Motor control exercise for persistent, nonspecific low back pain: a systematic review
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CRD summary
The review found motor control exercise significantly reduced pain at short, intermediate and long-term follow-up, and disability at long-term follow-up, compared with a minimal intervention, or when added to another intervention, in patients with persistent, non-specific lower back pain. The main conclusion appears to be reliable, although there was limited evidence for the minor conclusions.

Authors' objectives
To evaluate the effectiveness of motor control exercise for persistent non-specific low back pain.

Searching
MEDLINE (from 1950), CINAHL (from 1982), AMED (from 1985), EMBASE (from 1988) and PEDro were searched to June 2008 for publications in any language; search terms were reported. Bibliographies of each retrieved article and previous reviews were handsearched. Relevant published researchers were contacted in order to identify grey literature and articles in press, and citation tracking was performed using Web of Science.

Study selection
Randomised controlled trials (RCTs) or quasi-randomised controlled trials (quasi-RCTs) that compared motor control exercise (MCE) with a placebo treatment, no treatment, or another active treatment, or where motor control exercise was added as a supplement to other interventions, for non-specific lower back pain, were eligible for inclusion. The low back pain (with or without leg pain) had to be of at least six weeks duration (non-acute low back pain) or recurrent low back pain for trials to be eligible for inclusion. Participants could be of any age and either sex. If the motor control exercise was added as a supplement to other treatment, it had to represent at least 40% of the treatment programme in the opinion of the reviewers. To be eligible trials had to evaluate at least one of the following outcomes: pain, disability, quality of life, return to work, or recurrence.

Relevant interventions were considered to have evaluated motor control exercise if the exercise treatment was described as motor control, or specific spinal stabilisation, or core stability exercise, or where the protocol described exercise targeting specific trunk muscles in order to improve control and coordination of the spine and pelvis.

The interventions and their comparisons in the included trials were grouped into four types: motor control exercise versus minimal intervention (no intervention, general practitioner care, or education) or as a supplement to another treatment (general exercise or usual physical therapy); motor control exercise versus manual therapy (high or low-velocity thrust); motor control exercise versus other forms of exercise (pain management, general exercises, or the McKenzie approach); and motor control exercise versus surgery (lumbar fusion). Where given, motor control exercise intervention duration ranged from five weeks to 20 weeks, with three to 60 sessions lasting 30 to 90 minutes.

Included patients were from orthopaedic clinics or orthopaedic surgery departments, general or health care practitioners, physical therapy clinics or departments in hospitals, neurosurgery departments, outpatient rehabilitation departments, or recruited by advertisement. The age of patients ranged from 16 to 80 years, where given. Exclusion criteria for patients were also reported. Results were only reported for pain, disability and quality of life. Authors were contacted for further information when necessary.

Two independent researchers reviewed the articles for eligibility, with any disagreements resolved by a third reviewer.

Assessment of study quality
Methodological quality scores were extracted from the PEDro database, where quality was assessed by two trained reviewers independently, with any disagreements resolved by a third reviewer. The PEDro scale allotted a score of 0 to 11, where the criteria used included blinding, allocation concealment, and intention-to-treat analysis. Two authors assessed the quality of one trial and allocated the PEDro score.
Data extraction
Three independent reviewers extracted data using a standardised extraction form. Mean scores, standard deviations and sample sizes were extracted. Pain, disability and quality-of-life outcomes were converted to a common 0 to 100 scale. Authors were successfully contacted for missing data. Pain and disability outcomes were extracted for short-term (less than three months), intermediate (three to 12 months), and long-term follow-up (12 months and over).

Methods of synthesis
Trials were pooled according to the four treatment contrasts. Weighted mean differences (WMD), with 95% confidence intervals (CI), were calculated using a fixed-effect model when trials were sufficiently homogeneous ($I^2<50\%$), or a random-effects model when they were heterogeneous ($I^2>50\%$). Between trial heterogeneity was determined using the $I^2$ statistic.

A sensitivity analysis was performed excluding trials with quality scores lower than 5.

Results of the review
Fourteen trials were included (1,696 participants, range 30 to 204), including 13 RCTs and one non-randomised trial (n=78 participants). The mean PEDro score was 6 (range 2 to 8), with an intention-to-treat analysis for 36% of trials, allocation concealment in 58% of trials, and no blinding due to the nature of the interventions. Random-effects models were used for the analysis when there was significant heterogeneity.

