SCIENTIFIC SECTION

Original Articles

Acute low back pain

Comparison of two conservative treatment approaches

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ABSTRACT: In a controlled clinical trial, we allocated 48 subjects with acute low back pain but without neurological signs, at random to two treatment groups. The conservative treatments compared were passive mobilisation and manipulation of the lumbar spine and a regimen of microwave diathermy, isometric abdominal exercises and ergonomic instructions. The duration of low back pain symptoms was significantly shorter for subjects receiving mobilisation and manipulation; they also achieved symptom-free status with fewer treatment sessions. While the duration of symptoms before first treatment, the treatment administered, and the pretest forward flexion movement indices accounted for 44% of the variance in the duration of symptoms, a stepwise multiple regression analysis showed that treatment is the most significant factor in predicting the length of time before a subject achieves symptom-free status.

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PASSIVE MANIPULATION of the vertebral column has been used to treat low back pain since ancient times.[1] The reasons for the success of this method of physical therapy are obscure. This has contributed towards the reluctance of many medical practitioners to recommend its use. Additional factors which have militated against its widespread acceptance include: *(a)* the potential for injury associated with the use of long body levers; *(b)* dubious claims for the success of manipulation for a variety of medical conditions beyond those which are purely musculoskeletal; *(c)* the problems of accurate diagnosis in acute low back pain; and *(d)* the limited number of controlled, well designed clinical trials to test its effectiveness.

Clinical research into the effectiveness of treatment of low back pain is notoriously difficult and limited in scope.[2-5] Since the cause of most acute low back pain is unknown, subjects must be selected in terms of the signs and symptoms displayed and the patient's history of the disorder. A double-blind trial is impossible in this situation,[4] and an independent observer must be made responsible for assessment and measurement.

In recent years, a number of studies have considered the role of manipulation in the treatment of low back pain.[2, 6-16] None of them has proved to be wholly satisfactory. The studies of Glover *et al.*,[10] and Doran and Newell,[12] are widely referred to in the literature, and yet even these excellent studies are open to criticism. For instance, Glover *et al.* used a general regional manipulation rather than one specifically directed to the affected segment(s), and in the analysis of results, the subjects were stratified unacceptably.[4] In Doran and Newell's investigation,[12] the manipulative techniques used were not standardised and the treatment therapist was able to exclude any patient who was unlikely to benefit from manipulation, thereby biasing the target population.

The object of this clinical trial was to compare the effectiveness of a regimen of passive mobilisation and manipulation to that of a standard physical therapy treatment, consisting of microwave diathermy, isometric abdominal exercises and ergonomic instructions.

Materials and methods

We accepted subjects of both sexes into the study if they *(a)* were aged 20 to 65 years; *(b)* experienced pain on lumbar movements or straight leg raising; *(c)* complained of pain (intermittent or constant) centrally or paravertebrally between T12 and the gluteal folds; *(d)* had symptoms of three weeks' duration, or less; and *(e)* had experienced a pain-free period of six months before the onset of the current episode.

Subjects excluded from the trial were those who *(a)* had other physical treatment for the current episode of low back pain; or *(b)* were pregnant; or *(c)* showed signs of caudaequinal pressure, or altered sensation, reflexes, or muscle weakness in the lower extremity; or *(d)* had previous surgery in the lumbar region; or *(e)* had a past history of fracture in the lower thoracic/lumbar region; or *(f)* showed evidence of systemic disease, such as rheumatoid arthritis or ankylosing spondylitis, or of carcinoma.

Of fifty-six eligible subjects, 48 completed the study; eight subjects did not comply with the criteria listed and were withdrawn. The remaining subjects were placed at random into two groups (Table 1); of these, the XE group received manipulative treatment.

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There was no significant difference between the treatment groups in terms either of age (t (46) = 0.24) or of sex ($\chi^2 = 0.3356$).

TABLE 1: The range, mean and standard deviation of chronological age data by sex by treatment group

Treatment group	Number of patients (n = 48)	Age of patients (years)			
		Range	SD	Mean	Mean age by group
XE					
M	16	21 to 57	10.32	40.81	43.37
F	8	29 to 63	10.30	48.50	
YC					
M	14	24 to 62	11.89	39.71	41.83
F	10	25 to 60	10.90	44.80	

XE = manipulative treatment.
YC = non-manipulative treatment

There was no significant difference between the treatment groups as to their past history of low back pain and eight common behavioural characteristics of low back pain (Table 2). An analysis of variance showed no significant difference in the duration of symptoms before treatment between the two groups (F(1.46) = 1.188; $P < 0.05$). The clinical trial was conducted over a nine-month period.

