



## **Introduction**

The 1st Neurological Physiotherapy Conference was held in Sydney from November 27th to 29th 2003. This was the inaugural biennial conference of the National Neurology Group of the Australian Physiotherapy Association. The Conference provided an excellent opportunity for physiotherapists with an interest in neurological physiotherapy from across Australia, and internationally, to meet and discuss the latest research in the area.

Nearly 250 delegates participated in the Conference. There were physiotherapists from each state and territory in Australia as well as from New Zealand, Thailand, the United States of America, The Netherlands and India.

The Conference Organising Committee arranged an outstanding scientific program that encouraged interaction between presenters and delegates. The invited speakers were Dr Louise Ada, Dr Sharon Kilbreath, Professor Meg Morris and Dr Barbara Singer. The Physiotherapy Research Foundation (PRF) New Researcher Presentation was given by Ms Coralie English. Supplementing the plenary sessions were 18 workshops, 40 oral presentations and 13 posters. The peer reviewed abstracts for the invited speakers, PRF New Researcher Presentation, oral presentations and posters are presented in the following pages.

### **Suzanne Kuys**

*Chairwoman, National Neurology Group  
Australian Physiotherapy Association*

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## Changing the way we view the contribution of motor impairments to physical disability after stroke

Ada L

*The University of Sydney*

The neurologist Hughlings Jackson, in the late 19th century, observed that the motor problems resulting from lesions of the central nervous system could be categorised as positive or negative. Negative impairments are those that represent a loss of function previously present (such as loss of strength and dexterity) while positive impairments are additional (such as abnormal postures, and proprioceptive (spasticity) and cutaneous reflexes). A major concern of neurological physiotherapists is the relative contribution of the positive versus negative impairments to disability after brain damage. This paper presents the contribution to this debate made by studies carried out at the Neurology Research Unit at The University of Sydney. Spasticity is often used to describe a wide range of motor impairments. However, it is now widely accepted as a motor disorder characterised by a velocity-dependent increase in tonic stretch reflexes ('muscle tone') with exaggerated tendon jerks resulting from hyperexcitability of the stretch reflex. It is difficult to measure spasticity during the performance of tasks in order to assess its contribution to disability. When stretch reflexes were measured under active conditions to mimic active movement, they were found to be decreased rather than exaggerated. When the relative contribution of different positive and negative impairments to disability was examined by charting the development of impairments compared with disability over time, spasticity made very little contribution to disability compared with weakness. This reinforces the view that the major contribution to disability after brain damage is not the result of the positive impairments but rather, the negative impairments. This has led to a shift in focus towards the contribution of the negative impairments, ie loss of strength and dexterity. It is important for physiotherapists to understand as much as possible about the nature of these impairments, as well their relative contribution to disability after brain damage, in order that rehabilitation has a sound scientific basis. Loss of dexterity refers to a loss of co-ordination of voluntary muscle activity to meet environmental demands. It is difficult to measure because measures of dexterity, which are typically measures of function, are usually confounded by strength since they rely upon a prerequisite amount of strength to perform the test. To overcome this problem, a measure of dexterity that requires precise co-ordination, but minimal strength, was devised. When the relative contribution of weakness versus loss of dexterity to disability was examined by charting their development over time, strength was found to be the major contributor to disability. Therefore, stroke patients with initial weakness may remain disabled because rehabilitation has not targeted their most significant impairment, ie loss of strength. Insufficient attention may be given to strength training in rehabilitation of individuals after stroke because of the commonly held but erroneous assumptions that spasticity is the most important contributor to disability and that resisted exercise will increase spasticity. It is now necessary to identify the most effective methods of increasing strength early after stroke. Once some strength has been regained, therapy should be directed towards dexterity as well as strength, since both are necessary for long-term optimal function.

## Thirty minutes of positioning reduces the development of external rotation but not flexion contracture in the shoulder after stroke: A randomised controlled trial

Ada L<sup>1</sup>, Goddard E<sup>2</sup>, McCully J<sup>2</sup>, Stavrinou T<sup>3</sup> and Bampton J<sup>1</sup>

<sup>1</sup>The University of Sydney <sup>2</sup>Royal Prince Alfred Hospital, Sydney

<sup>3</sup>Balmain Hospital, Sydney

The aim of this study was to determine the efficacy of positioning the affected shoulder in flexion and external rotation on maintaining range of motion early after stroke. A randomised controlled trial was carried out in four metropolitan mixed rehabilitation units. Thirty-six first time stroke subjects, with a mean age of 68 years, who were within 18 days post-stroke and scored less than 4 on Item 6 of the Motor Assessment Scale were randomised into an experimental (n = 18) and a control (n = 18) group. The experimental group received two 30 min sessions per day for four weeks where the affected upper limb was placed in maximum comfortable external rotation and 90 degrees of flexion in addition to 0-10 minutes of shoulder exercises and standard upper limb care. The control group received 0-10 minutes of shoulder exercises and standard upper limb care. The primary outcome measures were maximum passive shoulder external rotation and flexion of the affected side compared with the intact side measured by an assessor blinded to group allocation. Four weeks of the 30 min program of positioning the shoulder in maximum external rotation significantly reduced the development of contracture in the experimental group by 15 degrees (20%) compared with the control group ( $p = 0.02$ ). However, the 30 min program of positioning the shoulder in 90 degrees flexion did not prevent the development of contracture ( $p = 0.89$ ). It is recommended that at least 30 minutes of positioning the affected shoulder in external rotation should be started as soon as possible for those patients who have little activity in the upper arm after stroke.

## Effect of body position on intracranial pressure and cerebral perfusion pressure in neurosurgical patients

Aggarwal R, Bala A and Suri A

*All India Institute of Medical Sciences, New Delhi*

The aim of this study was to elucidate the postural pressure change in the subarachnoid space with the objective of obtaining information that might be useful in planning and prescribing physiotherapeutic treatment to neurosurgical patients. In 10 neurosurgical patients, intracranial pressure (ICP) and systemic arterial blood pressure were measured with the patients in four different positions: supine lying, 30 degrees head elevation, right side lying and 30 degrees head down position without turning the head. Cerebral perfusion pressure (CPP) was calculated by subtracting ICP from mean blood pressure. Intracranial pressure results were as follows: at supine lying  $9.0 \pm 5.4$  mm Hg (mean  $\pm$  SD); 30 degrees head elevation,  $8.5 \pm 7.6$  mm Hg; right side lying,  $10.6 \pm 6.4$  and 30 degrees head down,  $12.3 \pm 6.6$  mm Hg. Cerebral perfusion pressure at supine lying was  $90.6 \pm 13.3$  mm Hg (mean  $\pm$  SD); at 30 degrees head elevation,  $88.6 \pm 14.6$  mm Hg; right side lying,  $86.9 \pm 15.8$  mm Hg and at 30 degrees head down position,  $88.5 \pm 13$

mm Hg. The data suggest that a rise in ICP is significant in head down ( $p < 0.006$ ) and right side lying position ( $p < 0.01$ ) compared with supine lying where a fall in CPP was insignificant in head down position. There was a significant fall in CPP ( $p < 0.05$ ) in side lying but this can be attributed to an unusual fall of blood pressure in one patient. Thus it can be concluded that CPP remains unchanged in spite of changes in ICP.

### **Recovery of the upper limb: A survey of stroke survivors**

**Barker RN and Brauer SG**

*The University of Queensland, Brisbane*

A comprehensive survey of stroke survivors has been undertaken as the first step in a larger research project that aims to optimise upper limb recovery after stroke. The purpose of the survey was to explore the human dimension to stroke recovery and consult with those to whom a training program would apply. The objective was to determine factors other than medical diagnosis and comorbidities that influence recovery of the upper limb after stroke. Comparison is made between stroke survivors who have had a good recovery and those who have not. The experience of stroke survivors from rural and remote areas where resources are scarce is also compared with stroke survivors who reside in a metropolitan area where resources are more readily available. Results from this survey are being used in the design of a randomised controlled clinical trial of a physiotherapy intervention concentrating on upper limb function. The overall project advocates a best practice approach recognising the need to not only systematically measure the outcome of interventions, but also to systematically measure the stroke survivor's perception of the experience, to provide a foundation for what must be a stroke survivor centred program.

### **Reflective practice – a model for neurological physiotherapy**

**Batchelor FA**

*Western Health, Melbourne*

The concept of reflective practice in its various forms has been applied to many disciplines, for example teaching and social work. Physiotherapy as a profession has not embraced the concept of reflective practice in the same way as other professions, perhaps due in part to physiotherapy's positivist traditions. Without evidence to support the value of reflective practice, the risk exists that reflective practice as a form of evaluation and development will not be considered of value. However, reflective practice is of particular relevance to neurological physiotherapists in helping them to integrate evidence-based and clinical practice and should not be ignored. Recent demand for professional development within neurological physiotherapy has focused on clinical reasoning and justification for clinical treatment and this highlights the profession's tacit desire to explore reflection. Models of reflective practice have not explicitly incorporated kinaesthetic reflection but this is of particular relevance to

neurological physiotherapists as they attempt to make sense of what they feel and observe. In particular, "reflection-in-action" has not been emphasised enough in terms of neurological physiotherapy practice. A model of reflective practice which is spiral in nature and incorporates kinaesthetic and reflection-in-action components can be applied to neurological physiotherapy. By utilising reflection-in-action, neurological physiotherapists can harness a wealth of information which will contribute to skill development and expertise. The synthesis of available evidence and results of reflection can lead to improved outcomes for patients as well as improved clinical education for students.

### **A model of community partnership and physiotherapy delivery that is culturally appropriate**

**Binns EE**

*Auckland University of Technology, New Zealand*

Historically, Maori in New Zealand under-utilise mainstream medical services. This may be due to cultural discomfort experienced by Maori in a Western health system based on a biomedical model of health. Furthermore, the number of physiotherapists who themselves are Maori is very low. Together, these factors limit the physiotherapy profession in New Zealand from meeting the special health needs of Maori, a legal requirement. Auckland University of Technology is committed to working in partnership with Maori health groups to improve access for Maori patients and to promote workforce development among physiotherapy graduates. In order to achieve these goals, Wai Physiotherapy Clinic has been established as a joint venture between the physiotherapy school and Te Whanau o Waipareira (a pan-tribal urban Maori trust) in West Auckland. The philosophy underpinning the clinic is the *whare tapa wha* model - a belief that there are four parts to a whole person: spirituality, family, mental health and physicality. The clinic also operates out of the Waipareira health campus and therefore is identified as a place to seek health that is culturally safe. By addressing these two issues, the clinic has seen an increase in the utilisation of this service by Maori. Of those people attending Wai Physiotherapy 15% identify as Maori compared with the 3% who use hospital services. From a professional perspective, the clinic provides a role models of the profession to young Maori and hopes to address the under-representation of Maori in the physiotherapy profession.

### **A randomised controlled trial evaluating additional task-related practice during stroke rehabilitation**

**Blennerhassett JM and Dite W**

*Royal Talbot Rehabilitation Centre, Melbourne*

The amount of practice required to regain functional arm movement or locomotor ability following stroke is unknown. The aim of this study was to evaluate the effect of additional task related practice during four weeks of stroke rehabilitation on key functional outcome measures.

