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Fifteen Months' Follow-up of Intensive Inpatient Physiotherapy and Exercise in Ankylosing Spondylitis

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Summary **Long-term effects of three or four-week inpatient physiotherapy and exercise courses were studied in 141 adult patients with ankylosing spondylitis (AS). Eight cervical and thoracolumbar range of motion (ROM) measurements and straight leg raise test, vital capacity (VC) and fitness index were measured at the beginning and end of an intensive course and 15 months later.**

All nine mobility measurements, vital capacity and fitness index were significantly improved after the course. Fifteen months later only chest expansion and vital capacity had significantly deteriorated from the baseline, while CR, FFD and fitness index were still significantly better. Disease duration did not influence treatment results.

We conclude that it is possible by means of intensive rehabilitation courses to prevent for more than one year deterioration of spinal function and fitness in AS patients irrespective of disease duration.

Key words **Ankylosing Spondylitis, Spinal Mobility, Rehabilitation, Exercise, Follow-up.**

INTRODUCTION

Ankylosing spondylitis (AS) involves spinal and extraspinal joints and entheses frequently leading to increasing limitation of spinal and joint mobility. These changes are, in the early stage of the disease, mostly reversible, but in the most severe cases will lead to irreversible ossification of ligaments and articular structures. There are only limited chemotherapeutical means of controlling and influencing the disease course (1-5).

In maintaining the posture and flexibility of the spine and in preventing the progression of functional disability in AS, intensive physiotherapy and exercise (6,7) play an essential role, together with education (8) and training of the patient for self care. Supervised sessions and group therapy are included in outpatient programs (9-11), mainly once or twice a week, but results of these treatments have so far not been encouraging. "The wisdom of putting AS patients into regular supervised gym classes and pool sessions, often for repeated courses" has been questioned (12). On the other hand, short-term results of supervised outpatient treatments (with training) have also shown marked improvement in spinal mobility and patients' fitness (13,14) and are more effective than unsupervised self-administered individualized therapy (15).

Previous reports (16-19), together with our own (20), provide evidence of a marked improvement in spinal mobility after a three- or four-week period on an intensive inpatient course. In order to evaluate whether the improvement achieved with different disease durations can be maintained after the intensive inpatient course we carried out a follow-up study of patients treated at our institute.

SUBJECTS AND METHODS

The fifteen months follow-up study covered 141 out of 153 consecutive adult AS patients who had been admitted to our institute for a rehabilitation period of either three or four weeks. Patients with a history of psoriasis, chronic intestinal disorder (e.g. Crohn's disease or colitis ulcerosa), reactive arthritis or juvenile onset of the disease were excluded. The modified New York criteria for AS were fulfilled by 127 patients; six patients had unilateral sacroiliitis with syndesmophytes in the spine and eight patients had unilateral sacroiliitis only. Radiolog-

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Table I: *Characteristics of the patients at baseline (N=141)*

			N	mean	(SD)
Age (years)	males (m)		102	44.9	(8.9)
	females (f)		39	44.8	(9.7)
Symptoms duration		m	102	20.8	(8.2)
(years)		f	39	25.2	(10.3)
Disease duration		m	102	10.8	(9.8)
(years)		f	39	14.3	(9.7)
Disease duration (subgroups):					
< 1	year	m/f	12/8	*42.7	(Age)
1-5	years	m/f	20/12		
6-10	years	m/f	26/12		
11-15	years	m/f	18/4		
16-20	years	m/f	11/3		
> 20	years	m/f	15/0	*53.1	(Age)
Laboratory characteristics:					
B-ESR	(mm/h)		141	22.2	(16/3)
S-CRP	(g/l)		141	12.0	(13.6)
S-IgG	(mg/ml)		141	13.0	(3.3)
S-IgA	(mg/ml)		141	3.1	(1.3)
S-IgM	(mg/ml)		141	1.3	(0.6)
Limb joint symptoms (44%)			62		
hip/shoulder			40		
knee/elbow			28		
peripheral joints (hand/foot)			34		
Socio-demographic data:					
married			100		
employed			114		
Income (6 answ. not incl.):					
high			46		
middle (&)			66		
low			23		
Education level:					
academic			6		
middle stage school			65		
primary school only			70		
Medication:					
NSAIDs			135		
Sulphasalazine			28		
Others DMARDs			12		

NSAIDs: nonsteroidal anti-inflammatory drugs,
DMARDs: disease modifying antirheumatic drugs

&) Middle income per year: $10 000 - $20 000
*) mean ages of the subgroups.

ical results are given in a separate publication (21). The relevant characteristics of the patients are shown in Table I.

