

# Conservative interventions provide short-term relief for non-specific neck pain: a systematic review

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**Question:** Which interventions for non-specific neck pain are effective in reducing pain or disability? **Design:** Systematic review with meta-analysis of randomised controlled trials. **Participants:** Adults with non-specific neck pain. **Intervention:** All interventions for neck pain that were evaluated in trials with a placebo, minimal- or no-intervention control. **Outcome measures:** Pain and disability outcomes (0–100 scale) at the conclusion of a course of treatment (short term), and in the medium (3 to 9 months) and long (> 9 months) term. **Results:** 33 trials were identified. The interventions with significant short-term effects on pain were manipulation (MD –22, 95% CI –32 to –11), multimodal intervention (MD –21, 95% CI –34 to –7), specific exercise (MD –12, 95% CI –22 to –2), combination orphenadrine/paracetamol (MD –17, 95% CI –32 to –2), and manual therapy (MD –12, 95% CI –16 to –7). There was a significant short-term effect on disability for acupuncture (MD –8, 95% CI –13 to –2) and manual therapy (MD –6, 95% CI –11 to –2). Treatment with laser therapy resulted in better pain outcomes at medium-term follow-up but not at short-term follow-up. No other intervention demonstrated medium- or long-term effects. **Conclusion:** Some conservative interventions for neck pain are effective in the short term. Few interventions that have been investigated have shown longer term effects that are better than placebo or minimal intervention. [Leaver AM, Refshauge KM, Maher CG, McAuley JH (2010) Conservative interventions provide short-term relief for non-specific neck pain: a systematic review. *Journal of Physiotherapy* 56: 73–85]

**Key words:** Systematic review, Randomised controlled trial, Neck pain

## Introduction

Neck pain affects up to two-thirds of people at some point during their life (Cote et al 1998). It remains one of the most common musculoskeletal complaints in primary care (Rekola et al 1993), yet many of those affected do not seek health care (Badcock et al 2003). Neck pain may be associated with specific conditions such as fracture, inflammatory disease, vascular disorders, or neurological compromise. However, for the majority of cases of neck pain, a specific cause cannot be identified and the classification *non-specific* neck pain is used (Hoving et al 2001).

The efficacy of interventions for non-specific neck pain has not been well established. Although many interventions have been investigated, previous systematic reviews (Binder 2005, Gross et al 2007, Hurwitz et al 2008) have investigated a diverse group of conditions additional to non-specific neck pain including radiculopathy, whiplash, and conditions that commonly, though not necessarily, have concomitant neck pain (eg headache, dizziness, brachialgia, back pain, and shoulder pain). These conditions are not homogeneous in that they have different clinical presentations and they are also believed to have different mechanisms. Better estimates of the effects of interventions for non-specific neck pain are likely to be found in trials in which all participants have non-specific neck pain.

Another factor that limits understanding of the effects of

interventions for non-specific neck pain is that many of the available trials compare two or more active interventions without a no-intervention control. This type of trial is appropriate in circumstances where the efficacy of one of the interventions has been well established, or where the use of a no-intervention control might be unethical (Saunders 2003). However, in instances where the efficacy of the comparison intervention is simply presumed, there is no way of knowing whether either intervention is beneficial, ineffective, or even harmful. The use of a placebo or no intervention as a control provides a clearer answer about the efficacy of an intervention. Therefore, the research question for this review was:

Which interventions for non-specific neck pain are more effective than placebo, sham, minimal intervention, or no intervention in reducing pain and disability?

## Method

### Identification and selection of studies

The databases MEDLINE, CINAHL, EMBASE, PEDro, and the Cochrane Register of Clinical Trials were searched from inception to February 2008 using a sensitive search strategy described by van Tulder et al (2003). (See Appendix 1 on the eAddenda for the full search strategy.) The bibliographies of all included trials and all systematic reviews located were searched for further relevant trials that had not been identified by the electronic search.

The inclusion criteria for trials are shown in Box 1. Two-arm trials that compared the relative effectiveness of two interventions, or different dosages or regimens of the same intervention, were excluded. Trials published in languages other than English were included if a suitable translation could be obtained. Trials that described participants having specific diagnoses (eg, cervical osteoarthritis or cervical myofascial pain) without confirmatory diagnostic tests as inclusion criteria were considered to be trials of non-specific neck pain. Trials that investigated mixed populations (eg, neck and back pain, neck/shoulder pain, neck/arm pain) or diffuse pain states (eg, chronic pain syndrome, fibromyalgia, cervicobrachialgia) were included only if outcomes were reported separately for the group of participants with neck pain. Trials were excluded if any of the participants had been given a specific diagnosis such as radiculopathy, myelopathy, fracture, infection, dystonia, tumour, inflammatory disease, or osteoporosis. Trials were excluded if some or all of the participants had whiplash-associated disorder or neck pain associated with trauma. Trials in which the participants' primary complaint was headache or upper limb pain were excluded unless the presence of neck pain was a specific inclusion criterion. Trials were excluded if prevention of neck pain in otherwise pain-free participants was the main aim of the intervention.

#### Box 1 Inclusion criteria.

Design
• Randomised controlled trial
Participants
• Adults, >18 years old
• Non-specific neck pain (in the area defined by Merskey and Bogduk, 1994)
Intervention
• All interventions for neck pain
Outcome measures
• Pain
• Disability
Comparisons
• Intervention versus placebo / sham
• Intervention versus minimal intervention (eg, wait list)
• Intervention versus no intervention (eg, self-care advice)

Retrieved citations were screened (AML) and titles unrelated to neck pain (eg, neck of femur, neck of bladder) were excluded. The remaining papers were independently screened by the lead author (AML) and by a second reviewer (KMR, CGM, or JHMc). Disagreement about inclusion or exclusion of studies was resolved by discussion. The reviewers were not blinded to information regarding the authors, journal of origin, or outcomes for each reviewed paper.

