A systematic review of systematic reviews on the effects of core training for a-specific chronic low back pain – with an attached protocol for training these patients.

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Preface

This thesis is the work of two ESP students, Anthony Brightwell and Nicolay Morland. It was completed in February 2010. The aim of this thesis was to make a systematic review to investigate the effects of core training on a-specific chronic low back pain and then to make an exercise protocol for our client.

We put a lot of time and effort into this thesis and we hope that you will enjoy reading it and find it useful.

Lastly, we would like to thank our coach Jan-Jaap Bakker for helping us through this process and our client Tommy Jessurun for his feedback along the way. Additionally a small thanks goes out to Alex Youngman for

Sincerely,

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Main part

A systematic review of systematic reviews on core training for a-specific chronic low back pain - with a connected protocol for core training for a-specific chronic low back pain

Abstract

**Background:** Lower back pain (LBP) is one of the most dominant complaints of the western society today with lifetime prevalence of 70% in industrialised countries. Amongst others, exercise is often used as a method of intervention with the main aim to reduce pain and improve functionality in patients with LBP. The idea behind exercise working on patients with LBP is that muscles around the lumbar region of the spine that make up the “core muscles” are trained in facilitation, co-ordination, endurance and strength. These muscles include abdominal, pelvic floor, diaphragm, and para-spinal muscles. If these muscles are trained correctly they can work together to correct the posture of the spine and lower the load and pressure placed on the spine. They can keep the vertebrae in position and create a state of stability. All of this in turn can have positive effect on pain and functionality in patients with LBP.

**Purpose:** Carry out a systematic review of systematic reviews to find the best exercise interventions for core training in patients with a-specific chronic LBP and make a protocol for the training of these patients.

**Data Sources:** Systematic reviews were found through searches in PubMed, PEDro, and Cochrane Library. Inclusion of the reviews was determined by reading titles and abstracts to see if they met our inclusion/exclusion criteria.

**Study Selection:** Evidence taken from systematic reviews on exercise interventions for a-specific chronic low back pain. Highly graded articles from the included reviews were retrieved and the appropriate exercises taken from them for use in the making of our core training protocol.

**Data Extraction:** The included reviews were rated as to the quality of their method so that we could determine that the grading of the articles they used was sufficient and that we can trust the results and conclusions they came up with. The rating scale was designed using the Method Guidelines for Systematic Reviews in the Cochrane Collaboration Back Review Group and created a point’s system check list to rate the reviews with.

**Main results:** Information was extracted from 7 systematic reviews (rated between 70 and 89 on a 100 point scale) The information was inconclusive on which exercises are the best, but we were able to come up with a training protocol.
Limitations: It was difficult to determine what exercise interventions are the best for training a-specific chronic LBP due to the heterogeneity and lack of sub-grouping of patients in this category.

Conclusions: Exercise is effective in reducing pain and improving function in patients with a-specific chronic LBP. When indication of clinical instability is present specific stability exercises are effective in reducing pain and disability in patients with a-specific chronic LBP, and if not indicated general core exercises are as effective in reducing pain and disability in patients and therefore the specific stability exercises have no extra benefit.

Introduction

This review and its connected protocol is the bachelor thesis by 2 physiotherapy students at the European School of Physiotherapy. The making of it took place during a 15 week period in 2009-2010. As per the schools directives, the bachelor project is labelled as a Professional Assignment and as such we needed to have a client. Our client was an Orthopaedic Manual Therapist that we both had an internship with. We took on us the assignment of making an evidenced based protocol for treating chronic low back pain with core training (described further down), to be used in his private practice. To achieve this we first would have to make this systematic review that you are now reading.

Our research question was: What are the most effective core training exercises for pain and disability in patients with a-specific chronic low back pain?

Low back pain (LBP) is one of the most dominant complaints in western society today. This paper attempts to focus on finding the best available evidence for core training exercises for a-specific LBP in an attempt to make a protocol for training these patients. There has been and still is a lot of research effort (van Tulder et al 2004, La Touche et al 2007, Hettinga et al 2007, Hauggaard & Persson 2007) into improving treatment and finding causes for these complaints.

Definition and classification

Van Tulder et al (2004) define low back pain as: pain and discomfort, localised below the costal margin and above the gluteal folds, with or without leg pain. This can further be divided into a-specific and specific LBP. A-specific LBP is defined as low back pain that cannot be explained by a specific pathology such as tumours, osteoporosis, fracture, inflammatory process, radicular syndrome, cauda equina syndrome, infection or ankylosing spondylitis.

LBP can be further subdivided, according to course, into specific types; Acute, sub-acute and chronic LBP. Acute LBP can be defined as an episode of LBP persisting for less than 6 weeks. Sub-acute LBP is LBP persisting between 6 and 12 weeks. The chronic type is defined as LBP of duration of 12 weeks or more. LBP can also be recurrent, and this is defined as “a new episode of LBP after a symptom-free period of 6 months, but not an exacerbation of chronic low back pain” by van Tulder et al (2004). Hettinga et al (2007)
defined acute low back pain as pain persisting for up to 6 weeks and anything more as chronic LBP, but in this review we stick to the definition from van Tulder et al (2004).

**Epidemiology**

The KNGF Guidelines for a-specific low back pain (2001) state that “the natural course of low back pain is usually favourable and in 80–90% of cases, patients’ complaints diminish spontaneously within 4–6 weeks.”

In today’s society there are a lot of patients with complaints in the spine or originating from the spine. The lifetime prevalence of low back pain is reported as over 70% in industrialised countries (one-year prevalence 15% to 45%, adult incidence 5% per year). Peak prevalence occurs between ages 35 and 55. (van Tulder et al 2004).

In the UK, the cost of direct health care of back pain in 1998 was estimated to be £1632 million, of which 37% relates to care provided by physiotherapists and allied specialists. However, the direct cost of back pain is insignificant compared to the cost of informal care and the production losses related to it, which total £10668 million (Gray & Maniadakis 1999). As physiotherapists, we need to be in the frontline for preventing complaints and treating these patients effectively.

**Pathogenesis**

A multitude of structures in and around the vertebral column can give rise to back complaints, such as muscles, tendons, ligaments, vertebral facets, or intervertebral discs. Consequently, there will also be a lot of different causes and our understanding of this is so far lacking. A lot of patients show tight and tender muscles, but we do not yet fully understand the reason for this or if it is a primary cause of, or an effect of other causes of pain.

The zygapophyseal (facet) joints, when the spine is in the correct position (anatomical position or lumbar neutral position), carry little vertical load. When the lumbar position goes into excessive lordosis, the load on these joints increase (Bogduk, 1997). Repetitive load of the inferior articular facets caused by an increase in lumbar flexion or extension can cause failure. In the case of the intervertebral disks, which consist of a nucleus pulposus surrounded by annulus fibrosis rings and endplates on the top and bottom of the disks, if there are compressive or shearing loads placed on the disk it can cause injury and damage. The damage initially occurs at the endplates and then affects the annulus pulposus, which can end in herniation of the disc if the damage is bad enough. This excessive load on the disk and facet joints can be caused by a lack of muscular control, which results in the inability for the disks and facet joints to provide sufficient passive stability and stiffness (Solomonow et al, 1998).

