

## A research synthesis of therapeutic interventions for whiplash-associated disorder (WAD): Part 3 – interventions for subacute WAD

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Whiplash-associated disorder (WAD) represents a significant public health problem, resulting in substantial social and economic costs throughout the industrialized world. While many treatments have been advocated for patients with WAD, scientific evidence supporting their effectiveness is often lacking. A systematic review was conducted to evaluate the strength of evidence associated with various WAD therapies. Multiple databases (including Web of Science, EMBASE and PubMed) were searched to identify all studies published from January 1980 through March 2009 that evaluated the effectiveness of any clearly defined treatment for acute (less than two weeks), subacute (two to 12 weeks) or chronic (longer than 12 weeks) WAD. The present article, the third in a five-part series, evaluates the evidence for interventions initiated during the subacute phase of WAD. Thirteen studies that met the inclusion criteria were identified, six of which were randomized controlled trials with 'good' overall methodology (median Physiotherapy Evidence Database score of 6). Although some evidence was identified to support the use of interdisciplinary interventions and chiropractic manipulation, the evidence was not strong for any of the evaluated treatments. There is a clear need for further research to evaluate interventions aimed at treating patients with subacute WAD because there are currently no interventions satisfactorily supported by the research literature.

**Key Words:** Evidence-based medicine; Exercise; Neck pain; Randomized controlled trials; Subacute whiplash-associated disorder

The term 'whiplash-associated disorder' (WAD) describes the consequences of a whiplash injury, defined as bony and soft tissue injuries of the neck caused by rapid acceleration immediately followed by rapid deceleration of the neck and head (1), almost invariably occurring as a consequence of a

### Une synthèse de la recherche sur les interventions thérapeutiques à l'égard des troubles liés aux coups de fouet cervicaux (TCFC) : Partie 3 – Les interventions en cas de TCFC subaigus

Les troubles liés aux coups de fouet cervicaux (TCFC) représentent un problème important en santé publique, associé à des coûts sociaux et économiques substantiels dans le monde industrialisé. De nombreux traitements sont préconisés pour les patients ayant des TCFC, mais souvent, on ne possède pas de données scientifiques probantes en étayant l'efficacité. Les chercheurs ont procédé à une analyse systématique pour évaluer la qualité des preuves associées aux diverses thérapies des TCFC. Ils ont effectué des recherches dans de multiples bases de données (y compris Web of Science, EMBASE et PubMed) pour repérer toutes les études publiées entre janvier 1980 et mars 2009 qui évaluaient l'efficacité de tout traitement clairement défini en cas de TCFC aigu (moins de deux semaines), subaigu (de deux à 12 semaines) ou chronique (plus de 12 semaines). Le présent article, troisième d'une série de cinq, vise à évaluer les données probantes liées aux interventions amorcées pendant la phase subaiguë des TCFC. Les chercheurs ont repéré 13 études respectant les critères d'inclusion, dont six étaient des essais aléatoires et contrôlés à la qualité méthodologique globale « bonne » (indice médian de la base de données probantes en physiothérapie de 6). Même si les chercheurs ont repéré certaines données probantes pour étayer le recours aux interventions multidisciplinaires et à la manipulation chiropratique, ces données n'étaient pas solides à l'égard des traitements évalués. Il est clairement nécessaire de poursuivre les recherches afin d'évaluer les interventions visant à traiter les patients ayant un TCFC subaigu, car il n'existe actuellement aucune intervention appuyée de manière satisfaisante par les publications de recherche.

motor vehicle collision (MVC). With annual North American incidence rates estimated to be between 70 and 329 per 100,000 people (1,2), whiplash injuries are the most common injury following an MVC (2,3). Although it is widely held that the majority of whiplash patients recover naturally within

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a few months of their injury, recent research (4) suggests that recovery is often prolonged, with an estimated 50% of patients still complaining of neck pain one year after injury. Moreover, WAD is associated with significant economic costs as a result of lost work productivity, medical care, legal services and other disability-related expenses (5,6). Given the scope and cost of WAD, developing effective therapies that help to reduce pain and disability chronicity is of obvious importance.

