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Proceedings of SRR

The Society of Research in Rehabilitation (SRR) is the major multidisciplinary rehabilitation research society in the UK (<http://www.srr.org.uk>). Its aim is to advance education and research into all aspects of rehabilitation medicine and to disseminate the useful results of such research for the public benefit. The SRR runs two conferences a year, with topic-specific research symposia, free scientific presentations and 'research in progress' posters. The Society aims to be inspiring and educational, while providing excellent opportunities for networking for both junior and established researchers.

These are abstracts from the SRR Summer Meeting, hosted by the University of Bath, 1st and 2nd July 2009.

An investigation of the immediate effects of mirror feedback on standing postural control in normal healthy adults

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Background: A large component of rehabilitative physiotherapy involves training of movement/postural control. This is achieved partly by provision of augmented/extrinsic feedback. One means of providing this is by enabling people to view their reflected mirror image during training. Despite its historic precedence, this traditional strategy has received limited formal evaluation. This study investigated the immediate effects of mirror feedback on standing postural control in normal healthy young subjects.

Method: A convenience sample of 20 healthy undergraduate students (male=female, modal age 20 years) had standing postural control assessed in two controlled conditions: with/without full-body reflected mirror image. Subjects were tested three times per condition, testing sequence being varied between subjects using a Latin square procedure to control for order effect. Stability was assessed using a Balance Performance Monitor, measuring sway path (mm). Subjects performed single-leg stance during testing to ensure challenged postural control.

Results/findings: Stability was greater with mirror feedback than without: 178.7 mm (SD 41.1 mm) versus 229.0 mm (SD 38.2 mm). This difference was statistically significant (related *t*-test, $t=7.350$, $P<0.001$, 95% CI 36.0–64.7 mm). Post-hoc analysis indicated a gender influence, suggesting improved postural control, men > women, with mirror feedback, although this was not statistically significant.

Discussion: Results suggest that mirror feedback can have an immediate positive effect on postural control, albeit in normal healthy individuals. The extent to which this effect occurs in motor-impaired clients, or has a carryover effect, awaits investigation. The notion that there may also be a preferential gender effect has potential implications for clinical use, pending further study.

Improved sensory discrimination in healthy volunteers following electrosensory discrimination training

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Background: When subjects with post-amputation phantom limb pain are trained to attend to

patterns of electrical stimulation applied to the stump, there is a reduction in pain, associated with reorganization within the somatosensory cortex. We have examined whether sensory retraining can improve sensory discrimination and tactile acuity in healthy volunteers.

Method: Electrical stimulation training was applied to the forearm using four pairs of electrodes over 40 minutes. Subjects were asked to identify which pairs or combinations of electrodes were stimulated. There were five levels of difficulty. Blocks of 10 pairs of stimuli were given, with feedback being provided by the operator. Thirteen subjects (6M/7F) aged 8–60 years, received active training over four sessions; 10 control subjects (6M/4F) aged 23–60 years, received sham training. Subjects were tested on days 1, 3, 8 and 10. Two-point sensory discrimination and threshold to mechanical stimulation to von Frey hairs was assessed.

Results/Findings: No differences in two-point sensory discrimination or von Frey between the groups at baseline were found. After training, two-point sensory discrimination improved in the active group (40.7–35.5 mm), but not in the controls. There were no changes in von Frey. There was an association between task performance and improvement in two-point sensory discrimination (Kendall $r = 0.49$; $P = 0.035$).

Discussion/Conclusion: Four 40-minute sessions of electrical stimulation training can improve two-point sensory discrimination. There were no corresponding changes in perception threshold. Further work is needed to establish optimum training period and interval. The technique may be beneficial for rehabilitation of patients with complex pain syndrome or other sensory defects.

Work problems due to low back pain: what do GPs do? A questionnaire survey

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Background: Low back pain can affect work ability and remains a main cause of sickness absence. The UK government intends that the GP will

continue to be responsible for sickness certification and work advice. The aim of this study was to identify GPs' current practice in managing patients whose work ability is affected by low back pain, and their perception of the support services required.

Method: A postal questionnaire of the 441 GPs in the South Nottinghamshire area of the UK was carried out. Areas covered included referral patterns, sickness certification, and communication with therapists and employers.

