# BIJLAGE 5. SAMENVATTING VAN WETENSCHAPPELIJK BEWIJS

Dit hoofdstuk bevat een samenvatting in het Engels van wetenschappelijk bewijs voor diagnostiek en behandeling bij acute en chronische aspecifieke lage rugklachten. De literatuur betreffende behandeling van acute aspecifieke lage rugklachten is gebaseerd op reviews uitgevoerd binnen de Cochrane Back Review Group; de literatuur betreffende diagnostiek en de literatuur betreffende behandeling van chronische lage rugklachten is systematisch samengevat, waarbij studies zijn meegenomen die tot april 2009 zijn gepubliceerd. Dit systematisch literatuuronderzoek is uitgevoerd in opdracht van het College van Zorgverzekeringen en inmiddels deels gepubliceerd.[referenties] De informatie is van een systematisch literatuuronderzoek tot april 2009, gebaseerd op reviews uitgevoerd binnen de Cochrane Back Review Group en een rapport voor het College van Zorgverzekeringen. De richtlijncommissie heeft deze samenvatting gebruikt als basis voor de aanbevelingen in de huidige KKCZ richtlijn.

**Acute low back pain - diagnostics**
**Summary of the evidence**

**Diagnostic triage**
**Evidence**
Although there is general consensus on the importance and basic principles of differential diagnosis, there is little scientific evidence on the diagnostic triage (level D).

**History taking**
One systematic review of 9 studies evaluated the accuracy of history in diagnosing low back pain in general practice.[van den Hoogen et al. 1995] The review found that history taking does not have a high sensitivity and high specificity for radiculopathy and ankylosing spondylitis. The combination of history and erythrocyte sedimentation rate had a relatively high diagnostic accuracy in vertebral cancer (level A).

**Physical examination**
One systematic review of 17 studies found that the pooled diagnostic Odds Ratio for straight leg raising for nerve root pain was 3.74 (95% CI 1.2 – 11.4); sensitivity for nerve root pain was high (1.0 – 0.88), but specificity was low (0.44 – 0.11).[Deville et al. 2000] All included studies were surgical case-series at non-primary care level. Most studies evaluated the diagnostic value of SLR for disc prolapse. The pooled diagnostic Odds Ratio for the crossed straight leg raising test was 4.39 (95% CI 0.74 – 25.9); with low sensitivity (0.44 – 0.23) and high specificity ((0.95 – 0.86). The authors concluded that the studies do not enable a valid evaluation of diagnostic accuracy of the straight leg raising test (level A).[Deville et al 2000]

**Psychosocial risk factors**
**Evidence**
One systematic review was found of 11 cohort and 2 case-control studies evaluating psychosocial risk factors for the occurrence of low back pain.[Hoogendoorn et al 2000] Strong evidence was found for low social support in the workplace and low job satisfaction

as risk factors for low back pain (level A). There was moderate evidence that psychosocial factors in private life are risk factors for low back pain (level B). There was also strong evidence that low job content had no effect on the occurrence of low back pain (level A). Conflicting evidence was found for a high work pace, high qualitative demands, and low job content (level C).

Another systematic review found that there is strong evidence that psychosocial factors play an important role in chronic low back pain and disability, and moderate evidence that they are important at a much earlier stage than previously believed (level A).[Linton 2000]

**Diagnostic imaging**

**Evidence**

One systematic review was found that included 31 studies on the association between X-ray findings of the lumbar spine and non-specific low back pain.[van Tulder et al. 1997] The results showed that degeneration, defined by the presence of disc space narrowing, osteophytes and sclerosis, is consistently and positively associated with non-specific low back pain with Odds Ratios ranging from 1.2 (95% CI 0.7 – 2.2) to 3.3 (95% CI 1.8 – 6.0). Spondylolysis/listhesis, spina bifida, transitional vertebrae, spondylosis and Scheuermann's disease did not appear to be associated with low back pain (level A). There is no evidence on the association between degenerative signs at the acute stage and the transition to chronic symptoms.

A recent review of the diagnostic imaging literature (magnetic resonance imaging, radionuclide scanning, computed tomography, radiography) concluded that for adults younger than 50 years of age with no signs or symptoms of systemic disease, diagnostic imaging does not improve treatment of low back pain. For patients 50 years of age and older or those whose findings suggest systemic disease, plain radiography and simple laboratory tests can almost completely rule out underlying systemic diseases. The authors concluded that advanced imaging should be reserved for patients who are considering surgery or those in whom systemic disease is strongly suspected (level A).[Jarvik & Deyo 2002]

A recent RCT of 380 patients aged 18 years or older whose primary physicians had ordered that their low back pain be evaluated by radiographs determined the clinical and economic consequences of replacing spine radiographs with rapid MRI.[Jarvik et al. 2003] Although physicians and patients preferred the rapid MRI, there was no difference between rapid MRIs and radiographs in outcomes for primary care patients with low back pain. The authors concluded that substituting rapid MRI for radiographic evaluations in the primary care setting may offer little additional benefit to patients, and it may increase the costs of care because of the increased number of spine operations that patients are likely to undergo.

**Reassessment of patients whose symptoms fail to resolve**

**Evidence**

There is no scientific evidence on the reassessment of patients (level D).

## Acute low back pain - treatment

### Information and reassurance

#### Evidence

One non-systematic review evaluated the effectiveness of educational interventions for back pain in primary care.[Turner 1996] One study showed that an educational booklet decreased the number of visits to a general practitioner for back pain. Another study showed that a 15-minute session with a primary care nurse plus an educational booklet and a follow-up phone call resulted in greater short-term patient satisfaction and perceived knowledge compared with usual care, but symptoms, physical functioning and health care utilisation were not different (level C). In another trial published after the review, patients were given either an experimental booklet (the 'Back Book') or a traditional booklet.[Burton et al 1999] Patients receiving the experimental booklet showed greater early improvement in beliefs and functional status but there was no effect on pain (level C).

The review is not systematic and trials included in the review have various controls and outcomes. A Cochrane review is currently being conducted.

### Bed rest

#### Evidence

Six systematic reviews (10 RCTs, no statistical pooling) evaluated the effect of bed rest for acute low back pain.[Bigos et al. 1994, Evans & Richards 1996, Hagen et al 2000, Koes & van den Hoogen 1994, van Tulder et al. 1997, Waddell et al. 1997] Five RCTs (n=921) compared bed rest to alternative treatments, e.g., exercises, physiotherapy, spinal manipulation, or NSAIDs. They found either no differences or that bed rest was worse using outcomes of pain, recovery rate, time to return to daily activities and sick leave (level A). Five RCTs (n=663) found that bed rest was no different or worse than no treatment or placebo (level A). Two RCTs (n=254) found that seven days of bed rest was no different from 2 to 4 days bed rest.

### Advice to stay active

#### Evidence

Two systematic reviews found that advice to stay active (with or without other treatments) reduced disability, pain, and time spent off work compared with bed rest (with or without other treatments).[Waddell et al. 1997, Hilde et al. 2004]

One systematic review of eight RCTs found that there is strong evidence that advice to stay active is associated with equivalent or faster symptomatic recovery, and leads to less chronic disability and less time off work than bed rest or usual care (level A).[Waddell et al.1997] Advice to stay active was either provided as single treatment or in combination with other interventions such as back schools, a graded activity programme or behavioural counselling. Two RCTs (n=228) found faster rates of recovery, less pain and less disability in the group advised to stay active than in the bed rest group. Five RCTs (n=1500) found that advice to stay active led to less sick leave and less chronic disability compared to traditional medical treatment (analgesics as required, advice to rest and 'let pain be your guide').

The other systematic review included four trials with a total of 491 patients.[Hilde et al. 2004] Advice to stay active was compared to advice to rest in bed in all trials. The results were inconclusive. Results from one high quality trial of patients with acute simple LBP found

small differences in functional status and length of sick leave in favour of staying active compared to advice to stay in bed for two days. One of the high quality trials also compared advice to stay active with exercises for patients with acute simple LBP, and found improvement in functional status and reduction in sick leave in favour of advice to stay active.

Two subsequent RCTs do not change the conclusion [Hagen et al. 2000, Rozenberg et al. 2002].

**Exercise therapy**

**Evidence**

Five systematic reviews and 12 additional RCTs (39 RCTs in total, no statistical pooling) evaluated the effect of exercise therapy for low back pain.[Bigos et al. 1994, Evans & Richards 1996, van Tulder et al. 1997, Abenhaim et al. 2000, van Tulder et al. 2000] Results for acute and chronic low back pain were not reported separately in three trials.

Twelve RCTs (n=1894) reported on acute low back pain. Eight trials compared exercises with other conservative treatments (usual care by the general practitioner, continuation of ordinary activities, bed rest, manipulation, NSAIDs, mini back school or short-wave diathermy). Seven of these found no differences or even mildly worse outcomes (pain intensity and disability) for the exercise group (level A). Only one trial reported better outcomes for the exercise therapy group on pain and return to work compared to a mini back school. Four trials (n=1234) compared exercises with 'inactive' treatment (i.e., bed rest, educational booklet, and placebo ultrasound) and found no differences in pain, global improvement or functional status (level A). Two small studies (n=86) compared flexion to extension exercises, and found a significantly larger decrease of pain and a better improvement in functional status with extension exercises.

**Analgesia (paracetamol, nsaids, muscle relaxants)**

**Evidence**

***Paracetamol***

Two systematic reviews found strong evidence that paracetamol is not more effective than NSAIDs.[Bigos et al. 1994, van Tulder et al. 1997] There is strong evidence from a systematic review in other situations that analgesics (paracetamol and weak opioids) provide short-term pain relief.[de Craen et al. 1996] Six RCTs (total n=329) reported on acute low back pain. Three compared analgesics with NSAIDs. Two of these (n=110) found that meptazinol, paracetamol and diflunisal (a NSAID) reduced pain equally. The third trial found that mefenemic acid reduced pain more than paracetamol, but that aspirin and indomethacin were equally effective.

