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A CONTROLLED STUDY ON THE OUTCOME OF INPATIENT AND OUTPATIENT TREATMENT OF LOW BACK PAIN

Part II. Effects on Physical Measurements Three Months after Treatment

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ABSTRACT. Inpatient and outpatient treatments were compared with a control intervention in 288 men and 168 women, aged 35–54, who were at work, but suffered from chronic or recurrent low back pain. Physical measurements and back pain assessments were carried out before the intervention and at a 3-month follow-up. Physical fitness improved most in the inpatients, but the outpatients did not differ from the controls. Correlations between back pain and physical measurements indicated that increase of lumbar and hip mobility was more important than increase of trunk strength for subjective progress in these patients. Increased trunk extension strength correlated significantly with subjective progress in women, who also had higher correlations between improved physical fitness and progress than men.

Key words: low back pain, rehabilitation, spinal and hip mobility, trunk strength.

In contrast to chronic low back troubles, acute pain causes no great medical problem, because it usually subsides within quite a short time (15). But acute pain often recurs (1, 19). Between the attacks there may be continuous or intermittent pain which does not prevent from working and to which, in most cases, little therapeutical attention is paid. This condition predisposes to future pain (2, 16, 18) with a risk of incapacity for work; therefore prevention of this unfavourable course seems useful.

Insufficient knowledge on the causes and sequels of low back pain makes preventive and therapeutical interventions difficult. The possibilities of showing particular individual physical changes having therapeutical significance are in most cases slight for the present. A question of interest is if there are changes in body mechanics and spinal structures in connection with recurrent and continuous back pain which could be restored to diminish back troubles and to improve the prognosis in the long run.

Physical fitness and conditioning have been shown to protect from back injuries in a prospective study on firefighters by Cady et al. (5). In the study by Mayer et al. (9) those chronic low back pain patients who returned to work had improved their physical function during treatment more than those who did not return to work. Good isometric endurance of the back muscles may prevent first-time occurrence of back pain in men (3). Progress after treatment of chronic low back pain in men, aged 54–63, was found to correlate with improvements in physical measurements (11). These results indicate that an improvement of physical capacity may have a positive effect on low back pain.

In this study the effects of back treatment on physical measurements in patients who are at work, but who suffer from chronic or recurrent low back pain are presented. Two modes of treatment, currently in use in Finland, are studied: inpatient treatment at rehabilitation centres and outpatient treatment. This report concerns the short-term effects on physical measurements three months after the treatment, whereas the changes in low back pain and disability are reported in the first part of the study (6).

SUBJECTS AND METHODS

Subjects and procedure. The selection and description of the subjects and the general design are described in the previous report (6). The present study comprises 456 patients: 288 men and 168 women (three patients in the previous report lack physical measurements). They make up the inpatient, outpatient and control groups. The mean weight was 82.2 kg (SD 12.7) in men and 70.4 kg (SD 11.8) in women, whereas the average height was 175.3 cm (SD 5.9) in men and 162.0 cm (SD 5.7) in women. There were no statistically significant differences in weight and height between the intervention groups.

Back treatment. The contents of treatment are presented in detail in the first part of the study (6). The average amounts of treatment in the in- and outpatient groups are given in Table I.

Physical measurements. The measurements were car-

Table I. *Mean scores (M) and standard deviations (SD) of the number of back treatments per patient*

	Inpatients			Outpatients		
	n	*M*	SD	*n*	*M*	SD
Heat and electrotherapy	155	14.1	4.8	156	11.6	3.4
Massage	147	7.7	1.9	–	–	–
Back exercise	157	16.3	3.9	155	11.5	3.2
Physical exercise	121	7.7	1.8	–	–	–
Muscle strength exercise	63	8.2	1.4	–	–	–
Back school	157	5.2	0.7	153	3.6	0.7
Relaxation exercises	157	5.3	1.0	149	6.6	2.2

ried out by two physiotherapists. The same physiotherapist conducted both pre-treatment and follow-up measurements for each patient.

Measurements of lumbar spinal mobility. Inclinometers and a compass with auxiliary tools were used in the measurements which have been described earlier (12, 13). Forward flexion and extension were expressed as the curvature of maximum bending. Right and left movements of lateral flexion and rotation were combined in the calculations.

Measurements of hip mobility. Hip joint mobility was measured as active movements and straight leg raising passively. Movements of the right and left leg were combined. An inclinometer was used for these measurements.