TABLE 2: Frequencies and chi-squared values of eight behavioural variables of low back pain by treatment group

Variable ratios	XE	YC	χ^2 value	df	Probability value (P)
Type of LBP onset (sudden:gradual)	16:8	13:11	0.34846	1	0.5550
Type of LBP (constant:intermittent)	13:11	17:7	0.80000	1	0.3711
Area of LBP (central:unilateral)	9:14	6:18	0.52688	1	0.4679
Night pain (yes:no)	11:13	11:13	0.08392	1	0.7721
Morning pain (yes:no)	14:10	16:8	0.08889	1	0.7656
LBP aggravated by coughing (yes:no)	7:17	11:13	0.80000	1	0.3711
Pain when sitting (yes:no)	22:2	18:6	1.35000	1	0.2453
Pain when arising from chair (yes:no)	22:2	23:1	0.00000	1	1.0000

LBP = low back pain.

Data collection

All personnel involved in the assessment and treatment of the subjects were registered physiotherapists, who followed the same measurement and treatment procedures in each clinic. Before the first treatment, and at regular intervals during the course of treatment, an independent observer examined each subject carefully and helped him or her complete a questionnaire listing functional limitations as described by Berquist-Ullman and Larsen.[2] Subjects assessed the severity of their back pain on a 0 to 10 rating.[17] Active lumbar movements and straight leg raising were evaluated, and each subject was assessed before the test (before first treatment), after the test (immediately after first treatment), after the third treatment, after the final treatment, and three weeks from the date of the initial treatment.

The active lumbar movements were measured with the lumbar spondylometer and rotameter,[18, 19] while straight leg raising was measured with a standard goniometer. Intraobserver tests with the instruments showed no significant difference between measurements (F (1.80) = 0.75; $P < 0.01$). This finding reinforces the reliability of these devices, reported by Taylor and Twomey.[19]

For a subject to be pronounced "symptom-free", it was necessary that *(a)* he could perform all functional activities without difficulty; *(b)* his subjective pain rating was very low, that is, either 0 or 1; and *(c)* the objective measures of lumbar movements and straight leg raising were pain-free, with passive overpressure at the extreme of the patient's active range.

Treatment

Each subject was treated three times a week for up to three weeks. If the subject met the preset criteria for discharge before three weeks, treatment was discontinued. This occurred with eight subjects. Treatment was continued beyond three weeks if necessary; however, no further data were collected.

1. The YC treatment group received (i) 15 minutes of microwave diathermy in a comfortable side-reclining position;[20] (ii) 10 repetitions of isometric abdominal exercises,[21] which the subject also carried out independently another three to four times a day; and (iii) ergonomic instructions which include advice on activities such as lifting, sitting, standing, carrying objects and rest postures.[22]

2. The XE treatment group received passive mobilisation and manipulation. The choice of technique included (i) central, posterior-anterior pressures; (ii) unilateral, posteroanterior pressures over transverse processes; (iii) transverse pressures on spinous processes; and (iv) mobilisation (specifically localised to one motion segment in rotation or in combined movement positions, that is, flexion, side-flexion and rotation. These techniques have been described by Stoddart,[23] and Maitland.[24]

The physiotherapist was able to perform a number of passive techniques during a treatment session, based on reassessment of the patient after each technique. The choice of technique and grades of mobilisation and manipulation have been described by Maitland.[24] All reasonable precautions were taken to ensure that the dependent observer did not know the treatment group from which each patient was assigned.

Hypotheses

We proposed the following hypotheses:

Hypothesis 1.—There is no difference between treatment groups (XE or YC) in the number of days required to reach a symptom-free status.

Hypothesis 2.—There is no difference in lumbar movements between treatment groups at any of the five assessment levels.

Hypothesis 3.—The before-treatment measure of forward flexion lumbar index makes no significant additional contribution in predicting the duration of low back pain symptoms over and above the contributions of the treatment administered and the duration of symptoms before the first treatment.