Results: There was a 54.6% response rate. The majority of GPs (76.8%) 'mainly agreed' that they did not take responsibility for managing the work problems of patients with low back pain. Few initiated communication with employers (2.5%) or therapists (10.4%) regarding their patients' work. Most 'mainly agreed' that current rehabilitation services needed to be more effective (85.1%).

Discussion: The results of this study demonstrate that most GPs do not readily engage in vocational rehabilitation. They frequently refer patients for rehabilitation, but rarely initiate contact with employers or other healthcare practitioners with regard to employment matters.

Conclusion: The government expectation that GPs are able to successfully manage the responsibilities of sickness certification and provision of work advice to patients with low back pain may be unrealistic. Considerable training and a change in the GPs' perception of their role will be required. Extending the role of other professionals to assess and manage work problems may be more appropriate.

Prevalence and impact of musculoskeletal symptoms in people with stroke living in the community

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Background: Stroke and musculoskeletal disorders are both common causes of morbidity and while both conditions have been extensively investigated, little information is available about the

combined impact of musculoskeletal problems in people with stroke.

Method: Secondary analysis was undertaken on data collected from a large postal survey involving 16 222 community-living individuals aged >55 years. Stroke was identified in 415 individuals. Logistic regression examined the impact of various impairments upon activity limitation.

Results/Findings: It was found that 49.7% of individuals with stroke reported joint pains, stiffness or swelling lasting >6 weeks (a prevalence of 29.98 per 1000). There was an increased reporting of pain in the smaller peripheral joints in individuals with stroke compared with the general population. For example, 21.2% of individuals with stroke reported pain in the ankle joint compared with 11.3% of the general population. Both stroke-specific impairments and joint pain contributed to the difficulty in undertaking tasks. For example, foot pain increased the odds of reporting having difficulty with standing and walking by over 16 and stroke affecting either of the lower limbs increased the odds by 3. Similarly, pain in the left thumb independently increased the odds of reporting problems with gripping and holding by 3.6, whereas stroke affecting the upper limbs increased the odds by 4.

Discussion/Conclusion: This study suggests that musculoskeletal problems are far more widespread in people with stroke than previously anticipated, and that the combination of both conditions acting upon activities is often more than additive.

The use of 'plateau' to inform physiotherapy discharge decisions following stroke

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Background: Although research suggests recovery plateaus about six months after stroke, authors have challenged the assumption that plateau indicates the end of recovery. 'Plateau' is known to inform physiotherapists' decisions about when treatment should end. However, how their beliefs

about plateau inform discharge processes is unknown.

Method: A two-stage qualitative approach was taken. First, five focus groups with physiotherapists ($n=39$) working in stroke explored how discharge decisions were reached and enacted. Second, eight case studies with patient-therapist dyads were undertaken. Data were collected longitudinally during treatment observations and post-discharge interviews with physiotherapists and patients. All data were audio-recorded; recordings and field notes were converted into integrated transcripts. Charmaz's Grounded Theory analysis was employed, including use of memos and negative case analysis.

Results/Findings: Treatment observations and interviews confirmed that physiotherapists used 'plateau' to identify the end-point for treatment. In practice 'plateau' was presented to patients as an objective reality, demonstrable by scores on outcome measures despite the methodological weaknesses in how measures were employed. By contrast, focus group data highlighted the ambiguity of 'plateau'. Physiotherapists were uncertain about when and if plateau occurred, identified psycho-social and resource factors which impacted on improvement rates and questioned that 'plateau' indicated the end of recovery potential.

Discussion: Physiotherapists' dilemmas about plateau identified in the focus groups and their use of plateau in practice are paradoxical.

Conclusion: It appears that despite physiotherapists' concerns about the legitimacy of 'plateau', it provides them with a useful strategy to manage the tensions of discharge.

Scaling properties of the London Handicap Scale in stroke

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Background: Assessment of handicap (participation restriction) is an important part of assessing

the burden of post-stroke related dependency. The London Handicap Scale is a widely used measure of handicap based on the International Classification of Impairments, Disabilities, and Handicaps (ICIDH) model. It was originally developed by conjoint analysis with a weighted score, said to be interval. Recently the unweighted simple summation scores have been proposed as equivalent, which would imply that the original weighted score was ordinal, not interval scaled. This study sought to validate the London Handicap Scale for stroke and to test its scaling properties.