#### Assessment of characteristics of studies

**Quality:** Methodological quality was assessed using the PEDro scale (Maher et al 2003, de Morton 2009) by two independent trained assessors. Scores were extracted from the PEDro database where available. Trials were not excluded on the basis of quality.

**Participants:** The duration of the neck disorder was recorded to allow separate analysis of acute and chronic non-specific neck pain. Duration of up to 12 weeks was considered acute.

**Interventions:** Dosages of the interventions were recorded where available, as were descriptions of the intervention and the control intervention.

**Outcome measures:** The outcomes extracted were neck pain using a numerical scale and disability using a multi-item scale. Outcome data were extracted at the time closest to the conclusion of a course of treatment (short term), and at medium- and long-term follow-ups. We defined medium term as the time point between 3 and 9 months that was closest to 6 months. We defined long term as the time point after 9 months that was closest to 12 months (van Tulder et al 2003).

#### Data analysis

Data were extracted by the lead author (AML) and by a second reviewer working independently (KMR, CGM, JHMc). For trials with continuous outcomes the mean, standard deviation, and sample size of follow-up scores or change from baseline scores were extracted. If not reported, means and standard deviations were imputed from the reported measures of central tendency and variance (Higgins and Green 2006). For trials with dichotomous outcomes the number of subjects experiencing the outcome of interest and the total sample size were extracted.

Where continuous outcomes were reported in an individual study, the effects of the intervention were expressed as a mean difference with a 95% CI for each outcome. Where pooling of outcomes was deemed appropriate, a meta-analysis was conducted using a random effects model and the results were expressed as weighted mean differences. Pain and disability scores were converted to a 0–100 point scale prior to calculation of effect size to enable comparison of outcomes between interventions and trials.

Where dichotomous outcomes were reported, the effects of the intervention were expressed as the relative risk of beneficial outcome with 95% CI.

## Results

#### Flow of studies through the review

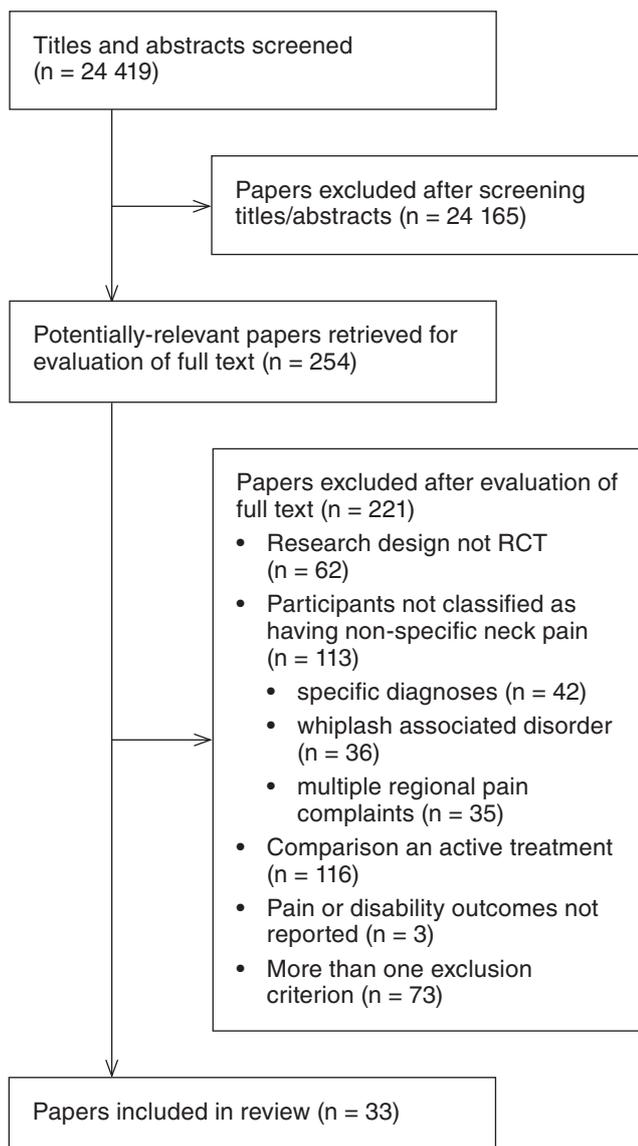
From 24 419 titles identified by the searches, 254 full-text publications were retrieved, of which 33 were included in the review. (Reasons for exclusion are presented in Figure 1.)

#### Characteristics of included studies

**Quality:** Trial quality was generally high with 60% of trials scoring at least 7 out of 10 on the PEDro scale (Table 1). The quality criteria related to blinding were commonly not met, with 17 trials not blinding participants and 26 trials not blinding therapists. Some of the interventions investigated, such as neck manipulation and exercise, are difficult to deliver with adequate blinding of participants or therapists. The other quality criteria that were most commonly not met were intention-to-treat analysis (22 trials) and concealment of treatment allocation (15 trials).

**Participants:** The majority of the eligible trials investigated participants with chronic neck pain (n = 19) or neck pain of mixed duration (n = 11). A single eligible trial (Pikula 1999) investigated acute neck pain. Two trials did not specify the duration of the episode of neck pain. (See Table 2.)

**Interventions:** The types of interventions investigated by the included trials were medications, relaxation, acupuncture,



**Figure 1.** Flow of studies through the review.

exercise, manual therapy, multi-modal intervention, and electrotherapy. (Specific interventions are presented in Table 2.) No eligible trials investigated the role of surgery, injections, or radiofrequency neurotomy for non-specific neck pain. The control intervention was a sham physical intervention in 20 trials, minimal intervention in 8 trials, no intervention in 3 trials, and placebo medication in 2 trials.

