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[Intervention Review]

Conservative treatments for whiplash

Arianne P Verhagen[1], Gwendolijne GGM Scholten-Peeters[2], Sandra van Wijngaarden[3], Rob de Bie[4], Sita MA Bierma-Zeinstra[1]

[1]Department of General Practice, Erasmus Medical Center, Rotterdam, Netherlands. [2]Den Bosch, Netherlands. [3]Erasmus Medical Center, Rotterdam, Netherlands. [4]Department of Epidemiology, Maastricht University, Maastricht, Netherlands

Contact: Arianne P Verhagen, Department of General Practice, Erasmus Medical Center, PO Box 2040, Rotterdam, 3000 CA, Netherlands. a.verhagen@erasmusmc.nl.

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ABSTRACT

Background

Many treatments are available for whiplash patients but there is little scientific evidence for their accepted use. Patients with whiplash-associated disorders (WAD) can be classified by the severity of signs and symptoms from Grade 0 (no complaints or physical signs) to Grade 4 (fracture or dislocation).

Objectives

To assess the effectiveness of conservative treatment for patients with whiplash injuries rated as Grades 1 or 2 (neck and musculoskeletal complaints).

Search methods

We searched the Cochrane Central Register of Controlled Trials (The Cochrane Library, 2006, Issue 3), MEDLINE, CINAHL, PsycINFO, and PEDro to November 2006 and screened references of identified randomised trials and relevant systematic reviews.

Selection criteria

We selected randomised controlled trials published in English, French, German or Dutch, that included patients with a whiplash-injury, conservative interventions, outcomes of pain, global perceived effect or participation in daily activities.

Data collection and analysis

Two authors independently assessed the methodological quality using the Delphi criteria and extracted the data onto standardised data-extraction forms. We did not pool the results because of the heterogeneity of the population, intervention and outcomes and lack of data. A pre-planned stratified analysis was performed for three different comparisons.

Main results

Twenty-three studies (2344 participants) were included in this update, including nine new studies. A broad variety of conservative interventions were evaluated. Two studies included patients with chronic symptoms (longer than three months), two included subacute (four to six weeks) symptoms, two had undefined duration of symptoms, and 17 studied patients with acute (less than three weeks) symptoms. Only eight studies (33.3%) satisfied one of our criteria of high quality, indicating overall, a poor methodological quality. Interventions were divided into passive (such as rest, immobilisation, ultrasound, etc) and active interventions (such as exercises, act as usual approach, etc.) and were compared with no treatment, a placebo or each other.

Clinical and statistical heterogeneity and lack of data precluded pooling. Individual studies demonstrated effectiveness of one treatment over another, but the comparisons were varied and results inconsistent. Therefore, the evidence neither supports nor refutes the effectiveness of either passive or active treatments to relieve the symptoms of WAD, Grades 1 or 2.

Authors' conclusions

The current literature is of poor methodological quality and is insufficiently homogeneous to allow the pooling of results. Therefore, clearly effective treatments are not supported at this time for the treatment of acute, subacute or chronic symptoms of whiplash-associated disorders.

PLAIN LANGUAGE SUMMARY

Conservative treatments for whiplash

Whiplash is defined as an acceleration-deceleration mechanism of energy transfer to the neck. It may result from rear-end or side-impact motor vehicle collisions or during diving, among other mishaps.

Whiplash-associated disorders (WAD) can be classified by the severity of signs and symptoms from Grade 0 (no complaints or physical signs) to Grade 4 (fracture or dislocation). Whiplash-associated disorders have been reported in 70 in 100,000 inhabitants in a Canadian province, to 188 to 325 per 100,000 inhabitants in The Netherlands. Conservative treatments (for example, physiotherapy, acupuncture, or a collar) are the most common treatment options for whiplash patients, but the evidence supporting their effectiveness remains conflicting.

We included 23 studies (2344 participants with WAD Grades 1 or 2), nine of which were new for this update. Overall, the methodological quality was poor and the studies included populations and interventions that were too different to pool. Two studies examined treatments for patients with chronic pain (longer than three months), two looked at subacute pain (four to six weeks), two were unclear (but one was probably chronic), and the rest looked at patients with acute symptoms of less than three weeks.

In 11 studies, an active treatment approach (treatment strategy including exercises or advice to 'act as usual') was compared to a passive strategy, no treatment or was an additional treatment. Eight studies compared an active intervention with a passive one (the patient received a treatment such as advice to rest and wear a neck collar, an educational video, electrotherapy, manipulation, hot and cold packs, traction, or acupuncture). Eight studies compared an intervention with a placebo or no treatment. In seven studies, two active treatments were compared against each other and in one, a passive intervention was compared to injections.

Since we were unable to pool any of the studies, we remain unable to either support or refute the effects of conservative treatments for acute, subacute or chronic whiplash-associated disorders with the current evidence.

BACKGROUND

Until recently, there was no consensus on the definition of whiplash. The term whiplash was used to describe a mechanism of injury, the injury itself, the various clinical manifestations that developed as a consequence of the injury, and signs and symptoms designated as 'the whiplash syndrome'. In 1995, the Quebec Task Force (QTF) on Whiplash Associated Disorders (WAD) adopted the following definition of whiplash: "*Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It may result from rear-end or side-impact motor vehicle collisions, but can also occur during diving or other mishaps. The impact may result in bony or soft-tissue injuries (whiplash-injury), which in turn may lead to a variety of clinical manifestations called Whiplash-Associated Disorders*" (Spitzer 1995). Patients with whiplash can be classified by the severity of signs and symptoms: Grade 0 means no complaints or physical signs; Grade 1 indicates neck complaints (such as pain, tenderness and stiffness) but no physical signs; Grade 2 indicates neck complaints and musculoskeletal signs (such as a decreased range of motion or muscle weakness); Grades 3 and Grade 4 indicate neck complaints and neurological signs (such as sensory deficit) or fracture or dislocation, respectively. Research (Hildingsson 1990; Norris 1983; Radanov 1991; Stovner 1996) revealed that the most commonly presented symptoms in the acute phase following a motor vehicle collision were neck pain (88% to 100%) and headache (54% to 66%). Other symptoms were neck stiffness, shoulder pain, arm pain or numbness, or both, paraesthesia, weakness, dysphagia, visual and auditory symptoms, dizziness and concentration difficulties (Scholten-Peeters 2003). The causal mechanism of an organic lesion as a result of an injury or the clinical manifestations are not widely accepted (Barnsley 1994; Bogduk 1986). It is controversial as to whether chronic pain and disability can be solely related to an organic lesion or musculoskeletal signs, or both. These complaints do not explain prolonged symptoms and disabilities in daily activities (Stovner 1996). Other factors, such as expectation of pain (Kasch 2000) and type of compensation system (Cassidy 2000) may also play a role in long-term complaints.

The incidence of whiplash injury varies greatly between different parts of the world, with rates as high as 70 per 100,000 inhabitants in Quebec (Spitzer 1995), 106 per 100,000 in Australia (Miles 1988) and 188 to 325 per 100,000 inhabitants in the Netherlands (Wismans 1994). There is no agreement in the literature about the natural course and epidemiology of whiplash injury (Barnsley 1994; Freeman 1998; Spitzer 1995). The Quebec Task Force's statement that whiplash injuries have 'favourable prognosis' and their conclusion that 87% and 97% of the patients recovered from their injury at six months and 12 months after the vehicle collision, respectively, is questionable. The authors defined 'recovery' as cessation of time-loss compensation. Whether these patients still had pain or discomfort and needed medical care was not reported. A review contradicted the QTF's conclusions that most whiplash injuries were short-lived (Barnsley 1994). These authors concluded that between 14% and 42% of the whiplash patients developed chronic complaints (longer than six months), and that 10% of those had constant severe pain. Internationally, the proportion of chronic complaints varies between two per cent and 58% (Coté 2001; Scholten-Peeters 2003), but lies mainly between 20% and 40%.

The effectiveness of conservative interventions for patients with WAD is still under debate (Aker 1996; Seferiadis 2004; Spitzer 1995). A lot of research has been done about the effect of treatment options that cover a wide range of conservative care: local heat and ice treatment, neck collar immobilization, ultrasound, traction, massage, (active) mobilization, exercises, pulsed electromagnetic therapy, multimodal rehabilitation, etc. Our previous review showed that there was little evidence for their 'accepted' use. Recently, nine new trials were found and this review was updated to see whether these new trials would enlarge the body of knowledge concerning the effectiveness of widely used interventions.

In this review we focus on WAD Grades 1 and 2 because these concern the major group of whiplash patients and these patients normally receive conservative interventions. The primary research question is: What types of conservative treatments are effective in patients with WAD Grades 1 and 2 regarding pain, global perceived effect or participation in daily activities? A second research question is: What is the difference in the efficacy of these treatments between patients with acute and chronic whiplash symptoms?

OBJECTIVES

The aim of this systematic review was to analyse the efficacy of conservative treatment options for patients with WAD Grades 1 and 2.

METHODS

Criteria for considering studies for this review

Types of studies

A study was included if the design was a randomised controlled trial (RCT).

Types of participants

A study was included if the study population included patients that suffered from a whiplash injury classified as WAD Grades 1 or 2, meaning patients with neck complaints with or without musculoskeletal signs.

Types of interventions

A study was included if the intervention was a conservative one. A conservative intervention was defined as any non-invasive, non-surgical form of treatment. Drug treatments were excluded.

Types of outcome measures

A study was included if pain, global perceived effect or participation in daily activities were one of the outcome measures. These were the main outcome measures of the review and were chosen with reference to the whiplash problem (Stovner 1996) and by considering that they could be influenced by conservative treatment strategies. Data on other outcome measures, such as well-being, disability or adverse effects were also considered when mentioned in the studies.

