Do Lycra-based sleeve/glove orthoses improve the bimanual ability of children with spastic hemiplegia: protocol for an exploratory randomised controlled trial.

Aims & Objectives

The long-term aim is to evaluate whether Lycra-based sleeve/glove orthoses improve the bimanual handling ability of children with spastic hemiplegia aged 5-12 years. This will be addressed by a subsequent, appropriately powered, definitive trial. The objectives of the exploratory pilot study are (i) to assess the feasibility and acceptability of a randomised controlled trial design to families and clinicians, (ii) to test the trial processes and procedures including the feasibility and adequacy of blinding outcome assessments, and (iii) to learn more about treatment of the upper limb in hemiplegia in the NHS.

Background

Cerebral palsy (CP) is a disorder of posture and movement and a common cause of childhood physical disability; spastic hemiplegia is a type of CP that affects a third of cases, equivalent to around 1 in 1300 live births. [1] Spastic hemiplegia affects the arm and leg on one side; most children with hemiplegia walk, but many have difficulty with manual tasks involving two hands. There has been considerable interest in testing interventions to improve the bimanual ability of children with hemiplegia. [2-5]

Orthoses are externally applied devices. Orthoses are prescribed to improve upper limb function for children with hemiplegia but evidence of effectiveness is lacking. [6-9] Most conventional orthoses are designed on biomechanical principles (forces and levers) and are fairly rigid. Lycra-based orthoses have emerged more recently. These are thin breathable fabric splints with elastic panels tailored across joints to apply corrective forces and encourage functional postures. The mechanisms by which Lycra-based orthoses are presumed to work are a combination of biomechanical and physiological effects. The biomechanical effect promotes functional postures, while physiologically there is sensory feedback and raised awareness from wearing the orthosis. [10] Advocates suggest that the benefits of Lycra-based orthoses are seen within 6 weeks of use while wearing the orthosis but and are not a life-long prescription; use of the orthosis can be reduced and cease once any improvements in function have stabilised although the length of time is not known. Advocates also propose there being a carry-over effect where functional benefits are maintained when the orthosis is not being worn.

Three systematic reviews identify that case series have shown equivocal results; some children appear to benefit, whereas other children have difficulty putting the orthoses on and tolerating them. [11-13] Major limitations of previous studies are the heterogeneity of the types of CP studied, and variability in the extent of the orthoses over the body. Case series suggest that the intervention might work for some children but are inconclusive. As the treatment effect is not large and not all subjects benefit, the results of small studies can be misleading and hard to generalise into routine clinical practice. Therefore more rigorous designs are required to evaluate effectiveness. Randomised controlled trials are recommended by all the authors of the reviews of this treatment. [11-13]

Variation in the orthotic management of children with cerebral palsy is recognised; with prescription typically based on personal preferences in the absence of good evidence. [14] Lycra-based orthoses are being provided in some areas of the UK but not others. In order to promote equitable health care the effectiveness of such orthoses should be

assessed. The equipoise, inconsistency of provision, and keen interest in the devices from families and clinicians make this an ideal treatment for evaluation.

The Peninsula Cerebra Research Unit (PenCRU) at the Peninsula Medical School, University of Exeter, has a strong ethos of involving disabled children and their families as partners in all aspects of the unit's work (www.pencru.org). This proposal has developed from questions raised by clinicians and parents asking whether Lycra-based orthoses are an effective treatment. Having reviewed the evidence we are clear that there is urgent need for a randomised controlled trial. The design for the pilot study has been developed by a team including parents, multidisciplinary clinicians, and health services researchers. We engaged a company who produce Lycra-based orthoses to verify that they believe the proposed trial design to be a fair test of their product.

A pilot of a pragmatic clinical trial will establish the feasibility and acceptability of conducting a definitive trial that can answer the question of whether Lycra-based orthoses improve bimanual functioning. The trial will also evaluate the feasibility of running pragmatic trials of orthoses in the NHS.

Methods

DESIGN: The study is a pilot study of a parallel randomised controlled trial using a wait-list design. The design will enable all children to receive, in time, access to the orthosis under evaluation, and hence be attractive to potential participants. Eligible children will be randomly allocated, using concealed allocation, to either 'orthosis' or 'no orthosis' for 6 weeks. After 6 weeks, children allocated to 'no orthosis' will receive an orthosis and all study participants will be followed up for a further 6 weeks. The proposed design enables between-group comparisons of (i) orthosis versus usual care after 6 weeks, and (ii) short term use (6 weeks) versus longer term (12 weeks).

