RADAR

www.brookes.ac.uk/go/radar

OXFORD
BROOKES
UNIVERSITY

Directorate of **Learning Resources**

Rehabilitation interventions for foot drop in neuromuscular disease (Review)

Sackley C, Disler PB, Turner-Stokes L, Wade DT, Brittle N, Hoppitt T

THE COCHRANE
COLLABORATION®

WILEY
Publishers Since 1807

TABLE OF CONTENTS

Rehabilitation interventions for foot drop in neuromuscular disease

Catherine Sackley[1], Peter B Disler[2], Lynne Turner-Stokes[3], Derick T Wade[4], Nicola Brittle[5], Thomas Hoppitt[5]

[1]Primary Care and General Practice, University of Birmingham, Birmingham, UK. [2]Bendigo Hospital and Monash University, Bendigo, Australia. [3]Regional Rehabilitation Unit, North West London Hospital NHS Trust, Harrow, UK. [4]Oxford Centre for Enablement, University of Oxford, Oxford, UK. [5]Primary Care Clinical Sciences, University of Birmingham, Birmingham, UK

Contact address: Catherine Sackley, Primary Care and General Practice, University of Birmingham, Primary Care Clinical Sciences Building, Edgbaston, Birmingham, B15 2TT, UK. sacklecm@bham.ac.uk. cath.sackley@public-health.oxford.ac.uk.

A B S T R A C T

Background

"Foot drop" or "Floppy foot drop" is the term commonly used to describe weakness or contracture of the muscles around the ankle joint. It may arise from many neuromuscular diseases.

Objectives

To conduct a systematic review of randomised trials for the treatment of foot drop resulting from neuromuscular disease.

Search methods

In this update, we searched the Cochrane Neuromuscular Disease Group Trials Register (April 2009), MEDLINE (January 1966 to April 24 2009), EMBASE January 1980 to April 24 2009), CINAHL (January 1982 to May 6 2009), AMED (January 1985 to April 24 2009), the British Nursing Index (January 1985 to January 2008) and Royal College of Nursing Journal of Databases (January 1985 to January 2008).

Selection criteria

Randomised and quasi-randomised trials of physical, orthotic and surgical treatments for foot drop resulting from lower motor neuron or muscle disease and related contractures were included. People with primary joint disease were excluded. Interventions included a 'wait and see' approach, physiotherapy, orthoses, surgery and pharmacological therapy. The primary outcome measure was quantified ability to walk whilst secondary outcome measures included range of movement, dorsiflexor torque and strength, measures of activity and participation, quality of life and adverse effects.

Data collection and analysis

Methodological quality was evaluated by two authors using the van Tulder criteria. Four studies with a total of n = 152 participants were included in the update to the original review. Heterogeneity of the studies precluded pooling the data.

Main results

Early surgery did not significantly affect walking speed in a trial including 20 children with Duchenne muscular dystrophy. Both groups deteriorated during the 12 months follow-up. After one year, the mean difference (MD) of the 28 feet walking time was 0.00 seconds (95% confidence interval (CI) -0.83 to 0.83) and the MD of the 150 feet walking time was -2.88 seconds, favouring the control group (95% CI -8.18 to 2.42). Night splinting of the ankle did not significantly affect muscle force or range of movement about the ankle in a trial of 26 participants with Charcot-Marie-Tooth disease. Improvements were observed in both the splinting and control groups. In a trial of 26 participants with Charcot-Marie-Tooth disease and 28 participants with myotonic dystrophy, 24 weeks of strength training significantly improved six-metre timed walk in the Charcot-Marie-Tooth group compared to the control group (MD 0.70 seconds, favouring strength training, 95% CI 0.23 to 1.17), but not in the myotonic dystrophy group (MD -0.20 seconds, favouring the control group, 95% CI -0.79 to 0.39). No significant differences were observed for the 50 metre timed walk in the Charcot-Marie-Tooth disease group (MD 1.90 seconds, favouring the training group, 95% CI -0.29 to 4.09) or the myotonic dystrophy group (MD -0.80 seconds, favouring the control group, 95% CI -5.29 to 3.69). In a trial of 65 participants with facioscapulohumeral muscular dystrophy, 26 weeks of strength training did not significantly affect ankle strength. After one year, the mean difference in maximum voluntary isometric contraction was -0.43 kg, favouring the control group (95%CI -2.49 to 1.63) and the mean difference in dynamic strength was 0.44 kg, favouring the training group (95%CI -0.89 to 1.77).

Authors' conclusions

Only one study, involving people with Charcot-Marie-Tooth disease, demonstrated a statistically significant positive effect of strength training. No effect of strength training was found in people with either myotonic dystrophy or facioscapulohumeral muscular dystrophy. Surgery had no significant effect in children with Duchenne muscular dystrophy and night splinting of the ankle had no significant effect in people with Charcot-Marie-Tooth disease. More evidence generated by methodologically sound trials is required.

P L A I N   L A N G U A G E   S U M M A R Y

Rehabilitation for foot drop (weakness or muscle shortening (contracture) at the ankle joint)

Foot drop is the term commonly used to describe weakness or contracture of the muscles at the ankle joint. It may arise from many neuromuscular diseases. Interventions might include a 'wait and see' approach, physiotherapy, orthotics (appliances), surgery or drug therapy. The review update identified four randomised controlled trials that met the criteria for inclusion, including 152 participants in total. In one trial strength training had a significant beneficial effect on walking ability in people with Charcot-Marie-Tooth disease (hereditary motor and sensory neuropathy), but no significant effect on walking ability in people with myotonic dystrophy. In another study strength training had no significant effect on ankle strength in people with facioscapulohumeral muscular dystrophy. Night splinting of the ankle had no significant effect on flexibility or muscle strength around the ankle in people with Charcot-Marie-Tooth disease, and surgery on the Achilles tendon in boys with Duchenne muscular dystrophy had no significant effect on their walking ability. Further randomised controlled trials are needed.

B A C K G R O U N D

This Cochrane review investigated the problem of weakness and contracture of the muscles around the ankle joint, which arise from neuromuscular diseases affecting lower motor neurons (LMN) or muscle. This condition is commonly called foot drop or 'floppy foot drop' (Donaghy 2001). Foot drop can have a profound effect on gait. In moderate cases, the front of the foot drops to the floor after heel strike, preventing the stride leg from swinging through, while in severe cases toe strike may precede heel strike and the toe may catch the ground during swing-through of the leg, which may lead to tripping or falling. Using the terminology of the International Classification of Function, Disability and Health (WHO 2001), foot drop is thus an 'Impairment of Body Structure' that may markedly influence the 'Activities' and 'Participation' of the affected individual.

The major cause of foot drop is weakness of the muscles of ankle dorsiflexion, primarily tibialis anterior, but also weakness of the

long extensors of the toes (extensor hallucis longus and extensor digitorum longus). A significant, secondary effect of this weakness is shortening and contracture of the Achilles tendon, which is formed by the merging of the tendinous portions of the major muscles of plantar flexion, the gastrocnemius and soleus. However, the ankle is a complex bipartite joint, able to move in four directions: dorsiflexion, plantar flexion, eversion and inversion. Many of the conditions, which cause weakness of the dorsiflexors, also affect the muscles of eversion (peroneus tertius and peroneus longus) and inversion (tibialis posterior). The foot drop syndrome therefore often incorporates weakness of these muscles, and associated contracture of their antagonist muscle tendons. The exact contribution may differ between conditions.

This review, therefore, has greater clinical relevance if the term Achilles tendon is seen as convenient shorthand for all the tendons acting around the ankle joint, which may be involved when foot drop occurs. We included research that describes weakness of the other muscles that move the ankle, not only isolated involvement of the dorsiflexion agonists, as long as the lower motor neuron was primarily affected. This review specifically excluded ankle weakness secondary to upper motor neuron lesions and soft tissue contractures associated with non-neurological disease, such as arthritis or burns.

Aetiology of foot drop and contracture

Floppy foot drop can result from damage to any part of the lower motor neuron between the lumbosacral spine and the muscles of ankle dorsiflexion. Classified anatomically, a non-exhaustive list of the common causes would include:

• Anterior horn cell of the spinal cord (e.g. poliomyelitis and motor neuron disease).

• Motor nerve root (e.g. cauda equina lesions and involvement of the lumbosacral nerve roots as they exit from the spine, usually associated with intervertebral disc prolapse).

• Peripheral motor nerve as part of a diffuse peripheral neuropathy (including Guillain-Barré syndrome, chronic inflammatory demyelinating polyneuropathy).

• Hereditary motor and sensory neuropathy (e.g. Charcot-Marie-Tooth disease).

• Involvement of specific peripheral nerves derived from the sciatic plexus:

(a) the sciatic nerve as it passes from the pelvis through the sciatic notch, past the hip joint and into the leg (e.g. with pelvic fractures, buttock injections, and following pelvic surgery and hip replacement).

(b) the peroneal nerve, which supplies all the evertors and dorsiflexors of the ankle (often as a result of lower limb fractures where the nerve traverses the fibular head).

• Primary muscle disease (e.g. muscular dystrophy, including Duchenne, Becker, facioscapuloperoneal and Emery-Dreifuss dystrophies).

Incidence and prevalence of foot drop

The incidence and prevalence is hard to establish. Geboers (Geboers 2001a) suggested one new case per 6000 people each year, based on referrals of newly affected patients to a Neurology and Rehabilitation Service in Heerlen, Netherlands, serving an estimated population of 300,000. As the majority of the cases had either peroneal nerve palsy or prolapsed discs, and the referral rate in the area was not known, this may well have been an underestimate. Any neurological rehabilitation unit sees a significant number of affected patients annually.

Treatment modalities

Despite the frequency of foot drop, and the serious effect that it has on gait and general function, the literature provides little direction as to its treatment. Recent comprehensive textbooks on neurology and neurorehabilitation tend to address the matter only briefly, offering various therapeutic options in a non-critical way; for example 'it is important to prevent contracture of the Achilles tendon, and the foot should be splinted in dorsiflexion day and night, and the ankle moved through its full range passively' (Donaghy 2001).

Several therapeutic approaches known to be used in practice include 'wait and see' (i.e. no intervention), physiotherapy, surgery and drug treatment. The authors could not locate any recent, formal reviews in the published literature that critically compare these approaches. This review aims to fill the gap as a basis for making clinical decisions, identifying the need for trials and maintaining an up to date record of such research in the future.

OBJECTIVES

The objective was to systematically review all randomised and quasi-randomised trials of the treatment and rehabilitation of foot drop resulting from lower motor neuron or muscle disease, including the prevention and treatment of contractures that develop in association with such foot drop.

METHODS

Criteria for considering studies for this review

Types of studies

We included all randomised controlled trials (RCTs) and quasi-randomised trials of physical, orthotic and surgical approaches in the treatment of lower motor neuron foot drop, and the prevention and treatment of Achilles tendon contracture, and other soft tissue contractures that develop in association with such foot drop. Quasi-randomised trials are those trials in which treatment allocation was intended to be random, but might have been biased (e.g. alternate allocation).

Types of participants

We included studies pertaining to participants of all ages who were described as at having:

- lower motor neuron or 'floppy' foot drop, whether the diagnosis was made clinically or through nerve conduction studies and EMG; and/or
- contractures of the Achilles tendon (or other associated tendons) that had developed secondary to the foot drop, and which affected the range of motion of the ankle.

We specifically excluded participants with primary joint or soft tissue problems (e.g. arthritis or burns).

Types of interventions

We included all therapeutic approaches that are known to be used in practice, whether used alone or within the context of a multi-disciplinary rehabilitation programme, such as:

- A non-interventionist approach based on the expectation that recovery will occur equally well without treatment or that the deficit does not warrant treatment, at least at present.
- Physiotherapy, which may have several components:

(a) maintenance of passive range of motion;
(b) attempts to improve active muscle movement and/or strength through isotonic or isometric exercise (Germain 1995; Rozier 1979);
(c) attempts to improve active muscle movement and/or strength through electrical nerve stimulation, often referred to as Functional Electrical Stimulation. Functional Electronic Stimulation is also an "orthotic" intervention in that the stimulation of dorsiflexors during heel strike can cause the muscle to contract and dorsiflex the foot, whether or not it has any lasting effect upon the muscle or nerve.

- Orthoses, used to splint the joint in a functional position. At rest, these prevent the foot falling into a position of forced plantar flexion, which could lead to the development of a contracture and have a major effect on gait. The risk of tripping while walking is also minimised, with a positive effect on patient safety. However, some debate has developed as to whether orthotics will enhance recovery of the paretic muscle by facilitating walking, or retard recovery through immobilisation

and disuse atrophy (Geboers 2001a; Geboers 2001b; Geboers 2002; Tropp 1995). As noted above, Functional Electric Stimulation can also be considered to be an orthotic intervention.

- Surgery of various types, including tendon lengthening procedures and transfers (Wiesseman 1981), and other orthopaedic interventions such as subtalar arthrodesis (Jaivin 1992). Surgical management of the primary cause, such as lumbar disc surgery for prolapse or decompression of the peroneal nerve, is outside the scope of this review.
- Pharmacological therapy was included as some modalities (such as nerve growth factor administration) may well become important in the future. However where this has formed the topic for another Cochrane review, the authors will defer to its content, rather than reviewing the topic independently.

Types of outcome measures

The primary outcome measure was walking ability, using a validated objective test, limited either by distance (e.g. the 10-metre walk, with and without stairs) or time (e.g. the six-minute endurance test).
Secondary outcomes included:

- Active and passive range of motion of the ankle (measured using a goniometer or inclinometer).
- Dorsiflexor torque and strength (measured using a dynamometer, 1 Repetition maximum, Medical Research Council scale).
- 'Activities' and "participation" (WHO 2001) measured with validated tools, and orientated to either Basic Activities of Daily Living (e.g. the Barthel Activities of Daily Living Index), or Instrumental Activities of Daily Living (e.g. Nottingham Extended Activities of Daily Living scale).
- Quality of life (including measures of pain and fatigue).
- Adverse effects attributable to the intervention, e.g. ulceration preventing use of an orthodox device, and falls.

Search methods for identification of studies

Electronic searches

For this update, we searched the Cochrane Neuromuscular Disease Group Trials register (searched April 2009), MEDLINE (from January 1966 to April 24 2009), EMBASE (from January 1980 to April 24 2009), CINAHL (from January 1982 to May 6 2009) and AMED (from January 1985 to April 24 2009). The British Nursing Index and Royal College of Nursing Journal of Databases was also studied (from January 1985 to January 2008).
The following search terms were used:

- foot drop OR floppy foot drop
- ankle contracture OR Achilles tendon contracture OR shortening

- lower motor neuron lesions
- exercise OR physiotherapy
- orthotics
- nerve stimulation
- surgery

The search strategies have been modified for this update to identify randomised controlled trials that were not being identified in the original search. See Appendix 1, Appendix 2, Appendix 3, Appendix 4 and Appendix 5 for search strategies.

Searching other resources

In the original protocol we proposed to contact authors but we were only able to contact Dr E van der Kooi and Dr E Lindeman.

Data collection and analysis

The titles and abstracts were screened and the full texts of potentially relevant articles were obtained. Three authors (NB, TH, PD) independently reviewed these articles and decided on their inclusion. No disagreement between authors was encountered. Two of the authors (NB, TH) independently assessed the methodological quality of the studies using a standardised grading system. Any uncertainties were discussed and mutual agreement was formed.