The principles and methods of physiotherapy used are more fully discussed in a separate publication (22). For each patient an individual intensive program was commenced on the first day after the initial examination. The intensity and frequency of available therapies were applied in submaximal dosages which the patient could tolerate. Both individual and group exercises were daily practice and the most common management was superficial heat and massage besides group exercises. Therapies and mean values of their frequencies and durations are given in Table II. Each patient participated weekly in more than 20 activities. In addition, patients participated in education seminars (8) dealing with the nature of the disease, its treatment and necessary exercises at home.

At the end of the course, the patients were encouraged to continue exercises at home carried out as an uncontrolled self-administered program or in available groups freely chosen by the patient at place of domicile. A total of 34% of the patients had taken outpatient physiotherapy on an average 15 times during the follow-up period. At the follow-up study the patients were asked concerning their activities. Table III indicates that most had continued an exercise program, but 38 (27%) had participated only in walking, not in other exercises. The patients' estimation of the intensity of the home programs was on the average 36.5% of that during the course.

Spinal and thoracic measurements (20), straight leg raise test and fitness index (23) were measured at the beginning (baseline) and at the end of the in-patient course (post-treatment) as well as 15 months after entry (follow-up). The spinal ROMs were measured by six tests, including a new method for the measurement of thoracolumbar rotation (24), and thoraco-pulmonary function by chest expansion (CE) and vital capacity (VC). In addition, finger-floor distance (FFD) and straight leg raise (SLR) were measured. The measurement methods are given in the Appendix.

The bicycle ergometer test was used in the estimation of maximal oxygen intake and the Åstrand index for fitness (23). Only 104 patients were able to perform the bicycle test on all three occasions. The main reasons for drop-out were medication influencing pulse rate (13 patients), acute infection (7 patients) and cardiovascular disorder (5 patients).

No injections were given nor any changes made in the medication during the course or follow-up period. A total of 33% of the patients used or had earlier (during last five years) used sulphasalazine medication for more than six months. Six patients did not need any anti-inflammatory or disease-modifying anti-rheumatic drugs (DMARD).

Random samples of 38 and 39 in-patients, respectively, were drawn for intra- and inter-observer reliability determination. Repeated mobility measurements were recorded during two hours in the morning, without warm-

Table II: *The treatment modalities in AS: duration and weekly frequency as mean, range and median*

Treatment	Mean	Range	Median	Duration(min)
Heat deep	0.2	0- 2	0	10-15
Heat superficial	3.2	1- 5	3	15-20
Cold superficial	1.0	0- 8	0	10-15
Electrotherapy	0.9	0- 4	0	15-25
Pool exercise	5.1	2- 6	6	15-25
Group exercise*	7.1	2-12	9	25-30
Exercise (supervised)	1.7	0- 3	2	25-30
-"- in suspension	1.1	0- 3	1	25-30
Suspension (stretch)	0.4	0- 3	0	20-30
Mobilization/stretch	0.2	0- 2	0	20-30
Massage	1.2	0- 2	2	20-30

*) Including gymnastics, keep fit club, jogging or walking.

ing-up or treatment by the patient's personal physiotherapist and by one observer as control. The results are given as intraclass correlation coefficients (ICCs) in Table IV, showing good reliability except for intertester ICC in CE (0.53).

The results are given as means, standard deviations (SD) and 95% confidence intervals (95% CI).

Table III: *Home exercise and gym programs during the follow-up*

	Frequency (per week)			Duration (min.)		
Activity	Mean	Range	Median	Mean	Range	Median
Walking	4.1	1 - 12	3	41.5	15 - 90	30
Jogging/Skiing	0.6	0 - 7	0	22.5	0 - 75	0
Swimming/Playing	1.0	0 - 3	1	30.6	0 - 130	15
Rowing/Cycling(*)	1.7	0 - 7	0	22.5	0 - 120	0
Keep fit club	1.7	0 - 7	1	18.1	0 - 60	20
Home gymnastics	3.0	0 - 7	2	25.0	0 - 60	20
Group gymnastics	1.0	0 - 4	1	23.4	0 - 60	20

*) Both outdoor and indoor.