ELIGIBILITY: Children with cerebral palsy spastic hemiplegia aged 5-12 years with limitations in manual ability, and who have not previously used a Lycra-based upper limb orthosis, will be eligible for the trial. Ability to handle objects will be graded before entry into the trial using the Manual Ability Classification System (MACS) for children with cerebral palsy. [10] Classifications made by parents using the MACS have been shown to be reliable when compared to clinicians. [11] Children must have passive and active range of muscle and joint motion within typical functional positions for the upper limb. Specifically, the ability to fully extend fingers and extend and abduct thumb with the wrist in a neutral position; forearm supination to the mid-prone position; not more than 30 degrees of flexion contracture at the elbow. Children must be cognitively able to understand and follow instructions and intellectually competent to participate in the assessments.

EXCLUSION CRITERIA: 1) Severe muscle spasticity (Modified Ashworth Scale level 3 or above) and/or unable to achieve functional range of passive muscle and joint motion (see above). 2) Predominant dyskinetic, rather than spastic, impairment. 3) Orthopaedic surgery, serial casting or Botulinum A Toxin injections in the upper limb within preceding 6 months. 4) Previously used a Lycra-based upper limb orthosis.

RECRUITMENT: The study will be advertised to clinicians treating children in Devon and Oxfordshire, and also via networks such as the British Academy of Childhood Disability

and special interest groups, and the charities HemiHelp, Cerebra, SCOPE, and the Cerebra Research Unit website. Children and their families will volunteer to take part in the study by contacting the research team. The research fellow will telephone the family and use a screening questionnaire to ensure eligibility criteria are met and document contact details of the child's physiotherapist or occupational therapist. The researcher will contact the therapist nominated by the family to check eligibility and record brief medical history.

CONSENT: The administrator will arrange for a therapist to visit and meet with the child and parent to confirm eligibility and ensure that they understand the study before seeking, and documenting, the child's and parent's consent. A baseline clinical assessment will then be recorded.

TREATEMENT ALLOCATION: Assignment for each child will be given via a password-protected web-based trial portal developed and supported by the Peninsula Clinical Trials Unit (PenCTU). The portal provides access to a computer generated random allocation sequence. Allocation is concealed until the child is registered and cannot be changed. After simple randomisation of the first 10 children, minimisation will be used to balance key covariants (i.e. MACS level and age) between assigned groups. Allocation to usual care will involve a 6 week delay before referral to the orthotist, and the orthosis will be provided but requested not to be used before first assessments are completed.

ORTHOSIS SPECIFICATION: The orthosis extends from axilla/sub-deltoid level to 10mm distal to the metacarpal-phalangeal joints. The sleeve is tailored to include 20 degrees of wrist extension and to abduct the thumb. Three additional panels, made from a nylon and Lycra Powernet, exert an externally rotating force along the full length of the sleeve, an extension moment at the wrist, and external rotation of the thumb. A zip extends from the wrist proximally two-thirds of the length to aid donning and doffing. A silicon band at the proximal upper arm level helps with fixation and restricts migration of the orthosis during use. Children are able to choose from five colours for the material and eight stitching options, which engages children in the designing their own orthosis.

COMPARATOR: There is no standardised alternative treatment for the upper limb in hemiplegia. The idea of a 'placebo orthosis' is unfeasible as it would not be credible. In considering an appropriate comparator we considered a sham sleeve; however it would be self-evident to families that this would not constitute active treatment. We considered another orthosis, but this would change the research question to which orthosis is better, when in many cases none is currently provided. Hence we think usual care is appropriate. To counter potential 'placebo effect' from the orthosis, usual care will be supplemented with encouragement to carry out age-appropriate therapeutic exercises for 10 -20 minutes a day. During the control period the child will be encouraged to practice two-handed activities of daily living activities of daily living such as using cutlery, doing up buttons as well as play activities including ball skills.

BLINDING: The assessors rating the child's functioning from video recordings using the primary outcome measure will be blinded. Every assessment (with or without orthosis) will be conducted with the child wearing a thin loose cotton sleeve that covers an orthosis when one is being worn. We will check the robustness of this blinding process in the pilot study by asking the assessors to guess whether each child they assess is in the intervention or control group. Blinding the child, family and therapist to treatment

allocation is not possible due to the physical nature of the intervention. Blinded assessment of outcome is a pragmatic solution in such circumstances. [12]

ACTIVE TREATMENT: At the appropriate time, children will be referred to their local orthotic department in order for their orthosis to be measured. The orthosis will be fabricated and supplied after two weeks. At the time of fitting, children and carers will be provided with instructions for use and practice putting on the orthosis. Manufacturer's guidance recommends the orthosis be used for one hour on day 1, two hours on day 2, four hours on day 3, eight hours on day 4, and from morning to night thereafter. The manufacturer suggests that the longer the orthosis is worn the better the improvement that can be expected and modified their recommended usage time up from the previous 6-8 hours per day to from morning until night. The recommended regimen is to encourage use of the limb and to maintain a stretching programme.