Selection of studies

Studies were included if:
- they were randomised or quasi-randomised
- over 60% of participants included initially had follow up data
- the control group did not exercise the leg systematically

Studies were excluded if:
- the study protocol was not adhered to
- the groups varied greatly at entry (baseline) and there was no statistical adjustment for this

Assessment of methodological quality

Many previous Cochrane reviews have based their assessments on the three essential criteria described by Jadad et al. (Jadad 1996) including method of treatment allocation, whether trials have ensured an intention-to-treat analysis and attempted concealment of allocation. These criteria were developed for interventional trials of drug therapy, but are less easy to apply to trials of rehabilitation where, as discussed by Turner-Stokes (Turner-Stokes 2005), blinding of subjects and therapists is rarely possible as they are aware of when treatment is being implemented and received. An alternative checklist, the van Tulder scale was therefore employed (van Tulder 1997). The scale includes the three Jadad criteria, but

adds further criteria to reach a total of 19 (11 criteria for internal validity, 6 descriptive criteria and 2 statistical criteria) (Table 1). This approach was used for methodological evaluation in this review, and on this basis an RCT was considered to be of high methodological quality if there were positive scores on at least six out of eleven internal validity items, at least three out of six descriptive items and at least one out of two statistical items.

Blinding

In the rehabilitation context, it is seldom possible to blind either participants or therapists to the therapeutic intervention. However it is usually possible to blind the assessor.

Concealment of treatment allocation

Examples of 'adequate procedures' for treatment allocation concealment are:
- assignment of treatment at random by an independent person not responsible for determining the eligibility of the participants
- a centralised randomisation scheme, e.g. a computer system providing allocations in a locked, unreadable file that could be assessed only after inputting the characteristics of an enrolled participant
- numbered or coded containers, or sequentially numbered, sealed, opaque envelopes

If the concealment of treatment allocation was described only as random or randomised, it was considered unclear.

Adverse effects

Adverse effects of rehabilitation are potentially possible, but are considered infrequent by clinicians. The absence of adverse effects is therefore seldom specifically recorded. Nonetheless we looked for recording of adverse events.

Analysis and data synthesis

Meta-analysis can be undertaken only if the study populations, interventions, outcomes and study designs are agreed to be sufficiently consistent to allow pooling of data. There was, as will be seen, too much clinical heterogeneity among the studies with regard to participants (diagnosis and severity of disease), intervention (duration, frequency and setting) and outcome measures (diversity of assessment tools) to make such analyses possible in this review. To facilitate interpretation of results, mean difference is scored positive if the outcome favours the intervention group as opposed to the control group.

R E S U L T S

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

Included studies

The total number of references yielded by the search update (original search) was as follows: NMD Group specialised register 17 (17) references, AMED 157 (15) references, CINAHL 288 (52) references, EMBASE 290 (44) references, MEDLINE 56 (17) references. The number studied in full text was 23, compared to 12 in the original review. A PhD thesis reporting a study published in two articles was not reviewed separately. There was no disagreement between the two authors in terms of the inclusion and exclusion of studies. Four studies were included (reported in eight publications). One study included boys with Duchenne muscular dystrophy, one included adults with facioscapulohumeral muscular dystrophy, one included participants with Charcot-Marie-Tooth disease and one included participants with either myotonic dystrophy or Charcot-Marie-Tooth disease (Hereditary Motor and Sensory Neuropathy). These studies have been discussed below under their respective neuromuscular disease headings.

Duchenne muscular dystrophy

Surgical intervention

Manzur 1992 studied the effects of surgical intervention in boys with Duchenne muscular dystrophy. Participants, aged four to six years, were randomised to either conservative treatment or surgical intervention. Surgery used Rideau's approach (Rideau 1986). This consists of open release at the hip of the sartorius muscle, the superficial head of the rectus femoris muscle and tensor fasciae lati. The Achilles tendon is lengthened and hamstring tendons released if there are knee flexion contractures. Participants were transferred to hospital after three days where they were mobilised by physiotherapy between the third and sixth day after surgery. They were discharged home four to six days following surgery, walking without orthotic support, and without routine passive stretching or physiotherapy. The control group continued with regular passive stretching of the Achilles tendon, iliotibial bands and hip flexors, performed daily by the parents after demonstration by the physiotherapist. All boys were assessed at three-month intervals in the first year, and twice annually thereafter.

Outcome evaluation was based on walking time over 28 and 150 feet, muscle strength (rated using the Medical Research Council Scale (MRC 1943), myometry of five muscle groups in the

legs and two in the arms, the timing of Gowers' manoeuvre, motor ability (based on 20 activities), measurement of contractures, gait analysis, ultrasound of the quadriceps femoris muscle. Needle muscle biopsy of the vastus lateralis muscle was carried out before and after operation. Clinical photographs and video recordings of movement quality were also taken.

Twenty-eight boys were assessed for recruitment. Eight were rejected. Three were too weak, two were unable to co-operate with assessments, the parents of two boys refused consent and one had experienced complications during previous surgery. Twenty boys were therefore randomised into the two groups defined above (n = 10 in each group). Surgery was tolerated well in the surgical group with all participants discharged within a week of surgery. The motor ability score and Medical Research Council Scale scores were similar between the two groups at baseline. All participants were followed up for a minimum of one year, the time used for follow-up analysis. Four of the ten operated boys showed initial improvement in qualitative gait analysis. This improvement was defined by the authors as "particularly related to improved heel strike" and was apparently "still noticeable up to a year after surgery". Formal gait analysis revealed no significant difference between the two groups at one year on any of the six parameters studied (step and stride length, swing phase duration, double support time, cadence and velocity). No difference between groups was found in Medical Research Council Scale score, myometry or Gower's times at follow-up.

Achilles tendon contractures were all severe in the surgical group and were reduced by surgery from a mean of 26° to 16° at three months. However, two of the ten boys developed contractures again within one year of surgery. Iliotibial band contractures were reduced from a mean of 6° to 1° at one-year follow-up.

Ultrasound scanning of the muscles which was found to be abnormal in all participants before surgery, revealed no significant change or differences between groups at one year follow-up.

At two years, five boys in the control group and six in the surgical group were reassessed. Recurrences of Achilles tendon contractures were noted in five of the six operated boys on at least one side. One boy lost independent ambulation by 2.5 years after surgery. The authors concluded that "there was no measurable difference between our surgical and conservative groups and our study has not shown any benefit of early surgery in relation to muscle strength and function". They noted that contractures could be reduced in the short-term but recurred in at least seven of the 10 boys within one to two years of surgery.

A long-term follow up of the same group of 20 boys a mean of nine years after surgery was published as an abstract for the Fourth International Congress of the World Muscular Dystrophy Society in 1999, but the number of participants at follow up was not specified. The follow-up revealed recurrence of contractures in all boys in the surgical group and authors concluded that early limb surgery demonstrated no functional benefit. The Rideau operation was not therefore recommended as routine treatment for this

condition.

Facioscapulohumeral muscular dystrophy

Exercise and strength training

Moderate-resistance strength training was studied in patients with facioscapulohumeral muscular dystrophy by van der Kooi 2007; van der Kooi 2004. Sixty-five of the 97 participants that were randomly assigned either to a "training" (T) or "non training" (NT) group completed the study. The training group underwent moderate, progressive strength training focusing on elbow flexors and ankle dorsiflexors. Training consisted of predominantly dynamic exercises carried out at home three times a week for 26 weeks. After 26 weeks the training and non-training groups were secondarily randomised to either albuterol (A) or placebo (P). Assessments took place at 0, 26 and 56 weeks for muscle strength (isometric, sustained and dynamic). Muscle mass was also estimated using computerised tomography. Questionnaires on self-reported pain, fatigue, health-related functional status and psychological distress were collected from participants at 0 and 52 weeks.

All strength parameters of the ankle dorsiflexors decreased significantly between 0 and 52 weeks in each of the four treatment groups (T+P, T+A, NT+P, NT+A). These results were not influenced by training or the use of albuterol. Training of elbow flexors did not result in any significant on isometric or sustained muscle strength, however dynamic elbow strength improved significantly. Isometric elbow flexor strength increased significantly in the Albuterol group compared to the placebo group. The difference in mean change from baseline between the albuterol and control groups for sustained and dynamic strength of the elbow flexors was not significant. The authors concluded that strength training and albuterol appear safe interventions with limited muscle strengthening effects in fascioscapulohumeral muscular dystrophy.

Strength training and albuterol failed to have a significant effect on pain, fatigue, health-related functional status and psychological distress. The authors concluded that neither strength training nor albuterol have a clear positive or negative effect on these outcomes.

Myotonic dystrophy

Exercise and strength training

Lindeman 1995 studied strength training in participants with myotonic dystrophy. Patients living within 100 km of Maastricht between the age of 16 and 60 years were recruited and subjected to a "qualification period" to establish their suitability for the trial, and provide them with the information necessary for them to consent. Participants were excluded based on any contraindications to muscle strengthening exercises or other unrelated disabling conditions that could influence the scoring. Thirty-six participants were

individually matched on the basis of muscle strength and performance on a stair-climbing test before being randomly assigned to a training or control group. The treatment group carried out home based knee extension and flexion, and hip extension and abduction weight exercises three times a week for 24 weeks, completing a training diary over the course of the programme. Training was progressive over the course of the 24-week programme. Over the first eight weeks participants carried out three sets of 25 repetitions at 60% of one maximum repetition (1RM). From the ninth to the sixteenth week, intensity was increased to three sets of fifteen repetitions at 70 % of 1RM, and during the final eight week period, the intensity progressed further to three sets of ten repetitions at 80 % of 1RM. Outcome assessments were carried out after eight, sixteen and 24 weeks by an observer blinded to treatment allocation. Outcome measures used included isokinetic and isometric muscle strength and endurance (using a CYBEX Dynamometer), and functional performance based on stair climbing, rising from a chair or from supine, and walking 6 and 50 metres. In addition participants completed the Western Ontario & MacMaster University Osteoarthritis Index (WOMAC) and the Sickness Impact Profile (SIP). Participants also scored their difficulty in performing life activities on a Visual Analogue Scale. Finally they were asked to identify the "disease related problems they faced in daily life" using a questionnaire adapted from the "Problem Elicitation Technique" (PET).

Compliance with therapy was high and a low drop out rate was observed. Of the 36 participants randomised, 28 were analysed. With respect to physical functional abilities, there was no significant change in stair climbing, rising from a chair or from supine position, or walking six or 50 metres. Based on the WOMAC, statistically significant improvement was found in standing, getting into and out of a car and putting on socks.

Most of the hindrances reported in the Problem Elicitation Technique scale concerned activities that participants believed were compromised by impaired leg function. In the treatment group, four out of fifteen participants reported they could perform more activities, whilst one reported a decrease in capacity to do so. In the control group four out of eighteen reported a decrease and only one reported an increase in the ability to perform activities. However, no statistically significant change was found.

Based on the "global assessment" the training group showed significant improvement compared with controls in the responses to the questions: "How were your complaints last week" and "I am less hindered in daily activities because of my strength reduction. Sixty-four per cent of the training group felt they had derived benefit from the intervention.

With respect to strength, there was no significant change in knee torque or endurance although a small non-significant training effect was observed in individuals in the training group who had higher baseline strength. This is thought to be due to a higher potential for strength increase in the stronger individuals. The training group also increased in strength endurance compared to

a decrease in the control group. However, these differences were non-significant.

Only one participant experienced adverse effects in the form of muscle pain and transient strength reduction. The authors suggest that as no adverse effects were observed as a result of the training, a more intense workload should be investigated in a similar population in future studies.

Peripheral neuropathy

Exercise and strength training

Strength training was evaluated in participants with Charcot-Marie-Tooth disease (Types 1 or 2) in conjunction with the exercise programme for people with myotonic dystrophy described previously (Lindeman 1995). Thirty participants were individually matched based on muscle strength and performance on a stair-climbing test. Within each matched pair, participants were randomly assigned to a training or control group. Outcome measures and the training group's intervention were identical to those outlined above for Lindeman 1995.

Compliance with therapy was high and a low dropout rate was observed. Of the 30 participants randomised, 26 were analysed.

- Six-metre walk time decreased significantly in the training group compared to the control group (P = 0.01).
- With respect to functional abilities on the WOMAC, significant changes were found in stair climbing, rising from a chair, getting into and out of a car, putting on socks and lying down on the bed.
- From the Problem Elicitation Technique, in the treatment group 7 out of 15 participants could perform more activities as a result of training, whereas two reported a decrease in capacity to do so. In the control group 2 out of 13 participants reported a decrease in activities, and none reported an increase.
- No significant changes were found in the "global assessment". However, 93% of the participants felt they had derived benefit from the intervention.
- Isokinetic knee extension torque increased significantly in the training group (14%, P < 0.005) and flexion torque increased but without statistical significance (13%, P = 0.07).

Two participants experienced adverse effects in the form of muscle pain and transient strength reduction. The authors suggest that as minimal adverse effects were observed as a result of the training, a more intense workload could be investigated in a similar population in future studies.

Night splinting

The effects of wearing pre-formed ankle splints at night were evaluated in a randomised crossover trial of participants with Charcot-Marie-Tooth disease Type 1A and a restricted range of passive dorsiflexion (Refshauge 2006). The splints were fitted and adjusted into dorsiflexion by the treating physiotherapist until participants felt a tolerable stretch in their calf muscles. Participants were instructed to wear the splint all night and to remove it only to walk short distances. At the initial assessment the treating physiotherapist randomly selected the leg to be splinted first by tossing a coin. After 6 weeks the splint was changed to the opposite leg and at 12 weeks the splint was removed. A blinded assessor evaluated participants at 6, 12 and 26 weeks for passive range of movement (dorsiflexion and eversion) and isometric muscle strength (dorsiflexors, invertors and evertors). Pooling of limbs is inappropriate as it artificially inflates sample size and therefore power. To satisfy independence requirements for statistical analysis, only data from the first period of the cross-over trial was included in this review, as recommended in the Cochrane handbook (Higgins 2008). This also eliminated any concerns of carry-over effects.

Fourteen patients (8 female) with a mean age of 15 (SD 8), were randomised into the study. One participant dropped out during the first 6-week period and was excluded from analysis. The remaining 13 participants complied well with treatment, wearing the splints for a mean of 7 hours per night for 37 out of a possible 42 nights. Despite this, wearing night splints for 6 weeks did not have a significant effect on passive dorsiflexion, eversion or muscle strength around the ankle. The authors concluded that wearing night splints does not increase ankle range of movement or strength in people with Charcot-Marie-Tooth disease Type 1A.

Risk of bias in included studies

Details of the methodological quality of the included studies are described in the 'Characteristics of included studies, and Table 2. All studies were rated using the van Tulder (van Tulder 1997) scale of methodological quality. Studies were included if they fulfilled the criteria specified above.

Manzur 1992

Details of randomisation were not explicit stating only that participants were randomised into groups. No details of allocation concealment were provided. In addition blinding of outcome assessors was not carried out. However, withdrawal and dropouts were described and acceptable and follow-up measures were carried out at short and long-term. Intention-to-treat analysis was also carried out.

Lindeman 1995

In the Lindeman 1995 study, participants were individually matched into pairs on the basis of muscle strength and performance on a stair-climbing test. Within each matched pair participants were randomly assigned to a training or control group. Although treatment allocation was not concealed during randomisation, assessors were blinded to treatment allocation. This was monitored and results revealed assessors were aware of participants' group in only 20% of cases. Withdrawal and dropouts were de-

scribed and acceptable and follow-up measures were performed at both short and long-term stages. Dropouts were not accounted for in the statistical analysis therefore it can not be described as intention-to-treat.

van der Kooi 2007, van der Kooi 2004

In van der Kooi 2007 the secondary outcome measures of a previously published study (van der Kooi 2004) are reported. In the study participants were randomly assigned either to a "training" or "non-training" group and again into a drug treatment or placebo group. No further details on the randomisation methods were provided and there was no evidence of allocation concealment. Participants and therapists and clinical evaluators were blinded to the drug treatment. Clinical evaluators were also blinded to training allocation, with the exception of the one repetition maximum. This specific measurement was carried out by an unblinded physiotherapist as it carried too great a risk of unblinding the clinical evaluator. Withdrawals and dropouts were described and acceptable. Short-term and long-term follow up measures were collected and an intention-to treat analysis was performed.

