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REVIEW ARTICLE

MECHANICAL TRACTION FOR MECHANICAL NECK DISORDERS: A SYSTEMATIC REVIEW

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Objective: **To assess whether mechanical traction, either alone or in combination with other treatments, improves pain, function/disability, patient satisfaction and global perceived effect in adults with mechanical neck disorders.**

Methods: **We conducted a systematic review up to September 2004 of randomized controlled trials and used pre-defined levels of evidence for qualitative analysis. Two independent reviewers conducted study selection, data abstraction and methodological quality assessment. Using a random effects model, relative risk and standardized mean differences were calculated. The reasonableness of combining studies was assessed on clinical and statistical grounds. In the absence of heterogeneity, pooled effect measures were calculated.**

Results: **Of the 10 selected trials, one study was of high quality. Our review revealed low-quality trials for mechanical neck disorders, showing evidence of benefit favouring intermittent traction for pain reduction. Continuous traction showed no significant difference for defined outcomes.**

Conclusion: **Inconclusive evidence for continuous and intermittent traction exists due to trial methodological quality. Two clinical conclusions may be drawn, one favouring the use of intermittent traction and the other not supporting the use of continuous traction. Attention to research design flaws and description of traction characteristics is needed.**

Key words: systematic review, neck, traction, pain, disability, function, mechanical neck disorders, whiplash-associated disorders, arthritis.

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INTRODUCTION

Neck disorders are common, disabling to various degrees, and costly (1–5). Mechanical traction is often used as part of a comprehensive program in outpatient rehabilitation. The value of this treatment has often been questioned because studies of its usefulness have generally been inconclusive and there are no data on cost-effectiveness (6–9). Mechanical traction for the cervical spine involves a tractive force applied to the neck via a mechanical system. This can be applied intermittently or continuously. Indications for this type of intervention include herniated disc, degenerative disc disease and hypomobile facet joints (10). The physiological effects of such treatment may include separation of vertebral bodies, distraction and gliding of facet joints, widening of the intervertebral foramen, tensing of ligamentous structures, straightening of spinal curves and stretching of spinal musculature (10). Traction has also been reported to decrease pain by providing muscle relaxation, stimulation of mechanoreceptors and inhibition of reflex muscle guarding (10). More definitive information about its effect on pain, function and patient satisfaction is needed for specific subgroups of disorders and symptom durations, to guide further clinical practice.

This systematic review assessed the effect of mechanical traction either alone or in combination with other treatments on pain, function/disability, patient satisfaction and global perceived effect in adults with mechanical neck disorders. Where appropriate, it also assessed the influence of 3 factors: quality of study methodology, symptom duration and subtypes of the disorder.

METHODS

Criteria for considering studies for this review

Types of studies. Any randomized controlled trial (RCT) or quasi-RCT was included.

Types of participants. The participants were adults who suffered from acute (less than 30 days), sub-acute (30–90 days) or chronic (greater than 90 days) neck disorders, categorized as:

- mechanical neck disorders (MND), including whiplash-associated disorders (WAD) (11, 12), myofascial neck pain, and degenerative changes (DC) (13);
- neck disorder with headache (NDH) (14–16);
- neck disorders with radicular findings (NDR) (11, 12).

Studies were excluded if they investigated neck disorders with definite or possible long tract signs, neck pain caused by other pathological entities (13), headache not of cervical origin but

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associated with the neck, co-existing headache when either neck pain was not dominant or the headache was not provoked by neck movements or sustained neck postures, or "mixed" headache.

Types of interventions. Studies using mechanical traction techniques, whether combined with other therapies or not, and contrasted against a control or comparison group or not, were all included.

Types of outcome measures. The outcomes of interest were pain relief, disability/function, patient satisfaction, and global perceived effect.

Search strategy for identification of studies

Computerized bibliographic databases were searched by a research librarian without language restrictions for medical, chiropractic and allied health literature. This search was part of a comprehensive search on physical medicine modalities. The following databases were searched from root up to September 2004: MEDLINE, EMBASE, Manual Alternative and Natural Therapy, Cumulative Index to Nursing and Allied Health Literature, Index to Chiropractic Literature, and the Cochrane Controlled Trials Registry. Our personal files, screening of references, communication with the Cochrane Back Group and content experts were also used. Subject headings (MeSH) and key words included anatomical terms, disorder or syndrome terms, treatment terms and methodological terms.

