A systematic review of upper extremity casting for children and adults with central nervous system motor disorders

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CRD summary
This review found that there is insufficient high-quality evidence to evaluate the effectiveness of upper limb casting for children or adults with central nervous system motor disorders. Despite some limitations in the search and in the reporting of the review methods, the authors' conclusions appear reliable.

Authors' objectives
To evaluate the clinical effects of upper limb casting for adults and children with central nervous system (CNS) motor disorders.

Searching
MEDLINE, CINAHL, EMBASE, DARE, PEDro, the Cochrane Database of Systematic Reviews, OTseeker and Google Scholar were searched up to 2006; the search terms were provided. The reference lists of retrieved articles were handsearched and studies known to experts in the field were screened. The search was limited to peer-reviewed studies published in English.

Study selection
Eligible studies involved the administration of a cast to the wrist, hand or elbow following upper motor neurone damage. A cast was defined as a non-removable external device made out of plaster or casting tape and intended to modify structural or functional neuromuscular characteristics. The interventions in the review included casting with regular or intensive neurodevelopmental therapy (NDT) and serial casts. Some casts were bivalved or ultraflex. Several studies included cointerventions such as weight-bearing activities, functional bilateral upper limb exercises, occupational therapy based on NDT and passive exercises. Several studies included post-casting therapy programmes, all involving stretching by long-duration positioning or splinting. The intensity of the programmes varied, from overnight plus daytime splinting to an hour of positioning for stretch daily. Other studies utilised movement training, weight-bearing activities or passive joint exercises. Control interventions comprised NDT without casting, traditional therapy, stretching, casting for shorter periods or no treatment. Joint angle in the included studies (which determines the degree of stretch), varied from 5° to 10° below full range to neutral or end of available range. Where stated, the duration of the intervention varied from 2 hours to up to 6 weeks. Cast-changing frequency and total cast-wearing time also varied greatly both across and within studies, with some casts being worn continuously and others overnight or for limited periods each day. In eligible studies, over half of the participants were required to be clearly described as children or adults with brain injury, cerebral palsy or stroke, receiving wrist, hand or elbow casting. Studies in the review included children (aged from 6 months to 18 years) and adults with conditions such as cerebral palsy, brain injury, stroke and cerebral haemorrhage. Indications for casting included soft tissue contracture, spasticity, reduced active range of joint movement, pathological reflexes, unfeasibility of a splint or orthosis, prevention of contracture and planned motor training in finger extension. There were a wide range of contraindications to casting, including rigid upper limb tone, athetoid/fluctuating tone, unstable medical condition, absent sensation, joint calcification, open wounds/compromised skin condition, younger than 5 years, intellectual impairment, hypertension/raised intracranial pressure, and contracture for over 6 months. Factors that were contraindications in some studies were indications in others (e.g. contracture for more than 6 months). The outcomes measures in eligible studies were measures of functional hand use, range of joint motion (to measure contracture), tone, spasticity, oedema and pain. Only one study used a torque-controlled methodology. The review also reported safety issues and adverse events. Eligible studies were required to generate level IV (case series) evidence or higher, using the Oxford Centre for Evidence-based Medicine (CEBM) Levels of Evidence (Phillips 2008). The level of evidence in primary studies included in the review ranged from level I (randomised controlled trials, RCTs) to level V (expert opinion).

Two reviewers selected the studies independently, with any discrepancies resolved by discussion.
Assessment of study quality
The quality of the RCTs was assessed using the PEDro scale. This includes the following criteria: specification of eligibility criteria; random allocation; concealed allocation; prognostic balance at baseline; blinding of participant, therapist and assessor; intention-to-treat analysis; at least 85% follow-up; between-group statistical comparison; and point estimate of variability for at least one key outcome. A score out of 10 (excluding the first item) was awarded.

Three reviewers independently rated the quality of the included studies.

Data extraction
Descriptive data were reported in a summary table for all studies. In some cases effect estimates were reported: these comprised mean differences for continuous data and odds ratios (ORs) for binary data, with associated 95% confidence intervals (CIs), and/or p-values.

The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.