Method: One hundred and eighty-eight community-dwelling post-stroke patients (mean age 63 ± 12 , 54% male) were assessed by the London Handicap Scale. The data were fitted to the Rasch measurement model which, given appropriate fit, transforms ordinal scores into interval scale measurement.

Results/Findings: After adjustment for local dependency, the data showed good fit to Rasch model expectations with a mean item fit 0.265 (SD 0.947), person fit -0.523 (SD 0.931) and chi-square interaction 2.203 (df 4, $P=0.698$). The London Handicap Scale was found to be a strictly unidimensional scale of handicap. The scatterplot of weighted scores versus Rasch transformed scores shows the former to be ordinal. Likewise the scatterplot of raw unweighted scores versus Rasch transformed scores reveals the former to be ordinal.

Discussion: Both raw unweighted and weighted scores of London Handicap Scale are ordinal, but a linear transformation is possible through Rasch analysis.

Conclusion: The London Handicap Scale is a valid strictly unidimensional scale of participation for use in stroke.

Factorial structure of the World Health Organization Disability Assessment Schedule (WHODAS-11) in stroke

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Background: The World Health Organization Disability Assessment Schedule (WHODAS-II) is a generic questionnaire for measuring disability in terms of activities and participation. The scale, based on the International Classification of Functioning, Disability and Health framework, includes six domains: understanding/communicating, getting around, self-care, getting along with people, life activities, and participation in society. Currently there is little evidence of its validity in stroke. This study sought to validate the factorial structure of the scale in a group of stroke patients.

Method: One hundred and eighty-eight post-stroke patients (mean age 63 ± 12 , 54% male) were assessed by the WHODAS-II. A mix of confirmatory factor analysis and exploratory factor analysis approaches were used.

Results/Findings: In the confirmatory factor analysis, four domains included items that highly loaded on the domain. However, one item in 'getting along with people' and six items in 'participation in society' failed to adequately load. The RMSEA was 0.164, suggesting that the existing structure of the scale was not confirmed. Consequently, an exploratory factor analysis was used to explore the dimensions of the scale. This revealed two dimensions, the first 'interacting with people' included items from 'understanding/communicating' and 'getting along with people', and the second dimension 'activities' included the remaining items. Some of the items in the latter dimension cross-loaded on the former. The root mean square error of approximation was acceptable at 0.09.

Discussion: The factorial structure of the WHODAS-II in stroke is not currently supported.

Conclusion: The data from this study suggest that two dimensions, named as 'interacting with people' and 'activities', can be obtained, but replication of these findings is required in other stroke populations.

How to measure balance in clinical practice? A systematic review of the psychometrics and clinical utility of measures of balance activity for neurological conditions

LA Connell University of Nottingham, **SF Tyson** University of Salford, on behalf of the GMOM steering group

Background: Using objective measures is part of evidence-based practice, to the extent that it is included in clinical guidelines and core standards of practice. There is currently no recognized 'gold standard' measure for balance activity in patients with neurological conditions.

Objective: To identify psychometrically robust and clinically feasible measurement tools of balance activity in people with neurological conditions to recommend for use in clinical practice.

Data sources: MEDLINE, CINAHL, EMBASE, PEDro and AMED.

Review methods: Independent reviewers selected and extracted data from articles that assessed the reliability, validity, sensitivity to change and clinical utility of measures of balance activity in adult neurological conditions. Quality assessment was based on Jorstad *et al.* Measures with 'good' psychometrics and $\geq 9/10$ clinical utility scores were recommended.

Results/Findings: Nineteen measurement tools were selected. Of these, the Brunel Balance Assessment, Berg Balance Scale, Trunk Impairment Scale, Arm Raise and Forward Reach tests in sitting and standing, Weight Shift, Step/Tap and Step-Up tests reached the required standards and are useable in clinical practice. The Brunel Balance Assessment and its associated functional performance tests have the additional advantages of being a hierarchical scale with established lack of redundancy.