**Outcome measures:** Pain outcomes were reported by 31 of the 33 eligible trials. The most frequent pain outcome used was a numeric scale (n = 29). One trial reported pain outcomes using the von Korff scale (von Korff et al 1990), and one trial reported the number of participants who experienced improvement in neck pain. Disability outcomes were reported by 18 of the 33 eligible trials. The disability measures used included the Neck Disability Index (Vernon and Moir 1991, n = 8), Northwick Park Neck Pain Questionnaire (Leak et al 1994, n = 3), Million Scale (Million et al 1982, n = 2), Neck Pain and Disability Index (Wheeler et al 1999, n = 2), Modified Whiplash Disability Questionnaire (Skillgate et al 2007, n = 1), and single- and multiple-item numerical scales (n = 2) (Petrie and Hazleman 1986, Viljanen et al 2003).

## Effect of interventions

For all interventions, pain outcomes at the conclusion of treatment are presented in Figure 2 and at medium- and long-term follow-up in Figure 3. For all interventions, disability outcomes at the conclusion of treatment are presented in Figure 4 and at medium- and long-term follow-up in Figure 5. (See also Tables 3 to 6 on the eAddenda for detailed data.)

**Medication:** Two trials were identified that compared the short-term analgesic effects of medications with placebo. One trial (Hoivik and Moe 1983) found more effective pain relief from an 8-day course of Norgesic (ie, combination orphenadrine 35mg and paracetamol 450mg) than placebo (MD -17, 95% CI -32 to -2). One trial (Thomas et al 1991) found no significant difference in immediate pain relief between single doses of diazepam (5mg) and placebo (MD -1, 95% CI -5 to 3). Neither trial reported medium- or long-term outcomes.

**Relaxation:** One trial investigated relaxation (Viljanen et al 2003). This three-arm trial compared intensive relaxation training with dynamic strengthening exercise and with minimal intervention in women with chronic neck pain. There was no significant difference in pain outcomes between relaxation training and minimal intervention at the conclusion of treatment (MD 2, 95% CI -4 to 8) or at medium- (MD 1, 95% CI -6 to 8), or long-term (MD 1, 95% CI -6 to 8) follow-up. In addition, there was no significant difference in disability outcomes between relaxation training and minimal intervention at the conclusion of treatment (MD 0, 95% CI -4 to 4), medium- (MD 1, 95% CI -3 to 6), or long-term (MD 3, 95% CI -2 to 7) follow-up.

**Acupuncture:** Five trials compared acupuncture with sham intervention. The shams used in these trials included needling procedures without skin penetration (Itoh et al 2007, Nabeta and Kawakita 2002) and deactivated electrotherapy devices (Petrie and Hazleman 1986, Vas et al 2006, White et al 2004). One trial compared acupuncture with minimal treatment (Witt et al 2006).

A variety of acupuncture approaches were investigated including traditional Chinese practice, western medical practice, and acupuncture applied to tender points identified by the practitioner. One four-arm trial (Itoh et al 2007) compared traditional Chinese acupuncture with acupuncture directed at 'trigger points', acupuncture directed to regions adjacent to 'trigger points', and sham acupuncture. The three acupuncture groups in this trial were combined to create a single pair-wise comparison.

Pooled outcomes from five trials (Itoh et al 2007, Nabeta and Kawakita 2002, Petrie and Hazleman 1986, Vas et al 2006, White et al 2004) showed no significant difference in pain outcomes between acupuncture and control at the conclusion of a course of treatment (WMD -12, 95% CI -23 to 0.1). Pooled results from the three trials (Petrie and Hazleman 1986, Vas et al 2006, White et al 2004) that reported medium-term pain outcomes showed acupuncture to be no more effective than control (WMD -4, 95% CI -15 to 7), consistent with the single trial (White et al 2004) that reported long-term pain outcomes (MD -4, 95% CI -13 to 7).

Pooled outcomes from five trials (Itoh et al 2007, Petrie and Hazleman 1986, Vas et al 2006, White et al 2004, Witt et al 2006) showed a significant but small difference in disability

**Table 1 .** Quality of included studies (PEDro scores).

Study	Random allocation	Concealed allocation	Groups similar at baseline	Participant blinding	Therapist blinding	Assessor blinding	< 15% dropouts	Intention-to-treat analysis	Between-group difference reported	Point estimate and variability reported	Total (0 to 10)
Altan 2005	Y	N	Y	Y	N	Y	Y	N	Y	Y	7
Checcherelli 1989	Y	N	N	Y	Y	Y	Y	N	Y	Y	7
Chow 2004	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	9
Chow 2006	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10
Cleland 2005	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8
Dundar 2007	Y	Y	Y	Y	N	Y	Y	N	Y	Y	8
Gur 2004	Y	N	Y	Y	N	Y	Y	N	Y	Y	7
Hemmila 2005	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Hoivik 1983	Y	N	Y	Y	Y	N	Y	N	Y	Y	7
Hoving 2002	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Hoving 2006	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Itoh 2007	Y	N	Y	Y	N	Y	N	N	Y	Y	6
Martinez-Segura 2006	Y	N	Y	N	N	N	Y	N	Y	Y	5
Nabeta 2002	Y	N	Y	Y	N	Y	N	Y	Y	Y	7
Kjellman 2002	Y	Y	Y	N	N	N	Y	N	Y	Y	6
Lewith 1982	Y	Y	N	N	N	N	Y	N	Y	Y	5
Ozdemir 2001	Y	N	Y	Y	N	Y	N	N	N	Y	5
Palmgren 2006	Y	Y	Y	N	N	N	Y	N	Y	Y	6
Petrie 1986	Y	N	N	N	N	Y	Y	N	Y	Y	5
Pikula 1999	Y	Y	Y	N	N	N	Y	N	Y	Y	6
Revel 1994	Y	N	Y	N	N	N	N	N	Y	Y	4
Skillgate 2007	Y	Y	Y	N	N	N	Y	Y	Y	Y	7
Sutbeyaz 2006	Y	Y	Y	Y	Y	Y	Y	N	N	Y	8
Taimela 2000	Y	N	Y	Y	N	N	Y	Y	Y	Y	7
Takala 1994	Y	N	Y	N	N	Y	Y	N	Y	Y	6
Thomas 1991	Y	N	Y	Y	N	N	Y	N	Y	Y	6
Thorsen 1992	Y	N	Y	Y	Y	Y	Y	N	N	Y	7
Trock 1994	Y	Y	N	Y	N	Y	Y	N	Y	Y	7
Vas 2006	Y	Y	Y	N	N	Y	N	Y	Y	Y	7
Viljanen 2003	Y	Y	Y	N	N	Y	Y	Y	Y	Y	8
Vitiello 2007	Y	Y	N	N	N	Y	N	N	Y	Y	5
White 2004	Y	Y	Y	N	Y	N	N	Y	Y	Y	7
Witt 2006	Y	N	Y	N	N	N	N	Y	Y	Y	5