Methods of synthesis
The studies were combined in a narrative, with focus on the randomised data. The results of all studies were presented in a summary table. Clinical and methodological heterogeneity between the studies was discussed in the text. It was planned to statistically pool RCT data if they were homogeneous.

Results of the review
Nineteen studies were included: 3 RCTs (2 parallel group, n=99 and one crossover, n=50), one non-randomised crossover study (n=15), one observational study with historical controls (n=105), 7 case series (each with 3 to 21 participants or casts, where reported) and 7 case studies (n=7). Differences in study design precluded any statistical pooling of the data.

The quality of the RCTs was high. The crossover RCT scored 9 out of 10 on the PEDro scale, meeting all criteria except for blinding of the participants. The other 2 RCTs scored 8 out of 10: one did not use allocation concealment, one did not blind the therapist, and neither blinded the participant. There was marked heterogeneity in the designs, populations, interventions and outcome measures used in these RCTs. None had control groups with non-stretch conditions. The non-RCTs were of low methodological quality and did not provide evidence from which conclusions on the effects of casting could be drawn. They were therefore not considered in the narrative synthesis of results.

Effectiveness of casting (3 RCTs, n=149).
Two RCTs reported modest short-term benefits associated with casting. One (n=73) reported a non significant benefit in the quality of upper limb movement associated with casting plus NDT, compared with NDT alone, in children with cerebral palsy aged 18 months to 8 years. A second RCT (n=26) comparing elbow casting with 1-hour stretching in adults with brain injury reported a mean reduction in contracture at 1 day that was of borderline statistical significance at -11° (95% CI: -21, 0); however, the effect had almost completely disappeared by 42 days. When casting plus NDT was compared with traditional therapy among children aged 18 months to 4 years (1 RCT, n=50), no difference was found between the groups in quality of movement.

Adverse effects.
One RCT (n=26) reported significantly more adverse events in the intervention group, by physiotherapist report (OR 14.7, 95% CI: 1.5, 147.0). However, there was no difference between groups for this outcome when measured by participant report. The adverse events reported by physiotherapists and/or participants were skin irritation, skin breakdown, pain, swelling and inconvenience.

Other results (from non-randomised studies) were reported in the tables in the review.
Authors' conclusions
There is insufficient evidence to evaluate the effectiveness of upper limb casting for children or adults with central nervous system motor disorders.

CRD commentary
The review objectives and inclusion criteria were clear and relevant sources were searched, although the restriction to peer-reviewed articles published in English means that the review may be subject to language and publication biases. Steps were taken to limit the potential for reviewer error and bias by having more than one reviewer independently make decisions on the study selection and validity assessment processes. However, it is unclear whether this also applied to the data extraction. Relevant criteria were used to assess the quality of the RCTs. The status of non-randomised studies was unclear, but the review appropriately focused on the randomised evidence and the findings of lower quality studies appeared only in the data tables. The decision not to pool the results statistically was well founded given the heterogeneity between the studies. Despite some limitations in the search and in the reporting of the review methods, the authors' conclusions appear reliable in view of the lack of consistent high-quality evidence.

Implications of the review for practice and research
Practice: The authors stated that there is insufficient evidence to support or refute the practice of upper limb casting for people with CNS motor disorders. Pending further research, casting should not be withdrawn as a common practice. There appears to be little consistency or consensus about casting protocols used in clinical practice.

Research: The authors stated that there is an urgent need for studies of the effect of upper limb casting on children and adults with CNS motor disorders. This will require adequately powered RCTs, with consistent cast design, protocol and safety management. Controls should have no cast and no stretch or training likely to increase contractures. Underlying theoretical rationales for casting should be explored.

Funding
Not stated.

Bibliographic details

PubMedID
17984149

DOI
10.1177/0269215507079141

Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Ataxia /etiology /therapy; Casts, Surgical; Central Nervous System Diseases /complications /therapy; Child; Humans; Muscle Contraction /physiology; Muscle Hypertonia /etiology /therapy; Outcome Assessment (Health Care); Upper Extremity /physiopathology

AccessionNumber
12008009264

Date bibliographic record published
09/08/2008

Date abstract record published
01/12/2008
Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.