

Long-Term Effects of Specific Stabilizing Exercises for First-Episode Low Back Pain

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Study Design. A randomized clinical trial with 1-year and 3-year telephone questionnaire follow-ups.

Objective. To report a specific exercise intervention's long-term effects on recurrence rates in acute, first-episode low back pain patients.

Summary of Background Data. The pain and disability associated with an initial episode of acute low back pain (LBP) is known to resolve spontaneously in the short-term in the majority of cases. However, the recurrence rate is high, and recurrent disabling episodes remain one of the most costly problems in LBP. A deficit in the multifidus muscle has been identified in acute LBP patients, and does not resolve spontaneously on resolution of painful symptoms and resumption of normal activity. Any relation between this deficit and recurrence rate was investigated in the long-term.

Methods. Thirty-nine patients with acute, first-episode LBP were medically managed and randomly allocated to either a control group or specific exercise group. Medical management included advice and use of medications. Intervention consisted of exercises aimed at rehabilitating the multifidus in cocontraction with the transversus abdominis muscle. One year and three years after treatment, telephone questionnaires were conducted with patients.

Results. Questionnaire results revealed that patients from the specific exercise group experienced fewer recurrences of LBP than patients from the control group. One year after treatment, specific exercise group recurrence was 30%, and control group recurrence was 84% ($P < 0.001$). Two to three years after treatment, specific exercise group recurrence was 35%, and control group recurrence was 75% ($P < 0.01$).

Conclusion. Long-term results suggest that specific exercise therapy in addition to medical management and resumption of normal activity may be more effective in reducing low back pain recurrences than medical management and normal activity alone. [Key Words: multifidus, low back pain, rehabilitation] **Spine 2001;26:E243–E248**

The major costs of low back pain (LBP) have been identified with two groups: those who develop chronic LBP and those who have recurrent disabling episodes of LBP.¹² These two groups incur 85% of the total costs.^{13,23,33} Efforts have been made to identify the 2–3% of patients who go on to develop chronic symptoms,²² but little is known about the factors that lead to recurrence.

It is documented and generally accepted that a single episode of acute LBP has a favorable natural history with respect to symptom reduction and restoration of function and work capacity in the short term.¹ In the majority of cases, the pain associated with an initial acute episode resolves within 2–4 weeks.^{5,7–11,21} It is estimated that 2–3% of patients go on to develop disabling chronic LBP after an acute episode.^{5,18,22} However, the course of LBP for most primary care patients is recurrent rather than acute or chronic in the usual sense of these terms.³⁹

When the frequency of low back pain recurrences following an acute episode is examined, the recurrence rate is found to be staggeringly high. Recurrence rates range from 60% to 86% for patients suffering recurrences, particularly in the first year after the acute episode.^{3,35–37} Bergquist-Ullman and Larsson³ conducted a detailed study of 217 workers in an industrial setting in Sweden. The median duration of pain for the initial episode was 35 days and short-term resolution of painful symptoms occurred in the majority of cases (70% within 2 months, 86% within 3 months). However, during the 1-year follow-up, 62% of the patients experienced at least one recurrence of LBP and a further 36% experienced two or more recurrences. The median time from resolution of the initial episode to the first recurrence of LBP was only 2 months. These high figures would suggest that it is important to identify the factors that may relate to this vulnerability to recurrence.

Although several processes are likely to be involved, the model provided by Panjabi^{26,27} could provide an explanation for recurrences after painful symptoms have subsided. This model of spinal stability encompasses the passive, active, and neural control subsystems. It has been proposed that instability at the spinal segmental level is a loss of control or excessive motion in the spinal segment's neutral zone, which is associated with injury, degenerative disc disease, and muscle weakness.^{26,27} It has been shown in *in vitro* biomechanical studies that muscles can provide segmental stabilization by controlling motion in the neutral zone, and the neutral zone can be returned to within physiologic limits by effective muscle control.^{14,28,41} While various muscles may be able to control and protect the spinal segments, one muscle that has been investigated in relation to this role is the lumbar multifidus. The multifidus provides segmental stiffness and controls motion in the neutral zone.^{14,28,34,41} Further evidence of this stabilizing role has been provided by *in vivo* animal research.²⁰ Investigations have also demonstrated a relation between multifidus muscle dysfunction