Thirty stroke participants who could walk 10 metres with supervision were randomly assigned into an upper limb (UL) or locomotor training group. Each group received one hour per day of task-related supervised practice in addition to their usual rehabilitation services. Independent assessors blinded to group allocation, tested participants pre- and post-training. Outcome measures used included three items of the Jebsen Hand Function Test (JHFT), the upper arm and hand items of the Motor Assessment Scale (MAS), and three mobility measures: the Timed Up and Go Test (TUGT); Step Test; and Six Minute Walk Test (6MWT). Across the whole training period, both groups improved significantly for all of the mobility measures ( $p < 0.001$ ), while only the UL group made significant gains on the JHFT ( $p < 0.001$ ) and upper arm item MAS ( $p = 0.001$ ). Comparing pre- and post-test scores, the locomotor group made greater gains for mobility with significant between-group differences for the 6MWT and TUGT ( $p = 0.001$ ), while the Step Test approached significance ( $p = 0.02$ ). These results demonstrate task specific improvements in motor performance for each group and support the use of additional task-related practice during stroke rehabilitation.

### **Brain reorganisation demonstrated with functional MRI in children with cerebral palsy, following intramuscular Botulinum toxin A and upper limb training**

Boyd RN<sup>1,3,4</sup>, Bach T<sup>3</sup>, Morris M<sup>3</sup>, Abbott D<sup>4</sup>, Syngeniotis A<sup>4</sup>, Imms C<sup>1,2,3</sup>, Johnson L<sup>2</sup>, Graham HK<sup>1</sup> and Jackson GD<sup>4</sup>

<sup>1</sup>Murdoch Children's Research Institute, Melbourne <sup>2</sup>Royal Children's Hospital, Melbourne <sup>3</sup>La Trobe University, Melbourne <sup>4</sup>Brain Research Institute, Melbourne

We report a case of rapid cerebral motor transfer in a child with congenital right hemiplegia as measured by fMRI, after peripheral Botulinum toxin A (BoNTA) and upper limb training. After baseline assessment on Melbourne Universal Upper Limb and fMRI, she received BoNTA to the spastic forearm muscles (1-4 U BoNTA/kg/muscle) and six weeks of upper limb training. Whole-brain fMRI studies (3 Tesla) were conducted at baseline, three and 12 weeks, using two motor paradigms (finger tapping or wrist extension). After image realignment, statistical maps were compared with unpaired *t*-tests, thresholded at  $p < 0.001$ . Region of interest analysis was undertaken on the contralateral primary motor cortex (PM1), ipsilateral PM1 and supplementary motor area (SMA). The motor tasks were performed with EMG to assess for mirror movements. At baseline for the impaired finger there was low-level activation in contralateral PM1 (4 voxels). This switched to a large increase in ipsilateral activation (102 voxels) after BoNTA and training at three weeks. The increase was maintained at 12 weeks. These activations were not accompanied by mirror movements confirmed by EMG. Function improved from a baseline score of 74.6% by 11.4% at three weeks and 18.8% at 12 weeks. These unique observed activation changes suggest that the ipsilateral side has taken the role of controlling hand movement, possibly using previously under-utilised or un-utilised corticospinal projections. This appears to have been facilitated by the reduction in spasticity with BoNTA injection to the impaired side, and the central

reorganisation may have occurred due to a change in sensory feedback from the impaired side.

### **Randomised trial of Botulinum toxin A and upper limb training in congenital hemiplegia – activity, participation, health-related quality of life**

Boyd RN<sup>1,3,4</sup>, Bach T<sup>3</sup>, Morris ME<sup>3</sup>, Imms C<sup>1,2,3</sup>, Johnson L<sup>2</sup>, Graham HK<sup>1</sup>, Syngeniotis A<sup>4</sup>, Abbott D<sup>4</sup> and Jackson GD<sup>4</sup>

<sup>1</sup>Murdoch Children's Research Institute, Melbourne <sup>2</sup>Royal Children's Hospital, Melbourne <sup>3</sup>La Trobe University, Melbourne <sup>4</sup>Brain Research Institute, Melbourne

In a single-blind randomised trial we assessed if upper limb training with or without intramuscular Botulinum toxin A (BoNTA) enhances activity, participation and health-related quality of life (HRQOL). Thirty children with congenital hemiplegia were matched for age (5-15 years), gender and side of hemiplegia. Outcomes were across the ICF including resonant frequency (RF); activity: Melbourne Unilateral Upper Limb; participation: Paediatric Motor Activity Log (PMAL), Canadian Occupational Performance Measure (COPM), Goal Attainment Scale (GAS); and HRQOL: Child Health Questionnaire (CHQ). Real life activity was measured using covert monitoring of eating, drinking, and dressing in the Actual Amount of Use Test. Intervention included random allocation to six weeks of upper limb training alone/with injections 1-4U BoNTA/kg muscle (Allergan USA). Training used principles of motor learning, occupational performance and goal attainment. For impairments there was a greater reduction in spasticity ( $p = 0.01$ ) on RF at three weeks than at 12 weeks in the BoNTA group. The BoNTA group had better functional outcomes ( $p = 0.03$ ) and greater and better use of the impaired arm (PMAL) but there was no significant difference between the groups. Both groups had a clinically relevant improvement for participation on COPM and GAS. Health-related quality of life demonstrated a treatment effect for BoNTA on the domains of physical functioning, self esteem and family activities. There is evidence of a treatment effect for the addition of BoNTA to upper limb training to improve spasticity, functional outcomes and HRQOL. An intensive program of upper limb training improves participation both with and without BoNTA.

### **Executive function and task demands important in dual-task interference with balance**

Brauer SG<sup>1,2</sup>, Broome A<sup>2</sup>, Stone C<sup>2</sup>, Clewett S<sup>2</sup>, Herzig P<sup>1,2</sup> and Low Choy NL<sup>1</sup>

<sup>1</sup>The University of Queensland, Brisbane <sup>2</sup>Princess Alexandra Hospital, Brisbane

One contributor to poor balance following an acquired brain injury (ABI) could be a difficulty in performing multiple tasks, as attentional deficits are frequently reported in this population. This study aimed to determine whether poor balance ability when performing concurrent cognitive tasks was more related to poor balance ability, poor attention, or an inability to prioritise between the tasks in patients with an ABI. Forty subjects participated: 20 ABI

patients admitted to a tertiary brain injuries unit who were out of post-traumatic amnesia, could maintain a 60 s step-stance position, and who had no additional comorbidities affecting balance; and 20 control subjects matched by age, gender and years of education. Subjects performed a balance-only task (step stance for 60 seconds), several cognitive-only tasks (non-spatial, visuo-spatial, control), and both together (dual tasks). Several neuropsychological tests of attention were also performed. ABI subjects showed a greater centre of pressure (COP) excursion in all conditions than controls. Adding a cognitive task did not change COP in controls, but the ABI patients demonstrated an increase in COP excursion, which was most evident for non-spatial tasks. Dual-task interference with balance was most associated with poor balance ability ( $r = 0.59-0.91$ ), but was also correlated with neuropsychological tests of attention and executive function ( $r = 0.56-0.70$ ). Both groups prioritised the cognitive over the balance task. As poor balance was highly correlated with dual-task interference, it suggests that multi-tasking should be assessed in firstly those with known balance deficits, but also in those with specific attentional problems.

### **Quantifying the magnitude of stretch torque applied by physiotherapists to the hamstring muscles of people with spinal cord injury**

**Byak A,** Harvey L, McQuade L and Hawthorne S  
*Royal Rehabilitation Centre Sydney*

Stretch is widely administered to the hamstring muscles of people with spinal cord injury. Presumably, the effectiveness of this intervention is in part determined by the magnitude of the stretch torque. Yet we do not know the magnitude of the stretch torque typically applied to these patients. The aim of this study was to quantify the magnitude of stretch that physiotherapists apply to the hamstring muscles of people with spinal cord injury and to compare these results with the stretch torque typically tolerated by individuals with normal sensation. A repeated measures design was used. Twelve physiotherapists manually administered a stretch to the hamstring muscles of 15 individuals with motor complete paraplegia or tetraplegia. The stretch was applied by flexing the hip with the knee extended. A device specifically designed for the study was used to determine the stretch torque applied by each therapist to each subject. Previously published studies were used to ascertain the stretch torque tolerated by able-bodied individuals. Therapists applied median hip flexor torques of between 30 and 68 Nm, although some torques were as large as 121 Nm. This was well in excess of the stretch torques tolerated by individuals with intact sensation. The stretch applied by different therapists to any one subject varied by as much as 40-fold. Future attention needs to be directed at firstly establishing optimal stretch torques and then providing therapists with a means of standardising the stretch torques they apply, particularly in patients without sensation.

### **The effect of attention on walking performance under dual-task conditions in individuals with Parkinson's disease**

**Canning CG**  
*The University of Sydney*

The aim of this study was to investigate the effect of attention on walking performance under dual-task conditions in people with Parkinson's disease (PD). Twelve subjects with mild to moderate PD were tested 'on' medication. Subjects were instructed to walk over a 10 m grid walkway at their comfortable speed under two baseline and two experimental conditions. The baseline conditions were walking hands-free with no specific instructions and walking carrying a tray and glasses with no specific instructions. The two experimental conditions were walking carrying a tray and glasses with instructions to attend to walking and walking carrying a tray and glasses with instructions to attend to the tray and glasses. The variables analysed were velocity, stride length, cadence and time in double support. Dependent sample *t*-tests were used to compare variables between the two experimental conditions. Subjects walked faster ( $p < 0.001$ ), with longer strides ( $p < 0.001$ ), higher cadence ( $p = 0.03$ ) and less time in double support ( $p = 0.002$ ) when they attended to their walking during dual-task performance compared with attending to the tray and glasses. When attention was directed towards walking, walking performance under dual-task conditions improved to a level comparable to the baseline hands-free single-task condition. Walking performance under dual-task conditions is improved when people with Parkinson's disease attend to walking, as opposed to the concurrent task. This suggests that specific instructions can be used to manipulate attention to enhance the performance of everyday tasks in people with mild to moderate PD.

### **Does instrumented quantitative gait analysis have a role in the clinical setting?**

**Danoudis M,** Rawicki B, Kravtsov S and McGinley J  
*Kingston Centre, Melbourne*

Instrumented gait analysis has been used extensively as a research tool. The kinetic and kinematic information from three dimensional gait analysis (3DGA) is routinely used in planning and managing the treatment of gait impairments for children with neurological disorders. However, there has been little systematic use of instrumented gait analysis in clinical decision making in the adult population. The complex gait disorders resulting from acquired brain or spinal cord injury can be difficult to evaluate by observation alone. Three dimensional gait analysis can assist by guiding the detection of the primary gait disorders and identifying other compensatory gait mechanisms so that the correct muscle or muscles can be targeted. Recent advances in the medical management of spasticity are among those interventions that can be assessed using 3DGA. The growing use of Botulinum toxin, intrathecal Baclofen and selected surgical interventions has driven the need to more thoroughly evaluate their effectiveness. Instrumented gait analysis can provide this information and thus enhance and facilitate clinical decision making. Southern Health has initiated a gait analysis service to

provide services to adults with gait disorders. This service is located within the existing research-based Kingston Centre Gait Laboratory. Within this new clinical service team, physiotherapists have a vital role in data acquisition, interpretation and decision making. It is anticipated that 3DGA will become an integral part in the assessment and evaluation in the management of complex gait disorders.

### **An evaluation of assessment processes used to educate novice clinicians in neurological physiotherapy**

**Denisenko S**

*La Trobe University, Melbourne*

The aim of this study was to examine the processes which experienced physiotherapists use to assess their clients, and to propose a framework based on the literature to assist novice physiotherapists in developing their assessment skills. Focus group methodology was used to evaluate the assessment processes of experienced neurological physiotherapists who supervised neurology student placements in Victoria. Eight clinicians participated in the focus group, which was moderated by an independent assessor. Data were analysed to establish consistent themes in the discussion. Experienced clinicians did not demonstrate a consistent format in their evaluation processes, but did consider holistic functional assessment a key requirement of their practice. Health education literature supports the use of theoretical frameworks to assist the novice clinician in developing their clinical reasoning skills, however no such framework was clearly being used by the clinicians who were interviewed. The World Health Organisation's "International Classification of Function" is proposed as a useful framework applicable to neurological physiotherapy education, as it was designed to establish a common language to improve communication between different disciplines, it has previously been used as a clinical and educational tool in curriculum design, and it assists the novice clinician to evaluate problems at different levels (activity, impairment, and participation) which are highly applicable to this area of physiotherapy practice.

