

Abstracts 2001

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J. Halfens, M. Lynch-Ellerington, E. Panturin, J. Kool

To facilitate the use of these abstracts you find:

- Subject List (below) followed by a list of
- Abstracts by Author

Aids and orthoses Janssen-Potten;

Arm-Hand Function

Bender; Bhakta; Binkofski; Chae; Hendricks; Kondo; Ma; Morris; Nelles; Page; Price; Taub; van der Lee; van der Lee;

Assessment

Bhakta, Cozens, Chamberlain and Bamford; Bowen; Dean; Feld; Lamontagne; Morris, Uswatte, Crago, Cook and Taub; Morris; Pandyan; Salbach; Stevenson;

Balance and Postural Control

Campbell; Cheng; de Seze; Feld, Rabadi, Blau and Jordan; Geiger; Kusoffsky; Perennou; Ruckenstein; Stevenson; Trueblood; Welgampola;

Cognition-Emotion-Behaviour (incl. Neglect)

Booth; Bowen, Wenman, Mickelborough, Foster, Hill and Tallis; de Seze, Wiart, Bon-Saint-Come, Debelleix, Joseph, Mazaux and Barat; Fong; Page; Perennou, Leblond, Amblard, Micallef, Herisson and Pelissier; Swan; Tilikete;

Education Rowat;

Epidemiology Kimura;

Face, speech, swallowing Finestone; Freed; Pulvermuller;

Gait

Barbeau; Bowen, Wenman, Mickelborough, Foster, Hill and Tallis; Cheng, Wu, Liaw, Wong and Tang; Dean, Richards and Malouin; Feld, Rabadi, Blau and Jordan; Hesse; Lamontagne, Malouin and Richards; Laufer; Lennon; Macko; Morris, Morris and Iansek; Nilsson; Said; Salbach, Mayo, Higgins, Ahmed, Finch and Richards; Stevenson; Trueblood;

Impairments (Neurological, Muscular, Sensory, Pain)

Nelles, Jentzen, Jueptner, Muller and Diener; Pandyan, Price, Rodgers, Barnes and Johnson;

Management

Chatterton; Kondo, Hosokawa, Soma, Iwata and Maltais; Rowat;

Measurement/assessment Outcome

Alexander; Bhakta, Cozens, Chamberlain and Bamford; Binkofski, Seitz, Hacklander, Pawelec, Mau and Freund; Green;

Medical and surgical treatment

Benabid; Scheidtmann;

Movement Analysis

Bowen, Wenman, Mickelborough, Foster, Hill and Tallis; Campbell, Ashburn, Pickering and Burnett; Janssen-Potten, Seelen, Drukker, Huson and Drost; Kusoffsky, Apel and Hirschfeld; Lamontagne, Malouin and Richards; Ma and Trombly; Said, Goldie, Patla and Sparrow;

Neuropathology

Benabid, Koudsie, Benazzouz, Vercueil, Fraix, Chabardes, Lebas and Pollak; Swan; Toffola;

Neurophysiology

Biernaskie; Campbell, Ashburn, Pickering and Burnett; Lamontagne, Malouin and Richards; Ma and Trombly; Nelles, Jentzen, Jueptner, Muller and Diener; Pandyan, Price, Rodgers, Barnes and Johnson; Toffola, Sparpaglione, Pistorio and Buonocore; Welgampola and Colebatch;

Prediction of outcome

Alexander, Bugge and Hagen; Binkofski, Seitz, Hacklander, Pawelec, Mau and Freund; Feld, Rabadi, Blau and Jordan; Fong, Chan and Au; Salbach, Mayo, Higgins, Ahmed, Finch and Richards;

Reorganisation/Recovery

Biernaskie and Corbett;

Treatment and Effectiveness of treatment

Andersen; Andersen; Barrett; Bateman; Bender and McKenna; Booth, Davidson, Winstanley and Waters; Chae, Fang, Walker and Pourmehdi; Chatterton, Pomeroy and Gratton; Cheng, Wu, Liaw, Wong and Tang; de Goede; de Seze, Wiart, Bon-Saint-Come, Debelleix, Joseph, Mazaux and Barat; Finestone, Foley, Woodbury and Greene-Finestone; Freed, Freed, Chatburn and Christian; Geiger, Allen, O'Keefe and Hicks; Hendricks, MJ, de Kroon, in 't Groen and Zilvold; Hesse, Werner, Uhlenbrock, von Frankenberg, Bardeleben and Brandl-Hesse; Kondo, Hosokawa, Soma, Iwata and Maltais; Langhammer; Laufer, Dickstein, Chefez and Marcovitz; Lennon; Lennon; Macko, Smith, Dobrovolny, Sorkin, Goldberg and Silver; Nieuwboer; Nilsson, Carlsson, Danielsson, Fugl-Meyer, Hellstrom, Kristensen, Sjolund, Sunnerhagen and Grimby; Page, Levine, Sisto and Johnston; Page, Sisto, Levine, Johnston and Hughes; Panturin; Park; Perennou, Leblond, Amblard, Micallef, Herisson and Pelissier; Price and Pandyan; Pulvermuller, Neininger, Elbert, Mohr, Rockstroh, Koebbel and Taub; Ruckenstein; Scheidtmann, Fries, Muller and Koenig; Taub and Morris; Tilikete, Rode, Rossetti, Pichon, Li and Boisson; Trueblood; van der Lee; van der Lee, Snels, Beckerman, Lankhorst, Wagenaar and Bouter; van Vliet; Wade;

Abstracts alphabetically ordered by author

Alexander H., Bugge C. and Hagen S.

What is the association between the different components of stroke rehabilitation and health outcomes?
Clin Rehabil, 15 (2001) 207-15.

OBJECTIVES: To describe the rehabilitation input stroke patients received from health professionals during the early post stroke period and to explore possible associations between health outcomes and these rehabilitation inputs. **DESIGN:** Community-based study with prospective identification of stroke patients from a random sample of 24 general practices stratified by geographical area and practice size. **SETTING:** Ayrshire and Arran Health Board area, West of Scotland. **INTERVENTIONS:** All physiotherapy, occupational therapy, dietetics, podiatry, speech and language therapy and community nursing inputs given to stroke patients in the course of normal treatment were recorded. **OUTCOME MEASURES:** Barthel Index and Medical Outcomes Study Short Form-36 (SF-36). Both recorded at one, three and six months post stroke. **RESULTS:** Of the 152 people providing data, more had received physiotherapy than any other rehabilitation input at all three follow-ups (81%, 47%, 39%), with occupational therapy being the next most common service (65%, 44%, 25%). Amount of rehabilitation input was significantly negatively correlated with health outcomes measured at each discrete time point: those patients with the poorest outcomes received greatest input. However, regression analysis of change in outcome scores showed that increasing amounts of rehabilitation input were significantly associated with a reduction in disability, particularly between one and three months post stroke. **CONCLUSIONS:** Not only have we shown that those stroke patients with poorest outcomes received most rehabilitation input, but, from analysis of the individual rehabilitation inputs, we have identified some rehabilitation inputs that significantly predict improved outcomes. This suggests that there would be merit in further investigation of these associations.

Andersen H.E., Jurgensen K.S. and Boysen G.

Intervention for apoplexy patients discharged from hospital. Physical training: a literature review
Ugeskr Laeger, 163 (2001) 1255-9.