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tion and poor functional outcome and recurrence of LBP following disc surgery.^{29,32}

Optimal functioning of the muscle system is desirable to control and protect the spinal segments following injury. Despite initial resolution of painful symptoms, failure to protect spinal segments could increase the likelihood of a recurrence of symptoms. Specific exercises targeting the multifidus and transversus abdominis muscles have been shown to decrease pain and disability in chronic low back pain patients.²⁵ Our research has shown the occurrence of localized segmental dysfunction of the multifidus muscle after an initial episode of acute unilateral LBP.^{15,16} To establish the low back pain recurrence rates in the two groups, the present study presents the follow-ups of the patients from the study at 1 year and 3 years after treatment.

■ Methods

During a 6-month period, patients were recruited from a hospital accident and emergency department.¹⁶ Men and women were eligible for the initial study if they were aged 18 to 45 years, were experiencing their first episode of unilateral mechanical LBP for less than 3 weeks, and presented to the accident and emergency department because of this condition. Inclusion and exclusion criteria are provided in detail elsewhere.¹⁶ Thirty-nine patients were accepted into the study. All patients gave their consent and the Medical Ethical Review Committees of the University of Queensland and the Mater Adult Hospital, Brisbane, Australia approved the study.

Assessment Procedures. Assessments for the short-term phase of the trial were performed by two independent examiners, who were blinded to group allocation and patient presentation. The following assessments were conducted to establish baseline levels and to monitor improvement over time: pain (McGill Pain Questionnaire and Visual Analogue Scales), disability (Roland Morris Disability Index), range of motion (using inclinometers), habitual activity levels,² and muscle cross-sectional area (using ultrasound imaging).¹⁶ The aim of the long-term follow-ups was to determine the incidence of recurrence of LBP. To meet this aim, a telephone questionnaire was selected as the most appropriate assessment tool. Methodologic research has indicated that well-designed telephone interviews provide results comparable to face-to-face interviews⁶ and investigations of pain data obtained in this way also support the validity of telephone interviews.^{38,39} The questionnaires were administered by a research assistant who was not involved in the first stage of the study and who was blind to group allocation. The questionnaires used to determine the recurrence rate of LBP episodes during the 1-year and 3-year follow-up periods were devised especially for the patients in this study, as the information sought was specific to the design and methods implemented. The questionnaire consisted of three groups of questions, and took approximately 5 minutes to complete. Questions related to episodes of LBP experienced in the year after the study (1-year follow-up) and then in years two to three (3-year follow-up). A general opening question was used to determine whether patients had experienced any episodes of LBP in the time period in question. Subsequent questions determined the number of episodes experienced in that time frame, their length, severity, precipitating factors, and

treatment sought. Ideally, it would have been useful to reimage the patients' multifidus muscles. This was not possible because many of the patients had relocated interstate or overseas.

Intervention and Patient Management. Patients in Group 1 (control group) received medical management, including advice on bedrest, absence from work, prescription of medication, and advice to resume normal activity as tolerated, whereas those in Group 2 (specific exercise group) additionally performed specific localized exercises aimed at restoring the stabilizing protective function of the multifidus. The exercises were designed specifically to activate and train the isometric holding function of the multifidus muscle at the affected vertebral segment (in cocontraction with the transversus abdominis muscle). Contraction of the multifidus was confirmed by real-time ultrasound imaging. This rehabilitation approach is described in detail elsewhere.^{17,19,30,31} The intervention period was 4 weeks, and patients from the specific exercise group were seen twice per week in this period.