Refshauge 2006

The study was not truly randomised as the participants' contralateral legs formed the control group. In addition, the treating physiotherapist performed the randomisation procedure so allocation was not concealed. Baseline scores of flexibility and strength appear matched between groups but statistical differences were not given. Blinding of participants and care providers was not possible but blinding of outcome assessors was ensured. Retention and adherence rates were described and acceptable, and short- and long-term follow-up measures were taken. Adverse events were not documented as such, however the authors did report one dropout on the grounds of discomfort. This participant was not included in the statistical analysis so the study was not analysed on an intention-to treat basis.

Effects of interventions

Duchenne muscular dystrophy

Primary outcome measure: Walking ability using a validated objective test

In the Manzur 1992 study (n = 20), "early" surgery did not have a significant effect on 28 foot or 150 foot walking times at one-year follow-up. The 28 foot walking time deteriorated (increased time) by a mean of 0.1 seconds in both the control and intervention group (MD 0.00 seconds, 95% confidence interval (CI) -0.83 to 0.83, see Analysis 1.1). The 150 foot walking time also deteriorated (increased time) by a mean of 1.22 seconds in the control group and 4.1 seconds in the intervention group (MD -2.88, favouring the control group, 95% CI -8.18 to 2.42, see Analysis 1.2). At

the two-year follow-up data for 150 foot walking times were only available for five control and six surgery participants. Three of the six operated boys deteriorated rapidly in the second year post surgery. The data were not available at the nine-year follow up stage.

Secondary outcome measures: ankle ROM, ankle dorsiflexor strength, activity/participation measures, QOL and adverse effects

In the same study, early surgery did not have a significant effect on muscle strength measured by mean kg force of six lower limb muscle groups (MD 0.00 kg force, 95% CI -0.55 to 0.55, see Analysis 1.4). Both groups had deteriorated by 0.7 kg at 12 months follow-up. Motor ability score decreased by a mean of two out of 40 in the surgery group compared to one out of 40 in the control group (MD -1.00, favouring the control group, 95% CI -3.08 to 1.08, see Analysis 1.3). Surgery appeared to have a positive effect on Achilles tendon contractures in the short-term, with a mean increase of 3º in the control group compared to a mean decrease of 7.5º in the surgery group. At two years, five of six operated boys had recurrence of contracture and all (number not given) had recurrence at nine years (Manzur 1992).

Facioscapulohumeral muscular dystrophy

Primary outcome measure: Walking ability using a validated objective test

Data for this outcome were not available.

Secondary outcome measures: ankle ROM, ankle dorsiflexor strength, activity/participation measures, QOL and adverse effects

In the van der Kooi 2004 trial, with a total of 65 participants, there was a mean decrease in isometric dorsiflexor strength at the ankle of 1.13 kg in the control group and a mean decrease of 1.56 kg in the training group. There was no significant difference between the two groups (MD -0.43 kg, favouring the control group, 95% CI -2.49 to 1.63, see Analysis 2.1). Dynamic strength decreased by a mean of 1.5 kg and 1.06 kg in the control and training groups respectively (MD 0.44 kg, favouring the training group, 95% CI -0.89 to 1.77, see Analysis 2.2). There was an increase in the strength of the other exercised muscle group, elbow flexors, but that was not the topic of this review.

In the same trial moderate intensity strength training did not lead to any significant changes in pain, fatigue, functional status or psychological distress (van der Kooi 2007). The mean differences (95% CI) between training and non-training groups for the Visual

Analogue Scale (VAS) (main pain measure), Checklist Individual Strength (CIS) (main fatigue measure), Sickness Impact Profile (SIP) (functional status), Symptom Checklist-90 (SCL) and Beck Depression Inventory for primary care (BDI) (psychological distress) were as follows; VAS -2.30, favouring the control group (-11.16 to 6.56), CIS -3.00, favouring the control group (-8.00 to 2.00), SIP -62.00, favouring the control group (-228.99 to 104.99), SCL -2.00,favouring the control group (-10.51 to 6.51) and BDI -0.60, favouring the control group (-1.66 to 0.46), see Analysis 2.3, Analysis 2.4, Analysis 2.5, Analysis 2.6 to Analysis 2.7.

Myotonic dystrophy

Primary outcome measure: Walking ability using a validated objective test

In the Lindeman 1995 study, there was no significant change in mean walking time over six or 50 metres following a 24-week strength training programme. The mean improvement (decrease in time) was 0.5 and 3.5 seconds respectively in the control group and 0.3 and 2.7 seconds in the training group. For the six-metre walk, the MD between groups was -0.20 seconds, favouring the control group, 95% CI -0.79 to 0.39 (see Analysis 3.1) and for the 50 metre walk the MD was -0.80 seconds, favouring the control group, 95% CI -5.29 to 3.69 (see Analysis 3.2).

Secondary outcome measures: ankle ROM, ankle dorsiflexor strength, activity/participation measures, QOL and adverse effects

The same study demonstrated no significant change in time taken (in seconds) for descending stairs, climbing stairs, rising from a chair or standing from lying supine (see Analysis 3.3). There was statistically significant improvement in self-report of ease of standing, getting into and out of a car and putting on socks, but the numerical results were not provided. No serious side effects of training occurred however one patient dropped out, on the advice of their general practitioner, due to back complaints.

Charcot-Marie-Tooth disease

Primary outcome measure: Walking ability using a validated objective test

In the Lindeman 1995 study, the mean six metre walking time improved (decreased) significantly following a 24-week strength-training programme. The walking time decreased by 1 second in the training group and 0.3 seconds in the control group (MD 0.70 seconds, favouring the training group, 95% CI 0.23 to 1.17, see Analysis 4.1). A significant difference was not seen in the 50 metre timed walk. The training group decreased by a mean of 2.2 seconds and the control group decreased by a mean of 0.3 seconds (MD 1.9 seconds, favouring the training group, 95% CI -0.29 to 4.09, see Analysis 4.2).

Secondary outcome measures: ankle ROM, ankle dorsiflexor strength, activity/participation measures, QOL and adverse effects

The training programme in the Lindeman 1995 study led to no significant change in time taken for descending stairs, climbing stairs, rising from a chair or standing from lying supine (see Analysis 4.3). There was a significant improvement in self reported stair climbing, rising from a chair, getting into and out of a car, putting on socks and lying down on the bed, but numerical results were not provided.

Night splinting for six weeks had no significant effect on passive ankle range of movement or strength (Refshauge 2006). Mean dorsiflexion increased by 3 degrees in both the night splinting and control groups immediately after the intervention period (MD 0.00 degrees, 95% CI -5.13 to 5.13, see Analysis 5.1). Mean eversion increased by 1 degree in both the night splinting and control groups (MD 0.00 degree, 95% CI -1.96 to 1.96, see Analysis 5.2). Mean dorsiflexion force increased by 20 N and 1 N in the intervention and control groups respectively (mean difference 19.00 N, favouring night splinting, 95% CI -60.14 to 98.14, see Analysis 5.3), mean eversion increased by 0 N in the intervention group and 5 N in the control group (mean difference -5.00 N, favouring the control group, 95% CI -138.18 to 128.18, see Analysis 5.4), and mean inversion increased by 95 N in the intervention group and 93 N in the control group (mean difference 2.00 N, favouring night splinting, 95% CI -124.00 to 128.00, see Analysis 5.5).

Subgroup analysis

Insufficient data were available to allow us to compare interventions in the common aetiological subgroups proposed in the protocol.

DISCUSSION

The review update provides little evidence to support any intervention for treating foot drop in terms of improving walking or secondary outcomes. The differences in patient condition and outcome measures between studies made meta-analysis impossible and made it difficult to present firm conclusions from the review. In addition, many of the studies examined were excluded due to insufficient methodological quality, which substantially reduced the body of evidence.

Duchenne muscular dystrophy

There is some evidence that early surgery intervention is not effective in people with Duchenne muscular dystrophy in terms of walking speed, muscle strength or other measures of functional 'motor ability' at one, two or nine years after surgery. Surgery appeared to have a positive effect on contractures in the short-term although no long-term advantage was observed (Manzur 1992). The long-term risk of surgery increasing disability has not been assessed.

Facioscapulohumeral muscular dystrophy

A six-week strength training programme of the ankle flexors failed to have a significant effect on strength in participants with facioscapulohumeral muscular dystrophy (van der Kooi 2004). The training programme also failed to have a significant effect on either activity and participation levels as measured by the Sickness Impact Profile, and dimensions of quality of life including pain, fatigue and psychological distress (van der Kooi 2007). The strength training intervention was well tolerated with no reported adverse events.

Myotonic dystrophy

A 24-week strength-training programme was found to have no effect on walking speed or time taken to complete functional tasks (Lindeman 1995). Participants reported more ease with standing, getting into and out of a car and putting on socks, but numerical data were not presented.

Charcot-Marie-Tooth disease

A 24-week strength training programme was found to improve walking speed but led to no significant change in time taken for climbing stairs, descending stairs, rising from a chair or standing from lying supine (Lindeman 1995). Participants reported improvement in functional tasks such as rising from a chair, getting into and out of a car, putting on socks and lying down on the bed, but numerical data were not presented.

Night splinting, holding the ankle in maximum dorsiflexion for six weeks, did not lead to any significant improvement in muscle strength or passive range of movement around the ankle (Refshauge 2006). One participant out of 14 reported discomfort from wearing the splint.

Excluded studies

Most of the studies were excluded because of methodological inadequacies, for example lack of randomisation or drop outs exceeding 40%, and/or did not use outcome measures specified in the review. A non-randomised study (without masked assessment) by Forst 1999 described the long-term outcome of 213 participants with Duchenne muscular dystrophy 87 of whom had surgery. They concluded that the operation delayed the loss of independent ambulation by 1.25 years, and change in strength did not differ between groups. However, the baseline characteristics of the two groups were not reported. In a randomised study of 27 boys with Duchenne muscular dystrophy Hyde 2000 investigated the effects of wearing night splints on contractures and concluded that the treatment group had a statistically significant annual delay of 23% in the development of contractures compared to the control group. However, the study was categorised as flawed because the number of dropouts was excessive (9 of 15, 60% in the intervention group). The effect of an ankle-foot orthosis on the strength of paretic dorsiflexors was investigated in a non-randomised study of 26 people with foot drop secondary to peroneal neuropathy or L5 radiculopathy of six weeks to twelve months duration by Geboers 2001a. The authors concluded that ankle-foot-orthosis did not influence the restoration of strength in participants with recent peripheral paralysis and, did not adversely influence recovery. Additionally, the authors stated that the decrease in strength observed in the healthy side of participants might be attributable to an overall loss of strength due to a decrease in activity.

This review covered participants of all ages, described as having lower motor neuron or floppy foot drop or contractures of tendons that develop secondary to foot drop. The wide range of patient characteristics, incomparable outcome measures and poor methodological quality made it difficult to carry out any meta-analysis which in turn made it difficult to draw hard conclusions from the review. Exercise intervention is well tolerated and without adverse effects and may have a positive effect particularly in those with Charcot-Marie-Tooth disease. However strong evidence is lacking and further studies to support these findings would be beneficial. Early surgery was also shown to have few benefits for children with Duchenne muscular dystrophy but the long-term risks have not been assessed.

Limitations of this review

This review is subject to various limitations. First, our search may have missed some relevant studies. The terms we used to identify the groups of participants are imprecise and it is possible that studies may have been undertaken and reported using other terms or simply giving the underlying disease (e.g. poliomyelitis), on the grounds that there would be no clinical need to specify that there was a floppy foot drop. Nevertheless, searching for studies through the treatment given (e.g. orthoses) would have identified many of these studies.

Second, the review was based on the assumption that rehabilitation treatments for foot drop resulting from reduced muscle strength and no increase in muscle tone could be considered as being similar in their effects and side effects. However this may not

be the case. For example it is possible that muscle strengthening exercises could be beneficial in people with disease of the lower motor neuron but harmful in people with disease of the muscle itself. In fact the evidence would suggest that this is not the case, but there may be other examples where there is a differential effect. This review excluded studies where foot drop resulted from upper motor neuron disorders (e.g. stroke) and non-pathological nerve damage (e.g. laceration, crush injury, ischemia, mechanical irritation, compression, traction). Still, it is important to consider that the aetiology of foot drop may differ between different lower motor neuron conditions alone. For example, in conditions such as diabetes and hereditary sensory motor neuropathy, foot drop may be a result of proprioceptive impairments as well as motor neuropathy itself. Responsiveness to treatment may therefore vary. Third, the choice of primary outcome measure (quantitative measures of walking performance) was based on the assumption that walking speed would correlate with performance in most other activities involving mobility. The results in at least one of the studies suggest that this may not be true, and that it may not be sensible in future to focus on walking speed. The alternative is to investigate a range of specific activities that depend upon aspects of mobility. Scales such as the Rivermead mobility index will be considered in future updates.

There is empirical evidence that the use of scales, which use a scoring system to assess quality of studies, give variable results. Therefore, in line with the latest Cochrane guidelines, future updates of this review will assess risk of bias using methods set out in Chapter 8 of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2008) .

that strength training is not effective at improving walking ability in patients with myotonic dystrophy, and not effective at increasing ankle strength in patients with facioscapulohumeral muscular dystrophy. Results from one trial suggests that wearing night splints for six weeks has no effect on range of movement or strength of the ankle in people with Charcot-Marie-Tooth disease, and data from another trial suggest that early surgery to lengthen the Achilles tendon in Duchenne muscular dystrophy has no significant benefit on walking ability after one, two or nine years.

Implications for research

More evidence is needed to prove/disprove rehabilitation effects aimed at foot drop in patients with neuromuscular diseases at the level of the lower motor neuron. Exercise regimens of varying intensity and frequency have provided some evidence of benefit and should be evaluated in more detail in the future. The use of orthotics on function and physiological cost would be worthy of more investigation. Future studies should include outcome measures which assess aspects such as activities of daily living and gait, not just outcomes aimed at the impairment level of disability, e.g. strength and range of motion. It is important to link changes in strength and range of motion with actual levels of activity and participation, which are more meaningful in clinical practice and would allow readers to assess the influence of interventions on every day life.

ACKNOWLEDGEMENTS

AUTHORS' CONCLUSIONS

Implications for practice

Evidence from one trial suggests that strengthening exercises are not detrimental and may benefit the ability to walk in patients with Charcot-Marie-Tooth disease. However, limited evidence suggests

REFERENCES

References to studies included in this review

Lindeman 1995 *{published data only}*
Lindeman E, Leffers P, Spaans F, Drukker J, Reulen J, Kerckhoffs M, et al.Strength training in patients with Myotonic Dystrophy & Hereditary Motor & Sensory Neuropathy : A randomized clinical trial. *Archives of Physical Medicine and Rehabilitation* 1995;**76**(7):612–20.

Manzur 1992 *{published data only}*
* Manzur AY, Hyde SA, Rodillo E, Heckmatt JZ, Bentley G, Dubowitz V. A randomized controlled trial of early surgery in Duchenne muscular dystrophy. *Neuromuscular Disorders* 1992;**2**(5-6):379–87.
Manzur AY, Maine M, Mercuri E, Muntoni F, Dubowitz V. Long-term results of early limb surgery in Duchenne muscular dystrophy. Abstracts: 4th International Congress of World Muscular Dystrophy Society, Turkey;

Neuromuscular Disorders; 1999. 1999; Vol. 9, issue 6–7: 487.

Refshauge 2006 *{published data only}*
Refshauge KM, Raymond J, Nicholson G, van den Dolder PA. Night splinting does not increase ankle range of motion in people with Charcot-Marie-Tooth disease: a randomised, cross-over trial. *The Australian Journal of Physiotherapy* 2006;**52**(3):193–9.

van der Kooi 2004 *{published data only}*
van de Kooi EL, Vogels OJ, van Asseldonk RJ, Lindeman E, Hendriks JC, Padberg GW. Strength training and albuterol in Facioscapulohumeral Muscular Dystrophy. *Neurology* 2001;**56**(Suppl 3):A80.
* van de Kooi EL, Vogels OJ, van Asseldonk RJ, Lindeman E, Hendriks JC, Wohlgemuth MD, et al.Strength training and albuterol in facioscapulohumeral muscular dystrophy. *Neurology* 2004;**63**(4):702–8.
van der Kooi EL, Vogels OJ, van Asseldonk RJ. The efficacy of strength training in Facioscapulohumeral Muscular Dystrophy. Neurology. 2000; Vol. 55 (Suppl 3):A435.

van der Kooi 2007 *{published data only}*
van der Kooi E, Kalkman J, Lindeman E, Hendriks J, van Engelen B, Bleijenberg G, Padberg G. Effects of training and albuterol on pain and fatigue in facioscapulohumeral muscular dystrophy. *Journal of Neurology* 2007;**254**(7): 931–940.