Discussion/Conclusion: The Brunel Balance Assessment is recommended to measure balance activity in clinical practice. Future outcome

measure development should consider the theoretical construct of the measure, the minimal detectable change and use in clinical populations other than stroke.

Which are the best measures of walking and mobility in neurological populations? A systemic review of the psychometric properties and clinical utility

LA Connell University of Nottingham, **SF Tyson** University of Salford, on behalf of the GMOM steering group

Objective: To identify psychometrically robust and clinically feasible outcome measures (OMs) of walking and mobility in people with neurological conditions.

Data sources: MEDLINE, CINAHL, EMBASE, PEDro and AMED.

Review methods: Independent reviewers selected and extracted data from articles that assessed the reliability, validity, sensitivity to change or clinical utility of measures of walking and mobility in adult neurological conditions. Quality assessment was based on Jorstad *et al.* Measures with 'good' psychometrics and 9/10 clinical utility scores were recommended.

Results: Seventeen outcome measures were selected. Of these, the 5-m and 10-m walk tests, 6-minute walk test, High Level Mobility Assessment Tool and the Rivermead Mobility Index reached the required standards and are useable in clinical practice. None of the recommended measures assessed wheelchair mobility. The least frequently assessed property was sensitivity to change. Further outcome measures could be recommended if the minimal detectable change were demonstrated.

Discussion/Conclusion: The 5-m, 10-m and 6-minute walk test, High Level Mobility Assessment Tool and the Rivermead Mobility Index are psychometrically robust and feasible for use in clinical practice.

An exploratory study of patients' perceptions towards an exercise-based rehabilitation programme following traumatic brain injury

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Background: Exercise has many health benefits identifiable in neurological rehabilitation settings, where exercise groups are increasingly used. It is unknown what the patients' perceived benefits are, or the impact upon future exercise intentions. This research aimed to explore, traumatic brain injury patients' experiences of group exercise rehabilitation.

Method: Semi-structured interviews and observations of group participation were undertaken. Six participants were interviewed and observed at varying points in their rehabilitation pathway.

Results: Interpretative phenomenological analysis identified four themes of exercise group rehabilitation: (1) social benefits, (2) effects on the mind and body, (3) exercise participation and significant others, (4) previous exercise activity and future plans.

Discussion: Head injury patients face unique challenges resulting from often complex injuries, which may result in varying perspectives. The study revealed common perceptions of group exercise as beneficial with perceived improvements in physical ability, psychological mood and increased social interactions. There were indications that exercising prior to injury resulted in greater perceived benefits of the group. These patients may become more independent in exercising post rehabilitation. Future research utilizing objective measures of programme benefits (e.g. the Hospital Anxiety and Depression Scale), and long-term exercise continuation should be considered. Implications for practice include additionally supporting and motivating individuals with no history of exercising and when initiating group rehabilitation programmes, it may be unclear whether patients derive any enjoyment. However, this study suggests patients perceive more benefits

and gain greater enjoyment from group exercise than is obvious.

The Brain Injury Community Rehabilitation Outcome (BICRO) scale: working towards a well-established measure of community rehabilitation

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Background: Valid outcome measures are essential for understanding rehabilitation efficacy following traumatic brain injury. This study investigated the Brain Injury Community Rehabilitation Outcome (BICRO) scales (a measure of activity and participation) construct validity, internal reliability and sensitivity to change in a traumatic brain injury cohort.

Method: BICRO and Hospital Anxiety and Depression Scale (HADS) scores were obtained at \leq four weeks and three months post injury from a traumatic brain injury sample ($n=78$, median age 33, (range 16–68) years) participating in a vocational outcome study and BICRO scores from healthy controls ($n=50$, median 27 (16–60) years). Cronbach's alpha was used to determine internal reliability, Spearman's rho and Mann-Whitney U for construct validity and Wilcoxon to measure sensitivity to change.