Stroke is among the leading causes of disability in Denmark. Rehabilitation services are in the process of being reorganised into dedicated stroke units. There is a general tendency toward reduction of length of in-patient treatment. The literature on outpatient rehabilitation services following primary rehabilitation on an inpatient basis was reviewed. The results of 16 randomised studies indicate that: 1) Continued rehabilitation after discharge can improve functional capacity of disabled stroke survivors; 2) Home-based rehabilitation is as effective as hospital-based outpatient rehabilitation; 3) Early supported discharge (ESD) services can reduce length of hospital stay but the relative advantages and drawbacks remain unclear. Ongoing rehabilitation by teams specialised in stroke rehabilitation seems to be crucial. More research, including evaluation of home-based rehabilitation services, is called for and existing outpatient rehabilitation services should be evaluated scientifically.

Andersen H.E., Schultz-Larsen Jurgensen K., Kreiner S., Forchhammer B.H., Eriksen K. and Brown A.

Can readmission after apoplexy be prevented? Post-hospital follow-up intervention for apoplexy patients
Ugeskr Laeger, 163 (2001) 6421-7.

INTRODUCTION: The aim of this study was to evaluate two models of an organised postdischarge follow-up service for stroke survivors in comparison with standard aftercare. **METHODS:** One hundred and fifty-five stroke patients discharged to their homes with lasting impairment were randomised as follows: 54 to follow-up home visits by a physician (INT1-HVP), 53 to instruction by a physiotherapist in their home (INT2-PI), and 48 to standard aftercare (control). Six months after discharge, data on readmission were collected. **RESULTS:** The readmission rate over the six-month period was 26% in the INT1-HVP group, 34% in the INT2-PI group, and 44% for the controls ($p = 0.028$). Multivariate analysis of the readmission risk showed a significant, favourable effect of intervention in interaction with the length of hospital stay ($p = 0.0332$), which indicates that the effect of intervention was strongest for patients with a long inpatient rehabilitation. **DISCUSSION:** Follow-up intervention after discharge seems to be a way of preventing readmission, especially for patients with a long inpatient rehabilitation.

Barbeau H. and Fung J.

The role of rehabilitation in the recovery of walking in the neurological population

Curr Opin Neurol, 14 (2001) 735-40.

Recent studies demonstrate that neurological patients show great potential for recovery in both the early and late stages following injury. Enhancement of the recovery process could be achieved with new rehabilitation approaches alone or in combination with pharmacological intervention. These new approaches have evolved from fundamental advances in both animal and human studies. To date few randomized clinical trials have addressed the efficacy or effectiveness of these new approaches. In this paper, important quantitative studies will be reviewed and discussed in relation to the important mechanisms of locomotor control and plasticity that take place following lesions of the central nervous system.

Barrett J.A., Evans L., Chappell J., Fraser C. and Clayton L.

Bobath or Motor Relearning Programme: a continuing debate

Clin Rehabil, 15 (2001) 445-6.

OBJECTIVE: To examine whether two different physiotherapy regimes caused any differences in outcome in rehabilitation after acute stroke. **DESIGN:** A double-blind study of patients with acute first-ever stroke. Sixty-one patients were consecutively included, block randomized into two groups, and stratified according to gender and hemiplegic site. Group 1 (33 patients) and group 2 (28 patients) had physiotherapy according to Motor Relearning Programme (MRP) and Bobath, respectively. The supplemental treatment did not differ in the two groups. **MAIN OUTCOME MEASURES:** The Motor Assessment Scale (MAS), the Sodrting Motor Evaluation Scale (SMES), the Barthel ADL Index and the Nottingham Health Profile (NHP) were used. The following parameters were also registered: length of stay in the hospital, use of assistive devices for mobility, and the patient's accommodation after discharge from the hospital. **RESULTS:** Patients treated according to MRP stayed fewer days in hospital than those treated according to Bobath (mean 21 days versus 34 days, $p = 0.008$). Both groups improved in MAS and SMES, but the improvement in motor function was significantly better in the MRP group. The two groups improved in Barthel ADL Index without significant differences between the groups. However, women treated by MRP improved more in ADL than women treated by Bobath. There were no differences between the groups in the life quality test (NHP), use of assistive devices or accommodation after discharge from the hospital. **CONCLUSION:** The present study indicates that physiotherapy treatment using the MRP is preferable to that using the Bobath programme in the acute rehabilitation of stroke patients.

Bateman A., Culpan F.J., Pickering A.D., Powell J.H., Scott O.M. and Greenwood R.J.

The effect of aerobic training on rehabilitation outcomes after recent severe brain injury: a randomized controlled evaluation

Arch Phys Med Rehabil, 82 (2001) 174-82.

OBJECTIVE: To examine the impact of fitness training with recently brain-injured inpatients on exercise capacity and functional and psychologic outcome measures. **DESIGN:** A randomized controlled trial of exercise versus relaxation training for 3 months. Blind assessments were conducted before and after the end of a 12-week training program, as well as at follow-up assessment 12 weeks posttraining. **SETTING:** Four regional neurologic inpatient rehabilitation units. **PATIENTS:** Of 157 patients recruited 24 +/- 14 weeks after single-incident brain injury, 142 patients were assessed at week 12, and 128 patients at follow-up. **INTERVENTIONS:** Patients were randomized between cycle ergometer aerobic training and a relaxation training control condition, which was theoretically inert with respect to cardiovascular fitness. **MAIN OUTCOME MEASURES:** Validation of exercise training (peak work rate, peak heart rate, body mass index); mobility and physical function (modified Ashworth scale, Berg balance scale, Rivermead Mobility Index, 10-m walk velocity); disability and dependency (Barthel index, FIMtrade mark instrument, Nottingham Extended Activities of Daily Living); and psychologic function (fatigue questionnaire, Hospital Anxiety and Depression Scale). **RESULTS:** Significant improvements in exercise capacity ($p < .05$) in the exercise training group ($n = 70$) relative to the control group ($n = 72$) were not matched by greater improvements in functional independence, mobility, or psychologic function, at either 12 weeks or follow-up. **CONCLUSIONS:** The benefits of improved cardiovascular fitness did not appear to extend to measurable change in function or psychologic state.

Benabid A.L., Koudsie A., Benazzouz A., Vercueil L., Fraix V., Chabardes S., Lebas J.F. and Pollak P.

Deep brain stimulation of the corpus luyisi (subthalamic nucleus) and other targets in Parkinson's disease. Extension to new indications such as dystonia and epilepsy

J Neurol, 248 Suppl 3 (2001) III37-47.