### **Neurological physiotherapy in the acute setting: Not the same game**

**Dennis KC and Keating LJ**

*Western Health-Western Hospital Footscray, Melbourne*

Ten years ago, the role of the acute neuro-physiotherapist was predominantly concerned with assessment, rapport building and provision of specialised fine-tuned treatment. Length of stay in hospital was often two to three weeks, necessitating that the physiotherapist provide treatment prior to the patient's transfer to rehabilitation or to home. With major pressure on hospitals to increase patient throughput, the average length of stay in the acute setting for neurological patients has decreased over the years, with patients moving into rehabilitation settings within 10 days. This has led to the need for discharge planning to start from the day of admission. The physiotherapist needs to be able to implement an effective assessment and utilise analytical, diagnostic and prognostic skills. The current role of the

physiotherapist has a major emphasis on accurately and rapidly predicting discharge destination and implementing discharge planning. Consequently, efficiency of assessment has become vital. Innovative strategies are required for efficient utilisation of acute beds and development of methods to transfer information within care settings. Further shifts in the role are related to changes in manual handling techniques. The introduction of the "no lift" policy (in recognition of high risk of injury to neurological physiotherapists together with nurses when moving and transferring patients) has had a major influence within hospitals, and has the potential to dramatically change the way in which physiotherapists practise. Ongoing necessity for physiotherapists to provide high quality care whilst working within these constraints presents new and exciting challenges.

### **The effect of sensory retraining to the foot on postural control in stroke clients – a pilot study**

**Dunsford AF and Hillier S**

*University of South Australia, Adelaide*

The aim of this study was to determine the effect of sensory retraining to the affected foot of stroke patients on their postural control. Three single case studies were carried out simultaneously over a six week period. Subjects were measured at baseline once per week for two weeks for sensory deficits in light touch and proprioception using Semmes-Wenstein monofilaments and the distal proprioception test. They were also tested for postural control using the 3SPACE tracker. The outcome measures used were time taken to transfer weight from double limb stance to single limb stance, duration of single limb stance and sway path length in single limb stance. Sensory retraining was then carried out three times per week over two weeks. This involved education, detection, localisation, discrimination, recognition and proprioception training. Baseline measures were then repeated once per week for two weeks. The results showed that sensory retraining was effective in improving the subjective reports of sensation as tested with monofilaments. For some subjects, the results showed that sensory retraining improved postural control, while for others there was no difference before and after retraining. Subjectively, all subjects reported improvements in sensation in some way. Thus, sensory retraining is recommended as an important treatment method which requires further investigation for rehabilitation post-stroke.

### **Is task-related circuit training an effective means of providing rehabilitation to acute stroke patients?**

**English C<sup>1</sup>, Warden-Flood A<sup>2</sup>, Stiller K<sup>3</sup> and Hillier S<sup>2</sup>**

*<sup>1</sup>Hampstead Rehabilitation Centre, Adelaide <sup>2</sup>University of South Australia, Adelaide <sup>3</sup>Royal Adelaide Hospital*

Task-related circuit training can provide a greater amount of physiotherapy to patients undergoing rehabilitation after stroke and has been shown to be effective in treating chronic stroke patients. This study investigates the efficacy of task-related circuit training in the acute rehabilitation period after stroke. Patients with stroke admitted to

Hampstead Rehabilitation Centre are allocated to receive either one-to-one therapy (up to one hour daily), or task-related circuit training in classes (up to six patients for up to 90 minutes twice daily). Outcomes are assessed at admission, four-weekly intervals throughout inpatient stay, discharge and six months post-stroke by a blinded examiner. Outcome measures include the Berg Balance Scale, Motor Assessment Scale, gait speed, gait endurance, Nottingham Health Profile and a patient satisfaction questionnaire. A Seeding Grant from the Physiotherapy Research Foundation enabled employment of the blinded examiner. To date, 47 patients have been recruited to the study, 31 receiving one-to-one therapy and 16 receiving circuit class therapy. Recruitment will continue until a sample size of 60 is reached. Analysis to date indicates that task-related circuit training has been well tolerated, with 88.5% of sessions attended. Similar attendance rates have been seen for patients in the one-to-one group (88.4%,  $p = 0.99$ ). The mean duration of therapy to date has been significantly different between groups, with the circuit training group receiving on average 147 minutes per day of therapy compared with 36 minutes per day for the one-to-one group ( $p < 0.001$ ). Anecdotally, patients have enjoyed the group interaction and peer support provided by the circuit classes.

### **Use of slings to prevent subluxation of the shoulder after stroke: A survey of Australian practice**

**Foongchomcheay A, Ada L and Canning CG**  
*The University of Sydney*

The purpose of this study was to examine the current clinical practice in Australia for the use of slings in the prevention of shoulder subluxation after stroke. A questionnaire was designed to investigate how physiotherapists use slings in current practice. All hospitals in Australia with physiotherapy services and with more than 50 beds were included. A letter of invitation together with a questionnaire package was sent to physiotherapy departments. The questionnaires were sent to 362 hospitals across Australia. Two hundred and eighty-nine responses were received, a response rate of 80%. Of the 289 responses, 210 were completed questionnaires, four were blank questionnaires and 75 indicated that the questionnaire was not applicable. The data were analysed descriptively to determine the percentage of respondents using slings, who prescribed slings, the types of slings prescribed and the criteria used for prescription of slings. Ninety-one per cent of the respondents use slings for the prevention of shoulder subluxation. Physiotherapists were responsible for prescribing slings in 96% of the hospitals. The most frequently prescribed sling was the collar-cuff (72%). The most frequent criterion used to prescribe slings was inadequate muscle strength (63%). The survey shows that the most common current practice in Australia is for physiotherapists to prescribe collar-cuff slings for stroke patients who present with inadequate muscle strength. However, there is no evidence of the efficacy of slings for the prevention of shoulder subluxation, therefore it is necessary for prescription of slings to become evidence-based.

### **Strapping of the hemiplegic shoulder prevents development of shoulder pain during rehabilitation**

**Griffin AL<sup>1,2</sup> and Bernhardt J<sup>3,4</sup>**

<sup>1</sup>Broadmeadows Health Service, Melbourne <sup>2</sup>The Victorian Rehabilitation Centre, Melbourne <sup>3</sup>Melbourne Extended Care and Rehabilitation <sup>4</sup>National Stroke Research Institute, Melbourne

Stroke rehabilitation aims to help patients gain optimal functional recovery. Yet too often patients leave rehabilitation with painful shoulders. Chronic shoulder pain impacts on individuals in a number of ways, rendering many aspects of day-to-day life more difficult. We wanted to explore and test methods to reduce the number of patients who develop shoulder pain during rehabilitation. One method that appeared to have the potential to prevent hemiplegic shoulder pain was shoulder strapping. This paper presents the results of a randomised controlled trial of shoulder strapping targeted at those individuals most at risk of developing shoulder pain. We included all stroke patients with an upper arm function score on the Motor Assessment Scale of 3 or less and those presenting to rehabilitation within four weeks of their stroke. Subjects had no pre-morbid history of shoulder pain. Patients were randomly allocated to one of three groups: 1) strapping; 2) placebo; and 3) no strapping (control). Treatment was continued for four weeks. The primary outcome measure was number of pain-free days. A researcher blinded to group allocation gathered outcome data. Thirty-four clients were analysed in the results. Preliminary results are promising and further studies are required with longer follow up, earlier commencement of strapping, and testing of those clients already presenting with pain.

### **Effects of four weeks of daily stretch on the extensibility of the hamstring muscles in people with spinal cord injuries**

**Harvey L<sup>1</sup>, Byak A<sup>1</sup>, Ostrovskaya M<sup>1</sup>, Glinsky J<sup>1</sup>, Katte L<sup>2</sup> and Herbert R<sup>3</sup>**

<sup>1</sup>Royal Rehabilitation Centre Sydney <sup>2</sup>The Prince Henry Hospital, Sydney <sup>3</sup>The University of Sydney

Contractures are common and debilitating for people with spinal cord injuries. It is widely believed that stretch can prevent or treat contractures. However, the effectiveness of this intervention has not been rigorously evaluated. The aim of this randomised controlled trial was to determine the effects of four weeks of daily 30 min stretches on the extensibility of the hamstring muscles in people with recent spinal cord injuries. A consecutive sample of 16 spinal cord-injured patients with poor hamstring muscle extensibility was recruited. Subjects' legs were randomly allocated to experimental and control groups. The hamstring muscles of the experimental leg of each subject were stretched for 30 minutes each weekday for four weeks; hamstring muscles of the contralateral leg were not stretched. The extensibility of the hamstring muscles (hip flexion range of motion with knee extended) of both legs was measured by a blinded assessor at the commencement of the study and one day after the completion of the four week stretch period with a device designed to standardise stretch torque. Changes in hamstring extensibility from

initial to final measurements were calculated. The effect of stretching was expressed as the mean difference in these changes between stretched and non-stretched legs. The mean effect of stretching was 1 degree (95% CI -2 degrees to +5 degrees). Four weeks of stretches does not affect the extensibility of the hamstring muscle in people with spinal cord injuries. These results suggest that therapists need to reconsider the provision of stretch-based interventions.

### **Database of training exercises for people with spinal cord injury**

Harvey L<sup>1</sup>, **Glinisky J**<sup>1</sup>, Byak A<sup>1</sup>, Batty J<sup>2</sup>, Katte L<sup>2</sup> and Eyles J<sup>3</sup>

<sup>1</sup>Royal Rehabilitation Centre Sydney <sup>2</sup>The Prince Henry Hospital, Sydney <sup>3</sup>The Royal North Shore Hospital, Sydney

Physiotherapists without experience in the management of people with spinal cord injury often have difficulty in devising appropriate exercises and training programs for these patients. This problem is compounded by a lack of educational resources (textbooks or the like) that specifically help therapists devise treatment programs. The aim of this project was to compile a database of training strategies, stretches and strengthening exercises appropriate for people with spinal cord injuries. All exercises address specific but common problems that prevent these patients attaining independence in functional tasks. The database consists of a sketch and corresponding photograph of each exercise with a brief explanation appropriate for either a therapist or patient. The database can be searched by various categories including "level of lesion", "aim of therapy", "required exercise equipment" and "skill level of the patient". The database also enables therapists to compile exercise sheets in different formats for either clients or other therapists. The database will be widely available on CD free of charge. Not only will the database provide an invaluable educational resource but it will also enable therapists to compile personalised and professional-looking exercise and training books for patients. The database will be updated as new evidence emerges about best practice and as therapists devise new and appropriate exercises. It is hoped that in the future the database will be available on the web. In this way it can develop into an interactive program through which therapists world-wide can contribute treatment ideas.