Flexion was measured in a supine position with concomitant flexion of the knee, while the other leg was straight on the examination table. Measurements were carried out with the inclinometer fixed on the lateral thigh.

Extension was measured in a prone position with both legs straight, while the inclinometer was fixed like in flexion measurement.

Rotation was measured in a prone position with the knee in a 90° flexion and the other leg straight. The inclinometer was fixed to the leg and zeroed, when the leg was in a vertical position.

Straight leg raising was measured in a supine position by passive flexion of the hip with the knee straight and the other leg straight on the examination table. The inclinometer was fixed to the lateral thigh.

Trunk strength measurements. Trunk flexion and extension strength was measured with the subject lying on a bench and exerting isometric force against a tightened belt passing under the axillas. The force was transferred to a spring balance dynamometer. The best of three measurements was recorded. These methods have been described in detail previously (11).

Trunk strength was expressed as torque values (kp×m) with the distance between jugulum sterni and spina iliaca superior anterior as the lever arm. The torque was reported as a percentage of body weight.

The dynamic exercises comprised trunk raising from a supine knee-bent position and from a prone position. Each exercise was done a maximum of fifteen times. The results of the two exercises were combined.

Reliability of the measurements. Intra- and intertester reliability of the spinal mobility measurements have been reported previously (12, 13). The correlation coefficients for intratester reproducibility of hip mobility measurements on ten subjects without back pain were between 0.65 and 0.92, whereas intra- and intertester reproducibility of trunk strength measurements on ten subjects were between 0.73 and 0.95.

Index of physical measurements (IPM). The index of physical measurements included all the measurements described above and was formed by summing the scores after standardization. Missing separate observations were estimated by regression analyses. The index could be formed for 287 men and 165 women at the pre-treatment phase, and change scores between pre-treatment and follow-up measurements were calculated for 277 men and 159 women.

Subjective progress. The degree of low back disability was assessed with the LBP Disability Index (6). The subjective progress was the change of this index from pre-treatment to the follow-up.

Statistical analyses. The statistical significance of differences between the means of study groups were calculated with one-way analyses of variance and *t*-tests for unmatched groups (BMDP7D).

The correlation calculations were made by using Pearson coefficients. Corrections for age were carried out with partial correlation analyses.

Multiple linear regression analyses (BMDP1R) were carried out where the change in the LBP Disability Index was used as the dependent variable and changes in the physical measurements as predictors. These analyses were made for men and women separately.

RESULTS

Only the most important findings of the different physical measurements in the inpatient, outpatient and control groups are given (tables presenting pre-treatment measurements and their follow-up changes in the intervention groups for men and women separately can be obtained from the authors). There were no statistically significant differences between the groups in the pre-treatment measurements.

Of the spinal mobility measurements, only rotation, in both sexes, showed statistically significant

Table II. *Index of physical measurements (IPM): means and standard deviations of pre-treatment (PT) and change (CH) scores of men and women by study group and statistical significances of differences between groups (p)*

		Men				Women			
		In-patients	Out-patients	Controls	*p*	In-patients	Out-patients	Controls	*p*
IPM PT	*M*	−0.64	1.38	−0.52	NS	0.86	−0.09	−0.48	NS
	SD	8.13	7.49	8.88		7.46	7.41	7.80	
	n	98	90	99		56	57	52	
IPM CH	*M*	3.48	0.70	1.27	$<0.001^a$	4.04	0.82	1.04	$<0.01^b$
	SD	5.43	4.70	5.25		5.81	5.11	6.01	
	n	94	86	97		53	56	50	

I–O $^ap<0.001$ $^bp<0.01$
I–C $p<0.01$ $p<0.05$
O–C NS NS

differences between the intervention groups at the follow-up; the greatest increase was observed for the inpatients (change 5.2–6.0 degrees). Decrease of extension and lateral flexion in the study groups was found though it was not significant.

Hip mobility improved after treatment in all groups. Improvement was greater in the inpatients than in the two other groups in extension, flexion, and straight leg raising in men and in flexion only in women.

Trunk strength increased after treatment in all groups. Changes in trunk extension strength in both men and women as well as dynamic exercises in men differed significantly between the groups; the greatest improvements occurred in the inpatients (change of extension 5.3–5.7 kpm, of dynamic exercises 2.8–5.2).

