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The Effects of Spinal Flexion and Extension Exercises and Their Associated Postures in Patients With Acute Low Back Pain

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Study Design. A prospective randomized clinical trial compared the effects of flexion and extension back exercises and postures among soldiers with acute low back pain.

Objective. To compare the immediate effects of back exercise on functional status, spinal mobility, straight leg raising, pain severity, and treatment satisfaction, and to determine whether spinal exercise during the acute stage of low back pain reduces recurrent episodes of low back pain.

Summary of Background Data. Conflicting reports exist concerning the efficacy of spinal flexion and extension exercises in patients with low back pain of varying duration. Poor study design and lack of functional outcomes characterize many of these studies.

Methods. One-hundred-forty-nine subjects with acute low back pain received flexion exercise and posture (n = 57), extension exercise and posture (n = 62), or no exercise or posture (n = 30) for 8 weeks. Outcomes were assessed 1, 2, 4 and 8 weeks after treatment onset. A questionnaire assessed the recurrence of low back pain 6–12 months after study entry.

Results. Flexion and extension exercise groups did not differ in any outcome over 8 weeks. After 1 week, both exercise groups had reduced disability scores, a higher proportion returning to work, and fewer subjects with a positive straight-leg raise compared with the control group. There was no difference among groups regarding recurrence of low back pain after 6–12 months.

Conclusions. There was no difference for any outcomes between the flexion or extension exercise groups. However, either exercise was slightly more effective than no exercise when patients with acute low back pain were treated. [Key words: extension exercise, extension posture, flexion exercise, flexion posture, low back pain, recurrence, Roland disability] **Spine 1995;20: 2303–2312**

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The magnitude of the low back pain (LBP) dilemma is well documented.[19,20,22,27,31,39,42] Low back pain affects approximately 80% of all adults at some time during their lives[27] and is the second most common reason a patient seeks the care of a physician.[22,39] The prevalence of LBP and the extent of disability also have been investigated. This condition is not unique to the civilian population in the United States. A recent study by the Army Medical Department reports that back pain accounts for at least 20% of all medical discharges from the United States Army.[31]

Although LBP continues to affect a large portion of the population, most treatments for this condition remain unproven. Patients routinely receive various forms of treatment that include some type of "back exercise" intended to relieve pain or prevent it from recurring. Extensive "postural training" often accompanies these exercises. Two common back exercise methods of treating LBP—spinal flexion and extension exercises and their associated postures—remain contradictory, both conceptually and in practice.[13]

Advocates of spinal flexion exercises insist that the standing lordotic curve, formed because of the evolutionary upright posture, is the primary reason for most LBP and degenerative processes in the low back.[16,43–45] The purposes of spinal flexion exercises and flexion posture are to flatten the lordotic curve, stretch out tight back extensor muscles, strengthen the abdominal muscles, and open the intervertebral foramen, thus relieving nerve root compression.[1,24,25]

Those who advocate spinal extension exercises and extension posture suggest that a lordosis protects the spine by decreasing disk pressure and increasing its mechanical stability.[32,35] The goals of spinal extension exercises and posture include regaining and maintaining the normal lumbar lordosis, reducing posterior stress on intervertebral discs and spinal ligaments, and centralizing peripheral symptoms toward the lumbar midline.[24,25,32,35]

Table 1. Studies Reporting Effects of Flexion Versus Extension Exercise on Low Back Pain

Author (yr)	Design	Treatment	n	Population	Outcome Measures	Results	Comments
Kendall (1968)[28] and Jenkins	Randomized clinical trial	1. Mobilizing exercise 2. Isometric flexion exercise 3. Active back extension exercise	14 14 14	Not described	Clinical judgement	Group 2 statistically better	1. No demographic data 2. No blinding of observer 3. No definitive test to verify diagnosis 4. Poor outcome measures
Davies et al (1979)[5]	Randomized clinical trial	1. SWD 2. SWD and active back extension exercise 3. SWD and flexion exercise	15 14 14	General population with symptoms >3 weeks and <6 months	1. Pain 2. ROM	1. All groups improved 2. Group 2 improved most, but not statistically significant	1. Low power to detect difference (not reported) 2. No functional outcomes 3. Heterogeneous population
Zylbergold and Piper (1981)[46]	Randomized clinical trial	1. Flexion exercise 2. Manual therapy 3. Active back extension exercise	10 8 10	General population, 25–65 years old	1. Pain 2. ROM 3. Functional activities	1. No statistical difference among groups 2. Group 2 best 3. All groups improved	1. Low power to detect difference (not reported) 2. Functional instrument not tested
Buswell (1982)[4]	Randomized clinical trial	1. Flexion exercise and posturing; manual therapy 2. Extension exercise and posturing; manual therapy	25 25	General population, 16–59 years old	1. Pain 2. Muscle spasm 3. Posture 4. Frequency and duration of symptoms	1. Both groups improved 2. Group 1 significantly reduced muscle spasm	1. No functional outcomes 2. Clinical judgement used to assess posture and muscle spasm 3. Heterogeneous population
Ponte et al (1984)[37]	Quasi-experiment	1. Williams flexion exercise 2. McKenzie extension exercise	10 12	General population with low back pain <3 weeks	1. Pain 2. ROM 3. SLR 4. Sitting time	Group 2 better on all outcome measures	1. No functional outcomes 2. No random allocation of groups
Nwuga and Nwuga (1985)[36]	Quasi-experiment	1. Williams flexion exercise 2. McKenzie extension exercise	32 32	Females with clinical radiculopathy, 20–40 years old	1. Pain 2. ROM 3. SLR 4. Sitting time 5. Number of treatments	Group 2 better on all outcome measures	1. No. functional outcomes 2. No. random allocation of groups 3. No. definitive test to verify diagnosis
Elnaggar et al (1991)[13]	Randomized clinical trial	1. Flexion exercise 2. Extension exercise	28 28	General population with low back pain >3 months, 20–50 years old	1. Pain severity 2. ROM (three planes)	1. Group 1 with better sagittal plane ROM 2. Pain reduced in both groups; no difference between groups	1. No control group 2. No functional outcomes
Delitto et al (1993)[6]	Randomized clinical trial	1. Manipulation and extension exercise 2. Williams flexion exercise	14 10	Selected patients with low back pain classified as candidates for extension-manipulation treatment	Functional questionnaire	Group 1 responded to treatment faster	1. No control group 2. Treatment not blinded 3. Short follow-up period 4. Unequal treatment—unable to determine if benefit resulted from extension exercise or manipulation