### **The pusher patient: Implications on outcome in stroke – a pilot study**

**Keating L**<sup>1</sup>, Walkenhorst H<sup>2</sup> and King A<sup>2</sup>

<sup>1</sup>Western Health, Melbourne <sup>2</sup>Melbourne Health

Pushing, a phenomenon that can occur with stroke patients, provides significant challenges to physiotherapists. This study examined the implications of pushing on various outcomes measured across the inpatient stay (acute and sub-acute) for 51 stroke subjects, with comparisons made between those identified as pushers or non-pushers initially post-stroke. Pushers (41% of subjects) were less likely to be discharged home from the acute setting, but discharge destinations from the sub-acute setting were similar for the two groups. There was a statistically significant

relationship between the presence of pushing and severity of stroke ( $p = 0.001$ ). Acute length of stay was greater for pushers ( $p = 0.001$ ), even when the influence of severity of stroke was excluded. For the use of physiotherapy resources, there were no significant differences when the influence of length of stay was factored out. Physical function scores were significantly less for pushers in the acute setting, and when excluding the influence of severity of stroke, mild stroke patients who were pushers demonstrated lower sitting and walking functional measures. This may reinforce anecdotal evidence that pushing can reduce physical function regardless of the severity of stroke. In the sub-acute setting, no significant differences existed for functional scores, possibly because pushing resolved for many patients during the inpatient stay. The presence of pushing may have potential as a prognostic indicator for acute outcomes such as function, discharge destination and length of stay, but it appears that it is not a great predictor of longer-term outcomes.

### **Cardiorespiratory fitness following stroke**

**Kilbreath SL**

*The University of Sydney*

Cardiorespiratory (CR) fitness is reduced early after stroke. Regardless of whether cycle ergometry or supported treadmill testing is used, aerobic fitness is significantly less than that of age-matched healthy adults. Current physiotherapy practice does not appear to provide sufficient stimulus to improve CR fitness. No change in CR fitness occurred over six weeks in the sub-acute phase in a group of patients receiving rehabilitation, and monitoring of heart rate during physiotherapy and occupational treatments indicated that patients' heart rates did not elevate sufficiently to produce a CR training effect. Persons who have had a stroke months and years previously are still likely to have impaired CR fitness. Notably, these same persons are amenable to CR training, and benefit from training. Improvement in indices of CR fitness has been demonstrated in persons who have undergone cycle ergometry or treadmill training. There are many physiological and psychosocial benefits to be gained from CR training. Potempa and colleagues outlined many of the physiological changes in persons following stroke that occur as a result of CR training, and the benefits gained as a result of these changes. For example, CR training reduces the risk of having either a cardiovascular event or another stroke, common sequelae for many stroke patients. Specifically, relatively strenuous exercise enhances fibrinolysis, which is important in reducing the occurrence of a stroke or myocardial infarction. Improvement in CR capacity via training will also reduce the strain with which persons following stroke perform everyday tasks. This is particularly important for the person who has low CR reserves, as the cost required to perform tasks such as walking may limit the person's ability to resume community ambulation. Another benefit of CR training is the improvement in aspects related to the psychosocial domain, including self-worth. Aerobic training may have some carryover to function. For example, Potempa and co-workers described a modest positive relationship between the gain in CR fitness and overall improvement in sensorimotor function. Also, Kelly and colleagues showed

significant improvement in walking endurance for persons who had undergone 10 weeks of CR training using cycle ergometry. To date, no studies have investigated CR training during the rehabilitation phase. This period, however, may be the ideal time to introduce CR training. Against the background of an ageing lifestyle, CR training could address, in part, the downward degenerative cycle of reduced cardiorespiratory fitness and muscular strength compounded by loss of dexterity which leads to an eventual loss of active lifestyle and further medical sequelae. American College of Sports Medicine guidelines for CR assessment and training, used in the studies on chronic stroke patients, could be used in the early phase of rehabilitation for those patients who have the ability to activate large muscle groups.

### **Suitability for rehabilitation: The ‘Step Down Program’ – enhancing discharge options for the severe neurological patient**

Kravtsov S, Bennett J, Bravin J, Rawicki B and  
**Marshall F**

*Kingston Centre, Melbourne*

With increasing economic pressure to reduce length of stay in both public and private acute care settings, medical and allied health staff are forced to make early predictions on patients’ suitability for rehabilitation to promote timely discharge. For patients who have had a severe neurological event, prognosis is often unclear in the acute stage. Such patients often remain blocking a bed in the acute care setting, and/or are discharged to a nursing home. The ‘Step Down Program’ was developed as an alternative discharge destination by Southern Health for those patients who had suffered a severe neurological event but were too early in their recovery phase for it to be possible to predict if a period of rehabilitation would improve their level of function. The patient stay in the Step Down Program is approximately six weeks, during which time daily assessment of the patient’s functional progress occurs and appropriate intervention is provided by a team of medical and allied health professionals. The final outcome is a recommendation by the team on the most appropriate discharge destination. Thirty-seven patients have been admitted to the program since 1999. Data analysis on 33 patients has revealed that 81.8% were discharged to a rehabilitation program, with an average admission Functional Independence Measure (FIM) score of 33 and an average FIM discharge score of 60. At 12 months follow-up, 79% were living at home. The Step Down Program appears to improve the quality and cost-effectiveness of care for the severe neurological patient and gives the patient the necessary time to prove his or her rehabilitation potential.

### **Systematic review of progressive resistance training in older adults**

Latham NL<sup>1</sup>, Bennett DA<sup>2</sup>, **Stretton CS<sup>3</sup>** and  
Anderson CS<sup>2</sup>

<sup>1</sup>*Boston University, Boston, USA* <sup>2</sup>*University of Auckland, New Zealand* <sup>3</sup>*Auckland University of Technology, New Zealand*

We undertook a systematic review to assess the effects of progressive resistance strength training (PRT) on physical functioning in older adults. We also wished to identify any adverse events associated with PRT. Trials were identified through database searches and study reference lists. Researchers and Cochrane groups were also contacted. Two reviewers independently screened the trials for eligibility, rated their quality, and extracted the data. Data were pooled using fixed or random effects models to produce weighted mean differences (WMD) or standardised mean differences (SMD). Sixty-six trials with a total of 3,783 participants were included. The quality of trials was generally poor. Progressive resistance strength training appeared to have a large positive effect on lower limb strength (41 trials with  $n = 1948$ , SMD 0.68, 95% CI 0.52 to 0.84) and a modest effect on gait speed (14 trials with  $n = 798$ , WMD 0.07 m/s, 95% CI 0.04 to 0.09). No effect of PRT on the physical function domain of the SF-36 was found (seven trials with  $n = 493$ , WMD 0.96, 95% CI -3.4 to 5.3). Adverse events were poorly monitored, but did occur in most studies that prospectively defined and monitored them. Progressive resistance strength training has a large positive effect on strength and a modest positive effect on gait speed in older adults, but the data are limited to support an effect on measures of self-reported health or quality of life. We conclude there is ongoing uncertainty regarding the benefit of PRT in neurological patients, but these findings provide useful indirect evidence of some benefit in older adults.

### **Exercise training improves stair climbing task in chronic stroke patients**

**Lee MJ<sup>1</sup>**, Kilbreath SL<sup>1</sup>, Davis GM<sup>1</sup>, Singh MF<sup>1</sup>,  
Zeman B<sup>2</sup> and Lord S<sup>3</sup>

<sup>1</sup>*The University of Sydney* <sup>2</sup>*Royal Rehabilitation Centre Sydney* <sup>3</sup>*Prince of Wales Medical Research Institute, Sydney*

Muscle weakness and loss of co-ordination following stroke can affect the ability of the patient to ascend stairs. To evaluate the effect of progressive resistance training (PRT) on stair climbing ability, 30 stroke subjects who were no longer receiving rehabilitation were randomly allocated to PRT ( $n = 15$ ) or sham training ( $n = 15$ ). Progressive resistance training comprised 30 sessions over 10-12 weeks, with the training resistance initially set to 80% of one repetition maximum (1RM) for each muscle group and then incremented by 3% per session using Keiser pneumatic resistance machines. Sham training used the same machines, but was performed bilaterally without resistance. Stair-climbing power (W) was calculated from the time to ascend 10 stairs of known vertical displacement and body mass. Comparison of the change score (post/pre), using leg press 1RM as a covariate, revealed that subjects who underwent PRT significantly increased the power with which they ascended stairs compared with those in the sham group, 36% to 0.4%, respectively ( $p = 0.001$ ). Progressive resistance training also significantly improved

IRM of leg muscles more than sham training ( $p < 0.003$ ). An important finding was that power of stair ascent was significantly correlated with IRM of the affected leg muscles ( $r = 0.47-0.72$ ), but was not associated with IRM of the unaffected leg muscles. In conclusion, PRT was effective in addressing muscle weakness and subsequent inability to climb stairs. As it was well tolerated, addressed a major impairment and led to improved function, PRT should be included in rehabilitation for persons following stroke.

### **An audit on shoulder pain in people with traumatic brain injury during rehabilitation**

**Leung J**

*Royal Rehabilitation Centre Sydney*

While the prevalence of chronic pain in the neck or shoulder region after traumatic brain injury (TBI) is reported to be as high as 51%, we have been unable to identify any studies investigating shoulder pain in the acute rehabilitation phase. Early recognition and management of shoulder pain may minimise the possibility of acute pain becoming a chronic problem. The aim of this study was to estimate the prevalence of shoulder pain in adults participating in inpatient rehabilitation after TBI. A retrospective audit of the medical records of 67 people with TBI admitted for inpatient rehabilitation in a large metropolitan brain injury unit over a 12-month period was conducted. The prevalence of shoulder pain was found to be high (30 cases or 45%). This is a conservative estimate as two people who could not report pain reliably but demonstrated some pain behaviours during shoulder assessment were excluded. In most cases (90%) shoulder pain was present on admission to the rehabilitation unit. A cause of the shoulder pain could be identified in eight cases (six had orthopaedic injuries and two had adhesive capsulitis). Limited shoulder range of motion was extremely common amongst those with shoulder pain (90%). While this audit provided valuable information regarding the prevalence of shoulder pain amongst people with TBI participating in inpatient rehabilitation, underestimation is likely due to the lack of a standardised assessment and documentation format. A prospective study on shoulder pain would address these issues and provide more comprehensive and reliable data.

### **Impact of ankle-foot orthoses on gait and leg muscle activity in adults with hemiplegia: Systematic literature review**

**Leung J<sup>1</sup> and Moseley AM<sup>2</sup>**

*<sup>1</sup>Royal Rehabilitation Centre Sydney <sup>2</sup>The University of Sydney*

Ankle foot orthoses (AFOs) are clinical devices designed to improve gait and mobility. The indications for an AFO include foot drag and equinovarus posturing, particularly when walking safety is compromised. However, concerns exist with respect to possible gait deviations arising from the AFO itself, induced disuse of the ankle dorsiflexors and premature firing of plantarflexors, all of which may limit functional recovery. The aim of this systematic review was to investigate if AFO use improves the gait pattern of adult

hemiplegics and determine the impact of AFO use on the muscle activity of the paretic limb. We searched MEDLINE (1966-2000), CINAHL (1982-2000) and EMBASE (1982-2000) for relevant trials. Thirteen trials were included for the effects on gait and four trials for the effects on muscle activity. The results suggest that AFO use may lead to immediate kinematic and temporal improvements in gait (including velocity, stride length, overall gait pattern and walking efficiency) in selected hemiplegic patients. While AFOs may immediately reduce ankle dorsiflexor activity, the long term and cumulative effect is unclear. No evidence supports that AFOs lead to premature firing of plantarflexors. The overall evidence of the impact of AFOs on gait and muscle activity is weak and no strong conclusion can be drawn due to large individual differences, conflicting findings and poor generalisability of some of the studies. The review highlights a lack of well designed and adequately powered randomised controlled trials.