Search methods for identification of studies

We searched the Cochrane Central Register of Controlled Trials (The Cochrane Library, 2006, Issue 3), MEDLINE (1966 to November 2006), CINAHL (1982 to November 2006), PsycINFO (November

2006), PEDro (November 2006) databases, and reference lists of relevant RCTs and reviews. We used the search strategy recommended by the Cochrane Back Group (van Tulder 2003). See Appendix 1 and Appendix 2 for search details. We did not limit by language.

Data collection and analysis

Study selection

For this update, two authors (AV and SvW) independently reviewed the titles and abstracts of the identified articles to determine potential relevance. The same two authors independently applied all selection criteria to the full text of the articles that had passed the first eligibility screening. Disagreements were solved by consensus (100%) and if necessary, by a third party (GGMSP).

Methodological Quality Assessment

Pairs of two authors (GGMSP, SvW or RAdB) independently assessed the methodological quality of the studies using the Delphi criteria (Verhagen 1998). Depending on information available, criteria were marked 'yes', 'no', or 'don't know'. In cases of disagreement, another author (APV) made a final decision. The assessment was not performed under masked conditions since the authors were familiar with many of the trials, and there is no consensus whether assessment should be blinded for authors, institutions, journal, publication year and results (Jadad 1998; Verhagen 1998b). Equal weights were applied to all Delphi criteria. Items scoring a 'yes' contributed to the quality scores, ranging from zero to 10.

We choose to use the Delphi criteria for quality assessment in this update because we found that these criteria appeared to be as reliable as the Maastricht-Amsterdam criteria but easier to use (Verhagen 2000). The Delphi criteria are listed in Table 1.

Data extraction

Pairs of two authors (GGMSP, RAdB or SvW) extracted the data from each study into a pre-formatted table. Information on clinical relevance items such as detailed information on treatments, patient's characteristics and outcome measures were also extracted.

Analysis

A quality score was calculated by adding the Delphi criteria that scored positive, resulting in a score ranging from 0 to 10. In an attempt to address the observation that the use of different criteria to assess quality might effect the conclusions of a systematic review (Moher 1996), we defined 'high' quality studies in two ways: 1) studies that reported a concealed randomisation procedure and adequate blinding, or 2) a positive score on at least six (more than 50%) Delphi criteria.

We calculated inter-observer reliability of the quality assessment using IntraClass Correlation Coefficients (ICC). ICCs greater than 0.7 are considered to indicate good agreement, between 0.5 and 0.7 moderate, and less than 0.5 poor agreement (Landis 1977).

Quantitative analysis

The outcome measures are presented separately for each comparison (see Graphs). For dichotomous data, results are expressed, if possible, as relative risks (RR) with corresponding 95 per cent confidence intervals (95% CI), and as weighted (WMD) or standardised mean differences (SMD) with 95% CI for continuous data. MetaView (RevMan 2000) was used to analyse the data. Pooling was not implemented, as studies were considered clinically heterogeneous for both the study population and intervention.

Qualitative analysis

When data were lacking but the trials were clinically homogeneous, we had planned to analyse the results using levels of evidence (van Tulder 2003). The five levels of evidence take into account the study design, methodological quality and direction for each outcome for each comparison across studies and are defined as:
1) **Strong evidence**: consistent findings among multiple (two or more) high quality RCTs;
2) **Moderate evidence**: one high quality RCT or consistent findings among multiple (two or more) low quality RCTs;
3) **Limited evidence**: one low quality RCT;
4) **Conflicting evidence**: inconsistent findings among multiple RCTs;
5) **No evidence**: no RCTs found.

Findings were to be considered consistent when over 75% of the studies come to the same conclusion (Smidt 2002). Because of clinical heterogeneity, we also did not pool the results from studies qualitatively.

Clinical relevance

Clinically relevant improvement was defined as a 15% improvement relative to a control. A relative percentage difference (RPD) as defined by the Philadelphia Panel on Rehabilitation Interventions (Philadelphia 2001) of greater than 15% indicates clinical importance. RPD was calculated as the absolute benefit divided by the average of the baseline means (weighted for the treatment and control groups). Absolute benefit was calculated as the improvement in the experimental group less the improvement in the control group, in the original units.

Pre-planned stratified analyses were:

1. Trials comparing conservative treatment with placebo, no treatment or waiting list controls
2. Trials comparing different forms of conservative treatment
3. Trials comparing conservative treatments with other treatment(s) (e.g., oral medication)

RESULTS

Description of studies

For this update, a total of 29 eligible reports were identified, six of which were double publications, so 23 trials are included. Nine are new studies identified for this update (Aigne 2006; Brison 2005; Bunketorp 2006; Crawford 2004; Ferrari 2005; Florio 1999; Oliveira 2006; Scholten-Peeters2006; Söderlund 2001a). One non-randomised study was excluded (Gennis 1996). All studies varied considerably with respect to study population, intervention and outcome measures, therefore we did not pool the results, but instead offer a brief summary of the studies.

Participants

Two studies included chronic whiplash patients (pain lasting for at least three months) (Fitz-Ritson 1995; Söderlund 2001a). In two studies, the duration of neck pain was unclear (Florio 1999;

Thuile 2002), but in Florio 1999 we assumed this concerns chronic patients, since there was reference to 'post-acute' treatment. Two new studies included subacute patients with complaints that had been present for at least four to six weeks (Bunketorp 2006; Scholten-Peeters2006), while Provinciali 1996 included patients with a combination of acute and subacute pain that was less than two months in duration. The rest of the studies included patients with acute whiplash, with pain that was less than three weeks in duration. Studies varied considerably with respect to study population; factors like previous whiplash injury, history of headaches or neck pain prior to the crash, sort of collision, etc, varied. In the literature, these factors are seen as important prognostic factors and are associated with a delayed recovery (Scholten-Peeters 2003; Spitzer 1995; Stovner 1996).

Interventions

The trials examined different types of interventions, ranging from immobilization with a soft cervical collar to early active mobilization (Mealy 1986), Pulsed ElectroMagnetic Therapy (PEMT) (Foley-Nolan 1992), laser acupuncture (Aigne 2006), multimodal treatment (Provinciali 1996) and the use of a psycho-educational video in the waiting room (Brison 2005; Oliveira 2006). Often a combination of interventions was compared with another combination of control interventions. The dosage was often not described.

Two studies included a control group receiving placebo treatment (Aigne 2006; Foley-Nolan 1992), six studies included a no-treatment control group (Brison 2005; Ferrari 2005; Fialka 1989; Gennis 1996; Hendriks 1996; Oliveira 2006). In one study, a passive approach (ultra-reiz current) was added to a standard treatment with exercises (Hendriks 1996) and in one study the control treatment was unclear (Thuile 2002).

In total, eight of the 23 studies compared an active approach with periods of rest and a soft cervical collar (Bonk 2000; Borchgrevink 1998; Crawford 2004; McKinney 1989; Mealy 1986; Pennie 1990; Rosenfeld 2000; Schnabel 2004); two studies compared an active approach to a passive approach other than rest and a collar (Fialka 1989; Provinciali 1996), and in one study an active approach was added to a passive approach (Fitz-Ritson 1995).

Six studies compared two active approaches (Bunketorp 2006; McKinney 1989; Rosenfeld 2000; Scholten-Peeters2006; Söderlund 2000; Söderlund 2001a), and in one study passive physiotherapy (electrotherapy) is compared to mesotherapy (injection of ketorolac tromethamine 30 mg + xylocaine 2%) (Florio 1999).

Outcome assessment

The outcome measures that were used changed from pain and cervical range of motion (ROM) in studies up to 1995, to pain and days off work or state of health in studies published after 1995.

Most studies presented the data poorly, if at all, which made it impossible to calculate relative risks or weighted mean differences for most outcome measures.

Overall, most new studies included in this update (Aigne 2006; Crawford 2004; Florio 1999; Oliveira 2006; Söderlund 2001a) did not perform better on methodological quality assessment than the studies in the previous review. However, the second and third publications from Rosenfeld et al as and the most recent publication from Schnabel et al met more of the Delphi criteria than earlier publications by the same study teams (Rosenfeld 2000; Schnabel 2004).

Risk of bias in included studies

The interobserver reliability of the overall methodological quality assessment (ICC = 0.73) can be described as 'good'. Disagreements occurred mainly because of reading errors and differences in interpretation of the methodological criteria. The quality assessments resulted in a hierarchical list in which higher scores indicated higher methodological quality, that is, more of the Delphi criteria were met.

Five studies were assessed to be high quality based on the first criterion: presented a concealed randomisation procedure and adequate blinding (Brison 2005; Bunketorp 2006; Rosenfeld 2000; Schnabel 2004; Scholten-Peeters2006). Eight studies met six or more Delphi criteria (Borchgrevink 1998; Brison 2005; Bunketorp 2006; Ferrari 2005; Foley-Nolan 1992; Provinciali 1996; Scholten-Peeters2006; Schnabel 2004), and therefore were considered high quality because of the second criterion. The mean score was 4.7 points, which still corresponds with an overall poor methodological quality, but is higher compared to the last version of this review (3.6).

The most prevalent shortcomings of the trials concerned: no description of the randomisation procedure; no description of blinding, poor data presentation and no proper analysis (intention-to-treat). Most authors failed to describe which method of randomisation was used. Two studies used the word random but their treatment allocation could not be regarded as appropriate (Oliveira 2006; Pennie 1990). Five studies mentioned a concealed randomisation procedure (Brison 2005; Bunketorp 2006; Rosenfeld 2000; Scholten-Peeters2006; Schnabel 2004).