Table V: *Baseline and post-treatment means (SD) of ROMs and fitness index, and mean changes at 15 months follow-up from the baseline measurements with 95% confidence intervals (95% CI).*

Test		Baseline	Posttreatment (3-4 weeks)	15 months, changes from baseline
	N	Mean (SD)	Mean (SD)	Mean (95% CI)
Schober	141	3.3 (1.6)	3.6 (1.6)	–0.1 (–0.2 to 0.1)
TLF(cm)	141	5.6 (2.6)	6.3 (2.6)	0.2 (–0.1 to 0.6)
TR(°)	113	45.2 (24.4)	61.6 (28.0)	3.9 (–1.0 to 8.8)
CR(°)	141	99.0 (43.0)	113.6 (43.2)	3.9 (0.6 to 7.3)
OWD (cm)	141	5.4 (6.4)	3.9 (5.8)	0.2 (–0.2 to 0.6)
CCD (cm)	141	4.0 (2.3)	3.3 (2.1)	–0.1 (–0.3 to 0.2)
CE (cm)	141	3.4 (1.9)	4.1 (2.0)	–0.7 (–0.9 to –0.4)
VC(1)	139	3.8 (1.0)	4.0 (1.0)	–0.4 (–0.5 to –0.3)
FFD(cm)	138	17.5 (14.6)	9.0 (13.5)	–5.0 (–6.5 to –3.6)
SLR(°)	140	73.0 (16.0)	81.4 (15.5)	–4.3 (–6.5 to –2.0)
Åstrand	104	31.8 (6.6)	36.3 (8.2)	7.7 (6.4 to 9.1)

TLF thoracolumbar flexion, TR thoracolumbar rotation, CR cervical rotation, OWD occiput-wall distance, CCD chin-chest distance, CE chest expansion, VC vital capacity, FFD finger-floor distance, SLR straight leg raise test and Åstrand index for fitness.

Table IV: *Intraclass Correlation Coefficients (ICC) for reliability of measurements*

ROM	ICC	
	Intra-observer	Inter-observer
Schober test	0.95	0.88
TLF	0.95	0.91
TR	0.93	0.89
OWD	0.99	0.92
CCD	0.95	0.72
CR	0.97	0.96
FFD	0.97	0.98
SLR	0.97	0.80
CE	0.93	0.53
VC	0.76	0.85

TLF thoracolumbar flexion, TR thoracolumbar rotation CR cervical rotation, OWD occiput-wall distance, CCD chin-chest distance, CE chest expansion, VC vital capacity, FFD finger-floor distance and SLR straight leg raise test.

RESULTS

Table I shows the clinical and laboratory characteristics. There were no marked differences between the various disease duration groups or between men and women, and also no correlation between degree of restrictions of mobility and ESR, CRP or immunoglobulin levels (data not given).

Table V shows baseline and post-treatment results and follow-up changes from the baseline level. A statistically significant ($p < 0.01$, except for VC $p < 0.05$) improvement during the course was seen in all measurements. The improved mobility had mainly disappeared at follow-up, but not all; CR, FFD and the fitness index (Åstrand) were still significantly better than the baseline results; fitness even slightly improved after the course. A significant deterioration was seen only in CE and VC during the follow-up.

Figure 1 shows the means and 95% CIs of the baseline (the left column), post-treatment (the mid-column) and follow-up (the right column) measurements in patients with different disease duration. Spinal mobility deteriorated with disease duration, but improvement during the inpatient course was marked even in patients with advanced disease. The follow-up results were the same irrespective of the duration of AS.

DISCUSSION

It is possible that the outcome of the AS patient is better today than a few decades ago (26,27), but it is not known whether this improvement is due to better treatment of the disease itself or of infections, which are believed to play a certain role in the aetiology. AS is often a disease of young adults. Although most patients have a good long-term outcome, severe and disabling cases are not rare (27). In addition to suffering, disability, in particular retirement (28) at a young age is very expensive for society. No cost-benefit analysis of in-patient courses in AS has been carried out, but the outlay may be assumed to be at least partly covered by the retardation of the disabling process.