Subject headings (MeSH), text words and key words included anatomical terms (neck, neck muscles, cervical plexus, cervical vertebrae, atlanto-axial joint, atlanto-occipital joint, spinal nerve roots, brachial plexus); disorder and syndrome terms (arthritis, myofascial pain syndromes, fibromyalgia, spondylitis, spondylosis, spinal osteophytosis, spondylolisthesis, headache, whiplash injuries, cervical rib syndrome, torticollis, cervicobrachial neuralgia, radiculitis, polyradiculitis, polyradiculoneuritis, thoracic outlet syndrome); treatment terms (traction, combined modality therapy, electric stimulation therapy, transcutaneous electric nerve stimulation, rehabilitation, ultrasonic therapy, phototherapy, lasers, physical therapy, acupuncture, biofeedback, chiropractic, electric stimulation therapy); and methodological terms (randomized controlled trial, double-blind method, single-blind method, placebos, clinical trial, controlled clinical trial). For details see protocol.

Review methods

Four pairs of 2 independent reviewers each, with differing backgrounds conducted citation identification, study selection, data abstraction, and assessment of methodological quality. Agreement was assessed for study selection using the quadratic weighted Kappa statistic (Kw); Cichetti weights. A third reviewer was consulted in case of persisting disagreement.

Assessment of methodological quality. Methodological quality was judged using the validated criteria by Jadad et al. (17) (maximum score 5, high score greater than 2).

Criteria and scores according to Jadad et al. (17):

- 1a. Was the study described as randomized? (score 1 if yes)
- 1b and 1c. Was the method of randomization described and appropriate to conceal allocation (score 1 if appropriate and −1 if not appropriate)
- 2a. Was the study described as double-blinded? (score 1 if yes)
- 2b and 2c. Was the method of double blinding described and appropriate to maintain double-blinding (Score 1 if appropriate and −1 if not appropriate)
- 3. Was there a description of how withdrawals and dropouts were handled? (score 1 if yes)

Quantitative analysis of trial results. For continuous data, standardized mean differences (SMD) (95% CI) were calculated using a random effects model. In the absence of clear guidelines on the size of clinically important effect sizes, we used a commonly applied system by Cohen (18): small (0.20), medium (0.50) or large (0.80). We assumed the minimum clinically important difference to be 10 on a 100-point pain intensity scale. Similarly, a minimum clinically important difference of 5 neck disability index units or 10% was considered relevant for the neck disability index (19). Relative risks (RR) were calculated for dichotomous outcomes. To facilitate analysis, data imputation rules were used when necessary (20). For continuous outcomes reported as medians, effect sizes were calculated (21). The number needed to treat (NNT) and treatment advantages were calculated for primary findings (20). Power analyses were conducted for each article reporting non-significant findings (22). Prior to calculation of a pooled effect measure, the reasonableness of pooling was assessed on clinical grounds. Statistical heterogeneity between the studies was tested using a random effects model. In the absence of heterogeneity ($p > 0.05$), a common SMD or RR was calculated. Sensitivity analysis or meta-regression was performed where appropriate.

Qualitative analysis of trial results. To reach final conclusions, qualitative analysis was carried out, using the levels of evidence listed below.

- "Strong evidence" denoted consistent findings in multiple high-quality RCTs.
- "Moderate evidence" denoted findings in a single, high-quality RCT or consistent findings in multiple low-quality trials.
- "Limited evidence" indicated a single low-quality RCT.
- "Unclear evidence" denoted inconsistent results in multiple RCTs.
- "Conflicting evidence" meant no studies were identified.
- "Evidence of adverse effect" was used for trials that showed lasting negative changes.