See Table 2.

Effects of interventions

Study Selection

Initially, 35 studies met the inclusion criteria. After the first eligibility screening, both authors independently excluded six articles. Four of them were non-controlled studies, and two included a patient population without whiplash. Six articles were duplicate publications of other included studies. Consequently, 23 articles were included for quality assessment in the systematic review, nine of which were new trials for this update (Aigne 2006; Bonk 2000; Borchgrevink 1998, Brison 2005; Bunketorp 2006; Crawford 2004; Ferrari 2005; Fialka 1989, Fitz-Ritson 1995, Florio 1999; Foley-Nolan 1992, Hendriks 1996, McKinney 1989, Mealy 1986, Pennie 1990, Oliveira 2006; Provinciali 1996; Rosenfeld 2000; Schnabel 2004; Scholten-Peeters2006; Söderlund 2000; Söderlund 2001a; Thuile 2002).

Trials comparing conservative treatment with placebo or no treatment

1. Passive intervention versus placebo or no treatment

We defined passive intervention as an intervention where the patient was not actively involved in exercises or activities e.g. ultrasound, electrostimulation, rest, immobilisation, etc. Nine studies evaluated a passive intervention with a placebo, no

treatment control group or as additional treatment and three studies were considered high quality (Brison 2005; Ferrari 2005; Foley-Nolan 1992). Four studies (617 participants) provided data (Brison 2005; Ferrari 2005; Fialka 1989; Foley-Nolan 1992)

a) Passive intervention versus placebo

One high quality study (Foley-Nolan 1992, n = 40) reported that PEMT (Pulsed ElectroMagnetic Therapy) was more effective than placebo for reducing pain (Relative Risk (RR) 0.23; 95%confidence interval (CI): 0.08 to 0.69) and improving 'subjective assessment of progress' (or 'perceived effect') in patients with an acute whiplash injury (less than 72 hours) at two and four weeks. By the end of the 12-week intervention period, the effects were no longer significant (RR 0.38; 95%CI: 0.12 to 1.21). However, the groups were not comparable at baseline with respect to previous whiplash injury; 20% of the patients in the experimental group compared to five per cent of the patients in the control group had previous whiplash injury.

One low quality study (Aigne 2006) compared laser acupuncture with placebo laser in 50 patients and found no differences between the groups on symptoms and range of motion. They provided no supporting data.

b) Passive intervention versus no treatment

Six studies (Brison 2005; Ferrari 2005; Fialka 1989; Hendriks 1996; Oliveira 2006; Thuile 2002) compared a passive treatment with no treatment or as an addition to a standard treatment; four of which were low quality studies and only two of which provided data (Brison 2005; Ferrari 2005).

Two studies evaluated the benefit of adding a psycho-educational video on cervical spine radiographs and pain medication to usual care (Brison 2005; Oliveira 2006). Brison 2005 (n = 405) compared a 20-minute educational video plus usual care with usual care. Usual care was defined as usual follow-up care, for example, from other practitioners. At six weeks (RR 0.98; 95%CI: 0.8 to 1.19) and six months (RR 0.86; 95%CI: 0.63 to 1.16) there were no significant differences between the two groups in pain reduction. Oliveira 2006 (n = 126) stated they found statistically significant benefit of the video at one, three and six-month follow-up, but did not provide supporting data.

Another high quality study (Ferrari 2005, n = 112) evaluated the use of an educational pamphlet with information based on current evidence with usual care. In this case, usual care was defined as usual emergency department care, which included giving the patient an information sheet. No differences in short-term (two weeks) (RR 1.02; 95%CI: 0.91 to 1.13) or long term (three months) recovery and pain (RR 0.9; 95%CI: 0.92 to 1.2 and RR 97; 95%CI: 0.79 to 1.19, respectively) were found.

Fialka 1989 (n = 60) compared two groups with a passive intervention (middle frequency electrotherapy and iontophoresis) with a group that received no treatment and found no differences in pain in short-term follow up (RR 0.89; 95% CI: 0.47 to 1.67). Hendriks 1996 (n = 16) compared the addition of Ultra-reiz current to a standard treatment of ice, home exercises and advice, but did not provide supporting data. Thuile 2002 (n = 92) compared magnetic therapy with a control group (unclear) and provided no data.

In conclusion, for the moment, it appears that a passive treatment is not more effective than a placebo or no treatment for relieving symptoms for individuals with acute whiplash.

2. Active interventions versus no treatment

We defined active interventions as those in which the patient actively participated (e.g. exercises). One low quality trial compared an active intervention of exercises, traction and massage with a control group receiving no treatment (Fialka 1989, n = 60). At six weeks, neck pain was significantly reduced (RR 0.33; CI: 0.11 to 0.99).

In another study, Hendriks 1996 (n = 16) added a passive approach as a surplus treatment to a standard treatment with exercises. Only data on ROM are presented, but show no significant differences at six weeks.

Trials comparing different forms of conservative treatments

1. Active versus passive treatments.

a) Active interventions versus rest and a collar

Eight out of 23 studies compared an active approach with periods of rest and use of a soft cervical collar (Bonk 2000; Borchgrevink 1998; Crawford 2004; McKinney 1989; Mealy 1986; Pennie 1990; Rosenfeld 2000; Schnabel 2004). Two trials were considered high quality (Borchgrevink 1998; Schnabel 2004).

Borchgrevink 1998 (n = 201) found that there was no significant difference in reduction of neck pain (RR 0.86; 95%CI: 0.42 to 1.76), global perceived effect (RR 0.91; 95%CI: 0.61 to 1.35) or return to work (RR 1.34; 95%CI: 0.51 to 3.53) between those who had been advised to act as usual (continue to engage in their normal pre-injury activities) and those who were given time off from work and immobilized with a soft collar during the first 14 days after a car accident, measured at six months.

Schnabel 2004 (n = 200) found no difference in neck pain at six weeks (RR 0.84; 95%CI: 0.53 to 1.34) and six months (RR 0.71; 95%CI: 0.38 to 1.3) between participants who had suffered a whiplash within the past 48 hours and were told to rest and use a collar and those who received physiotherapy (heat, massage and exercises). However, when available VAS data were used (n = 173), those receiving physiotherapy reported significant reduction in pain at six weeks (standardized mean difference (SMD) 0.48; 95%CI: 0.18 to 0.78) and six months (SMD 0.49; 95%CI: 0.19 to 0.8).

Six low quality studies (Bonk 2000; Crawford 2004; McKinney 1989; Mealy 1986; Pennie 1990; Rosenfeld 2000) compared an intervention including exercise therapy with a control group who was advised to rest and use a soft collar. In four studies, the active physiotherapy intervention included exercises or an 'act as usual' approach plus passive treatments such as massage, traction and thermo therapy (Bonk 2000; McKinney 1989; Mealy 1986; Pennie 1990)

Rosenfeld 2000 (n = 97) randomised participants into four groups. Two groups received exercises; one group starting within 96 hours after the accident and the other group after 14 days. Two control groups received a standard treatment (rest, collar, information on posture and advice on activities); one group starting treatment within 96 hours after the accident and the other group after 14 days. The results showed reduction of pain intensity (RR 0.70; 95% CI: 0.52

to 0.94) for those who received physiotherapy at six months but not at three years (RR 0.80; 95% CI; 0.53 to 1.21). A cost effectiveness analysis showed significantly lower costs for the active groups at six month compared to the standard treatment.

McKinney 1989 (n = 170) compared physiotherapy (combination of active and passive exercises, hot or cold applications, traction diathermy, hydrotherapy), advice to exercise at home and advice to rest for two weeks, gradually increasing activities and exercises. They did not provide supporting data. Bonk 2000 (n = 103) reported better pain control for those who received physiotherapy compared to those who were advised to rest and wear a collar, when measured at six weeks (RR 0.17; 95% CI: 0.07 to 0.40), and 12 weeks (RR 0.13; 95% CI: 0.02 to 1.02). There were no significant differences in return-to-work in the long-term (longer than three months) (RR 0.73; 95% CI: 0.43 to 1.22). Mealy 1986 (n = 61) reported decreased pain in the short term (less than six weeks) for those who received physiotherapy compared to those who received advice to rest and wear a collar (SMD -0.79; 95% CI: -1.31 to -0.27). Crawford 2004 (n = 108) found no significant difference in pain between the two groups when measured at 12 weeks (SMD -0.18; 95% CI: -0.55 to 0.20), while Pennie 1990 (n = 135) found no statistical differences when pain was measured at six months (RR 2.41; 95% CI: 0.22 to 25.95).

None of the studies were clinically homogenous, so we did not pool the results.

b) Active interventions versus other passive treatments

Two studies compared an active approach with a passive approach other than rest and a collar (Fialka 1989; Provinciali 1996), and one study added a passive treatment to the active treatments (Fitz-Ritson 1995). Provinciali 1996 is high quality.

Provinciali 1996 (n = 60) compared multimodal treatment (exercises combined with psychological education) with different physical agents (TENS + ultrasound) in patients within an average of 30 days from whiplash injury (standard deviation (SD): 17.4; range 16 to 60). This study reported non-significant positive effects of multimodal treatment at long- term follow-up (six months) on pain (RR 0.90; 95%CI: 0.43 to 1.90) and global perceived effect (no data). There was no significant difference between the number of people reporting sick leave between the groups, but significantly fewer people who received the multimodal active treatment took days off than in the group who received passive treatment (SMD 1.05; 95%CI: 0.51 to 1.59).

Fialka 1989 (n = 60) reported an insignificant improvement in pain for those who received active physiotherapy.