In 1995, the Quebec Task Force (QTF) published its benchmark review (1) of the scientific literature and expert opinion on WAD. One of the primary conclusions of the report was that the majority of therapeutic interventions used in the treatment of WAD had undergone little to no scientific investigation. Accordingly, the QTF emphasized the need for more and higher quality research. More recently, Conlin et al (7,8) conducted a systematic review of the whiplash treatment literature (including studies published from 1993 to 2003) and noted that despite the QTF's recommendations, "remarkably little quality research" (8) had been published in the area of WAD management.

The objective of the present review is to update and expand previous work by evaluating the strength of evidence for therapies initiated during the acute (less than two weeks), subacute (two to 12 weeks) and chronic (longer than 12 weeks) stages of WAD. Treatments were grouped according to time from injury to assist clinicians in deciding on an appropriate treatment course. Previous reviews of the whiplash literature have focused on acute and chronic WAD, incorporating patients in the subacute phase of their injury into either one or both categories. However, there is no indication that therapies effective during the acute or chronic stages of WAD will also be effective when delivered during the subacute phase, and vice-versa. As well, most treatment takes place in the subacute phase for whiplash patients. The present article, the third in a five-part series, evaluates the evidence for interventions initiated during the subacute (two to 12 weeks) phase of WAD.

## METHOD

The following is a brief summary of the methods used for the current review. A more detailed explanation of the methodology is provided in the first article of the present series (9). A multistage screening process was conducted to identify all literature that evaluated therapeutic interventions for WAD published from January 1980 to March 2009, regardless of study design. Multiple databases were searched (including PubMed, CINAHL, EMBASE, PsycINFO, Web of Science and the Cochrane Central Register of Controlled Trials [CENTRAL]) using the following search terms: whiplash AND (therapy OR treatment OR intervention OR rehabilitation OR surgery OR neurotomy). The literature search was limited to clinical studies written in English that examined adult (18 years of age and older) human populations. A study was deemed eligible for review if it met the following criteria established a priori:

- The purpose of the study was to evaluate the effects of one or more clearly defined treatment protocols for WAD (eg, 'physiotherapy' without further elaboration was not considered to be a clearly defined protocol).
- At least 60% of the participants in the study sample must have experienced a whiplash injury resulting from an

MVC; alternatively, the sample must have included a distinct and separately analyzed subgroup of MVC-related whiplash patients.

- Evaluation of the treatment effect must have involved measurable outcomes.
- Sample included at least three participants with a whiplash injury.

In total, the search procedure yielded 969 citations, 387 of which were duplicates. On screening titles and abstracts for relevance, 121 articles were considered for full review and, after applying inclusion criteria, 83 articles were selected for full review. Information abstracted from studies that met inclusion criteria was organized into tables, and studies were grouped according to the type of intervention. For the present review, only studies in which the interventions were initiated during the subacute stage (ie, between two and 12 weeks after injury) were included. However, in some cases, it was difficult to determine exactly when patients began an intervention; for example, in some studies, the only indication of time from injury was the study's exclusion criteria regarding the maximum duration of symptoms. In such cases, these maximum values were used to categorize the study, assuming that the value defined the intended treatment stage. Therefore, some of the studies categorized as investigating subacute interventions may also include a percentage of patients treated during the acute phase.

All of the included randomized controlled trials (RCTs) were evaluated for methodological quality using a standardized rating scale – the Physiotherapy Evidence Database (PEDro) scale. This evaluation tool was specifically designed for assessing physical therapy research and has been validated for the quality assessment of RCTs (10). The PEDro scale consists of 10 equally weighted yes/no questions relating to issues of methodological quality, and can be accessed at [www.pedro.org.au/english/downloads/pedro-scale/](http://www.pedro.org.au/english/downloads/pedro-scale/). Two independent raters reviewed each article and discrepancies were resolved through consensus or, when that was not possible, by a third rater. Studies with PEDro scores of 9 to 10 were considered to be of 'excellent' methodological quality, while scores of 6 to 8 were considered to be of 'good' quality and scores of 4 to 5 were considered to be of 'fair' quality. Studies scoring below 4 were judged to be of 'poor' quality and were considered to be methodologically equivalent to non-RCTs for the purpose of formulating conclusions. These descriptive terms of quality assessment were used to simplify the interpretation of results; however, it is important to note that these terms are only intended to provide an indication of a study's rating on the PEDro scale. Non-RCTs were not assigned a PEDro score and were instead given a 'no score' designation.