Chronic high frequency (130 Hz) stimulation (HFS) of the thalamic target Vim, first used in our group in 1987 as a treatment of tremor of various origins, has been used over the last ten years in 137 patients. Since 1993, this method has been extended to two other targets (subthalamic nucleus (STN): 137 patients and the medial pallidum (GPI): 12 patients), based on recent experimental data in rats and monkeys. STN appears to be a target of major interest, able to control the three cardinal symptoms and to allow the decrease or suppression of levodopa treatment, which then also suppresses levodopa induced dyskinesias. The stereotactic technique is based on the determination of the target using ventriculography, MRI and electrophysiology, with both microrecording of single neuron activity and microstimulation inducing therapeutic symptom suppression and side effects. Chronic electrodes are then placed bilaterally at the best physiologically defined location and then connected to implantable stimulators (either 2 Itrel II or the new double channel Kinetra), operated at 130-185 Hz, 60 ms pulse width, 2.5 to 3.5 volts. There was no operative mortality and permanent morbidity was observed in 3 patients. The mechanisms of action of HFS are not fully understood, but are definitely related to high frequency and are probably different depending on the target. Inhibition of cellular activity or of neural network functions could be induced, by jamming of a retroactive loop for tremor, or by shutdown of neurotransmitter release in STN. Mechanisms within an individual target are also probably different for tremor or for other symptom alleviation. All cardinal symptoms are alleviated from tremor to akinesia and rigidity. This strong improvement allows the decrease of the drug dosage to approximately 30% of the preoperative level, which suppresses the levodopa-induced dyskinesias. The off period dystonias are also suppressed as well as freezings and falls. The effects remain stable over more than 5 years and in the same period, the off stimulation-off medication UPDRS remains stable and does not increase at the usual rate. The low rate of permanent complications, the minor side effects and their immediate reversibility, the possibility of bilateral implantation in one session and the long-term persistence of symptom relief are strong arguments which support chronic HFS of STN as the method of choice when a surgical procedure is indicated for the treatment of Parkinson's disease and even more when a bilateral procedure is necessary. Recent data show that STN stimulation could be useful in the treatment of dystonia as well as some forms of epilepsy. It is therefore possible that DBS in STN as well as in other targets could become a potent therapeutic tool in the near future for neurological disorders.

Bender L. and McKenna K.

Hemiplegic shoulder pain: defining the problem and its management

Disabil Rehabil, 23 (2001) 698-705.

PURPOSE: Hemiplegic shoulder pain can affect up to 70% of stroke patients and can have an adverse impact on rehabilitation outcomes. This article aims to review the literature on the suggested causes of hemiplegic shoulder pain and the therapeutic techniques that can be used to prevent or treat it. On the basis of this review, the components of an optimal management programme for hemiplegic shoulder pain are explored. **METHOD:** English language articles in the CINAHL and MEDLINE databases between 1990 and 2000 were reviewed. These were supplemented by citation tracking and manual searches. **RESULTS:** A management programme for hemiplegic shoulder pain could comprise the following components: provision of an external support for the affected upper limb when the patient is seated, careful positioning in bed, daily static positional stretches, motor retraining and strapping of the scapula to maintain postural tone and symmetry. **CONCLUSIONS:** Research is required to evaluate the effectiveness of the components of the proposed management programme for the prevention and treatment of hemiplegic shoulder pain and to determine in what combination they achieve the best outcomes.

Bhakta B.B., Cozens J.A., Chamberlain M.A. and Bamford J.M.

Quantifying associated reactions in the paretic arm in stroke and their relationship to spasticity

Clin Rehabil, 15 (2001) 195-206.

OBJECTIVES: (1) To present a measurement protocol for assessing associated reactions (AR) in the paretic arm and (2) to use it to investigate the pattern of AR and its association with spasticity. **SETTING:** Inpatient

rehabilitation unit. **DESIGN:** Associated reactions in 49 adults with stroke were measured in terms of force generated, electrical muscle activity and wrist movement in the paretic arm using hand dynamometry, surface electromyography and electrogoniometry respectively. Simultaneous recording of the effort used to elicit the associated reaction was made using a second hand dynamometer. The magnitude and persistence of AR was compared with the clinical assessment of spasticity (using the modified Ashworth Scale, MAS). **RESULTS:** There was poor correlation between peak AR and MAS, suggesting that AR are not confined to patients with severe spasticity. Co-activation of forearm flexors and extensors was evident during the AR. AR fluctuated during a single period of effort in some patients. Only 12 out of 31 patients who maintained uniform effort over the measurement period produced a uniform AR. AR often persisted for some time after effort had ceased. Eight were classified as minimal (median AR 0.23 N), 25 as mild (median AR 2.7 N), 11 as moderate (median AR 6.4 N) and 3 as severe (median AR 11.0 N). AR tended to persist in patients with higher MAS although this result was not statistically significant. **CONCLUSION:** The magnitude, profile and persistence of AR varied considerably between individuals. Associated reactions were present in people with minimal spasticity. As this technique allows the magnitude of AR to be quantified in relation to effort it has the potential to be a useful outcome measure in clinical trials evaluating the treatments (e.g. physiotherapy) directed at reducing associated reactions.

Biernaskie J. and Corbett D.

Enriched rehabilitative training promotes improved forelimb motor function and enhanced dendritic growth after focal ischemic injury

J Neurosci, 21 (2001) 5272-80.

Chronic impairment of forelimb and digit movement is a common problem after stroke that is resistant to therapy. Previous studies have demonstrated that enrichment improves behavioral outcome after focal ischemia; however, postischemic enrichment alone is not capable of enhancing fine digit and forelimb function. Therefore, we combined environmental enrichment with daily skilled-reach training to assess the effect of intensive task-specific rehabilitation on long-term functional outcome. Rats were subjected to either endothelin-1-induced focal ischemia or sham surgery and subsequently designated to enriched-rehabilitation or standard-housing treatment groups starting 15 d after ischemia. Functional assessment of the affected forelimb at 4 and 9 weeks after treatment revealed that ischemic plus enrichment (IE) animals had improved approximately 30% on the staircase-reaching task and were indistinguishable from sham animals for both latency and foot faults in a beam-traversing task. In contrast, ischemic plus standard (IS) animals remained significantly impaired on both tasks. Interestingly, both ischemic groups (IE and IS) relied on the nonaffected forelimb during upright weight-bearing movements, a pattern that persisted for the duration of the experiment. Dendritic arborization of layer V pyramidal cells within the undamaged motor cortex was examined using a Golgi-Cox procedure. IE animals showed enhanced dendritic complexity and length compared with both IS and sham groups. These results suggest that enrichment combined with task-specific rehabilitative therapy is capable of augmenting intrinsic neuronal plasticity within noninjured, functionally connected brain regions, as well as promoting enhanced functional outcome.

Binkofski F., Seitz R.J., Hacklander T., Pawelec D., Mau J. and Freund H.J.

Recovery of motor functions following hemiparetic stroke: a clinical and magnetic resonance-morphometric study
Cerebrovasc Dis, 11 (2001) 273-81.

Predictors for the degree of clinical recovery after stroke are still poorly defined. In this study we tried to assess the predictive value of clinical data and of lesion size for motor recovery after ischemic stroke. In 52 hemiparetic patients we monitored the course of clinical recovery by a dedicated score of sensorimotor hand function after their first stroke. The course of the lesion size was measured in proton density magnetic resonance images. Three groups of patients were identified. Patients with moderate initial motor deficit recovered almost completely within 9 days (17/17, group 1). From the patients with severe initial motor deficit, about equal numbers recovered (16/35, group 2) or remained severely impaired during the entire observation period of more than 6 months (19/35, group 3). There was no correlation between changes of lesion size and motor deficit. Logistic regression of probability of good clinical outcome on initial lesion size, initial motor score and subcortical versus cortical location of lesion showed that only the initial motor score was predictive ($p = 0.006$). A relative improvement of the initial motor score of about 20% in the first 4 weeks after stroke appeared to be a relevant cut point for good outcome. The data indicate that patients with mild initial motor deficits recover well, whereas severely affected patients may

differ in outcome. Since lesion size was not correlated with outcome the amount of spared residual function appeared as major determinant for the capacity for motor recovery.