***NSAID's***

Two systematic reviews found strong evidence that regular NSAIDs relieve pain but have no effect on return to work, natural history or chronicity.[Koes et al. 1997, van Tulder et al. 2000] NSAIDs do not relieve radicular pain. Different NSAIDs are equally effective. Statistical pooling was only performed for NSAIDs *v* placebo in acute low back pain.

*Versus placebo:* Nine RCTs (n=1135) found that NSAIDs increased the number of patients experiencing global improvement (pooled OR after 1 week 2.00, 95% CI 1.35 to 3.00) and reduced the number needing additional analgesic use (pooled OR 0.64, 95% CI 0.45 to 0.91). Four RCTs (n=313) found that NSAIDs do not relieve radicular pain.

*Versus paracetamol:* Three trials (n=153) found conflicting results. Two RCTs (n=93) found no differences in recovery, and one RCT (n=60) found more pain reduction with mefenamic acid than paracetamol.

*Versus muscle relaxants and opioid analgesics:* Five out of six RCTs (n=399 out of 459) found no differences in pain and overall improvement. One RCT (n=60) reported more pain reduction with mefenamic acid than with dextropropoxyphene plus paracetamol.

*Versus non-drug treatments:* Three trials (n=461). One RCT (n=110) found that NSAIDs improved range-of-motion more than bed rest and led to lesser need for treatment. One trial (n=241) found no statistically significant difference. Two studies (n=354) found no differences between NSAIDs and physiotherapy or spinal manipulation in pain and mobility.

*Versus each other:* 15 RCTs (n=1490) found no difference in efficacy. One recent trial (n=104) found somewhat better improvement of funcioning with nimesulide, a COX-2 inhibitor, compared with ibuprofen 600 mg, but no differences on pain relief.[Pohjalainen et al. 2000]

***Muscle relaxants***

Three systematic reviews (24 RCTs; n=1662 ) found strong evidence that muscle relaxants reduce pain and that different types are equally effective.[Bigos et al. 1994, van Tulder et al. 1997, van Tulder et al. 2004]

Twenty-four trials on acute low back pain were identified. Results showed that there is strong evidence that any of these muscle relaxants (tizanidine, cyclobenzaprine, dantrolene, carisoprodol, baclofen, orphenadrine, diazepam) are more effective than placebo for patients with acute LBP on short-term pain relief. The one low quality trial on benzodiazepines for acute LBP showed that there is limited evidence (1 trial; 50 people) that an intramuscular injection of diazepam followed by oral diazepam for 5 days is more effective than placebo on short-term pain relief and better overall improvement (level C). The pooled RR for non-benzodiazepines versus placebo after two to four days was 0.80 [95% CI; 0.71 to 0.89] for pain relief and 0.49 [95% CI; 0.25 to 0.95] for global efficacy (level A). The various muscle relaxants were found to be similar in performance.

**Epidural steroids**

**Evidence**

Four systematic reviews included two small RCTs on acute low back pain.[Bigos et al. 1994, van Tulder et al. 1997, Koes et al. 1999, Nelemans et al. 2001, Watts & Silagy 1995] The second trial (n=63, epidural steroids *v* epidural saline, epidural bupivacaine and dry needling) found no difference in number of patients improved or cured. We found conflicting evidence on the effectiveness of epidural steroids.

**Spinal manipulation**

**Evidence**

We found six systematic reviews [Bigos et al. 1994, van Tulder et al. 1997, Evans & Richards 1996, Koes et al. 1996, Shekelle et al. 1992, Bronfort 1999] and one Cochrane review [Assendelft et al. 2004] (search date 2000). The Cochrane review included 17 RCTs on acute low back pain.

*Versus placebo/Sham:* Patients receiving manipulation showed clinically important short-term (less than 6 weeks) improvements in pain (10-mm difference in pain (95% CI, 2-17 mm) on a 100-mm visual analogue scale) and functional status (2.8 points difference on the

Roland-Morris Scale (95% CI, -0.1 to 5.6)) compared to sham therapy or therapies judged to be ineffective or even harmful. After 6 months follow up there were no significant differences. *Versus other treatments:* Spinal manipulative treatment had no statistically or clinically significant advantage on pain and functional status over general practitioner care, analgesics, physical therapy, exercises, or back school.

**Back schools**

**Evidence**

A systematic review of three RCTs found conflicting evidence that back schools are effective for acute low back pain.[van Tulder et al. 2000] Two RCTs (n=242) compared back schools with other conservative treatments (McKenzie exercises and physical therapy). They found no difference in pain, recovery rate, and sick leave. One trial (n=100, physical therapy (McKenzie exercises) *v* back school) found that exercises improved pain and reduced sick leave more than back school up to five years, but the back school in this study consisted of one 45 minute-session while exercises were ongoing. The other trial (n=145) compared back schools with short-wave diathermy at lowest intensity, and found that back schools are better at aiding recovery and reducing sick leave in the short-term.

**Behavioural therapy**

**Evidence**

Five systematic reviews were identified on behavioural therapy for low back pain.[Bigos et al 1994, Turner 1996, van Tulder et al. 1997, Evans & Richards 1996, van Tulder et al. 2000] However, there was only one RCT on acute non-specific low back pain. There is limited evidence (one RCT; n=107) that behavioural treatment reduced pain and perceived disability more than traditional care (analgesics and exercise until pain had subsided) at 9 to 12 months.

**Traction**

**Evidence**

Three systematic reviews [Evans & Richards 1996, van Tulder et al. 1997, van der Heijden et al. 1996] included two RCTs that reported on acute low back pain (total n=225, traction *v* bed rest + corset, traction *v* infrared). One trial found that traction significantly increased overall improvement compared with both other treatments after 1 and 3 weeks. But the second trial found no significant difference in overall improvement after 2 weeks.

**Massage therapy**

**Evidence**

One systematic review found insufficient evidence to recommend massage as a stand-alone treatment for acute non-specific low back pain.[Furlan et al. 2004] Two low quality RCTs investigated the use of manual massage as a treatment for acute non-specific low back pain. In both studies massage was the control intervention in evaluating spinal manipulation. There is limited evidence showing that massage is less effective than manipulation immediately after the first session. At the completion of treatment and at 3 weeks after discharge there is no difference between massage and manipulation.

**TENS**

**Evidence**

Two systematic reviews of two RCTs found insufficient evidence.[Bigos et al. 1994, van Tulder et al. 1997]

One study (n=58) compared a rehabilitation program with TENS to the rehabilitation program alone in an occupational setting and found no differences on pain and functional status. The other low quality study (n=40) compared TENS with paracetamol and reported significantly better improvement in the TENS group after 6 weeks regarding pain and mobility.

**Multidisciplinary treatment programmes**

**Evidence**

One systematic review of two RCTs (n=233) found that multidisciplinary treatment leads to faster return to work and less sick leave than usual care.[Karjalainen et al. 2000] In one study in patients who had been absent from work for eight weeks the multidisciplinary 'graded activity' programme consisted of 1) measurement of functional capacity, 2) a workplace visit, 3) back school education, and 4) an individual, sub-maximal, gradually increased exercise programme, with an operant-conditioning behavioural approach. In the other study in patients who had been absent from work for more than four weeks, the comprehensive multidisciplinary programme consisted of a combination of clinical intervention (by a back pain specialist, back school, functional rehabilitation therapy, and therapeutic return to work), and occupational intervention (visit to an occupational physician and participatory ergonomics evaluation conducted by an ergonomist, including a work-site evaluation).

**Chronic low back pain - treatment**

**Summary of evidence**

**Physical treatments**

**Interferential therapy**

**Summary of evidence**

There is no evidence for the effectiveness of interferential therapy compared with sham/placebo treatments in the treatment of chronic low back pain (level D).

There is limited evidence that interferential therapy and motorized lumbar traction plus massage are equally effective in the treatment of chronic low back pain (level C).

**Low Level Laser therapy**

**Summary of evidence**

*Low Level Laser Therapy versus SHAM treatment*

One study with a low risk of bias, compared low level laser therapy treatment with sham laser therapy treatment in elderly patients over 60 years.[Soriano & Rios 1998] Pain relief at intermediate follow-up (6 months) was reported in 44.7% of the patients in the LLLT group and 15.2% of the sham LLLT group ($p<0.01$).

*Low level laser therapy + exercise versus sham LLLT + exercise*

Results on pain and disability at post-treatment were reported by one study and no difference was found between the intervention groups for both outcome measures. [Djavid et al. 2007]

Two studies reported on pain intensity and disability at short-term (3 months) follow-up.[Djavid et al. 2007, Klein & eek 1990] The pooled analysis of these two small trials (n=61) showed a significant difference in pain relief (WMD –13.57 [95%CI –26.67; -0.47; Q=2,26, df 1]). No difference was found on the outcome disability between those who received LLLT plus exercise and those who received sham LLLT + exercise (WMD –5.42 [95%CI –23.55; 12.71; Q=18.41, df 1].

*Low Level laser therapy versus exercise*

One study compared the effectiveness of low level laser therapy with exercise therapy post-treatment.[Gur et al. 2003] No statistical significant difference was found between both therapy groups on pain level and disability.

**Lumbar supports**

**Summary of evidence**

There is no evidence for the effectiveness of lumbar supports compared with sham/placebo treatments in the treatment of chronic low back pain (level D).

There is no evidence for the effectiveness of lumbar supports compared with other treatments in the treatment of chronic low back pain (level D).