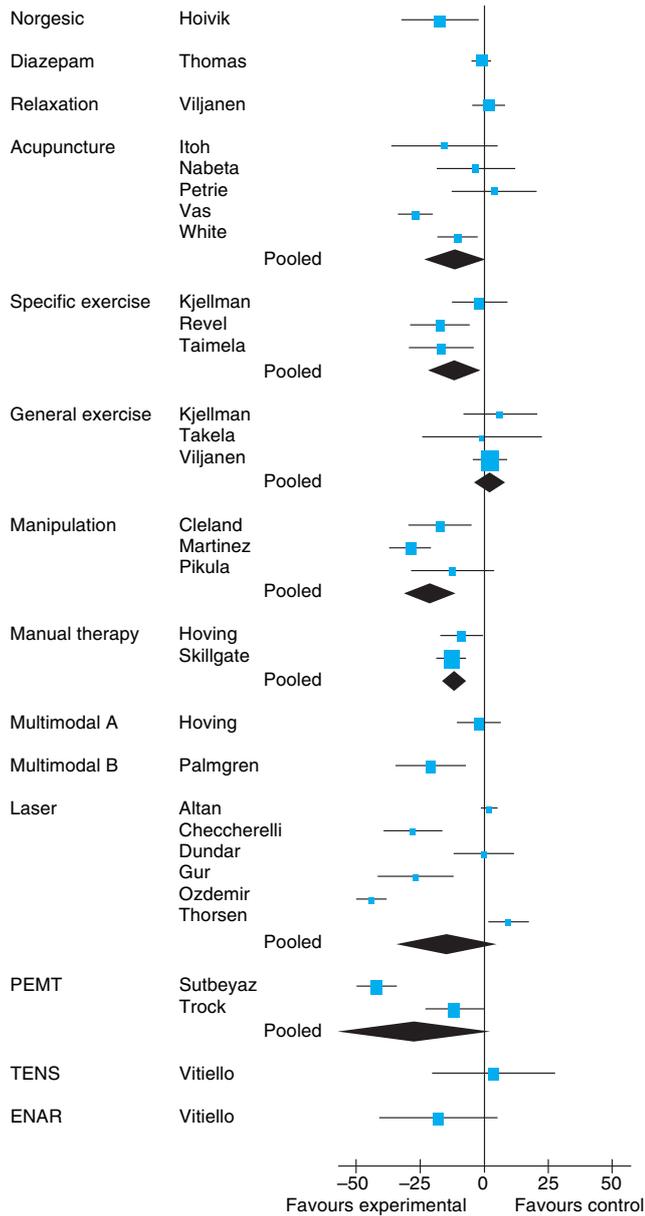
**Table 2.** Table of description of main aspects of studies.

Study	Participants	Intervention	Outcome measures
Altan et al (2005)	n = 53 Chronic	Exp = Laser: GaAs, 1000 Hz, 904 nm, 50 W Con = Sham laser Both groups: 2 min per point, 10 treatments over 10 days	Pain: VAS
Checcherelli et al (1989)	n = 27 Chronic	Exp = Laser: GaAlAs, 1000 Hz, 904 nm, 25 W Con = Sham laser Both groups: 12 treatments over 4 wk	Pain: VAS
Chow et al (2004)	n = 27 Chronic	Exp = Laser: Diolase, 830 nm, 300 mW Con = Sham laser Both groups: 30 min x 14 treatments over 7 wk	Pain: VAS Disability: Northwick Park Neck Pain Questionnaire
Chow et al (2006)	n = 27 Chronic	Exp = Laser: Diolase, 830 nm, 300 mW Con = Sham laser Both groups: 30 min x 14 treatments over 7 wk	Pain: VAS Disability: Northwick Park Neck Pain Questionnaire
Cleland et al (2005)	n = 36 Mixed	Exp = Thoracic spine manipulation Con = Sham manipulation: placed in pre-manipulative position Both groups: single treatment	Pain: VAS
Dundar et al (2007)	n = 27 Unspecified	Exp = Laser: GaAsAl, 1000 Hz, 9830 nm, power 450 mW Con = Sham laser Both groups: 15 treatments over 15 days	Pain: VAS Disability: Vernon Moir Neck Disability Index
Gur et al (2004)	n = 60 Chronic	Exp = Laser: GaAlAs, 2800 Hz, 904 nm, 11.2 mW Con = Sham laser Both groups: 10 treatments over 2 wk	Pain: VAS Disability: Vernon Moir Neck Disability Index
Hemmila et al (2005)	n = 42 Sub-acute or chronic	Exp = Bone setting: traditional non-manipulative manual therapy 5 treatments over 5 wk Con = No intervention	Disability: Million scale
Hoivik et al (1983)	n = 44 Unspecified	Exp = Norgesic: orphenadrine 35 mg, paracetamol 450 mg 3 tablets/day x 8 days Con = Placebo medication	Pain: VAS
Hoving et al (2002)	n = 183 Mixed	Exp 1 = Manual therapy: spinal mobilisation techniques 6 treatments over 6 wk Exp 2 = Multimodal intervention: exercise and passive techniques excluding manual therapy 12 treatments over 6 wk Con = Minimal intervention: medical primary practitioner visit up to 3 visits	Pain: VAS Disability: Vernon Moir Neck Disability Index
Hoving et al (2006)	n = 183 Mixed	Exp 1 = Manual therapy: spinal mobilisation techniques 6 treatments over 6 wk Exp 2 = Multimodal intervention: exercise and passive techniques excluding manual therapy 12 treatments over 6 wk Con = Minimal intervention: medical primary practitioner visit up to 3 visits	Pain: VAS Disability: Vernon Moir Neck Disability Index