SWD = short wave diathermy. ROM = range of motion. SLR = straight leg raising.

Although the rationale for employing each of these exercises is well described, this is not the case for beneficial clinical results. Studies investigating different exercise programs report conflicting results. Some support spinal flexion exercise,[28,30] some support spinal extension exercise, [6,36,37] and others demonstrate no difference between the exercises.[4,5,13,23,34,46] Many of these studies suffer from one or more design flaws, including nonrandom allocation of subjects, lack of functional outcome measures, low power to detect differences between groups, no control group, and nonblinding of the evaluators. Table 1 summarizes the studies published to date comparing spinal flexion and extension exercises.

The present study compares the results of spinal flexion and extension exercises and postural instruction on the functional and clinical status of active duty soldiers with acute LBP. Specifically, this study sought to: compare the effects of spinal flexion or extension exercises and their associated postures with no exercise or posture instruction (controls) based on functional status, spinal mobility, straight leg raising, pain severity, and treatment satisfaction of active duty soldiers with acute LBP; and to determine if either form of spinal exercise and posture or combination of spinal exercises and posture reduces recurrent episodes of LBP, compared with control subjects and each other.

■ Methods

Subjects. Army active duty personnel (men and women) living in Germany participated in a prospective randomized clinical trial comparing the effects of flexion and extension back exercises and their associated postures in acute LBP. Three

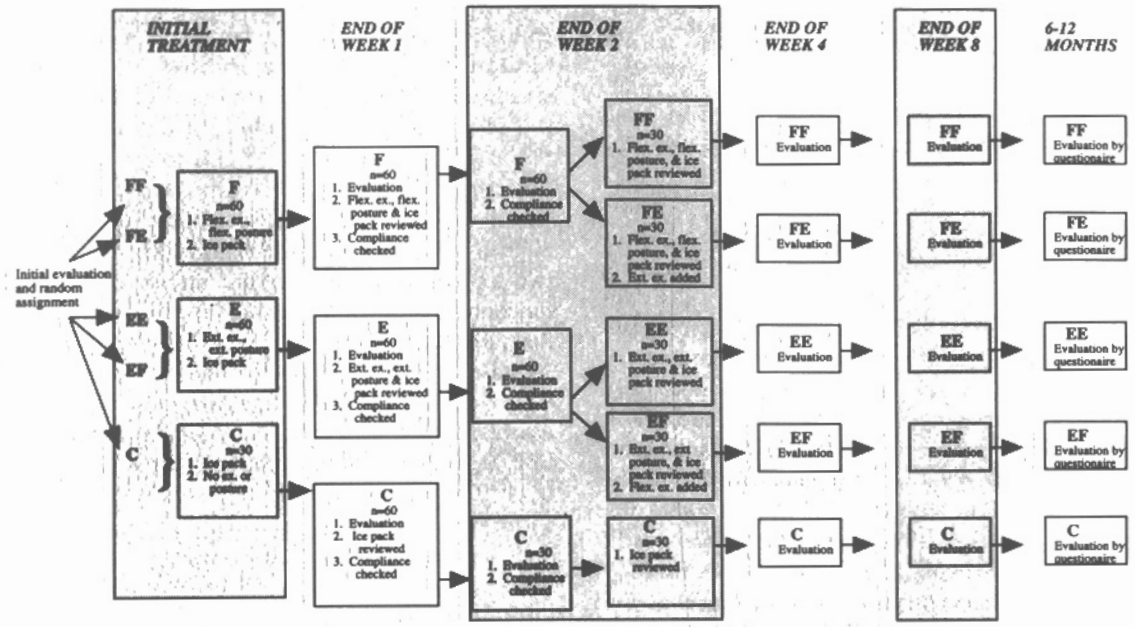

Figure 1. Study design. F = flexion group. E = extension group. C = control group. FF = flexion exercise, flexion posture throughout entire study. FE = flexion exercise, flexion posture; extension exercise added. EE = extension exercise, extension posture throughout entire study. EF = extension exercise, extension posture; flexion exercise added.