References to studies excluded from this review

Brumett 2005 *{published data only}*
Brumett D Sr, Rouhe SA, Struven JB, Trindade C. Treatment of foot drop using a dynamic, non-rigid dorsiflexion foot lifter. *Orthopedics* 2005;**28**(6):551–554.

Farmer 2006 *{published data only}*
Farmer SE, Pearce G, Whittall J, Quinlivan RC, Patrick JH. The use of stock orthoses to assist gait in neuromuscular disorders: a pilot study. *Prosthetics and Orthotics International* 2006;**30**(2):145–154.

Forst 1995 *{published data only}*
Forst R, Forst J. Importance of lower limb surgery in Duchenne muscular dystrophy. *Archives of Orthopaedic and Trauma Surgery* 1995;**114**(2):106–11.

Forst 1999 *{published data only}*
Forst J, Forst R. Lower limb surgery in Duchenne muscular dystrophy. *Neuromuscular Disorders* 1999;**9**(3):176–81.

Geboers 2001a *{published data only}*
Geboers JF, Janssen-Potten YJ, Seelen HA, Spaans F, Drost MR. Evaluation of effect of ankle-foot orthosis use on strength restoration of paretic dorsiflexors. *Archives of Physical Medicine and Rehabilitation* 2001;**82**(6):856–60.

Geboers 2001b *{published data only}*
Geboers J. *Effects of ankle-foot orthosis on paretic ankle dorsiflexors*. Maastricht: Universiteit Maastricht, 2001:112.

Geboers 2002 *{published data only}*
Geboers JF, Drost MR, Spaans F, Kuipers H, Seelen HA. Immediate and long term effects of an ankle-foot orthosis on muscle activity during walking, a randomised study of patients with unilateral foot-drop. *Archives of Physical Medicine and Rehabilitation* 2002;**83**(2):240–5.

Hove 1998 *{published data only}*
Hove LM, Nilsen PT. Posterior tibial tendon transfer for drop-foot. *Acta Orthopaedica* 1998;**69**(6):608–610.

Hyde 2000 *{published data only}*
Hyde SA, Floytrup I, Glent S, Kroksmark AK, Salling B, Steffensen BF, et al.A randomized comparative study of two methods for controlling Tendo Achilles contracture in Duchenne muscular dystrophy. *Neuromuscular Disorders* 2000;**10**(4-5):257–263.

Matjaic 2006 *{published data only}*
Matjaic Z, Zupan A. Effects of dynamic balance training during standing and stepping in patients with hereditary sensory motor neuropathy. *Disability and Rehabilitation* 2006;**28**(23):1455–1459.

McDonald 2005 *{published data only}*
McDonald CM, Widman LM, Walsh DD, Walsh SA, Abresch RT. Use of step activity monitoring for continuous physical activity assessment in boys with Duchenne muscular dystrophy. *Archives of Physical Medicine and Rehabilitation* 2005;**86**(4):802–808.

Olsen 2005 *{published data only}*
Olsen CB, Ørngreen MC, Vissing J. Aerobic training improves exercise performance in facioscapulohumeral muscular dystrophy. *Neurology* 2005;**64**:1064–1066.

Richardson 2001 *{published data only}*
Richardson JK, Sandman D, Vela S. A focused exercise regimen improves clinical measures of balance in patients with peripheral neuropathy. *Archives of Physical Medicine and Rehabilitation* 2001;**82**(2):205–9.

Vigasio 2008 *{published data only}*
Vigasio A, Marcoccio I, Patelli A, Mattiuzzo V, Prestini G. New tendon transfer for correction of drop-foot in common peroneal nerve palsy. *Clinical Orthopaedics and Related Research*. 2008;**466**(6):1454–1466.

Wiesinger 1998 *{published data only}*
Wiesinger GF, Quittan M, Aringer M, Seeber A, Volc-Platzer B, Smolen J, et al.Improvement of physical fitness and muscle strength in polymyositis/dermatomyositis patients by a training programme. *British Journal of Rheumatology* 1998;**37**(2):196–200.

Additional references

Donaghy 2001
Donaghy M (editor). *Brain's Diseases of the Nervous System*. 11th Edition. Oxford: Oxford University Press, 2001.

Germain 1995
Germain P, Guell A, Marini JF. Muscle strength during bedrest with and without muscle exercise as a countermeasure. *European Journal of Applied Physiology and Occupational Physiology* 1995;**71**(4):342–8.

Higgins 2008
Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions 5.0.0 [updated February 2008]. The Cochrane Collaboration, 2008. Available from www.cochrane-handbook.org..

Jadad 1996
Jadad AR, Moore RA, Carroll D, Jenkinson C, Reynolds DJ, Gavaghan DJ, et al.Assessing the quality of reports of randomized clinical trials: is blinding necessary?. *Controlled Clinical Trials* 1996;**17(1)**:1–12.

Jaivin 1992
Jaivin JS, Bishop JO, Braly WG, Tullos HS. Management of acquired adult drop foot. *Foot and Ankle* 1992;**13**(2): 98–104.

MRC 1943
Aids to the investigation of peripheral nerve injuries. War Memorandum (revised 2nd Edition). Medical Research Council. London: HMSO, 1943.

Rideau 1986
Rideau Y, Duport G, Delaubier A. Remissions Reproductibles Dans l' Evolution de la Dystrophie Musculaire de Duchenne. *Bulletin de l'Academie Nationale de Medecine* 1986;**170**(5):605–610.

Rozier 1979
Rozier CK, Elder JD, Brown M. Prevention of atrophy by isometric exercise of a casted leg. *Journal of Sports Medicine and Physical Fitness* 1979;**19**(2):191–4.

Tropp 1995
Tropp H, Norlin R. Ankle performance after ankle fracture : a randomized study of early mobilization. *Foot and Ankle International* 1995;**16**(2):79–83.

Turner-Stokes 2005
Turner-Stokes L, Disler P, Nair A, Wade D. Multi-disciplinary rehabilitation for acquired brain injury in adults of working age. *Cochrane Database of Systematic Reviews* 2005, Issue 3. [DOI: 10.1002/14651858]

van Tulder 1997
van Tulder MW, Assendelft WJ, Koes BW. Method guidelines for systematic reviews in the Cochrane Collaboration: Back Review Group for spinal disorders. *Spine* 1997;**22**(20):2323–330.

WHO 2001
World Health Organisation. *International Classification of Functioning, Disability and Health*. Geneva: WHO, 2001.

Wiesseman 1981
Wiesseman GJ. Tendon transfers for peripheral nerve injuries of the lower extremity. *The Orthopedic Clinics of North America* 1981;**12**(2):459–67.

References to other published versions of this review

Sackley 2007
Sackley C, Disler PB, Turner-Stokes L, Wade DT 2007, Issue. Rehabilitation interventions for foot drop in neuromuscular disease. *Cochrane Database of Systematic Reviews* 2007, Issue 2. Art.No.:CD003908. [DOI: 10.1002/14651858.CD003908.pub2.]

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Lindeman 1995

Methods	RCT of matched pairs (matching on muscle strength).
Participants	Participants with myotonic dystrophy (myD) or Charcot-Marie-Tooth disease (CMT)
Interventions	Exercise versus no exercise. 14 of 18 randomised matched MyD pairs analysed at 24 weeks. 13 of 15 randomised matched CMT pairs analysed at 24 weeks.
Outcomes	Muscle strength and endurance, walking, stairs, WOMAC, SIP, VAS (life activities)
Notes	Statistical change only in walking in CMT: trends to positive effect in all parameters

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Manzur 1992

Methods	Unblinded RCT.
Participants	Boys aged 4 to 6 years with Duchenne muscular dystrophy.
Interventions	Surgical (n = 10) versus conservative treatment (n = 10).
Outcomes	Muscle strength, walking, Gower's time, contracture measurement, motor activities
Notes	No difference in outcome at 1 year. Follow up study in 1999, No difference in outcome at 8 to 11 years

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Refshauge 2006

Methods	Randomised, crossover trial with repeated measures.
Participants	Individuals with genetically confirmed Charcot-Marie-Tooth disease Type 1A and less than or equal to 15 degrees dorsiflexion
Interventions	Night splint worn for 6 weeks (n = 14 legs) versus no splint (n = 14 legs) One drop-out due to splint discomfort before 3/52 - excluded from analysis (13 legs analysed in each group)
Outcomes	Range of motion (dorsiflexion and eversion) and muscle strength (dorsiflexion, eversion and inversion)
Notes	Night splinting did not have a significant effect on any of the outcomes measured

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	C - Inadequate

van der Kooi 2004

Methods	Unblinded RCT (two stage).
Participants	Participants with facioscapulohumeral muscular dystrophy.
Interventions	Strength training (n = 34) versus no training (n = 31): second randomisation at 26/52 into albuterol vs no drug treatment
Outcomes	Muscle strength in legs and arms and muscle mass at 6 weeks. Muscle strength in legs and arms at 1 year.
Notes	At 6 weeks, training led to increased strength: statistically significant only at elbow At 1 year, training led to increased dynamic of elbow; albuterol increased elbow flexion: ankle dorsiflexion deteriorated . Published abstracts of both parts of the study van der Kooi 2000 and van der Kooi 2001

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	C - Inadequate

van der Kooi 2007

Methods	Unblinded RCT (two stage).
Participants	Participants with a clinical diagnosis of facioscapulohumeral muscular dystrophy
Interventions	Randomisation at baseline into strength training (n = 34) versus no training (n = 31). Second randomisation at 26/52 into albuterol versus no drug treatment
Outcomes	Self-reported pain (MPQ and DOP), fatigue (CIS, DOF and DOA), functional status (SIP) and psychological distress (SCL and BDI-PC)
Notes	Neither strength training nor albuterol had a clear positive or negative effect on pain, fatigue, functional status or psychological distress One patient stopped training and four discontinued medication due to side effects Each participant had to complete 6 questionnaires at the baseline and final visit. Only 19/780 questionnaires were not handed in Primary outcomes reported previously (van der Kooi 2004).

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	No	C - Inadequate

RCT - randomised controlled trial
WOMAC - Western Ontario and McMaster University Osteoarthritis Index
SIP - Sickness Impact Profile
VAS - Visual analogue scale
MPQ - McGill Pain Questionnaire
DOP - daily observed pain score
CIS - Checklist individual strength
DOF - daily observed fatigue
DOA - daily observed activity
SIP - sickness impact profile
SCL - symptom checklist-90
BDI-PC - Beck depression index - Primary care

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

Study	Reason for exclusion
Brumett 2005	Not a RCT (series of case studies), 3 participants with probable upper rather than lower motor neuron weakness and 2 participants with unclear diagnosis

Farmer 2006	Not a RCT (all participants completed 10 m walk under 3 different conditions). The 9 participants did not share common diagnosis. Possible contamination of results due to participant familiarity with orthoses being tested
Forst 1995	Not randomised, compared with 'natural history' cohort.
Forst 1999	Not randomised, compared with 'natural history' cohort.
Geboers 2001a	Not randomised, if alternative allocation on enrolment was used there would not be a 4 person difference between groups at entry (11,15). Assessment not masked. No allocation concealment. Large between group difference in mean age at entry (42 versus 60 years)
Geboers 2001b	Same as Geboers 2001a and Geboers 2002.
Geboers 2002	Same study as 2001a, compliance not reported for follow up data
Hove 1998	Not a RCT (case series design).
Hyde 2000	Drop out rate, 9 of 15 in intervention, 7 of 12 in 'control', total 16 of 27
Matjaic 2006	Balance intervention not targeted at foot drop.
McDonald 2005	Not a RCT (epidemiological case-control).
Olsen 2005	Not a RCT (case series). All of the participants had upper limb and facial weakness but only half had lower limb weakness
Richardson 2001	Did not use the specified outcome measures. Foot drop not diagnosed, paper talks about 'subclinical motor involvement'
Vigasio 2008	Not a RCT (case series design).
Wiesinger 1998	Not foot drop.

RCT - randomised controlled trial

DATA AND ANALYSES

Comparison 1.   Early surgery versus control in Duchenne muscular dystrophy

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in 28 ft walking time (seconds)	1	20	Mean Difference (IV, Fixed, 95% CI)	Not estimable
2 Change in 150 ft walking time (seconds)	1	20	Mean Difference (IV, Fixed, 95% CI)	-2.88 [-8.18, 2.42]
3 Change in motor ability score (max 40)	1	20	Mean Difference (IV, Fixed, 95% CI)	-1.0 [-3.08, 1.08]
4 Change in combined strength of 6 lower limb muscle groups (kg)	1	20	Mean Difference (IV, Fixed, 95% CI)	Not estimable

Comparison 2.   Strength training versus control in FSHD

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in muscle strength of ankle dorsiflexors - maximum voluntary isometric contraction (kg)	1	65	Mean Difference (IV, Fixed, 95% CI)	-0.43 [-2.49, 1.63]
2 Change in muscle strength ankle dorsiflexors - dynamic strength (kg)	1	65	Mean Difference (IV, Fixed, 95% CI)	0.44 [-0.89, 1.77]
3 Change in visual analogue scale - pain (min 0, max 100)	1	65	Mean Difference (Fixed, 95% CI)	-2.3 [-11.16, 6.56]
4 Change in Checklist Individual Strength - Fatigue (min 0, max 120)	1	65	Mean Difference (Fixed, 95% CI)	-3.0 [-6.00, 2.00]
5 Change in health related function - Sickness Impact Profile (min 0, max 10,289)	1	65	Mean Difference (Fixed, 95% CI)	-60.00 [-228.99, 104.99]
6 Change in psychological distress - Symptom Cheklist-90 (min 90, max 450)	1	65	Mean Difference (Fixed, 95% CI)	-2.0 [-10.51, 6.51]
7 Change in psychological distress - Beck Depression Inventory for primary care (min 0, max 21)	1	65	Mean Difference (Fixed, 95% CI)	-0.6 [-1.66, 0.46]

Comparison 3.   Strength training versus control in myotonic dystrophy

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in time to walk 6 m at a comfortable pace (seconds)	1	28	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-0.79, 0.39]
2 Change in time to walk 50 m at a fast pace (seconds)	1	28	Mean Difference (IV, Fixed, 95% CI)	-0.80 [-5.29, 3.69]
3 Change in time spent to achieve mobility activities in seconds	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Descending stairs	1	28	Mean Difference (IV, Fixed, 95% CI)	2.0 [-2.22, 6.22]
3.2 Climbing stairs	1	28	Mean Difference (IV, Fixed, 95% CI)	0.8 [-2.38, 3.98]
3.3 Standing up from a chair	1	28	Mean Difference (IV, Fixed, 95% CI)	1.0 [-1.14, 3.14]
3.4 Standing up from lying supine	1	28	Mean Difference (IV, Fixed, 95% CI)	-0.9 [-2.27, 0.47]

Comparison 4.   Strength training versus control in Charcot-Marie-Tooth disease

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in time to walk 6 m at a comfortable pace (seconds)	1	26	Mean Difference (IV, Fixed, 95% CI)	0.7 [0.23, 1.17]
2 Change in time to walk 50 m at a fast pace (seconds)	1	26	Mean Difference (IV, Fixed, 95% CI)	1.90 [-0.29, 4.09]
3 Change in time spent to achieve mobility activities (seconds)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Descending stairs	1	26	Mean Difference (IV, Fixed, 95% CI)	0.79 [-0.37, 1.95]
3.2 Climbing stairs	1	26	Mean Difference (IV, Fixed, 95% CI)	0.71 [-0.29, 1.71]
3.3 Standing up from a chair (seconds)	1	26	Mean Difference (IV, Fixed, 95% CI)	0.15 [-0.17, 0.47]
3.4 standing up from lying supine (seconds)	1	26	Mean Difference (IV, Fixed, 95% CI)	0.2 [-0.22, 0.62]