Booth J., Davidson I., Winstanley J. and Waters K.

Observing washing and dressing of stroke patients: nursing intervention compared with occupational therapists. What is the difference?

J Adv Nurs, 33 (2001) 98-105.

This study sought to compare the interventions of qualified nurses with those of occupational therapists during morning care with the same population of stroke patients. Nonparticipant structured observation was used to identify the activities and interventions carried out by each of the two groups in a naturalistic care setting. Approval for the study was granted by the local ethics committee. In order to allow comparison between pairs, staff-patient interactions during morning care (n=10) were observed by a single researcher, firstly, with an occupational therapist and within 3 days of this, with a nurse. Twenty observation sessions were recorded in total during which time the activities, contacts and interactions were coded and recorded at 20- second intervals on a standard proforma. Analysis was undertaken using the Statistical Package for Social Sciences (SPSS) for windows. The results showed that occupational therapists used 'prompting and instructing' commands more than nurses and used facilitation techniques significantly more (P=0.0283). 'Supervision' interactions were preferred by nurses with 42.1% of their time spent performing this activity compared with 25.1% for occupational therapists. These results are limited to the group under observation. It is suggested that the reasons for the observed differences in intervention styles used by occupational therapists and nurses may be attributed to the approach taken to the assessment and treatment of stroke patients. This difference might be attributed to a lack of preparation for specialist neurological/neurovascular practices of nurses working in the field of stroke rehabilitation.

Bowen A., Wenman R., Mickelborough J., Foster J., Hill E. and Tallis R.

Dual-task effects of talking while walking on velocity and balance following a stroke

Age Ageing, 30 (2001) 319-23.

BACKGROUND: Therapists and nurses often use verbal instruction in the rehabilitation of mobility following stroke. This study aimed to determine whether performing a verbal cognitive task while walking adversely affected patients' balance and velocity. **METHODS:** There were two counterbalanced conditions: walking only and walking and concurrent cognitive activity. The cognitive activity used was to give one of two verbal responses to two verbal stimuli. An electronic GaitMat measured gait velocity and balance (double support time as a percentage of stride time). **RESULTS:** 11 people with stroke participated in the study (five women and six men, mean age 72 years, SD 9). They were on average 120 (SD 48) days post-stroke. Velocity decreased (P=0.017) and double-support time as a percentage of stride time increased (P=0.010) when the cognitive activity was added to the test. **CONCLUSIONS:** Performing a verbal cognitive task while walking adversely affected stroke patients' balance and gait velocity. Susceptibility to disruption varied within the patient group, suggesting clinical heterogeneity. Further research is required before changes to clinical practice are justified.

Campbell F.M., Ashburn A.M., Pickering R.M. and Burnett M.

Head and pelvic movements during a dynamic reaching task in sitting: implications for physical therapists

Arch Phys Med Rehabil, 82 (2001) 1655-60.

OBJECTIVES: To describe the distance reached, speed, and movement of the head and pelvis of healthy volunteers; to describe any influence of age on these variables; and to compare healthy volunteers and subjects with hemiplegia while performing a seated reaching task. **DESIGN:** Age- matched, case-control study. **SETTING:** Gait laboratory in a general hospital. **PARTICIPANTS:** A convenience sample of 53 healthy volunteers (30 women; 23 men; mean age, 57yr; range, 30-79yr) and 5 subjects with hemiplegia (2 women, 3 men; mean age, 65yr; range, 60-78yr) were recruited within 6 weeks poststroke. **INTERVENTIONS:** Participants sat on a bench with feet supported and reached laterally as far as they could without falling. **MAIN OUTCOME MEASURES:** The speed, distance reached, and angular movements of the head and pelvis were recorded by using the 3-dimensional movement analysis system. **RESULTS:** A significant age- related reduction in the distance reached (p < .001), velocity of the movement (p = .000), and pelvic tilt used (p < .01) was found among healthy volunteers. Comparison of data from healthy volunteers and subjects with hemiplegia showed a significant reduction in the

angular movements of the heads of subjects with hemiplegia. **CONCLUSIONS:** The findings suggest conservation of movement with increasing age and stroke. This movement reduction could have negative effects on a subject's ability to make postural changes in response to disturbance and activity. Such information may assist therapists to gain insight into the nature of balance deficits and the adaptive behavior that could result.

Chae J., Fang Z.P., Walker M. and Pourmehdi S.

Intramuscular electromyographically controlled neuromuscular electrical stimulation for upper limb recovery in chronic hemiplegia

Am J Phys Med Rehabil, 80 (2001) 935-41.

We report three cases of survivors of chronic stroke who were treated with active repetitive movement training of the paretic finger extensors mediated by intramuscular electromyographically controlled neuromuscular electrical stimulation for the purpose of motor relearning. These case reports demonstrate the feasibility of using intramuscular electromyographically controlled neuromuscular electrical stimulation for facilitating the upper limb motor recovery of chronic stroke survivors with mild to moderate hemiplegia.

Chatterton H.J., Pomeroy V.M. and Gratton J.

Positioning for stroke patients: a survey of physiotherapists' aims and practices

Disabil Rehabil, 23 (2001) 413-21.

PURPOSE: The survey was undertaken to identify current physiotherapy practice for positioning patients in the first week following stroke. **METHOD:** A postal questionnaire comprised of closed questions, was sent to 674 physiotherapists identified as working with patients in the first week following stroke, who were employed in 155 randomly selected NHS Trusts throughout England. **RESULTS:** Response rate was 73%. Specific positions were recommended during the first week following stroke by 98 % of respondents. The most common aims of positioning were modulation of muscle tone (93%), preventing damage to affected limbs (92%) and supporting and stabilizing body segments (91%). The positions sitting in an armchair, side lying on the non-hemiplegic side and side lying on the hemiplegic side were recommended by 98%, 96% and 92% of respondents respectively. The components of the positions considered as 'most important' varied between positions, proximal components were usually preferred to distal components. **CONCLUSION:** Positioning is still an important part of physiotherapy practice and therefore requires evaluation. The positions used and the aims of positioning identified by clinicians accord with those in the literature. However, there is a lack of consensus regarding key components of the positions. The positions identified in this study should now be systematically evaluated for their ability to achieve different aims.

Cheng P.T., Wu S.H., Liaw M.Y., Wong A.M. and Tang F.T.

Symmetrical body-weight distribution training in stroke patients and its effect on fall prevention

Arch Phys Med Rehabil, 82 (2001) 1650-4.