**Shortwave diathermy**

**Summary of evidence**

There is no evidence for the effectiveness of shortwave diathermy compared with sham/placebo treatments in the treatment of chronic low back pain (level D).

There is no evidence for the effectiveness of shortwave diathermy compared with other treatments in the treatment of chronic low back pain (level D).

**Therapeutic ultrasound**

**Summary of evidence**

There is limited evidence that therapeutic ultrasound is not effective in the treatment of chronic low back pain (level C).

There is no evidence for the effectiveness of therapeutic ultrasound compared with other treatments in the treatment of chronic low back pain (level D).

**Thermotherapy**

**Summary of evidence**

There is no evidence for the effectiveness of thermotherapy compared with sham/placebo treatments in the treatment of chronic low back pain (level D).

There is no evidence for the effectiveness of thermotherapy compared with other treatments in the treatment of chronic low back pain (level D).

**Traction**

**Summary of evidence**

One study (n=42) with a high risk of bias compared motorized traction treatment plus standard physiotherapy with standard physiotherapy only.[Borman et al. 2003] No statistical significant differences were found on pain intensity, disability and recovery at post-treatment and after 3 months follow-up between both intervention groups.

**Transcutaneous electrical nerve stimulation (TENS)**

**Summary of evidence**

*TENS versus sham treatment*

Five studies, of which two with a low risk of bias, compared the effectiveness of TENS with sham TENS or sham PENS (Percutaneous Electrical Nerve Stimulation). Four studies [Deyo et al. 1990, Ghoname et al. 1999, Jarzem et al. 2005, Topuz et al. 2004] described post-treatment results on pain and the pooled WMD was –4.47 [95%CI –12.84;3.89; Q=13.01, df 3]. Data for the analysis of post-treatment disability could be pooled for two studies [Deyo et al. 1990, Topez et al. 2004] and the pooled WMD was –1.36 [95%CI –4.38; 1.66; Q=1.63, df 1]. Ghoname et al. [1999] reported on disability and found no significant difference between the TENS and sham-PENS group. The study of Jarzem et al. [2005] with a low risk of bias, compared TENS with sham-TENS and demonstrated a significant carryover effect with conventional TENS having a greater effect on pain intensity than the sham TENS.

Two studies [Deyo et al. 1990, Jarzem et al. 2005] reported on short-term pain and disability. Deyo et al. [1990] found no significant difference between the TENS and sham TENS groups at short-term follow-up and Jarzem et al. [2005] either did not find a significant difference between the TENS and sham TENS group at short-term follow-up.

*TENS versus PENS/acupuncture*

Four studies, all with a high risk of bias, compared the effectiveness of TENS with acupuncture or PENS.[Ghoname et al. 1999, Grant et al. 1999, Jarzem et al. 2005, Yokoyama et al. 2004] Post-treatment results of two studies [Ghoname et al. 1999, Yokoyama et al. 2004] showed a pooled mean difference for the outcome pain intensity of 16.64[95%CI 5.86; 27.41; Q=5.61, df 1], in favour of the control group. Outcomes on pain intensity at short-term follow-up were reported in three studies.[Ghoname et al. 1999, Grant et al. 1999, Yokoyama et al. 2004] The pooled WMD was 6.51[95%CI –0.41; 13.44; Q=4.37, df 2] in favour of the PENS/acupuncture intervention. One study, with a high risk of bias, reported on the outcome disability at short-term follow-up.[Jarzem et al. 2005] No statistical significant difference was found between both intervention groups for the outcome disability.

*TENS versus active treatments*

Two studies, of which one with a high risk of bias, compared the effectiveness of TENS with active treatments.[Deyo et al. 1990, Ghoname et al. 1999] Ghoname et al. [1999] found no statistical significant difference in the outcome pain intensity post-treatment between both intervention groups. Deyo et al. [1990] reported on the outcomes pain intensity, disability and recovery at short-term follow-up. No significant difference between TENS and exercise therapy was observed between the subjects receiving true TENS and those receiving exercise therapy.

*Conventional TENS versus biphasic new wave TENS*

One study with a high risk of bias investigated the effectiveness of conventional TENS compared to biphasic new wave TENS for the outcomes pain and disability post-treatment and at short-term follow-up.[Jarzem et al. 2005] No statistical significant differences were found for both outcome measures at both time points between the intervention groups.

**Exercise therapy**

**Summary of evidence**

*Exercise therapy versus waiting list controls/no treatment*

Eight studies were identified as comparing some type of exercise therapy to waiting list controls or no treatment.[Alexandre et al. 2001, Galantino et al. 2004, Gladwell et al. 2006, Risch et al. 1993, Sjogren et al. 2005, Smeets et al. 2006, Turner et al. 1990, Harts et al. 2008] For this comparison, in five studies data is available for post-treatment, because after the treatment period, the no treatment group or waiting list control also received the treatment. Only two studies had a intermediate or long-term follow-up time for this comparison.[Alexandre et al. 2001, Sjogren et al. 2005]

All studies reported data that could be used in the statistical pooling. The pooled mean difference of the 5 studies with post-treatment measurement of pain intensity was –4.51 [95%CI –9.49; 0.47, Q=5.49, df 4], meaning that there was statistical significant effect in pain intensity between exercise therapy and waiting list controls at post-treatment. The weighted mean difference for post-treatment disability was –3.63 [95%CI –8.89; 1.63, Q=18.16, df 6]. The pooled mean difference for intermediate follow-up for pain intensity was –16.46 [95%CI –44.48; 11.57; Q=13.80, df 1]. Only one study (102 people) reported intermediate outcomes for disability and long-term outcomes for pain intensity and disability, and for these both outcomes there were no differences between the group receiving exercise therapy and the waiting list control group.[Smeets et al. 2006]

*Exercise therapy versus usual care/advised to stay active*

A total of six studies investigated the effect of exercise therapy compared to usual care/ normal activity pattern.[Frost et al. 2004, Hildebrandt et al. 2000, Niemisto et al. 2003, Yelland et al. 2004, Koldas Dogan et al. 2008, Tekur et al. 2008] Four of these studies had an intermediate or long-term follow-up time. Three studies could be used for the pooling of the post-treatment measurement for pain intensity and disability.[Frost et al. 2004, Koldas Dogan et al. 2008, Tekur et al. 2008] A significant decrease in pain intensity and disability was found in favour of the exercise group (WMD –9.23 [95%CI -16.02;-2.43; Q=0.27, df 1]) and –12.35 [95%CI –23.00;-1.69; Q=10.44, df 2], respectively. One study reported on pain and disability at short-term follow-up, and found no statistical differences between the exercise group and the control group receiving home exercises.[Koldas Dogan et al. 2008] Two studies reported on the outcomes at intermediate follow-up for pain intensity and disability.[Frost et al. 2004, Niemisto et al. 2003] However, one study did not report the pain intensity data of this follow-up moment. We found a significant pooled mean difference for disability during intermediate follow-up of –5.43 [95%CI –9.54; -1.32; Q=1.74, df 1]. One study found at intermediate follow-up a statistical significant difference in pain for the exercise group compared to the usual care group.[Niemisto et al. 2003] Three studies reported on pain and/or disability at long-term follow-up.[Frost et al. 2004, Yelland et al. 2004, Niemisto et al 2005] The pooled mean difference for pain was nearly significant (WMD

–4.94 [95%CI -10.45; 0.58; Q=0.56, df 1]) and the WMD for disability was statistically significant in favour of the exercise group (WMD –3.17 [95%CI –5.96;-0.38; Q=1.90, df=2]).

One study reported recovery at post-treatment and during intermediate and long-term follow-up.[Hildebrandt et al. 2000] There was a statistically significant difference between the groups at 3 and 6 months follow-up in favour of the exercise group (p<0.001). Eighty percent of the patients in the exercise group regarded themselves recovered at 3 months follow-up versus 47% in the usual care group.

*Exercise therapy versus back school/education*

Three studies with a high risk of bias were identified.[Donzelli et al. 2006, Goldby et al. 2006, Williams et al. 2005] Post-treatment results for disability were reported in two studies, with a significant pooled WMD of –11.20 [95%CI –16.78; -5.62; Q=2.10, df 2]. One study reported on pain post-treatment and found no significant difference between both intervention groups.[Williams et al. 2005] The pooled mean differences for pain and disability at 3 months follow-up were –7.63 [95%CI –17.20; 1.93; Q=2.92. df 2] and –2.55 [95%CI –10.07; 4.97; Q=10.61, df 2], respectively.

Two studies [Donzelli et al. 2006, Goldby et al. 2006] reported intermediate outcomes on pain and three studies [Donzelli et al. 2006, Goldby et al. 2006, Sherman et al. 2005] reported on disability. The pooled WMDs showed no statistically significant differences between the groups: –5.58 [95%CI -16.65; 5.48; Q=0.12 df=1] and –4.42 [95%CI –9.90; 1.05, Q=6.40 df=3], respectively. Only one study (n=346) reported long-term outcomes, and these were not statistically significantly different between the groups.[Goldby et al. 2006]

*Exercise therapy versus behavioural treatment*

Three studies, one with a low risk of bias, were identified comparing exercise therapy with a behavioural treatment.[Critchley et al. 2007, Smeets et al. 2006, Turner et al. 1990] Two studies reported post-treatment pain and disability and the pooled WMDs were 1.21 [95%CI –5.42; 7.84; Q=0.21 df 1] and 0.34 [95%CI –2.64; 3.31; Q=0.23 df 1], respectively.

All three studies reported intermediate and long-term on pain intensity and disability. For intermediate follow-up the pooled WMDs for pain and disability were –2.23 [95%CI -7.58; 3.12; Q=0.60, df 2] and 1.97 [95%CI –3.55; 7.48; Q=5.06 df 2], respectively. Long-term results showed a pooled WMD for pain intensity of –0.88 [95%CI –6.34; 4.58; Q=0.23, df 2] and a pooled WMD for disability of 2.77 [95%CI –3.43; 8.96; Q=7.65, df 2].