Study	Participants	Intervention	Outcome measures
Itoh et al (2007)	n = 40 Chronic	Exp 1 = Standard acupuncture Exp 2 = Trigger-point acupuncture Exp 3 = Non-trigger-point acupuncture Con = Sham acupuncture: blinded simulated needling without skin penetration All groups 30 min x 6 treatments over 10 wk	Pain: VAS Disability: Vernon Moir Neck Disability Index
Kjellman et al (2002)	n = 77 Mixed	Exp 1 = General exercises: ROM, endurance and strength 16 sessions over 8 wk Exp 2 = McKenzie exercises sessions at discretion of therapist over 8 wk Con = Sham ultrasound regimen unspecified	Pain: VAS Disability: Vernon Moir Neck Disability Index
Lewith et al (1982)	n = 26 Sub-acute or chronic	Exp = Infra-red: applied to tender points for 5 to 10 s Con = Sham TENS Both groups: 4 treatments over 2 wk	Pain: Number improved
Martinez-Segura et al (2006)	n = 70 Sub-acute or chronic	Exp = Neck manipulation Con = Sham manipulation: manual positioning of the neck Both groups: single treatment	Pain: VAS
Nabeta et al (2002)	n = 27 Chronic Acupuncture students	Exp = Acupuncture: 'sparrow pecking technique' directed at tender points Con = Sham acupuncture: blinded simulated acupuncture with blunt needles no penetration, simulated removal of needles Both groups: 5 min x 3 treatments over 3 wk	Pain: VAS
Ozdemir et al (2001)	n = 60 Mixed	Exp = Laser: Ga-As Al, 830 nm, 50 mW Con = Sham laser: not well described Both groups: 12 points x 15 s/point x 10 treatments over 10 days	Pain: VAS Disability: Neck Pain and Disability Index
Palmgren et al (2006)	n = 37 Chronic	Exp = Multimodal intervention: chiropractic mobilisation/manipulation, massage, exercises 3 to 5 treatments over 5 wk Con = Minimal intervention: advice	Pain VAS
Petrie et al (1986)	n = 27 Chronic	Exp = Acupuncture: 5 needles Con = Sham TENS Both groups: 20 min x 8 treatments over 4 wk	Pain: VAS Disability: Single item scale
Pikula et al (1999)	n = 36 Acute	Exp 1 = Manipulation in direction of the painful side Exp 2 = Manipulation in direction of the non-painful side Con = Sham ultrasound	Pain: VAS
Revel et al (1994)	n = 60 Chronic	Exp = Eye coordination exercises 15 sessions over 8 wk Con = Minimal intervention: not fully described	Pain: VAS
Skillgate et al (2007)	n = 263 Mixed	Exp = Multimodal intervention: Naprapathic therapy (spinal manual therapy, massage, stretches, and advice re prevention, rehabilitation activities and ergonomics) 45 min x 6 treatments over 6 wk Con = Minimal intervention: medical primary practitioner visit up to 2 visits	Pain: von Korff scale Disability: Modified Whiplash Disability Questionnaire

Sutbeyaz et al (2006)	n = 34 Chronic	Exp = PEMT: 0.1 to 64 Hz Con = Sham PEMT: not well described Both groups: 30 min x 2 treatments/day over 3 wk	Pain: VAS Disability: Million scale
Taimela et al (2000)	n = 76 Chronic	Exp 1 = Active multimodal intervention: stabilisation exercises, relaxation training, behavioural support, eye fixation exercises, posture training 24 sessions over 12 wk Exp 2 = A neck lecture and 2 training sessions in home exercises, progress diary Con = Minimal intervention: A neck lecture with written information about home exercises	Pain: VAS
Takela et al (1994)	n = 44 Chronic	Exp = Group gymnastics 45 min x 10 sessions over 10 wk Con = No intervention	Pain: VAS
Thomas et al (1991)	n = 44 Chronic	Exp = Diazepam: 5mg single dose Con = Placebo medication	Pain: VAS
Thorsen et al (1992)	n = 60 Mixed Laboratory technicians	Exp = Laser: GaALAs, 830 nm, 30 mW, max 9J per treatment Con = Sham laser Both groups: 6 treatments over 2 wk	Pain: VAS
Trock et al (1994)	n = 81 Chronic	Exp = PEMT Con = Sham PEMT: not well described Both groups: 30 min x 18 treatments over 4 to 6 wk	Pain: VAS
Vas et al (2006)	n = 123 Chronic	Exp = Acupuncture Con = Sham TENS Both groups: 30 min x 5 treatments over 3 wk	Pain: VAS Disability: Northwick Park Neck Pain Questionnaire
Viljanen et al (2003)	n = 393 Chronic	Exp 1 = Dynamic muscle training: stretching and strengthening of muscles of neck and upper arm using dumbbells 36 sessions over 12 wk Exp 2 = Relaxation training techniques: progressive muscle relaxation, autogenic training, functional relaxation, systematic desensitisation 36 sessions over 12 wk Con = No intervention	Pain: VAS Disability: 8 item scale
Vitiello et al (2007)	n = 30 Sub-acute or chronic	Exp 1 = ENAR Exp 2 = TENS Con = Sham ENAR All groups: 15 min x 12 treatments over 6 wk	Pain: VAS Disability: Vernon Moir Neck Disability Index
White et al (2004)	n = 135 Chronic	Exp = Acupuncture Con = Sham TENS Both groups: 20 min x 8 treatments over 4 wk	Pain: VAS Disability: Vernon Moir Neck Disability Index
Witt et al (2006)	n = 3766 Chronic	Exp = Acupuncture Up to 15 treatments Con = Minimal intervention	Disability: Neck Pain and Disability Index