Army hospitals served as sites for the study during an 18-month period. Physicians or physician assistants identified and screened all subjects during initial clinic visits. Each participant had standing posteroanterior and lateral radiographs taken to rule out bony tumors, fractures, or spondylolisthesis. Those found to have acute LBP (less than 7 days) or pain radiating to the lower extremity reported to the physical therapy clinic for inclusion in the study. Those with a neurologic deficit, spondylolysis, spondylolisthesis, fracture, tumor, known pregnancy, prior LBP within the previous 6 months requiring medical assistance, litigation, or history of spinal surgery were excluded.

All subjects included in the study fit categories 1, 2, and 3 (pain without radiation, pain with radiation to the extremity proximally, or pain with radiation to the extremity distally), A (acute, less than 7 days), and W (working), of the Quebec Task Force on Spinal Disorders.[40] One-hundred-seventy subjects met the criteria and through written informed consent agreed to participate in the study. Twenty-one subjects could not complete the study, primarily because of the rapid military reduction in troop strength in Europe. Nine of these chose early release from the military, four were sent back to posts outside Germany, and three could not be contacted after the initial visit. Four additional subjects did not attend treatment because of extended military field duty, and one soldier refused to continue treatment after the initial visit for no stated reason. Data analysis was completed on the remaining 149 subjects (120 men, 29 women), all of whom attended three or more assessment sessions.

Study Design. After the initial evaluation, a physical therapy assistant (PTA) randomly assigned each subject to one of five subgroups—1) flexion-flexion, 2) flexion-extension, 3) extension-extension, 4) extension-flexion, or 5) control—by blindly drawing a card from a box. During the first 2 weeks, the flexion-flexion and flexion-extension subgroups received the same treatment and formed the main flexion group. Likewise, the extension-extension and extension-flexion subgroups formed the main extension group. Figure 1 illustrates the study design. Subjects in each main treatment group received a 20-minute application of an ice pack to the lumbar spine and a generic patient information booklet instructing them in general body mechanics. A PTA read all of the instructions for exercises and postural training to each appropriate subject.

Exercise Program. The treatment intervention for each main group consisted of the following.

Flexion. The subjects lay prone with a pillow under the pelvis and with an ice pack positioned on the lumbar spine for 20 minutes. After the application, subjects assumed the supine position on a treatment table and practiced 10 repetitions of three common flexion exercises designed to flatten the lumbar lordosis.[45] These exercises included the following.

1. Pelvic tilt. With hips and knees bent, subjects flattened the lumbar spine against the table by contracting the abdominal muscles. Each repetition was held for 5 seconds.
2. Partial sit-ups. With hips and knees bent, subjects slowly lifted their head and shoulders off the table while keeping their feet flat on the table. This position was held for 5 seconds.
3. Double knee to chest. Subjects bent both knees and, using their arms, pulled their knees gently to their chest. They held this position for 30 seconds.

A PTA supervised all exercises. After the exercises, subjects practiced keeping the lumbar lordosis as flat as possible while standing (by actively tilting the pelvis posteriorly), sitting (by

placing the feet on a stool, keeping the knees higher than the hips), and lying (by placing pillows under the knees in the supine position).

Extension. Subjects lay prone with an ice pack positioned on the lumbar spine for 20 minutes. During these 20 minutes, three pillows under the chest gently extended the subject's trunk, one at a time, every 5th minute. Twenty "press-up" exercises in the prone position followed. During each repetition, subjects pushed their chest off the table while keeping their pelvis down to maximize the amount of lumbar lordosis.[32] This position was held for 5 seconds. The subjects practiced maintaining the lordosis in positions of standing (by occasionally bending backward), sitting (using a lumbar roll), and lying (by lying prone or by avoiding hip and knee flexion). In subjects with LBP who have lateral trunk shifts, advocates of extension exercises contend that the lateral shift must be corrected before extension movement is begun.[32] Therefore, the PTA manually corrected all subjects who presented with lateral shifts and who were assigned to the extension group before the extension treatment was administered. This was done passively as the PTA applied translational force in the direction opposite the shift while the subject was standing. This force was applied for approximately 2 minutes.

Control. Subjects lay prone with an ice pack positioned over the lumbar spine for 20 minutes. No exercise or postural instructions were given.