Burton et al (1996) found that torsions, whole-body vibrations, lifting, repetitive work and discomfort related to working situation is connected to an increased reporting of symptoms. A systematic review (Lings & Leboeuf 2000) concluded that there is a connection with whole-body vibrations and LBP, but no dose response relationship was found meaning that the cause and effect remains unclear. All of these factors show weak and varying relationship with LBP (SBU, 2000)
Patients with chronic LBP have altered may experience deconditioning of their back muscles and there is some evidence that there is weakening of the local muscles initially and then are substituted by global muscles resulting in altered patterns of muscle control between trunk synergists and impaired function. (O’Sullivan, 1997)

**Diagnostics**

Today, here in The Netherlands, patients have the ability to visit the physiotherapist without the requirement of a referral from their General Practitioner. This means that patients will not always go to their GP with their LBP complaints, where the GP can do diagnostics tests and refer the patient to the necessary discipline for the appropriate treatment. When a patient comes to the physiotherapist without a referral it becomes the job of the physiotherapist to carry out diagnostic tests. Although physiotherapists cannot make a medical diagnosis, they can create a “physiotherapy diagnosis” and if not completely sure refer the patient on in the appropriate direction. This could be to the GP in case of yellow and/or red flags, or to an orthopedic surgeon for example, both of whom can send the patient for radiographic imaging if necessary.

The European Guidelines on a-specific low back pain (van Tulder, 2004) recommend the following on diagnosing chronic low back pain:

A physical examination and case history should be carried out to exclude specific pathologies and pain caused by nerve root impairment, indicating whether the case is specific or a-specific. Yellow and red flags should also be tested for.

Although useful tests, The European Guidelines on a-specific lower back pain (van Tulder, 2004) cannot recommend the use of spinal palpatory tests, soft tissue tests and segmental range of motion or straight leg raising tests (Lasegue) in the diagnosis of a-specific CLBP. They do not say that the tests would not add any information; their reasoning behind not recommending these tests is due to the reliability of these tests when they were investigated in research articles.

In the case that the physiotherapist is not sure or is worried about the possible presence of yellow or red flags, the patient can be referred to GP. Radiographic imaging can be useful to identify any specific structural damage such as radicular syndromes, discitis or neoplasms but the guidelines do not recommend them unless a specific cause is suspected.

Special attention should be given to assessing factors that may have contributed to the problem at hand and can give more information as to what structures may be involved such as: re-occurrence, depression, work–related stress or overuse due to sustained poor postures and repetitive movements.
Treatment

A-specific chronic LBP is a syndrome where the underlying causes are hard to determine and therefore the treatment options are not very specific but quite general and can outcomes might differ per patient. The following is a summary of the concepts of treatments available.

There are three main ways that CLBP can be treated. These ways include conservative treatment methods, pharmacological treatment, and invasive treatment mainly as a result of the first two methods failure to have an effect. According to the European Guidelines on a-specific Lower Back Pain (van Tulder, 2004) the three main treatment areas are as follows:

Conservative treatments include hands-on therapy such as mobilization and manipulation techniques performed by a therapist, education interventions such as back schooling, and exercise therapy (supervised). Psychological treatment is also an option with psycho-social treatment and behavioural therapy often being used.

Pharmacological treatment (can also be considered conservative) is an option in treating CLBP. Short term pain relief can be achieved with the use of non-steroidal anti-inflammatory drugs (NSAIDs) or opioids. Muscle relaxants can also help relieve symptoms of pain.

Invasive treatment in the form of surgery is only recommended by the European Guidelines on a-specific Lower Back Pain (van Tulder, 2004) only after at least 2 years of conservative treatments have been tried. Examples of invasive treatment include: facet nerve block as pain treatment or epidural injections against the pain.

Core stability training

Core stability training is a term that has been referred to under many different names: Lumbar stabilization; Dynamic stabilization; Motor control (neuromuscular) training; Neutral spine control; Muscular fusion; Trunk stabilization. In essence, it is the training aimed at improving the muscular control around the lumbar spine to maintain functional stability. Its use has been spread to a variety of disorders and aims, such as low back pain, musculoskeletal injuries and to increase the performance of athletes. This review will stick to the general ideas of core training and emphasise only the parts to do with low back pain specifically.

The core has been described by Richardson et al (1999) to be a box with the abdominals in the front, paraspinals and gluteals in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom (figure 1) These muscles make up the active part of the 3-part system controlling the spine, which we will get back to later. They are of importance as without these muscles, we would be unable
to keep the spine stable not only in movements, but also in postures requiring much less than opposing the weight of the upper body (Crisco et al, 1992). Without muscles the load on other structures in the spine, such as the intervertebral disc and facet joints would be greater.

It is common to view these muscles as a muscular corset around the lumbar spine that works as unit to stabilize the spine and the body (Akuthota & Nadler, 2004). They work together via a system of co-contractions. Co-contractions (simultaneous contractions) can be either synergists helping agonists in performing movements, but also includes co-contracting antagonists to apply an opposing force in order to ensure stability.

The core is the centre of the functional kinetic chain that is the human body and core needs to be stable in order for humans to have sustainable healthy postures and to successfully move limbs and perform functional tasks. Konin et al (2003) describes the “serape effect”, where co-contractions of the core, via the thoracolumbar fascia, provides ample proprioceptive stimulus. This stimulus enables adjacent body parts to respond accordingly for optimal performance. An example of this is for instance overhead activities in athletes where the torque and counter torque of diagonally related muscles retains optimal stability throughout the movement. The core also needs to be stable to ensure optimal energy transfer from upper to lower limbs and vice versa. If the core is not stable and thus allows excessive movement and loss of control around the vertebrae, some energy will be lost with every little movement that is allowed in the kinetic chain (this also holds true for all joints in general). When the system works as it should, the result is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain (Fredricson & Moore, 2005).

Panjabi (1992) describes the effects of a dysfunctional spinal system in the following manner: “(1) Injury, degeneration and/or disease may decrease the (2) passive stability and/or (3) active stability. (4) The neural control unit attempts to remedy the stability loss by increasing the stabilizing function of the remaining spinal components: (5) passive and (6) active. This may lead to (7) accelerated degeneration, abnormal muscle loading, and muscle fatigue. If these changes cannot adequately compensate for the stability loss, a (8) chronic dysfunction or pain develop.”