Due to the limited number of studies investigating each of the specific WAD interventions, it was decided that both meta-analytical and levels-of-evidence approaches would be inappropriate. Therefore, a narrative approach was used to summarize the findings and formulate conclusions.

Because studies using a nonexperimental or uncontrolled design are generally considered to be of inferior quality, these types of studies were only used to formulate conclusions in the absence of RCTs or when the results of RCTs were conflicting. In addition, when the results of RCTs were conflicting, studies with higher PEDro scores were weighted more heavily.

**TABLE 1**  
**Physiotherapy Evidence Database (PEDro) scores for randomized controlled trials evaluating subacute whiplash-associated disorder therapies**

Reference, year	PEDro criteria										Total score
	RA	CA	BS	SB	TB	AB	AF	ITT	BC	PVM	
Bunketorp et al (11), 2006	✓	✓	✓			✓	✓	✓	✓	✓	8
Carroll (26), 2008	✓	✓		✓	✓	✓			✓	✓	7
Scholten-Peeters et al (12), 2006	✓	✓				✓	✓	✓	✓	✓	7
Fernández-des-las-Peñas et al (22), 2004	✓		✓				✓	✓	✓	✓	5
Provinciali et al (16), 1996	✓		✓			✓	✓		✓		5
Fernández-des-las-Peñas et al (23), 2004	✓		✓						✓	✓	4

AB Assessor blinding; AF Adequate follow-up; BC Between-group comparisons; BS Baseline similarity; CA Concealed allocation; ITT Intention-to-treat analysis; PVM Point estimates and variability reported; RA Random allocation; SB Subject blinding; TB Therapist blinding

## RESULTS

Six RCTs and seven non-RCTs were identified that evaluated therapeutic interventions initiated during the subacute stage of WAD (ie, between two and 12 weeks after injury) and met the inclusion criteria. The median PEDro score of the RCTs was 6, with scores ranging from 4 to 8 (Table 1). The most common methodological limitation of these RCTs was a failure to blind patients and therapists, with only one study actually achieving this. Furthermore, only two of the studies conducted their analyses on an intention-to-treat basis, and only three of the six used concealed allocation. In all, the studies included in the analysis involved interventions that were in one of four different treatment categories: exercise programs, interdisciplinary interventions, manual joint manipulation and injection-based interventions.

### Exercise programs

Two RCTs of good quality and three non-RCTs evaluated the use of exercise programs in the treatment of subacute WAD (Table 2). The two RCTs produced somewhat conflicting results. While Bunketorp et al (11) demonstrated that a supervised exercise program was more effective over the short term than an equivalent unsupervised program, Scholten-Peeters et al (12) found that the addition of an exercise component to a program of education and advice actually impeded recovery compared with education and advice alone. However, because Bunketorp et al (11) did not include a 'no' exercise control group, it is not clear whether patients improved in response to the exercise program or simply did better when they were supervised. Furthermore, in the study by Scholten-Peeters et al (12), because the experimental group was treated by a physiotherapist and the control group was treated by a general practitioner, it was difficult to determine whether the difference could be accounted for by the added exercises or the nature of the therapeutic involvement.