OBJECTIVE: To determine the role of symmetrical body-weight distribution training in preventing falls among patients with hemiplegic stroke. **DESIGN:** A prospective study using a standing biofeedback trainer. **SETTING:** Hospital-based rehabilitation units. **PATIENTS:** Fifty-four patients with hemiplegic stroke (30 in the training group, 24 in the control group). **INTERVENTIONS:** Conventional stroke rehabilitation program, plus symmetrical standing training and repetitive sit-to-stand training, with a standing biofeedback trainer. Training effect was evaluated by assessing the sit-to-stand performance and comparing the occurrence of falls in the 2 groups at a 6-month follow-up. **MAIN OUTCOME MEASURES:** Occurrence of falls, sit-to-stand performance, including body-weight distribution, rate of rise in force, and sway in center of pressure (COP). **RESULTS:** Significant improvement in sit-to-stand performance was found in patients in the training group. Body weight was distributed more symmetrically in both legs, with less mediolateral sway in the COP when rising and sitting down. The mean difference in body-weight distribution between the left and right legs while subjects were rising from a chair significantly decreased, from 49.5% +/- 18.9% to 38.6% +/- 15.8% of body weight (BW) ($p < .005$). The rate of rise in force while rising from a chair significantly increased, from 28.3% +/- 13.5% BW/s to 53.6% +/- 20.5% BW/s ($p < .001$). At the 6-month follow-up, 10 of 24 patients (41.7%) in the control group had fallen, compared with only 5 of 30 patients (16.7%) in the training group ($p < .05$). **CONCLUSIONS:** Symmetrical body-

weight distribution training may improve sit-to-stand performance and, consequently, decrease the number of falls by stroke patients.

de Goede C.J., Keus S.H., Kwakkel G. and Wagenaar R.C.

The effects of physical therapy in Parkinson's disease: a research synthesis

Arch Phys Med Rehabil, 82 (2001) 509-15.

OBJECTIVE: To present a critical review and meta-analysis of studies evaluating the effects of physical therapy in patients suffering from Parkinson's disease (PD), in terms of neurologic signs, activities of daily living (ADLs), and walking ability. **DATA SOURCES:** Articles published from 1966 to May 1999 were compiled by means of MEDLINE, Cochrane register of controlled trials, and CINAHL using combinations of the key words Parkinson's disease, exercise, exercise therapy, physical therapy, and group training. References presented in relevant publications were also examined. Articles written in English, German, or Dutch were included. **STUDY SELECTION:** Studies had to meet the following selection criteria: (1) patients with PD were included in the intervention study, (2) the effects of physical therapy (PT) were evaluated, (3) the study could be classified as true or quasi-experiment, and (4) the study was published in a journal or book. **DATA EXTRACTION:** Two reviewers assessed independently the methodologic quality of the data of each included study. One reviewer extracted relevant meta-analysis data. **DATA SYNTHESIS:** For each outcome measure the estimated effect size and the summary effect size (SES) were calculated, using fixed (ie, Hedges's g) and random effects models. The meta-analysis resulted in a significant homogeneous SES with regard to ADLs (.40; confidence interval [CI] = .17-.64) and stride length (.46; CI = .12-.82). The SES with regard to walking speed showed a significant heterogeneous SES, which remained significant after applying a random effects model (.49; CI = .21-.77). The SES with regard to neurologic signs was not significant (.22; CI = -.08 to .52). The small number of studies included and the shortcomings of the methodologic quality of these studies, however, bias the results of the present study. **CONCLUSIONS:** The results of the present research synthesis support the hypothesis that Parkinson patients benefit from PT added to their standard medication.

de Seze M., Wiart L., Bon-Saint-Come A., Debelleix X., Joseph P.A., Mazaux J.M. and Barat M.

Rehabilitation of postural disturbances of hemiplegic patients by using trunk control retraining during exploratory exercises

Arch Phys Med Rehabil, 82 (2001) 793-800.

OBJECTIVE: To assess use of the Bon Saint Come device for axial postural rehabilitation in hemiplegic patients, a technique based on voluntary trunk control during exploratory retraining. **DESIGN:** A 3-month randomized controlled trial. **SETTING:** A public neurorehabilitation center. **PATIENTS:** Twenty consecutive hemiplegic patients with axial postural disturbance resulting from recent stroke were randomly assigned to a device group (DG) or control group (CG). The 2 groups of 10 patients were similar. **INTERVENTION:** For 1 month, the DG patients followed an experimental program for 1 hour daily and conventional neurorehabilitation for 1 hour daily, whereas CG patients had conventional neurorehabilitation for 2 hours daily. For the next 2 months, all 20 patients had conventional neurorehabilitation for 2 hours daily. **MAIN OUTCOME MEASURES:** Patients were assessed on days 0, 30, and 90 by using a battery of postural tests, gait evaluation, the Bells neglect test, and the FIM instrument. **RESULTS:** On day 30, postural and neglect tests improved significantly more in DG than in CG. The benefit remained at day 90. Gait improved earlier in DG than in CG. FIM scores improved equally. **CONCLUSIONS:** Voluntary trunk control retraining during spatial exploration with the Bon Saint Come device appears to be a useful approach for rehabilitation of postural disorders in hemiplegic patients. Treatments designed to improve spatial cognition deficits probably enhance postural disorder recovery in hemiplegia.

Dean C.M., Richards C.L. and Malouin F.

Walking speed over 10 metres overestimates locomotor capacity after stroke

Clin Rehabil, 15 (2001) 415-21.

OBJECTIVE: To examine 10-m comfortable walking speed and 6-minute distance in healthy individuals and individuals after stroke and to assess the level of disability associated with poor walking endurance after stroke. **DESIGN:** Descriptive study in which comfortable walking speed over 10 m and distance covered in 6 minutes (6-minute walk test) were compared between healthy subjects and subjects after stroke. **SUBJECTS:** Twelve

healthy subjects and 14 subjects after stroke. MAIN OUTCOME MEASURES: Walking speed and 6-minute distances were compared between groups. In addition, for each group, actual distance walked in 6 minutes was compared with the distance predicted by the 10-m walking speed test and the distance predicted by normative reference equations. RESULTS: Subjects after stroke had significant reductions in 10-m speed and 6-minute distance compared with healthy subjects ($p < 0.05$). Subjects after stroke were not able to maintain their comfortable walking speed for 6 minutes, whereas healthy subjects walked in excess of their comfortable speed for 6 minutes. The average distance walked in 6 minutes by individuals after stroke was only 49.8 +/- 23.9% of the distance predicted for healthy individuals with similar physical characteristics. CONCLUSION: In our subjects after stroke, walking speed over a short distance overestimated the distance walked in 6 minutes. Both walking speed and endurance need to be measured and trained during rehabilitation.

Feld J.A., Rabadi M.H., Blau A.D. and Jordan B.D.

Berg balance scale and outcome measures in acquired brain injury
Neurorehabil Neural Repair, 15 (2001) 239-44.

OBJECTIVE: To examine the relationship of the Berg Balance Scale (BBS) to outcome after acquired brain injury. METHODS: Forty consecutive patients with acquired brain injury were admitted for multidisciplinary rehabilitation. Patients were assessed with the BBS. The BBS was originally designed as a quantitative measure of balance and risk for falls in community-dwelling elderly patients. The BBS comprises 14 different tasks graded on a 56-point scale. Community-dwelling elders with a BBS score of ≤ 42 have $> 90\%$ risk for falls. RESULTS: In our study, there were 27 patients with a low BBS score (≤ 42) and 13 patients with a high BBS score (> 42). The discharge total Functional Independence Measure (FIM) scores were lower in the low BBS patients (96.4 +/- 21.2) compared with the high BBS patients (111.5 +/- 12.5) ($p < 0.007$). The length of stay (LOS) was significantly longer in the low BBS patients (38.9 +/- 18.5 days) compared with the high BBS patients (14.2 +/- 6.1 days; $p < 0.000$). Among the three patients that experienced falls during their hospitalization, all exhibited low BBS scores. The admission BBS score strongly correlated with admission total FIM scores ($r = 0.86$; $p < 0.000$) and moderately correlated with discharge total FIM scores ($r = 0.56$; $p < 0.000$) and LOS ($r = -0.55$; $p < 0.000$). Using a multiple regression analysis, the admission FIM score was found to be the better predictor of discharge FIM scores, and time admitted after injury was the better predictor of LOS. CONCLUSIONS: Prediction of rehabilitative outcome might be enhanced by the use of the BBS scores in combination with other clinical measures on admission to inpatient acute rehabilitation.