Mean scores of the pre-treatment values of the index of physical measurements (IPM) and its changes from pre-treatment to follow-up in the three study groups are given in Table II. The groups did not differ significantly from each other at the pre-treatment phase. At the follow-up the inpatients showed the greatest improvement, but there were no statistically significant differences in the change scores between the outpatients and controls.

Correlation coefficients between the change scores of physical measurements and the subjective progress are shown in Table III. Improvement in lumbar lateral flexion and rotation, hip extension, and straight leg raising in both men and women as well as hip external rotation in men and extension strength in women had statistically significant correlations with subjective progress. Except for external rotation of the hips, the correlations were higher in women, but only the lumbar rotation and hip external rotation showed a statistically significant ($p<0.05$) difference between men and women.

The multiple regression analyses showed that changes in the physical measurements explained statistically significantly the variance of subjective progress in both women ($R^2=0.21$, $p<0.001$) and men ($R^2=0.10$, $p<0.003$).

Table III. *Correlation coefficients between subjective progress (changes in the LBP Disability Index) and the change scores of physical measurements in men and women*

The coefficients have been corrected for the effects of age

	Men	Women
Lumbar		
Flexion	0.05	0.07
Extension	−0.03	0.10
Flexion+extension	0.00	0.12
Lateral flexion	0.12*	0.16*
Rotation	0.12*	0.31***
Hip		
External rotation	0.20***	0.00
Internal rotation	0.01	0.08
Extension	0.19**	0.33***
Flexion	0.09	0.07
Straight leg raising	0.15*	0.21**
Trunk		
Flexion strength	0.01	0.10
Extension strength	0.04	0.19*
Dynamic exercises	0.09	0.08
Index of physical measurements	0.20***	0.33***

*$p<0.05$. **$p<0.01$. ***$p<0.001$.

Two separate analyses where either the spinal and hip mobility measurements or the trunk strength measurement were used as predictors showed that the variance was explained mainly by changes in the mobility measurements. The squared multiple correlation coefficient of mobility measurements was $R^2=0.21$ ($p<0.001$) for women and $R^2=0.10$ ($p<0.001$) for men, and those of trunk strength measurements $R^2=0.03$ (NS) and 0.01 (NS), respectively.

DISCUSSION

In contrast to the inpatients, the outpatients did not improve physically more than the controls although in the first part of the study (6) their subjective progress was found to be significantly better than that of the controls. The better result of inpatient treatment is probably due to more frequent and versatile exercises during the patients' leave from work at the rehabilitation centres.

Hip mobility and trunk strength improved, at least to some degree, in all groups but, with the exception of rotation, lumbar mobility increased only little and even decreased in extension and lateral flexion measurements. Therapeutical stabilizing of hypermobile painful spinal segments by muscle strengthening has been discussed (7). In a three-year follow-up by Lankhorst et al. (8) reduced mobility of the spine was associated with a decrease in back troubles. This result is not evident in the short-term follow-up of our patients whose increases in spinal mobility were associated with subjective progress.

The correlations between the changes in physical measurements and reported back pain may give indices of which physical impairments are significant for progress and possibly should be paid attention to in treatment.

In the present study the improvements of hip and lumbar motions correlated better with subjective progress than trunk strength did. This may suggest, although the correlations are low, that diminishing stiffness rather than improving strength is more rewarding in these patients.

Mobilization of hips and spine in treatment of low back pain has been discussed and suggested earlier (10, 14). However, women's increase in trunk extension also seemed important and, on the whole, women had stronger correlations between increase in physical fitness and progress than men. The physical capacity of women as regards to the demands of their manual labour may be insufficient and diminished in comparison with that of men. This was also indicated by the finding that women estimated their work as physically more strenuous than men did (6).

An increase of spinal and hip mobility associated with a decrease of back pain has also been observed in men, aged 54–63 (11), but their trunk strength correlated with progress, too. Except for extension strength in women, increase of trunk strength in the patients of the present study did not significantly correlate with progress. Possibly trunk muscles were not weak enough before the intervention or an insufficient increase was achieved through treatment to be significant for progress. An increase in mobility is probably faster and easier to achieve than an increase in strength.

The change in physical measurements was not, on an average, very great and its clinical significance may be modest, especially in consideration of the generally low correlations between physical signs and subjective disability in chronic low back pain patients (4, 11, 17). The patients of this study, not in acute need of treatment and employed at physically strenuous work, could not probably improve very much physically. A question of interest is, if more intensive physical exercises during and after treatment could be more effective in patients of this category.

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