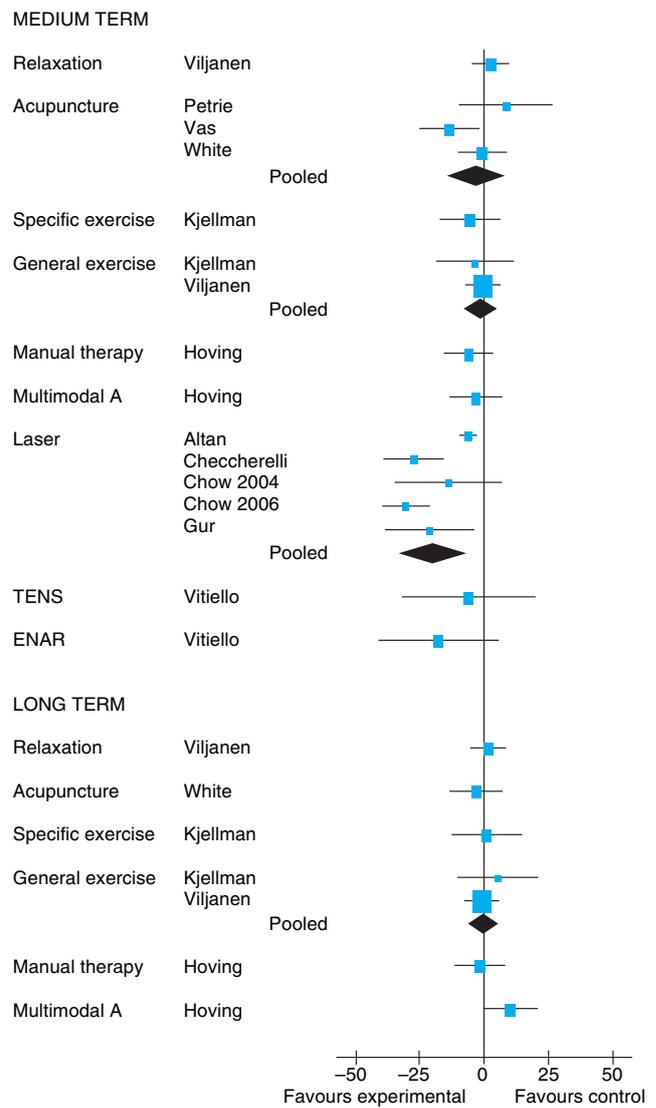
Exp = experimental group, Con = control group, ENAR = electro neuro adaptive regulator (proprietary branded TENS), PEMT = pulsed electromagnetic therapy, TENS = transcutaneous electrical nerve stimulation, VAS = visual analogue scale



**Figure 2.** Weighted mean difference (95% CI) effect of conservative interventions on pain at the conclusion of a course of treatment compared with control. ENAR = electro neuro adaptive regulator (proprietary branded TENS), Multimodal A = exercises, massage and electrotherapy, Multimodal B = exercises, massage, electrotherapy and manual therapy, PEMT = pulsed electromagnetic therapy, TENS = transcutaneous electrical nerve stimulation.

outcomes in favour of acupuncture at the conclusion of treatment (WMD -8, 95% CI -13 to -2). Pooled outcomes from the three trials (Petrie and Hazleman 1986, White et al 2004, Witt et al 2006) that reported medium-term disability outcomes demonstrated that acupuncture was not more effective than control (WMD -1, 95% CI -2 to 0.3), consistent with the single trial (White et al 2004) that reported long-term disability outcomes (MD -4, 95% CI -10 to 2).

**Exercise:** Five trials investigated exercise for non-specific neck pain. One three-arm trial (Kjellman and Oberg 2002) compared McKenzie exercise with general exercise



**Figure 3.** Weighted mean difference (95% CI) effect of conservative interventions on pain at medium- and long-term follow-up compared with control. ENAR = electro neuro adaptive regulator (proprietary branded TENS), Multimodal A = exercises, massage and electrotherapy, TENS = transcutaneous electrical nerve stimulation.

and with sham ultrasound. Four trials compared various exercise approaches with minimal intervention. The exercise approaches included ‘proprioceptive’ exercises (Revel et al 1994), a combined program of neck stabilisation, relaxation, eye fixation, behavioural support, and posture training (Taimela et al 2000), group gymnastic exercises (Takala et al 1994), and muscle strengthening (Viljanen et al 2003).