Analysis of data

We coded all data collected at the five assessment intervals for analysis using the Statistical Package for the Social Sciences (SPSS). We decided to accept a 0.05 level of significance to minimise possibility of a type 1 error. The data from one XE and three YC subjects were omitted from the final analysis of Hypothesis 1, because they did not achieve a symptom-free status within three weeks.

We converted the measured range of motion of lumbar flexion, extension and rotation to a lumbar index (lumbar index = (range of movement in degrees)/(mean score in degrees, according to age and sex, in "normal" subjects)).

Results

Figure 1 shows the number of days taken for each treatment group to reach a symptom-free status. A Mann-Whitney U-test yielded a U value of 3.77 ($P < 0.001$), indicating a significant difference between the two groups in the number of days taken to reach this status. The XE (manipulative) group required 3.5 ($\pm$1.6) treatments to reach a symptom-free status, while the YC group needed 5.8 ($\pm$2.3) treatments to achieve the same result. Figures 2 and 3 show the mean indices for lumbar movement and the amount of straight leg raising for the two treatment groups at each of the five assessment intervals. Results of analysis of covariance indicate a significant difference between the two treatment groups (F (1.43) = 4.238; $P < 0.05$) favouring lumbar extension assessed on the day on which treatment was discontinued. However, there was no significant difference between treatments XE and YC on any other motion indicator at any other assessment interval.

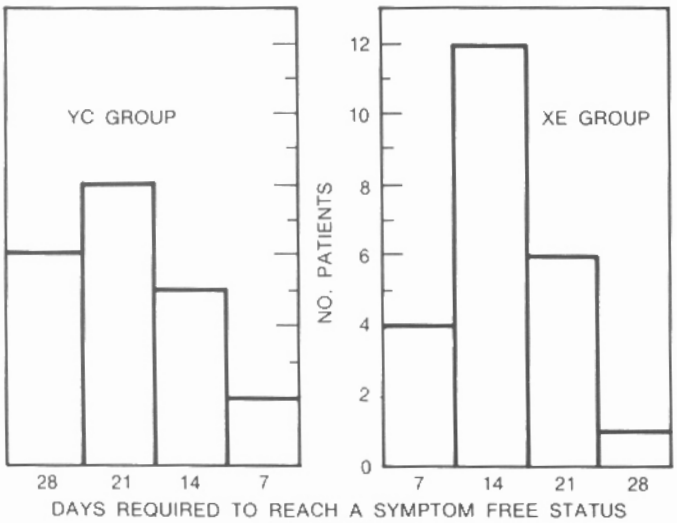

FIGURE 1. Days required to reach a symptom-free status.

We completed a stepwise multiple regression analysis, wherein we added the independent variables into the regression equation in the following order: (i) duration of symptoms before the first treatment (DOS); (ii) treatment administered (TTG); and (iii) before-test forward flexion indices (FF).

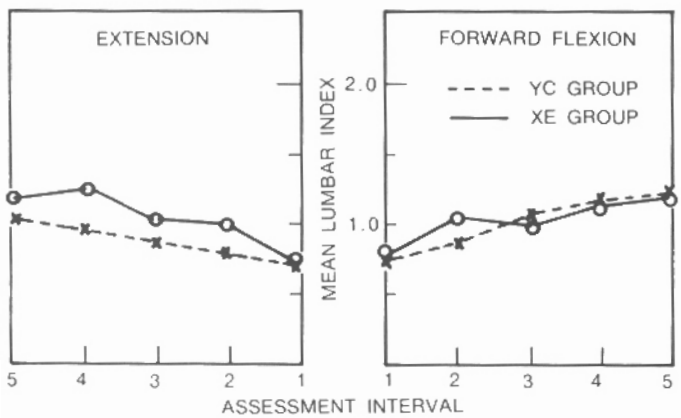

FIGURE 2: Mean lumbar indices for lumbar forward flexion and extension by assessment interval. Lumbar index = (actual range of motion in degrees)/(mean range of motion in degrees, according to age (grouped) and sex in "normal subjects").