Comparison 5.   Night splinting versus control in Charcot-Marie-Tooth disease

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Change in dorsiflexion range of motion (deg)	1	26	Mean Difference (IV, Fixed, 95% CI)	Not estimable
2 Change in eversion range of motion (deg)	1	26	Mean Difference (IV, Fixed, 95% CI)	Not estimable
3 Change in dorsiflexion force (N)	1	26	Mean Difference (IV, Fixed, 95% CI)	19.0 [-60.14, 98.14]

4 Change in eversion force (N)	1	26	Mean Difference (IV, Fixed, 95% CI)		-5.0 [-138.18, 128.18]
5 Change in inversion force (N)	1	26	Mean Difference (IV, Fixed, 95% CI)		2.0 [-124.00, 128.00]

Analysis 1.1. Comparison 1 Early surgery versus control in Duchenne muscular dystrophy, Outcome 1 Change in 28 ft walking time (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 1 Early surgery versus control in Duchenne muscular dystrophy

Outcome: 1 Change in 28 ft walking time (seconds)

Study or subgroup	Surgery		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Manzur 1992	10	-0.1 (0.95)	10	-0.1 (0.95)		100.0 %	0.0 [-0.83, 0.83]
Total (95% CI)	**10**		**10**			**100.0 %**	**0.0 [-0.83, 0.83]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Not applicable

```
        -2    -1    0    1    2
     Favours control    Favours surgery
```
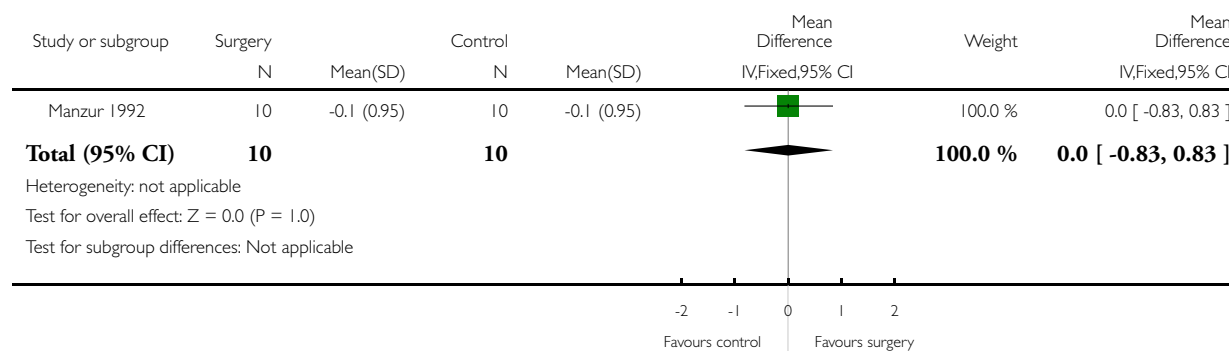
Analysis 1.2. Comparison 1 Early surgery versus control in Duchenne muscular dystrophy, Outcome 2 Change in 150 ft walking time (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 1 Early surgery versus control in Duchenne muscular dystrophy

Outcome: 2 Change in 150 ft walking time (seconds)

Study or subgroup	Surgery		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Manzur 1992	10	-4.1 (6.64)	10	-1.22 (5.38)		100.0 %	-2.88 [-8.18, 2.42]
Total (95% CI)	**10**		**10**			**100.0 %**	**-2.88 [-8.18, 2.42]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.07 (P = 0.29)							
Test for subgroup differences: Not applicable							

-10   -5   0   5   10

Favours control   Favours surgery
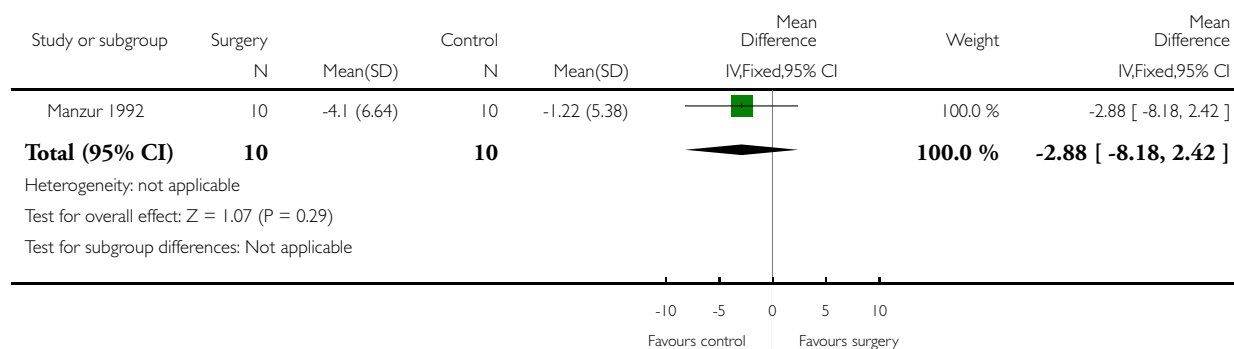
Analysis 1.3. Comparison 1 Early surgery versus control in Duchenne muscular dystrophy, Outcome 3 Change in motor ability score (max 40).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 1 Early surgery versus control in Duchenne muscular dystrophy

Outcome: 3 Change in motor ability score (max 40)

Study or subgroup	Surgery		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Manzur 1992	10	-2 (2.21)	10	-1 (2.53)		100.0 %	-1.00 [-3.08, 1.08]
Total (95% CI)	**10**		**10**			**100.0 %**	**-1.00 [-3.08, 1.08]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.94 (P = 0.35)							
Test for subgroup differences: Not applicable							

-4   -2   0   2   4

Favours control   Favours surgery
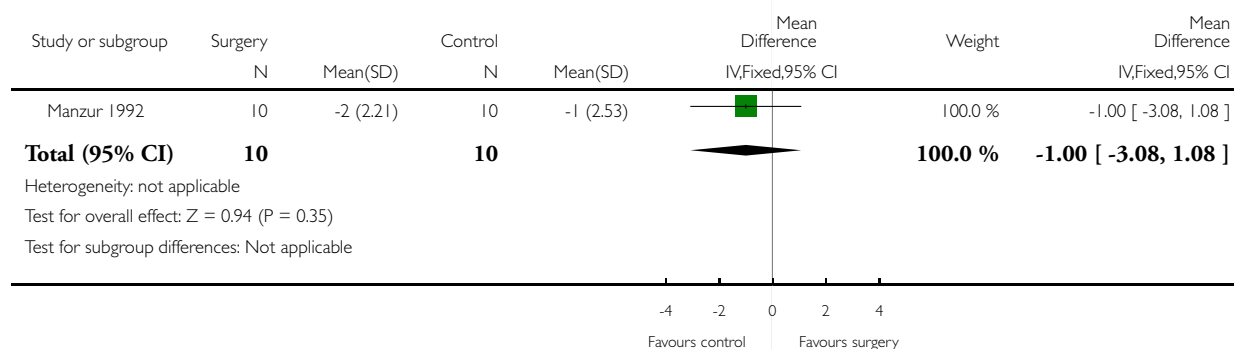
Analysis 1.4. Comparison 1 Early surgery versus control in Duchenne muscular dystrophy, Outcome 4 Change in combined strength of 6 lower limb muscle groups (kg).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 1 Early surgery versus control in Duchenne muscular dystrophy

Outcome: 4 Change in combined strength of 6 lower limb muscle groups (kg)

Study or subgroup	Surgery		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Manzur 1992	10	-0.7 (0.63)	10	-0.7 (0.63)		100.0 %	0.0 [-0.55, 0.55]
Total (95% CI)	**10**		**10**			**100.0 %**	**0.0 [-0.55, 0.55]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Not applicable

```
        -2    -1    0    1    2
      Favours control   Favours surgery
```
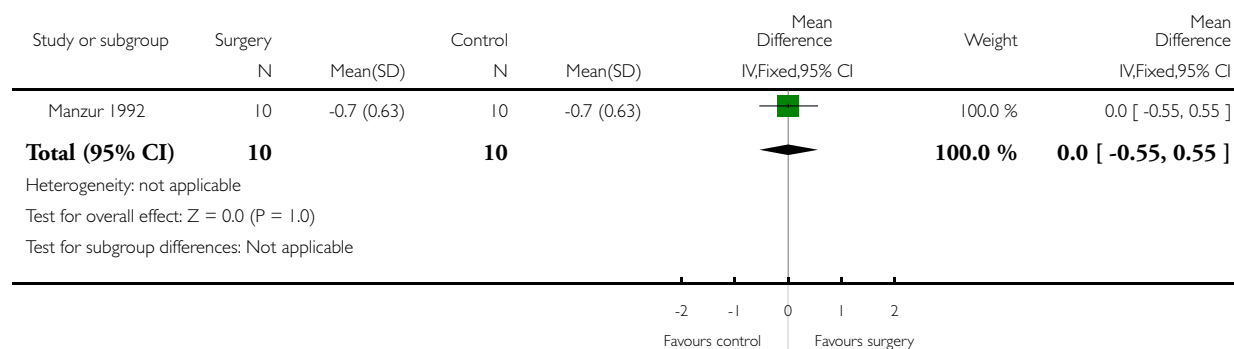
Analysis 2.1. Comparison 2 Strength training versus control in FSHD, Outcome 1 Change in muscle strength of ankle dorsiflexors - maximum voluntary isometric contraction (kg).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 1 Change in muscle strength of ankle dorsiflexors - maximum voluntary isometric contraction (kg)

Study or subgroup	Training		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
van der Kooi 2004	34	-1.56 (4.16)	31	-1.13 (4.28)		100.0 %	-0.43 [-2.49, 1.63]
Total (95% CI)	**34**		**31**			**100.0 %**	**-0.43 [-2.49, 1.63]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.41 (P = 0.68)

Test for subgroup differences: Not applicable

```
      -4    -2    0    2    4
    Favours control   Favours training
```
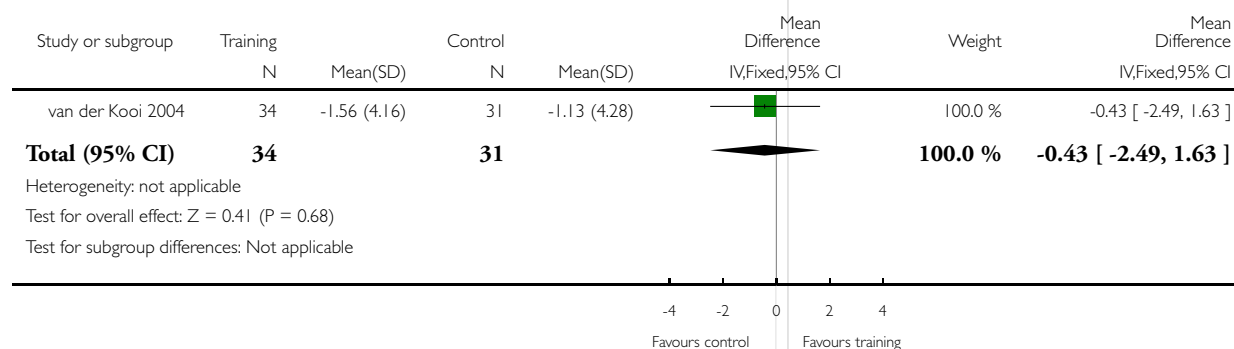
Analysis 2.2. Comparison 2 Strength training versus control in FSHD, Outcome 2 Change in muscle strength ankle dorsiflexors - dynamic strength (kg).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 2 Change in muscle strength ankle dorsiflexors - dynamic strength (kg)

Study or subgroup	Training		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
van der Kooi 2004	34	-1.06 (2.78)	31	-1.5 (2.68)		100.0 %	0.44 [-0.89, 1.77]
Total (95% CI)	**34**		**31**			**100.0 %**	**0.44 [-0.89, 1.77]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.65 (P = 0.52)

Test for subgroup differences: Not applicable

```
        -4   -2    0    2    4
```

Favours control   Favours training
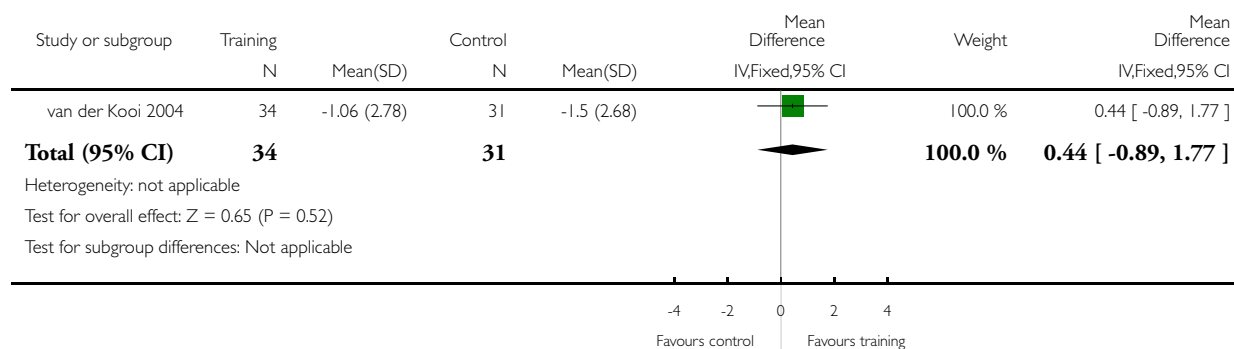
Analysis 2.3. Comparison 2 Strength training versus control in FSHD, Outcome 3 Change in visual analogue scale - pain (min 0, max 100).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 3 Change in visual analogue scale - pain (min 0, max 100)

Study or subgroup	Training	Control	Mean Difference (SE)	Mean Difference	Weight	Mean Difference
	N	N		IV,Fixed,95% CI		IV,Fixed,95% CI
van der Kooi 2007	34	31	-2.3 (4.52)		100.0 %	-2.30 [-11.16, 6.56]
Total (95% CI)					**100.0 %**	**-2.30 [-11.16, 6.56]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.51 (P = 0.61)

Test for subgroup differences: Not applicable

```
       -10   -5    0    5   10
```

Favours control   Favours training
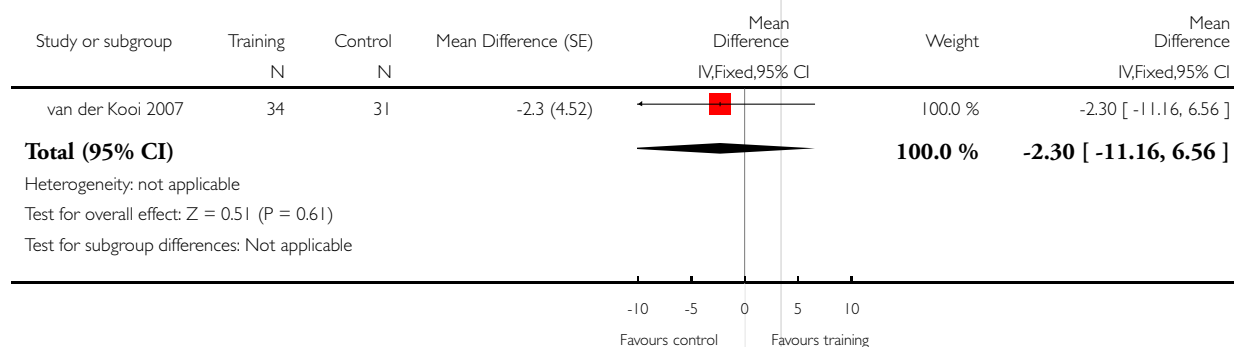
Analysis 2.4. Comparison 2 Strength training versus control in FSHD, Outcome 4 Change in Checklist Individual Strength - Fatigue (min 0, max 120).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 4 Change in Checklist Individual Strength - Fatigue (min 0, max 120)