Fitz-Ritson 1995 (n = 30) compared the addition of phasic exercises to chiropractic treatment against standard exercises plus chiropractic for patients with chronic whiplash. Those who received the phasic exercises reported less disability (weighted mean difference (WMD) -24.20; 95% CI: -29.40 to -19.00) at eight weeks.

In conclusion, there was statistical and clinical heterogeneity which prevented us from combining the results. Overall, there was conflicting evidence about the effectiveness of either an active or a passive approach when compared to each other.

2. Active versus active treatments

Seven studies compared two active approaches, three of which addressed acute whiplash patients (McKinney 1989; Rosenfeld 2000; Söderlund 2000), two subacute patients (between four weeks and three months duration) (Bunketorp 2006; Scholten-Peeters2006) and one chronic whiplash patients (Söderlund 2001a). Only Bunketorp 2006 and Scholten-Peeters2006 are considered high quality.

a. Acute whiplash

Rosenfeld 2000 (n = 97) randomised whiplash patients (within 96 hours after accident) into four groups. Two of the groups received an active treatment consisting of exercises; one group started treatment within 96 hours while the other group started after 14 days. The authors reported that there were no significant differences in pain (RR 1.44; 95% CI: 0.72 to 2.86) at six months nor sick leave between the two groups. McKinney 1989 (n = 170), on the other hand, showed that participants who received advice plus mobilisation exercises at home showed significant recovery after two years compared to those who received physiotherapy (RR 1.94; 95% CI: 1.07 to 3.53). Söderlund 2000 (n = 66) added kinaesthetic and co-ordination exercises to those receiving regular exercises, and compared them against a group that just received regular exercises. There was no significant difference in pain between the two groups at 12 weeks (WMD 0.40; 95% CI: -0.79 to 1.59).

b. Subacute whiplash

We found two high quality studies that examined patients with subacute whiplash (pain lasting between four and 13 weeks). Scholten-Peeters2006 (n = 80) found no statistical significant differences in pain (WMD -0.01; 95%CI: -2.24 to 0.22) or work activities (WMD 0.88; 95%CI: -0.47 to 2.23) at three months between those who received usual GP care that included advice and education and those who received physiotherapy that included exercises and advice. However, at one year there was significant improvement in work activities in the group treated by the GP (WMD 2.35; 95%CI: 0.79 to 3.91). Bunketorp 2006 (n = 49) found no significant difference in pain at three and nine months between a group who received home exercises and those who had exercise therapy supervised by a physiotherapist. However, those who were supervised by the physiotherapist were significantly improved in self efficacy and exhibited less fear of movement. There were no data provided.

c. Chronic whiplash

Söderlund 2001a (n = 33) found no significant differences in pain at three (WMD 0.40; 95% CI: -0.79 to 1.59) and six months (WMD -0.20; 95% CI: -1.17 to 0.77) between those who received physiotherapy plus a cognitive behavioural component and those who received regular physiotherapy.

In conclusion, we were unable to pool any of the data due to clinical and statistical heterogeneity. Overall, we found no differences between the groups, indicating that none of the active approaches were more effective than another.

3. Conservative treatments versus other treatments

We found no trials in which a conservative treatment was compared with oral medication.

In one low quality study of 50 (probably chronic) patients, passive physiotherapy (electrotherapy) was compared to mesotherapy (injection with ketorolac tromethamine 30 mg + xylocaine 2%) (Florio 1999). There was no difference between the two groups; 52% of participants in each group reported feeling better at the end of treatment.

DISCUSSION

The overall quality of the included studies was poor and clinical and statistical heterogeneity did not allow us to pool the results. Therefore, we conclude that there is still conflicting evidence as to whether active or passive treatments are more effective for treating acute, subacute or chronic whiplash-associated disorders.

The value of this review depends on the success of obtaining reports on all RCT's conducted in this area. There are some indications that small clinical trials with negative results are not as easily published as positive trials (Dickersin 1987). Some relevant studies, referenced in unknown databases or difficult to locate or retrieve, may not be included. So, publication bias could be a threat to the validity of this review.

Relying on the information in the written report may create bias due to misclassification (Verhagen 2001). In an attempt to address the influence of using different criteria to assess quality on the conclusion of the systematic review (Moher 1996), we used two different approaches to define 'high' quality studies. In this review, we considered a study to be high quality when it presented a concealed randomisation procedure and adequate blinding, or met six or more of the Delphi criteria. Five studies fulfilled the first criteria and eight the second, with an overlap of four studies. Rosenfeld 2000 met the first criteria of concealed randomisation and adequate blinding, but only met five of the Delphi criteria. The methodological quality of the majority of the trials was disappointingly low.

Ten studies compared an active treatment with an inactive one and most low quality trials found evidence in favour of the active treatment. Our conclusions that there is still conflicting evidence about whether active treatments are more effective than inactive treatments is independent of the criteria used to determine high quality. A sensitivity analysis of the results that does not consider the quality of the study results in stronger support of individual active treatments, but because of clinical and statistical heterogeneity that prevents pooling, evidence must still be regarded as conflicting.

Most studies failed to describe a concealed treatment allocation procedure, although this is considered to be of the utmost importance (Moher 1999). But even when an adequate randomisation procedure has been carried out, there is no guarantee of an equal distribution of prognostic factors and confounding variables among the groups, particularly when the sample size is small (Windt 1995). The groups were comparable for relevant prognostic factors in 14 studies. Description of any blinding procedures was absent in 14 studies. Blinding is also considered to be important to obtain unbiased reporting of effects (Schulz 1995), but in these studies, patients and care providers could not easily be blinded, given the kind of interventions (e.g. exercises).

Another potential source of bias might be the broad inclusion criteria we used; whiplash-patients with WAD Grades 1 and 2 and a described duration of the symptoms. We did not use a strict definition of whiplash, because until recently there has been no agreement on its definition. Most of the articles did not describe what they meant by the whiplash injury. In order to get a more homogeneous population, we excluded patients who had whiplash with neurological signs, fractures, dislocations or some combination of the three (WAD Grades 3 and 4). The time interval between the injury that caused the whiplash and inclusion in the trial ranged from 24 hours (Brison 2005) to three months (Florio 1999; Söderlund 2001a). Some authors did not describe the duration of the disorder (Mealy 1986; Pennie 1990; Thuile 2002). In most studies, the setting of recruitment was the Accident and Emergency Department of a Hospital. Fitz-Ritson 1995 recruited their patients from chiropractic centres, while Scholten-Peeters2006 recruited patients of General Practitioners. Moreover, the exclusion criteria varied considerably across the studies. These broad selection criteria increased the risk for heterogeneity and made the interpretation of the results more difficult.

In this review, we focused on three primary outcome measures: pain, global perceived effect and participation in daily activities. Pain or recovery was used as an outcome measure in all studies. In early studies, the main measures of effect were physical outcome measures: pain and cervical range of motion. However, in studies reported after 1995, measurements such as time off work and 'state of health' were also used. Similar to other physical disorders (e.g. non-specific low back pain), outcome measurement should be seen in multidimensional terms. Psychological and social factors have been shown to have consequences for mental state and quality of life (Söderlund 1999; Waddell 1998). This broader perspective introduced the bio-psychosocial model to the medical world. In the bio-psychosocial model, the focus is not only on pain, but also on disabilities in daily activities and pain coping strategies. The goal of treatment is not only pain relief, but also to help patients continue with their normal lives. Individual beliefs and psychological distress might influence pain and disability and the way patients will respond to treatment (Waddell 1998). Therefore, we believe that besides physical outcomes, aspects like patients' beliefs, coping strategies, locus of control and ability to perform activities of daily living should also be measured. Given the unknown natural course of the whiplash injury, and the range of chronic complaints and problems with daily activities, future trials should have a follow-up of at least six months, and preferably 12 months.

AUTHORS' CONCLUSIONS

Implications for practice

Given the current evidence, no clear conclusions can be drawn about the most effective therapy for patients with acute, subacute or chronic whiplash-associated disorders, Grades 1 or 2. There is a trend that active interventions are probably more effective than passive interventions, but no clear conclusion can be drawn.

Implications for research

1. Large, high quality research trials are needed, focusing on appropriate allocation concealment, blinding and adequate data presentation and analysis. The design and reporting of future trials should conform to the CONSORT-statement.

2. New research should measure outcomes relevant to the patients and responsive to the treatment under study. Follow-up should be of sufficient length to assess long-term effects.
3. New research reports should provide full data on outcome measures, including the means and standard deviation or 95% confidence interval.
4. Future research should examine the effect of active treatments not only in pragmatic trials, comparing various interventions with each other, but also in more explanatory trials, comparing the intervention with no treatment.
5. Future research should focus on chronic whiplash patients because there are a broad variety of treatments available, most treatments are costly, and data on effectiveness are not available.