Disease process as explained by Panjabi.
ANATOMY

The stability of the lumbar spine does not only rely on the muscles. It is a 3-part system that Panjabi (1992a) divided into:

- Neuromuscular control (neural elements)
  - Central nervous system and peripheral nervous system (coordination, proprioception, reflexes etc.)
- Passive subsystem (osseous and ligamentous elements)
  - Ligaments, facets, lamina, pars interarticularis, pedicles, intervertebral discs and vertebral body
- Active subsystem (muscular elements)
  - Muscle bellies and tendons

Spinal stability will be compromised if structures in one of these groups are disturbed. Instability can vary in amount and cause. Gross instability is a marked displacement of vertebrae that can be seen on radiographic imaging. This often also involves neurological deficit and deformity (Akuthota & Nadler, 2004). Functional instability on the other hand is defined by as a relative increase in the neutral zone. This neutral zone was described by Panjabi (1992b) as “the part of the range of physiological intervertebral motion, measured from the neutral position, within which the spinal motion is produced with a minimal internal resistance”. The neutral position is the positioning of the spine in which overall internal stresses in the spinal column and the muscular effort to hold the posture are minimal. We can achieve active stability by muscular co-contraction

Muscular anatomy

The coordination of all the muscles surrounding the lumbar spine are critically important for stability and movement in the lumbar spine. Recent research (Hides 1996, Hodges 1996, Richardson 1999) has advocated the importance of a few muscles (in particular, the transversus abdominis and multifidi), and reported that the multifidi have been found to atrophy in people with chronic LBP (Hides, 1996). However, it appears that both deep and superficial core muscles are needed for optimal stabilization and performance (Akuthota, & Nadler, 2004) To acquire this co-contraction, precise neural input and output are needed.

Another structure of great importance is the thoracolumbar fascia. The thoracolumbar fascia has in recent reviews been regarded as “nature’s back belt” (Akuthota & Nadler, 2004). The thoracolumbar fascia offers large attachments on its middle and posterior layers to the transversus abdominis (Bogduk, 1997). The deep lamina of the posterior layer attaches to the processus spinosi at the lumbar level. McGill (2002) sees the thoracolumbar fascia as serving
as part of a “hoop” around the trunk and according to Vleeming et al (1995) it provides a connection between the lower and upper limbs. The thoracolumbar fascia also has a neural factor in that it provides proprioceptive input of the position of the trunk when its muscular components contract.

There are two main types of muscle fibers; slow-twitch and fast-twitch. This, of course, also holds true for the core muscles. Their different types determine their functions. The Queensland research group (Richardson et al, 1999) has suggested the differentiation of local and global muscle groups to outline the postural segmental control function and general multisegmental stabilization function for these muscles groups, respectively (table 1).

<table>
<thead>
<tr>
<th>Local/Deep Muscles (postural, tonic, segmental stabilizers, aerobic)</th>
<th>Global/Superficial Muscles (dynamic, phasic, torque producing, anaerobic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifidi</td>
<td>Rectus abdominis</td>
</tr>
<tr>
<td>Psoas major</td>
<td>External oblique</td>
</tr>
<tr>
<td>Transversus abdominis</td>
<td>Internal oblique (anterior fibers)</td>
</tr>
<tr>
<td>Quadratus lumborum</td>
<td>Iliocostalis (thoracic portion)</td>
</tr>
<tr>
<td>Diaphragm</td>
<td></td>
</tr>
<tr>
<td>Internal oblique (posterior fibers)</td>
<td></td>
</tr>
<tr>
<td>Iliocostalis and longissimus (lumbar portions)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1: Key muscles of the core**

The local muscle system (the deep muscle layer) are primarily made up by slow-twitch fibers, although they do contain important fast-twitch fibres. One example of this is the multifidus where the deep fibres are slow-twitch and the superficial fibres are fast-twitch (McDonald 2006). These primarily aerobic muscles are short in length and are suited for controlling intersegmental motion and responding to changes in posture and extrinsic loads (Akuthota et al, 2008). The most important of these muscles can be seen in table 1. The fast-twitch fibers belong to the global muscle system (the superficial muscle layer, table 1). These muscles can also be referred to as prime movers, as they are long and possess large lever arms that permit the production of large amounts of torque and gross movements.

One of the most important parts of the core is the abdominals. Recent reviews and articles have directed their attention to the transversus abdominis for its stabilizing effects. The fibres of the transversus abdominis run horizontally (except for the most inferior fibers, which run parallel to the internal oblique muscle), creating a belt around the abdomen.

Abdominal “Hollowing in” of the abdomen promotes contraction of the transversus abdominis and internal oblique with minimal contraction of rectus abdominis (O’Sullivan, 1997, Strohl et al, 1981). The transversus abdominis and multifidi have been shown to contract 30 ms before movement of the
shoulder and 110 ms before movement of the leg in healthy people, and the theory is that they
do this to stabilize the lumbar spine (Hodges & Richardson, 1996, Hodges & Richardson,
1999). Patients with LBP on the other hand have delayed contraction of the transversus
abdominis and multifidi prior to limb movement (Hodges & Richardson, 1996). Another
factor contributing to spinal stability is the intra-abdominal pressure (McGill, 2002). Through
the thoracolumbar fascia, the internal oblique and the transversus abdominis may increase
this pressure by working together to tighten the “hoop” the thoracolumbar fascia creates.
Cholewicki et al (1999) claim that the abdominals (and multifidi) only need 5-10% of their
maximal volitional contraction to stiffen spinal segments. This would indicate these muscles’
suitability to perform this action for a longer period of time and could also be an indicator
that core exercises need not be felt as especially taxing on the patient as opposed for instance
regular strength training.

The hip musculature is of the utmost impo

The psoas muscle is mainly a hip flexor, but also functions as a weak flexor of the lumbar
spine (Bogduk, 1997). Although the function in the lumbar spine is small, it has potential to
exert extensive compressive forces on the intervertebral discs in the lumbar spine. Full sit-ups
and other activities that promote maximal psoas contraction can exert a compressive load on
the L5-S1 disc equal to 100 kg of weight (Bokduk, 1997). Tightness of the psoas muscle may
be an added cause of LBP by increasing compressive loads to the lumbar disks.

As mentioned before the pelvic floor can be seen as the floor of the core “box” with the
diaphragm working as the roof. Diaphragm contraction increases intra-abdominal pressure
and thus adds to spinal stability. The pelvic floor musculature has been shown to coactivate
with transversus abdominis contraction (Sapsford, 2000).

The osseoligmentous structures of the lumbar spine impart passive stiffness. Injuries to the
tissues of any of these structures may cause functional instability. At the posterior of the
spine, we find facet joints, lamina and pars interarticularis. These structures are slightly
flexible, but repetitive loading of the inferior articular facets with excessive lumbar flexion
and extension may lead to failure. The facet joints only ever carry significant load in a few
positions, such as excessive lumbar lordosis (Bogduk, 1997).

The intervertebral disc is made up by the annulus fibrosis, which contains the nucleus
pulposus, and at the top and bottom are the endplates. Compressive and shearing loads can
damage the discs. Initially the damage is done to the endplates, but through further loading
the annulus will also sustain damage, with the risk of posterior disc herniation. A lack of
muscular control may, through the theory of the 3-part system, increase the load on the disc.
This may turn into a viscous cycle where the muscles aren’t able to protect the disc and the
discs ability to provide stability is diminished and thus requires even more by way of
compensation from the muscles. The ligaments of the spine do not provide much stability in
the neutral position of the spine. Solomonow et al (1998) suggest that they might rather play a larger role in supplying the neural system with proprioceptive information about the lumbar spine.

