻⁶ Muscular isokinetic endurance has not been studied to the same extent as muscular strength. In this study we found a highly significant decrease of isokinetic endurance of the extensors and flexors of the knee at the velocity of 180 degrees/s for the rheumatoid group as compared with the healthy group. Hsieh *et al.*,⁶ however, reported no significant difference between patients with RA of mainly functional class I and controls for isokinetic endurance of the knee muscle groups at the velocity of 60 degrees/s. Calculations in the latter study were based on percentage of torque decline. Thus the opposite result we obtained might have been due to different measuring procedures as well as to the study of non-comparable control groups.

Tests of endurance, performed at a velocity of 180 degrees/s, were found to discriminate between the two groups most clearly. This result may shed light on earlier findings—for example, the selective type II fibre (fast twitch) atrophy previously reported to occur in the skeletal muscle of patients with RA of functional class II.²⁰

Measurements of muscle strength and endurance, with an isokinetic (Cybex II) dynamometer, were chosen owing to the possibility of obtaining more exact force determinations than with manual muscle testing procedures, for example. However, the importance of correcting isokinetic measurements for the effect of gravity has previously been pointed out.^{21, 22} In our study such corrections were made by computer. Divergent results of various isokinetic measurements might perhaps be explained, to some extent, by such methodological differences.

Muscle strength and endurance, isometric as well as isokinetic, must be related to age and sex of the subjects.²³ Isokinetic muscular endurance was decreased in the group with RA compared with the healthy group. Also, women as compared with men, and older subjects (> 54 years) as compared with younger ones showed decreased function.

Aerobic capacity was decreased in the group with RA as compared with the healthy group, in accordance with results obtained by Ekblom *et al.*² but not with the results reported by Beals *et al.*⁷ In the latter study, however, very sedentary matched controls were used and both patients and controls showed reduced aerobic capacity.

Rate of perceived exertion was scored by the subjects of both groups immediately after the bicycle ergometer test. The significant difference in the rate of perceived exertion between the rheumatoid and the healthy group indicated that the patients with RA force themselves harder during the test procedure (closer to their maximum capacity) than the healthy subjects. This result was not expected as sometimes patients with RA have to 'pay' for their physical activity with increased pain or disease activity.

The finding that patients with RA were less active in daily life than healthy subjects might perhaps have been expected. In this study the rheumatoid patients also showed reduced performance on the functional tests (muscle function index). In general, patients with RA as well as rheumatologists and physiotherapists are uncertain what frequency and intensity of activity and exercise is most beneficial. Recent studies^{10 24} show that quite intensive dynamic training can be performed by patients with RA of functional class II, with no negative side effects like increased pain or disease activity. The importance of maintaining physical activity has also been pointed out in a long term (10 years) study.²⁵

Results obtained for both the women and men in the group with RA indicated significant correlations between muscle function, on the one hand, and joint mobility and activities of daily living (Health Assessment Questionnaire), on the other. Sufficient joint mobility is needed to perform the tests of muscle function adequately. The patients with RA included in the study had only slight limitations. Thus the results indicate that reduced joint mobility has to be observed and treated at an early stage to prevent muscular dysfunction.

In conclusion, to avoid unnecessary functional deficits for patients with RA it seems important to include and evaluate different types of muscular training in rehabilitation programmes.

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