The PTA instructed each treatment group to carry out their treatment three times each day at home and to track ice pack and exercise compliance using home treatment logs. Subjects were encouraged to carry out their prescribed treatment to the best of their ability even if the pain increased with exercise. Each subject in all three treatment groups received the same work limitation, defining the amount of lifting and physical exercise allowed for the next week. Subjects added lifting and exercise at their own discretion during the following 7 weeks. Each subject received 21 ibuprofen tablets (400 mg) with instructions to take one tablet up to three times per day. The subjects returned the unused tablets at the end of the first week and the PTA validated compliance. Subjects returned for follow-up at the end of 1 week, 2 weeks, 4 weeks, and 8 weeks. At each follow-up, the PTA reviewed the home treatment and collected exercise and ice compliance. A follow-up questionnaire assessed subsequent episodes of LBP 6–12 months later.

Some proponents of the exercise programs tested prefer to add both exercises at some point in the treatment regimen to ensure long-term benefit.[32] Therefore, at the end of 2 weeks, the main groups divided into their respective subgroups. Half of the main flexion group added extension exercises to their program, but continued in the flexion posture, creating a flexion-extension subgroup. Those who did not add extension exercises at 2 weeks remained a flexion-flexion subgroup. Likewise, an extension-flexion subgroup added flexion exercises but continued with the extension posture, and the extension-extension subgroup continued with extension exercises only.

Follow-up. One-hundred-fifteen subjects (78.5%) returned questionnaires designed to assess recurrent episodes of LBP 6–12 months after the initiation of the trial. To estimate the severity of the recurrent episodes, subjects were asked if the episode required medical attention. For those who sought medical care, severity was further delineated by asking whether the subject was limited in work by the medical care provider for the recurrent LBP.

Outcome Measures. Three experienced physical therapists (one at each facility) evaluated all of the subjects and remained blinded to the treatment intervention. The therapists employed two separate outcome measures to assess each participant's functional status. First, they used the Roland self-administered functional disability instrument. This simple survey presented 24 statements selected to determine patient-perceived disability in a range of daily living activities. This tool has been described and shown to be reliable and sensitive[38] for use with LBP. Second, they assessed the subject's ability to return to full work. The subjects achieved full work status when they could perform their job and complete normal physical training with their respective military unit. This physical training usually included pushups, sit-ups, calisthenics, and running 2–3 miles three times per week.

Participants rated their own pain level on a six-point scale (0 = no pain; 5 = maximum pain). Therapists measured spinal mobility with a flexible tape measure to determine the amount of distraction and attraction between two points on the lumbar spine during flexion and extension.[2,21,33] Subjects exhibited a positive straight leg raising test if they could not flex the hip beyond 70° with a fully extended knee because of pain in the lower extremity or low back.[29] A goniometer measured the hip flexion angle. A simple questionnaire measured the subject's satisfaction with the healthcare received initially and after 4 weeks.[9]

The therapists established inter-rater reliability for straight leg raising and spinal mobility before the beginning of the trial. They achieved perfect agreement for straight leg raising. The estimated intraclass correlation coefficient (3,1) was 0.96 for spinal flexion and 0.95 for spinal extension.

Statistical Analysis. For analytic purposes, the results were separated into the initial response to treatment (1–8 weeks) and the follow-up response to treatment (6–12 months). The analysis for the initial response period included the main treatment groups (control, flexion, extension) and an exercise group made up of those who exercised using either the flexion or extension exercises. The analysis for the follow-up period included the three main treatment groups, the five subgroups (control, flexion-flexion, flexion-extension, extension-extension, extension-flexion) and a combination of the two subgroups, which performed both flexion and extension exercises (flexion-extension and extension-flexion).

Demographic, initial response, and follow-up data were analyzed using the Kruskal-Wallis and chi-square tests for categorical data and one-way analysis of variance for continuous data. Roland disability scores and straight leg raising were analyzed by analysis of covariance and logistic regression, respectively, to control for the differences in baseline measurements for these two outcomes. Survival analysis measured differences in the time to return to work. All analyses were performed with the Statistical Package for the Social Sciences, Windows version.[41]

Table 2. Demographic and Initial Assessment Data by Treatment Group

Variable	Treatment Groups		
	Flexion	Extension	Control
No. of subjects	57	62	30
Mean age (yr)	28.6	30.6	26.1
Male (%)	84.2	77.4	80.0
Married (%)	53.3	64.9	64.5
Military rank (%)			
Enlisted 1–4	53.0	56.0	37.0
Enlisted 5–9	43.0	40.4	55.0
Officer	3.0	4.0	8.0
Current smoker (%)	43.9	45.9	43.4
Mean body mass index (kg/m^2)	25.1	25.6	25.3
Mean Army physical fitness score	246.0	246.7	248.8
Prior low back pain (%)			
1–3 episodes	32.0	29.0	30.0
≥4 episodes	18.0	23.0	10.0
Mean duration of current episode of pain (days)	3.14	3.39	3.30
Mean initial trunk range of motion (Schoeber test, mm)			
Flexion	38.3	36.5	40.3
Extension	9.4	8.8	9.7
Mean initial pain score	2.7	2.6	2.7
Mean initial Roland disability score	11.4	12.1	11.3
Mean initial satisfaction score	7.2	7.1	7.0
Positive straight leg raising ≤70° (%)	28.1	30.6	20.0

Results

Table 2 displays demographic and initial assessment data. There were no significant differences for any variable at baseline. Sixty percent of the subjects were white, 30% black, 7% Hispanic, and 3% of other ethnic or racial groups. Upon entry into the study, 54% of the subjects described pain with standing, 67% with sitting, and 28% with lying. There was no difference among groups regarding their satisfaction with treatment after the initial visit and after 4 weeks of treatment.