Statistical Analysis. Data analysis was performed using the SPSS statistics program. Comparability of baseline measurements between the two groups was assessed using a one-way analysis of variance (ANOVA) to examine differences in all baseline measurements. ANOVA also was used to examine differences between groups over time for all outcome measures used. For ultrasound imaging data, the percentage difference between the painful and nonpainful side was calculated for each vertebral level measured. Analysis of muscle recovery was conducted using the data from the most affected vertebral level (*i.e.*, the vertebral level with the largest percentage difference between sides). For the 1-year and 2–3-year follow-up analysis, the data were expressed as the likelihood of recurring LBP in the control group relative to that in the intervention group. A relative risk ratio of 1.00 indicates that patients in both groups were equally likely to report recurring LBP. A large risk ratio indicates that the treatment was effective, while a ratio less than one would indicate that the treatment increased the likelihood of recurrence. The significance of the treatment was determined with a χ^2 test. Because the three patients who were lost for 2–3-year follow-up were all from the control group, the analysis was repeated using the “best case” analysis, assuming that the three patients had all completely recovered, and did not suffer recurrences in this period.

■ Results

Study Sample

Patients were randomly allocated to Group 1 (control, $n = 19$) or Group 2 (specific exercise, $n = 20$). The demographics for the groups are shown in Table 1.

Baseline Characteristics

Comparability between groups was found to be satisfactory at baseline for age, height, weight, duration of symptoms, premorbid activity, and outcome measures used.¹⁶

Primary Outcomes for Weeks 1–4

Results of the short-term study have been presented in detail in an earlier report,¹⁶ but in summary, ultrasound imaging revealed that asymmetry of the multifidus muscle was present with diminished muscle size evident on

Table 1. Demographic Data for Groups 1 (Control) and 2 (Specific Exercise)

	Group 1 (Control) n = 19			Group 2 (Specific Exercise) n = 20		
	Mean	SD	Range	Mean	SD	Range
Age (years)	31	8	17–45	31	7	22–44
Gender	9 male, 10 female			7 male, 13 female		
Height (cm)	173	7	159–187	171	10	157–185
Weight (kg)	73	13	51–105	72	17	52–113
Duration of Symptoms (Days)	9	7	1–21	8	8	1–21
Smokers	7	—	—	4	—	—
Worker's Compensation	5	—	—	8	—	—
Pre-morbid Activity Levels						
Work	3	.8	1.8–4.1	3	.7	1.6–4.3
Sport	2.3	1	1.5–4.3	2.8	1	1.5–4.8
Leisure	2.5	.6	1–3.8	2.6	.5	1.5–3.8

the patient's nominated painful side in all cases. The difference between the sides at the most affected vertebral level was expressed as a percentage of the CSA for the unaffected side at that level. The mean of these percentages was $22\% \pm 8.7\%$ for the control group and $26\% \pm 8.7\%$ for the specific exercise group (range, 12–46%). Results at follow-up immediately after the intervention period and at a 10-week follow-up examination revealed that multifidus muscle recovery was not spontaneous on remission of painful symptoms in control group patients. In the control group, multifidus CSA at the most affected vertebral level remained $16.8\% \pm 9.3\%$ less at 4 weeks and $14\% \pm 6.3\%$ less at ten weeks. Muscle recovery was more rapid and more complete in patients in Group 2 who received specific and localized exercises ($P = 0.0001$). Multifidus CSA at the most affected vertebral level was only $0.7\% \pm 2.5\%$ less at 4 weeks and $0.2\% \pm 3.3\%$ less at ten weeks. The other outcome measurements of disability and physical function were similar for the two groups at the 4-week examination (pain and disability had completely resolved in 90% of the patients). Although they resumed normal levels of activity, patients in Group 1 still exhibited significantly decreased multifidus muscle size at the 10-week follow-up examination, and the difference between groups was still significant ($P = 0.0001$).

Long-Term Follow-Up

Study Sample The response rate to the questionnaire at 1 year was 100%, with all 39 patients interviewed. Three patients could not be contacted for the 3-year interview, despite records of work, residence, mobile phone, and stable relative contact. All three were from the control

group. For the 3-year follow-up interview, questions related to recurrence of symptoms in the previous 2 years.