Finestone H.M., Foley N.C., Woodbury M.G. and Greene-Finestone L.

Quantifying fluid intake in dysphagic stroke patients: a preliminary comparison of oral and nonoral strategies
Arch Phys Med Rehabil, 82 (2001) 1744-6.

OBJECTIVE: To determine whether dysphagic stroke patients receiving oral (thickened-fluid dysphagia) diets or nonoral (enteral feedings supplemented with intravenous fluids) diets met their estimated fluid requirements. DESIGN: Cohort study. SETTING: University-affiliated hospital. PARTICIPANTS: Thirteen dysphagic patients with new strokes were studied for 21 days postadmission to hospital. INTERVENTIONS: Seven patients (group 1) were started on nonoral feeding and later progressed to oral diets and 6 patients (group 2) received oral dysphagia diets only. MAIN OUTCOME MEASURE: Fluid intake. RESULTS: Fluid intake of patients in group 1 significantly declined over the 21 days (mean +/- standard deviation, 3158 +/- 523mL/d vs 984 +/- 486mL/d; $p < .0001$), representing 134% +/- 26% and 43% +/- 20% of their fluid requirements, respectively. Mean fluid intake of patients in group 2 was 755 +/- 162mL/d, representing 33% +/- 5% of requirements. This volume was significantly lower than the fluid intake of patients who received nonoral feeding ($p < .0001$). CONCLUSIONS: Dysphagic stroke patients who received thickened-fluid dysphagia diets failed to meet their fluid requirements whereas patients on enteral feeding and intravenous fluid regimens received ample fluid.

Fong K.N., Chan C.C. and Au D.K.

Relationship of motor and cognitive abilities to functional performance in stroke rehabilitation
Brain Inj, 15 (2001) 443-53.

This study explored the relationships between the motor and cognitive abilities, and the functional performance of patients with stroke. Motor and cognitive abilities were measured by the Fugl-Meyer Assessment (FMA) and the Neurobehavioural Cognitive Status Examination (NCSE), and functional performance was measured by the Functional Independence Measure (FIM). All assessments were conducted at admission, after 2 and 4 weeks, and at discharge. A total of 37 patients with first stroke at mean age 62.3 years (SD=5.4) participated in the study. Results indicated that the lower extremity and balance scores on the FMA were highly correlated with the FIM (motor subscale) on all occasions ($r = 0.65--0.92$), whereas upper extremity and hand scores on the FMA were moderately correlated ($r = 0.53--0.73$). Cognitive abilities such as judgement, comprehension and repetition had moderate positive relationships with functional performance ($r = 0.35--0.62$). Consistent with previous studies, motor functional performance at discharge was best predicted by balance and judgement abilities at admission, or lower extremity abilities and balance at 2-weeks, or lower extremity and repetition abilities at 4-weeks. At admission, lower extremity and cognitive abilities were found to be the best predictors of patients' length of stay. The results from this study substantiated the fact that motor impairment, including balance and lower limb ability, strongly accounts for functional recovery in the rehabilitation of patients with stroke staying in hospital. This study provided good data for rehabilitation professionals on monitoring neurological recovery, especially balance and lower extremity abilities, to enhance the functional recovery of patients after stroke. More intensive intervention in these aspects should be provided to patients to promote more efficient functional regain and shortening of the length of stay.

Freed M.L., Freed L., Chatburn R.L. and Christian M.

Electrical stimulation for swallowing disorders caused by stroke
Respir Care, 46 (2001) 466-74.

BACKGROUND: An estimated 15 million adults in the United States are affected by dysphagia (difficulty swallowing). Severe dysphagia predisposes to medical complications such as aspiration pneumonia, bronchospasm, dehydration, malnutrition, and asphyxia. These can cause death or increased health care costs from increased severity of illness and prolonged length of stay. Existing modalities for treating dysphagia are generally ineffective, and at best it may take weeks to months to show improvement. One common conventional therapy, application of cold stimulus to the base of the anterior faucial arch, has been reported to be somewhat effective. We describe an alternative treatment consisting of transcutaneous electrical stimulation (ES) applied through electrodes placed on the neck. **OBJECTIVE:** Compare the effectiveness of ES treatment to thermal-tactile stimulation (TS) treatment in patients with dysphagia caused by stroke and assess the safety of the technique. **METHODS:** In this controlled study, stroke patients with swallowing disorder were alternately assigned to one of the two treatment groups (TS or ES). Entry criteria included a primary diagnosis of stroke and confirmation of swallowing disorder by modified barium swallow (MBS). TS consisted of touching the base of the anterior faucial arch with a metal probe chilled by immersion in ice. ES was administered with a modified hand-held battery-powered electrical stimulator connected to a pair of electrodes positioned on the neck. Daily treatments of TS or ES lasted 1 hour. Swallow function before and after the treatment regimen was scored from 0 (aspirates own saliva) to 6 (normal swallow) based on substances the patients could swallow during a modified barium swallow. Demographic data were compared with the test and Fisher exact test. Swallow scores were compared with the Mann-Whitney U test and Wilcoxon signed-rank test. **RESULTS:** The treatment groups were of similar age and gender ($p > 0.27$), co-morbid conditions ($p = 0.0044$), and initial swallow score ($p = 0.74$). Both treatment groups showed improvement in swallow score, but the final swallow scores were higher in the ES group ($p > 0.0001$). In addition, 98% of ES patients showed some improvement, whereas 27% of TS patients remained at initial swallow score and 11% got worse. These results are based on similar numbers of treatments (average of 5.5 for ES and 6.0 for TS, $p = 0.36$). **CONCLUSIONS:** ES appears to be a safe and effective treatment for dysphagia due to stroke and results in better swallow function than conventional TS treatment.

Geiger R.A., Allen J.B., O'Keefe J. and Hicks R.R.

Balance and mobility following stroke: effects of physical therapy interventions with and without biofeedback/forceplate training

Phys Ther, 81 (2001) 995-1005.