The results from the three non-RCTs do not help to clarify these findings. Cassidy et al (13) reported that patients who were referred to a fitness program recovered 32% slower than patients who were not referred for any treatment. This program was an aggressive work-hardening type of exercise program and seemed to suggest that these types of formal exercise programs in the subacute phase may be detrimental; however, these results may simply indicate that patients who do not require therapy recover faster than those who do, presumably because they have less severe injuries. Similarly, both Amirfezy et al (14) and Goodman and Frew (15) reported that

physiotherapy programs are significantly more likely to lead to improvement when they are initiated early (within the first three months or six weeks, respectively) rather than later. Although these studies found that early therapy is better than later therapy, the results may be explained by the fact that patients with chronic WAD are less likely to improve than patients at an earlier stage.

### Conclusions regarding exercise programs in subacute WAD:

While a supervised exercise program may be more effective than an unsupervised program over the short term, and earlier therapy appears to be more effective than later therapy, the use of fitness and exercise programs during the subacute stage of WAD may actually be counterproductive. In particular, an aggressive work-hardening type of approach may be detrimental at this stage.

### Interdisciplinary interventions

Three studies (one RCT and two non-RCTs) were identified that investigated an interdisciplinary approach in which psychological counselling was combined with another type of therapy (Table 3). In an RCT of fair quality, Provinciali et al (16) reported that an exercise program complemented by psychological counselling was more effective in reducing pain and sick leave than an intervention consisting of passive physiotherapy modalities. While these results suggest that a more complex interdisciplinary approach is more effective than physiotherapy alone, it is not clear which component of this intervention was responsible for the observed treatment effect (ie, the psychological component, the combination of several therapies or the active rather than the passive nature of the treatment) – a problem compounded by the fact that neither the patients nor the therapists were blinded to what were very disparate interventions.

The other two studies do not help to clarify this issue. In a case series that included 75 patients, Adams et al (17) found that patients who began interdisciplinary therapy within three months of injury were significantly more likely to return to work than those who began therapy after six months; however, without a control group, this study may only demonstrate that individuals with chronic WAD are less likely to improve than individuals with subacute WAD. Suissa et al (18) conducted a population-based cohort study and found that patients who participated in an interdisciplinary program after four weeks of standard therapy experienced a significantly higher rate of insurance file closure and compensation ending one year after injury. However, the validity of time to