The term "evidence of benefit" was used for trials or meta-analyses large enough (for example: sample size greater than or equal to 70 per intervention arm) to be positive, with low risk of

false-positive conclusions. The sample size per intervention arm was based on criteria for clinically important changes in outcomes seen in rheumatoid arthritis trials (23), since we were aware of no other criterion available for neck specific trials. The term "evidence of no benefit" was used for trials or meta-analyses large enough (for example: power greater than or equal to 80%; or sample size greater or equal to 70 per intervention arm) to be negative, with low risk of false-negative conclusions. In the absence of a meta-analysis, temporality, consistency, plausibility, strength of association, dose-response, adverse events, and costs were considered.

Description of studies. Ten trials were selected from 395 citation postings:

- 7 publications representing 6 trials studied neck disorder with some radicular signs and symptoms of the following duration: chronic (24–30). Lee et al. (27) and Wong et al. (28) was a duplicate publication.
- 2 studied mechanical neck disorder of the following duration: acute (31), chronic, not defined (32).
- 0 studied headache of cervical origin.
- 2 studied mixed neck disorders of the following duration: subacute and chronic (33) not defined (34).

See Table I for specific data outlining treatment characteristics, co-intervention, validity scoring, baseline values, absolute benefits, reported results, SMD, RR, side effects and costs of care. We excluded 2 RCTs as less than 15% of the study participants received mechanical traction in one (35), and in the other, mechanical traction was a standardized co-intervention for both index and comparison groups (36). Agreement between pairs of independent reviewers from varied professional backgrounds for physical medicine methods was Kw 0.86, SD 0.10.

Methodological quality of included studies. Overall, selected studies were of poor methodological quality on the 5-point scale by Jadad et al. (17) (mean 1.75, SD 1.14). Concealment of allocation was poorly described in 90% (9/10) of the studies and was inadequate in 50% (5/10). All but one study (25) used poor blinding technique of the outcome assessor, patient and treating therapist. Most studies (90%) had accounted for withdrawals and dropouts.

RESULTS

Traction vs placebo/control

We selected 5 studies comparing traction with a placebo or a control. Three of the studies by Zylbergold & Piper (29): group 2 (intermittent traction) versus group 3 (manual traction); Goldie & Landquist (24): traction versus control; and Kogstad et al. (33): continuous traction versus placebo, examined intermittent traction for chronic mechanical neck disorder, neck disorder with radicular signe or meachanical neck disorder (MND) with associated degenerative changes. We found an additional 3 comparisons investigating continuous traction for acute, subacute or chronic MND, neck disorder with radicular signs (NDR) or MND with associated degenerative changes (albeit some positive pattern in all 3 studies by Brewerton et al. (30); Klaber-Moffett et al. (25); Zylbergold & Piper (29) group 1 continuous traction versus group 3). Although we found the diagnostic subgroups and outcomes to be somewhat similar, the types of therapy included both continuous and intermittent tractions. Clinically, we judged the traction types not to be homogenous (see Figs 1–3).

Intermittent traction

For pain outcomes we determined that there was moderate evidence of benefit favouring intermittent traction for pain reduction when compared with control or placebo for chronic MND, NDR, degenerative change ((29): 2 v 3; (24): trac vs cntl). These were short-term results. For global perceived effect, we found conflicting evidence (24, 33).

Continuous traction

Our evaluation of static traction vs placebo or control for acute to chronic MND, NDR or degenerative change revealed moderate evidence of no benefit for pain reduction in Brewerton et al. (30); Klaber-Moffett et al. (25); Zylbergold & Piper (29) 1 vs 3; and function Brewerton et al. (30); Klaber-Moffet et al. (25) based on 3 studies: Because all 3 studies were small and 2 had poor methodological quality, these results would need to be confirmed through larger RCTs. Albeit, the activity of daily living outcome had a positive pattern but the study was underpowered (25).

Traction vs comparison

We selected 7 studies from 8 publications each with a small sample size. Four of the studies; Kogstad et al. (33), continuous traction versus placebo, Lee et al. (27), Loy (32), Wong et al. (28), Zylbergold & Piper (29) 2 vs 3 examined intermittent traction for chronic MND, NDR or MND with associated degenerative changes, one study looked at whiplash association disorder (WAD) (31), and another at MND/DC. We found 2 studies investigating continuous traction for chronic NDR and MND (26, 34).