Table 3 shows self-reported compliance with the randomly prescribed exercise and ice treatment programs. The total number of ibuprofen tablets also is recorded. There was no significant difference among the groups in any of these categories.

Table 3. Self-Reported Home Treatment Compliance

	Exercises*	Ice*	Ibuprofent
Control			
Week 1	—	21	15
Week 2	—	16	—
Flexion			
Week 1	20	20	15
Week 2	21	16	—
Extension			
Week 1	20	20	15
Week 2	23	16	—

* Number of sessions per week.
† Number of tablets per week.

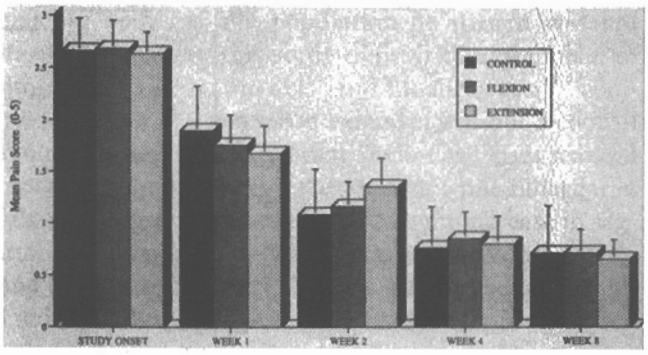

Figure 2. Self-reported pain scores during 8 weeks of initial therapy for three treatment groups (95% confidence intervals).

Initial Response Period

Each treatment group had significant improvement in all outcome measures during the initial 8-week study period. Figure 2 shows that mean pain scores steadily decreased for all groups, with the greatest reduction occurring during the first 2 weeks. There were no significant differences in mean pain scores among treatment groups.

The two functional status measures (return to work and Roland disability scores) also showed no significant differences during the initial 8-week period (Figures 3 and 4). However, after just 1 week of treatment, both exercise groups demonstrated greater improvement in their functional status and in straight leg raising, whereas the control group showed little or no improvement (Figures 5A–C). Because improvement in the flexion and extension exercise groups was similar after 1 week, these two groups were united to form one exercise group for comparison with the control group. Table 4 shows this comparison.

The type of exercise affected trunk range of motion very little during the first 4 weeks. Subjects who were given flexion exercises, however, displayed significantly less trunk extension after 4 weeks compared with the control group ($P = 0.049$; Figure 6). There was no difference in trunk flexion (Figure 7). Subjects in the control group had more improvement in trunk flexion and extension than subjects in either exercise group.

Follow-up Period

Sixty-three percent of those who returned questionnaires reported one or more recurrent episodes of LBP after treatment. Table 5 displays the 6–12-month follow-up results for the main groups, the subgroups, and the combination of the two subgroups, which performed both flexion and extension exercises (flexion-extension and extension-flexion). The rate of recurrence of LBP was similar for all groups. Fewer subjects who received some exercise therapy required medical care or a work limitation compared with those who received no exercise. In particular, the groups that performed some extension exercise had the greatest decrease in recur-

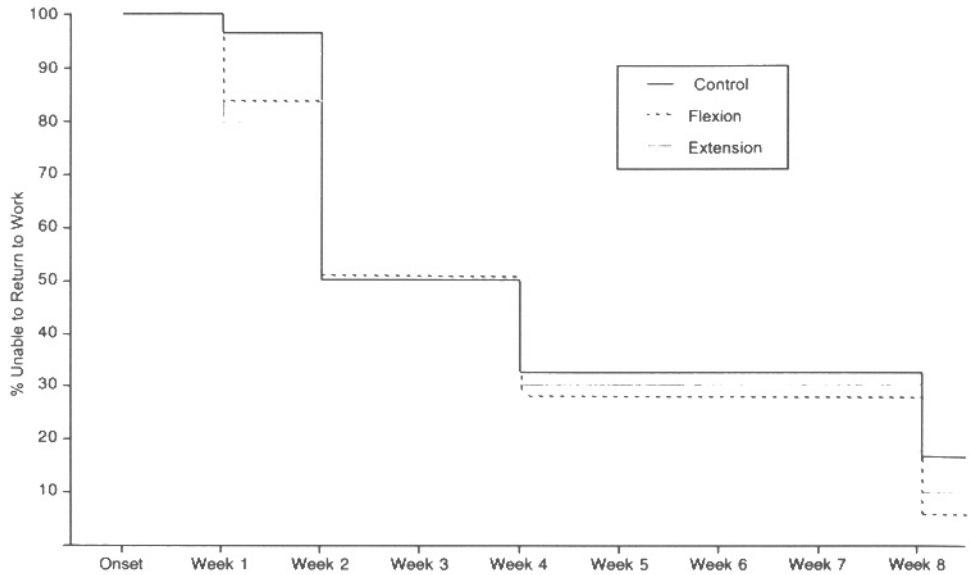

Figure 3. Proportion of participants who were unable to return to work in each treatment group during the initial 8 weeks of therapy. Thirteen subjects were censored, five in the control group, four in the flexion group, and five in the extension group.