**Methodology**

The aim of this search for evidence is to find the best exercise interventions for training patients with a-specific chronic low back pain. We aim to extract information that tells of the best exercise treatment options available. Information into how and why specific exercises work is also important to retrieve.

Appropriate information on therapies will be incorporated into the protocol of core training for patients with a-specific chronic low back pain.

**Search strategy**

In November 2009 we carried out a preliminary search on the internet, using databases of PubMed and Cochrane. The search results gave us a large number of randomized control trials (RCT’s) that it would have been too many to get through in the limited time available to complete our research. Observing that there were quite a few systematic reviews carried out that were relative to our topic we decided that our evidence would come from them. We would do a systematic review of the systematic reviews available, and then take information from the appropriate articles that they found and graded as high quality.

<table>
<thead>
<tr>
<th>A-specific</th>
<th>Multifidi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
<td>Non-specific</td>
</tr>
<tr>
<td>Co-ordination</td>
<td>Pain</td>
</tr>
<tr>
<td>Core muscles</td>
<td>Physiotherapy</td>
</tr>
<tr>
<td>Core training</td>
<td>Rectus abdominis</td>
</tr>
<tr>
<td>Endurance</td>
<td>Spine</td>
</tr>
<tr>
<td>Erector spinae</td>
<td>Stability</td>
</tr>
<tr>
<td>Exercise</td>
<td>Strength</td>
</tr>
<tr>
<td>Low back pain</td>
<td>Therapy</td>
</tr>
<tr>
<td>Lumbar</td>
<td>Transverse abdominis</td>
</tr>
</tbody>
</table>

Table 2: The search terms used for finding the systematic reviews.

During November and December 2009 we searched PubMed, PEDro and The Cochrane Library for systematic reviews related to our topic. Although EMBASE is also recommended
in the Updated Method Guidelines for Systematic Reviews in the Cochrane Collaboration Back Review Group (van Tulder et al, 2003), we were not able to obtain access to this source on our student access without extra funding. We retrieved the reviews using the access offered at three different institutions in the Netherlands: Hogeschool van Amsterdam (HvA), Vrije Universiteit (VU) and Leiden University (LU).

While searching the above-mentioned search engines the keywords in table 2 were used to get as many related reviews as possible. The results of the search can be seen in Flowchart 1. The keywords can also be combined together or broken down, and the use of “AND”, “OR”.

After searching the databases with the keywords mentioned above, appropriate reviews were retrieved based on their title and abstract and how they fit with the inclusion and exclusion criteria. The retrieved reviews were scanned through again and crosschecked with the inclusion and exclusion criteria.

**Inclusion criteria:**

- The reviews have to include at least 1 group that receive treatments that fall under our definition of core training.
- Must be a systematic review.
- All reviews must be in English.
- Reviews must show evidence of grading.
- The definition of CLBP must be the same as ours in duration (pain>12 weeks/3 months). If not the same, then it has to at least mention clearly the definition used by the articles so that we can use the information provided by the articles that do share our definition.

**Exclusion criteria:**

- Studies where the duration of the current episode of recurrent LBP was less than approximately 12 weeks or not stated.
- Reviews written in a language other than English
- Reviews published before 1999 were excluded due to sheer amount of research that needed to be gone through in limited time and because the reviews in the past decade should include relevant articles from before this cut-off point.
- RCTs were excluded because there are already systematic reviews done on this subject that summarizes the information well.
- Previous versions of reviews by the same author(s) were excluded.
- Reviews of systematic reviews were excluded.
Grading of strength of the evidence:

To grade the evidence found in the reviews, we applied a grading system that was recently used successfully in the European Guidelines for the Management of Acute Nonspecific Low Back Pain in Primary Care (van Tulder et al, 2004). A system of rating the levels of evidence grading of therapeutic and preventive interventions that has been proven appropriate in these kinds of reviews (van Tulder et al, 2003) was used. Bigos et al (1994) developed the rating system for the AHCPR Guidelines (1994) on which this is based on. This system can be seen in table 3.

Most of the reviews applied this system themselves to state the strength of their evidence. If they had not done so, we attempted to apply it to their results. To do this we applied the definition used by the individual reviews when given as to whether a trial was of high or low quality. If only a grade was given, but not whether it is high or low quality we looked up the source of the grading system used and found their definition. PEDro score of 6 or higher was considered high quality.

Table 3: System of grading strength of evidence.

Rating of quality of reviews

Systematic reviews are generally regarded as the best evidence after meta-analysis in judging the efficacy of an intervention (Moore & Jull 2006). Systematic reviews are, as opposed to the trials that they judge and include, not commonly graded. Although sites like PEDro will list the grades of the articles they have in their database you will never find the grade of a review. This does pose a problem with regards to how sure you can be on the results of the review. A well-made review will be trustworthy, but how can we know if that is indeed the case? Since we, due to time constraints of this project, have been forced to rely directly on the abundance of reviews available, instead of in the generally accepted way of judging RCTs, we have also been forced to take the above into account and decided to rate the reviews we included. Rating of the reviews would enable us to relate the evidence they collected with how good we perceive their method of grading to be and thus how much we can trust their conclusions.

We were not able to find a method of rating systematic reviews, partly due to the time limitation on this project. We have since learned that for instance the Oxman & Guyatt index (1991) is a possibility to use for this purpose, but could not change our methods half way through. Instead, we have chosen to create a rating system based on the Method Guidelines for Systematic Reviews in the Cochrane Collaboration Back Review Group as these are among the
highest quality in this field. The rating system was designed as a checklist based on the important points noted there, but also with the possibility of scoring higher or lower on the individual items. Also, as the purpose of this review is to come up with a protocol for core training and not specifically grade reviews, some points were added as to how relevant the reviews were to our objective. In doing this, we attempted to create a matrix system in which to choose the most valid and relevant information. The rating form used can be found in appendix 2.

In accordance with The Editorial Board of the Cochrane Collaboration Back Review Group (van Tulder et al 2003), which recommend a pilot test of the methodological quality assessment, we performed a pilot study on the inter reliability of the rating form. We did this on an excluded systematic review relevant to our topic. After making a few adjustments, we retested it on yet another systematic review.

After being satisfied with the rating form, the 2 reviewers independently rated all the reviews. The scores achieved were averaged. If the difference between the 2 scores were more than 5 points, a consensus approach would be used. This difference did not occur in any of the results. The reviewers were not blinded to the author and journal as this was impossible due to the fact that they also retrieved them.

A full meta-analysis was not done due to heterogeneity of the studies.