Results: Internal reliability was high for personal care ($\alpha=0.85$), mobility ($\alpha=0.83$), self organization ($\alpha=0.89$) and psychological well-being ($\alpha=0.75$) but unacceptable for socializing ($\alpha=0.54$) and productive employment ($\alpha=0.22$) subscales. Traumatic brain injury scores differed significantly from controls ($U=1117$, $P\leq 0.001$). The psychological well-being scale correlated significantly with HADS anxiety ($r_s(78)=0.755$, $P=0.001$) and depression ($r_s(78)=0.620$, $P=0.001$) scores. Mobility ($P=0.001$), self organization ($P=0.004$) and productive employment ($P=0.011$) subscales showed significant change. Significant changes were not found on personal care ($P=0.262$), socializing ($P=0.844$) or psychological well-being ($P=0.202$) subscales.

Discussion: The BICRO had good construct validity and was sensitive to change for some subscales. The productive employment, socializing and personal care subscales should be interpreted with caution.

Conclusion: The BICRO provides a partially reliable and valid measure for traumatic brain injury patients. Future work should address improving the BICRO as a measure of community participation after traumatic brain injury.

Feasibility of using a dual rehabilitation robotic system (iPAM) to improve quality of voluntary upper limb movement in people with stroke: a pilot evaluation of upper limb reaching kinematics

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Background: The iPAM robotic system enables stroke patients to undertake voluntary arm exercises, prescribed by the physiotherapist. We investigated the feasibility of delivering iPAM exercises in a broad range of people with stroke, and measured its effect on voluntary arm movement.

Method: Fifteen people with moderate to severe stroke were recruited (age, median 62 years (41–81); time post stroke, median 3 years (0.4–12); M:F, 3:1; right hemiparesis, 9; Fugl-Meyer median 12 (interquartile range 9–16). A physiotherapist prescribed individualized robot-assisted exercises for each patient. Participants were offered 20 iPAM-assisted exercise sessions in a laboratory setting over 5–7 weeks. Pre- and post-programme kinematic measurement of voluntary reaching movements for each participant were measured in a standardized task (Optotrack Certus). Movement distance, time (MD, MT) and jerk were analysed using Wilcoxon signed-rank test.

Results/Findings: Between 406 and 718 arm exercises were completed per participant. No clinical

adverse events occurred in the total of 7579 exercises. Seventy-nine rectifiable technical issues arose; none were hazardous to patients. Pre-MD (median 155 mm); post-MD (median 252 mm); $n=15$, $z=-2.67$, $P<0.05$, $r=0.48$. Pre-MT (median 2.0 seconds); post-MT (median 1.6 seconds); $n=10$, $z=-1.89$, $P=0.06$, $r=-0.42$. Pre-jerk (median 977 units); post-jerk (median 749 units); $n=10$, $z=-1.17$, $P=0.24$, $r=-0.26$. No significant change in Fugl-Meyer.

Discussion: This pilot study demonstrates that iPAM can safely deliver physiotherapist-prescribed exercises at reasonable intensity. Changes in MT and Jerk did not reach statistical significance. Range of voluntary movement improved but requires further confirmation. Lack of control limits conclusions.

Conclusion: Further refinement of device and appropriately powered (see r -values) controlled clinical trials are planned to investigate impact on functional outcome and quality of voluntary arm movement.

Home upper limb exercise system (HB-RES) for children with cerebral palsy: A pilot evaluation

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Background: Cerebral palsy is the commonest cause of severe physical disability in childhood. Difficulties with arm movement are common. We have developed a computer home-based rehabilitation exercise system (HB-RES) using a force-feedback joystick computer game. HB-RES enables children with arm paresis to participate in independent home exercise. The software generates engaging exercise environment, controls assistive forces and logs usage data. We investigate the feasibility and impact of using HB-RES in the home setting.

Method: Eighteen children with cerebral palsy (median age 7.5 years (range 5–16)) were recruited

and a HB-RES installed in their home for a period of approximately four weeks. Baseline and post-intervention assessments used were Canadian Occupational Performance Measure (COPM); kinematic measurement of arm movement time (MT) and smoothness (NARJ) measured using a motion tracking system and standardized computer tasks. Analysis used the Wilcoxon signed-rank test.