Study or subgroup	Training N	Control N	Mean Difference (SE)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
van der Kooi 2007	34	31	-3 (2.55)		100.0 %	-3.00 [-8.00, 2.00]
Total (95% CI)					**100.0 %**	**-3.00 [-8.00, 2.00]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.18 (P = 0.24)

Test for subgroup differences: Not applicable

-10   -5   0   5   10

Favours control   Favours training
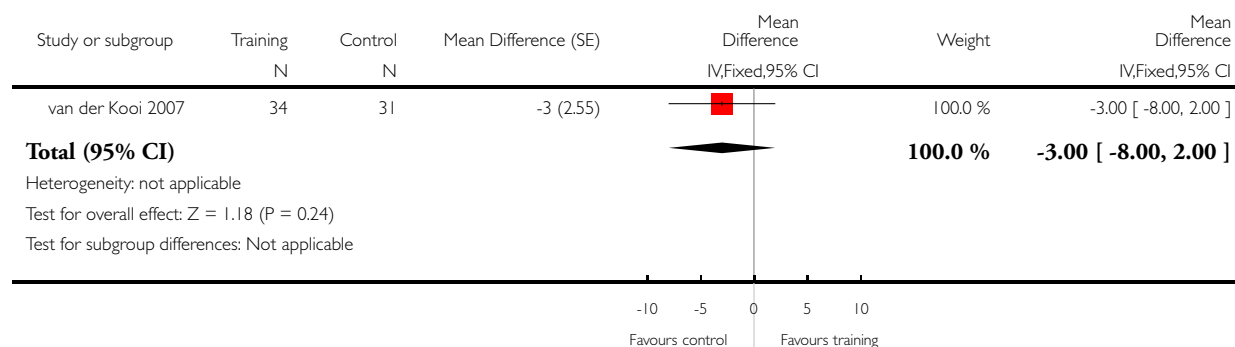
Analysis 2.5. Comparison 2 Strength training versus control in FSHD, Outcome 5 Change in health related function - Sickness Impact Profile (min 0, max 10,289).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 5 Change in health related function - Sickness Impact Profile (min 0, max 10,289)

Study or subgroup	Training N	Control N	Mean Difference (SE)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
van der Kooi 2007	34	31	-62 (85.2)		100.0 %	-62.00 [-228.99, 104.99]
Total (95% CI)					**100.0 %**	**-62.00 [-228.99, 104.99]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.73 (P = 0.47)

Test for subgroup differences: Not applicable

-200   -100   0   100   200

Favours control   Favours training
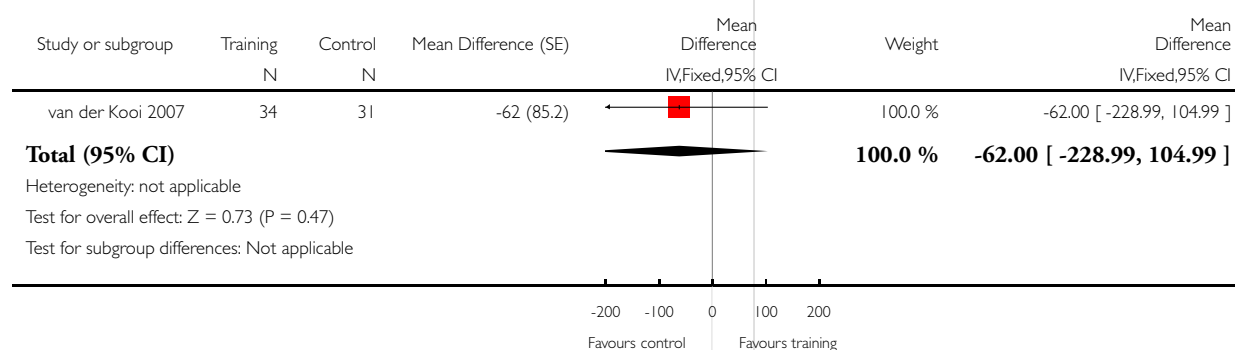
Analysis 2.6. Comparison 2 Strength training versus control in FSHD, Outcome 6 Change in psychological distress - Symptom Cheklist-90 (min 90, max 450).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 6 Change in psychological distress - Symptom Cheklist-90 (min 90, max 450)

Study or subgroup	Training N	Control N	Mean Difference (SE)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
van der Kooi 2007	34	31	-2 (4.34)		100.0 %	-2.00 [-10.51, 6.51]
Total (95% CI)					**100.0 %**	**-2.00 [-10.51, 6.51]**
Heterogeneity: not applicable						
Test for overall effect: Z = 0.46 (P = 0.64)						
Test for subgroup differences: Not applicable						

```
       -10   -5    0    5    10
      Favours control   Favours training
```
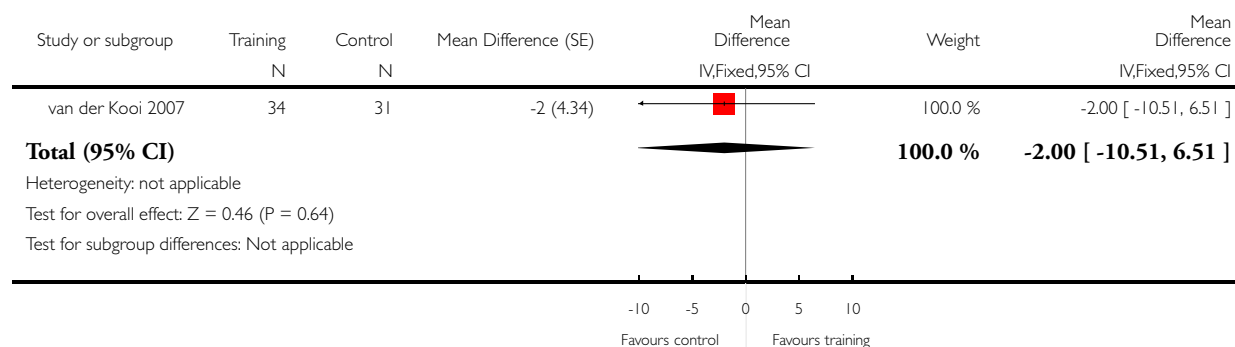
Analysis 2.7.   Comparison 2 Strength training versus control in FSHD, Outcome 7 Change in psychological distress - Beck Depression Inventory for primary care (min 0, max 21).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 2 Strength training versus control in FSHD

Outcome: 7 Change in psychological distress - Beck Depression Inventory for primary care (min 0, max 21)

Study or subgroup	Training N	Control N	Mean Difference (SE)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
van der Kooi 2007	34	31	-0.6 (0.54)		100.0 %	-0.60 [-1.66, 0.46]
Total (95% CI)					**100.0 %**	**-0.60 [-1.66, 0.46]**
Heterogeneity: not applicable						
Test for overall effect: Z = 1.11 (P = 0.27)						
Test for subgroup differences: Not applicable						

```
       -4    -2    0    2    4
      Favours control   Favours training
```
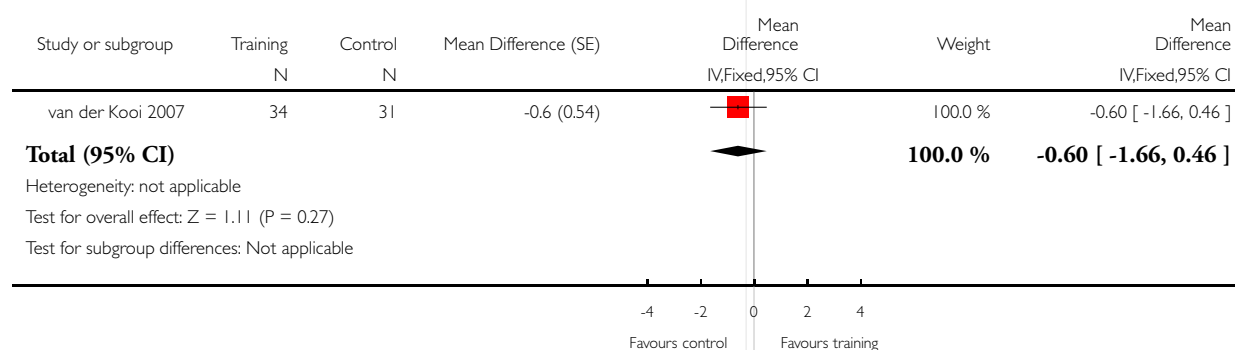
Analysis 3.1. Comparison 3 Strength training versus control in myotonic dystrophy, Outcome 1 Change in time to walk 6 m at a comfortable pace (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 3 Strength training versus control in myotonic dystrophy

Outcome: 1 Change in time to walk 6 m at a comfortable pace (seconds)

Study or subgroup	Training		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Lindeman 1995	14	0.3 (0.8)	14	0.5 (0.8)		100.0 %	-0.20 [-0.79, 0.39]
Total (95% CI)	**14**		**14**			**100.0 %**	**-0.20 [-0.79, 0.39]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.66 (P = 0.51)

Test for subgroup differences: Not applicable

```
        -10   -5    0    5    10
      Favours control    Favours training
```
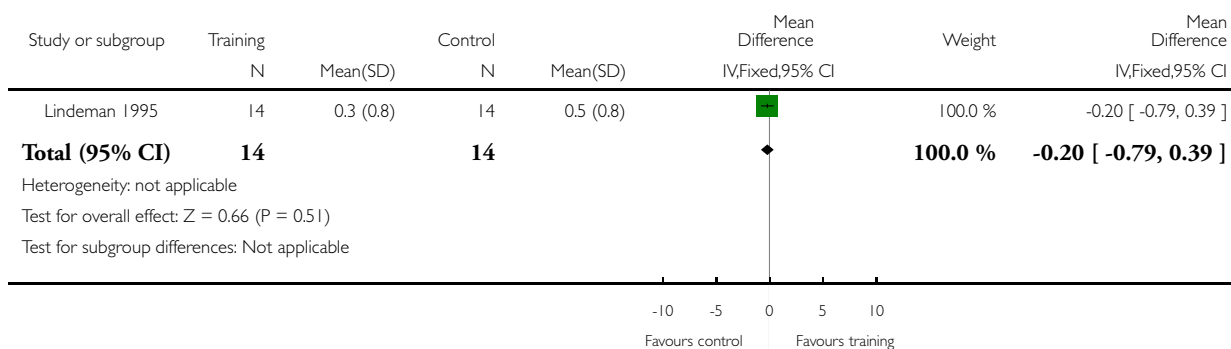
Analysis 3.2. Comparison 3 Strength training versus control in myotonic dystrophy, Outcome 2 Change in time to walk 50 m at a fast pace (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 3 Strength training versus control in myotonic dystrophy

Outcome: 2 Change in time to walk 50 m at a fast pace (seconds)

Study or subgroup	Training		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
Lindeman 1995	14	2.7 (6.3)	14	3.5 (5.8)		100.0 %	-0.80 [-5.29, 3.69]
Total (95% CI)	**14**		**14**			**100.0 %**	**-0.80 [-5.29, 3.69]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.35 (P = 0.73)

Test for subgroup differences: Not applicable

```
        -10   -5    0    5    10
      Favours control    Favours training
```
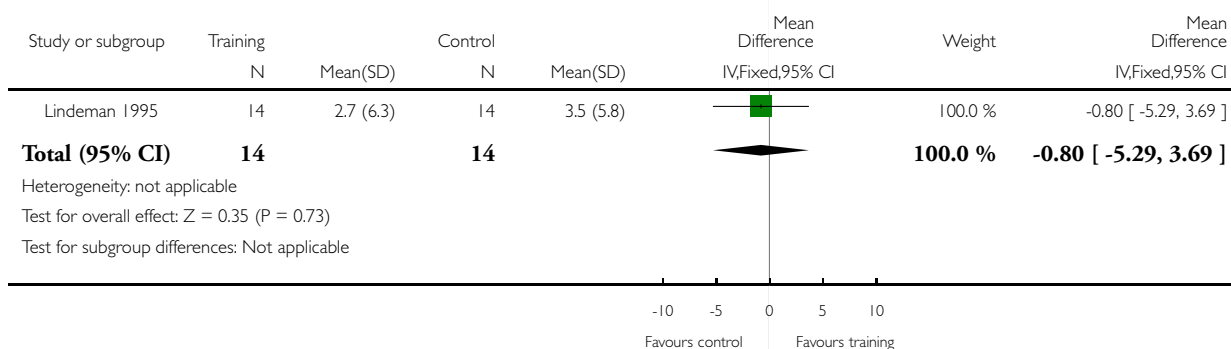
Analysis 3.3.   Comparison 3 Strength training versus control in myotonic dystrophy, Outcome 3 Change in time spent to achieve mobility activities in seconds.

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 3 Strength training versus control in myotonic dystrophy

Outcome: 3 Change in time spent to achieve mobility activities in seconds

Study or subgroup	Training		Control		Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
	N	Mean(SD)	N	Mean(SD)			
1 Descending stairs							
Lindeman 1995	14	2.5 (7.2)	14	0.5 (3.6)		100.0 %	2.00 [-2.22, 6.22]
Subtotal (95% CI)	**14**		**14**			**100.0 %**	**2.00 [-2.22, 6.22]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.93 (P = 0.35)							
2 Climbing stairs							
Lindeman 1995	14	1.1 (5.8)	14	0.3 (1.8)		100.0 %	0.80 [-2.38, 3.98]
Subtotal (95% CI)	**14**		**14**			**100.0 %**	**0.80 [-2.38, 3.98]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.49 (P = 0.62)							
3 Standing up from a chair							
Lindeman 1995	14	1.2 (4)	14	0.2 (0.8)		100.0 %	1.00 [-1.14, 3.14]
Subtotal (95% CI)	**14**		**14**			**100.0 %**	**1.00 [-1.14, 3.14]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.92 (P = 0.36)							
4 Standing up from lying supine							
Lindeman 1995	14	-0.4 (1.4)	14	0.5 (2.2)		100.0 %	-0.90 [-2.27, 0.47]
Subtotal (95% CI)	**14**		**14**			**100.0 %**	**-0.90 [-2.27, 0.47]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.29 (P = 0.20)							

Test for subgroup differences: Chi^2 = 3.59, df = 3 (P = 0.31), I^2 =17%

```
        -10    -5    0    5    10
     Favours control    Favours training
```

Analysis 4.1. Comparison 4 Strength training versus control in Charcot-Marie-Tooth disease, Outcome 1 Change in time to walk 6 m at a comfortable pace (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 4 Strength training versus control in Charcot-Marie-Tooth disease

Outcome: 1 Change in time to walk 6 m at a comfortable pace (seconds)

Study or subgroup	Training		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Lindeman 1995	13	1 (0.5)	13	0.3 (0.7)		100.0 %	0.70 [0.23, 1.17]
Total (95% CI)	**13**		**13**			**100.0 %**	**0.70 [0.23, 1.17]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.93 (P = 0.0033)							
Test for subgroup differences: Not applicable							

```
          -10   -5    0    5    10
        Favours control   Favours training
```

Analysis 4.2. Comparison 4 Strength training versus control in Charcot-Marie-Tooth disease, Outcome 2 Change in time to walk 50 m at a fast pace (seconds).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 4 Strength training versus control in Charcot-Marie-Tooth disease

Outcome: 2 Change in time to walk 50 m at a fast pace (seconds)

Study or subgroup	Training		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Lindeman 1995	13	2.2 (2.8)	13	0.3 (2.9)		100.0 %	1.90 [-0.29, 4.09]
Total (95% CI)	**13**		**13**			**100.0 %**	**1.90 [-0.29, 4.09]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.70 (P = 0.089)							
Test for subgroup differences: Not applicable							

```
          -10   -5    0    5    10
        Favours control   Favours training
```

**Analysis 4.3.   Comparison 4 Strength training versus control in Charcot-Marie-Tooth disease, Outcome 3
Change in time spent to achieve mobility activities (seconds).**