We conclude that performing randomised studies with high methodological quality concerning the effectiveness of active treatments or other frequently performed treatments is both possible and necessary to provide strong evidence on the effectiveness of treatments for whiplash-associated disorders.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Aigne 2006

Methods	RCT; randomisation procedure not described;
Participants	Acute whiplash within 4 days. n=50.
Interventions	E: laser acupuncture + cervical collar (1-2 weeks), n=25 C: placebo laser + cervical collar (1-2 weeks), n=25 Treatment 3 weeks.
Outcomes	ROM, symptoms
Notes	Treatment stopped when ROM was normal. 5 dropouts.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Bonk 2000

Methods	RCT; randomisation procedure not described; no blinding described.
Participants	Acute whiplash following a rear end collision, within 3 days (WAD grade 1 or 2). N=103.
Interventions	E: Active Therapy. 7 physiotherapy sessions in 3 weeks: ice, active and passive mobilisation, strength and isometric exercises. No collar. N=53 C: Collar for 3 weeks during daytime. N=50 Follow-up at 6 and 12 weeks.
Outcomes	Symptom (pain) prevalence (yes/no), ROM (?)
Notes	6 drop-outs in E

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Borchgrevink 1998

Methods	RCT; randomisation procedure not described; blinded outcome assessment
Participants	Acute neck sprain injury caused by car accident , N=201.
Interventions	E: act as usual (no sick leave or collar) (n=96) C: rest and immobilisation for 14 days with cervical collar (n=105) All: instructions and NSAIDs. Follow-up 6 weeks and 6 months.
Outcomes	Subjective symptoms (number), ROM (Cybex), symptom intensity (5-point Likert), head and neck pain (VAS), global improvement (3-point Likert).
Notes	14 drop-out in E; 9 in C

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Brison 2005

Methods	RCT; randomisation by independent researcher using opaque sealed envelopes; blinded outcome assessment
Participants	Acute whiplash injury (less than 24h) after a road traffic accident, n=405.
Interventions	E: 20-minute educational video + usual care (n=206) C: usual care (n=199)
Outcomes	Pain (5-point scale).
Notes	74 drop-out (31 in E; 43 in C)

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Bunketorp 2006

Methods	RCT; randomisation by independent person by coin flipping; outcome assessor blinded.
Participants	Subacute (between 6 and 13 weeks) disorders following whiplash trauma, n=49.
Interventions	E: Supervised physiotherapy training (exercises, twice a week for ? wks), n=24 C: home training (exercises at home twice a day), n=25.
Outcomes	Neck pain (VAS) Self efficacy (Self Efficacy Scale) Fear of movements (TAMPA-scale)

Bunketorp 2006 *(Continued)*

	Cervical mobility (CROM).
Notes	2 dropouts after randomisation (E); 7 dropouts (15%) during treatment (5 in C; 2 in E). Only data on differences.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Crawford 2004

Methods	RCT; randomisation based on casualty number (even or odd); no blinding described.
Participants	Acute whiplash injury (less than 48h) after a road traffic accident. N=108.
Interventions	All: initially a standard soft cervical collar and NSAID's. E: active treatment: advice to mobilise freely out of the collar and self-mobilisation exercises (n=55). C: standard soft collar for 3 weeks and then mobilise using the same self-mobilisation exercises (n=53). Follow-up at 3, 12 and 52 weeks.
Outcomes	Activities of daily living (10-point scale), pain (VAS), ROM (sum of 6 directions, 0-380 degrees), return to work (mean number of days).
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	High risk	C - Inadequate

Ferrari 2005

Methods	RCT; randomisation stated as concealed but not described.
Participants	Acute whiplash injury (less than 72 h) after car accident (WAD grade 1 or 2), n=112.
Interventions	E: educational pamphlet with current evidence, n=55. C: usual care (generic information sheet), n=57.
Outcomes	Recovery, severity of symptoms (3-point scale).
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Fialka 1989

Methods	RCT; randomisation procedure not described; no blinding described.
Participants	Acute whiplash injury, within 5-10 days. N=60.
Interventions	E: Therapy: traction, massage, exercises twice a week for 5 weeks (n=15). C1: Middle frequency (50 Hz, 1 electrode cervical, 1 thoracal) 15 min, twice a week, 5 weeks (n=15). C2: Iontophoresis mobilat gel (o.1 mA/cm2 cathode cervical anode sternum) 20 min, twice a week, 5 weeks (n=15). C3: no treatment (n=15). No follow-up.
Outcomes	ROM (goniometer); neck pain (yes/no).
Notes	No between groups analysis.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Fitz-Ritson 1995

Methods	RCT; randomisation by letting patient pick a piece of paper; no blinding described.
Participants	Chronic patients; complaints at 12 weeks after a vehicle accident. N=30.
Interventions	E: Phasic exercises (n=15). C: Standard exercises (n=15). All: chiropractic treatment for 8 weeks, 5 times a week. No follow-up.
Outcomes	Disability (NDI).
Notes	Pre-post analysis; all data provided.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	High risk	C - Inadequate

Florio 1999

Methods	RCT; randomisation procedure not described; no blinding described.
Participants	Patients with cervical whiplash injuries. Probably chronic. N=50.
Interventions	All: Interpunction of any therapy; prescription of mesilated pridinole, twice a day, 15 days. E: Mesotherapy, 6 sessions (n=25). C: Antalgic instrumental physiotherapy (antalgic electrotherapy and endogen thermotherapy), 12 sessions (n=25).

Florio 1999 *(Continued)*

	No follow-up
Outcomes	Recovery, Track length values and Area underlying (stabilometric test).
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Foley-Nolan 1992

Methods	RCT; randomisation procedure unknown; blinding of patient, careprovider and outcome assessment.
Participants	Acute whiplash injury (less than 72 h) after rear-end collision. N=40.
Interventions	E: soft collar + pulsed electromagnetic therapy (PEMT) (n=20). C: soft collar with placebo PEMT (n=20). All: NSAIDs. Treatment duration: 6 weeks, follow-up 12 weeks.
Outcomes	Pain (VAS), ROM (4-point Likert scale, summed up in 6 directions), subjective assessment of progress (9-point Likert scale).
Notes	After 4 weeks physiotherapy for non-improved patients: 9 in E, 12 in C.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Hendriks 1996

Methods	RCT; randomisation procedure not described; no blinding described.
Participants	Acute whiplash injury within 72 hours, N=16.
Interventions	E: Standard treatment (ice, home exercises, advice) + ultra-reiz current 15 min (n=unclear). C: Standard treatment (n=unclear). All: 5 treatment session within 7 days. Follow-up: 6 weeks after treatment.
Outcomes	Pain (VAS, McGill pain questionnaire), ROM (goniometer), Maitland assessment.
Notes	2 drop-outs at 6 weeks. No data on pain available, data on ROM unclear. Groups concerning ROM probably not comparable.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

McKinney 1989

Methods	RCT; randomisation procedure not described; blinded outcome assessment.
Participants	Acute flexion-extension neck sprain (less than 72 h). N=170.
Interventions	E1: Active physiotherapy (mobilisation, hot and cold applications, short wave diathermy, hydrotherapy, traction, active and passive movements according to McKenzie and Maitland, 3 times a week (40 min), 6 weeks (n=71). E2: mobilisation advice, verbal and written instruction, once for 30 min (n=66). C: rest and analgesics for 2 weeks and than advice about mobilisation (n=33). Follow-up at 1 and 2 months.
Outcomes	ROM (goniometer), pain (VAS).
Notes	During study randomisation into C stopped.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Mealy 1986

Methods	RCT; randomisation using sealed envelopes; blinded outcome assessment .
Participants	Acute whiplash injury; N=61. No cervical fractures.
Interventions	E: active treatment (ice, neck mobilisation using Maitland techniques, daily exercises) (n=31). C: soft collar, rest and education (n=30). Treatment duration unknown. Follow-up: (4 and) 8 weeks.
Outcomes	Pain (VAS); ROM (goniometer).
Notes	Five patients from each group were withdrawn. Groups not comparable concerning ROM.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Oliveira 2006

Methods	RCT; pseudo randomisation by alternating; no blinding.
Participants	Acute whiplash injury (within 24h) (n=126).
Interventions	E: 12-minute psycho-educational video + usual care (n=?) C: usual care not described (n=?)

Oliveira 2006 *(Continued)*

Outcomes	In total 66 different outcome measures including pain.
Notes	16 patients unable for follow-up (6 in E, 10 in C).

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	High risk	C - Inadequate

Pennie 1990

Methods	RCT; random allocation based on casualty number; no blinding described.
Participants	Soft tissue injury of the neck, presumably acute injury, N=135.
Interventions	E: physiotherapy (traction, exercises, education), twice a week (n=61). C: rest with soft collar for 2 weeks, than exercises, at 6-8 weeks physiotherapy when no improvement (n=74). Follow-up: 6-8 weeks, 5 months.
Outcomes	ROM (goniometer), pain (VAS).
Notes	No between group analysis.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	High risk	C - Inadequate

Provinciali 1996

Methods	RCT; randomisation procedure not described; blinded outcome assessment.
Participants	Acute - subacute whiplash injury after car-accident (< 2 months), regular job performance before; N=60. No serious diseases.
Interventions	E: multimodal treatment (relaxation and postural training, psychological support, eye fixation exercises, manual treatment) (n=30). C: physical agents (TENS, PEMT and calcium iontophoresis) (n=30). All: 10 sessions over 2 week period, muscle relaxants, analgesics and sof collar. Follow-up at 2 and 4 weeks, 6 months.
Outcomes	Pain (VAS); ROM (4-point Likert scale, summed up into 6 directions); self rating treatment efficacy (7-point Likert scale); return to work (number of working days).
Notes	Of most outcome measures no data available.