rence of LBP requiring medical attention, although this was not statistically significant.

■ Discussion

In the present study, neither flexion nor extension exercises and postural instruction significantly affected the outcome of subjects with acute LBP during an 8-week period. However, at the end of 1 week, functional ability and straight leg raising had recovered sooner in subjects who performed either exercise, compared with a control group that performed no exercise. This initial benefit of exercise did not continue past the first week, with all groups recovering at similar rates thereafter.

The benefits of early motion are well accepted in injuries affecting extremities.[7,12,14,18] These benefits, not the specific mechanics of either exercise, may have been responsible for the initial improvement in LBP during

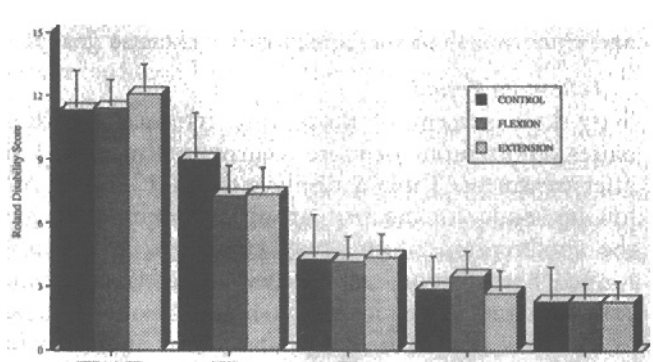

Figure 4. Roland disability scores for participants in each of three treatment groups during the initial 8 weeks of therapy (95% confidence intervals).

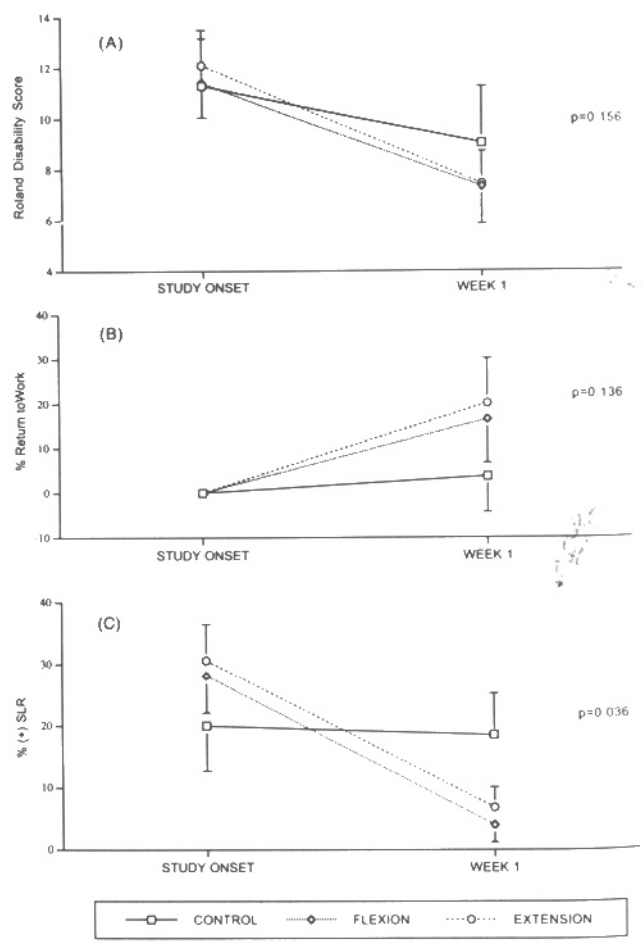

Figure 5. Comparison of treatment groups after 1 week of treatment (and their 95% confidence intervals), describing **(A)** Roland disability score (*P* value from analysis of covariance), **(B)** percent who returned to work (*P* value from Kruskal-Wallis), and **(C)** percent with a positive straight leg raise (*P* value from logistic regression).