**TABLE 2**  
**Summary of studies evaluating exercise programs for subacute whiplash-associated disorder (WAD)**

Reference, year, country, score	Population and methods	Outcome measures	Results
Bunketorp et al (11), 2006, Sweden, PEDro score = 8	Randomized controlled trial. 47 patients with WAD (6 weeks to 3 months) were randomly assigned to one of two exercise programs. The home exercise program included stability and postural training through shoulder adduction, passive cervical rotation, and rowing and stretching exercises. Supervised physiotherapy included two 90 min sessions/week comprised of cervical rotation, functional exercises (lifting and bending), stretching, and strength and endurance training	Primary outcome measures included the Self-Efficacy Scale, Tampa Scale for Kinesiophobia and Pain Disability Index. Assessments were made at baseline, immediately after the 3-month intervention period and 6 months later	The proportion of patients who improved in terms of self-efficacy (68% versus 36%), fear of movement (68% versus 36%) and pain disability (73% versus 40%) was significantly greater for the supervised group immediately after treatment (all at $P<0.05$ ); however, between-group differences were not maintained at 6 months
Scholten-Peeters et al (12), 2006, The Netherlands, PEDro score = 7	Randomized controlled trial. 80 patients with whiplash-related functional impairment 4 weeks postinjury were included. The general practitioner care group received advice on graded activity and the importance of remaining active. The physiotherapy group received the same advice and performed progressive loading exercises for cervical and shoulder muscle function, posture, and balance. Treatment ended at maximal improvement, up to 9 months postinjury	Primary outcomes included neck pain, headache intensity and pain during work activities in daily living, all rated on a visual analogue scale. Patients were assessed at baseline, and at 8, 12, 26 and 52 weeks postinjury	No differences in primary outcomes were found to be significant at any time point. However, a significantly greater proportion of patients in the general practitioner care group were found to have functionally recovered at 52 weeks (60% versus 29%, $P<0.05$ )
Amirfeyz et al (14), 2009, United Kingdom, ns	Case series. 141 patients with WAD received physiotherapy on an as-needed basis (with a mean length of treatment of 6 weeks). Patients were divided into two groups depending on whether treatment was initiated within or later than 3 months postinjury. Therapy included neck posture advice, graded activities and a range of exercises (stretching, ROM and strengthening)	Outcome measures included the Neck Bournemouth Questionnaire, the Patient Global Impression of Change and number of sick days. Assessments were made at baseline and immediately following treatment	Although a significant amount of improvement was seen in both groups, a significantly greater number of patients who began therapy in the first 3 months improved compared with those who began more than 3 months postinjury (67% versus 48%, $P<0.05$ )
Cassidy et al (13), 2007, Canada, ns	Cohort study. This study included all patients ( $n=6021$ ) treated for WAD over a two-year period. Patients were referred to 1 of 3 conditions: fitness training (aerobic exercises, group education and weight training), outpatient rehabilitation (assessment and care provided by an interdisciplinary health care team and fitness training) or inpatient rehabilitation (similar to outpatient, but for those requiring more intensive rehabilitation)	The primary outcome measure was recovery time (defined by self-report of improvement) assessed by telephone interview at 1.5, 3, 6, 9 and 12 months postinjury. Baseline assessments were made using insurance claim forms	Recovery rates were not found to be associated with participation in any of the three groups. On the contrary, the fitness training and outpatient programs were associated with slower recovery (32% and 50% slower, respectively)
Goodman and Frew (15), 2000, Canada, ns	Case series. 10 patients with WAD of mixed duration (subacute and chronic) completed 18 strength training sessions over 6 weeks. The program consisted of graduated-resistance isotonic exercises in all cervical planes	Cervical ROM and isometric strength in each cervical plane were assessed at baseline and at the end of the program	Cervical ROM improved by a mean of 28% (range 21% to 45%) and isometric strength improved by a mean of 245% (range 197% to 302%). Statistical significance was not reported

ns No score; PEDro Physiotherapy Evidence Database; ROM Range of motion

insurance claim closure as an outcome has been challenged by several authors who have argued that there is little evidence that this measure corresponds to recovery from pain, or improved range of motion (ROM) or any other whiplash-related impairment (19-21), and is often determined in a seemingly arbitrary manner.

**Conclusions regarding interdisciplinary interventions in subacute WAD:** There is some evidence that interdisciplinary interventions may be more effective in reducing pain and sick leave than passive physiotherapy modalities, although more research is needed to determine which components of such interventions are beneficial. There is also some evidence that patients who receive interdisciplinary treatment earlier are more likely to return to work, but it is uncertain whether this simply reflects natural history or is a consequence of the intervention.

#### Manual joint manipulation

Four studies (two RCTs of fair quality and two case series) were identified that assessed the efficacy of joint manipulation

for subacute WAD patients (Table 4). Results from both of the RCTs (22,23) suggest that thoracic and cervical spinal manipulations are effective in reducing pain and improving cervical ROM. However, because both of these studies used relatively short follow-up periods (one week and one month post-treatment, respectively), it is not clear whether this intervention resulted in any long-term benefit. Furthermore, neither of these two studies were blinded in any way, which introduced a number of important biases into the evaluation of the efficacy of the intervention. Similarly, although the results of the two case series (24,25) supported chiropractic manipulation, it is difficult to interpret the significance of their findings. Specifically, Suter et al (24) failed to include several pertinent details of their study (including the length of treatment, follow-up duration and the significance of their findings), while Osterbauer et al (25) evaluated 10 patients with a wide range of time since injury (from same day to 13 months).