Results

Reviews:

Below there is a flowchart (Flowchart 1) showing the search results for retrieving the systematic reviews. Reasons for exclusion of systematic reviews that made it the furthest in the inclusion process are included in the appendix. The remainder will be given upon request. After that there are the results of the reviews and the general findings and conclusions that the reviews found. The results have been summarized in text and general conclusions have been made and relative points discussed. The general characteristics of each review can be seen in table 5

Hauggaard & Persson (2007)

Hauggaard & Persson (2007) focus their review on specific spinal stabilization exercises that must include co contraction of multifidus muscles and transversus abdominis muscles. In this highly rated review (89) they look into the effects of these exercises for acute, recurrent and chronic LBP. Out of the 7 trials that included chronic low back pain, 5 were high quality. They conclude that there is moderate evidence suggesting improved disability level, reduced pain level and increased multifidus cross sectional area and limited evidence for improved quality of life. It is however interesting to note that their highest rated study (Koumantakis et al, 2005 (10/11 on a modified Cochrane Method Guidelines criteria list, in which they only added an extra question) report that there is no additional benefit to a stabilization enhanced exercise over a general exercise programme after 2/week x 8 weeks of intervention and a 3 month follow-up for patients with chronic low back pain that have no clinical signs suggesting presence of spinal instability.
**Ferreira et al (2006)**

Of the 13 trials included in the review by Ferreira et al (2006), 8 was considered as dealing with chronic low back pain. 4 were scored as high quality and 4 were scored as low quality on the PEDro scale. Two of the articles (Cairns et al 2006 & Rasmussen-Barr et al 2003) dealt with a definition of recurrent LBP and a definition of CLBP as pain for more than 6 weeks respectively and could not be used for our results. Both of these articles were rated as low quality.

**Flowchart 1: Retrieval and exclusion process of the systematic reviews**

The reviewers attempted to pool the results of several of their trials. Two trials (Goldby et al 2000 & O’Sullivan et al 1997) were used for an analysis concluding: “The pooled analysis indicated that specific stabilisation exercise was substantially more effective than usual care for reducing pain in the short term (effect = –21, CI –32 to –9) and medium term (effect = –24, CI –38 to –11). Specific stabilisation exercise was not more effective than usual care for reducing disability in the short term (effect = –5, CI –12 to 1) but was more effective in the medium term (effect = –9, CI –16 to –2)”. A 95% confidence interval was used. Usual care in this case was education or treatment by a general medical practitioner (GP). Although the
results show a considerable effect favouring exercise, it should be noted that the treatment given by the GP was described as “by the GP’s discretion”. The reviewers did not grade this piece of evidence, but we conclude that there is moderate evidence to support their statement based on 1 high quality and 1 low quality trial.

They also found some evidence that specific stabilization exercises (SSE) compared to spinal manipulative therapy (SMT) showed similar reductions in pain and disability; that SSE with SMT and education compared to either medical management or education proved beneficial on pain and disability in the short and long term; that SSE in addition to conventional physiotherapy produced similar effects as conventional physiotherapy only on pain and disability. They did not specify a level of evidence for this and largely because of excluding the two aforementioned trials, we conclude that this evidence is of limited quality.

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bell &amp; Burnett (2009)</td>
<td>Exercise for the primary, secondary and tertiary prevention of low back pain in the workplace: A systematic review</td>
<td>87</td>
</tr>
<tr>
<td>La Touche et al (2007)</td>
<td>Treating non-specific chronic low back pain through the Pilates method</td>
<td>78</td>
</tr>
<tr>
<td>Ferreira et al (2006)</td>
<td>Specific stabilisation exercise for spinal and pelvic pain: A systematic review</td>
<td>72</td>
</tr>
</tbody>
</table>

Table 4: Table of the rating received for each review (out of maximum 100)

**Hubley-Kozey C et al (2003)**

As opposed to most of the other reviews, Hubley-Kozey et al’s review (2003) focused their attention on strictly physiological responses in addition to pain and functionality rather than a decrease of symptoms or increase in abilities alone. They claim the physiological and structural processes in a specific LBP are not well known and attempt to explore the effects with regards to musculoskeletal and neuromuscular responses to the exercises in order to more specifically treat this patient group. They found that there is “moderate evidence for specific exercises increasing abdominal and trunk extensor strength, while minimal evidence supports improvements in neuromuscular control characteristics, posture, spinal motion, or muscle characteristics”. In conclusion, they find that the exercises reduced pain and improved function, but it is unclear why they work. The theoretical frameworks employed need more systematic research behind it to determine the claimed effects other than pain.
<table>
<thead>
<tr>
<th>Author</th>
<th>Number of articles</th>
<th>Exercise focus</th>
<th>Comparison (s)</th>
<th>Duration of intervention (min-max)</th>
<th>Outcome measures</th>
<th>Conclusion (s)</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hauggaard &amp; Persson (2007)</td>
<td>7</td>
<td>SSS with co-contraction of Multifidus &amp; Transverse Abdominis</td>
<td>Education booklet, control, McKenzie, conventional physiotherapy.</td>
<td>8-12 weeks</td>
<td>Pain, functional ability, generic tests</td>
<td>Moderate evidence: ↓ disability and pain. Multifidus cross section.</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Limited evidence: improved quality of life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bell &amp; Burnett (2009)</td>
<td>9</td>
<td>Exercise programs conducted in the work place with various combinations of the below: light resistance, strength, balance, stretching, lumbar neutral zone exercises, back extensions, cardiovascular, coordination exercises, calisthenics,</td>
<td>Control, usual physiotherapy care, low intensity back strength, stress management program</td>
<td>8 weeks-10months</td>
<td>LBP incidence, intensity, and impact of LBP and disability</td>
<td>Strong evidence: that exercise is effective in reducing the severity of LBP and activity interference caused by LBP. However limited evidence due to conflicting evidence from high quality articles, and low quality articles for exercise reducing LBP in the workplace.</td>
<td>87</td>
</tr>
<tr>
<td>Rackwitz et al (2006)</td>
<td>2</td>
<td>Segmental stabilizing exercises + warmth + massage Segmental stabilizing exercises + manipulation + GP</td>
<td>Segmental stabilizing exercises + warmth + massage + dynamic (static) strengthening training GP</td>
<td>4weeks -10weeks</td>
<td>Cross-sectional area: multifidus + paravertebral muscles</td>
<td>Moderate evidence: that segmental stabilizing exercises are better than GP treatment for chronic LBP Limited evidence: that segmental stabilizing exercises + dynamic (+ static) strengthening exercises has a larger increase of the cross-sectional area of the muscles compared to segmental stabilizing exercises + massage + warmth</td>
<td>82</td>
</tr>
<tr>
<td>La Touche et al (2007)</td>
<td>2</td>
<td>Pilates on mat</td>
<td>Back school method, continuous health care (without specific intervention)</td>
<td>10days -6weeks</td>
<td>Pain, function,</td>
<td>Moderate evidence: that Pilates method improved functionality and reduces pain in chronic LBP.</td>
<td>78</td>
</tr>
<tr>
<td>Study</td>
<td>N</td>
<td>Intervention</td>
<td>Comparison</td>
<td>Duration</td>
<td>Outcome</td>
<td>Evidence Level</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>May &amp; Johnson (2008)</strong></td>
<td>4</td>
<td>Stabilization exercises, stabilization class + back schooling, stabilization exercises + manual therapy + advice</td>
<td>General exercises, control, manual therapy + back schooling, one education class + back schooling, exercise + manual therapy + advice</td>
<td>8 weeks - 12 months</td>
<td>Pain, function</td>
<td>Strong evidence: stabilization exercises are comparable to general exercises in reducing pain and improving function for patients with Chronic a-specific LBP.</td>
<td></td>
</tr>
<tr>
<td><strong>Ferreira et al (2006)</strong></td>
<td>6</td>
<td>SSE ± manipulation, education</td>
<td>Manipulation, education, surgery + physiotherapy, heat+massage+swimming+walking, medical treatment</td>
<td>3-12 weeks</td>
<td>Pain, disability, quality of life</td>
<td>Moderate evidence SSE ↓ pain and disability when compared to usual care</td>
<td></td>
</tr>
<tr>
<td><strong>Hubley-Kozey et al (2003)</strong></td>
<td>11</td>
<td>Trunk extension strength, abdominal strengthening, flexibility training, dynamic stability training.</td>
<td>Control, home exercise, TENS, SWD, spinal manipulation, stretching, NSAIDs, aerobic exercise + muscle reconditioning, hip and trunk extension dynamic exercises.</td>
<td>15 days – 1 year.</td>
<td>Strength, endurance, neuromuscular control, flexibility, posture</td>
<td>Moderate evidence: trunk extensor and abdominal exercise ↑ abdominal and trunk extensor strength and endurance. Minimal evidence: improvement in neuromuscular control, posture, spinal motion or muscle tissue characteristics.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: The table tries to list the general characteristics of the included reviews. Only the characteristics relevant to this review have been listed while other characteristics pertaining to for instance acute low back pain, that some of the other reviews included, are not shown.