Results/Findings: HB-RES was used for a median time of 75 minutes (interquartile range 17–271) equating to 606 reach and 734 retrieve exercises. One child did not attend follow-up visits. Two children used HB-RES for less than 30 minutes. Pre-COPM (median 4.2); post-COPM (median 6.0); observed = 34; $z = 3.62$, $P < 0.05$, $r = 0.62$). Reach/retrieve movement components were combined for MT/NARJ analysis. Pre-MT (median 3.1 seconds); post-MT (median 2.1 seconds); observed = 64, $z = -4.03$, $P < 0.05$, $r = 0.50$). Pre-NARJ (median 36125); post-NARJ (median 11391); observed = 64; $z = -4.49$, $P < 0.05$, $r = 0.56$).

Discussion: Some improvements in self-report function and quality of movement are observed. This pilot study suggests that the HB-RES could be used to augment home-based arm exercise in an engaging way for children with cerebral palsy.

Conclusion: The lack of a control group limits the conclusions that can be drawn. Further controlled clinical studies are planned.

A new tool for assessing human movement: the Kinematic Assessment Tool

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Background: Effective rehabilitation requires accurate assessment of function. In some situations this can be captured through questionnaires or clinical measures. Nevertheless, there is a need to measure and assess how movements unfold over time to provide detailed and objective information on function. Current measurement methods range from

accurate but laborious laboratory systems to portable but simplistic and time-consuming pen-and-paper methods. The Kinematic Assessment Tool is a system for recording and analysing end-point human movements that has the power of laboratory measures but the advantages of pen-and-paper tests. The Kinematic Assessment Tool provides a highly portable computerized system based on configurable visuospatial tasks.

Method: The usefulness of the Kinematic Assessment Tool is shown in a study where 12 participants (median age 26 years, range 22–44) undertook sets of tracing and copying tasks using their preferred and non-preferred hand. End-point movements were recorded and analysed by the Kinematic Assessment Tool to obtain a compound speed-accuracy score of performance in each task.

Results/Findings: A repeated-measure ANOVA with task-type and hand as factors was performed on the speed-accuracy scores. A main effect of hand ($F(1,11) = 23.756$, $P < 0.05$; preferred = 23.512; non-preferred = 30.506) and task ($F(1,11) = 80.104$, $P < 0.05$; tracing = 14.844; copying = 39.175) was found. These results demonstrate that the Kinematic Assessment Tool can collect and analyse movement data that are capable of distinguishing between different levels of ability and task difficulty.

Discussion/Conclusion: The Kinematic Assessment Tool provides a fast, portable and powerful means to measure and assess human movement objectively. It can be used in clinical and educational settings and has the potential to dramatically improve on current assessment methods.

Systematic review of interventions to improve motor function in children with Developmental Coordination Disorder

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Background: Developmental coordination disorder affects around 6% of the population and is defined as marked impairment of motor skills which significantly interfere with a child's life. The disorder can have serious long-term consequences for a child's educational development

and participation, and there is a need investigate therapies to ameliorate the condition. We reviewed the evidence base for interventions aimed at improving motor function in children with developmental coordination disorder.

Method: Search strategy: The databases PsycINFO, Web of Science, Cochrane Library and MEDLINE were searched for relevant studies. Selection criteria: All studies published between 1995 and 2008 using behavioural therapies for children with developmental coordination disorder were included. Data collection and analysis: Studies were assessed for methodological quality and relevance by three independent researchers then graded according prespecified criteria based on the National Service Framework for Long Term Conditions.

Results/Findings: Twenty-three studies involving 414 participants were included. Four randomized controlled trials involving a total of 219 children using appropriate outcomes were identified. Three out of four reported improvement in motor function. Some methodological issues were identified. The other 19 studies were either case studies or non-randomized control studies. Five studies did not use any measurements of motor function. In most studies the interventions were clearly described to allow replication of the intervention.

Discussion: Although there is some evidence indicating that behavioural therapy for children with developmental coordination disorder improves motor function, there was insufficient evidence to recommend any particular type of intervention for children with developmental coordination disorder. Further phase 2 trials are required prior to larger scale pragmatic studies.

The association between muscle activation patterns, wrist tracking performance and upper limb function in post-stroke hemiplegia

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Background: The contribution of coactivation (simultaneous contraction of agonists and antagonists) to motor control and activity limitations post stroke is debated in the literature.