**Conclusions regarding manual joint manipulation in subacute WAD:** Although there is some evidence that joint

**TABLE 3**  
**Summary of studies evaluating interdisciplinary interventions for subacute whiplash-associated disorder (WAD)**

Reference, year, country, score	Population and methods	Outcome measures	Results
Provinciali et al (16), 1996, Italy, PEDro score = 5	Randomized controlled trial. 60 patients with WAD for less than 2 months received interdisciplinary treatment (relaxation training, active reduction of cervical and lumbar lordosis, massage and mobilization of the cervical spine, eye fixation exercises and psychological support) or a control treatment (transcutaneous electrical nerve stimulation, pulsed electromagnetic field therapy, ultrasound or calcic iontophoresis with CaCl <sub>2</sub> ). Each group completed 10 1 h sessions over 2 weeks	Pain intensity (visual analogue scale), cervical ROM (maximal flexion, declination and rotation) and subjective assessment of treatment efficacy were recorded before and after treatment as well as at 1 and 6 months post-treatment. Duration of sick leave was also recorded	Significantly greater improvement was seen in the interdisciplinary treatment group from baseline to 6 months in terms of pain intensity (median decrease of 4.9 versus 2.6), self-assessment of outcome (one-point increase versus one-point decrease) and sick leave (100% returned to work versus 80%), all at P<0.001. Median cervical ROM and pain intensity improved for both groups at 6 months (P<0.0001). Point estimates were not reported
Adams et al (17), 2007, Canada, ns	Case series. This study assessed the effects of a 10-week community-based psychosocial intervention aimed at facilitating return to work. 25 individuals with acute WAD (4–12 weeks), 25 with early chronic WAD (3–6 months) and 25 with chronic WAD (6–18 months) were included in the study (total n=75). In addition, all patients participated in physiotherapy programs	In addition to identifying return to work rates, participants completed the Pain Catastrophizing Scale, Tampa Scale for Kinesiophobia, Pain Disability Index and Pain Rating Index of the McGill Pain Questionnaire at baseline, mid-treatment and post-treatment	Return to work rates were 80%, 72% and 32% for the subacute, early chronic and chronic groups, respectively. Although all 3 groups reported similar changes on each of the self-report measures, participants who were absent from work for more than 6 months had the least amount of change in self-reported disability
Suissa et al (18), 2006, Canada, ns	Cohort study. 2163 patients with acute WAD were included. 288 patients presenting to reference hospitals participated in a maximum 16-week whiplash management program designed to promote return to work through regular activity (including counselling, mobilization and work-related exercises). 1875 patients who presented to nonreference hospitals served as a standard care reference group	Length of time receiving compensation, time to insurance file closure and amount of insurance compensation were recorded. Subjects were followed for 1 year	At 1 year, 40% of the experimental group was receiving compensation compared with 50% of the reference group. The experimental group had significantly higher rates of end of compensation (RR 3.2, 95% CI 2.8–3.6) and file closure (RR 1.5, 95% CI 1.2–1.8) than the reference group

ns No score; PEDro Physiotherapy Evidence Database; ROM Range of motion

manipulation may be of short-term benefit to patients in the subacute stage of WAD, further research using more rigorous methodology is needed before definitive conclusions can be drawn.

### Injection-based interventions

One study was identified that investigated the use of botulinum toxin injections during the subacute stage of WAD (Table 5). In this RCT of good quality, Carroll (26) reported that while patients in both the active and placebo groups showed improvement in pain, disability and cervical ROM, those who received the active treatment tended to make slightly larger, albeit nonsignificant, gains at both four weeks and three months post-treatment. The authors concluded that botulinum toxin injections may have a small treatment effect but that a much larger sample size would be needed to detect a significant difference.

**Conclusions regarding injection-based interventions in subacute WAD:** Based on the results of one RCT, it does not appear that botulinum toxin injections are any more effective than placebo in the treatment of subacute WAD, although further study is needed involving RCTs with larger sample sizes.

## DISCUSSION

Compared with the acute and chronic phases of WAD, there is substantially less research investigating the treatment of WAD initiated during the subacute phase, despite the fact that this is a period of time in which many treatments are

initiated. Thirteen studies were identified that met inclusion criteria and evaluated interventions initiated during the subacute phase. Several conclusions were reached, although these conclusions should be viewed cautiously because they are based on the results of one or two RCTs, and methodological quality is a concern.