Risk of bias

Bias	Authors' judgement	Support for judgement

Provinciali 1996 *(Continued)*

Allocation concealment?	Unclear risk	B - Unclear

Rosenfeld 2000

Methods	RCT; concealed randomisation; no blinding described.
Participants	Acute whiplash within 96 hours, N=97.
Interventions	E1: active treatment (exercise and posture control consistent with McKenzie principles) within 96 hours (n=21). E2: active treatment (exercise and posture control consistent with McKenzie principles) after 14 days (n=22). C1: standard treatment (rest, collar and leaflet with information on posture and advice on activities) within 96 hours (n=23). C2: standard treatment (rest, collar and leaflet with information on posture and advice on activities) after 14 days (n=22). Exercises every waking hour. Follow-up at 6 months.
Outcomes	ROM (inclinometer); pain (VAS); co-interventions
Notes	9 drop-outs. 8 patients in E1+2 and 18 in C1+2 received co-interventions from manual therapist.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment?	Low risk	A - Adequate

Schnabel 2004

Methods	RCT; randomisation by selecting a letter A or B; no blinding described.
Participants	Acute whiplash injury (within 48h), WAD 0-2. N=200.
Interventions	All: prescription of diclofenac tablets (50 mg 3 times daily). E: active treatment: exercises for mobilisations of affected body regions, 2-5 within the first week (n=103). C: advise for using a collar for one week, day and night (n=97). Follow up at 6 weeks.
Outcomes	Pain intensity (VAS), self assessed disability (VAS), symptom prevalence (%)
Notes	37 dropouts (36%) in E; 15 (15%) in C.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment?	Low risk	A - Adequate

Scholten-Peeters2006

Methods	RCT; concealed randomisation; outcome assessor blinded.
Participants	Acute whiplash injury still having complaints after 4 weeks, WAD 1-2. N=80.
Interventions	E: GP care including advice and education (n=42). C: PT care including advice, education and exercises (n=38).
Outcomes	Pain (VAS), work activities .
Notes	3 drop-out (2 in E, 1 in C).

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Söderlund 2000

Methods	RCT, randomisation procedure not described; no blinding.
Participants	Acute whiplash injury (on average within 20 days), WAD 0-3. N=66.
Interventions	E: Additional treatment: regular treatment + kinaesthetic sensibility and co-ordination neck exercises (3 times a day) (n=34). C: Regular treatment: exercises (3 times a day) alternating with rest, no collar unless, (n=32).
Outcomes	Pain (PDI, VAS), disability (SES), coping (CSQ), ROM (goniometer), kinaesthetic sensibility (laser devise).
Notes	13 dropouts, 7 in E and 6 in C.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Söderlund 2001a

Methods	RCT; randomisation with a balanced randomised block; no blinding described.
Participants	Chronic (> 3 months) whiplash without a direct head trauma. N=33.
Interventions	E: physiotherapy management with integrated components of cognitive-behavioural origin including 4 phases, max. 12 visits (n=16). C: regular primary care physiotherapy, max. 12 visits (n=17). Follow up at 3 months.
Outcomes	Pain (PDI, NRS), Head posture (goniometer), ROM (goniometer), kinaesthetic sensibility (laser devise).
Notes	

Söderlund 2001a *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Thuile 2002

Methods	RCT; randomisation procedure not described; no blinding described.
Participants	Whiplash, cervical distortion duration unknown. N=92.
Interventions	E: magnetic field treatment (n=44). C: control (n=48). Treatment duration unknown, follow-up unknown.
Outcomes	Pain (10-point Likert); ROM (goniometer).
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

ROM = Range of Motion, VAS = visual analogue scale, PDI = pain disability index, NDI = neck disability index, SES = self efficacy scale, CSQ = coping strategies questionnaire, GP = general practitioner, PT = physiotherapist, NRS = numerical rating scale, CROM = cervical range of motion device

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Corey 1996	Research population included patients with neck pain. No data on subgroups of whiplash patients were presented.
Fockler 1998	This study included healthy people
Gennis 1996	This is a non-randomised study
Goodman 2000	This is not a (randomised) controlled study
Sterner 2001	This is not a (randomised) controlled study
Suissa 2006	This is a case-control study
Söderlund 2001b	This is not a (randomised) controlled study
Zapletal 1999	Not a (randomised) controlled study, no whiplash patients, no conservative intervention

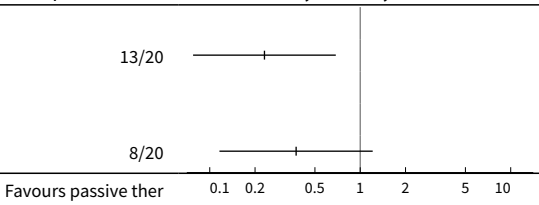
DATA AND ANALYSES

Comparison 1. Passive intervention versus placebo

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Improvement	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 +/- 4 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 +/- 12 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

Analysis 1.1. Comparison 1 Passive intervention versus placebo, Outcome 1 Improvement.

Study or subgroup	passive therapy n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
1.1.1 +/- 4 weeks				
Foley-Nolan 1992	3/20	13/20		0.23[0.08,0.69]
1.1.2 +/- 12 weeks				
Foley-Nolan 1992	3/20	8/20		0.38[0.12,1.21]

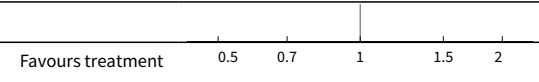


Comparison 2. Passive intervention versus no treatment

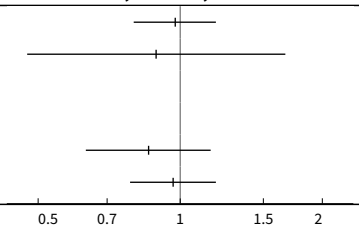
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain	3		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 +/- 6 weeks	2		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 +/- 6 months	2		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2 Recovery	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.1 +/- 2 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 +/- 3 months	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

Analysis 2.1. Comparison 2 Passive intervention versus no treatment, Outcome 1 Pain.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
2.1.1 +/- 6 weeks				

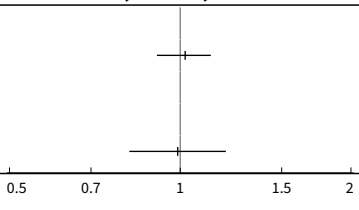


Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
Brison 2005	98/206	97/199		0.98[0.8,1.19]
Fialka 1989	8/15	9/15		0.89[0.47,1.67]
2.1.2 +/- 6 months				
Brison 2005	55/206	62/199		0.86[0.63,1.16]
Ferrari 2005	41/55	44/57		0.97[0.78,1.19]



Analysis 2.2. Comparison 2 Passive intervention versus no treatment, Outcome 2 Recovery.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
2.2.1 +/- 2 weeks				
Ferrari 2005	51/55	52/57		1.02[0.91,1.13]
2.2.2 +/- 3 months				
Ferrari 2005	43/55	45/57		0.99[0.82,1.2]

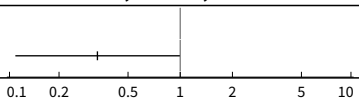


Comparison 3. Active intervention (e.g. physiotherapy) versus no treatment

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Neck pain	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 +/- 6 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2 Headaches	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.1 +/- 6 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

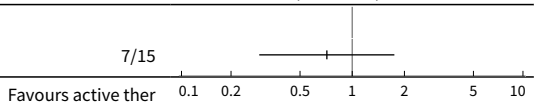
Analysis 3.1. Comparison 3 Active intervention (e.g. physiotherapy) versus no treatment, Outcome 1 Neck pain.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
3.1.1 +/- 6 weeks				
Fialka 1989	3/15	9/15		0.33[0.11,0.99]



Analysis 3.2. Comparison 3 Active intervention (e.g. physiotherapy) versus no treatment, Outcome 2 Headaches.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
3.2.1 +/- 6 weeks				
Fialka 1989	5/15	7/15		0.71[0.29,1.75]



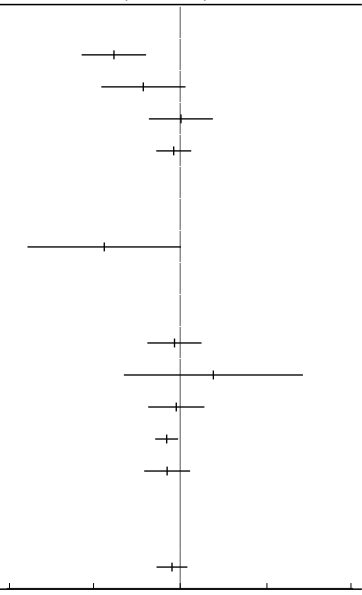
Comparison 4. Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Neck pain	7		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 +/- 6 weeks	4		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 +/- 12 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.3 +/- 6 months	5		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.4 Long-term (> 2 years)	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2 Neck pain	4		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 +/- 6 weeks	3		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 +/- 12 weeks	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.3 Long-term (6 months or more)	3		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Range of motion	5		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 +/- 6 weeks	4		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 +/- 12 weeks	2		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.3 Long term (6 months or more)	2		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4 Return to work	1		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
4.1 Long-term (over 6 months)	1		Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5 Return to work	4		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
5.1 Long-term (over 3 months)	4		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
6 Global improvement	4		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
6.1 +/- 6 weeks	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
6.2 Long-term (over 6 months)	4		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]

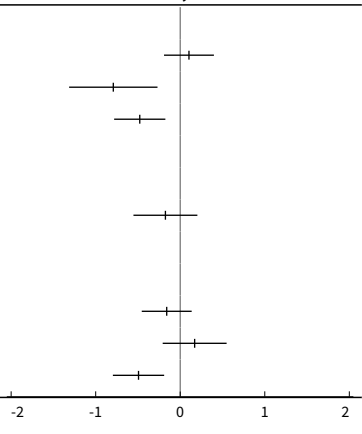
Analysis 4.1. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 1 Neck pain.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
4.1.1 +/- 6 weeks				
Bonk 2000	5/47	31/50		0.17[0.07,0.4]
Fialka 1989	3/15	8/15		0.38[0.12,1.15]
Pennie 1990	8/48	10/61		1.02[0.43,2.38]
Schnabel 2004	25/103	28/97		0.84[0.53,1.34]
4.1.2 +/- 12 weeks				
Bonk 2000	1/47	8/50		0.13[0.02,1.02]
4.1.3 +/- 6 months				
Borchgrevink 1998	11/82	15/96		0.86[0.42,1.76]
Pennie 1990	2/58	1/70		2.41[0.22,25.95]
Provinciali 1996	9/30	10/30		0.9[0.43,1.9]
Rosenfeld 2000	24/43	36/45		0.7[0.52,0.94]
Schnabel 2004	15/103	20/97		0.71[0.38,1.3]
4.1.4 Long-term (> 2 years)				
Rosenfeld 2000	18/36	23/37		0.8[0.53,1.21]