*Exercise therapy versus TENS/laser therapy/ultrasound/massage*

Five studies, two with a low risk of bias, were identified comparing exercise therapy with passive therapies such as TENS, low level laser therapy, ultrasound, thermal therapy and ultrasound.[Chatzitheodorou et al. 2007, Deyo et al. 1990, Gur et al. 2003, Kankaanpaa et al. 1999, Koldas Dogan et al. 2008] The pooled WMD for post-treatment pain intensity was –9.33 [95%CI –18.80; 0.13; Q=17.51, df 4] and for post-treatment disability –2.59 [95%CI –8.03; 2.85; Q=11.49, df 4]. Two studies [Deyo et al. 1990, Koldas Dogan et al. 2008] reported on short-term pain intensity and disability and the pooled mean differences were 1.72 [95%CI –6.05; 9.50; Q=0.19 df 1] and 1.02 [95%CI –0.38; 2.42; Q=0.09, df 1], respectively. One study with a low risk of bias reported intermediate and long-term outcomes, and found a statistically significantly difference for pain intensity of 16.8 and 21.2

points, respectively in favour of the exercise therapy.[Kankaanpaa et al. 1999] Also a statistical significant difference was found for disability.

*Exercise therapy versus manual therapy/manipulation*

Five studies, two with a low risk of bias, were identified comparing exercise treatment with spinal manipulation or manual therapy.[Ferreira et al. 2007, Goldby et al. 2006, Gudavalli et al. 2006, Marshall & Murphy 2008, Chown et al. 2008] Post-treatment data were available for three studies. The pooled WMDs for pain intensity and disability were 5.67 [95%CI 1.99; 9.35; Q=1.45, df 3] and 2.16 [95%CI –0.96; 5.28; Q=2.01 df 3], respectively. One study reported global perceived effect post-treatment[20] and there was statistical a significant difference between both groups in favour of the spinal manipulation group.[Ferreira et al. 2007] Two studies reported short-term effects on pain intensity and disability and the pooled WMDs were –1.33 [95%CI –10.11; 7.79; Q=3.03, df 1] and 0.29 [95%CI –3.15; 3.72; Q=0.11, df 1], respectively.[Goldby et al. 2006, Gudavalli et al. 2006] Intermediate results on pain and disability were reported by three studies and the pooled WMDs were –0.49 [95%CI –12.22; 11.23; Q=13.37, df 2] and 2.38 [95%CI –5.16; 9.93; Q=7.90, df 2], respectively.[Ferreira et al. 2007, Goldby et al. 2006, Gudavalli et al. 2006] All studies reported long-term results on disability and the pooled WMD –0.70 [95%CI –3.14; 1.74; Q=3.32, df 5]. Four studies reported long-term results on pain intensity and the pooled WMD was 2.09 [95%CI –2.94; 7.13; Q=6.23, df 4]. Global perceived effect was reported by one study during intermediate and long-term follow-up. No statistically significant between group differences were found in this study.[Ferreira et al. 2007]

*Exercise therapy versus psychotherapy*

One study with a high risk of bias was identified.[Machado et al. 2007] Post-treatment results showed a statistical significant difference in disability scores between both groups in advantage of the exercise group. No post-treatment differences between both groups were found for pain intensity. At 6 months follow-up, both disability and pain intensity scores were lower in the exercise group compared to the psychotherapy group, but not statistically significant.

*Exercise therapy versus other forms of exercise therapy*

Eleven studies compared different exercise interventions with each other.[Elnaggar et al. 1991, Ferreira et al. 2007, Johannsen et al. 1995, Lewis et al. 2005, Mannion et al. 1999, Rittweger et al. 2002, Roche et al. 2007, Sherman et al. 2005, Tritilanunt & Wajanavisit 2001, Yozbatiran et al. 2004, Harts et al. 2008] The data of these studies could not be pooled because of the heterogeneity of the types of interventions.

Two studies found statistical significant differences between different exercise interventions. One study with a high risk of bias compared an aerobic exercise training program with a lumbar flexion exercise program of 3-months and a significant better outcome on pain intensity was found after 3 months of training in the aerobic exercise-training group.[Tritilanunt & Wajanavisit 2001] One large trial with a low risk of bias (n= 240) compared a general exercise program (strengthening and stretching) with a motor control exercise program (improving function of specific trunk muscles) of 12 weeks.[Ferreira et al. 2007] The motor control exercise group had slightly better outcomes (mean adjusted between group difference function 2.9 and global perceived effect 1.7) than the general

exercise group at 8 weeks. Similar group outcomes were found at 6 and 12 months follow-up.

A total of nine studies did not find any statistical significant differences between the different exercise interventions. One study with a low risk of bias compared a program with trunk flexion exercises with spinal extension exercises for 2 weeks on post-treatment pain intensity.[Elnaggar et al. 1991] Harts et al. [2008] studied the effectiveness of a high-intensity and low-intensity strengthening program on the outcomes at 8 and 24 weeks follow-up. One study, with a high risk of bias, compared an intensive training of muscle endurance with muscle training with coordination, for once a week during 3 months.[Johannsen et al. 1995] Pain intensity and disability at post-treatment and at 6-months follow-up were not different in both groups. Lewis et al. [2005] investigated the effectiveness of a one-to-one treatment including spinal stabilization exercises and a 10 station exercise class involving aerobic exercises and spinal stabilization exercises. Both forms of intervention were associated with significant improvement, although there were no differences between both intervention groups. One study, with a low risk of bias, compared a 12-week muscle reconditioning on training devices with low-impact aerobics.[Mannion et al. 1999] Pain severity and disability showed a significant decrease, with no unique effect of group membership. Rittweger et al. [2002] compared a 12-week whole-body vibration exercise program with a 12-week iso-dynamic lumbar extension exercise program on pain an disability at post-treatment and at 6-months follow-up and also found no difference between both interventions. One study[37] with a high risk of bias compared the post-treatment outcomes of active individual therapy (flexibility training, pain management, stretching and proprioception exercises) with those of a functional restoration program.[Roche et al. 2007] And Sherman et al. [2005] compared a 12-week yoga (viniyoga) program with a 12-week conventional exercise class program. Back-related function in the yoga group was superior to the exercise group at 12 weeks. Finally, one study with a high risk of bias compared a 4-week fitness program with a 4-week aqua fitness program. Also similar effects in both treatment groups were found.[Yozbatiran et al. 2004]

**Spinal Manipulation / Mobilisation Therapy (SMT)**

**Summary of the evidence**

*SMT versus sham, placebo or passive modalities.*

In total, 3 RCTs (1 with a low risk of bias) were identified, which compared SMT to care consisting of an educational booklet [Goldby et al. 2006], sham manipulation [Liccardione et al. 2003], and ultrasound [Mohseni-Bandpei et al. 2006]. For pain, data could be pooled for two studies at 3 months only, which demonstrated no significant effect (MD 1.81, 95% CI -7.13 to 10.75).[Liccardione et al. 2003, Goldby et al. 2006] Only one study measured the long-term effects, which demonstrated no significant effect (very low quality evidence).[Goldby et al. 2006] The only study with a low risk of bias demonstrated no significant effect at the short-term or intermediate follow-up (low quality evidence).[Liccardione et al. 2003] For functional status, data could be pooled at all follow-up measurements. A moderate, significant effect was observed at 1 month from 2 RCTs [Liccardione et al. 2003, Mohseni-Bandpei et al. 2006] providing low quality evidence in favour of SMT (SMD -0.36, 95% CI -0.66 to -0.06); however, the only study with a low risk of bias demonstrated no significant effect (low quality evidence).[Liccardione et al. 2003] At all

other follow-up measurements, no significant effect was observed, also when examined for risk of bias. No studies reported recovery.

*SMT plus an intervention versus intervention alone.*

In total, 2 RCTs (1 with a low risk of bias) were identified, which examined the effects of SMT when added to usual care [Liccardione et al. 2003] or various forms of exercise (e.g. specific exercises with a Swiss ball, standard back exercises).[Marshall & Murphy 2008] For pain, data could be pooled at all follow-up measurements. No significant effect was found at any interval (very low quality evidence). The only study with a low risk of bias demonstrated significant pain relief at 3 months in favour of SMT (MD -14.20, 95% CI -26.89 to -1.51) (low quality evidence). Similarly, for functional status, data could be pooled for all follow-up measurements and no significant effect was found at any interval (low quality evidence). The only study with a low risk of bias did not demonstrate any significant effect.

*SMT versus any other intervention.*

In total, 4 RCTs (1 with a low risk of bias) were identified, which included interventions, such as exercise,[Ferreira et al. 2007, Goldby et al. 2006, Gudavalli et al. 2006] and treatment in hospital outpatient pain clinic [Wilkey et al. 2008]. Data could be pooled for pain at every follow-up measurement, except 6 months. A small, significant, but not clinically relevant effect was observed at one month from two RCTs [Wilkey et al. 2008, Gudavalli et al. 2006] with a high risk of bias in favour of SMT (MD -3.28, 95% CI -5.73 to -0.82) (moderate quality evidence). At 3 and 12 months, no significant effect was observed (low quality evidence). For functional status, three RCTs reported data for the long-term follow up, but the effect was non-significant (very low quality evidence).[Ferreira et al. 2007, Goldby et al. 2006, Gudavalli et al. 2006]

**Massage**

**Summary of evidence**

Three studies with a high risk of bias compared massage therapy with relaxation therapy [Field et al. 2007, Hernandez-Reif et al. 2001] and acupuncture massage.[Franke et al. 2000] Post-treatment, there was no statistical significant reduction in pain intensity in the massage group compared to the control group; the pooled WMD was –0.93 [95%CI –8.51; 6.66; Q=1.33, df 2].