We judged that there was limited evidence of no difference from multiple low-quality RCTs when intermittent traction was compared with manual traction ((33) continuous traction versus manual traction; (29) 2 vs 3 for pain outcomes, (31) for global perceived effect, or intermittent traction with electromyographic biofeedback (28) for symptom relief. This was also true when static traction was compared with manual traction (29) 1 vs 3 for pain. There was also no significant difference in another low-quality study comparing continuous traction to non-steroidal anti-inflammatory drug (NSAID) use (26). From 2 low-quality studies, we determined limited evidence that acupuncture was favoured over static (34) or intermittent traction (32).

Table I. *Methodological quality and outcome for each trial*

Author/year Participants	Intervention	Methodological quality (Jadad criteria list) 1a	1b	1c	2a	2b	2c	3	T	Main outcomes
Brewerton 1966 (*n* A/R = 412/466) Unspecified NDR	Continuous traction vs placebo heat vs placebo tablet vs collar vs positioning	1	0	0	0	0	0	1	2	Pain: (4-point scale) Baseline: NR Reported results: not significant for all groups RR (trac vs Pl(h)): 1.00 (95% CI 0.85, 1.18) RR (trac vs Pl(t)): 0.90 (95% CI 0.77, 1.04) RR (trac vs col): 0.99 (95% CI 0.86, 1.15) RR (trac vs pos): 0.97 (95% CI 0.85, 1.11) Ability to Work: (4-point scale) Baseline: NR Reported results: not significant for all groups RR (trac vs Pl(h)): 0.87 (95% CI 0.53, 1.44) RR (trac vs Pl(t)): 0.69 (95% CI 0.42, 1.14) RR (trac vs col): 0.76 (95% CI 0.50, 1.16) RR (trac vs pos): 0.86 (95% CI 0.56, 1.32) Side Effects: NR Cost of care: NR
Goldie 1970 (*n* A/R = 73/73) Chronic MND with possible radicular symptoms	Intermittent traction vs exercise, drug and patient education vs drug	1	0	−1	0	0	0	1	1	Global Percieved Effect (3-point scale) Baseline: NR Reported results: a slight tendency favouring traction RR (trac vs no treatment): 0.05 (95% CI random 0.27,0.90) RR (trac vs exercise): 1.19 (95% CI random 0.52, 2.69) Side effects: patient rated as not improved or worse = traction 9 of 26; isometric 7 of 24; no treatment 16 of 23 Cost of care: NR
Guangyue 2001 (*n* A/R = 536/536) Chronic MND, NDR	Static traction vs acupuncture	1	0	0	1	0	−1	1	2	Global Perceived Effect (3-point scale) Baseline: NA Reported results: significant favouring acupuncture RR 4.31(95% CI random: 2.93, 6.34) Side effects: NR Cost of care: NR
Klaber-Moffett 1990 (*n* A/R = 94/100) Chronic NDR	Static traction vs placebo, collar, drug	1	0	0	1	1	0	1	4	Pain Intensity (VAS 10 cm) Baseline: traction 5.10, placebo 4.60 End of study mean: trac 2.78, placebo 3.19 Absolute benefit: trac 2.32, placebo 1.41 Reported results: not significant SMD −0.16 (95% CI random −0.59, 0.27) [power 9%] Activity Of Daily Living Baseline: traction 5.86, placebo 5.74 End of study mean: traction 2.80, placebo 3.93 Absolute benefit: traction 3.06, placebo 1.81 Reported results: not significant SMD −0.39 (95% CI random −0.84, 0.06) [power 9%] Social Disturbance (VAS 0 − 10) Baseline: traction 3.65, placebo 3.77 End of study mean: traction 2.10, placebo 1.86 Absolute benefit: traction 1.55, placebo 1.91 Reported results: not significant SMD 0.16 (95% CI random −0.27, 0.60) [power 6%] Side effects: 2 patients from traction (group A) reported headaches Cost of care: NR
Kogstad 1978 (*n* A/R = 50/50) Chronic MND, NDH, NDR	Intermittent traction vs manual vs placebo	1	0	−1	0	0	0	0	0	Global Perceived Effect (3-point scale) Baseline: NR Reported results: favours traction; at 18 months, Conventional 80% improved, placebo 53% improved, manual 85% improved RR (CT vs Pl): 0.43 (95% CI random: 0.15, 1.20) [power 8%] RR (CT vs MT): 0.33 (95% CI random: 0.08, 1.32) [power 6%] Side effects: NR Cost of care: NR