### **The effects of traditional Thai massage on motor development of children with cerebral palsy: A preliminary study**

Lim S<sup>1</sup>, Tuntipidok Y<sup>2</sup>, Subboonmee P<sup>2</sup>, Taileelat N<sup>2</sup>, Srikrajang J<sup>2</sup> and Nualnetr N<sup>3</sup>

*<sup>1</sup>Foundation for Children with Disabilities, Bangkok, Thailand*

*<sup>2</sup>Health and Development Foundation, Bangkok, Thailand*

*<sup>3</sup>Khon Kaen University, Khon Kaen, Thailand*

The aim of this study was to investigate the effects of traditional Thai massage (TTM) in improving motor development in children with cerebral palsy. The participants were 14 children with athetosis and/or spastic cerebral palsy (mean age = 4.6 years, SD = 2.7, range = 2-10). Permission to participate in the study was provided by their parents or caregivers. In addition to their usual physical and occupational therapy programs, TTM was administered to participants by his/her parents or caregivers every day for three months. The main motor development outcome measures included gross motor ability, fine motor skills and oro-facial function. All assessments were carried out by a therapist at baseline and at one-month intervals for three months. The results of this study showed that, at the end of the study, 12 children demonstrated improvements in their motor development, ranked "much improvement" ( $n = 6$ ), "moderate improvement" ( $n = 5$ ) and "little improvement" ( $n = 1$ ). In addition, parents or caregivers reported improvements in children's mental functioning, sleep patterns and bowel movements. They also reported that they themselves had benefited by feeling closer to their child and less stressed. This study suggests that TTM may become a useful adjunct therapy to complement existing management strategies available for children with cerebral palsy. However, the apparent effect of TTM could be due to natural recovery. Further study using randomised controlled trials is suggested to verify the effectiveness of TTM in these children.

## **A pilot intervention program using work-stations to improve functional ability and flexibility in ageing clients with cerebral palsy**

Low Choy NL<sup>1</sup>, Isles RC<sup>2</sup>, Barker RN<sup>1</sup> and Nitz J<sup>1</sup>

<sup>1</sup>The University of Queensland, Brisbane <sup>2</sup>The University of Newcastle

The efficacy of a work-station intervention program to improve functional ability and flexibility in ageing clients with cerebral palsy (CP) was investigated. The study was implemented as health care workers associated with the long-term care of ageing clients with CP have reported on the adverse effects of less active daily activity programs with resultant decreased functional mobility. While the negative effects of ageing have been reported in these clients, programs have not been implemented to determine whether these adverse changes can be reversed or prevented. A clinical intervention study using repeated measures (pre-/post-intervention and at follow-up) to evaluate efficacy was undertaken. Twenty-two clients with CP participated in a twice-weekly work-station program delivered over eight weeks. The work-stations addressed posture awareness, seated forward reach tasks, seated extended reach, active assisted sit to stand and transfer to bed practice, bed mobility, flexibility, wheelchair skill practice and a tilt-table stand. The Physical Mobility Scale (PMS) items and the upper limb score of the Clinical Outcomes Variable Scale provided measures of functional motor ability while flexibility was assessed using seated reach and range limitation of hip and knee extension and gleno-humeral movement. Results showed a significant improvement that was retained at follow-up in functional ( $p < 0.01$ ) but not flexibility measures. The efficacy of a work-station exercise program for ageing clients with CP was demonstrated. Evidence was provided that the PMS is effective in showing level of dependency for these clients.

## **Outcomes of the Bobath approach on upper limb recovery following stroke**

Luke CL<sup>1</sup>, Dodd K<sup>2</sup> and Brock KA<sup>3</sup>

<sup>1</sup>Angliss Hospital, Melbourne <sup>2</sup>La Trobe University, Melbourne  
<sup>3</sup>St Vincent's Hospital, Melbourne

The aim of this study was to determine if the Bobath approach is more effective than other therapy approaches at reducing upper limb impairments, activity limitations and participation restrictions after stroke. Electronic databases from the years 1966-2003 were searched. Two reviewers independently determined if trials met the following inclusion criteria: 1) population: adults with upper limb disability after stroke; 2) intervention: stated use of part or whole of the Bobath approach in isolation from other approaches; and 3) outcomes reflecting upper limb impairment, activity limitations and participation restriction. From the 684 studies initially identified, only seven studies met the inclusion criteria. Five of these were randomised controlled trials and two were single case design studies. Four studies measured impairments including tone, motor control, strength and depression. Significant results were only found for measures of tone. The Bobath approach reduced tone significantly when compared with no intervention ( $d = 0.46$ ) and when compared with proprioceptive neuromuscular facilitation.

However, there was no significant difference in tone between Bobath and a functional approach. Six studies measured activity limitations, all finding equivocal effects of approaches (effect sizes ranged from -0.57 to 0.17). Results of one study reflected participation restriction and found equivocal results. Current literature does not demonstrate superiority of one approach over another. Further research is needed to consider contextual factors and other study limitations. This research should use trained Bobath therapists, sensitive upper limb assessments and homogenous stroke samples to identify the influence of patient factors in response to therapy approaches.

## **Efficacy of a resource-efficient exercise program in reducing disability and handicap in stroke survivors: A randomised controlled clinical trial**

McClellan R<sup>1,2</sup> and Ada L<sup>2</sup>

<sup>1</sup>Coledale Hospital, Wollongong <sup>2</sup>The University of Sydney

The aim of this study was to evaluate the effectiveness of a resource-efficient exercise program in reducing the disability and handicap of stroke survivors after discharge from physiotherapy services. The study was a double-blinded randomised controlled clinical trial. Twenty-six stroke survivors with residual walking deficits, median time six months post-stroke, were randomised into an experimental ( $n = 15$ ) or control ( $n = 11$ ) group. Both groups participated in a six-week home-based exercise program. Subjects in the experimental group were prescribed exercises that challenged their balance. Subjects in the control group were prescribed "sham" balance exercises consisting of upper-limb functional tasks. Exercises were videotaped for the subjects to enhance compliance and encourage correct practice. A blinded assessor performed outcome measures prior to, immediately after and two months after the cessation of intervention. Outcome measures included three measures of disability (standing up from sitting, standing and walking) and one measure of handicap. Subjects in the experimental group demonstrated a significant improvement in standing compared with the control group ( $p = 0.01$ ), which was maintained two months after the cessation of intervention ( $p = 0.04$ ). There was no difference between the groups in standing up from sitting ( $p = 0.91$ ), walking ( $p = 0.46$ ) or handicap ( $p = 0.66$ ). It is recommended that wherever possible, resource-efficient physiotherapy intervention incorporating task-specific training be utilised to provide continued rehabilitation to stroke survivors.

## **Clinical observation of push-off in gait after stroke: Kinetic evaluation of accuracy**

McGinley JL<sup>1,2</sup>, Morris ME<sup>1</sup>, Greenwood KM<sup>1</sup>,  
Goldie PA<sup>1</sup> and Olney S<sup>3</sup>

<sup>1</sup>La Trobe University, Melbourne <sup>2</sup>Kingston Centre, Melbourne  
<sup>3</sup>Queens University, Canada

Physiotherapists routinely use observation as a key component of assessment of gait dysfunction after stroke. The aim of this study was to examine the criterion-related validity (accuracy) of clinical observations of push-off in

gait after a stroke. Six physiotherapists working in a rehabilitation setting (mean experience of six years) were recruited to observe the gait patterns of nine stroke subjects currently under their care. The subjects were involved in gait training, and were able to walk either independently or with supervision. On individual occasions, each therapist observed a patient on their treatment list. All gait observations occurred in the physiotherapy department according to the usual clinical practice of the therapist. Push-off was observed and recorded as either normal or abnormal using two 11-point rating scales. Immediately post-observation, the stroke subject's gait was measured using a three dimensional (3-D) motion analysis system. Biomechanical modelling software calculated peak ankle power generation for each of multiple walking trials. Each subject's observational rating was then correlated with criterion ankle power measurements from a speed-matched walking trial. A strong positive linear relationship was obtained between the visual observations and ankle power generation values from 3-D motion analysis (Pearson  $r = 0.86$ ,  $p = 0.003$ ). The weight of evidence to date suggests that physiotherapists are able to infer push-off accurately in gait following stroke. Further research is in progress to determine whether these observations are sufficiently accurate to detect clinically significant gait changes during rehabilitation.

### **Implementation of evidence-based practice: Task-related circuit training**

Mackey F<sup>1</sup> and Dean CM<sup>2</sup>

<sup>1</sup>The Illawarra Area Health Service, Warrawong <sup>2</sup>The University of Sydney

The aim of this report is to describe the implementation of evidence-based practice to a clinical setting and report the outcome. Specifically, the evidence demonstrated by Dean and colleagues (2000) in their study investigating the effects of task-related circuit training was used to conduct a prospective outcome study at Port Kembla and Coledale hospitals. Limitations to full implementation of the protocol used by Dean and colleagues were identified and modifications made. The most significant change to the protocol was an increase in the duration of the program but a reduction in the frequency of classes. The program implemented was circuit classes conducted twice a week for six weeks and while preference was given to people following stroke, people with other neurological diagnoses were included. The outcome of the program was evaluated by measuring 10 m Walk, the Timed Up and Go, the 6 min Walk and the Step Test. Measurements were taken pre- and post-training, and at six and 12 months. The data reported is from the 60 participants who completed the classes and reassessment. The circuit training resulted in significant improvements in all measures ( $p < 0.001$ ). For all measures except the 10 m walk, the improvements had not changed significantly at six or 12 months. The 10 m walk performance had reduced significantly at six months ( $p = 0.007$ ) and at 12 months ( $p = 0.05$ ). These results suggest that the evidence demonstrated by Dean et al (2000) can be implemented in the clinic, and result in positive outcomes.

### **Examination of the use of weights to reduce tremor and improve function in ataxia**

Mannino N, Ada L and Canning CG

*The University of Sydney*

The purpose of this study was to examine the common practice of adding weights to the wrist to reduce ataxia in patients with cerebellar lesions. Two questions were asked. First, is there a learning effect after the weights have been worn for some time? Second, what is the mechanism underlying their effect? Five subjects primarily with cerebellar ataxia, but good strength were studied. They were tested under four conditions: without weights; immediately after the addition of weights; after 30 minutes of practice with the weights; and after the removal of the weights. In each condition they carried out two functional tests: the nine-hole peg test and the spiral test. In addition, electromyographic activity of the biceps and triceps was collected during a finger-nose pointing test. There was no significant effect of adding weights in the functional tests, however the traces from the spiral test were noticeably smoother. The amount of electrical activity in the biceps but not the triceps was increased during the conditions with the weights compared with without weights. However, there was no change in the timing of the muscle activity in relation to the movement or to each other. It appears that the addition of weights to the upper limb reduces tremor, but not to the extent that function is improved, even after practice. The mechanism by which this happens appears to be a mechanical one, ie the weights require more muscle activity, which has a dampening effect on the amplitude of the tremor.

### **Assessing mobility and locomotor outcomes of individuals with spinal cord injury using the Functional Independence Measure and five additional mobility and locomotor items**

Middleton J<sup>1</sup>, Harvey L<sup>1</sup>, Quirk R<sup>1</sup>, Batty J<sup>2</sup> and Cameron I<sup>3</sup>

<sup>1</sup>Royal Rehabilitation Centre Sydney <sup>2</sup>Prince Henry Hospital, Sydney <sup>3</sup>The University of Sydney

The Functional Independence Measure (FIM) is being increasingly used to gauge the effectiveness of physiotherapy interventions in spinal injury units. The purpose of this study was to compare the ability of the FIM with the ability of five newly designed mobility and locomotor items to discriminate between different impairment groups and to detect changes in mobility and locomotor function of individuals with spinal cord injury (SCI). The five mobility and locomotor items were adapted from a previously published scale and included two transfer items and three wheelchair propulsion items. All eligible patients with SCI admitted to the two Sydney spinal injury units between 1999 and 2002 were assessed using the FIM and the five additional mobility and locomotor items. Patients were tested at regular intervals for up to six months. Forty-three patients were included in the study with four lost to follow-up. The additional five mobility and locomotor items enabled better discrimination between different SCI impairment groups and better responsiveness to functional changes over time, than the FIM locomotor and mobility items. In particular, the vertical (floor-to-

chair) transfer item showed enhanced responsiveness over time and a reduced ceiling effect for the low-level paraplegic group compared with any of the FIM locomotor or mobility items. In the same way, the bed mobility item showed enhanced responsiveness over time for the tetraplegic group. The three wheelchair propulsion items better discriminated between people with tetraplegia and high and low paraplegia, and was more sensitive to changes in locomotor ability over six months than the original FIM locomotor items.

