

Supplementation of general endurance exercise with stabilisation training versus general exercise only Physiological and functional outcomes of a randomised controlled trial of patients with recurrent low back pain

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Abstract

Background. Determination of the mode of action of new exercise techniques in different back pain populations is lacking. The effectiveness of supplementing an exercise programme with stabilisation exercises concerning physiological and functional parameters in non-specific back pain patients is unknown.

Methods. Randomised controlled trial, comparing a general trunk muscle endurance exercise approach enhanced with specific muscle stabilisation exercises (S&G group) with a general exercise approach only (G group). 55 patients with recurrent back pain were randomised in S&G group ($n = 29$) and G group ($n = 26$). Both groups received an 8-week exercise intervention and written advice. Paraspinal muscle strength and electromyographic fatigue of the erector spinae and multifidus were measured. Additionally, 3 functional speed tests were assessed. Outcomes were collected pre- and post-intervention.

Findings. No differences were detected for any of the paraspinal fatigue characteristics either within or between groups, apart from a significant decrease in normalised median frequency slope of the erector spinae for the G group. Paraspinal muscle strength and all functional tests have demonstrated significant within-group improvements for both groups, without any between-group differences.

Interpretation. An 8-week stabilisation exercise-enhanced approach presented equal benefits to a general endurance-based exercise programme for patients with recurrent non-specific back pain. A slightly steeper slope for the erector spinae in the G group was the only electromyographic fatigue alteration noted. Concomitant strength improvement probably reflects neural input changes rather than histochemical muscle changes. Physical exercise alone and not the exercise type was the key determinant for improvement in this patient group.

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1. Introduction

The low back pain (LBP) epidemic is responsible for a great number of reported disability days (Maniadakis and Gray, 2000). A better understanding regarding the extent of physiological and functional effects of more modern exercise techniques used in LBP rehabilitation,

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like stabilisation exercise training, is currently considered an important area of research (Chartered Society of Physiotherapy, 1999; American Physical Therapy Association, 2000).

Classic trunk exercises performed in physiotherapy, activate the abdominal and paraspinal muscles as a whole and at a relatively high contraction level (Arokoski et al., 1999). Although there are several randomised controlled trials on the usefulness of classic trunk exercises (Kellert et al., 1991; Hansen et al., 1993; Risch et al., 1993), recently, increasing attention has been paid to the preferential re-training of the local stabilising muscles of the spine (Hides et al., 1996; O'Sullivan et al., 1997; Hides et al., 2001; Danneels et al., 2001). Biomechanical models suggest that all the muscles with intervertebral attachments are better suited for intersegmental stability provision and are categorised under this group (multifidus, transversus abdominis, internal oblique), as opposed to the longer trunk muscles (erector spinae, rectus abdominis), which are dedicated to movement generation (Bergmark, 1989). Inadequate activation of the local stabilising trunk muscles may lead to instability of the lumbar spine (Panjabi, 1992) and some clinical research has demonstrated that re-training those muscles leads to a decrease in short and long term LBP symptoms in some special populations with apparent instability pre-disposition (Hides et al., 1996; O'Sullivan et al., 1997; Hides et al., 2001). What remains currently unknown is whether stabilisation exercises can be generally applied to any patient with LBP.

There seems to be a lack of knowledge concerning stabilising exercises evaluated with electromyographic (EMG) muscle fatigue. Muscle fatigue functional assessment with EMG, is an approach that presents the main advantages of overcoming the motivational problems of prolonged contractions that classic endurance assessment methods require, as well as the ability to concurrently monitor the fatigue patterns of different muscles during a sunergistic contraction (Roy and Oddsson, 1998). Endurance measurement is particularly relevant for the paraspinal muscles, which have an anti-gravity role (Mannion, 1999) and subsequently sufficient endurance of the low back musculature should offer the necessary stability to the spine over strenuous and prolonged physical tasks. The median frequency (MF) shift of the EMG power spectrum towards lower values is considered a valid descriptor of fatigue time-dependent muscle changes, representing mainly the decrease in motor unit conduction velocity associated with fatigue (Roy and Oddsson, 1998). Previous studies have demonstrated that the EMG fatigue assessment method is able to monitor significant improvements in fatigue characteristics (i.e. less steep MF slopes) following exercise (Kankaanpää et al., 1999; Roy et al., 1995), although alternative findings have also been reported (Mannion et al., 2001; Capodaglio et al., 1995).

Paraspinal muscle strength performance is a variable often included in trunk function assessment batteries (Newton and Waddell, 1993). According to some authors trunk strength itself is considered less important than motor control-related parameters for the treatment outcome of patients with LBP (Richardson et al., 1999a), as strength performance is influenced by both physiological muscle state (Rissanen et al., 1995; Sale, 1988) and psychological factors (Al-Obaidi et al., 2000; Lackner and Carosella, 1999).

In contrast, limitation in the performance of functional daily activities is currently considered as the principal outcome measure for back pain (Deyo et al., 1998; Simmonds et al., 1998), particularly for clinically-based assessments. As discrepancies between patients' self-reported disability and actual physical performance have been previously identified, assessing functional activities that are fundamental to day-to-day practice and that are compromised by LBP is deemed as more objective and direct (Simmonds et al., 1998).

The aim of this study was to investigate whether spinal stabilisation exercises are a useful supplement to general trunk exercises in patients with simple recurrent non-specific LBP. Our experimental hypothesis was that a general exercise programme combined with specific trunk muscle stabilisation exercise techniques would be more beneficial than a programme including only general exercise, for a range of physiological and functional outcomes.

2. Methods

2.1. Design

A randomised controlled trial (RCT) was performed with patients being allocated to one of two treatment groups: general exercise combined with specific trunk muscle stabilisation exercise techniques or general exercise only.

The research physiotherapist in charge of the study who performed the outcome assessments of participants and data analyses was blind to group allocation throughout. However, the clinical physiotherapist administering the exercise programmes could not be blinded. Patients were not aware of the theoretical underpinnings of each of the exercise regimes, as the study's objective was described to them as "to identify any differential effect between two exercise regimes for the trunk muscles, which have a role in protecting the spine from further injury".

2.2. Participants

Patients were recruited from the orthopaedic clinic of one local hospital and several General Practitioners'

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