Table I (*Continued*)

Author/year Participants	Intervention	Methodological quality (Jadad criteria list) 1a	1b	1c	2a	2b	2c	3	T	Main outcomes
Loy 1983 (*n* A/R 53/60) Unspecified MND with degenerative changes	Intermittent traction vs electroacupuncture	1	0	−1	0	0	0	1	1	Patient Perceived Effect (symptomatic improvement): Baseline: NR Absolute benefit: PT 53.9; EAP 87.2 Reported results: significant favouring electroacupuncture Side effects: NR Cost of care: NR
Pennie 1990 (*n* A/R = 128/135) Acute MND/WAD	Intermittent traction vs collar and exercise	1	0	−1	0	0	0	1	1	Pain Intensity (VAS 100 mm) Baseline: NR Reported results: not significant Days Off Work Baseline: NR Reported results: not significant RR 1.02 (95% CI random: 0.43, 2.38) Global Perceived Effect (4 point scale) Baseline: NR RR 1.02 (95% CI random: 0.43, 2.38) Side effects: NR Cost of care: NR
Shakoor 2002 (*n* A/R = 199/218) Chronic MND, NDR	Continuous traction and exercise vs NSAID	1	0	0	0	0	0	1	2	Pain Intensity: summation of pain score, tenderness index, pain frequency score and VAS (no length provided) Baseline mean: group A 13.73, group B 13.32 End of study mean: group A 6.60, group B 7.52 Absolute benefit: group A 7.13, group B 5.8 Reported results: nearly significant SMD −0.26 (95% CI random −0.54,0.01) Side effects: NSAID some adverse reaction, not specific Cost of care: NR
Wong 1997 (*n* A/R = 24/24) Subacute and chronic NDR	Intermittent traction with EMG biofeedback vs conventional intermittent traction	1	0	0	0	0	0	1	2	Symptom Relief (4-point scale) Baseline: NR Reported results: no significant difference RR 1.12 (95% CI random 0.67,1.89) Side effects: NR Cost of care: NR
Zylbergold 1985 (*n* A/R = 100/100) Subacute, chronic MND, NDR with degenerative changes	Continuous traction (G1) vs intermittent traction (G2) vs manual traction (G3) vs placebo, patient education, moist heat and exercise (G4)	1	0	0	0	0	0	1	2	Pain Intensity (McGill Pain Questionnaire) Baseline mean: G1 2.02, G2 1.80, G3 1.60, G4 1.86 End of study mean: G1 0.74, G2 0.30, G3 0.58, G4 0.98 Absolute benefit: G1 1.28, G2 1.50, G3 1.02, G4 0.88 Reported results: favours intermittent traction SMD (1 vs 4): −0.22 (95% CI random: −0.78, 0.34) SMD (2 vs 4): −0.78 (95% CI random: −1.36, −0.21) SMD (1 vs 3): 0.17 (95% CI random: −0.39, 0.72) SMD (2 vs 3): −0.39 (95% CI random: 0.95, 0.17) Side effects: NR Cost of care: NR

MND = mechanical neck disorder; NDH = neck disorder with headache; NDR = neck disorder with radicular signs; WAD = whiplash-associated disorder; *n* A/R = sample number analysed/randomized; VAS = visual analogue scale; SMD = standard mean difference; RR = relative risk; CI = confidence interval; NR = not reported, trac = traction; Pl = placebo; Pl(h) = placebo heat; Pl(t) = placebo tablet; col = collar; pos = positioning; CT = continuous traction; MT = manual traction; EAP = electroacupuncture; PT = physiotherapy group; G = group, vs or v-vs = versus.