Overall Recurrence Rate and Risk of Recurrences

Results of the contingency χ^2 analysis revealed that, in the year after the initial episode, patients in the control group were 12.4 times more likely to experience recurrences of LBP than patients in the specific exercise group ($\chi^2(1) = 12.41, P < 0.001$). Additionally, these patients were 9 times more likely to experience LBP recurrences in years 2–3 ($\chi^2(1) = 9.31, P < 0.01$). The risk of pain for each group is presented in Table 2, along with confidence intervals. In year 1, approximately 1 patient in the specific exercise group reported pain for every 3 patients who did not, whereas approximately 4 patients in the control group reported recurrences for every 1 that did not. In years 2–3, the likelihood of reporting recurrences of LBP in the exercise group increased slightly to around 2:5, while the likelihood of recurrences in the control group reduced to 10:3. A repeat analysis of the data using the best case analysis revealed that patients in the control group were still 5.9 times more likely to suffer recurrences of LBP than patients in the specific exercise group in years 2–3 ($\chi^2(1) = 5.92, P = 0.015$). Figure 1 shows the pattern of recurrence over time for each patient of the two groups. Figure 1(a) shows the control group patients' recurrence patterns and 1(b) shows the specific exercise group patients' recurrence patterns.

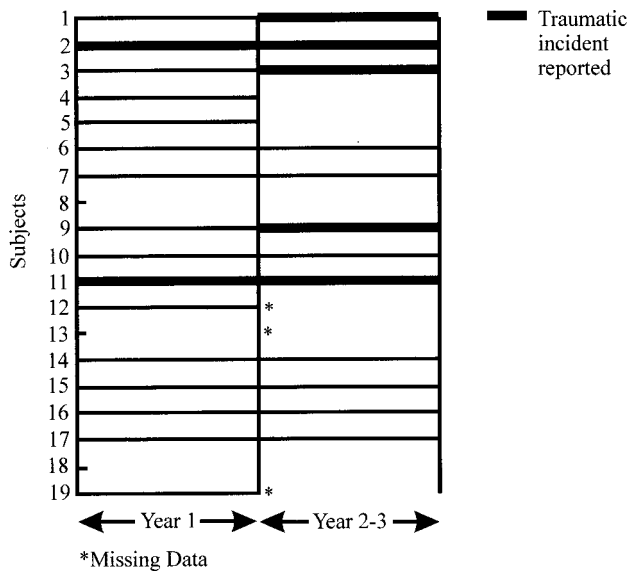
Number and Severity of Recurrent Episodes

For the first year, the mean number of episodes reported by those in the control group was 4.2 ± 3.4 compared with 2.8 ± 2 episodes on average for the specific exercise group. Recurrent episodes of LBP were rated as "as se-

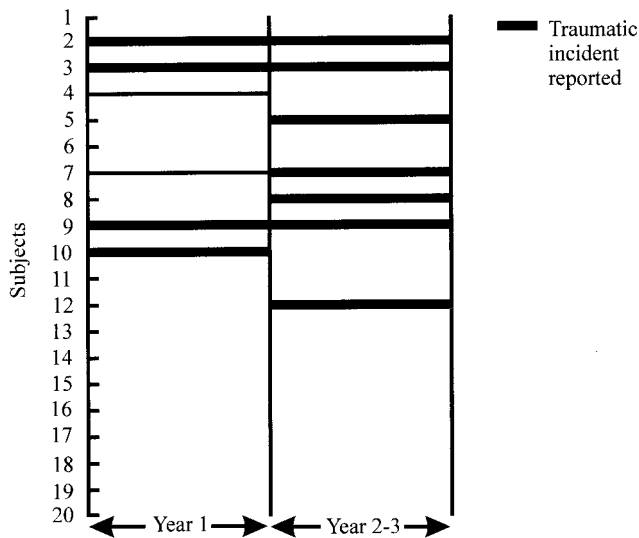
Table 2. Risk of Recurrent Episodes of LBP and Confidence Limits for Each Group in Year 1 and Years 2–3

	Year 1			Year 2–3		
	Risk	95% Confidence	Limits	Risk	95% Confidence	Limits
Exercise	.33	.16	.68	.37	.17	.81
Control*	4.12	1.43	11.88	3.35	1.33	8.44

* Less than 5 subjects in the control group reported no recurrences of LBP in both years.