There was no difference in treatment results (data not given) between two patient groups with respect to sulphasalazine medication: non-users (never DMARD) (47%) and users (33%) (during the last five years for more than 6 months or throughout); the two groups were comparable in age and disease duration. We observed no marked changes or bias on the treatment outcome by different medication. Pain intensity (on VAS) was assessed by the patients during the whole in-patient period, showing a decrease by a third (data not shown).

The main goals of intensive physiotherapy and exercise for AS patients are: prevent functional disability, in particular spinal and thoracic limitations of mobility, maintain posture and improve fitness. This can be achieved by intensive inpatient treatment (18-20) or by well planned and carefully executed individual therapy, training and education of patients (1,8,14). Results of out-patient programmes have been modest (9-11), and a small but steady loss of spinal movement despite regular weekly exercise sessions has been observed (10). Comparison of different programmes has proved difficult by reason of the different measurement methods used or even lack of data on these (22). In some studies, the groups have been small, which is also the case with a comparative analysis (29) between an in-patient and two different out-patient groups, in which no difference in treatment results could be observed at 6 months follow-up.

In a recent study by Hidding and co-workers (14) modest results were achieved with supervised individual therapy for 30 minutes twice weekly during six weeks; this patient population was almost identical to ours (Table I). Comparison between those and the improvements in our study -which were even slightly less than in our previous retrospective analysis (20) at the same institute - shows that 3-4 weeks of in-patient physiotherapy and exercise yields a better outcome than out-patient therapy.

It may be that one or two exercise sessions weekly are better than none, but is apparently not likely to be sufficient to prevent restrictions of mobility. Motivation and energy for exercise cannot be optimal after working hours, and for practical reasons participation in guided sessions can only take place a couple of times per week (14). Since our rehabilitation period includes more than 20 weekly sessions of physical therapy or exercise and the patients can totally concentrate on these, efficacy is more