Other considerations

Adverse events. Side effects were reported in 1 of 10 trials (25) in which 2 patients reported headaches following traction. One further study showed unequivocal results across all groups (24).

Cost of care. Cost of care using traction was not assessed in these trials.

Sensitivity analysis. We did not conduct formal sensitivity analysis because there were not enough trials in each subgroup.

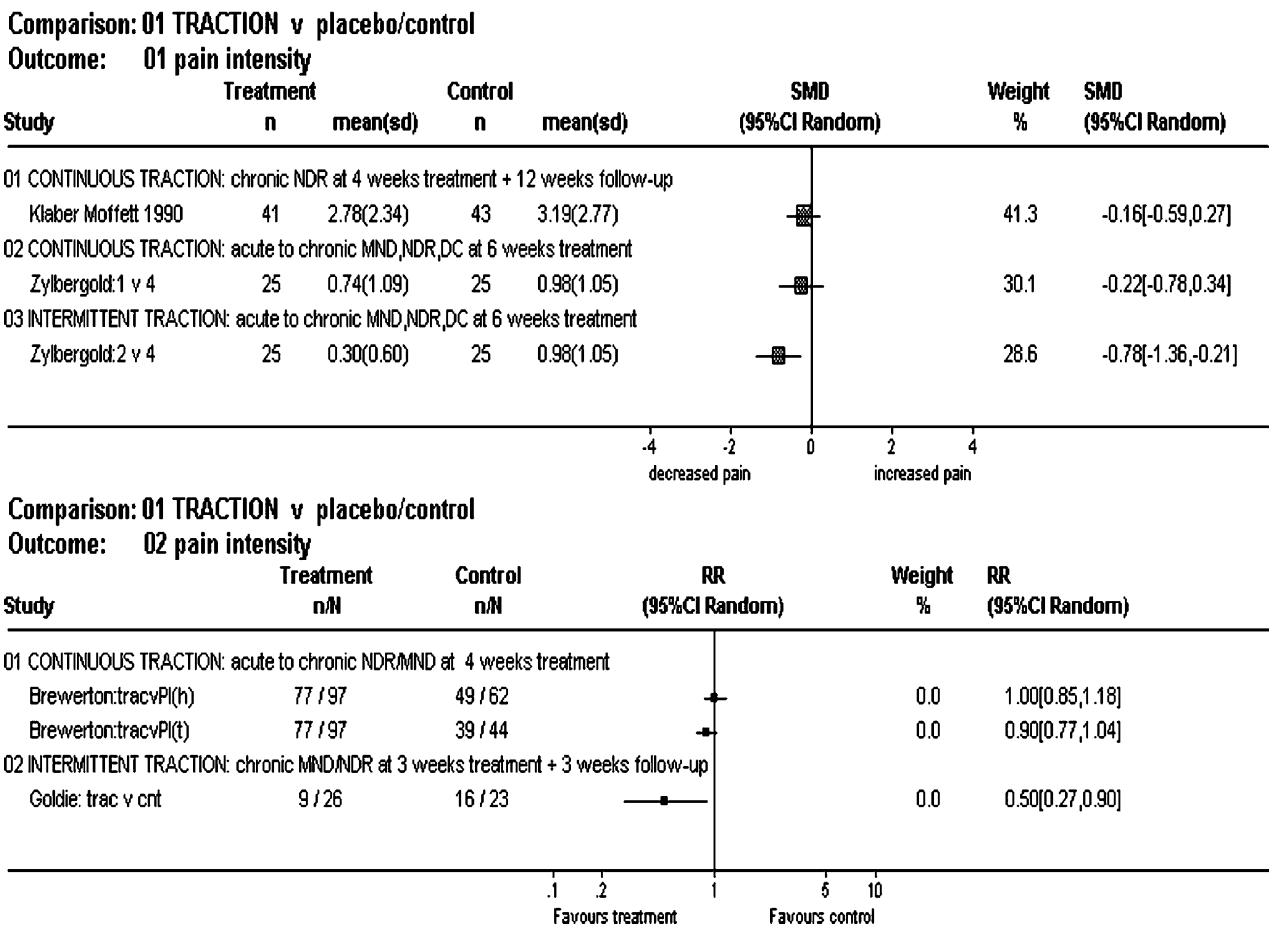

Fig. 1. Continuous and intermittent traction vs placebo/control: the relative risk (95% confidence interval (CI)) for pain reduction in subjects with acute to chronic mechanical neck disorder (MND), neck disorder with radicular finding (NDR), or degenerative changes (DC). Immediate post-treatment and short-term follow-up.