Pooled outcomes from three trials (Kjellman and Oberg 2002, Revel et al 1994, Taimela et al 2000) showed significant reduction in pain at the conclusion of a course of specific exercises (WMD -12, 95% CI -22 to -2). The single trial that reported medium- (MD -6, 95% CI -17 to 5) and long-term (MD 1, 95% CI -12 to 14) pain outcomes for specific exercise programs did not demonstrate similar benefit (Kjellman and Oberg 2002). One trial (Kjellman and Oberg 2002) showed no significant difference in disability at the conclusion of a course of specific exercises (MD -3,



Pooled outcomes from two trials (Hoving et al 2002, Skillgate et al 2007) show that manual therapy provided better pain relief after a course of treatment than minimal treatment (WMD  $-12$ , 95% CI  $-16$  to  $-7$ ). A similar benefit was not reported in the single trial (Hoving et al 2006) that reported medium- (MD  $-7$ , 95% CI  $-16$  to  $2$ ) and long-term (MD  $-1$ , 95% CI  $-11$  to  $9$ ) pain outcomes. Pooled outcomes from three trials (Hemmila 2005, Hoving et al 2002, Skillgate et al 2007) show that manual therapy resulted in significantly better disability outcomes at the conclusion of treatment than control (WMD  $-6$ , 95% CI  $-11$  to  $-2$ ). A similar benefit was not demonstrated in the two trials (Hemmila 2005, Hoving et al 2006) that reported medium- (WMD  $-8$ , 95% CI  $-24$  to  $7$ ) and long-term (WMD  $-1$ , 95% CI  $-12$  to  $9$ ) disability outcomes.

**Multimodal physical therapies:** Two trials compared multimodal physical therapies, which included exercises, massage, and various electrotherapies, with minimal treatment. One trial excluded manual therapies (Hoving et al 2002, 2006), and one trial included manual therapies (Palmgren et al 2006) in the range of treatments provided.

Multimodal physical therapy that did not include manual therapy did not provide better pain relief than control following a course of treatment (MD  $-2$ , 95% CI  $-10$  to  $6$ ) or at medium- (MD  $-3$ , 95% CI  $-13$  to  $7$ ) or long-term (MD  $10$ , 95% CI  $-0.4$  to  $20$ ) follow-up. It also did not provide better disability outcomes than control following a course of treatment (MD  $0$ , 95% CI  $-5$  to  $5$ ) or at medium- (MD  $0.2$ , 95% CI  $-5$  to  $5$ ) or long-term (MD  $4$ , 95% CI  $-11$  to  $10$ ) follow-up.

Multimodal physical therapy that included spinal manual therapy provided better pain relief than control following a course of treatment (MD  $-21$ , 95% CI  $-34$  to  $-7$ ). Medium- and long-term pain outcomes and disability outcomes were not reported in this trial.

**Laser therapy:** Eight trials were identified that compared laser therapy to sham. Pooled outcomes from the six trials (Altan et al 2005, Ceccherelli et al 1989, Dundar et al 2007, Gur et al 2004, Ozdemir et al 2001, Thorsen et al 1992) that reported pain outcomes at the completion of treatment showed no significant difference between laser and control (WMD  $-14$ , 95% CI  $-34$  to  $5$ ). Pooled outcomes from the five trials (Altan et al 2005, Ceccherelli et al 1989, Chow et al 2004, Chow et al 2006, Gur et al 2004) that reported pain outcomes at medium-term showed a statistically significant difference in favour of laser therapy over control (WMD  $-20$ , 95% CI  $-33$  to  $-7$ ). No trials reported long-term outcomes.

Pooled outcomes from two trials (Dundar et al 2007, Ozdemir et al 2001) that reported disability outcomes following a course of treatment showed no significant difference between laser and control (WMD  $-28$ , 95% CI  $-72$  to  $17$ ). Pooled outcomes from two trials (Chow et al 2004, Chow et al 2006) that reported medium-term disability outcomes showed no significant difference between laser and placebo (WMD  $-6$ , 95% CI  $-14$  to  $2$ ). No trials reported long term outcomes.

**Pulsed electromagnetic therapy:** Two trials (Sutbeyaz et al 2006, Trock et al 1994) compared pulsed electromagnetic therapy with sham. Pooled outcomes show no significant difference between pulsed electromagnetic therapy and control in pain (WMD  $-27$ , 95% CI  $-57$  to  $3$ ) or disability

(WMD  $-18$ , 95% CI  $-48$  to  $11$ ) outcomes at the conclusion of a course of treatment. Neither trial reported medium- or long-term outcomes.

**Electrotherapies:** One three-arm trial (Vitiello et al 2007) compared two types of transcutaneous electrical nerve stimulation (TENS) with sham TENS. The active treatment arms were standard TENS and a commercially branded stimulator called 'ENAR'. There was no significant difference found between TENS or ENAR and control in terms of pain or disability at any of the time points reported, with the exception of better medium-term disability outcomes in favour of the nine participants in the ENAR group (MD  $-18$ , 95% CI  $-31$  to  $-6$ ). Long-term outcomes were not reported.

**Infra-red therapy:** A single trial (Lewith and Machin 1981) was identified that compared heat treatment using an infra-red device with a sham TENS device. A larger proportion of participants treated with the infra-red device reported pain relief than in the control group (RR  $7$ , 95% CI  $1$  to  $39$ ).

## Discussion

For people with non-specific neck pain, our findings suggest that there are several interventions that provide clinically worthwhile improvements in pain and disability, at least in the short term. The long-term benefits of these interventions have not been demonstrated; however, few studies have examined long-term outcomes. Importantly, we identified only one eligible trial that investigated patients with acute neck pain, greatly limiting evidence-based decision making about management of this group.