BACKGROUND AND PURPOSE: Visual biofeedback/forceplate systems are often used for treatment of balance disorders. In this study, the researchers investigated whether the addition of visual biofeedback/forceplate training could enhance the effects of other physical therapy interventions on balance and mobility following stroke. **SUBJECTS:** The study included a sample of convenience of 13 outpatients with hemiplegia who ranged in age from 30 to 77 years (mean=60.4, SD=15.4) and were 15 to 538 days poststroke. **METHODS:** Subjects were assigned randomly to either an experimental group or a control group when the study began, and their cognitive and visual-perceptual skills were tested by a psychologist. Subjects were also assessed using the Berg Balance Scale and the Timed "Up & Go" Test before and after 4 weeks of physical therapy. Both groups received physical therapy interventions designed to improve balance and mobility 2 to 3 times per week. The experimental group trained on the NeuroCom Balance Master for 15 minutes of each 50-minute treatment session. The control group received other physical therapy for 50 minutes. **RESULTS:** Following intervention, both groups scored higher on the Berg Balance Scale and required less time to perform the Timed "Up & Go" Test. These improvements corresponded to increased independence of balance and mobility in the study population. However, a comparison of mean changes revealed no differences between groups. **DISCUSSION AND CONCLUSION:** Although both groups demonstrated improvement following 4 weeks of physical therapy interventions, no additional effects were found in the group that received visual biofeedback/forceplate training combined with other physical therapy.

Green J., Forster A. and Young J.

A test-retest reliability study of the Barthel Index, the Rivermead Mobility Index, the Nottingham Extended Activities of Daily Living Scale and the Frenchay Activities Index in stroke patients

Disabil Rehabil, 23 (2001) 670-6.

PURPOSE: To assess the test-retest reliability of a range of outcome measures in stroke patients. **METHOD:** Twenty-two patients > 1 year post-stroke were tested twice at an interval of 1 week using the Barthel Index (BI); the Rivermead Mobility Index (RMI); the Nottingham Extended Activities of Daily Living Scale (NEADL); and the Frenchay Activities Index (FAI). The mean difference (bias) and reliability coefficient (random error) were calculated for the total scores. Percentage agreement and the kappa coefficient were used to analyse individual items. **RESULTS:** The mean differences and reliability coefficients were BI 0.4 +/- 2.0, RMI 0.3 +/- 2.2, the NEADL 0.6 +/- 5.6, FAI -0.6 +/- 7.1. There was little bias between assessments. The performance of the BI and RMI were better with lower random error. The NEADL and FAI did not perform as well having larger random error components. Percentage agreements were generally high especially for the BI (>75%) and RMI (>85%), but there was considerable variation in the kappa coefficients. **CONCLUSION:** Measurement of basic activities of daily living and mobility as measured by the BI and RMI is reliable post-stroke. Measurements used to assess extended activities of daily living were less reliable in this study.

Hendricks H.T., MJ I.J., de Kroon J.R., in 't Groen F.A. and Zilvold G.

Functional electrical stimulation by means of the 'Ness Handmaster Orthosis' in chronic stroke patients: an exploratory study

Clin Rehabil, 15 (2001) 217-20.

OBJECTIVE: To gain experience with 'Ness Handmaster Orthosis' treatment in chronic stroke patients, to identify suitable patients, and to study the effects of treatment. **DESIGN:** Exploratory, uncontrolled trial with measurement of motor functions and muscle tone of the upper extremity prior to, during, upon completion, and six weeks after a treatment period. **SETTING:** A rehabilitation centre in the Netherlands. **SUBJECTS:** Eighteen chronic stroke patients (more than six months post stroke), who exhibited upper extremity dysfunction due to spastic paresis. **INTERVENTION:** A 10-week therapy programme of functional electrical stimulation by means of the 'Ness Handmaster Orthosis'. **RESULTS:** The results of 15 patients were available for analysis. The differences in motor score and muscle tone before and at the end of treatment were statistically significant ($p = 0.008$ and 0.021 , respectively). The follow-up measurements showed that the effects on motor functions and muscle tone decreased after therapy completion. Stratification of the patients in two subgroups indicated that

patients with initial high motor scores benefited most during the intervention period. **CONCLUSION:** The present study suggests that Handmaster treatment possesses therapeutic opportunities in chronic stroke patients with spastic paresis of the upper extremity.

Hesse S., Werner C., Uhlenbrock D., von Frankenberg S., Bardeleben A. and Brandl-Hesse B.

An electromechanical gait trainer for restoration of gait in hemiparetic stroke patients: preliminary results

Neurorehabil Neural Repair, 15 (2001) 39-50.

Modern concepts of gait rehabilitation after stroke favor a task- specific repetitive approach. In practice, the required physical effort of the therapists limits the realization of this approach. Therefore, a mechanized gait trainer enabling nonambulatory patients to have the repetitive practice of a gait-like movement without overstraining therapists was constructed. This preliminary study investigated whether an additional 4-week daily therapy on the gait trainer could improve gait ability in 14 chronic wheelchair-bound hemiparetic subjects. The 4 weeks of physiotherapy and gait-trainer therapy resulted in a relevant improvement of gait ability in all subjects. Velocity, cadence, and stride length improved significantly ($p < 0.01$). The kinesiological electromyogram of selected lower-limb muscles revealed a more physiologic pattern. The confounding influence of spontaneous recovery, the lack of a control group, and the double amount of therapy limit the clinical relevance of this study. Nevertheless, the gait trainer seems feasible as an adjunctive tool in gait rehabilitation after stroke; further studies are needed.

Janssen-Potten Y.J., Seelen H.A., Drukker J., Huson T. and Drost M.R.

The effect of seat tilting on pelvic position, balance control, and compensatory postural muscle use in paraplegic subjects

Arch Phys Med Rehabil, 82 (2001) 1393-402.

OBJECTIVE: To study the effect of seat tilting on pelvic tilt, balance control, and postural muscle use in persons with a thoracic spinal cord injury (SCI). **DESIGN:** Cross-sectional group study. **SETTING:** Rehabilitation centers and rehabilitation hospital departments. **PATIENTS:** Ten complete high thoracic SCI (level T2-8) patients, 10 complete low thoracic SCI (level T9-12) patients, and 10 matched able-bodied controls. **INTERVENTION:** A 10 degrees forward inclination of the seat. **MAIN OUTCOME MEASURES:** Pelvic tilt, center of pressure displacement, and muscle activity. **RESULTS:** Anterior tilting of the pelvis as a result of forward inclination of the seat could not be shown, either in persons with or without SCI. Balance control was not influenced by forward inclination of the seat. Participants' overall muscle activity decreased while they were seated in the chair with the forwardly inclined seat. **CONCLUSIONS:** Evidence provided by the kinematic and electromyographic data is not sufficient to develop a protocol for wheelchair prescription on the basis of pelvic positioning.

Kimura M., Murata Y., Shimoda K. and Robinson R.G.

Sexual dysfunction following stroke

Compr Psychiatry, 42 (2001) 217-22.

This study was undertaken to examine the prevalence of sexual dysfunction among 100 patients (75 men and 25 women) following stroke and its relationship to neuropsychiatric impairments or stroke characteristics. Forty-four men (58.6%) and 11 women (44.0%) reported dissatisfaction with their sexual functioning after stroke, as compared with only 16 men (21.3%) and five women (20.0%) before stroke. Twenty men (26.6%) and six women (24.0%) reported diminished libido after stroke as compared with eight men (10.6%) and seven women (28.0%) before stroke. Patients with sexual dysfunction had significantly more depressive symptoms among both males ($P = .007$) and females ($P = .0005$) and more impaired activities of daily living (ADL) in males ($P = .0009$). Based on logistic regression, the independent predictors of poststroke sexual dysfunction were Hamilton Rating Scale for Depression (HAM-D) score (odds ratio [OR] 1.55; 95% confidence interval [CI], 1.20 to 2.01), left hemisphere lesion (OR, 16.51; 95% CI, 2.34 to 116.25), and poststroke depression (OR, 8.09; 95% CI, 1.28 to 51.38). These data suggest that treatment of depression may have a significant beneficial effect on patients with sexual dysfunction. Our findings also suggest that left hemisphere lesions, for unknown reasons, play an important role in poststroke sexual dysfunction.