A: Control Group



B: Specific Exercise Group

Figure 1. Pattern of LBP recurrence over time for each patient of the two groups. **A**, Control group. **B**, specific exercise group. 16 of 19 (84%) of the control group reported recurrences in the first year after the acute episode compared with 6 of 20 (30%) of the specific exercise group. In years 2–3, of the 16 patients from the control group who had experienced recurrences in the first year, 2 were lost to follow-up. 12 of 14 (86%) of the control group patients who experienced recurrences in the first year reported continuing recurrences. For years 2–3 there were recurrences reported in 12 of 16 (75%). For the specific exercise group, of the 6 who experienced recurrences in the first year, 4 continued to have recurrences during years 2 and 3. Three subjects who had not experienced recurrences in the first year reported acute injuries during years 2 through 3, with 7 of 20 reporting recurrences in years 2 through 3.

vere” as the original episode by 9 of 16 (56%) of the control group and 2 of 6 (33%) of the specific exercise group. For years 2–3, of those who experienced recurrences, 5 of 12 of the control and 4 of 7 of the specific

exercise group reported persistent low level LBP that was subsequently aggravated by activities such as lifting. The number of specific episodes reported by the remaining patients in the two groups were similar (control group, mean = 5 ± 3.8 episodes, specific exercise group, mean = 4.6 ± 6.7). Recurrent episodes of LBP were rated as “as severe” as the original episode by 2 of 12 (17%) of the control group and 1 of 7 (14.2%) of the specific exercise group.

Precipitating Factors

At 1 year, a traumatic incident initialed the recurrences in 3 of 16 (19%) of the control group. These included bending and lifting (2 patients) and a trampoline accident. In contrast, 4 of 6 (67%) of the specific exercise group could relate traumatic incidences to recurrences. These included carrying a patient and slipping, heavy lifting (2 patients), and an incident that involved pulling a heavy sail on a boat. For years 2–3, a traumatic incident was related to recurrences in the preceding 2 years by 5 of 12 (42%) of the control group, and all (7 of 7) of the patients from the specific exercise group who experienced recurrences. The three patients in the specific exercise group who only reported episodes in years 2–3 related them to high-trauma incidents including a motor vehicle accident, a work-related heavy lifting incident, and an injury in representative level football. Apart from these cases, patients of both groups most commonly reported precipitating incidents related to lifting.

Treatment Sought

In the first year, treatment was sought by 8 of 19 (42%) of the patients from the control group and 3 of 20 (15%) of the specific exercise group. In all cases, this treatment consisted of medical management (time off from work, advice, medications) and physiotherapy treatment. A variety of physiotherapy treatments were reported. However, the patients did not report that the treating physiotherapists had prescribed specific multifidus exercises. Contamination of the exercise outcome from the 1-year follow-up can therefore be considered minimal. For years 2–3, 4 of 16 (25%) of the control group sought treatment in the 2-year period in comparison with 4 of 20 (20%) of the specific exercise group. Control group patients accessed physiotherapy, medical management, and one had received an orthopedic consult, whereas patients from the specific exercise group received physiotherapy only.

Patients Lost to Follow-Up

The three patients who were lost to follow-up for years 2–3 reported quite different patterns of recurrence over the 1-year follow-up period. Patient 12, at 1 year, reported that recurrent episodes started within 2–4 weeks of the 10-week initial trial period. She had experienced several episodes. The aggravating factor was prolonged sitting (studying), after which she reported experiencing pain at night. She did not suffer any traumatic predisposing injuries to precipitate these recurrences, but reported

that they were milder than the original incident, for which she sought treatment. In contrast, patient 13 was one of the 16% from the control group who had not experienced any recurrences at the 1-year follow-up. After bending over to make a bed during the 1 year follow-up period, patient 19 experienced one 2-week episode of LBP as severe as the original incident, for which treatment was sought. This had resulted in time off work (2 days) but medications were not used.