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 4 Strength training versus control in Charcot-Marie-Tooth disease
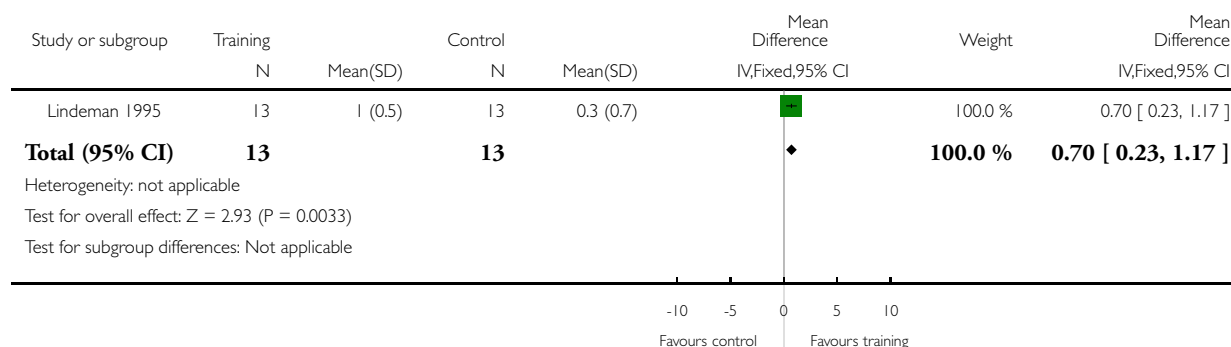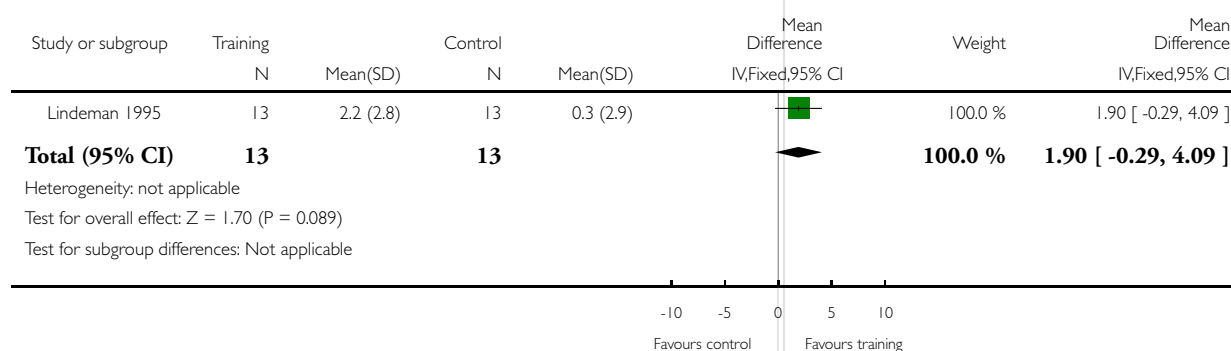
Outcome: 3 Change in time spent to achieve mobility activities (seconds)

Study or subgroup	Training		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
1 Descending stairs							
Lindeman 1995	13	0.7 (1.7)	13	-0.09 (1.3)		100.0 %	0.79 [-0.37, 1.95]
Subtotal (95% CI)	**13**		**13**			**100.0 %**	**0.79 [-0.37, 1.95]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.33 (P = 0.18)							
2 Climbing stairs							
Lindeman 1995	13	0.7 (1.4)	13	-0.01 (1.2)		100.0 %	0.71 [-0.29, 1.71]
Subtotal (95% CI)	**13**		**13**			**100.0 %**	**0.71 [-0.29, 1.71]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.39 (P = 0.17)							
3 Standing up from a chair (seconds)							
Lindeman 1995	13	0.2 (0.5)	13	0.05 (0.3)		100.0 %	0.15 [-0.17, 0.47]
Subtotal (95% CI)	**13**		**13**			**100.0 %**	**0.15 [-0.17, 0.47]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.93 (P = 0.35)							
4 standing up from lying supine (seconds)							
Lindeman 1995	13	0.3 (0.6)	13	0.1 (0.5)		100.0 %	0.20 [-0.22, 0.62]
Subtotal (95% CI)	**13**		**13**			**100.0 %**	**0.20 [-0.22, 0.62]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.92 (P = 0.36)							
Test for subgroup differences: Chi² = 2.03, df = 3 (P = 0.57), I² =0.0%							

-10   -5   0   5   10

Favours control   Favours training

Analysis 5.1. Comparison 5 Night splinting versus control in Charcot-Marie-Tooth disease, Outcome 1 Change in dorsiflexion range of motion (deg).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 5 Night splinting versus control in Charcot-Marie-Tooth disease

Outcome: 1 Change in dorsiflexion range of motion (deg)

Study or subgroup	Splinting N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Refshauge 2006	13	3 (8)	13	3 (5)		100.0 %	0.0 [-5.13, 5.13]
Total (95% CI)	**13**		**13**			**100.0 %**	**0.0 [-5.13, 5.13]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Not applicable
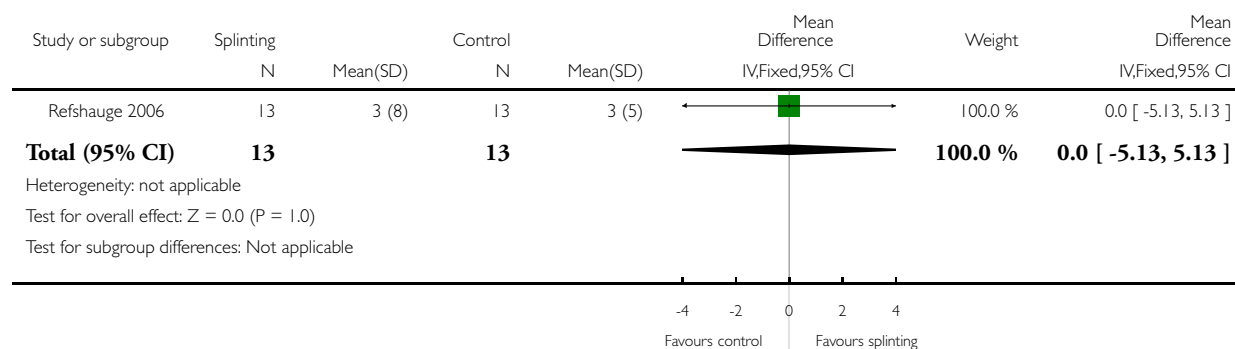
```
       -4    -2     0     2     4
      Favours control   Favours splinting
```
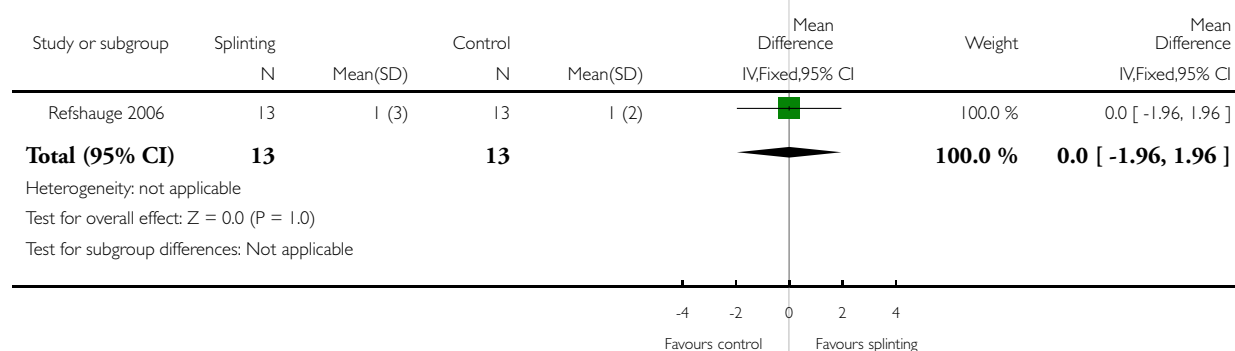
Analysis 5.2. Comparison 5 Night splinting versus control in Charcot-Marie-Tooth disease, Outcome 2 Change in eversion range of motion (deg).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 5 Night splinting versus control in Charcot-Marie-Tooth disease

Outcome: 2 Change in eversion range of motion (deg)

Study or subgroup	Splinting N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Refshauge 2006	13	1 (3)	13	1 (2)		100.0 %	0.0 [-1.96, 1.96]
Total (95% CI)	**13**		**13**			**100.0 %**	**0.0 [-1.96, 1.96]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Not applicable

```
       -4    -2     0     2     4
      Favours control   Favours splinting
```
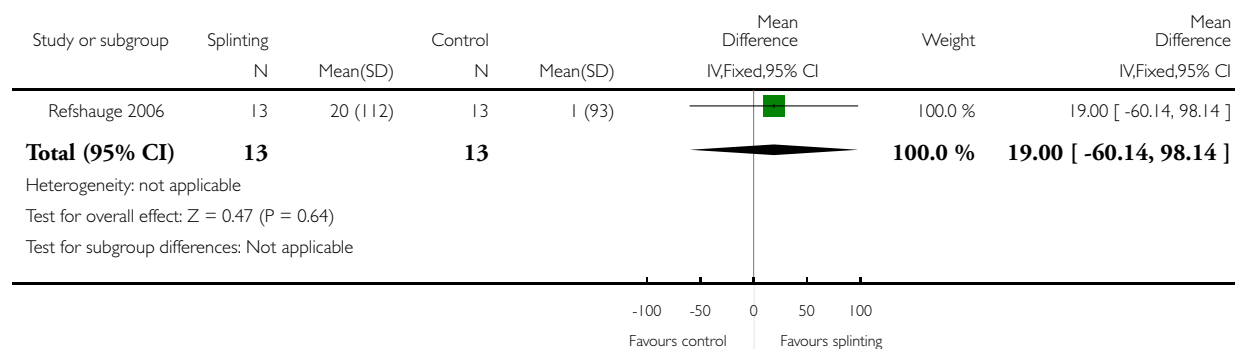
Analysis 5.3.   Comparison 5 Night splinting versus control in Charcot-Marie-Tooth disease, Outcome 3 Change in dorsiflexion force (N).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 5 Night splinting versus control in Charcot-Marie-Tooth disease

Outcome: 3 Change in dorsiflexion force (N)

Study or subgroup	Splinting		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Refshauge 2006	13	20 (112)	13	1 (93)		100.0 %	19.00 [-60.14, 98.14]
Total (95% CI)	**13**		**13**			**100.0 %**	**19.00 [-60.14, 98.14]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.47 (P = 0.64)							
Test for subgroup differences: Not applicable							

```
        -100    -50     0     50    100
        Favours control      Favours splinting
```
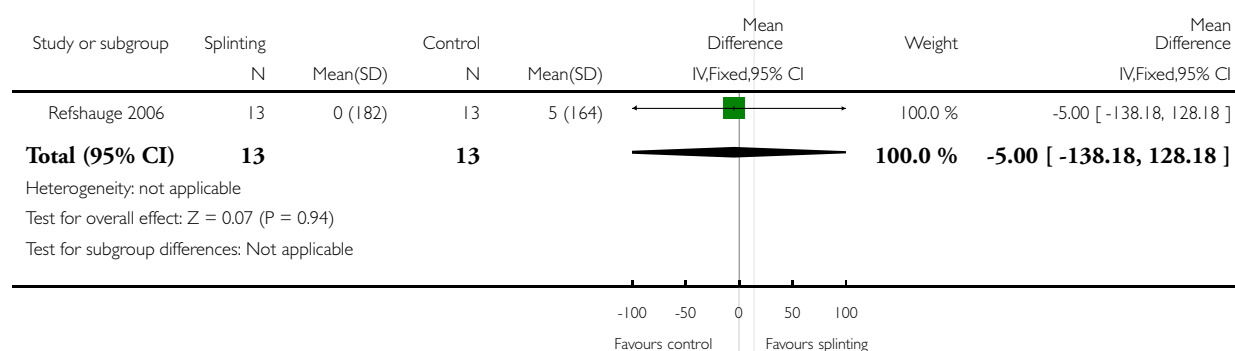
Analysis 5.4.   Comparison 5 Night splinting versus control in Charcot-Marie-Tooth disease, Outcome 4 Change in eversion force (N).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 5 Night splinting versus control in Charcot-Marie-Tooth disease

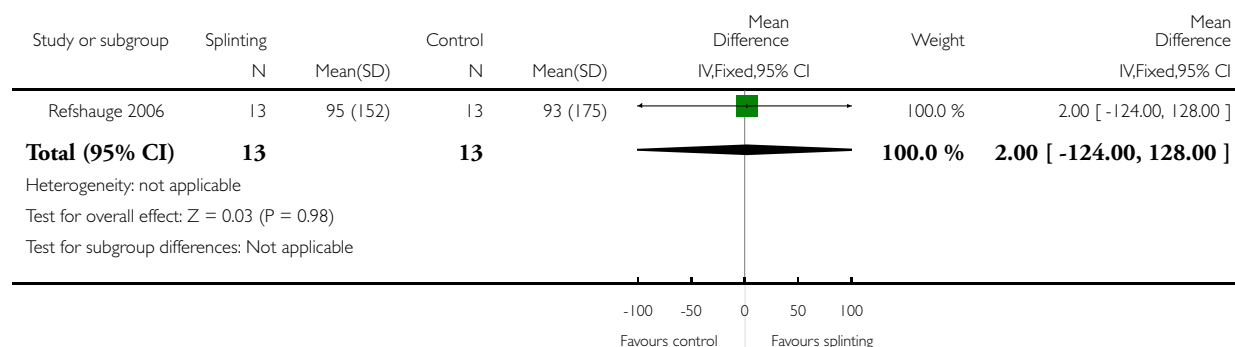Outcome: 4 Change in eversion force (N)

Study or subgroup	Splinting		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Refshauge 2006	13	0 (182)	13	5 (164)		100.0 %	-5.00 [-138.18, 128.18]
Total (95% CI)	**13**		**13**			**100.0 %**	**-5.00 [-138.18, 128.18]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.07 (P = 0.94)							
Test for subgroup differences: Not applicable							

```
        -100    -50     0     50    100
        Favours control      Favours splinting
```

Analysis 5.5. Comparison 5 Night splinting versus control in Charcot-Marie-Tooth disease, Outcome 5 Change in inversion force (N).