### **A multi-centre randomised controlled pilot study of intensive task-related training of the upper limb following acute stroke**

Miller KJ, Galea MP and Phillips BA  
*The University of Melbourne*

The objective of this study was to evaluate the efficacy of an early, intensive task-related training program designed to improve motor and sensory function of the upper limb following acute stroke. Subjects were recruited within six weeks of their first cortical stroke and randomly allocated to treatment (T) or control (C) interventions. All subjects received three weeks of daily intervention with assigned independent practice activities additional to their standard therapy program. The T group received task-related training of their upper limb emphasising uni-manual and bi-manual functional activities. The C group received exercises to improve postural control and concentration. Assessments were conducted pre- and post-intervention and three months following completion of training. Motor recovery of the affected upper limb was assessed using the Motor Assessment Scale (MAS) and the Chedoke-McMaster Stroke Assessment (CMSA). Manual dexterity, muscle strength and sensation were also assessed. Perceived quality of life was recorded using the Stroke-Adapted 30-Item Sickness Impact Profile (SA-SIP30) three months post-intervention. To date, 24 subjects (14 T and 10 C) have completed the study. While there were no statistically significant differences between the two groups initially, significantly greater gains in motor recovery of the arm on the CMSA ( $p = 0.001$ ), in advanced hand activities on the MAS 8 ( $p = 0.04$ ) and in hand sensation ( $p = 0.01$ ) were recorded in the T group at three months post-intervention. The T group reported significantly greater quality of life ( $p < 0.001$ ). Preliminary results support implementation of early intensive task-related upper limb training following acute stroke.

### **Current physiotherapy for Parkinson's disease: An evidence-based approach**

Morris ME  
*La Trobe University, Melbourne*

This presentation summarises the results of a systematic literature review on the effects of physiotherapy and surgical interventions for movement disorders in people with Parkinson's disease, and derives implications for physiotherapy practice. Journal articles indexed on electronic databases from January 1966 to June 2003 were reviewed. Terms such as Parkinson's Disease and

Parkinsonism were explored and the type of intervention was searched using terms such as physiotherapy, physical therapy, allied health, rehabilitation, neurosurgery, grafting and deep brain stimulation. Databases searched included CINAHL, EMBASE, the Cochrane Controlled Trials Register, Allied and Complementary Medicine, and PEDro. Study type was categorised according to the protocol by Harbour and Miller as: systematic reviews, meta-analyses of randomised controlled trials; randomised controlled studies; non-randomised intervention studies; observational studies; non-experimental studies; and expert opinion. The results provided preliminary evidence that some physiotherapy interventions enable people to reduce impairments, activity limitations and participation restrictions. Effective interventions included external visual and auditory cues, avoidance of dual-task performance, physical activity programs and repeated practice of motor skills using biomechanically efficient movement patterns. The surgical outcomes data showed some evidence for structural and functional recovery with neural grafting and improved motor performance with deep brain stimulation. Given the rapid population ageing currently under way, there is an increasing need for physiotherapists to provide evidence-based clinical interventions for people with this disabling condition, which affects more than 10% of people over 75 years of age.

### **How many trials are required to obtain a valid measure of isometric muscle strength in adults with traumatic brain injury?**

Morris SL, Dodd KJ and Morris ME  
*La Trobe University, Melbourne*

Several investigators have found that hand-held dynamometry (HHD) is a reliable measure of isometric muscle strength in neurological populations. However, the confounding effects of practice and fatigue as trial number increases on measures of isometric muscle strength and the within-session variability of isometric muscle strength in a sample of only traumatic brain injury (TBI) adults awaits investigation. The aim of this study was to determine how many trials are required within a single session to obtain a representative measure of typical within-session isometric muscle strength using HHD. Ten adults in the chronic phase (> 2 years) of their recovery following TBI were recruited. The within-session variability of isometric muscle strength was examined over six consecutively performed trials for the plantarflexors, hip flexors, quadriceps and triceps muscles. Variability was calculated by expressing the deviation (trial score/median) of each of the six trials as a proportion of the typical variability within the sample. Visual inspection of the data by the researchers showed that Trials 1, 5 and 6 were the most variable (mean absolute deviation = 2.1, 1.5, 1.4, respectively). This may have been related to "warm up" and "fatigue" effects respectively. Trials 2 to 4 showed the most stable measures of isometric muscle strength (mean absolute deviation = 1.3, 1.2, 1.2, respectively). To gain a valid measure of within-session isometric muscle strength, it is recommended that data from four trials be collected. The first trial should be used for familiarisation and practice, and to reduce random variability the mean from Trials 2, 3 and 4 should be taken.

## Outcomes of progressive resistance strength training following stroke

Morris SL, Dodd KJ and Morris ME  
*La Trobe University, Melbourne*

The aim of the study was to determine whether progressive resistance strength training programs reduce impairments, activity limitations and participation restrictions following stroke. Electronic databases were searched to find trials conducted from 1966 to 2002. Articles were assessed independently by two reviewers according to the following inclusion criteria: i) population: adults with stroke; ii) intervention: progressive resistive strength training; and iii) outcomes: changes in body structure or function, physical activity or societal participation. From the 350 articles initially identified, eight met the criteria for detailed review. There were three randomised controlled trials, with the remainder being single-case time series analyses or pre-post trials. The five trials that measured impairments of muscle strength showed positive outcomes for progressive resistance strength training, with large effect sizes ( $d = 1.2-4.5$ ). Few negative effects of strength training were reported, and these were minor. Only three of the eight trials that measured activity limitations reported improvements in activities such as walking and stair climbing. The effects of strength training on societal participation could not be determined due to insufficient data. There is preliminary evidence that progressive resistance strength training programs reduce musculoskeletal impairment following stroke. Whether strengthening enhances the performance of functional activities or participation in societal roles remains open to question.

## Inter-rater reliability of the TEMPA for the measurement of upper limb function in adults with traumatic brain injury

Moseley AM and Yap MC  
*The University of Sydney*

The aim of this study was to investigate the inter-rater reliability of the Test Évaluant la performance des Membres supérieurs des Personnes âgées (or the TEMPA) in adults with traumatic brain injury (TBI). Five physiotherapists independently assessed videotapes of 20 people with TBI being assessed using the TEMPA. Only the speed of execution and functional rating components of the TEMPA were assessed. For the functional rating, the total score and the unilateral and bilateral task subtotals were considered. For the speed of execution, individual tasks and the total time to complete all tasks were analysed. Judgment as to whether to time the task or not was also evaluated. Inter-rater reliability was excellent, with intraclass correlation coefficients ranging from 0.90 to 1.00. Eighty per cent agreement between raters was achieved within 0.7 to 0.9 seconds for unilateral tasks compared with 1.0 to 1.8 seconds for bilateral tasks for speed of execution, and within three points for the total functional rating. Although good, reliability of rater judgment of whether or not to time the speed of execution could be improved with more detailed procedures and training of raters. The use of the TEMPA is supported in adults with TBI.

## Walking after traumatic brain injury: A systematic review of prognostic factors

Moseley AM<sup>1</sup> and Glinsky JV<sup>2</sup>

<sup>1</sup>The University of Sydney <sup>2</sup>Royal Rehabilitation Centre Sydney

This systematic review aimed to identify prognostic factors for walking following traumatic brain injury. Both the ability to walk independently and the quality of walking (eg independent walking speed) were the focus of the review. Trials were identified using sensitive searches of the MEDLINE, EMBASE and CINAHL databases to June 2003. Cohort studies of people with traumatic brain injuries that included the outcome of walking or locomotion, had a follow-up of at least three months, and reported on prognostic factors were eligible. Two reviewers independently selected trials, then rated the methodological quality and extracted data (target population, inclusion and exclusion criteria, sample size, time post-injury the cohort was assembled, follow-up duration, outcome measures, and prognostic factors) for the included trials. Any disagreements were resolved by discussion. The searches yielded 2,014 records, but only two fulfilled the eligibility criteria. Both trials were of low quality, with incomplete follow-up, unblinded outcome measurement, and no statistical adjustment for prognostic factors. The prognostic factors identified in the first study were lower limb weakness (manual muscle test grade of two or less in either leg), lower limb incoordination, and pelvic or lower limb fractures. All factors were associated with walking dependence when discharged from inpatient rehabilitation, and lower limb weakness was predictive of walking dependence one year post-injury. For the second trial, age was associated with dependence in locomotion when discharged from inpatient rehabilitation. No robust conclusions can be drawn from this review. Large-scale, well designed prognostic studies are required.

## Reliability of a device designed to measure ankle mobility

Ostrovskaya M, Harvey L, Glinsky J and Byak A  
*Royal Rehabilitation Centre Sydney*

Whilst physiotherapists are aware of the need to measure the effectiveness of their interventions, often the errors associated with clinical measurements are greater than any real potential treatment effect. The aim of this study was to design and then test a device that could be easily and readily used in clinical practice to measure passive ankle mobility. The device consisted of a footplate attached to a wheel. Stretch torque was standardised and ankle range of motion measured with an inclinometer attached to the footplate. A consecutive sample of 15 recently-injured patients with paraplegia and tetraplegia participated in the study. Ankle mobility was measured on two separate occasions two or three days apart. Intraclass correlation coefficients and percent close agreement scores were used to assess agreement between mean measurements obtained on Day 1 and Day 2. The intraclass correlation coefficient was 0.95 (95% CI 0.91 to 0.98). Measurements obtained on Day 1 were within 3 degrees of the measurements obtained on Day 2 77% of the time and within 6 degrees 97% of the time. The footplate is a reliable and simple way to measure ankle mobility in people with spinal cord injuries and could

be widely used to measure the effect of interventions aimed at treating and preventing ankle contractures.

### **The effect of multiple task performance on walking after stroke**

Paul S, Canning CG and Ada L  
*The University of Sydney*

Walking is usually performed with minimal attention, ie it is automated. This allows the performance of additional tasks, such as carrying a glass of water or having a conversation, with little effect on walking performance. The aim of this study was to examine the effect of additional tasks on walking performance in subjects who had completed rehabilitation after stroke. Twenty stroke subjects and 20 age-matched healthy controls were filmed as they walked under four counterbalanced conditions: a single walking task; a dual cognitive task; a dual manual task; and a triple (combined cognitive and manual) task. Gait velocity, cadence, stride length and step length were analysed. Two-way repeated measures ANOVAs were used to compare the differences between stroke and control subjects across the four conditions of walking. Stroke subjects walked more slowly ( $p = 0.001$ ), took shorter strides ( $p = 0.002$ ) and fewer steps per minute ( $p = 0.04$ ) than controls. Velocity declined significantly across conditions ( $p < 0.001$ ) from the single to the dual cognitive to the dual manual and finally to the triple task. Both groups showed similar decrements in walking performance across conditions, ie, there was no significant interaction ( $p = 0.91$  to  $0.99$ ). This group of rehabilitated stroke subjects display automaticity of their impaired walking. This suggests that during rehabilitation every effort should be made to improve motor impairments, ie strength and dexterity, so that the walking performance which is learnt, and hence automated, is optimal.