SSS= Specific spinal stabilization exercises. SSE=Specific Stabilization Exercises TENS=Transcutaneous Electrical Nerve Stimulation. SWD=Short Wave Diathermy.
Bell J & Burnett A (2009)

From the 15 articles included in this review, 4 were graded as high quality with the rest being low quality. Of the high quality articles 2 showed that exercise reduces intensity and inactivity of lower back pain. Conflicting evidence between the 4 high quality articles as to exercise performed in the workplace limits the evidence that LBP in the workplace can be dealt with by exercise. A large limiting factor in the information given in this review is the variation in exercises performed across the articles as well as the comparisons present in the various articles. There is also a large difference in the populations that the different exercises were performed on.

May & Johnson (2008)

May & Johnson included a large number of articles dealing with stabilization exercises in their review, however some of the articles dealt with acute LBP, although those results were already separated, and some articles dealt with specific LBP rather than a-specific LBP. These were not separated and were amongst the results for Chronic LBP, which also included some articles with sub-acute patients. After filtering out all the articles that were not relevant 4 articles (Koumantakis et al, 2005, Shaughnessey and Culfield, 2004, Goldby et al, 2006, Cairns et al, 2006) were left that were chronic and a-specific. The results that were presented in this review were such that the conclusions from the relevant articles could easily be separated and taken. Of the 4 relevant articles 2 of them were graded as high quality (Koumantakis et al, 2005, Cairns et al, 2006) both with 7/10. These two articles concluded that stabilization exercises are comparable to general exercises for reducing pain and improving function in patients with chronic a-specific LBP. Although Koumantakis et al (2005) ruled out all patients with signs of clinical instabilities and Cairns et al (2006) did not make an effort to subcategorize.

The other 2 relevant articles (Shaughnessey and Culfield, 2004, Goldby et al, 2006) were graded as low quality articles with grades of 5/10 and 4/10 respectively. These articles compared stabilizing exercises to other forms of treatment that were not a form of exercise and therefore are not discussed as they are not relevant.

La Touche et al (2007)

This review was looking at Pilates method of exercise and its effects on functionality and pain in CLBP. They included 3 articles in their review but the results from one of the articles (Rydeard et al, 2006) was not considered for our review as they had included patients with sub-acute LBP. The other 2 included articles (Gladwell et al, 2006 and Donzelli et al, 2006) both showed that the Pilates method improves functionality and reduces pain in patients with CLBP. We only consider this to be of moderate evidence due to the fact that this review graded both of these articles with two grading scales (PEDro scale and Jadad scale) and one of the articles (Donzelli et al, 2006) was graded as low quality on both scales (3/10 and 1/5). The other included article (Gladwell et al, 2006) was graded as high quality on both scales (6/10 and 4/5).

This review looked at the effects of segmental stabilizing exercises on low back pain. They included 7 RCT’s in their review however they considered acute, sub-acute and chronic stages of low back pain and so only 2 RCT’s that were truly chronic LBP trials (Daneels et al, 2001 and Niemisto et al, 2003) were included in our conclusions. Of the 2 considered trials, one was low quality (Daneels et al, 2001) and the other was high quality (Niemisto et al, 2003). Both of these trials used segmental stabilizing exercises, but had 2 different focuses. One trial (Daneels et al, 2001) showed limited evidence that segmental stabilizing exercises in combination with dynamic strengthening exercises (with or without static hold) had a greater increase in the cross sectional area of muscles (multifidus and paravertebral) compared to segmental stabilizing exercises with warmth and massage. The high quality Niemisto et al (2003) trial showed moderate evidence that segmental stabilizing exercises is better than GP treatment for reducing pain and increasing functionality of chronic LBP.

Randomized controlled trials:

Below are the results of the RCT articles. These results show what exercises they recommend for training the core and why. Flowchart 2 shows the selection process for the RCTs included.

Koumantakis et al (2005) strayed slightly from our definition of patient category. They used recurrent LBP, but that can still be considered as chronic if it recurred within 6 months of the last episode of LBP. Consequently, some participants where still described as sub-acute. The mean duration of LBP in both groups was 12 weeks and the majority of patients had LBP for more than 12 weeks. They targeted a patient group without signs of clinical instability.

The exercise intervention was for the stabilization
enhanced exercise group at first a re-learning of the contraction of the transverse abdominis and multifidus muscle. Participants had to master 10 x 10 second isometric holds in various ways before progressing to lightly loaded situations and ultimately to heavy loaded situations. These isometric holds would be included progressively in ADLs when able. Patients trained twice a week with the physiotherapist and performed exercises at home for a maximum of 30 minutes 3 times a week. The control group performed a general core training programme targeted at the abdominal and extensor muscle groups.

Both interventions had a positive influence on all outcome measures, with the comparison group improving more in self-reported disability immediately after intervention, but not at the 3-month follow up. There is contradictory evidence for core training working on pain and disability in sub-acute LBP patients, with this being one that supports it. Other trials (Suni et al, 2006) say exercise in this period lowers rate of recurrence only. Although this review is aimed at chronic LBP patients specifically, we believe that we can still include this trial because the fact that the sub-acute patients where involved will not have jeopardised the positive results in any way other than potentially reduce the average results for pain and disability of this intervention for chronic LBP patients included in this trial.