**Back schools and education/advice**

**Back schools**

**Summary of evidence**

*Back school versus waiting list controls/no treatment/ usual care*

Three studies compared back school with waiting list controls, no treatment and a usual care clinic group.[Keijsers et al. 1989, Tavafian et al. 2007, Ribeiro et al. 2008] Pain post-treatment was reported by 2 studies [Keijsers et al. 1989, Ribeiro et al. 2008] and the pooled WMD was –4.64 [95%CI -13,65; 4,37; Q=0,24, df 1]. Disability post-treatment was only reported by Ribeiro et al. [2008] and showed no statistical significant difference between both groups. Two studies [Tavafian et al. 2007, Ribeiro et al. 2008] reported short-term follow-up data on disability and the pooled WMD was 12.63 [95%CI –12.15; 37.41; Q=9.68,

df 1] in favour of the control group. One study with a low risk of bias reported on pain intensity at short-term follow-up and found no statistical significant difference between both intervention groups.[Ribeiro et al. 2008] One study[53] with a high risk of bias, reported on disability at intermediate and long-term follow-up and no significant differences were found at both time points between the back school group and the clinic group.[Tavafian et al. 2007]

*Back school versus active treatment*

Two studies, one with a low risk of bias, were identified comparing a back school treatment with an active treatment.[Donzelli et al. 2006, Klaber Moffett et al. 1986] The pooled WMDs for pain intensity and disability at short-term follow-up were 4.75 [95%CI -2.13; 11.63; Q=0.95, df 1] and 0.12 [95%CI -2.37; 2.61; Q=0.98, df 1], respectively. At intermediate follow-up, the pooled WMDs for pain intensity and disability were –2.16 [95%CI -13.03; 8.71; Q=0.48, df 1] and 0.05 [-3.59; 3.69; Q=1,38, df 1], respectively.

*Back school versus education/information*

One study with a high risk of bias was identified comparing back school with given instructional material.[Hurri 1989] At 6 months follow-up, there was a statistical significant difference between both groups in pain intensity and disability in favour of the back school group. At long-term follow-up (12 months), there was still a significant difference between both intervention groups on the outcome disability in favour of the back school group.

**Patient education**

*Patient education versus active non-educational interventions*

Three studies, one with a low risk of bias, compared the effectiveness of patient education with physiotherapy [Goldby et al. 2006], Swedish Back School [Hurri 1989] and exercise/yoga exercises.[Sherman et al. 2005]

Sherman et al. [2005] compared the effectiveness of yoga exercises and conventional exercises with education on the outcome disability. Post-treatment, there was a statistical significant difference between the yoga exercise group and the education group in favour of the yoga group (MD -3.4 [95%CI –5.1; -1.6]). No statistical significant difference was found between the conventional exercise group and the education group.

Goldby et al. [2006] reported pain and disability at short-term follow-up. No significant difference between the education group and the exercise group was found for both outcome measures at this time point.

Two studies [Goldby et al. 2006, Hurri 1989] reported on pain intensity at intermediate follow-up and the WMD was –9.20 [95%CI –23.55; 22.45; Q=12.11, df 1].

Disability at intermediate follow-up was reported by all three studies; the pooled WMD was 3.16 [95%CI –3.97; 10.29; Q=10.31, df 3]. Long-term follow-up data on pain intensity and disability were reported by two studies [Goldby et al. 2006, Hurri 1989] and the pooled WMDs were –5.54 [95%CI –15.80; 5.12; Q=1.24, df 1] and –0.96 [95%CI –4.80; 2.88; Q=0.68, df 1], respectively.

*Patient education: focus on anatomy versus focus on neurosystem*

One study with a high risk of bias compared one-on-one education with a focus on anatomy compared to a focus on the neurosystem in 58 patients who presented themselves at private rehabilitation clinics.[Moseley et al. 2004] Fifteen weekdays after the first session, a

significant reduction in disability was found in the group with focus on the neurosystem compared to the control group. However, no differences on pain perception were found.

**Cognitive-behavioural treatment methods**

**Summary evidence**

*Behavioural treatment versus no treatment/waiting list controls/ placebo*

Twelve studies, of which three studies had a low risk of bias, were identified comparing some type of behavioural treatment to waiting list controls, no treatment or a placebo treatment.

*Respondent therapy (progressive relaxation)*

Three studies compared progressive relaxation (respondent therapy) with waiting list controls or placebo.[Stuckey et al. 1986, Turner 1982, Turner & Jensen 1993] The pooled WMD post-treatment for pain intensity was –19.74 [95%CI –34.32; -5.16; Q=4.73, df 2] and –5.24 [95%CI –8.42; -2.06; Q=2.57, df 2] for disability. No short or long-term results were reported in these studies.

*Respondent therapy (EMG biofeedback)*

A total of four studies were identified comparing EMG biofeedback (respondent therapy) with waiting list controls or placebo.[Bush et al. 1985, Newton-John et al. 1995, Nouwen 1983, Stuckey et al. 1986] The WMD for pain intensity of the three studies of which the data could be pooled was –8.67 [95%CI –13.59; -3.74; Q=0.78, df 2]. Disability data were only available of 2 studies and the pooled WMD post-treatment was –7.33 [95%CI –21.38; 6.73; Q=2.76, df 1].

*Operant therapy*

Four studies, of which three could be pooled, were identified comparing operant therapy with waiting list controls.[Smeets et al. 2006, Turner et al. 1990, Kole-Snijders et al. 1999, Turner & Clancy 1988] Post-treatment there was a significant reduction in pain intensity compared to the waiting list control group with a WMD of –7.00 [95%CI -12.33; -1.67; Q=1.85, df 2]. The pooled WMD for disability was –2.87 [95%CI –7.15; 1.41; Q=10.51, df 2]. No short- or long-term results were reported in these studies. The study of Kole-Snijders et al. [1999], with a low risk of bias, showed a significant decrease in negative affect, motoric behaviour and coping control in the operant behavioural treatment group compared to the waiting list control group at post-treatment.

*Combined respondent and cognitive therapy*

Four studies were identified comparing a combination of respondent and cognitive behavioural treatment with waiting list controls. The WMDs for post-treatment pain intensity and disability were –12.74 [95%CI –24.10; -1.37; Q=11.50, df 3] and–2.60 [95%CI –6.48; 1.27; Q=8.74, df 3], respectively. No short or long-term results were reported in these studies.

*Cognitive therapy*

Two studies were identified comparing the post-treatment effectiveness of cognitive treatment compared with waiting list controls.[Buhrman et al. 2004, Turner & Jensen 1993]

The pooled WMD for pain intensity was –12.67 [95%CI –20.26; -5.08; Q=0.06, df 1]. Post-treatment disability was only described by Turner et al. 1993 and a significant decreased pain intensity between the pre- and post-treatment was found for the patients in the cognitive behavioural group, but not for the waiting list control group. One study[68] with a high risk of bias, reported on pain intensity at 3 months follow-up and found no statistical significant difference between the internet-based cognitive therapy group and the waiting list controls.[Buhrman et al. 2004] One study with a high risk of bias reported on the intermediate follow-up effects of cognitive therapy compared to waiting list controls.[Haas et al. 2005] No statistical significant differences were found for pain intensity and disability between both intervention groups at 6 months follow-up.

*Behavioural treatment in addition to an other treatment versus the other treatment alone*

Seven studies compared one type of behavioural treatment plus an additional treatment with the additional treatment alone.[Smeets et al. 2006, Turner et al. 1990, Altmaier et al. 1992, Nicholas et al. 1991, Nicholas et al. 1992, Schweikert et al. 2006, Magnusson et al. 2008] Three studies [Smeets et al. 2006, Turner et al. 1990, Nicholas et al. 1991], one with a low risk of bias, compared operant therapy plus exercise/physiotherapy with exercise/physiotherapy alone and the WMD for pain intensity and disability post-treatment were –8.06 [95%CI –23.02; 6.91; Q=13.90, df 2] and –1.43 [95%CI –3.68; 0.82; Q=1.51, df 2], respectively. At intermediate follow-up the WMD for pain and disability were respectively 0.40 [95%CI -5.00; 5.80;Q=1.86, df 2] and 1.26 [95%CI -1.78; 4.29; Q=0.68. df 2] Four other studies compared the effectiveness of cognitive therapy in combination with a standard inpatient program, physiotherapy and usual GP care with these treatments alone.[Altmaier et al. 1992, Nicholas et al. 1991, Nicholas et al. 1992, Schweikert et al. 2006] The post-treatment WMD for pain and disability were –0.03 [95%CI –6.72; 6.65; Q=10.12, df 3] and –3.88 [95%CI –8.65; 0.89; Q=0.74, df 2], respectively.

The pooled WMDs at intermediate follow-up showed no statistical significant differences on pain intensity and disability (4.49 [95%CI -1.53; 10.50; Q=0.40, df 2] and 1.29 [95%CI –4.34; 6.91; Q=4.54; df 2], respectively).

One study compared a combination of respondent (biofeedback) and physiotherapy with physiotherapy alone.[Magnusson et al. 2008] A significant difference in favour of the combination group was found for pain intensity post-treatment, but also after 6 weeks and 6 months.

We found a total post-treatment WMD for pain intensity and disability of –2.33 [95%CI –6.59; 1.93; Q=24.05, df 7] and –1.82 [95%CI –3.88; 0.24; Q=2.75, df 5], respectively. At 6 months follow-up the total WMDs for pain intensity and disability were –0.72 [95%CI –8.13; 6.69; Q=31.54, df 6] and 1.39 [95%CI -0.80; 3.59; Q=4.83, df 5], respectively.