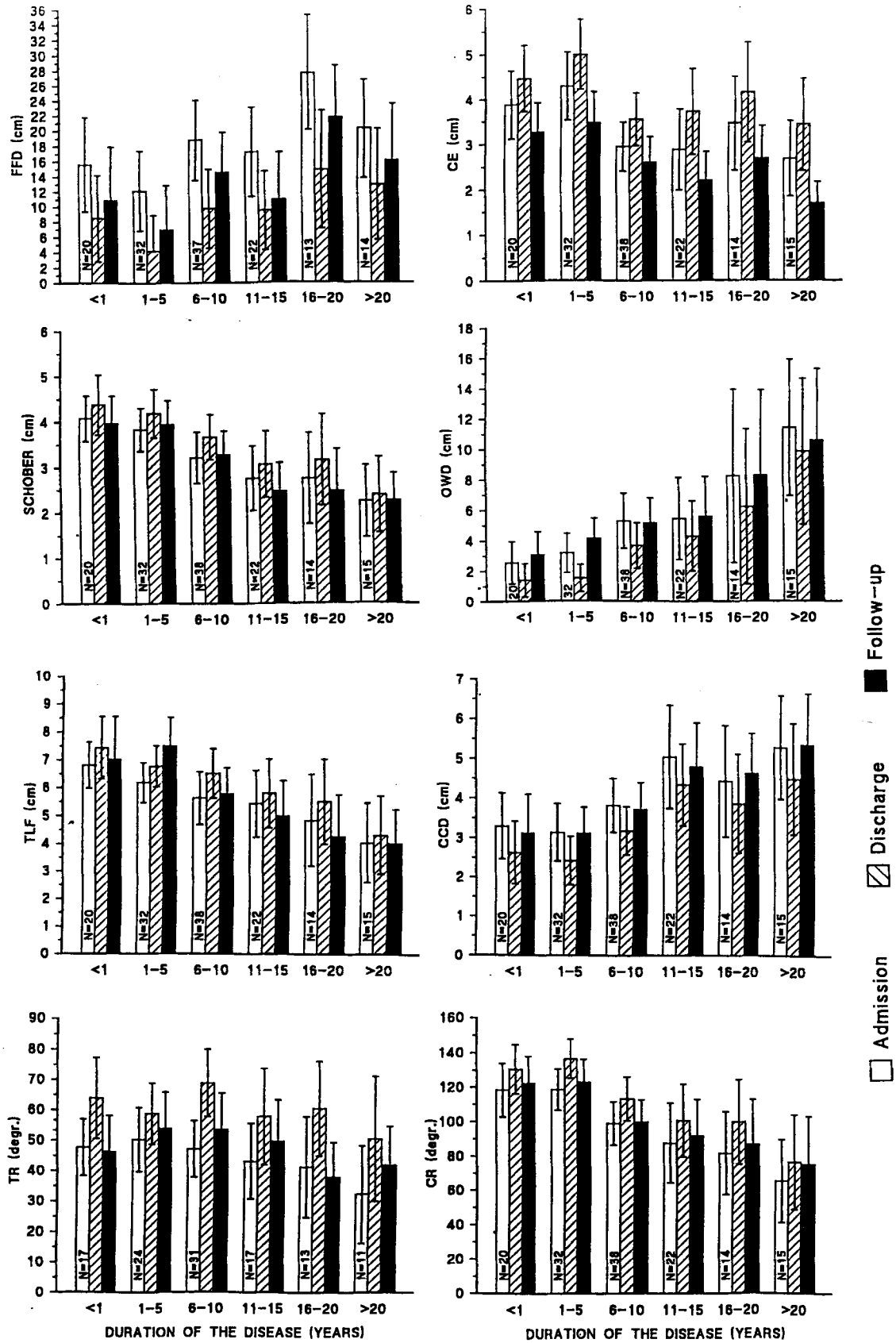

Fig. 1: Mean and 95% CI of eight thoracic and spinal measurements according to the duration of AS: finger-floor distance (FFD), Schober test, thoracolumbar flexion (TLF), thoracolumbar rotation (TR), chest expansion (CE), occiput-wall distance (OWD), chin-chest distance (CCD) and cervical rotation (CR).
Left column = baseline measurements, mid-column = posttreatment and right column = follow-up (15 months) results.

enhanced and improvement during the course is marked. In addition to the short-term improvement, the courses can obviously increase patients' motivation for home exercise.

Our results show that deterioration in spinal function could be prevented for at least 15 months. It seems possible that intensive physiotherapy and exercise could effectively prevent the progressive restrictions of mobility in AS. It should also be borne in mind that the goal of medical treatment must be the best, not the cheapest therapy. This is the case in particular in young patients with a long active life ahead of them, who are suffering from a potentially disabling disease.

Therefore, we suggest that intensive physiotherapy and exercise together with patient instruction (8) should be included in treatment programs for AS patients. This should intermittently be a full-time activity at least for patients who show clinical signs of progressive restriction in spinal mobility. A long disease duration does not seem to impede the treatment outcome. It is clear, however, that the better the spinal function, the better the possibilities of a favourable long-term outcome.

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APPENDIX. THE METHODOLOGY OF SPINAL AND THORACIC MEASUREMENTS

Modified Schober test: increase in the distance between two skin marks on the *first sacral spinous process (S 1) and 10 cm above* after maximal forward bending, measured with a tape.

Thoracolumbar flexion (TLF): increase in the distance between skin marks on the *first sacral spinous process (S1) and the spinous process of C VII* in maximal forward bending, measured with a tape.

Thoracolumbar rotation (TR): The subject is sitting on a stool with a 43-cm-long stiff needle indicator firmly attached to the chest (the xiphisternum) with a belt, and the stool so positioned that the needle indicator points to zero on a semicircular degree scale in front of the subject. The height of the scale is adjusted so that the needle indicator is horizontal. The diagonal of the scale passes through the subject approximately at the front of the spine. The examiner fixes the pelvis of the subject manually during the examination. The subject is asked to rotate the trunk maximally, to left and to right. The maximal rotations on both sides are recorded from the scale.

Occiput to wall distance (OWD): the distance between occiput and wall measured with a tape while the patient stands heels and back against a wall and tries to get the occiput against the wall with the chin horizontal.

Cervical rotation (CR): total range of rotation of the cervical spine from maximal leftward to maximal rightward rotation measured with a Myrin inclinometer.

Chin to chest distance (CCD): distance between the chin and the jugulum in maximal flexion of the cervical spine measured with a tape.

Finger to floor distance (FFD): distance between fingertips and floor measured with a tape at maximal flexion of the spine and pelvis while the knees are kept in extension.

Chest expansion (CE): difference in chest circumference at maximal inspiration and expiration at the level of the fourth intercostal space, measured with a tape.

Vital capacity (VC): volume of air at maximal expiration, measured with a simple spirometer.

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