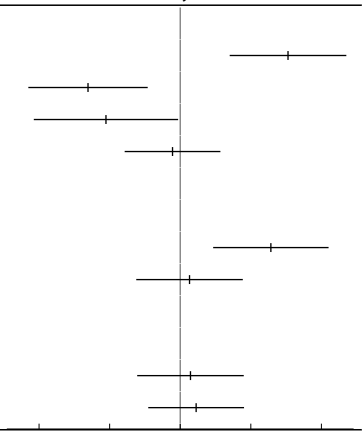
Analysis 4.2. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 2 Neck pain.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
4.2.1 +/- 6 weeks						
Borchgrevink 1998	82	32.9 (35.3)	96	29.7 (26.5)		0.1[-0.19,0.4]
Mealy 1986	31	1.7 (2.4)	30	3.9 (3.2)		-0.79[-1.31,-0.27]
Schnabel 2004	92	1.5 (2.3)	81	2.7 (2.8)		-0.48[-0.78,-0.18]
4.2.2 +/- 12 weeks						
Crawford 2004	55	2.5 (3.4)	53	3.1 (3.4)		-0.18[-0.55,0.2]
4.2.3 Long-term (6 months or more)						
Borchgrevink 1998	82	26.6 (23.5)	96	31.1 (31.4)		-0.16[-0.46,0.14]
Crawford 2004	55	1.8 (3.9)	53	1.1 (3.9)		0.17[-0.21,0.55]
Schnabel 2004	92	1.2 (2.1)	81	2.3 (2.6)		-0.49[-0.8,-0.19]



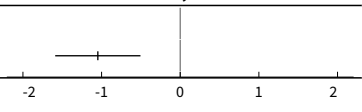
Analysis 4.3. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 3 Range of motion.

Study or subgroup	Control N	Control Mean(SD)	Treatment N	Treatment Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
4.3.1 +/- 6 weeks						
Bonk 2000	47	19.2 (2)	50	17.7 (1.9)		0.76[0.35,1.18]
McKinney 1989	33	55.1 (14.8)	71	64 (12.9)		-0.65[-1.08,-0.23]
Mealy 1986	30	29.6 (8.8)	31	34.1 (8.2)		-0.53[-1.04,-0.01]
Pennie 1990	61	361 (66.6)	74	366 (107.2)		-0.05[-0.39,0.28]
4.3.2 +/- 12 weeks						
Bonk 2000	47	19.4 (1.8)	50	18.3 (1.6)		0.64[0.23,1.05]
Crawford 2004	55	336.1 (206.5)	53	322.4 (206.5)		0.07[-0.31,0.44]
4.3.3 Long term (6 months or more)						
Crawford 2004	55	364.5 (292.8)	53	343.1 (292.8)		0.07[-0.3,0.45]
Pennie 1990	74	377 (87.8)	61	366 (107.3)		0.11[-0.23,0.45]



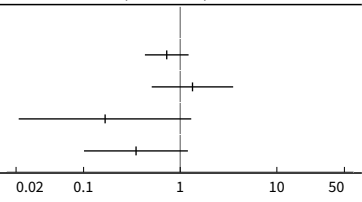
Analysis 4.4. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 4 Return to work.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Std. Mean Difference Random, 95% CI
4.4.1 Long-term (over 6 months)						
Provinciali 1996	30	38.4 (10.5)	30	54.3 (18.4)		-1.05[-1.59,-0.51]



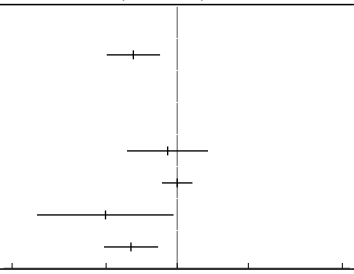
Analysis 4.5. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 5 Return to work.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
4.5.1 Long-term (over 3 months)				
Bonk 2000	15/47	22/50		0.73[0.43,1.22]
Borchgrevink 1998	8/82	7/96		1.34[0.51,3.53]
Provinciali 1996	1/30	6/30		0.17[0.02,1.3]
Rosenfeld 2000	3/43	9/45		0.35[0.1,1.2]



Analysis 4.6. Comparison 4 Active intervention (e.g. physiotherapy) versus passive intervention (e.g. collar, rest), Outcome 6 Global improvement.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
4.6.1 +/- 6 weeks				
Schnabel 2004	45/103	65/97		0.65[0.5,0.85]
4.6.2 Long-term (over 6 months)				
Borchgrevink 1998	28/82	36/96		0.91[0.61,1.35]
Crawford 2004	46/53	46/53		1[0.86,1.16]
McKinney 1989	11/48	12/26		0.5[0.26,0.97]
Schnabel 2004	44/103	65/97		0.64[0.49,0.83]



Comparison 5. Active intervention versus active intervention

Outcome or sub-group title	No. of studies	No. of partici-pants	Statistical method	Effect size
1 Recovery	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
1.1 +/- 2 years	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2 Pain	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.1 +/- 6 months	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 +/- 3 years	1		Risk Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
3 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.1 +/- 12 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 +/- 6 months	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.3 +/- 1 year	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4 Work activities	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.1 +/- 12 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 +/- 6 months	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.3 +/- 1 year	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

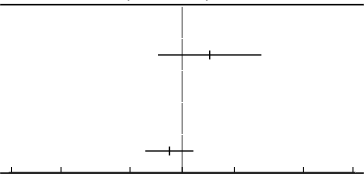
Analysis 5.1. Comparison 5 Active intervention versus active intervention, Outcome 1 Recovery.

Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
5.1.1 +/- 2 years				
McKinney 1989	24/54	11/48		1.94[1.07,3.53]

Favours physiother — Favours advice +

Analysis 5.2. Comparison 5 Active intervention versus active intervention, Outcome 2 Pain.

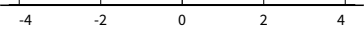
Study or subgroup	Treatment n/N	Control n/N	Risk Ratio M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI
5.2.1 +/- 6 months				
Rosenfeld 2000	11/21	8/22		1.44[0.72,2.86]
5.2.2 +/- 3 years				
Rosenfeld 2000	25/43	31/45		0.84[0.61,1.16]



Favours direct — Favours after 14 day

Analysis 5.3. Comparison 5 Active intervention versus active intervention, Outcome 3 Pain.

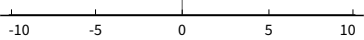
Study or subgroup	GP Treatment N	GP Treatment Mean(SD)	PT Treatment N	PT Treatment Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
5.3.1 +/- 12 weeks						
Scholten-Peeters2006	42	1.3 (2.6)	38	2.3 (3)		-1.01[-2.24,0.22]
5.3.2 +/- 6 months						
Scholten-Peeters2006	42	2.3 (2.5)	38	1.9 (3.1)		0.38[-0.85,1.61]
5.3.3 +/- 1 year						
Scholten-Peeters2006	42	2.5 (2.5)	38	2.5 (3)		-0.02[-1.22,1.18]



Favours GP — Favours PT

Analysis 5.4. Comparison 5 Active intervention versus active intervention, Outcome 4 Work activities.

Study or subgroup	GP Treatment N	GP Treatment Mean(SD)	PT Treatment N	PT Treatment Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
5.4.1 +/- 12 weeks						
Scholten-Peeters2006	42	2.2 (3.3)	38	1.3 (2.9)		0.88[-0.47,2.23]
5.4.2 +/- 6 months						
Scholten-Peeters2006	42	3.3 (4.3)	38	1.7 (3.5)		1.59[-0.1,3.28]
5.4.3 +/- 1 year						
Scholten-Peeters2006	42	4.6 (3.7)	38	2.3 (3.5)		2.35[0.79,3.91]



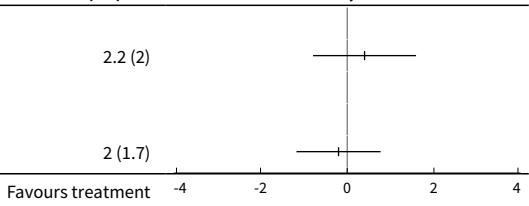
Favours PT — Favours GP

Comparison 6. Additional exercises in acute patients

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 +/- 12 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 +/- 6 months	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2 Range of motion	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 +/- 12 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 +/- 6 months	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

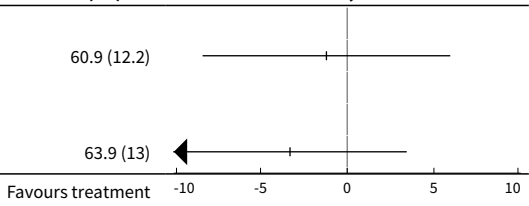
Analysis 6.1. Comparison 6 Additional exercises in acute patients, Outcome 1 Pain.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
6.1.1 +/- 12 weeks						
Söderlund 2000	27	2.6 (2.4)	26	2.2 (2)		0.4[-0.79,1.59]
6.1.2 +/- 6 months						
Söderlund 2000	27	1.8 (1.9)	26	2 (1.7)		-0.2[-1.17,0.77]



Analysis 6.2. Comparison 6 Additional exercises in acute patients, Outcome 2 Range of motion.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
6.2.1 +/- 12 weeks						
Söderlund 2000	29	59.7 (14.8)	26	60.9 (12.2)		-1.2[-8.34,5.94]
6.2.2 +/- 6 months						
Söderlund 2000	29	60.6 (12.4)	26	63.9 (13)		-3.3[-10.03,3.43]



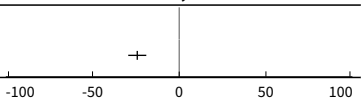
Comparison 7. Additional exercises in chronic patients

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Disability	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
1.1 +/- 8 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Outcome or sub-group title	No. of studies	No. of partici-pants	Statistical method	Effect size
2 Pain	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.1 +/- 12 weeks	1		Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

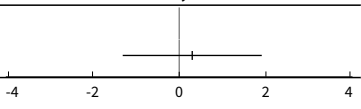
Analysis 7.1. Comparison 7 Additional exercises in chronic patients, Outcome 1 Disability.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
7.1.1 +/- 8 weeks						
Fitz-Ritson 1995	15	30.9 (8.2)	15	55.1 (6.2)		-24.2[-29.4,-19]



Analysis 7.2. Comparison 7 Additional exercises in chronic patients, Outcome 2 Pain.