Three studies reported on the long-term outcomes pain and disability.[Smeets et al. 2006, Turner et al. 1990, Nicholas et al. 1990] Three studies compared a combination of operant behavioural treatment with exercise therapy/ physiotherapy with exercise/physiotherapy alone.[ The WMDs for pain intensity and disability were –1.23 [95%CI -7.29.4.83; Q=1.11. df 2] and 0.87 [95%CI –2.32; 4.06; Q=0.74, df 2], respectively. One study also compared a combination of cognitive treatment with physiotherapy with physiotherapy alone. We found a

non-signficant total WMD for long-term pain intensity and disability of –0.16[95%CI –6.03; 5.70; Q=2.28, df 3] and 0.85[95%CI –2.28; 3.98; Q=0.64, df 3], respectively.

Smeets et al. [2006] compared operant therapy in combination with exercise with exercise therapy alone and was the only study reporting on the outcome recovery. No significant differences were found post-treatment and at 6-months follow-up. However, a statically significant difference in favour of the exercise group was found at 12 months follow-up.

Only two studies reported on return to work and sick leave. Altmaier et al. [1992] found that 48% in the behavioural treatment group had returned to work after six months, compared to 67% in the control group. However, this difference was no statically significant. Schweikert et al. [2006] reported on the costs due to sick leave. During follow-up, the costs were lower in the cognitive behavioural group than in the usual care group.

*Behavioural treatment versus other kinds of treatment*

A total of six studies compared some kind of behavioural treatment with another treatment. Two studies [Smeets et al. 2006, Turner et al. 1990] compared operant behavioural treatment with exercise therapy, one study [van der Roer et al. 2008] compared operant therapy with physiotherapy, one study [Kole-Snijders et al. 1999] compared respondent therapy (muscle relaxation) with self-hypnosis, one study [Johnson et al. 2007] compared cognitive treatment with usual GP care and one study [Donaldson et al. 1994] compared operant therapy and respondent therapy (biofeedback) with education. All studies reported on pain intensity, four studies reported on disability and two studies reported on global recovery.

Post-treatment pain intensity was reported by four studies and the WMD for operant treatment was –1.61 [95%CI –6.83; 3.60; Q=2.96, df 3] and for respondent (biofeedback) therapy –11.33 [95%CI –22.81; 0.16; Q=0.23, df 1]. The total non-significant WMD for post-treatment pain intensity was –2.91 [95%CI -7.96; 2.13; Q=4.65, df 5].

Disability post-treatment was reported by three studies, all comparing operant therapy with exercise therapy/physiotherapy and the total WMD was –0.32 [95%CI –3.32; 2.68; Q=2.74, df 2].

Short-term follow-up results were reported by four studies.[Donaldson et al. 1994, Johson et al. 2007, McCauley et al. 1983, van der Roer et al. 2008] The WMD for pain intensity for operant therapy was –1.86 [95%CI –9.97; 6.25; Q=0.94, df 1], for respondent therapy (biofeedback) –5.03 [95%CI -18.15; 8.10; Q=0.01, df 1] and the total WMD for pain intensity was –5.00 [95%CI –10.08; 0.07; Q=0.99, df 4]. Disability was reported by two studies [Johnson et al. 2007, van der Roer et al. 2008], of which one had a low risk of bias, and the total WMD for disability at short-term follow-up was –0.84 [95%CI -5.23; 3.64; Q=0.78, df 1].

Three studies, comparing an operant therapy with exercise/ physiotherapy reported on the intermediate outcomes pain and disability and the WMDs were –0.11 [95%CI –7.64; 7.42; Q=3.35, df 2] and –0.28 [95%CI –4.16; 3.60; Q=3.21, df 2], respectively.

Four studies, of which two with a low risk of bias, reported on pain and disability at 12 months follow-up.[Smeets et al. 2006, Turner et al. 1990, Johnson et al. 2007, van der Roer et al. 2008] The significant WMD for pain intensity was –6.05 [95%CI –10.70; -1.40; Q=1.42, df 3] and the WMD for disability was –2.04 [95%CI –5.19; 1.10; Q=5.00, df 3].

Global perceived effect was reported by van der Roer et al. [2008] and by Smeets et al. [2006] and both studies did not find statistical significant differences between operant

behavioural treatment and exercise/physiotherapy, at post-treatment and at 3, 6 and 12 months follow-up.

*Comparison among different types of behavioural treatment*

*Cognitive versus operant*

One small study (n=20) with a high risk of bias compared cognitive to operant therapy.[Nicholas et al. 1991] All groups in this study also received a physiotherapy back-education and exercise program. The operant therapy group reported a significantly greater improvement in general function status, but not in pain intensity.

*Cognitive versus respondent therapy*

Two studies (n=67) with a high risk of bias compared cognitive to respondent therapy consisting of progressive muscle relaxation training.[Turner 1982, Turner & Jensen 1993] The pooled WMD of these two trails (n=67) for post-treatment pain intensity was –3.02 [95%CI -13.55; 7.52;Q=0.19, df 1] and for disability 2.31[95%CI -1.42; 6.04; Q=0.30, df 1]. Only one study (n=33) reported on long-term pain and disability, and these outcomes were not statistically significantly different between the groups.[Turner & Jensen 1993]

*Operant therapy versus respondent*

One study with a high risk of bias compared operant therapy (relaxation training) with respondent biofeedback therapy.[Donaldson et al. 1994] No statically significant differences were found on short-term and long-term (4 years) follow-up.

*Cognitive-behavioural versus cognitive*

Only one study (n=33) with a high risk of bias included a comparison between groups receiving cognitive-behavioural therapy and cognitive therapy.[Turner & Jensen 1993] The cognitive behavioural therapy consisted of cognitive therapy plus progressive muscle relaxation and imagery. There were neither post-treatment nor long-term statistically significant differences between the groups on any of the outcome measures (global improvement, disability and pain intensity).

*Cognitive-behavioural versus operant therapy*

Two studies, one with a low risk of bias, were identified.[Kole-Snijders et al. 1999, Turner & Clancy 1988] One study compared cognitive-behavioural therapy to operant therapy and found statistically significant better post-treatment results on pain behaviour, and physical functioning with operant therapy, but no differences between the groups after 6 and 12-month follow-up.[Turner & Clancy 1988] The second study reported better pain control post-treatment with cognitive-behavioural therapy, but no other post-treatment or long-term differences.[Kole-Snijders et al. 1999]

*Cognitive-behavioural versus respondent therapy*

One small study (n=28) with a high risk of bias was identified.[Newton-John et al. 1995] Cognitive behavioural therapy was compared to EMG-biofeedback. No significant differences were found between the groups for pain or any of the outcome measures in the behavioural domain, at either post-treatment or six-month follow-up.

*Operant therapy: in vivo exposure versus graded activity*

One study (n=85) with a low risk of bias compared an exposure in vivo treatment with a graded activity program.[Leeuw et al. 2008] No significant differences on pain intensity and disability at post-treatment or six-month follow-up were identified between both intervention groups.

*Cognitive-behavioural treatment: group or individual therapy*

One study compared the effectiveness of cognitive-behavioural group treatment with individual treatment.[Rose et al. 1997] No significant effects of group membership (individual versus group) on pain intensity and disability were demonstrated post-treatment and at 6-months follow-up.

**Multidisciplinary treatment**

**Summary of evidence**

*Multidisciplinary treatment versus no treatment/waiting list controls*

Three studies were identified comparing a multidisciplinary treatment with no treatment or waiting list controls.[Bendix et al. 1996, Jackel et al. 1990, Harkapaa et al. 1989] Jackel et al. [1990] reported on post-treatment pain intensity and found a statistical significant difference in favour of the multidisciplinary treatment compared to the waiting list controls.

Two studies [Bendix et al. 1996, Harkapaa et al. 1989] reported on short-term pain intensity and the significant pooled WMD was –9.47 [95%CI -13.87; -5.07; Q=0.11, df 1] and the pooled WMD for disability was –8.84 [95%CI –18.49; 0.82; Q=2.51, df 1]. Long-term outcomes revealed no statistical significant differences between a multidisciplinary rehabilitation and no treatment. The long-term non-significant WMDs for pain intensity and disability were –9.27 [95%CI –27.86; 9.12; Q=6.71, df 1] and –0.77 [95%CI -4.62; 3.08; Q=0.46, df 1], respectively.

One study reported on sick leave and found a statistical significant difference at 4-months follow-up between the treated and the non-treated group; the median days of sick leave in the intervention group was 10 days compared to 122 days in the control group.[Bendix et al. 1996]

*Multidisciplinary treatment versus other kinds of active treatment*

Four studies were identified comparing a multidisciplinary treatment with inpatient exercises [Alaranta et al. 1994], physiotherapy [Kaapa et al. 2006], usual care [Vollenbroek-Hutten et al. 2004] and exercise therapy.[Bendix et al. 1995]

One study reported on post-treatment disability and found no significant difference between both intervention groups.[Vollenbroek-Hutten et al. 2004]

Short-term pain-intensity was reported in two studies [Bendix et al. 1995, Alaranta et al. 1994] and the significant pooled WMD was –11.55 [95%CI –19.68;-3.43; Q=2.32, df 1]. One study reported on functional outcome and found a significant difference between both groups in favour of the multidisciplinary treatment at short-term follow-up.[Bendix et al. 1995]

Only one study with a low risk of bias reported on intermediate pain intensity and disability and no statistical significant differences between the two groups were found. [Kaapa et al. 2006]

Two studies [[Alaranta et al. 1994, Kaapa et al. 2006] reported on long-term pain intensity and we found a non-significant pooled WMD of –3.34 [95%CI –11.64; 4.97; Q=2.26, df 1]. Only one study, with a low risk of bias, reported on long-term (12 and 24 months) disability and found no statistically significant difference between multidisciplinary treatment and physiotherapy.[Kaapa et al. 2006]

One study with a low risk of bias, reported on work readiness and found a highly significant difference between the multidisciplinary intervention and the exercise intervention; 75% of the patients in the multidisciplinary group achieved work-readiness at 4-months compared to 42% in the active treatment group.[Bendix et al. 1995] Another study with a low risk of bias reported on sick leave and found no significant difference between both intervention groups, one and two years after rehabilitation.[Kaapa et al. 2006]

One study with a low risk of bias reported on pain, disability and return to work after 5-years follow-up.[Bendix et al. 1995] No significant differences were found on pain intensity, however patients in the multidisciplinary treatment group showed a lower disability level compared to the patients in the exercise group.