DISCUSSION

Methodological quality

In the 1970s and 1980s, we noted 3 key features of poor methodology in 5 studies: (*i*) all 5 studies had poor methodological quality (less than 3/5 on the scale by Jadad et al., (17)); (*ii*) 80% (4/5) of these studies did not have long-term follow-up, that is one year or greater; and (*iii*) 66% (3/5) of these studies had small sample size and low power. There has been little progress in this regard over the last decade; an additional 5 RCTs were conducted. Of these, only one study were of high methodological quality, 2 had long-term follow-up, and 3 also had adequate sample size. We do not have much confidence in the evidence of this review. One larger study could either support or refute the findings on intermittent traction to improve quality.

Comparison against other review findings

From our previous review, we found limited evidence of no benefit. From our current review, we have 5 additional studies that has started to shift the findings in favour of intermittent traction and revealed moderate evidence of benefit for pain reduction. Our current review includes neck disorder with radicular findings while the past review did not. In this current review, it became evident that intermittent traction should be examined separately. Additional outcomes in the categories of function, disability and patient satisfaction were included in this update, while in the past only pain was assessed. There are no current reviews assessing traction and neck pain. Two older reviews (8, 9) show that either no clear conclusions can be drawn or there was no benefit. Any discordance with respect to intermittent traction finding is due to addition of new studies since their publication. We agree that non-standardization of traction dosage and clinical variables have not been reported clearly. This is consistent with the lumbar traction reviews (9, 37).

Adverse events and cost of care

Cost of care and risk rates of adverse events could not be determined with these data. Clearly, there is inadequacy in reporting these data. Authors should follow consort guidelines in standardization of RCT reporting.

Methodological issues

"Selection bias" was not likely to be present in our review. We used pairs of independent reviewers from diverse professional