Study or subgroup	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Mean Difference Random, 95% CI
7.2.1 +/- 12 weeks						
Söderlund 2001a	16	3.7 (2.3)	17	3.4 (2.4)		0.3[-1.3,1.9]



ADDITIONAL TABLES

Table 1. Delphi criteria for methodological assessment

criteria
1. Was a method a randomisation performed?
2. Was the treatment allocation concealed?
3. Were the groups similar at baseline regarding the most important prognostic indicators?
4. Were the eligibility criteria specified?
5. Was the outcome assessor blinded to the intervention?
6. Was the care provider blinded to the intervention?
7. Was the patient blinded to the intervention?
8. Were point estimates and measures of variability presented for the primary outcome measures?
9. Did the analysis include an intention-to-treat analysis?
10. Was the dropout or withdrawal rate unlikely to cause bias?

Table 2. Methodological quality

Study	1	2	3	4	5	6	7	8	9	10	Total
Aigne 2006	1	0	0	1	0	0	0	0	0	1	3
Bonk 2000	1	0	1	1	0	0	0	1	0	1	5
Borchgrevink 1998	1	0	1	1	1	0	0	1	0	1	6
Brison 2006	1	1	1	1	1	0	0	1	1	0	7
Bunketorp 2006	1	1	1	1	1	0	0	1	1	1	8
Crawford 2004	1	0	0	1	0	0	0	0	0	0	2
Ferrari 2005	1	0	1	1	1	1	0	1	0	1	7
Fialka 1989	1	0	0	0	0	0	0	1	1	1	4
Fitz-Ritson 1995	1	0	0	0	0	0	0	1	1	1	4
Florio 1999	1	0	0	0	0	0	0	0	0	0	1
Foley-Nolan 1992	1	0	1	1	1	1	1	1	1	1	9
Hendriks 1996	1	0	0	1	0	0	0	0	0	1	3
McKinney 1989	1	0	1	1	1	0	0	0	0	0	4
Mealy 1986	1	0	1	0	1	0	0	1	0	1	5
Oliveira 2006	1	0	1	1	0	0	0	1	0	1	5
Pennie 1990	1	0	0	0	0	0	0	0	0	0	1
Provinciali 1996	1	0	1	1	1	0	0	1	1	1	7
Rosenfeld 2000	1	1	1	1	0	0	0	1	0	0	5
Schnabel 2004	1	1	1	1	0	0	0	1	1	1	7
Scholten-Peeters 2006	1	1	0	1	1	0	0	1	1	1	7

Table 2. Methodological quality *(Continued)*

Söderlund 2000	1	0	1	1	0	0	0	1	0	0	4
Söderlund 2001a	1	0	0	1	1	0	0	1	0	0	4
Thuile 2002	1	0	0	1	0	0	0	1	0	0	3

APPENDICES

Appendix 1. MEDLINE search strategy

1. randomized controlled trial.pt.
2. controlled clinical trial.pt.
3. Randomized Controlled Trials/
4. Random Allocation/
5. Double-Blind Method/
6. Single-Blind Method/
7. or/1-6
8. Animals/ not Human/
9. 7 not 8
10. clinical trial.pt.
11. exp Clinical Trials/
12. (clin$ adj25 trial$).tw.
13. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).tw.
14. Placebos/
15. placebo$.tw.
16. random$.tw.
17. Research Design/
18. (latin adj square).tw.
19. or/10-18
20. 19 not 18
21. 20 not 9
22. Comparative Study/
23. exp Evaluation Studies/
24. Follow-Up Studies/
25. Prospective Studies/
26. (control$ or prospective$ or Volunteer$).tw.
27. Cross-Over Studies/
28. or/22-27
29. 28 not 8
30. 29 not (9 or 21)
31. 9 or 21 or 30
32. neck muscles.sh.
33. exp Neck/
34. whiplash injuries.sh.
35. neck.ti,ab.
36. or/33-35
37. exp Whiplash Injuries/
38. exp Neck Injuries/
39. exp "Sprains and Strains"/
40. 37 or 38 or 39
41. effectiveness.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
42. efficacy.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
43. treatment outcome.mp. [mp=title, original title, abstract, name of substance word, subject heading word]
44. 41 or 42 or 43
45. exp Case Management/
46. exp Manipulation, Chiropractic/
47. exp Manipulation, Orthopedic/
48. exp Manipulation, Osteopathic/
49. exp Manipulation, Spinal/
50. exp Musculoskeletal Manipulations/
51. exp Chiropractic/
52. exp Patient Education/
53. exp Exercise/
54. exp Exercise Therapy/
55. exp Physical Therapy Modalities/
56. or/45-55
57. 40 and 56

58. 44 and 57

Appendix 2. EMBASE search strategy

1. Clinical Article/
2. exp Clinical Study/
3. Clinical Trial/
4. Controlled Study/
5. Randomized Controlled Trial/
6. Major Clinical Study/
7. Double Blind Procedure/
8. Multicenter Study/
9. Single Blind Procedure/
10. Phase 3 Clinical Trial/
11. Phase 4 Clinical Trial/
12. crossover procedure/
13. placebo/
14. or/1-13
15. allocat$.mp.
16. assign$.mp.
17. blind$.mp.
18. (clinic$ adj25 (study or trial)).mp.
19. compar$.mp.
20. control$.mp.
21. cross?over.mp.
22. factorial$.mp.
23. follow?up.mp.
24. placebo$.mp.
25. prospectiv$.mp.
26. random$.mp.
27. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).mp.
28. trial.mp.
29. (versus or vs).mp.
30. or/15-29
31. 14 and 30
32. human/
33. Nonhuman/
34. exp ANIMAL/
35. Animal Experiment/
36. 33 or 34 or 35
37. 32 not 36
38. 31 not 36
39. 37 and 38
40. neck muscles.mp.
41. exp NECK/
42. whiplash injuries.mp.
43. neck.mp.
44. or/40-43
45. 39 and 44
46. exp Whiplash Injury/
47. exp Neck Injury/
48. exp Cervical Spine Injury/
49. exp Traffic Accident/
50. or/46-49
51. exp Clinical Effectiveness/
52. effectiveness.mp.
53. efficacy.mp.
54. exp Treatment Outcome/
55. or/51-54
56. exp Case Management/
57. exp CHIROPRACTIC/
58. exp Orthopedic Manipulation/

59. exp Manipulative Medicine/
60. exp Osteopathic Medicine/
61. exp Patient Education/
62. exp EXERCISE/
63. exp KINESIOTHERAPY/
64. exp PHYSIOTHERAPY/
65. exp REHABILITATION/
66. exp PREVENTION/
67. or/56-66
68. 50 and 67
69. 55 and 68
70. limit 69 to yr="2004 - 2006"

WHAT'S NEW

Date	Event	Description
19 January 2011	Amended	Contact details updated.

HISTORY

Protocol first published: Issue 4, 2001
Review first published: Issue 4, 2001

Date	Event	Description
23 November 2009	Amended	Contact details updated.
26 May 2008	Amended	Converted to new review format.
15 January 2007	New search has been performed	This update included nine new trials.
15 January 2007	New citation required but conclusions have not changed	This update included nine new trials, but did not result in a change in conclusion. With the state of the current literature, we still cannot draw a clear conclusion on the effectiveness of conservative treatments for patients with acute, subacute or chronic whiplash-associated disorders.

CONTRIBUTIONS OF AUTHORS

Arianne Verhagen (APV) and Gwendolijne Scholten-Peeters (GGMSP) initiated the review and APV wrote the first draft of the review. APV and GGMSP developed the search strategy and performed study selection. APV performed the analysis and wrote the review. Rob de Bie (RAdB) GGMSP and APV performed the quality assessment and data-extraction. Sita Bierma (SMABZ), GGMSP and RAdB all critically reviewed successive drafts of the review.

In the most recent update (2007) Sandra van Wijngaarden (SvW) contributed to the search, quality assessment, data extraction and writing.

APV is the guarantor of the review.

DECLARATIONS OF INTEREST

None

SOURCES OF SUPPORT

Internal sources

- Erasmus Medical Center University, Netherlands.

External sources

- Canadian Chiropractic Association, Canada.

INDEX TERMS

Medical Subject Headings (MeSH)

Chronic Disease; Complementary Therapies; Immobilization [instrumentation]; Randomized Controlled Trials as Topic; Whiplash Injuries [*therapy]

MeSH check words

Humans