These three independent variables together show a relatively high multiple correlation ($R = 0.66$) with the dependent variable (number of days required to reach a symptom-free status). That is to say, 44% ($R^2 = 0.44$) of the variance in the dependent variable is attributable to the combined contributions of DOS, TTG and FF. However, the results of the stepwise multiple regression analysis reveal that the additional contribution of the before-treatment measure of forward flexion lumbar index (FF) above and beyond those of the treatment (TTG), and before-treatment duration of symptom variables (DOS), was not significant, indicating that the explained variance in the dependent variable can be accounted for by DOS and TTG. Further, the additional contribution of the treatment variable (TTG) was significant over and above the DOS variable (F (3.40) = 15.878; $P < 0.01$), indicating a significant effect after partialling out differences in before-treatment duration of symptoms (DOS).

Figure 4 shows the subjective pain rating at four time intervals, while Figure 5 contains the average pain rating of 12 functional activities measured on three occasions. These histograms indicate a trend toward pain reduction (subjective opinion) both in the XE and in the YC groups with time, and demonstrate that both groups were almost identical in their responses three weeks after the initial treatment. A Spearman rank correlation showed a fair degree of association ($r = 0.46$, $P < 0.013$) between the before-test measures of the subjective pain rating and the average pain rating.

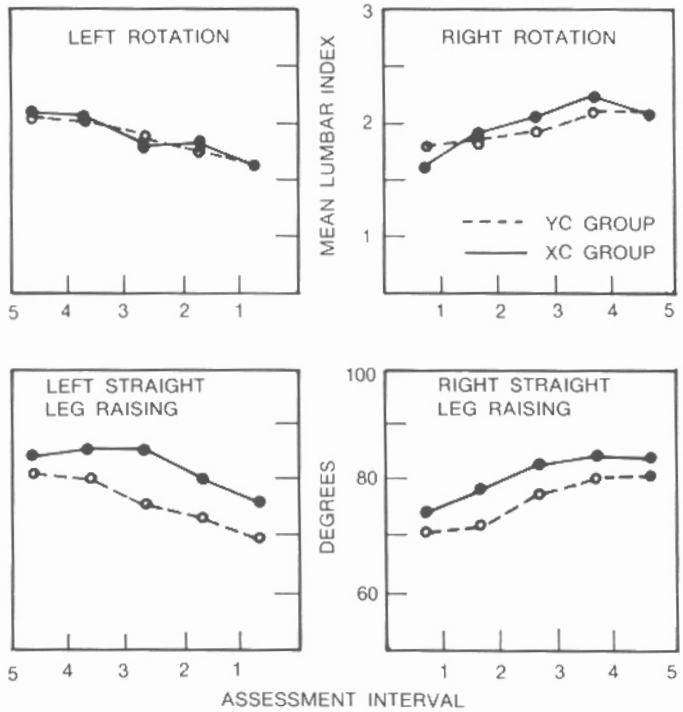

FIGURE 3: Mean lumbar indices for lumbar rotation, and straight leg raising by assessment interval. Assessment intervals: 1 = before-test (before the first treatment); 2 = after-test (after the first treatment); 3 = after third treatment; 4 = on the day on which treatment was discontinued; 5 = three weeks from initial treatment.

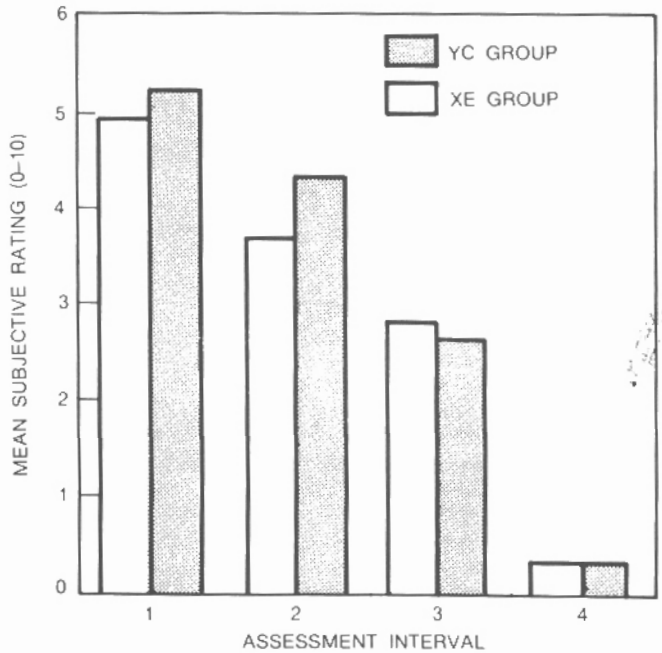

FIGURE 4: Mean subjective pain rating at four assessment intervals. Assessment intervals: 1 = before-test (before the first treatment), 2 = after-test (after the first treatment); 3 = after third treatment; 4 = three weeks after initial treatment.