CLINICAL MANAGEMENT: Children in both arms of the trial will receive their regular therapy and appropriate ‘usual care’. What exactly ‘usual care’ constitutes has not been easy to deduce. This will be monitored and recorded for each child throughout enrolment in the study.

OUTCOMES: Outcomes will be assessed prior to randomisation (T0), after 6 (T1) and 12 weeks (T2) by a trained researcher who is not child’s regular therapist, and using family-completed questionnaires. Process outcomes will be assessed after T2, i.e. when the clinical study is completed. The assessments will be completed at a clinical location and time selected by the family as most convenient to them. Parents helping design the study thought this was a better arrangement than undertaking the assessments in the family’s home. Standardised assessments will be video-recorded. Scoring of assessments will be carried out, remotely and independently at a later date, by two therapists who did not carry out the assessment in person. Thus scoring can be audited and checked for reliability. All the standardised outcome measures have been shown to be valid and reliable for children aged 5-12 years. The assessments at T0 will all be done without an orthosis, at T1 the group who have used the orthosis will be assessed wearing their orthosis and the control group will be without any orthosis, and at T2 all participants will wear their orthosis. The current range of assessments should be able to be completed in 60 minutes, and this will be determined as part of the pilot study.

PRIMARY OUTCOME: The Assisting Hand Assessment (AHA) is a valid, reliable and responsive measure of the effectiveness with which a child with hemiplegia makes use of their impaired hand in bimanual activities. [13] The AHA involves a therapist taking the child through 22 tasks with various objects that require using both hands and takes approximately 15 minutes. The assessments will be conducted with the child wearing a loose cotton sleeve to mask whether an orthosis is being worn or not to blind the assessors rating the test on video. We considered conducting assessments with and without the orthosis to assess any carry-over effect. Currently we believe this would make each assessment too long, be tiring for the child and difficult to maintain their attention. This decision will be reviewed as part of the pilot study.

SECONDARY OUTCOMES: Standardised family-reported outcome measures will include a new valid and reliable condition and site-specific measure of upper limb functioning in cerebral palsy, the Children's Hand-use Experience Questionnaire. A customised family questionnaire will be designed to ask about the usability of the orthosis; e.g. ease of use, side effects or complications, durability of the garments such

any problems with zips, tearing of material or seams. A family diary will be provided to record the families' experience of using the orthosis and any reasons why the orthosis is not used.

ECONOMIC EVALUATION: The future definitive trial will include an economic evaluation, the aim of which will be to estimate the incremental cost-effectiveness of the orthosis compared to usual care from an NHS perspective. Cost-effectiveness analyses will follow good practice for conduct of economic evaluation in health technology assessment, [14,15] and involve calculation of incremental cost-effectiveness ratios (ICER). The pilot study will assess the feasibility and acceptability of collecting self-reported NHS resource use (self-report and/or routine/electronic records), and during the study we will develop and test methods for estimating the resource use and costs associated with delivery of the intervention (e.g. via case report forms, and/or interviews with intervention providers).

TRIAL PROCESS OUTCOMES: As this is an pilot trial specifically designed to assess the acceptability and feasibility of the study processes, key outcomes are the time taken to recruit subjects, number of children retained to final assessment. We will monitor the number of eligible children, if any, who are provided an orthosis outside the trial. After the pilot is completed, we will survey clinicians and the families who took part, for their experience of taking part in the trial, and their views on the orthoses and usual care.

DATA MANAGEMENT: Quantitative data will be entered in a custom-built database designed by PenCTU. Data will be entered twice and audited for accuracy; inconsistencies will be corrected with reference to the original data collection forms until agreement between the two entries is perfect. Qualitative data will be transcribed.