While exercise programs appear to be effective in the treatment of acute and chronic WAD (27,28), the effectiveness of exercise programs for the treatment of subacute WAD has not been demonstrated. Moreover, there is some evidence that aggressive work-hardening programs may be detrimental during this stage of recovery. Only one RCT (12) compared exercise with another intervention, and this study did not blind patients or therapists. Further research is needed to determine the role of exercise during subacute WAD and to evaluate the relative effectiveness of various exercise regimens, particularly those that are less aggressive. There was positive, albeit weak, evidence that both interdisciplinary interventions and manual joint manipulation may provide some benefit during the subacute phase of WAD; however, given that the evidence for both of these interventions is derived from studies that were not blinded and only followed patients for a short period of time, further research is clearly needed before definitive conclusions can be drawn regarding the effectiveness of these two treatments. Based on one study, the use of botulinum toxin injections in subacute WAD is not supported, but more research is needed.

The present review was limited by several methodological concerns. First, because of the small number of studies in the

**TABLE 4**  
**Summary of studies evaluating manual joint manipulation for subacute whiplash-associated disorder (WAD)**

Reference, year, country, score	Population and methods	Outcome measures	Results
Fernández-des-las-Peñas et al (22), 2004, Spain, PEDro score = 5	Randomized controlled trial. 88 patients with <3 months of whiplash-related thoracic joint dysfunction causing cervical and upper thoracic pain were included. All patients received 15 sessions of physiotherapy, including ultrasound therapy, home exercises, muscle stretching, massage and electrotherapy; the experimental group also received dorsal manipulation of dysfunctional thoracic joints during the fifth and 10th sessions	A VAS was used to assess neck, head and upper thoracic region pain at baseline, and 1 week after the 10th and 15th sessions (ie, 1 week after the first and second manipulations)	Following the first manipulation, reductions in upper thoracic pain significantly differed between the experimental and control groups (3.3±1.5 versus 0.7±0.8, P<0.001). After the second manipulation, a significantly greater reduction in both upper thoracic (5.4±1.9 versus 1.3±0.9, P<0.001) and neck pain (2.3±0.9 versus 1.7±0.9, P<0.01) was reported for patients in the experimental group
Fernández-des-las-Peñas et al (23), 2004, Spain, PEDro score = 4	Randomized controlled trial. 380 patients with WAD for <3 months were included. The experimental group received weekly manipulation of the cervical and thoracic spine, a neuromuscular technique in paraspinal soft tissues and myofascial trigger point manual therapies; the control group received daily therapy consisting of ultrasound therapy, home exercises, multimodal therapy and pulsed electromagnetic field therapy	Head and neck pain (VAS), and cervical ROM in flexion and rotation (goniometer) were assessed at baseline after each of the 4 monthly sessions for the experimental group and after each of the 10 biweekly sessions for the control group	At the first follow-up assessment, the experimental group had greater pain reduction (40% versus 19%, P<0.01) and greater improvement in cervical flexion and rotation (20° in cervical rotation and 17.5° in cervical flexion versus 2.5° and 6°, respectively; P<0.05) than the control group
Suter et al (24), 2002, Canada, ns	Case series. 23 patients with whiplash injury of 3 days to 6 weeks duration underwent cervical spinal manipulation without muscle work	Cervical ROM (goniometer) and muscle strength during maximal effort neck flexion/extension and arm abduction/adduction (modified sphygmomanometer dynamometer) were assessed before and after treatment	Improvement was reported in all outcomes; however, statistical significance was not reported
Osterbauer et al (25), 1992, USA, ns	Case series. 10 patients with WAD of varying duration (range 1 day to 13 months) received spinal manipulative therapy for 6 weeks, 2–3 times per week. 4 of the patients also received interferential electrotherapy and 6 took analgesics in unmonitored doses	Cervical ROM (finite helical axis parameters during normal movements) and neck pain intensity (VAS) were assessed at 1-week intervals throughout treatment and at a 1-year follow-up assessment	At 6 weeks, mean pain scores decreased from 44.1 to 10.5 (P<0.001) and total ROM increased from 234° to 297° (P<0.001). Of the 7 patients who responded by the 1-year follow-up, all but one had reported at least minimal categorical improvement from 6 weeks

ns No score; PEDro Physiotherapy Evidence Database; ROM Range of motion; VAS Visual analogue scale