Table 4. Functional Outcome Measures and Straight Leg Raising Testing After 1 Week of Treatment for Flexion and Extension Groups Combined Into One Exercise Group

	Exercise Group	Control Group	*P* Value
Roland disability score, mean (95% confidence interval)	7.35 (6.77, 11.23)	9.0 (6.40, 8.30)	0.054*
Subjects who returned to work (%)	18.3	3.6	0.053†
Subjects with (+) SLR (%)	5.5	8.5	0.008‡

* Analysis of covariance with the baseline mean score as the covariate.
† Chi-squared test.
‡ Logistic regression with the percent at baseline as the covariate.

the first week of the study. It may not be the movement of the nucleus pulposus[32] (from extension exercises) nor the opening of the intervertebral foramen to relieve spinal nerve pressure[45] (from flexion exercises) that causes the initial improvement. Rather, the benefits may result from the act of moving the intervertebral joints and their associated soft tissues, which results from these particular exercises or by other means. For example, in some studies, patients who receive spinal manipulation or mobilization show a similar pattern of initial clinical benefit that quickly tapers off after about a week.[17,26] In these studies, motion occurs in the patients through the forces of a care giver. Likewise, patients with LBP who initiate early spinal motion by resuming activity after just 2 days of bed rest do better than those who remain on bed rest for a week.[8]

The results of the present study differ from those of investigators who reported greater improvement with flexion[4,13,28] or extension exercises.[36,37] Kendall[28], in 1968, claimed that patients improve more when doing isometric flexion exercises. These results were based on the overall subjective judgment of a nonblinded clinician. In addition, the population he treated was not described, making this study difficult to extrapolate to other populations. Buswell[4] and Elnaggar et al[13] compared flexion and extension exercises without a control group. Buswell concluded that flexion exercises reduced muscle spasm (subjective assessment), while Elnaggar et al's flexion group demonstrated a slight increase in sagittal plane range of motion. In contrast, Ponte et al[37] and Nwuga and Nwuga,[36] in two quasi-experiments (no random assignment), reported marked improvement in those performing McKenzie extension exercises, compared with those performing flexion exercises in two different populations. Neither study used a control group or had functional outcome measures.

Sixty-three percent of the respondents had recurrence of LBP 6–12 months after they entered the study. This is similar to the proportion of recurrent LBP in the Volvo study, which reported a 62% relapse.[3] The exercises had no effect on the frequency of recurrence in our study. Seventeen percent of all subjects had recurrence that required medical attention, with 12% requiring limited work. Although there were no statistically significant differences among the treatment groups, those who exercised had slightly less recurrence requiring medical attention or limited work. In particular, those who performed back extension exercise as the only exercise or in conjunction with flexion exercise fared the best. There are a couple of explanations for this. First, it may be important to achieve and maintain the motion of spinal extension after an occurrence of LBP. Unless someone is actively trying to extend the spine through exercise or sports, few persons in our flexion-oriented society have reason to extend the spine in normal activity.[32] Second, subjects in this study who had been shown

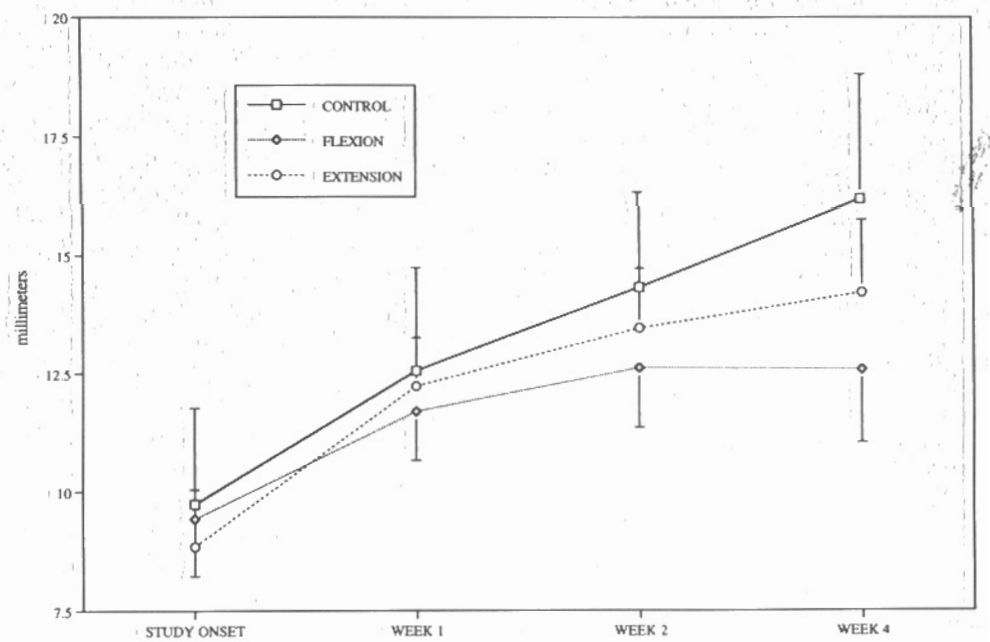

Figure 6. Trunk extension (95% confidence intervals) measured with a flexible tape measure in millimeters of attraction between two points on the spine, 10 cm apart.