*Outpatient versus inpatient multidisciplinary treatment*

One study (n=316) with a high risk of bias compared a 3-week inpatient back school rehabilitation program with a 15-session outpatient back school rehabilitation program. [Harkapaa et al. 1989] No statistically significant differences were found between both intervention groups at short-term as well as on the long-term follow-up.

**Pharmacological procedures**

**Antidepressants**

**Summary of evidence**

*Antidepressants versus placebo: pain intensity*

A meta-analysis of four small placebo-controlled trials was performed [Atkinson et al. 1999, Dickens et al. 2000, Katz et al. 2005, Atkinson et al. 2007], which included two studies by Atkinson et al [1999, 2007] with two and three intervention arms respectively. One trial was excluded in the meta-analysis as they did not report follow-up means and standard deviations (SDs).[Atkinson 1998] There is moderate quality evidence (four RCTs; n=292) that there is a no difference in pain relief between antidepressants and placebo for patients with chronic non-specific low-back pain (SMD -0.02; 95% CI -0.26 to 0.22).

Evaluation of different types of antidepressants showed that there is moderate evidence that selective serotonin reuptake inhibitors (SSRIs) (three RCTs; n=199; SMD 0.11; 95% CI -0.17 to 0.39) and tricyclic antidepressants (TCAs) (two RCTs; n=104; SMD -0.11; 95% CI -0.72 to 0.51) are not more effective than placebo in the reduction of pain.

*Antidepressants versus placebo: depression*

Four trials with a low risk of bias compared antidepressants with placebo and reported no differences in depression. [Atkinson et al. 1999, Dickens et al. 2000, Katz et al. 2005, Atkinson et al. 2007] Overall, these results suggest that there is moderate evidence that antidepressants do not reduce depression in patients with chronic low-back pain. Due to lack of data in three studies, only Dickens [2000] reported data on depression, a meta-analysis could not be performed.

*Antidepressants versus placebo: functional status*

One study with a low risk of bias included functional status as an outcome measure.[Dickens et al. 2000] There is low quality evidence (one RCT; n=92) that there is no difference in functional status with the use of antidepressants compared to placebo in patients with low-back pain.

*Adverse events*

Only two studies reported data about any adverse event during the study.[Atkinson et al. 1998, 1999] The pooled results of these studies show that there is moderate evidence (two RCTs; n= 157) that there is no statistically significant difference between antidepressants and placebo in the occurrence of any adverse event during the study (RR 0.93; 95% CI 0.84 to 1.04) (Table 5, graph 02.03). Adverse events that were frequently reported in both groups were dry mouth, insomnia, sedation, orthostatic symptoms and constipation.

In the study of Atkinson et al. [2007] adverse effects were reported that interfered at least 'mildly' with everyday function. Statistically significantly ($p < 0.05$) more adverse effects were reported in the experimental arms desipramine n= 19 (63.3%) and fluoxitine n=16 (51,6%) compared to placebo n=3 (13.6%).

**Muscle relaxants**

**Summary of evidence**

There is strong evidence that benzodiazepines are effective for pain relief (level A) and conflicting evidence that they are effective for relieving muscle spasm (level C).

There is conflicting evidence that non-benzodiazepines are effective for pain relief (level C) and that they are not effective for the relief of muscle spasm.

**NSAIDs**

**Summary of evidence**

*NSAIDs versus placebo: pain intensity*

There is moderate quality evidence (four RCTs; n=1020) that NSAIDs are more effective than placebo for short-term pain relief (WMD -12.40; 95% CI -15.53 to -9.26).[Berry et al. 1982, Birbara et al. 2003, Coats et al. 2004, Katz et al. 2003]]

There is moderate quality evidence (four RCTs; n=1034) that there are statistically significantly more adverse effects in the NSAIDs group compared with placebo (RR 1.24; 95% CI 1.07 to 1.43).

**Opioids**

**Summary of evidence**

*Opioids versus placebo: pain intensity*

A meta-analysis was performed to combine the results of seven trials [Schnitzer et al. 2000; Ruoff et al. 2003; Peloso et al. 2004; Katz et al. 2007; Hale et al. 2007; Webster et al. 2006; Vorsanger et al. 2008]. Webster et al. [2006] and Vorsanger et al. [2008] included more than one intervention arm.

There is moderate evidence (seven RCTs; n=2350) that those who received opioids reported greater pain relief than those who received placebo (SMD -0.57; 95% CI -0.66 to -0.48).

There is moderate evidence (four RCTs; n=1258) that opioids (tramadol) are more efficacious than placebo for improving function as measured by the Roland Disability Questionnaire (RDQ, score 0 to 24, 0=no disability) (SMD -0.19 (95%CI -0.31 to 0.08).

*Adverse events*

Four studies reported totals about adverse events. There is moderate evidence (four RCTs; n=1176) that there are statistically significantly more adverse events in patients using opioids compared to placebo (RR 1.28; 95% CI 1.14 to 1.44). Adverse events most frequently reported were headache and nausea.

*Opioids versus other drugs*

Only one study, with a high risk of bias, compared opioids to another analgesic, i.e. naproxen.[Jamison et al. 1998] There is low quality evidence (one RCT; n=23) that there is no difference in pain intensity between opioids compared to other drugs (SMD -0.58; 95% CI -1.42 to 0.26). This was likely due to the small sample size. Jamison 1998 found no improvement in function for opioids compared with naproxen (SMD -0.06; 95% CI -0.88 to 0.76).

**Invasive procedures**

**Acupuncture**

**Summary of evidence**

*Acupuncture versus no treatment or waiting list control.*

Only one study (with a low risk of bias) was identified that showed a large significant effect at 8 weeks for pain relief in favour of acupuncture (MD -24.10, 95% CI -31.52 to -16.68) and for functional status (SMD -0.61, 95% CI -0.90 to -0.33) (low quality evidence).[Brinkhaus et al. 2006]

*Acupuncture versus sham, placebo or passive modalities.*

In total, 7 RCTs (5 with a low risk of bias) were identified.[Carlsson & Sjolund 2001, Haake et al. 2007, Brinkhaus et al. 2006, Itoh et al. 2006, Kerr et al. 2003, Leibing et al. 2002, Mendelson et al. 1983] One small study (n=19), which examined sham acupuncture in elderly subjects was excluded from the analysis because it has unexplainable, extremely large effects.[Itoh et al. 2006] For pain relief, a small, significant, but not clinically relevant effect was observed at the short-term and intermediate follow-ups in favour of acupuncture (MD -5.88, 95% CI -11.20 to -0.55; -7.27 95% CI -12.66 to -1.89; -3.26, 95% CI -6.28 to -0.23, respectively) (moderate quality evidence). Similarly, a significant, but small clinical effect was observed for functional status at the short-term and intermediate follow-up measurements (SMD -0.18, 95% CI -0.32 to -0.04; -0.28, 95% CI -0.41 to -0.16; -0.27, 95% CI -0.40 to -0.15, respectively) (moderate quality evidence).

*Acupuncture plus an intervention versus intervention alone.* In total, 5 RCTs (3 with a low risk of bias) were identified, which examined the therapeutic effects of acupuncture in addition to another therapy (physiotherapy [Leibing et al. 2002], standard medical care [Gunn et al. 1980, Witt et al. 2006, Meng et al. 2003], and exercise[Yeung et al. 2003]). A significant, but not clinically relevant effect was observed for pain relief at one, three and 12 months, but not six months (for which there was no data) (MD -9.80, 95% CI -14.93 to -4.67;

-16.91, 95% CI -25.18 to -8.64; -14.00, 95% CI -21.83 to -6.17, respectively) (moderate quality evidence). A strong, significant clinically relevant effect was observed for functional status at one and three months in favour of acupuncture (SMD -1.04, 95% CI -1.46 to -.61; -0.66, 95% CI -0.74 to -0.58, respectively) (moderate quality evidence). A significant effect was observed for recovery at 3 months in one study with a high risk of bias in favour of acupuncture (RR 5.90; 95% CI 1.96 to 17.70) (very low quality evidence).[Gunn et al. 1980] This was a study which examined the effects of acupuncture in exclusively male subjects who had failed traditional medical or surgical therapy. The long-term follow-up measurement was highly variable and therefore, not presented.

*Acupuncture versus any other intervention*

Only one study (with a low risk of bias) examined the effects of acupuncture versus another intervention, namely standard care, consisting of treatment by a physician or physiotherapist, and comprised a "multimodal treatment program".[Haake et al. 2007] Patients in the acupuncture group were allowed "rescue medication" for acute episodes consisting of a short course of NSAIDs (no more than 2 days per week). A statistically, but not clinically relevant effect was observed for pain at the short-term and intermediate follow-ups (MD -8.50, 95% CI -11.04 to -5.96; -9.40, 95% CI -12.13 to -6.67; -12.10, 95% CI -15.25 to -8,95, respectively) (low quality evidence). Also, a moderate statistically significant and clinically relevant effect was observed for functional status at the short-term and intermediate follow-ups in favour of acupuncture (SMD -0.53, 95% CI -0.67 to -0.38; -0.64, 95% CI -0.79 to -0.49; -0.76, 95% CI -0.91 to -0.61, respectively) (low quality evidence).