### **The effect of external cues on balance and alignment in sitting after stroke**

Pepperall N<sup>1</sup>, Brauer SG<sup>1,2</sup>, Isles R<sup>3</sup> and Manning F<sup>1</sup>  
<sup>1</sup>*The University of Queensland, Brisbane* <sup>2</sup>*Princess Alexandra Hospital, Brisbane* <sup>3</sup>*University of Newcastle*

Problems with alignment in sitting following stroke are widely recognised clinically but few studies have investigated the effects of physiotherapy intervention. This study aimed to relate sitting balance and alignment to hemiplegic side and sensory, visual and perceptual impairments; and to determine the effect of external cues on improving sitting balance and alignment. Thirteen stroke patients, six right and seven left hemiplegics, receiving inpatient rehabilitation participated in the study. Sitting balance was measured using force plates for five conditions: comfortable sitting; erect sitting; erect sitting with visual (mirror) feedback; erect sitting with visual, verbal and tactile feedback; and erect sitting with feedback withdrawn. Alignment was measured with a goniometer. Sensory, visual or perceptual impairments were recorded from the medical chart. A letter cancellation task of unilateral neglect was administered. Left hemiplegics showed a greater medio-lateral centre of pressure (COP)

variability for comfortable sitting, and range for erect sitting with mirror than rights. They also showed a greater deviation in alignment in erect sitting. Differences between the five sitting conditions were found for medio-lateral COP variability. More subjects were able to achieve vertical sitting as feedback increased. Correlations were found between sensory loss, hemianopia and unilateral neglect and decreased stability in sitting. This study confirms clinical perceptions that left hemiplegics showed greater alignment, sitting balance, sensory and perceptual problems than right hemiplegics and that they were related. This study provides evidence that physiotherapy intervention can improve sitting balance and alignment even when used on a single occasion.

### **Stimulation-induced plasticity of disynaptic reciprocal Ia inhibition in subjects with and without spinal cord injury**

Perez MA<sup>1,2</sup>, Field-Fote EC<sup>1,2</sup> and Floeter MK<sup>3</sup>

<sup>1</sup>*The Miami Project to Cure Paralysis, Miami, USA* <sup>2</sup>*University of Miami, USA* <sup>3</sup>*National Institutes of Health, Washington DC, USA*

Reciprocal Ia inhibition facilitates alternation between antagonist muscles for normal motor function. Reciprocal Ia inhibition between ankle plantar and dorsiflexor muscles is impaired following spinal cord injury (SCI). This may contribute to abnormal co-contraction of antagonistic muscles that is observed in these individuals. Recent evidence indicates spinal networks may be plastic and may respond to sensory input. This plasticity may be important for motor recovery after SCI. Our goal was to determine whether sensory stimulation induces plasticity of reciprocal Ia inhibition in subjects with SCI and in able-bodied (AB) subjects. Fourteen individuals with incomplete SCI and 25 AB individuals participated in these studies. The stimulation protocols were: 1) patterned peripheral nerve stimulation; 2) combined peripheral and cortical stimulation; 3) uniform peripheral nerve stimulation; and 4) muscle tendon vibration. Plasticity of the Ia reciprocal inhibition circuit was observed in subjects with SCI and AB subjects, but the protocol that elicited plasticity was different for each group. In subjects with SCI, muscle tendon vibration strengthened reciprocal inhibition ( $p = 0.001$ ). No changes in the amount of inhibition were observed using the stimulation protocol. In AB subjects, both patterned ( $p < 0.001$ ) and combined ( $p = 0.001$ ) stimulation strengthened reciprocal inhibition, but uniform stimulation and vibration did not. These results demonstrate the presence of short-term plasticity within spinal inhibitory circuits, both in individuals with SCI and AB individuals. These findings may have implications for the use of sensory stimulation in rehabilitative efforts to motor function in individuals with SCI.

## Does buttock taping improve hip extension following stroke?

Perkins S<sup>1</sup>, Kilbreath SL<sup>1</sup>, Crosbie J<sup>1</sup> and McConnell J<sup>2</sup>

<sup>1</sup>The University of Sydney <sup>2</sup>McConnell and Clements Physiotherapy, Sydney

The aim of the study was to determine whether taping which lifted the buttock region on the affected side improved hip extension during stance phase of walking for persons following stroke. Fifteen stroke subjects walked under three conditions (control, placebo tape and buttock tape) at two speeds (self selected and fast). For each of the six conditions, subjects performed three trials, and all data were analysed. The order in which subjects completed the conditions and the speed at which the trials were completed within each condition were randomised. The hip angle at late stance (heel-off) of the affected leg, stride length of the non-affected leg and walking velocity were measured. The mean maximum hip angle at heel-off for the control, placebo and buttock tape conditions, respectively, at self selected walking speed were  $-3.1 (\pm 6.6)$ ,  $-1.0 (\pm 10.5)$  and  $11.1 (\pm 9.9)$  degrees and  $-2.4 (\pm 5.5)$ ,  $-3.1 (\pm 10.3)$ , and  $8.1 (\pm 8.6)$  degrees at fast walking speed. Hip extension significantly increased with buttock taping from the control condition by 14 degrees at self selected walking speed and by 11 degrees at fast walking speed. Average stride length of the non-affected leg increased with buttock taping by approximately 30 millimetres from both the control and placebo tape conditions, at both walking speeds. Average walking velocity did not change among the three conditions. In conclusion, buttock taping produces an immediate improvement in hip extension during the stance phase of walking, with a concomitant increase in stride length of the unaffected leg.

## Lead and trail limb control during obstacle crossing following stroke

Said CM<sup>1</sup>, Goldie PA<sup>2</sup>, Patla AE<sup>3</sup>, Sparrow WA<sup>4</sup> and Culham E<sup>5</sup>

<sup>1</sup>Austin Health, Melbourne <sup>2</sup>La Trobe University, Melbourne  
<sup>3</sup>University of Waterloo, Canada <sup>4</sup>Deakin University, Melbourne  
<sup>5</sup>Queens University, Canada

The ability to step over small obstacles is essential for safe community ambulation, however many stroke subjects have difficulty negotiating obstacles. The aim of this study was to further quantify the movement disorder following stroke by comparing kinematic variables during obstacle crossing between 12 stroke subjects and 12 healthy subjects, matched for age, gender and height. A six-camera VICON 512 system and forceplate measured kinematic and kinetic variables as subjects stepped over a 4 cm high and 4 cm wide obstacle. Before crossing the obstacle, stroke subjects reduced the distance between the lead limb and the obstacle ( $p < 0.05$ ), but did not alter trail limb position ( $p > 0.05$ ). Lead limb clearance did not differ between the groups ( $p > 0.05$ ), but affected trail limb clearance tended to be reduced in stroke subjects. Stroke subjects landed closer to the obstacle after crossing ( $p < 0.05$ ). Affected limb swing time was greater following stroke ( $p < 0.05$ ). Both the affected and unaffected stance limbs of the stroke subjects were more flexed during obstacle clearance. Some of the differences observed following stroke may have contributed to safety; for example modifying lead limb position before the obstacle

may have assisted in optimal trail limb placement. Other differences, such as landing closer to the obstacle after crossing, may have placed stroke subjects at risk of contact with the obstacle and threatened safety. The findings highlight that obstacle crossing is appropriate for inclusion in a comprehensive physiotherapy assessment of mobility following stroke.

## Shoulder pain, range of movement and functional motor skills after acute tetraplegia

Salisbury S<sup>1</sup>, Low Choy N<sup>2</sup>, Nitz J<sup>2</sup> and Souvlis T<sup>2</sup>

<sup>1</sup>Princess Alexandra Hospital, Brisbane <sup>2</sup>The University of Queensland, Brisbane

The incidence of shoulder pain is reported to be as high as 78% of people with acute tetraplegia, however there is little detailed information in the literature about shoulder pain and its effects. This study aimed to: 1) identify tetraplegic clients who were at risk of developing shoulder pain; 2) identify any relationship between pain and other physical factors such as shoulder range of motion (ROM) and functional skills; and 3) document the course of pain during rehabilitation. Thirty-five subjects with acute tetraplegia were assessed on admission, at intervals during rehabilitation and on discharge. Data collected included demographic details, pain intensity, shoulder ROM and functional outcome using the Clinical Outcomes Variables Scale. The prevalence of pain during rehabilitation was 85%. Risk factors associated with pain during rehabilitation included age less than 30 or over 50 ( $p = 0.06$ ), admission motor level of C2-C5 ( $p = 0.02$ ), admission sensory level of C2-C5 ( $p = 0.006$ ), lower total motor scores ( $p = 0.009$ ) and a shorter duration of bed rest ( $p = 0.06$ ). Subjects with pain lost ROM in left abduction ( $p = 0.04$ ) and right abduction ( $p = 0.05$ ). There was no relationship between shoulder pain and functional motor skills on discharge. Shoulder pain is common in acute tetraplegia and is associated with changes in ROM. An understanding of who is more likely to develop shoulder pain and the associations between pain and other factors such as ROM may assist with early intervention and prevention strategies.

## Contracture management following acquired brain injury

Singer BJ

The University of Western Australia, Perth

The term acquired brain injury (ABI) usually denotes injury due to external trauma, although it can include diffuse injury to brain tissue secondary to pathologies such as stroke or subarachnoid haemorrhage. Musculoskeletal complications, for instance joint contracture, are not uncommon after ABI in spite of considerable improvements in acute and rehabilitative care. Joint contracture usually refers to a fixed loss of joint mobility originating from soft tissue or articular components. Factors which are thought to contribute to the development of contracture include: disuse-induced changes within the musculo-tendinous unit, adaptive muscle shortening and disordered descending neural control producing abnormal

joint posturing. The lack of a clear delineation between fixed contracture and functional deformity related to muscle imbalance may account for the paucity of data describing the incidence of contracture following ABI. Loss of joint range has important implications for the performance of functional tasks, even in individuals who have limited recovery of volitional movement. For instance, loss of ankle range can affect seating posture, compromise stability during standing transfers and interfere with the generation of forward momentum during sit-to-stand and gait. Pain associated with contracture may exacerbate existing disability. Amelioration of joint contracture is a high priority in the physical rehabilitation of patients following ABI. Physiotherapists routinely apply a range of techniques to maintain or restore joint range of motion and muscle length. These include the application of manual or weight bearing passive stretch, strapping, splinting and serial plaster casting. Retraining of correct movement patterns and task specific muscle control is an important component of programs to restore normal function following interventions designed to improve range of motion. Intermittent stretch can produce short term changes in muscle extensibility and reflex excitability; however it is unlikely to prevent or correct loss of joint range where adaptive shortening is severe or where it is associated with persistent involuntary muscle contraction. The application of longer duration stretch to soft tissue structures using orthoses or serial plaster casting is well documented. Although splints are more commonly used to prevent loss of joint range, adjustable orthoses may have a role in contracture management. Evidence of the efficacy of splinting or serial casting to correct adaptive shortening and joint deformity comes largely from uncontrolled trials or small sample descriptive studies. If muscle overactivity is a major and ongoing contributor to contracture it is essential to address this issue to prevent recurrence following corrective treatment. Botulinum toxin type A (BTXA) has been used for over a decade to treat 'spastic' muscle overactivity and related deformity. Evaluation of the prophylactic use of BTXA in brain injured individuals at high risk of developing contracture does not appear to have been undertaken. The need, in some cases, for recurrent conservative intervention to maintain biomechanical alignment and correct muscle imbalance should be weighed against the much more significant cost of failed prevention, namely surgical management.