Based on an examination of the responses to the questionnaire about the functional limitations, the activities which most frequently resulted in an aggravation of the low back pain were: *(a)* getting in and out of cars; *(b)* prolonged sitting; *(c)* stooping over a wash-basin; *(d)* dressing; and *(e)* riding in a car. Pain on forward flexion was the most common finding at the before-test assessment.

Discussion

Every attempt was made to ensure that the two samples tested in this trial were comparable in terms of signs and symptoms, behavioural characteristics and occupational status. The subjects were allocated at random into the two treatment groups. While we made no attempt to ensure psychological homogeneity of the groups, there was no reason to suggest they were markedly different, since their test scores on a number of behavioural characteristics were almost identical (Table 2). Eighty-five per cent of the subjects were in sedentary occupations and these individuals were spread evenly between the groups.

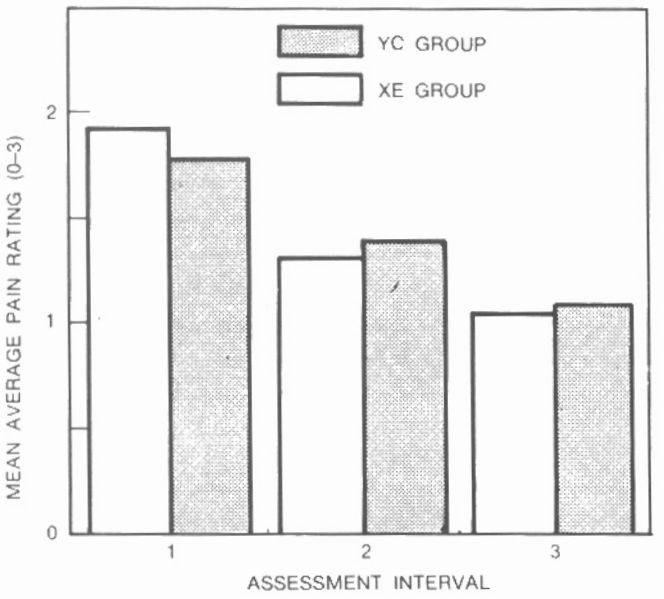

FIGURE 5: Mean average pain rating of aggravating factors by treatment group, on three occasions. Assessment intervals: 1 = before-test (before the first treatment); 2 = after third treatment; 3 = three weeks after initial treatment.

The findings of this study strongly suggest that patients with acute low back pain treated by passive mobilisation and manipulation (XE group) had a shorter mean duration of symptoms compared with those who were treated by microwave diathermy, isometric abdominal exercises and ergonomic instructions (YC group). Thus, Hypothesis 1 (no difference between XE and YC treatment groups in the duration of acute low back pain symptoms) can be rejected.

Ninety-one per cent of all subjects recovered from their symptoms within four weeks. This compares favourably with the conclusion of Dixon that 86% of all patients with low back pain became symptom-free within four weeks irrespective of treatment.[25] As the subjects in the present study were obtained from family-oriented general practice, and the success rates were similar to Dixon's, the sample studied was likely to be representative of the "general" population with acute low back pain.

The current study confirms the results of previous trials of manipulative therapy for acute low back pain in hospital environments,[6, 13] but not those of trials held in industrial complexes.[2, 10] The differing results may be attributed to two factors:

1. Patients seeking hospital treatment differ in economic, occupational and psychological status from those attending private practices.[15] Similarly, patients treated within an industrial complex may differ from the previous two groups.

2. The manipulative treatment regimen in the Berquist-Ullman and Larsen study[2] also included stability and stretching exercises which were not included in our study. However, as there is no accompanying loss of strength in abdominal and erector spinae muscles with low back pain,[26, 27] the effect of the exercises on the course of the pain is open to question.

At the end of three weeks treatment, there was no significant difference between the subjective pain ratings of the two treatment groups (Figure 4), although the trend favoured the manipulative (XE) group. In this respect, the results confirmed those of Glover *et al.*,[10] and Berquist-Ullman and Larsen[2]—two studies which used similar subjective pain rating scales.