<table>
<thead>
<tr>
<th>Author</th>
<th>N. Pat.</th>
<th>Exercise focus</th>
<th>Comparison (s)</th>
<th>Duration of intervention</th>
<th>Outcome measures</th>
<th>Conclusion (s)</th>
<th>Included in review (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koumantakis et al (2005)</td>
<td>57</td>
<td>Stabilization enhanced</td>
<td>Paraspinal/Abdominal exercises</td>
<td>8 weeks</td>
<td>Pain, disability, cognitive status</td>
<td>Both intervention improved all outcomes: Stabilization exercises add no additional benefit over the comparison for LBP without instability.</td>
<td>1,2,3</td>
</tr>
<tr>
<td>O’Sullivan et al (1997)</td>
<td>42</td>
<td>SSE</td>
<td>GP treatment (general exercise for all but 1+some additional interventions)</td>
<td>10 weeks</td>
<td>Pain, disability</td>
<td>SSE is effective in reducing pain and functional disability.</td>
<td>1,2,3,4</td>
</tr>
</tbody>
</table>


O’Sullivan et al (1997) was included as a high quality trial in 4 of the included reviews (table 6). It targeted a very specific population; chronic LBP patients with radiographic spondylolisthesis or spondylosis grade 2 or less (out of 5). When it is grade 2 or less it can be argued to still be an a-specific cause of LBP. However, out of the 42 participants, only 5 participants had a grade 2 slip, with 20 participants suffering grade 1 slip and 18 participants having a grade 0 slip (this adds up to 43, possibly indicating that 1 person had 2 slipped vertebrae). The spondylolisthesis or spondylosis was most common at L5-S1 with a total of 35 defects, with L4-L5 numbering 7 defects.
The exercise intervention was very similar in build-up as the stabilization enhanced exercise done in the Koumantakis et al (2005) trial, because O’Sullivan et al’s (1997) exercises served as a basis to build on for the trial of Koumantakis et al (2005). It also starts with the same teaching of co-contraction of the deep abdominals and multifidus (10 x 10 second holds) before progressing them into harder and harder tasks while maintaining the co-contraction. They performed home exercises daily with duration of 10-15 minutes.

The control group used was the recommendations of their treating general practitioner. All but one of the participants in the control group various forms of general exercise as treatment, while some also received additional pain-relieving methods such as heat, massage and ultrasound. The general exercises was a loosely set as gym work, swimming, walking, but eight participants also received supervised exercise programmes.

The intervention group had a significant improvement on pain and disability at end of trial, whereas the control group did not. The intervention group retained the effects at 3- and 6-month follow up, but increased slightly at 30-month follow up.

Discussion

In the review by Hauggaard & Persson (2007), they concluded that specific spinal stabilisation exercises that focus on co-contraction of the multifidi and transverse abdominis muscles are effective for chronic low back pain. However, it is interesting to note that their highest rated study (Koumantakis et al, 2005) report that there is no additional benefit to a stabilization enhanced exercise over a general exercise programme after 2/week x 8 weeks of intervention and a 3 month follow-up for patients with chronic low back pain that have no clinical signs suggesting presence of spinal instability. In the light of this information, we may start to think more deeply on the possible importance of sub-categorizing a-specific CLBP. This fits also with the requests made by Hubley-Kozey et al (2003) to improve the diagnostics of a-specific CLBP. A recent article by Donelson (2008) claims to have found a large sub-group of LBP using “a paradigm called Mechanical Diagnosis and Therapy (a.k.a. McKenzie methods)” that can identify this sub-group and then carry out a treatment regime to rapidly reverse the LBP, both acute and chronic. The line of thinking of sub-categorizing LBP could be interesting to pursue in further research.

In all the included reviews various grading scales were used to grade the quality of the articles they included. Some of the reviews used the same, recommended scales. Hettinga et al (2007) judged the same Koumantakis et al (2005) article as Hauggaard & Persson (2007) with the same van Tulder scale (except for the extra point that Hauggaard & Persson included in their review). There was a difference of 2 points using the same grading system which draws into question the inter reliability of the grading tools.
One major factor that could affect the reliability of our results is the lack of sub-grouping of the patient category “a-specific chronic low back pain”. Each review had different criteria for patient inclusion and, with the lack of being able to sub-categorize the pathology, the varied populations between the reviews could also influence what exercises each review has recommended. With the reviews not being able to give reasons as to why specific interventions worked more than others, the specifications of the population groups involved could play a large part in the outcomes that are present. Bell and Burnett (2009) looked at the effects of exercise on pain and functionality with LBP patients in the work place. Limiting themselves to this particular population effects the implications of their results and also stops us from being able to directly compare their results to another review or study with a different population group, even with the same pathology. Making the target population as specific as possible is only really useful if it were specifically in the same direction that we are interested in, such as if we were investigating LBP interventions for patients in the work place. In our case it would be more useful to narrow down and make the physiological cause for this pathology more specific as a large diversity of patients come in to the clinic with LBP.

These reviews and other guidelines (van Tulder, 2004) agree that exercises do work, but they are not always sure why. This could be why it is so hard to find out which exercises are best and further enhance the need for sub-grouping.

The results of the systematic reviews in general come up with the following strength of evidence:

- There is strong evidence that exercise helps on pain and disability in patients with a-specific chronic LBP.
- There is strong evidence that stabilization exercises are comparable to general exercises in reducing pain and improving function for patients with a-specific chronic LBP.
- There is moderate evidence that abdominal and spinal erector strengthening exercises are effective in improving core strength and endurance.

The RCTs from Koumantakis et al (2005) and O’Sullivan et al (1997) have been graded as high quality in all of the reviews they were included in (3 and 4 respectively). We applaud their efforts in specifying their patient group and their description of training programmes. Their major lack in both cases is their relatively small group size. Recent reviews have advocated group sizes of at least 40 participants.

An additional problem is the control group used in the O’Sullivan et al (1997) trial. They used a very loose term for general exercise and it was not well controlled. As such we cannot conclude very specifically, other than that the stabilization exercise has a positive short and long term effect on pain and disability on these patients.
Limitations to our study

The decision to go with 3 databases only (PubMed, PEDro, Cochrane Library) were based on a few key aspects: The limited time available for this project demands that certain choices be made on where to focus you attention. None the less, these databases are highly regarded, up to date and relevant to our study. The fact that we were limited to certain institutional access (HvA, VU, LU) also took away the possibility of using Embase and Cinahl for our searches. The most important reason however is that the searches of those 3 databases provided us with substantial results on their own, in the form of 150 reviews (after duplicates were removed) and a total of 7 systematic reviews included.

Another point that may be a weakness in our review is that systematic reviews might not contain all the newest research due to being published afterwards, but there will always be a certain lockout point. Some interesting RCTs could also have been missed as they might not have fit in to other systematic reviews’ criteria. One can also argue that when one starts to combine information from different reviews one steps away from the true evidence. We have instead tried listing only the conclusions given, discussed them and attempted to theorize on how they may or may not fit together.

In creating our own rating scale for the reviews, we have also put ourselves in the position where the validity, reliability and potential bias may be drawn into question. There is a possibility of bias towards reviews that have followed the Cochrane Guidelines to make their review, but at the same time these guidelines have been developed to get the highest quality reviews possible when concerned with LBP. We did perform a pilot study to assess the inter reliability of our rating scale, which we found to be adequate, but still put in measures in case of disagreements. The third point is the validity of our scale. We have intentionally tried to tailor it towards our specific objective and as such should not be mistaken to be more than a tool to assist in selecting articles from the large amount available.