ANALYSIS: The analyses will use both quantitative and qualitative data to address the stated study objectives. Key quantitative data to be assessed includes the number of children recruited & retained from initial contact to follow up, any reasons for dropping out, time required to complete the assessments, completeness and utility of outcome data reported by therapists and family-completed questionnaires, and identification of routine care & NHS resource-use during the trial. Mean and standard deviation (or non-parametric equivalent) of the quantitative outcome measures will be calculated for each group and at each follow up to inform future sample size calculations. Qualitative data will be analysed using the Framework method to describe families' & clinicians' experience of the trial processes; and comparing the two sites.

SAMPLE SIZE: The sample size was pragmatically determined to meet the pilot objectives of the study; the minimum requirement is 20 children.

Reference List

1. Surveillance of Cerebral Palsy in Europe. (2000) Surveillance of cerebral palsy in Europe (SCPE): a collaboration of cerebral palsy surveys and registers. Developmental Medicine and Child Neurology 42: 816-24.

2. Eliasson AC, Krumlinde-sundholm L, Shaw K, Wang C. Effects of constraint-induced movement therapy in young children with hemiplegic cerebral palsy: an adapted model. Dev Med Child Neurol. 2005;47(4):266-75.

3. Naylor CE, Bower E. Modified constraint-induced movement therapy for young children with hemiplegic cerebral palsy: a pilot study. Dev Med Child Neurol. 2005 Jun;47(6):365-9.

4. Charles JR, Wolf SL, Schneider JA, Gordon AM. Efficacy of a child-friendly form of constraint-induced movement therapy in hemiplegic cerebral palsy: a randomized control trial. Dev Med Child Neurol. 2006; 48(8):635-42.

5. Gordon AM, Schneider JA, Chinnan A, Charles JR. (2007) Efficacy of a hand-arm bimanual intensive therapy (HABIT) in children with hemiplegic cerebral palsy: a randomized control trial. Dev Med Child Neurol. 49(11):830-8.

6. Sakzewski L, Ziviani J, Boyd R. Systematic review and meta-analysis of therapeutic management of upper-limb dysfunction in children with congenital hemiplegia.

8. Russo RN, Atkins R, Haan E, Crotty M. (2009) Upper limb orthoses and assistive technology utilization in children with hemiplegic cerebral palsy recruited from a population register. Dev Neurorehabil.12(2):92-9.

9. Morris, C, Condie, D. (Eds) (2009) Recent Developments in Healthcare for Cerebral Palsy: Implications and Opportunities for Orthotics. International Society for Prosthetics and Orthotics: Copenhagen. Available free at www.ispoint.org

10. Attard J, Rithalia S. (2004) A review of the use of lycra pressure orthoses for children with cerebral palsy. Int J Ther Rehabil. 11:120-6.

11. NHS Quality Improvement Scotland Evidence Note #11. Dynamic lycra splinting for children with cerebral palsy. NHS Quality Improvement Scotland, 2005. www.nhshealthquality.org/nhsqis/files/EN11%20Final.pdf

12. Blackmore M Garbellini SA Buttigieg PJ Wells J. (2006) A systematic review of the effects of soft splinting on upper limb function in people with cerebral palsy: An AACPDM Evidence Report. http://new.aacpdm.org/membership/outcome/resources/Softsplintingreview.pdf

13. National Horizon Scanning Centre. Lycra garments for cerebral palsy and movement disorders. Birmingham: National Horizon Scanning Centre. 2002.

14. Morris C, Newdick H, Johnson A. Variations in the orthotic management of cerebral palsy. Child Care Health Dev. 2002;28:139-47.

15. Eliasson A-C, Krumlinde-Sundholm L, Rösblad B, et al. The Manual Ability Classification System (MACS) for children with cerebral palsy: scale development and evidence of validity and reliability. Dev Med Child Neurol 2006; 48: 549–54.

16. Morris, C, Kurinczuk JJ, Fitzpatrick R. Rosenbaum P. (2006) Reliability of the Manual Ability Classification System. Developmental Medicine and Child Neurology 48(12):950-953.

17. Pocock, S. (1983). Clinical Trials: A Practical Approach. Wiley-Blackwell.

18. Krumlinde-Sundholm L, Holmefur M, Kottorp A, Eliasson A C (2007) The Assisting Hand Assessment: Current evidence of validity, reliability and responsiveness to change. Developmental Medicine and Child Neurology 49: 259-264

19. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. Third edition: Oxford: Oxford University Press; 2005.

20. Philips Z, Ginnelly L, Sculpher M, Claxton K, Golder S, Riemsma R, Woolacoot N, Glanville J. (2004) Review of guidelines for good practice in decision-analytic modelling in health technology assessment. Health Technol Assess 1-158.

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FLOW CHART DETAILING STUDY PROCESS