Our study employed three measures which were, in part, subjective: (i) the subject's assessment of the level of pain; (ii) questions as to the functional activity and the level of pain; and (iii) pain during measurement of lumbar movements. Although we employed a subjective pain rating, there was a fair correlation ($r=0.46$; $P<0.013$) between it and the average pain rating on before-test examination. However, since the present criteria for symptom-free discharge from trial called for the three measures to be equivalent (pain-free) and the subjective questions were simple and concise, the results are quite reliable.

This study is the first to measure objectively change in the ranges of lumbar movement in a comparison of two conservative treatment regimens for low back pain. Passive mobilisation and manipulation enabled the subjects to achieve a greater range of lumbar extension by the final day of treatment ($P<0.05$). There was no significant difference in other lumbar motions between treatment groups at any other assessment interval. However, while the significance of the increase in extension is encouraging, the results should be interpreted with caution, since we subjected six variables on five occasions to tests of significance and it is highly likely that one measure might achieve significance by chance. Thus, Hypothesis 2 (no differences in lumbar movements between the groups at the various assessment intervals) must be accepted.

The three independent variables *(a)* before-treatment limitation to the range of lumbar flexion; *(b)* the treatment administered; and *(c)* the duration of symptoms before treatment as predictors of the duration of symptoms together explained 44% of the variation in the duration of low back pain. In addition, flexion-related activities were more limited than other activities, and 88% of subjects demonstrated an increase in lumbar flexion during the treatment phase. This result is identical to the findings of Berquist-Ullman and Larsen,[2] and is consistent with previous studies showing increased loading on the intervertebral disc in flexion.[28, 29]

Although the three independent variables together explained 44% of the variance in the dependent variable, other factors are implicated as predictors of the number of days required to reach a symptom-free state.

The significant difference between the XE and YC groups may be due to the more specific assessment techniques used with manipulation and mobilisation. The constant assessment/treatment/reassessment for subjects in the XE group provided subject and therapist with immediate feedback on the status of the back pain. This was not the case for the YC group. (It may also be argued that the reassessment and physical contact implicit in the XE group were essentially placebo elements, which could help explain the shorter duration of symptoms in this group.)

A major emphasis of the YC treatment approach included an explanation of biomechanical principles of back care. The efficacy of the YC treatment may relate to the subject's capacity to understand such information. In addition, since heat and isometric abdominal exercises were also a consistent part of the YC treatment, it is impossible to determine if they were singularly responsible for any improvement.

The manipulative techniques employed with the XE treatment group would both "gap" zygoapophyseal joints and selectively stretch joint capsules. The rapid recovery of most of the patients in this group may be due to any of a large number of reasons.[30-33] For example, while Maigne,[34] and Cyriax,[35] consider that manipulation affects the intervertebral disc, Kos and Wolf suggest that the zygoapophyseal joint is the principal structure causing back pain and the main structure affected by manipulation.[36] However, this situation is exceedingly complex. Mathews and Yates, using epidurography, showed a reduction in the size of a disc protrusion after manipulation in five subjects,[24] and yet Chrisman *et al.* failed to see any such reduction in their myelographic study.[8] With nonspecific disc thinning, a situation considered to exist in most

people over the age of 30 years,[37, 38] the stretching of the postero-lateral fibres of the anulus fibrosus during manipulation may deactivate the nociceptor system, and be a possible cause of reduction in pain.[39, 40]

Another view suggests that manipulation "frees" entrapped interarticular menisci in zygoapophyseal joints.[36, 41] Separation of joint surfaces, and stretch of the joint capsules may free a meniscus from between joint surfaces and, at the same time, the oscillatory techniques may stimulate the articular mechanoreceptors and thereby reduce pain.[40]

The views presented are speculative, and have been used to account for the quite dramatic symptomatic relief which often follows manipulative therapy.

Conclusion

The major conclusion from our study was that the duration of low back pain symptoms was significantly less for patients who received passive mobilisation and manipulation than for those who received an alternative conservative treatment.

Patients who received passive mobilisation and manipulation demonstrated a larger range of lumbar extension movements on the final day of treatment compared to those who had undergone an alternative conservative treatment. However, this result has to be interpreted with caution because of the large number of tests completed for the several lumbar movement indices over the various assessment intervals.

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