### **Motor neurone disease – physiotherapy intervention in different onset patterns of motor loss**

**Smith A**

*Bethlehem Health Care, Melbourne*

Motor neurone disease (MND) is a progressive neurological disorder having an incidence of two per 100,000 and affecting men more than women in the ratio of three to two. Although incidence increases with age, MND can develop at any age. Duration from diagnosis to death is usually one to five years however in a minority of cases there is a much shorter or longer course. Motor neurone disease exhibits five different patterns of motor involvement at onset. Each pattern may predict the sequence of motor deterioration, the rate of deterioration

and the prognosis for an individual. Mainstream rehabilitation physiotherapists anecdotally express feelings of frustration and powerlessness in the face of MND. However at Bethlehem Health Care Melbourne (BCHM) we have found that physiotherapy has much to offer in the management of this disease. In addition, procedures which prolong life, such as percutaneous endoscopic gastrostomy, ventilation and drug therapy, mean that physiotherapy is increasingly relevant in helping to optimise the quality of life of people with MND and their carers. Our experience shows that intervention varies with the pattern of motor loss at onset. In some patterns early intervention leads to better outcomes. In other patterns, physiotherapy is often not involved until the later stages of the disease process. This paper discusses the five patterns of motor loss at onset of MND and the intervention physiotherapists at BCHM implement in each group.

### **Establishment of normative data for advanced gross motor skills in young adults to be used in the clinical situation**

**Stone CJ<sup>1</sup>, Hayes DL<sup>1</sup> and Brauer SG<sup>1,2</sup>**

*<sup>1</sup>Princess Alexandra Hospital, Brisbane <sup>2</sup>The University of Queensland, Brisbane*

This study was aimed at establishing normative data in the performance of advanced motor skills in the younger adult population. This data will be used to compare with young adult clients post-brain injury. A group of 24 males and 27 females aged 18 to 35 was established. The subjects were timed performing a series of standardised tests. Guidelines were established for the performance of these activities and what constituted a mistake. The parameters recorded were time taken to perform the tests and mistakes made. The average (avg) and standard deviation (SD) for each test was determined for both males (M) and females (F) in seconds. Results for the Ten Metre Tandem Walk were (M) avg 22.17, SD 4.72, (F) avg 26.99, SD 7.13. The results in the tests utilising all four limbs were star jumps (M) avg 7.51, SD 1.2, (F) avg 7.44, SD 0.85 and scissor jumps which involved the use of four limbs reciprocally (M) avg 8.19, SD 2.62, (F) avg 7.47, SD 0.82. The results of the predominately upper limb tests were alternate hand basketball (M) avg 9.21, SD 1.32, (F) avg 9.35, SD 1.16 and dominant throw and catch (M) avg 12.50, SD 2.53, (F) avg 16.20, SD 3.43. For all these tests the average mistake rate was less than one mistake (range 0 to 0.88) except for the dominant hand activity (F) with a mistake rate of 1.14 mistakes. Reliability and repeatability of these tests is presently being finalised.

### **Principal muscles for reaching forward in an unconstrained functional task: Adaptations following stroke**

**Taylor D<sup>1,2</sup> and Anson JG<sup>1</sup>**

*<sup>1</sup>University of Otago, Dunedin, New Zealand <sup>2</sup>Auckland University of Technology, New Zealand*

The aims of this study were to determine which muscles in the upper limb were consistently recruited during unconstrained forward reaching tasks performed at a self

selected pace and whether muscles were recruited in a proximal to distal sequence. Ten hemiparetic and five control participants completed 15 reaching trials with each arm. Electromyography from eight upper limb muscles was recorded. In the control group and in the unaffected arms of the stroke group, three muscles (anterior deltoid, biceps, and wrist extensors) were active on all trials and were identified as principal muscles. Although these muscles were active in more than 80% of the trials in the affected arm of participants in the stroke group, the onset of activity was delayed in biceps compared with the controls ( $p = 0.005$ ). Onset of activity in wrist extensors of the affected arm of participants in the stroke group was also delayed compared with the controls ( $p = 0.002$ ) and with the stroke participant's unaffected arm ( $p = 0.015$ ). There was no evidence of a proximal-to-distal sequence of muscle onsets in the control group ( $p = 0.89$ ), or the unaffected ( $p = 0.69$ ) or affected arms ( $p = 0.17$ ) of the stroke group. Thus the three muscles identified as principal muscles for the reaching tasks were not recruited in a fixed proximal-to-distal order, although onset of the biceps and wrist extensors was delayed relative to anterior deltoid in the affected arms of the stroke participants.

### **A pilot program to improve specific vestibular function, balance and mobility in patients with multiple sclerosis who are community ambulant**

Tee LH<sup>2</sup>, Low Choy NL<sup>1</sup>, Bew P<sup>3</sup> and Nitz JC<sup>1</sup>

<sup>1</sup>The University of Queensland, Brisbane <sup>2</sup>Tan Tock Seng Hospital, Singapore <sup>3</sup>Redcliffe Base Hospital, Brisbane

This study investigated the efficacy of a tailored work-station program to improve specific vestibular function, balance and mobility in patients diagnosed with multiple sclerosis (MS). A randomised pilot study with mixed repeated measure design was implemented using a convenience sample of 17 subjects. The experimental group participated in a tailored work-station program, delivered twice a week for six weeks. The control group received a "traditional" home exercise program for six weeks. Balance measures included Single Limb Stance, Sharpened Romberg, modified Clinical Test for the Sensory Interaction of Balance, and Functional Reach. Functional mobility measures included the Timed Up and Go Test and the Dynamic Gait Index. The Dynamic Visual Acuity Test and Dizziness Handicap Inventory were used to evaluate gaze stability and dizziness respectively. The Multiple Sclerosis Impact Scale provided a measure of self-perceived disability of MS. The experimental group demonstrated a significant improvement in Functional Reach compared with the control group post-intervention ( $p = 0.046$ ) retained at one month follow-up ( $p = 0.31$ ). There was no other significant improvement. While the specific vestibular function of MS subjects did not improve significantly following a tailored intervention program functional reach significantly improved compared with the control group. This pilot data provides preliminary support for the inclusion of functional balance tasks within a work-station model for retraining MS clients.

### **Cortical excitability and hand function following central and peripheral stimulation in chronic hemiparesis**

Uy J<sup>1</sup>, Ridding MC<sup>1</sup>, Hillier S<sup>2</sup> and Miles TS<sup>1</sup>

<sup>1</sup>The University of Adelaide <sup>2</sup>University of South Australia, Adelaide

This pilot study examined the effects of a combined peripheral and low-frequency cortical stimulation on neurophysiological and hand-function scores in six stroke subjects with chronic, stable hemiparesis. All subjects underwent a combined transcranial magnetic stimulation (TMS) and motor point stimulation of the affected extensor carpi ulnaris (ECU) for 30 minutes per day, five days/week for four weeks. Motor evoked potentials (MEPs) and maximal voluntary electromyographic (EMG) activity of the ECU, extensor digitorum, first dorsal interosseus and biceps brachii muscles were recorded daily. The motor cortex was also mapped using TMS to determine centre of gravity (CoG) of ECU. Functional measures of the hand using the Action Research Arm Test (ARAT) and subjective questionnaire responses were also obtained. The results for all subjects were highly variable and did not achieve statistical significance. However, by the end of the fourth week of stimulation, the CoG of the stimulated muscles shifted by an average of 0.4 centimetres, the voluntary EMG activity increased by 70%, and MEP amplitudes increased by 45% at rest and 42% during active contraction. Three subjects showed improvements in all four categories of the ARAT and all subjects reported subjective improvements. The effects of dual stimulation on both cortical excitability and functional outcome measures were inconsistent. However, some patients showed marked improvements. Future studies to identify the factors responsible for the positive responses to dual stimulation should optimise our novel approach of inducing cortical reorganisation and functional changes in chronic hemiparesis.

### **Measuring high-level mobility following traumatic brain injury: A review of recent literature**

Williams G<sup>1</sup>, Robertson V<sup>2</sup> and Greenwood K<sup>2</sup>

<sup>1</sup>Bethesda Rehabilitation, Epworth Hospital, Melbourne <sup>2</sup>La Trobe University, Melbourne

The aim of this review was to identify traumatic brain injury (TBI) studies that reported mobility outcomes and examine which measurement tools they used to measure it. The search strategy identified 678 studies. Excluding articles that focused on children, cognitive, behavioural or psychosocial outcomes, 137 studies were collected for full text review. The most frequently used measure for assessing mobility outcomes following brain injury was the Functional Independence Measure (FIM). Findings include the following: activity limitation scales focusing on mobility are seldom used and those that are have a ceiling effect and typically do not measure mobility beyond walking and stair use; inpatient measures such as the FIM are used as outpatient or long-term follow-up measures, applications for which they were not designed; and 'participation' scales are unable to identify if a restriction in participation relates to a mobility limitation. Many

studies developed and used their own unvalidated outcome measures, making comparisons and evaluations difficult and some studies did not use any outcome measures at all. A high level mobility scale is needed to fill the gap between the current 'activity' scales that measure mobility to a level of walking and stair use and the 'participation' scales that measure leisure and sporting activities. Such a high-level mobility scale is essential to identify and describe the deficits and changes that are currently not measurable following TBI, and may help guide treatment and goal setting for therapists.

### **Development of a high-level mobility scale for use in traumatic brain injury**

**Williams G<sup>1</sup>, Robertson V<sup>2</sup>, and Greenwood K<sup>2</sup>**

<sup>1</sup>Bethesda Rehabilitation, Epworth Hospital, Melbourne <sup>2</sup>La Trobe University, Melbourne

Existing methods of measuring high-level mobility following traumatic brain injury (TBI) are inadequate. The aim of this study was to develop a high-level mobility scale for use in the TBI population. High-level mobility items were generated from a review of adult and paediatric neurological mobility scales and a consensus method involving expert physiotherapists. One hundred TBI patients, aged 14 to 60, were tested on each of the 20 items generated. Data were analysed using Rasch analysis. Preliminary findings have reduced the number of items and indicate that the new scale is less susceptible to a ceiling effect than existing scales. The new high-level mobility scale is stable, more discriminative at a high level than existing scales and reliable in terms of inter-rater and retest reliability. This scale is intended to fill the gap between the current 'activity' scales that measure mobility to a level of walking and stair use and the 'participation' scales that measure involvement in leisure and sporting activities. The high-level mobility scale is also intended to be used to describe deficits and assess previously immeasurable changes as well as guiding treatment and goal setting for therapists, as the current activity scales do at a lower level of mobility.

### **Rehabilitation clinical pathway for stroke, with low and high Barthel scores on admission**

**Winter A and Boyle K**

*Caulfield General Medical Centre, Melbourne*

With the introduction in Victoria of the Casemix Rehabilitation and Funding Tree (CRAFT) for stroke, which distinguishes between high and low Barthel scores on admission, and funded length of stay, Caulfield General Medical Centre's medical, nursing and allied health staff designed a clinical pathway for stroke, with the aim of clearly identifying whether funding would be for 19 to 28 days (high Barthel score of > 60), or for 37 to 45 days (low Barthel score of < 60). Expectations of various outcomes are mapped, week by week, into the pathway (for example, level of dependence in transfers). The first week of the pathway is generic, but once admission Barthel scores are completed, the pathway is split into longer and shorter pathways, with expected outcomes per week reflecting the relevant CRAFT funding category. Variances to these expectations are noted and reasons for variance documented. This paper looks at the two pathways, with specific reference to the physiotherapy sections of the pathway and physiotherapy outcome data for the first three month trial of collection of outcome variables, and the first four month trial of the entire pathway, as well as the outcome data collected in this period. In the first three month trial of collection of outcome data, data from 20 patients was collected. The Motor Assessment Scale scores and the Timed Up And Go test times were collected on admission and discharge, as well as length of stay, admission and discharge Functional Independence Measure scores and discharge destination.

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