**TABLE 5**  
**Summary of a study evaluating botulinum toxin A injection for subacute whiplash-associated disorder**

Reference, year, country, score	Population and methods	Outcome measures	Results
Carroll (26), 2008, Ireland, PEDro score = 7	Randomized controlled trial. 37 patients who remained symptomatic 2 months after a whiplash injury were randomly assigned to receive either 250 units of botulinum toxin A (Dysport; Tercica Inc, USA) or placebo (injected equally into four trigger points)	Tenderness to palpation scores, pain intensity (visual analogue scale), Vernon-Mior Neck Pain and Disability Index and cervical range of motion (flexion, extension and lateral flexion) were assessed at baseline, 4 weeks and 3 months after treatment	Although patients in the active treatment group tended to make larger improvements than those in the placebo group, no significant differences were found between the two groups

PEDro Physiotherapy Evidence Database

whiplash literature, particularly for the treatment of subacute WAD, the inclusion criteria were quite broad. All studies were included regardless of study design as long as 60% of the sample experienced a WAD and the study included a sample of at least three participants with a whiplash injury. This may have resulted in the inclusion of some studies of lower scientific merit; however, such studies were only used to formulate conclusions in the absence of superior RCTs and these limitations were noted in the conclusions themselves as well as in the discussion. Second, there are limitations with the quality assessment process used in the current review to assess the methodological quality of RCTs. For example, it is possible

that an RCT with significant between-group differences at baseline that does not blind patients, therapists or assessors could still have a PEDro score of 6 and be considered a study of good methodological quality despite these significant limitations. Again, these issues were noted in relevant conclusions and study descriptions. Nevertheless, these measures do not negate the need for readers to be 'critical consumers' of the material presented.

According to Dufton et al (29), each additional month of time lag between sustaining a whiplash injury and seeking treatment is associated with a 20% increase in the odds of experiencing prolonged injury-related disability. Moreover,

**TABLE 6**  
**Summary of evidence for subacute whiplash-associated disorder (WAD) therapies**

Intervention	Conclusions
Exercise programs	While a supervised exercise program may be more effective than an unsupervised program over the short term, and earlier therapy appears to be more effective than later therapy, the use of fitness and exercise programs during the subacute stage of WAD may actually be counterproductive. In particular, an aggressive work-hardening type of approach may be detrimental at this stage
Interdisciplinary	There is some evidence that interdisciplinary interventions may be more effective in reducing pain and sick leave than passive physiotherapy modalities, although more research is needed to determine which components of such interventions are beneficial. There is also some evidence that patients who receive interdisciplinary treatment earlier are more likely to return to work but it is uncertain whether this simply reflects natural history or is a consequence of the intervention
Manual joint manipulation	Although there is some evidence that joint manipulation may be of short-term benefit to patients in the subacute stage of WAD, further research using more rigorous methodology is needed before definitive conclusions can be drawn
Injection based	Based on the results of one randomized controlled trial, it does not appear that botulinum toxin injections are any more effective than placebo in the treatment of subacute WAD, although further study is needed involving randomized controlled trials with larger sample sizes

although the estimates of recovery rates vary widely, a substantial proportion of WAD patients are still symptomatic during the subacute phase of the disorder (30). While several conclusions were reached in the present review (Table 6), the evidence was not strong for any of the treatments that were evaluated. Although some of the evidence regarding interventions initiated during the acute phase of WAD can be

extrapolated to patients in the subacute phase, it should not be assumed that treatments that are effective during one stage will also be effective or appropriate during another. Further investigation and the identification of effective therapies for patients suffering from subacute WAD are important, not only to relieve these patients' symptoms, but also to attempt to reduce the progression to chronic pain and disability.

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