**Injection Therapy**

**Zygapophyseal joint (facet joint)**

*Facet joint injections with corticosteroids versus placebo*

Two RCTs, one with low risk of bias [Carette et al. 1991] and one with high risk of bias [Lilius et al. 1989], compared the effects of facet joint injections with corticosteroids to placebo injections. There was insufficient data on pain and functional status in the Lilius study to allow for statistical pooling of outcomes. In the Carette study, no significant differences were found between the groups at one and three months for pain, functional status, or self-rated improvement. At the six month follow-up, significant differences were found in favour of the corticosteroid group [Carette et al. 1991]. The high risk of bias study compared intra-articular and peri-capsular corticosteroid injections to placebo injections. No significant differences between the groups were reported for pain, disability, or work attendance at either short or intermediate term follow-ups [Lilius et al. 1989]. No side effects apart from transient pain were reported.

*Facet joint injections with corticosteroids versus other treatment*

Five RCTs compared the effects of corticosteroids injections into and around the facet joints with other treatments [Mayer et al. 2004, Fuchs et al. 2005, Manchikanti et al. 2001, Manchikanti et al. 2008, Marks et al. 1992]. Because of the clinical heterogeneity of the reference treatments, pooling was determined to be unsuitable.

In a study with low risk of bias [Marks et al. 1992], intra-articular facet joint injections with corticosteroids and lignocaine were compared with facet nerve blocks using similar medication. The facet joint injections provided slightly better pain relief than facet nerve

blocks, although statistical significance was only reached at one month, not immediately post-treatment or after three months.

Two RCTs with high risk of bias compared intra-articular facet joint corticosteroid injections to other treatments; one compared facet joint injections with a mixture of local anaesthetics and corticosteroids combined with a home stretching exercise program to the home stretching exercise program only [Mayer et al. 2004]. No significant post-treatment differences between the groups were found for pain and disability. The other trial compared the effects of facet joint corticosteroid injections with intra-articular sodium hyaluronate injections. No significant differences in pain relief, disability and quality of life between the groups were found at different follow-up points over a 6 month period [Fuchs et al. 2005].

One RCT with low risk of bias compared the effects of multiple medial branch blocks of corticosteroids combined with local anaesthetics to multiple medial branch blocks consisting of only local anaesthetics.[Manchikanti et al. 2008] No significant differences between the groups were found at 3 months, 6 months, or 12 months post-treatment. One RCT with high risk of bias compared the effects of multiple medial branch blocks of corticosteroids combined with local anaesthetics and Sarapin, to multiple medial branch blocks consisting of local anaesthetics and Sarapin. No significant differences between the groups were found for pain relief, overall health, functional status, and return-to-work over more than 2 years of follow-up.[Manchikanti et al. 2001]

*Facet joint injections with local anaesthetic versus placebo*

One RCT with low risk of bias compared intra-articular facet joint injections with lidocaine to intra-articular facet joint injections with saline.[Revel et al. 1998] In both groups these injections were followed by an injection of corticosteroid (cortivazol) near the joints. The lidocaine group had significantly higher pain relief post-treatment than the saline group.

**Epidural space**

*Epidural corticosteroid injections versus other treatments*

In an RCT with high risk of bias, an epidural injection with a corticosteroid and dextrose solution was compared to an intrathecal benzodiazepine with dextrose injection. Two weeks and two months post-treatment, no significant differences between the groups were reported for pain relief or general improvement.[Serrao et al. 1992]

One RCT with low risk of bias compared caudal epidural local anaesthetic and steroid injection with targeted epidural local anaesthetic and steroid placement with a spinal endoscope.[Dashfield et al. 2005] No significant differences were found between the groups for any of the outcome measures at any of the times. In all patients in the endoscope group, post-treatment low back discomfort was experienced but this was not persistent.

*Epidural injections with local anaesthetics versus other treatments*

One RCT with low risk of bias compared the effects of epidural blocks with ropivacaine to epidural blocks with bupivacaine.[Lierz et al. 2004] Eight single shot epidural injections followed by active physiotherapy were performed in all patients. There were no significant differences found between the groups in post-treatment analgesia. There were three cases of short episodes of headache post-injection.

**Lumbar musculature**

*Intramuscular injections with Vitamin B12 versus placebo*

In one RCT with high risk of bias [Mauro et al. 2001], the effects of intramuscular Vitamin B12 injections were compared to intramuscular placebo injections. Post-treatment, there were significant improvements for pain and disability in favour of the Vitamin B12 group.

*Intramuscular injections with botulinum toxin A versus placebo*

In one small RCT (N=31) with low risk of bias, intramuscular injections of botulinum toxin A were compared to intramuscular placebo injections of saline [Foster et al. 2001]. At 3 weeks follow-up, the degree of pain relief was significantly different between groups in favour of the botulinum toxin A group. At 8 weeks patients in the botulinum toxin A group had significantly more pain relief and better ODI scores than the placebo group.

**Denervation procedures**

*Intervertebral disc*

*Percutaneous intradiscal radiofrequency thermocoagulation (PIRFT) versus placebo*

In one small placebo-controlled trial (n = 28) with low risk of bias, no significant differences were found between PIRFT and sham PIRFT in pain VAS scores, global perceived effect, Oswestry Disability Index (ODI), or a composite outcome of overall treatment success 8 weeks post-treatment [Barendse et al. 2001]. In a second small placebo-controlled trial (n = 20) with low risk of bias, only follow-up data collected after 6 and 12 months post-treatment were reported [Kvarstein et al. 2009]. No significant differences were seen between the PIRFT and sham-PIRFT groups on pain intensity or functional status at either of these time points. Because of the variability in the timing of outcome measures between these two studies, a decision was made not to pool the results.

A third small trial (n = 37) with high risk of bias found minimal improvement over 6 months on pain (VAS) and disability (ODI) with both lower- and higher- intensity of PIRFT. No significant differences were found between the groups at any of the follow-up assessments [Ercelen et al. 2003]. No complications or adverse events were reported in the placebo controlled trials. One patient was excluded from the analysis because of discitis.

*Intradiscal electrothermal therapy (IDET) versus placebo: pain*

In patients with a positive response to provocative discography, two small (n = 55 and n = 56), low risk of bias, placebo-controlled randomized trials evaluated IDET and both provided sufficient data for pooling [Freeman et al. 2005, Pauza et al. 2004]. Both studies measured pain with the SF-36 Bodily Pain Index (100- point scale). There is low quality evidence (two RCTs; n=111) that IDET is more effective than placebo for pain relief over a long-term (6 months) follow-up (WMD -7.84; 95% CI -14.96 to -0.72).

The same two RCTs [Freeman et al. 2005, Pauza et al. 2004] provided ODI scores on a 100-point scale which allowed statistical pooling. There is low quality evidence (two RCTs; n=111) that IDET is no more effective than placebo in improving functional status over a long term (6 months) follow-up (WMD -4.93; 95% CI -10.11 to 0.25).

In patients unresponsive to treatment with IDET, one high risk of bias RCT found radiofrequency denervation of the ramus communicans nerve was associated with better VAS pain, SF-36 bodily pain, and SF-36 physical function scores after 4 months compared

to sham denervation [Oh & Shim 2004]. In one RCT, 4 patients who underwent IDET experienced transient radiculopathy (< 6 weeks) [Freeman et al. 2005]. No other serious adverse events were reported in the three trials.

*Zygapophyseal joint (facet joint)*

*Radiofrequency denervation of facet joints versus placebo: pain*

Five RCTs provided sufficient data on pain VAS scores to allow for pooling over a short, intermediate, or long term follow-up [Gallagher et al. 1994, Nath et al. 2008, Tekin et al. 2007, van Kleef et al. 1999, van Wijk et al. 2005]. All studies included only patients with a positive response (~50-80% pain relief) to local anaesthetic nerve block. One RCT was not included in the primary analyses due to clinical heterogeneity of patient selection procedures [Leclaire et al. 2001].

For short-term outcomes, there is low quality evidence (two RCTs; n = 90) that radiofrequency denervation of lumbar facet joints is more effective than placebo for pain relief over a short-term follow-up (WMD -18.15 95% CI -24.21 to -12.09).

For intermediate term outcomes (1-6 months), there is low quality evidence (two RCTs; n = 112) that radiofrequency denervation of lumbar facet joints is no more effective than placebo for pain relief (WMD -9.29 95% CI -22.57 to 4.00).

For long-term outcomes (6 months), there is low quality evidence (three RCTs; n = 130) that radiofrequency denervation of lumbar facet joints is no more effective than placebo for pain relief (WMD -6.99 95% CI -14.73 to 0.76).

One RCT with low risk of bias compared radiofrequency denervation of the dorsal root ganglion to sham denervation.[Geurts et al. 2003] No significant differences were found between groups at 3 month follow-up. Adverse events and complications did not differ between treatments, and no serious complications or side effects arose in either group.

*Radiofrequency denervation of facet joints versus placebo: functional status*

There is very low quality evidence (one RCT; n = 60) that radiofrequency denervation of lumbar facet joints is more effective than placebo for improvement of function in the short term (WMD -5.53 95% CI -8.66 to -2.40).[van Kleef et al. 2005]

*Radiofrequency denervation of facet joints versus other treatment*

In a study with low risk of bias [Tekin et al. 2007], conventional radiofrequency denervation of the lumbar facet joints was compared to pulsed radiofrequency denervation. Both treatments improved pain VAS and ODI scores compared to placebo, with conventional denervation improving significantly more than pulsed denervation by 6 months and 1 year post-treatment.

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