Consistent with previous reviews (Gross et al 2007, Hurwitz et al 2008), our results support the use of physical therapies that involve combinations of manual therapy and exercise. Our results add to the evidence supporting manual therapy by demonstrating short-term analgesic benefit from neck manipulation, thoracic manipulation, and neck mobilisation applied as single modality interventions. Our results also support the use of exercise for neck pain. Exercise programs that targeted specific impairments, such as head repositioning accuracy (Revel et al 1994) or combinations of neck stabilisation, relaxation, eye fixation, and posture training (Taimela et al 2000), were effective interventions. In contrast, it would appear that general strength and conditioning programs (Kjellman and Oberg 2002, Takala et al 1994, Viljanen et al 2003), which are commonly used for treatment of chronic pain and disability, were not effective for neck pain.

Australian guidelines advocate primary care for neck pain that includes reassurance, advice, and prescription of simple analgesic medication (NHMRC 2004). The appeal of this approach is that the interventions are simple, inexpensive, accessible, and presumed to be safe and effective. Some of the recommendations in the guidelines (eg, reassurance and advice) have not been tested, and others (eg, prescription of simple analgesics) have not been tested adequately for non-specific neck pain. A trial investigating the efficacy of these primary care measures is therefore a research priority.

The scarcity of studies of simple analgesics is part of a broader pattern of lack of evidence for commonly used pharmacological interventions for neck pain. We found no trials that investigated the efficacy of non-steroidal anti-inflammatory, opioid, muscle relaxant, antidepressant, or

antineuritic medication. Similarly, we found no trials that investigated local anaesthetic, nerve block, or Botulinum toxin injection for non-specific neck pain. The widespread use of analgesic and other medications for neck pain underpins the need for better knowledge about the efficacy and safety of these interventions.

The therapeutic benefits of interventions such as acupuncture and laser are supported, although not convincingly, by this review. Although the pooled results of the acupuncture trials demonstrated a statistically significant improvement in disability outcomes, the point estimate of the effect size (7.5 points on a 100-point index) is small. This result is also disproportionately influenced by the single large ( $n = 3441$ ), lower quality trial (Witt et al 2006) that used a minimal-intervention comparison rather than sham acupuncture. Separate analysis of disability outcomes from the sham-controlled trials of acupuncture (WMD  $-6$ , 95% CI  $-15$  to  $3$ ) suggest that the small difference seen between acupuncture and minimal medical care relate to the non-specific effects of provision of care. Similarly, while the results for laser therapy were promising, the results from the eight included trials varied from exceptionally effective to slightly harmful. This conflict in the findings is difficult to explain. Pooled results demonstrated no between-group difference at the conclusion of treatment, whereas a significant reduction in pain was found at medium-term follow-up. A delayed analgesic effect does not seem plausible. Furthermore, this pattern of delayed onset of benefit did not consistently appear within trials that measured at both time points, and appears to be partly an artefact of the different studies included at the two time points. The included trials of laser therapy investigated similar treatment and dosage protocols, although there was considerable diversity in trial quality and outcomes measured. The lack of consistency between trials in the timing of follow-up assessments resulted in different trials being pooled at post-treatment and medium-term time points, so the clinical course of symptoms should not be inferred from these data. A more focused review of laser therapy might provide further explanation about the reasons for the inconsistent trial outcomes.

Few trials examined other electrophysical agents and those that did were inconclusive. Two trials of pulsed electromagnetic therapy suggest that this intervention is not effective. There was sparse evidence concerning the various forms of TENS therapy with only one small study reporting no significant results. There were no eligible trials that investigated any of the other electrophysical agents commonly used for neck pain.

There is increasing evidence for an association between psychological factors and musculoskeletal pain and disability (Linton 2000), and therefore a strong rationale supports psychological interventions. However, the role of psychological interventions for neck pain has not been well investigated despite the increasing popularity of these therapies. Some of the psychological therapies, such as those that address coping, adjustment, and problem solving, involve generic pain-management principles and have been investigated in broader spinal pain, or chronic musculoskeletal pain populations (Morley et al 1999). The one trial identified in this review that investigated intensive training in relaxation, a therapy often provided with other psychological interventions, showed that this treatment was not effective for decreasing neck pain.

The role of surgery in the management of non-specific neck pain was not well supported by this review. Surgical trials excluded from this review were almost exclusively conducted on patients with specific pathology, usually a demonstrated neurological compromise. We found no controlled trials that investigated the use of procedures such as fusion or disc replacement for non-specific neck complaints. Given the high potential for serious adverse events and the high costs associated with surgery there is a need to establish better knowledge about the outcome of these procedures.

Despite the extensive evidence identified and summarised by this review, several questions have not been answered comprehensively. Although we identified 221 studies that investigated interventions for neck pain, only 33 trials met our criteria of having participants with clearly defined non-specific neck pain, and using a placebo, sham, or minimal or no intervention as a control. There is a need for greater consistency in classification of neck pain and conditions associated with neck pain. We excluded a large number of trials in which two active interventions were compared, ie, without comparison to a placebo, sham, or minimal or no intervention. This type of comparative trial should be a lower research priority in making determinations about efficacy.

This review has identified evidence supporting some interventions for non-specific neck pain. However, none of these interventions was shown to have lasting benefit. There is a need to establish whether simple and inexpensive measures such as reassurance, self-care advice, and simple analgesics provided by trained practitioners are effective for neck pain. Future research might focus on the question of whether the addition of commonly provided or novel interventions confers additional benefits to quality baseline care. This is particularly pertinent for interventions that involve exposure to additional risks or incur additional costs. ■

**eAddenda:** Appendix 1, Tables 3 to 6 available at [jop.physiotherapy.asn.au](http://jop.physiotherapy.asn.au)

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