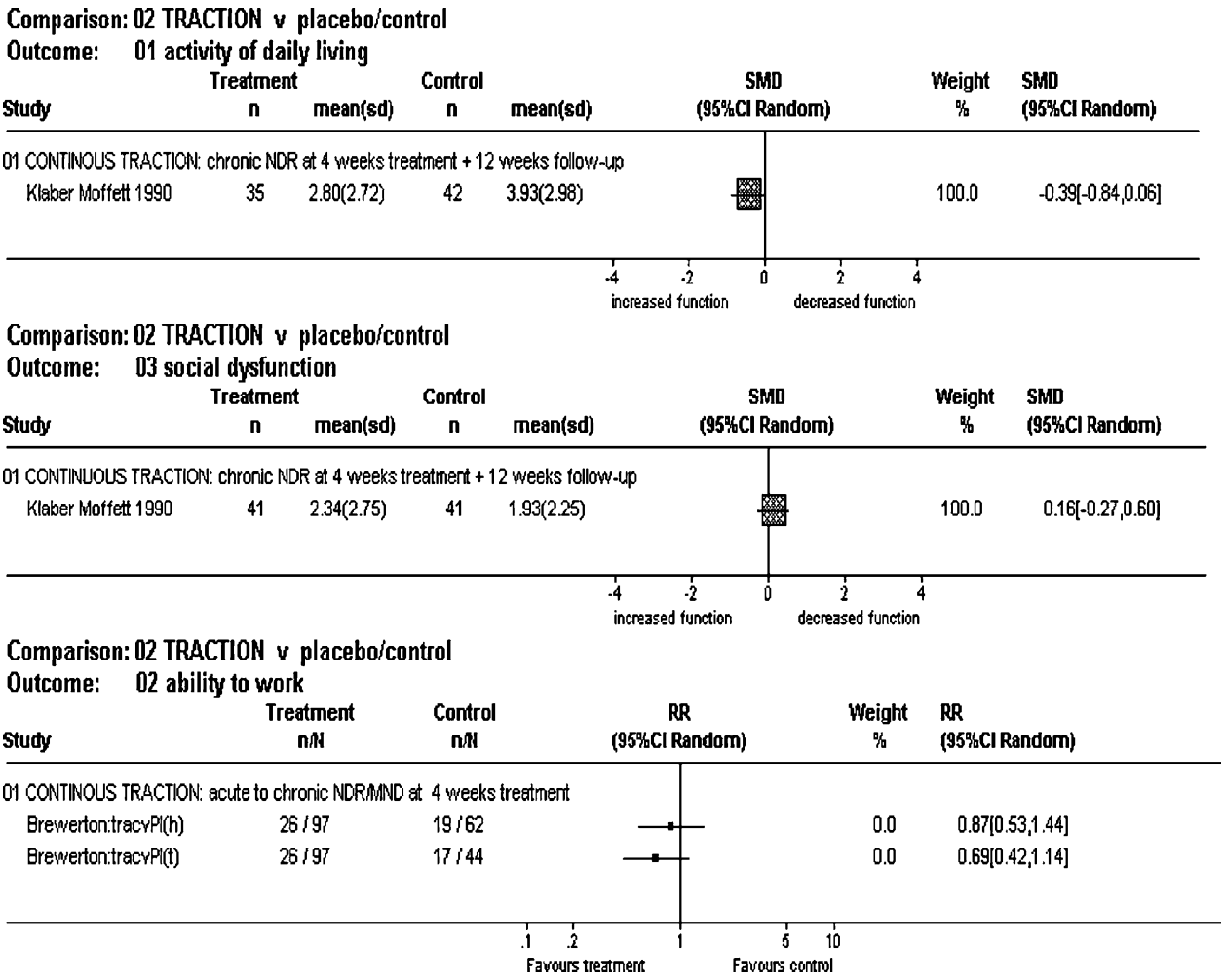

Fig. 2. Continuous traction vs placebo/control: the relative risk (95% confidence interval (CI)) and standard mean difference (95% CI) for function/disability in subjects with acute to chronic mechanical neck disorder (MND) and neck disorder with radicular finding (NDR). Immediate post-treatment and short-term follow-up.

backgrounds during selection of the studies. We did not search non-English databases, so "language bias" may be present in this review. We did not perform searches of databases for unpublished work nor did we write authors or agencies to elicit unpublished work, therefore "publication bias" was not guarded against in this update.

Reviewers' conclusions

Implications for practice. Inconclusive evidence for both continuous and intermittent traction exists due to trial methodological quality. Given the methodological quality limitations, 2 clinical conclusions may be drawn, as follows:

- Data analysis reveals moderate evidence of benefit for intermittent traction, which denotes findings in a single, high-quality RCT or consistent findings in multiple low-quality trials.
- There was moderate evidence of no benefit for continuous traction.

Implications for research. Attention to research design flaws and intervention in Phase II or III trials would help to

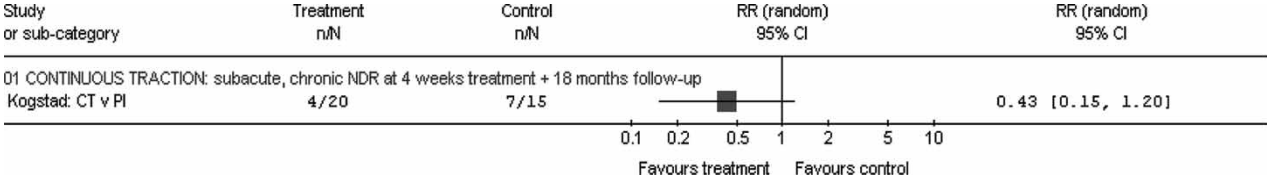

Fig. 3. Continuous traction vs placebo: the relative risk (95% CI) for global perceived effect in subjects with subacute and chronic neck disorder with radicular finding (NDR). Long-term follow-up.

identify the most effective treatment characteristics and dosages.

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