Method: EMG signals from wrist flexors and extensors of chronic stroke ($N=10$) and unimpaired participants ($N=12$) were recorded during performance of a tracking task in an instrumented rig. The impaired participants also performed an arm function test (Action Research Arm Test). Tracking accuracy was analysed using cross-correlation. Coactivation was quantified using correlation of rectified and smoothed flexor and extensor EMG when extensor EMG was increasing. Positive values ($r \geq 0.3$) signified coactivation; negative values signified reciprocal inhibition (extensor is increasing and flexor is decreasing).

Results: Coactivation was present in two impaired participants, who also had the lowest tracking and function scores, and one unimpaired participant. No significant difference was found between the groups ($P=0.394$). Within the impaired group we found a significant negative correlation between coactivation and tracking (-0.675 , $P=0.032$); and a non-significant trend with function (-0.621 , $P=0.055$).

Discussion: Results are limited by small sample size. Coactivation in a small number of the patients suggests it was not the main cause of disability, though extreme coactivation may contribute to poor motor control and functional inactivity. Coactivation and reciprocal inhibition may have been more strongly linked to tracking performance than function simply because the latter involved multi-joint movements and the tracking only the wrist. Coactivation can be a normal strategy for effective tracking.

Conclusion: Coactivation may be linked to tracking and (less) functional performance, but is unlikely to be the major cause of disability.

The development of the THROAT: The Holistic and Reliable Oral Assessment Tool - part 2

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Background: We have previously developed The Holistic and Reliable Oral Assessment Tool (THROAT) which was found to be reliable

within and between raters. The tool was tested in patients who were relatively independent. The aim of this study is to test further the inter-rater reliability of the THROAT in more dependent patients.

Method: A cross-sectional study, set in a north-west teaching hospital. Patients present on four wards on one day were considered for the study. On the day of the assessment two raters independently examined and rated the mouths of older patients using the THROAT; a seven item scale: lips, gums, mucous membranes, palate, tongue, smell and saliva. Raters were a stroke specialist and a research nurse.

Results/Findings: A total of 91 patients were considered and 40 patients were included (median age: 79 years, interquartile range (IQR) 72–83) 19 (48%) female). Their median Barthel Index score was 10.5, IQR 5.25–16.5; IQR 2.25–3. Overall, the percentage agreement ranged from 71.1% to 94.7%. When examining scores on the individual items of the tool, the inter-rater agreement was moderate to good (weighted kappa = 0.41–0.83) for all items except saliva and smell.

Discussion: The THROAT showed good reliability between raters for lips, gums and mucous membranes and moderate reliability for palate and tongue. Even though these patients were more dependent with the previous study, there was still a lack of variability in item scores.

Conclusion: Further development of the tool needs to include patients with more oral problems.

Rocking the boat: what interventions work for tremor? A systematic review

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Background: Tremor limits individuals' activities and participation and affects their quality of life. We aim to systematically evaluate the evidence for rehabilitation interventions in the management of tremor.

Method: The Cochrane Library, MEDLINE and CINAHL were searched up to January 2009 to identify primary research studies that investigated treatments for tremor, excluding pharmacological

and surgical interventions. We independently reviewed titles and abstracts identified by the search. Articles deemed suitable for inclusion in the review were read in full and assessed using the quality rating used by the UK National Service Framework for Long-term Conditions. Each article was evaluated and rated according to the aetiology of tremor, study design and treatment modality. Only high- and medium-quality papers were selected for data assimilation.

Results/Findings: A total of 391 titles and abstracts were screened for relevance. Of these, 27 were reviewed in full and 15 were selected for inclusion. Most studies included participants with Parkinson's disease, multiple sclerosis and essential tremor. Study populations ranged from three participants to 68. Only three randomized controlled trials were identified. The heterogeneous nature of the studies did not permit us to perform a meta-analysis.

Discussion: We found high-quality studies for tendon vibration, functional electrical stimulation and neuromuscular physiotherapy. There are medium-quality studies for strength training, writing devices, limb cooling, tremor-suppressing orthoses. Medium-quality evidence exists to say that weighted utensils or weighted cuffs are ineffective.

Conclusion: The evidence base for many rehabilitation interventions in tremor is poor. Future research should focus on high-quality randomized controlled trials of interventions which show promise.