■ Discussion

The results from the control group, who were managed medically and advised to resume normal activity, reflect the reported high recurrence rate of LBP that occurs after the initial episode.^{3,35-37} Their recurrence rate at 1 year (84%) is similar to the rates previously reported and furthermore, for 56% of these subjects, the recurrences were reported as being as severe and disabling as the original episode. In contrast, the group to whom specific exercise was given to the multifidus reported only 30% recurrence at 1 year and these were reported as being “as severe” in only 33% of cases. Results from the control group lead us to agree with the report of Von Korff and Saunders⁴⁰ in that the course of LBP for most primary care patients is recurrent rather than acute or chronic in the usual sense of these terms. Furthermore, as expressed by Von Korff and Saunders,⁴⁰ it is necessary to assess not only the short-term outcome of the index episode but also the long-term outcomes over a sufficient period of time. The positive natural history of acute LBP in the short-term, without provision of long-term follow-up, may have led to an underestimation of the importance of early intervention, which aims to prevent recurrences. Results from the control group highlight that the greatest number of recurrences (especially severe disabling ones) occur predominantly in the first year after the original episode.

Few detailed reports of long-term follow-up of acute LBP are available. The most detail for the year following the initial episode is provided by Bergquist-Ullman and Larsson.³ However, little information is available for longer-term outcomes. Von Korff and Saunders³⁹ report that LBP recurrence rates were similarly high at follow-up at 2 years. In this study, recurrence rates remained high for the control group for years two to three (75%), but episodes reported as equally severe as the original episode decreased from 56% to 17%. This investigation therefore demonstrated some moderation in LBP over time, and it has been previously reported that the risk of recurrence lessens 2 years after an acute episode.²⁴ As the highest rate of severe disabling recurrences occurred in the first year after the initial episode and one of the major costs of LBP is in association with those who have recurrent disabling episodes of LBP,¹² it would appear that intervention may have its maximal benefits in this period. However, long-term positive effects of the intervention used were demonstrated in this study (30% recurrence at 1 year to 35% recurrence rate for years two

to three). This long-term benefit was achieved with a short intervention period (4 weeks).

There is now biomechanical evidence to explain the role of the multifidus in stabilization of the lumbar segments.^{14,28,34,41} The rehabilitation approach aimed at retraining the multifidus for its functional role of protection and control of movements of the vertebral segments.^{14,28,34,41} It is now possible to hypothesize how this approach may be effective to account for the long-term differences between the control and specific exercise groups. Following an acute injury to the low back, a deficit in the multifidus may leave the injured segment susceptible to further injury. Specific exercise therapy may be required to restore normal muscle function, with the long-term sequelae of a deficient multifidus in control subjects being a susceptibility to further injury and recurrence of LBP.

Furthermore, the biomechanical model provided by Cholewicki and McGill⁴ may help to explain why recurrences occurred with seemingly little provocation, especially in the control group subjects. The model highlighted the importance of muscles that provide spinal segmental support, not only during high demand activities such as heavy lifting, but during low load activity requiring only low muscle forces. Deficient stabilization of lumbar segments caused by a deficient multifidus may explain LBP recurrence with minimal or no predisposing incidents.

This study provides one step forward in the knowledge concerning the long-term effects of conservative management for LBP patients. The results are promising in that they suggest that specific exercises help to reduce the high recurrence rate of LBP after the initial acute episode, and this pilot study may be used to determine a design model for further research. The limitations of this study include the small sample size and limited outcome measures (telephone questionnaire) for long-term follow-up. More evidence in a larger study population is required to further substantiate the findings of this study.

■ Conclusion

The results from this study showed that subjects with acute, first-episode LBP who received specific exercise therapy in addition to medical management and resumption of normal activity experienced fewer recurrences of LBP in the long-term than subjects who received only medical management and resumed normal activity. Biomechanical research may explain why it is important to focus on particular muscles for their stabilizing functions in rehabilitation.

Additional research on larger subject populations is required, and other factors will obviously be involved in low back pain recurrence. However, in terms of prevention of recurrences, this study might represent one step forward in the optimal management of the acute low back pain patient.

■ Key Points

- Following an initial episode of acute low back pain (LBP), the recurrence rate is high.
- This randomized clinical trial followed acute low back pain patients who undertook specific stabilization exercises and control subjects for 3 years.
- Results showed decreased recurrence of low back pain episodes in the specific exercise group compared with the control group.

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