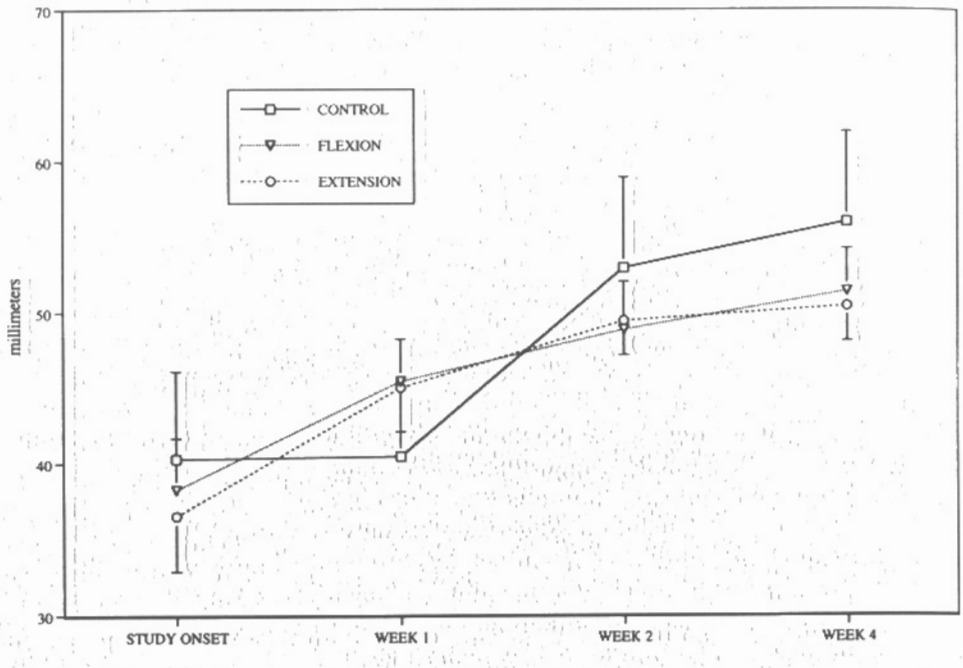

Figure 7. Trunk flexion (95% confidence intervals) measured with a flexible tape measure in millimeters of distraction between two points on the spine, 10 cm apart.

exercises previously may have managed the recurrence with the same exercises, reducing their need to seek medical attention. However, this does not fully explain why those who included some aspect of extension did better than those who included flexion alone.

Our study made no attempt to determine an "exercise preference" for subjects before treatment initiation. Some authors have argued for an evaluation system that documents the change in pain patterns with end-range movements of the trunk.[6,10,11,31] Patients who centralize pain with a directional movement (i.e., extension or flexion) at evaluation are thought to have a preference for that exercise during treatment. Centralization of pain refers to the change of distal referred pain more proximally toward the lumbar midline. Centralization has been shown to be a predictor of outcome in some patients.[11] Whether treatment employing exercises that centralize pain brings faster resolution of symptoms or just predicts those individuals who will most likely improve is being studied[6,15] and requires further investigation.

Our study has a common problem that occurs in many randomized clinical trials evaluating LBP therapies—the tendency to commit the type II error. The lack of statistical significance in the comparison of the three groups after 1 week of treatment may be attributed to the small and uneven sample sizes. For example, the power to detect a difference among groups regarding the Roland disability score was only 39%, whereas that for returning to work was 42%. We increased the power of our study by combining the two exercise groups into one exercise group after 1 week of treatment, as is shown in Table 4.

Table 5. Percent of Subjects With Recurrent Low Back Pain (and 95% Confidence Intervals) at 6–12-Month Follow-up for Each Treatment Group, by Severity of Discomfort

Groups	n	Recurrent Pain Only	Recurrent Pain Requiring Medical Care	Recurrent Pain Requiring Medical Care and Work Limitation
Main				
C	23	60.8 (41,81)	21.7 (5,39)	13.0 (3,29)
F	44	61.4 (47,76)	15.9 (5,27)	15.9 (5,27)
E	48	66.7 (53,80)	14.6 (5,25)	8.3 (2,23)
Subgroups				
FF	18	61.1 (39,84)	22.2 (6,42)	22.2 (3,40)
FE	26	61.5 (43,80)	11.5 (2,27)	11.5 (2,28)
EE	25	64.0 (45,83)	12.0 (2,26)	8.0 (1,24)
EF	23	69.6 (51,88)	17.4 (3,35)	8.7 (1,26)
Combined exercise FE and EF	49	65.3 (52,79)	14.3 (5,24)	10.2 (3,20)

■ Conclusions

We concluded the following in patients with acute LBP.

1. More patients receiving back flexion or back extension exercises and postural instruction return to work and have less functional disability after 1 week of treatment compared with patients who receive no exercise or postural instruction. This result appears to be the consequence of early back motion that accompanies these exercises.
2. After 1 week of treatment, patients recover at similar rates whether or not they perform back exercise. This recovery is significant and rapid.
3. Back flexion or extension exercises in treating acute LBP do not affect the rate of recurrence of LBP 6–12 months later. However, patients who receive back extension exercises may have a better recovery

requiring less frequent medical visits and work limitations for recurrent pain.

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