Review: Rehabilitation interventions for foot drop in neuromuscular disease

Comparison: 5 Night splinting versus control in Charcot-Marie-Tooth disease

Outcome: 5 Change in inversion force (N)

Study or subgroup	Splinting		Control		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	IV,Fixed,95% CI		IV,Fixed,95% CI
Refshauge 2006	13	95 (152)	13	93 (175)		100.0 %	2.00 [-124.00, 128.00]
Total (95% CI)	**13**		**13**			**100.0 %**	**2.00 [-124.00, 128.00]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.03 (P = 0.98)

Test for subgroup differences: Not applicable

-100   -50   0   50   100

Favours control   Favours splinting

ADDITIONAL TABLES

Table 1. 01 Scoring criteria using the method of van Tulder 1997

Criterion	Score positive if:
Eligibility criteria specified	A list of inclusion / exclusion criteria was explicitly stated
Adverse events	Adverse events described?
Assessment timings	Comparable between groups?
Sample size	Sample size described?
Method of randomisation	A random (unpredictable) assignment sequence was used.
Treatment allocation concealment	Assignment was concealed from the investigators.
Similarity of baseline characteristics	The study groups were comparable at baseline for the important prognostic parameters
Intervention and control specifically described	Details were given of the programme, including disciplines involved and treatment duration
Blinding of observers	Observers were blinded regarding treatment allocation and standardised assessment measures were used to structure the interviews. It was scored negative if only self-reported (questionnaire) outcomes were used and no observer outcomes

Table 1. 01 Scoring criteria using the method of van Tulder 1997 (*Continued*)

Co-interventions avoided or equal	Co-interventions were avoided in the design of the study or were equally divided among the intervention groups
Compliance	Compliance was measured and satisfactory in all study groups
Outcome measures relevant	Outcome measures reflected disability (activity) or participation as relevant to the intervention
Withdrawal rate acceptable	The number of randomised patients minus the number of patients at the main moment of effect measurement divided by all randomised patients and multiplied by 100, was less than 20% for short-term outcomes or less than 30% for long-term outcomes
Short-term outcome measurement	Outcomes were measured at the end of treatment (e.g. admission to discharge) or within 6 months of the end of treatment
Long-term outcome measurement	Outcomes were measured at 1 year or more.
Intention-to-treat analysis	All randomised patients were included in the analysis (minus missing values), irrespective of non-compliance and co-interventions. If loss to follow-up was substantial (20% or more), an intention-to-treat analysis as well as an alternative analysis, which accounts for missing values (e.g. a worst-case analysis), should have been performed
Point estimates and measures of variability	A mean or median figure was given for each important outcome parameter, together with a measures of variability such as standard deviation, standard error of the mean, or 95% confidence intervals

Table 2. Methodological Quality assessed by the van Tulder Method

Study ID	Internal validity	Descriptive criteria	Statistical Criteria	High Quality
Manzur 1992	5	4	2	High quality for descriptive and statistical criteria
Lindeman 1995	8	5	1	High quality for all criteria
van der Kooi 2004	9	6	2	High quality for all criteria
Refshauge 2006	7	4	2	High quality for all criteria
van der Kooi 2007	9	6	2	High quality for all criteria

APPENDICES

Appendix 1. MEDLINE search strategy

1 ((foot adj1 drop$3) or floppy foot or footdrop).mp. (632)
2 exp gait disorders, neurologic/ (1947)
3 (lower adj2 (motor neuron$2 or motorneuron$2 or motoneuron$2)).mp. (1537)
4 (lower or leg or foot or ankle or achilles or tendon or peroneal nerve).mp. (949337)
5 leg/ or foot/ or ankle/ or achilles tendon/ or tendon injuries/ or peroneal nerve/ or ankle injuries/ or foot injuries/ or foot deformities, acquired/ (88574)
6 4 or 5 (949337)
7 contracture$.mp. (16348)
8 Contracture/ (5633)
9 dorsiflex$.mp. (2834)
10 or/7-9 (19074)
11 neuromuscular$ disease$.mp. (9562)
12 exp Neuromuscular Diseases/ (197826)
13 nerve compression syndromes/ (8109)
14 nerve compression syndromes.mp. (8459)
15 exp peripheral nervous system diseases/ (96798)
16 peripheral$ nervous$ system$ disease$.mp. (16791)
17 or/11-16 (198822)
18 rehabilitation$.mp. (83228)
19 activities of daily living.mp. (40560)
20 exercise/ (46247)
21 exercise.mp. (165750)
22 (physical therap$ or physiotherap$ or physical stimulation$).mp. (44423)
23 SURGERY/ or surgery.mp. (584448)
24 ORTHOTIC DEVICES/ (3772)
25 (orthotic$ or orthos$).mp. (15726)
26 (muscle training or strength training).mp. (2418)
27 Splints/ (6507)
28 splint$.mp. (12591)
29 exp REHABILITATION/ (109523)
30 or/18-29 (930578)
31 6 and 10 (5289)
32 1 or 2 or 3 or 31 (9131)
33 17 and 32 (1881)
34 30 and 33 (282)
35 randomized controlled trial.pt. (268387)
36 controlled clinical trial.pt. (78963)
37 randomized.ab. (178675)
38 placebo.ab. (111207)
39 drug therapy.fs. (1300818)
40 randomly.ab. (129674)
41 trial.ab. (185925)
42 groups.ab. (895999)
43 or/35-42 (2373361)
44 (animals not (animals and humans)).sh. (3265712)
45 43 not 44 (2011688)
46 34 and 45 (56)
47 from 46 keep 1-56 (56)

Appendix 2. EMBASE search strategy

1 ((foot adj1 drop$3) or floppy foot or footdrop).tw. or peroneus nerve paralysis/ (1024)

2 exp locomotion/ or gait disorders/ (100211)

3 (lower or leg or foot or ankle or achilles or tendon or peroneal nerve).tw. (764026)

4 leg/ or foot/ or ankle/ or achilles tendon/ or tendon injury/ or peroneus nerve/ or ankle injury/ or foot injury/ or foot malformation/ (34190)

5 (lower adj2 (motor neuron$2 or motorneuron$2 or motoneuron$2)).tw. (1347)

6 contracture$.tw. (10209)

7 Contracture/ (1657)

8 dorsiflex$.tw. (2702)

9 neuromuscular$ disease$.tw. (2527)

10 exp Neuromuscular Diseases/ (67504)

11 nerve compression/ (5926)

12 nerve compression syndrome$1.tw. (151)

13 exp peripheral neuropathy/ (22618)

14 peripheral$ nervous$ system$ disease$.tw. (58)

15 rehabilitation$.tw. (56063)

16 activities of daily living.tw. (8544)

17 exercise/ (76202)

18 exercise.tw. (106666)

19 (physical therap$ or physiotherap$ or physical stimulation$).tw. (17404)

20 SURGERY/ or surgery.tw. (457184)

21 ORTHOTICS/ (944)

22 (orthotic$ or orthos$).tw. (9749)

23 (muscle training or strength training).tw. (2295)

24 Splint/ (1684)

25 splint$.tw. (4331)

26 exp REHABILITATION/ (105927)

27 or/9-14 (94389)

28 or/15-26 (730722)

29 3 or 4 (772431)

30 6 or 7 or 8 (13373)

31 29 and 30 (4132)

32 1 or 2 or 5 or 31 (105704)

33 27 and 32 (5174)

34 28 and 33 (602)

35 Randomized Controlled Trial/ (167923)

36 Clinical Trial/ (537938)

37 Multicenter Study/ (45581)

38 Controlled Study/ (2871815)

39 Crossover Procedure/ (21204)

40 Double Blind Procedure/ (72106)

41 Single Blind Procedure/ (8107)

42 exp RANDOMIZATION/ (26723)

43 Major Clinical Study/ (1282492)

44 PLACEBO/ (125715)

45 Meta Analysis/ (34998)

46 phase 2 clinical trial/ or phase 3 clinical trial/ or phase 4 clinical trial/ (27492)

47 (clin$ adj25 trial$).tw. (147188)

48 ((singl$ or doubl$ or tripl$ or trebl$) adj25 (blind$ or mask$)).tw. (96115)

49 placebo$.tw. (110339)

50 random$.tw. (395507)

51 control$.tw. (1496154)
52 (meta?analys$ or systematic review$).tw. (16639)
53 (cross?over or factorial or sham? or dummy).tw. (75274)
54 ABAB design$.tw. (42)
55 or/35-54 (4584558)
56 human/ (6459907)
57 nonhuman/ (3210836)
58 56 or 57 (9146511)
59 55 not 58 (383717)
60 55 and 56 (2870172)
61 59 or 60 (3253889)
62 34 and 61 (290)
63 from 62 keep 1-290 (290)

Appendix 3. CINAHL search strategy

S50 S18 and S37 and S48 and S50
S49 S22 OR S26
S48 S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45 OR S46 OR S47
S47 physiotherap* or physical therap* or stimulation
S46 muscle training or strength training
S45 rehabilitation or activities of daily living or exercise therapy or splint* or orthos* or orthotic*
S44 (MH "Foot Orthoses")
S43 (MH "Surgery, Operative")
S42 (MH "Splints")
S41 (MH "Therapeutic Exercise")
S40 (MH "Physical Therapy")
S39 (MH "Lower Extremity Exercises") or (MH "Muscle Strengthening")
S38 (MH "Rehabilitation+")
S37 S32 OR S33 OR S34 OR S35 OR S36
S36 peripheral N5 nervous N5 system N5 disease*
S35 neuromuscular N5 disease*
S34 (MH "Peripheral Nervous System Diseases+")
S33 (MH "Nerve Compression Syndromes") or (MH "Tarsal Tunnel Syndrome")
S32 (MH "Neuromuscular Diseases+")
S31 S22 or S30
S30 S26 AND S29
S29 S27 OR S28
S28 Contracture* or Dorsiflexion*
S27 (MH "Contracture") or (MH "Dorsiflexion")
S26 S24 OR S25
S25 (MH "Lower Extremity+") or (MH "Achilles Tendon") or (MH "Ankle Injuries") or (MH "Foot Injuries") or (MH "Foot Deformities") or (MH "Foot Deformities, Acquired")
S24 lower n3 extremit* or lower n3 limb or leg or foot or ankle or achilles or peroneal n5 nerve
S23 (MH "Lower Extremity+")
S22 S19 or S20 or S21
S21 "gait disorder*"
S20 (MH "Locomotion+")
S19 foot drop* or floppy foot or footdrop
S18 S17 or S16 or S15 or S14 or S13 or S12 or S11 or S10 or S9 or S8 or S7 or S6 or S5 or S4 or S3 or S2 or S1
S17 TI random* or AB random*

S16 (TI (cross?over or placebo* or control* or factorial or sham? or dummy)) or (AB (cross?over or placebo* or control* or factorial or sham? or dummy))

S15 (TI (clin* or intervention* or compar* or experiment* or preventive or therapeutic) or AB (clin* or intervention* or compar* or experiment* or preventive or therapeutic)) and (TI (trial*) or AB (trial*))

S14 (TI (meta?analys* or systematic review*)) or (AB (meta?analys* or systematic review*))

S13 (TI (single* or doubl* or tripl* or trebl*) or AB (single* or doubl* or tripl* or trebl*)) and (TI (blind* or mask*) or AB (blind* or mask*))

S12 ABAB design*

S11 PT clinical trial or PT systematic review

S10 (MH "Factorial Design")

S9 (MH "Concurrent Prospective Studies") or (MH "Prospective Studies")

S8 (MH "Meta Analysis")

S7 (MH "Solomon Four-Group Design") or (MH "Static Group Comparison")

S6 (MH "Quasi-Experimental Studies")

S5 (MH "Placebos")

S4 (MH "Double-Blind Studies") or (MH "Triple-Blind Studies")

S3 (MH "Clinical Trials+")

S2 (MH "Crossover Design")

S1 (MH "Random Assignment") or (MH "Random Sample") or (MH "Simple Random Sample") or (MH "Stratified Random Sample") or (MH "Systematic Random Sample")

Appendix 4. AMED search strategy

1 ((foot adj1 drop$3) or floppy foot or footdrop).mp. (70)

2 gait/ or locomotion/ or movement/ (5898)

3 (lower or leg or foot or ankle or achilles or tendon or peroneal nerve).mp. (23674)

4 leg/ or foot/ or ankle/ or achilles tendon/ or tendon injuries/ or peroneal nerve/ or ankle injuries/ or foot injuries/ or foot deformities, acquired/ (7192)

5 (lower adj2 (motor neuron$2 or motorneuron$2 or motoneuron$2)).mp. (38)

6 contracture$.mp. (426)

7 Contracture/ (131)

8 dorsiflex$.mp. (883)

9 neuromuscular$ disease$.mp. (557)

10 exp Neuromuscular Disease/ (2540)

11 nerve compression syndromes/ (208)

12 nerve compression syndromes.mp. (239)

13 exp peripheral nervous system disease/ (2246)

14 peripheral$ nervous$ system$ disease$.mp. (214)

15 rehabilitation$.mp. (36193)

16 activities of daily living.mp. (4314)

17 exercise/ (6690)

18 exercise.mp. (15287)

19 (physical therap$ or physiotherap$ or physical stimulation$).mp. (14513)

20 SURGERY/ or surgery.mp. (7759)

21 ORTHOTIC DEVICES/ (1295)

22 (orthotic$ or orthos$).mp. (1926)

23 (strength training or muscle training$).mp. (687)

24 Splints/ (84)

25 splint$.mp. (469)

26 exp REHABILITATION/ (29375)

27 or/9-14 (4804)

28 or/15-26 (67207)

29 3 or 4 (23674)
30 6 or 7 or 8 (1267)
31 29 and 30 (947)
32 1 or 2 or 5 or 31 (6786)
33 27 and 32 (137)
34 28 and 33 (51)
35 Randomized controlled trials/ (1350)
36 Random allocation/ (288)
37 Double blind method/ (388)
38 Single-Blind Method/ (1)
39 exp Clinical Trials/ (2959)
40 (clin$ adj25 trial$).tw. (4588)
41 ((singl$ or doubl$ or treb$ or trip$) adj25 (blind$ or mask$ or dummy)).tw. (1848)
42 placebos/ (504)
43 placebo$.tw. (2188)
44 random$.tw. (10213)
45 research design/ (1637)
46 Prospective Studies/ (234)
47 (cross over stud$3 or crossover stud$3).mp. (169)
48 meta analysis/ (100)
49 (meta?analys$ or systematic review$).tw. (1162)
50 control$.tw. (22842)
51 (multicenter or multicentre).tw. (598)
52 ((study or studies or design$) adj25 (factorial or prospective or intervention or crossover or cross-over or quasi-experiment$)).tw. (7787)
53 or/35-52 (35345)
54 34 and 53 (18)
55 or/1-5 (27847)
56 (or/9-14) or nervous system disease/ (5913)
57 55 and 56 and 28 and 53 (157)
58 from 57 keep 1-157 (157)

Appendix 5. British Nursing Index

1. ((foot adj1 drop$3) or floppy foot).mp
2. mobility/
3. (lower or leg or foot or ankle or achilles or tendon or peroneal nerve).mp
4. exp foot care/ and disorders/
5. ((lower adj2 motor neuron$2) or motorneuron$2).mp
6. contracture$.mp
7. Contracture/
8. dorsiflex$.mp
9. neuromuscular$ disease$.mp
10. exp Neuromuscular system/ and disorders/
11. nerve compression syndromes/
12. nerve compression syndromes.mp
13. exp peripheral nervous system diseases/
14. peripheral$ nervous$ system$ disease$.mp.
15. rehabilitation$.mp
16. activities of daily living.mp
17. physical fitness/
18. exercise.mp

19. (physical therap$ or physiotherap$ or physical stimulation$).tw.
20. surgery, operative/ or surgery.mp
21. orthopaedic devices/
22. orthotic$.mp
23. orthos$.mp
24. splint$.mp
25. exp REHABILITATION/
26. or/9-14
27. or/15-25
28. 3 or 4
29. 6 or 8
30. 28 and 29
31. 1 or 2 or 5 or 30
32. 26 and 31

WHAT'S NEW

Last assessed as up-to-date: 23 April 2009.

Date	Event	Description
13 May 2009	New citation required but conclusions have not changed	New authors involved in update
8 May 2009	New search has been performed	New studies included. Data amended to increase consistency and aid interpretation of results (signs assigned to mean difference adjusted accordingly so that a positive value always corresponds to favouring the intervention rather than control

HISTORY

Protocol first published: Issue 4, 2002

Review first published: Issue 2, 2007

Date	Event	Description
28 July 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Tom Hoppitt assisted with the quality scoring and data extraction for the original review. Peter Disler wrote the first draft of the original review. Following comments from Derick Wade and Lynne Turner Stokes, Tom Hoppitt and Cath Sackley wrote the next draft. Nicola Brittle and Tom Hoppitt carried out quality analysis and data extraction for the review update. Nicola Brittle and Cath Sackley wrote the review update.

DECLARATIONS OF INTEREST

All authors work in rehabilitation services that ultimately gain income from being referred participants who may have, inter alia, foot drop.

SOURCES OF SUPPORT

Internal sources

- Department of Medicine, University of Melbourne, Australia.
- Melbourne Health, Australia.

External sources

- Department of Health Research Capacity Development Programme, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Charcot-Marie-Tooth Disease [complications; rehabilitation]; Exercise Therapy [methods]; Gait Disorders, Neurologic [etiology; *rehabilitation; surgery]; Muscle Weakness [complications; rehabilitation]; Muscular Dystrophy, Duchenne [complications; rehabilitation]; Myotonic Dystrophy [complications; rehabilitation]; Resistance Training; Treatment Outcome; Walking

MeSH check words

Child; Humans; Male