The inter-rater reliability of the rating of clinically induced symptom responses in the physical examination of spinal pain: a systematic review

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Background: Clinically induced symptom responses are an important component of the physical

examination of spinal pain patients. Examining the reliability of these measurements across raters is essential when establishing their usefulness.

Method: Systematic review of inter-rater reliability studies: online databases and references were searched, followed by citation tracking of included articles. Selected studies were independently assessed for methodological quality by two raters. Extracted information was synthesized using a best-evidence synthesis approach.

Results/Findings: Twenty-five low back pain and six neck pain articles were analysed for reliability. Study quality was satisfactory in only 56% of studies. Pain responses to gross and segmental movement testing, non-organic signs, pain on palpation and neural signs were the most frequently studied tests. Most clinically induced symptom responses produced conflicting evidence or were found to lack reliability (reliability threshold: 0.7). Limited evidence was found that symptom changes in response to movement/sustained postures, the posterior shear test and pelvic torsion were reliable but only in low back pain.

Discussion: Some symptom responses may offer promise for use as reliable tests in spinal pain practice, however caution should be expressed in the light of the limited evidence found in this review.

Conclusion: More reliability studies are needed, especially in areas other than the lumbar spine. Significant improvements in study methodology are required for future reliability research on clinically induced symptom responses in order for these procedures to be used with confidence in clinical practice.

Measurement of free living activity in patients with COPD following a pulmonary rehabilitation programme

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Background: Pulmonary rehabilitation is recommended for individuals with chronic obstructive pulmonary disease (COPD). Although many

outcome measures have been used to assess the benefits of such programme, measurement of free living physical activity has proved difficult.

Method: This study used the ActivPal, thigh-worn, single axis accelerometer to assess the feasibility of measuring changes in 'uptime' (total time standing and walking) following pulmonary rehabilitation. Activity measurements were made at baseline (post rehabilitation), along with shuttle walking test and St Georges Respiratory Questionnaire. Activity monitoring was repeated for 15 hours/day over two consecutive days, at 6, 12, 18 and 24 weeks. A subgroup of nine subjects had test-retest.

Results/Findings: Thirty-four patients with COPD (mean age 70 years, mean FEV₁ 1.3 L) were recruited; 28 completed the study. Measurements were made for a further two-day period. There was a 12.4% coefficient of variation in uptime between the repeated monitoring periods, which was acceptable. Overall, there were small, non-significant changes in uptime, shuttle walking test and St Georges Respiratory Questionnaire score. However, in individuals, there was a significant improvement in uptime in 8 subjects and deterioration in 10 subjects. There was a positive weak correlation between changes in up time and changes in shuttle walking test (Kendall test 0.28) and St Georges Respiratory Questionnaire (Kendall test =0.4).

Discussion: This type of activity measurement is feasible in older COPD patients and appears reproducible. The correlation with the maximal exercise (shuttle walking test) suggests this device would give useful additional information on the long-term benefit of rehabilitation to individuals.

Supporting the self-management of stroke by applying a user-centred design approach

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Background: The aim of this user-centred design project is to develop interactive digital technologies to support the self-management of long-term conditions such as stroke. A personalized

self-management system is developed to assist stroke patients to manage their conditions at home.

Method: In order to promote behaviour change in stroke patients, we used a conceptual matrix for the stroke that incorporates patients' clinical needs, SMART goals, therapeutic interventions and feedback mechanisms provided by the technology. A mixed method of data collection has been applied using health and social sciences research methods and user-centred design methods. Data were collected through a series of focus groups, face-to-face interviews, non-participant observation and cultural probes.

Results/Findings: A number of personas, scenarios and in-depth narratives of users' life accounts have been created to inform the iterative process of

prototype design. The first round of focus groups with the therapists yielded the idea of envisioning a meaningful, personalized and humanistic technology. Similarly, the patients and carers shared their interpretation of stroke along the journey of illness and explored the changes they made during the disease trajectory.

Discussion/Conclusion: To date, the findings of the study have created a library of end-goals and input devices providing data for a coordinating algorithm. The SMART prototype uses PCs, GPS tracking and mobile devices to provide a means of self-reporting the data, education and location tracking of the users and to provide feedback to the users leading to a change in behaviour.