**Motor control exercise versus minimal intervention** (seven RCTs): Motor control exercise significantly reduced pain compared to a minimal intervention at short-term (WMD -14.3 points, 95% CI -20.4 to -8.1; five RCTs), intermediate (WMD -13.6 points, 95% CI -22.4 to -4.1; 5 RCTs), and long-term follow-up (WMD -14.4 points, 95% CI -23.1 to -5.7; five RCTs). Motor control exercise significantly reduced disability compared to a minimal intervention at long-term follow-up (WMD -10.8 points, 95% CI -18.7 to -2.8; five RCTs), but had no significant effect after short-term (five RCTs) or intermediate term follow-up (five RCTs). Motor control exercise had no significant effect on quality of life (two RCTs) compared with a minimal intervention at the three follow-up periods.

**Motor control exercise versus spinal manipulative therapy** (four RCTs): When compared to manipulative therapy, there was no significant difference in effect on pain or disability at short-term (three RCTs), or long-term follow-up (four RCTs), and also no significant difference in effect on quality of life at long-term follow-up (two RCTs). However, at intermediate term, motor control exercise compared with manipulative therapy significantly improved pain (WMD -5.7 points, 95% CI -10.7 to -0.8; four RCTs), disability (WMD -4.0 points, 95% CI -7.6 to -0.4; four RCTs), and quality of life (WMD -6.0 points, 95% CI -11.2 to -0.8; two RCTs).

**Motor control exercise versus other forms of exercise** (five trials): There was no significant difference in effect on pain at short-term (four trials), intermediate term (three RCTs), or long-term (three trials) follow-up. There was also no significant difference in effect compared to other forms of exercise on disability at intermediate term (three RCTs) and long-term follow-up (three trials), but motor control exercise significantly reduced disability at short-term follow-up (WMD -5.1 points, 95% CI -8.7 to -1.4; four RCTs). Only one RCT provided results for quality of life, with no significant difference between treatment groups at short-term follow-up.

**Motor control exercise versus surgery:** One RCT found no significant difference between motor control exercise and surgery for short-term pain, disability or quality of life.

For the comparison with minimal intervention, there was significant heterogeneity for most analyses except for quality-of-life at intermediate and long-term follow-up. Two other pooled analyses showed significant heterogeneity; the comparison for other forms of exercise and pain at short-term follow-up and disability at long-term follow-up, neither of which gave a significant result.

The sensitivity analysis excluding low quality studies for motor control exercise versus minimal intervention found a slightly larger effect size for pain and disability.

**Authors' conclusions**
Motor control exercise was superior to minimal intervention and conferred benefit when added to another therapy for pain at all time points, and for disability at long-term follow-up, in patients with persistent, non-specific low back pain.
Motor control exercise was not more effective than manual therapy, other forms of exercise, or surgery. The optimal implementation of motor control exercise was unclear.

**CRD commentary**
The review addressed a well-defined question in terms of participants, interventions, study design and relevant outcomes. Relevant databases were searched in any language and unpublished studies were considered. Publication bias was not assessed, but was unlikely to be present. Efforts were made to reduce error and bias throughout the review process.

Trial quality was assessed using suitable criteria. Relevant trial details were reported, but no details of loss to follow-up were given. Statistical heterogeneity was assessed; there was evidence for heterogeneity with some outcomes. The statistical method used for the meta-analysis of the RCTs seemed appropriate. A sensitivity analysis was carried out which reinforced some conclusions.

The main conclusion appears to be reliable, although there was limited evidence for the minor conclusions.

**Implications of the review for practice and research**

**Practice:** The authors stated that there was no standard protocol for motor control exercise or the type of feedback used.

**Research:** The authors identified a need for a RCT using clinical and physiological measures to detect improvements in motor control that could be associated with improvements in pain and disability and the maintenance of these changes. Research was also needed to establish whether individuals with reduced motor control respond better to motor control exercise or whether other clinical features could be used to identify the patients who would respond best to this intervention. More research was also needed to confirm the result of the comparison between the effectiveness of motor control exercise and surgery. Future trials should investigate dosage parameters, effects in defined patient subgroups, and establish reliable and valid clinical assessment tools.

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