Time played a large role in the way our research turned out. With the requirement that the research be completed within 15 weeks after acceptance of our topic, there were a few choices that were made due to time constraints and if more time was available the choice might have been different. One example is the choice to review systematic reviews rather than RCT’s as there were too many RCT’s related to our topic that we would not have been able to get through them all in time. Other decision that was made based on time include only using 3 search engines and also exclusion of reviews that did not show the grades they gave to the articles in their review where had we more time we could have contacted the authors and requested the grading results.
Conclusion
Exercise is effective in reducing pain and improving function in patients with a-specific chronic LBP.

Core training exercises are effective in reducing pain and disability as well as improving quality of life in patients with a-specific chronic LBP.

Abdominal and spinal erector strengthening exercises are effective in improving core strength and endurance.

When indication of clinical instability is present specific stability exercises are effective in reducing pain and disability in patients with a-specific chronic LBP, and if not indicated general core exercises are as effective in reducing pain and disability in patients and therefore the specific stability exercises have no extra benefit.

Suggestions for further research
Sub-categorizing a-specific LBP would be a large step in identifying which types of exercises would work best for more specific causes. For this we need clearer diagnostics to identify these groups. Lastly, if some steps can be taken in the first 2 recommendations we would recommend performing more trials with more homogenous groups.

Practical implications
Our study is the first to our knowledge to complete an evidenced based protocol of this type. Physiotherapists should feel confident that this evidence based protocol works for treating a-specific chronic LBP patients. However, this protocol should not be the only intervention given to patients. It is still important to educate the patient in their disorder, teach them coping strategies and interventions such as mobilization or back schools should not be neglected when appropriate.
References


References to excluded reviews:


Slade SC, Keating JL. Unloaded movement facilitation exercise compared to no exercise or alternative therapy on outcomes for people with nonspecific chronic low back pain: a systematic review. Journal of Manipulative and Physiological Therapeutics. 2007. Volume 30 number 4
Appendices

Appendix 1: Excluded reviews:

A recent Cochrane review (Hayden et al, 2005) is a review of high methodological quality, but their attempt to “lump” all exercise types into one group only assists in finding the answer of whether or not exercise works for chronic LBP, but in doing so dilutes the practical use of the results. It is impossible to sort out which specific exercises work and which do not and consequently fails to come up with the specific answers that we need.

Slade & Keating (2006, 2007) and Hettenga et al (2007) contained interesting results, but had to be excluded because of differences in the definition of chronicity of recurrent LBP.

Liddle et al (2004) was excluded due to the fact that the tables that were included in the PDF version were incomplete (cut off at the side because they were meant to be viewed in landscape format, but in this version everything was in the normal layout).
Appendix 2: Rating scale

Rating scale

Abstract: 4 (4 marks if all are included, 2 if at least 4 are included, 0 if less than 4)

- Background
- Objectives
- Search strategy
- Selection criteria
- Data collection & analysis
- Main results
- Authors’ conclusions

Background 6

- Relevant to our topic 2
  
  *(Completely relevant = 2, partially relevant = 1)*

- Inclusion of past studies 2
  
  *(Past studies included with references = 2, past studies mentioned = 1, no past studies included = 0)*

- Summary of current knowledge on this topic 2
  
  *(Inclusion of information with figures regarding current knowledge about the topic = 2, information with no figures = 1, no information on current knowledge = 0)*

Objectives 3

- Relevant to our topic 1
- Clear and easy to understand 1
- Explains why this adds something new 1

Criteria for selecting studies for this review 4

- Types of studies 1
- Types of participants 1
- Types of interventions 1
- Types of outcome measures 1
Methods of the review 20

Search strategy 10

List of databases included =2

(List of databases searched through =2, no list =0)

Keywords and mesh terms =2

(Keywords and mesh terms listed =2, not listed =0)

Inclusion/exclusion criteria =4

(Appropriate criteria for inclusion/exclusion =4, appropriate criteria but missing some areas =3, inappropriate inclusion/exclusion criteria =1, none listed =0)

Search results included =2

(Number of all search results before and after ex/inclusion and names of articles after ex/inclusion =2, search results and names for only after ex/inclusion criteria =1, either number of articles found or a list of the names or none listed =0)

Grading criteria 4

(Appropriate grading list and allocation of points + 2, clear and easy to use + 1, easy points system +1)

Pilot study 3

(Presence of pilot study =3, no pilot study performed =0)

Grading process 3

(Clear description of the grading process, e.g. who graded what and how many people graded =3, unclear description of grading =1, no description =0)

Description of studies 5

List of studies graded 1

Population information (type) 1

Number of participants 1

Group description and division 1

Duration of study 1

Results 20

Table of grading outcomes 3

(Tables clear and easy to understand = 3, presence of tables but not too clear = 1, no tables = 0)

Quality of included studies 7
(Clearly stated list of quality of individual studies = 7, list of quality studies mentioned = 3, not mentioned = 0)

Information to take from the studies 10

(Results from the articles presented, clearly, in accordance to the articles quality = 10, results from articles presented but not in accordance to article quality = 7, results from articles present but not clear = 4, not all results presented = 2, no results = 0)

Discussion 14

Discussion of reasons for inter study differences in results 4

(Clearly stated possible reasons for various results both positive and negative about the same or similar subject = 4, only positive or only negative discussions comparing results between studies = 2, no inter study discussions = 0)

Discussion of reasons for intra study anomalies and unexpected results 4

(Clearly stated possible reasons for the outcome of results both positive and negative = 4, only positive or only negative discussions comparing results in a study = 2, no intra study discussions = 0)

Discussions about mistakes made and suggestions for improvements regarding the articles 2

(Appropriate comments about things done wrong and how to make things better = 2, no comments regarding improvements for the articles = 0)

Discussions about mistakes made and suggestions for improvements regarding the their own review 2

(Appropriate comments about things done wrong and how to make things better = 2, no comments regarding improvements for their own review = 0)

Suggestions for further research 2

(Appropriate suggestions for further research = 2, inappropriate suggestions for further research = 1, no suggestions given = 0)

Conclusions 6

What to take from the results 3

(Clear and relevant comments on what the results mean and suggest = 3, little or unclear comments on what the results mean = 1, no comments on what the results mean = 0)

Implications for practice 3

(Clear comments on how the results can be used in real life practice = 3, little or unclear comments on how results can be used = 1, no comments on implications of results = 0)

Conflicts of interest 2

(Mentioned, possibility of conflicts of interest with the articles = 2, no mention = 0)
References:

References to studies in text or reference list 4

Included studies 2
Additional studies 1
Ongoing studies 1

Other references 1
Additional references that may not be articles or studies

Tables and figures:

Characteristics of included studies 4
(Clearly show characteristics of studies included the review =4, characteristics present but shown unclearly =2, only few characteristics shown =1, no characteristics of the study shown =0)

Characteristics of excluded studies 1

Comparisons, data and graphs 5
(All data and figures shown in tables and graphs clearly =5, some data and figures shown =3, data shown is not clear =1, no data shown in tables or graphs=0)

Additional tables and figures 1