Kondo I., Hosokawa K., Soma M., Iwata M. and Maltais D.

Protocol to prevent shoulder-hand syndrome after stroke

Arch Phys Med Rehabil, 82 (2001) 1619-23.

OBJECTIVE: To determine the effectiveness of a protocol designed to restrict passive movement of affected upper extremity on the incidence of shoulder-hand syndrome (SHS) after stroke. **DESIGN:** Before-and-after trial; follow-up duration of subject group and historical control group 231.6 and 257.2 days, respectively. **SETTING:** Rehabilitation medicine department in a hospital in Japan. **PARTICIPANTS:** Subjects: 81 stroke patients treated with the protocol from 1994 to 1996 who were followed for at least 4 months from the onset of stroke; controls: 71 stroke patients treated without the protocol from 1991 to 1994 who were followed for same length of time. **INTERVENTION:** Use of a set protocol for controlled passive movement by trained therapists and restriction of passive movement by the patients for 4 months after stroke. The SHS criterion used to detect early signs of SHS has not yet been validated. Corticosteroids were given to all subjects diagnosed with SHS. **MAIN OUTCOME MEASURES:** Swelling index, SHS diagnostic criteria applied in physical exam, Brunnstrom stage, and sensory disturbance evaluations. **RESULT:** The incidence of SHS in the subject group was 18.5% (n = 15), whereas the incidence of SHS in the control group was 32.4% (n = 23). The difference between the 2 groups was statistically significant ($\chi^2(2) = 3.885, p < .05$). **CONCLUSION:** The protocol helped to prevent development of SHS.

Kusoffsky A., Apel I. and Hirschfeld H.

Reaching-lifting-placing task during standing after stroke: Coordination among ground forces, ankle muscle activity, and hand movement

Arch Phys Med Rehabil, 82 (2001) 650-60.

OBJECTIVE: To investigate the coordination among hand movement, ground forces, and muscle activity in standing stroke patients reaching forward and lifting an object from a table. **DESIGN:** Survey. **SETTING:** Research laboratory. **PATIENTS:** Eight stroke patients and 8 persons serving as controls. **MAIN OUTCOME MEASURE:** Symmetry of percentage of body weight (BW) during initial standing, velocity and hand path trajectory, ankle muscle electromyography. Temporal and spatial parameters in percentage of movement time were recorded by using 2 forceplates, 3-dimensional kinematics, and surface electromyography. Motor function, sensory function, and functional performance were also assessed. **RESULTS:** Weight distribution during initial standing was significantly higher (57.4% +/- 8.1% BW) on the nonparetic leg. All subjects had preserved the preparatory loading phase, and after onset of hand movement loading shifted to the contralateral leg. Ankle muscle activity onset (lateral gastrocnemius [LG]) occurred after loading. In stroke subjects, LG was consistently activated first in the nonparetic leg, regardless of which arm performed the task. During paretic hand task, the reaching phase was significantly longer and the lifting phase significantly shorter compared with that of the nonparetic hand task and with that of the controls. In the paretic task, the hand path velocity was not bell-shaped; the object lifting was. **CONCLUSIONS:** Stroke subjects preserve the coordination between ground forces and hand movement. The lack of spontaneous use of the paretic hand is primarily caused by difficulties of planning the hand trajectory in space, as reflected by temporal and spatial parameters during task performance.

Lamontagne A., Malouin F. and Richards C.L.

Locomotor-specific measure of spasticity of plantarflexor muscles after stroke

Arch Phys Med Rehabil, 82 (2001) 1696-704.

OBJECTIVES: To study the stretch reflex excitability (spasticity) of the plantarflexor muscles during gait in patients with hemiparesis and to study the relationships of spasticity during gait with spasticity at rest and gait speed. **DESIGN:** Cross-sectional, descriptive. **SETTING:** Rehabilitation center. **PARTICIPANTS:** Convenience sample of 30 patients (58 +/- 11yr) with hemiparesis (<6mo poststroke) and 15 healthy controls (59 +/- 8yr). **INTERVENTIONS:** Patients walked at natural speed, healthy subjects at very slow speed for 10 gait cycles. Electromyographic activation of the medial gastrocnemius was recorded by using surface electrodes. A 2-dimensional video camera system with reflective markers was used to acquire kinematics of the lower limbs. **MAIN OUTCOME MEASURES:** Electromyography-lengthening velocity slopes, calculated from measures obtained during the lengthening periods of the medial gastrocnemius muscle during the stance and the swing phases. Measured spasticity (Modified Ashworth Scale [MAS]), static strength (ankle clonus), and motor control (Fugl-Meyer test). **RESULTS:** Velocity-sensitive electromyographic responses, indicative of hyperactive stretch reflexes, were found on the paretic side during the stance phase of gait (in 66% of the patients), but not on the

nonparetic side or in controls. In many patients, velocity-sensitive responses coexisted with low plantarflexor activation levels during the stance phase. No clear patterns of response were measured during the swing phase in either group. Spasticity during gait in the patients was found to be positively related ($r = .47$, $p < .01$; $r = .57$, $p < .001$) to spasticity at rest (MAS; ankle clonus), whereas it was found to be negatively related to gait speed ($r = -.47$ to $-.53$, $p < .01$). CONCLUSIONS: The validity of the present method is supported by the fact that it is locomotor-specific and that it allowed for a good discrimination between spastic and nonspastic limbs, as well as between stance and swing phases of the gait cycle. The results also support plantarflexor spasticity as a factor contributing to the poor locomotor performance after stroke.

Langhammer B. and Stanghelle J.K.

Physiotherapy after stroke - a randomized controlled trial

Tidsskr Nor Laegeforen, 121 (2001) 2805-9.

BACKGROUND: This study examines whether two different physiotherapy regimes used in rehabilitation after acute stroke have any differences in outcome. **MATERIAL AND METHODS:** A double-blind study of patients with acute first-ever stroke. 61 patients were consecutively included, block-randomized into two groups and stratified according to gender and hemispheric location. Group 1 (33 patients) received physiotherapy in the hospital's stroke unit according to the Motor Relearning Programme (MRP), group 2 (28 patients) according to the Bobath method. Supplemental treatment did not differ. The Motor Assessment Scale (MAS), the Sodrings Motor Evaluation Scale (SMES), the Barthel ADL (Activities of Daily Living) Index, and the Nottingham Health Profile (NHP) were used as outcome measures. The following variables were also registered: length of stay in hospital, use of assistive devices for mobility, and patients' accommodation after discharge. **RESULTS:** Patients treated according to the MRP had shorter stays in hospital compared to those treated according to Bobath (mean 21 days vs. 34 days, $p < 0.01$). Both groups improved on MAS and SMES, but motor functions improved significantly better in the MRP group. Both groups improved on the Barthel Index; there were no significant differences between the groups, though women treated by MRP improved more than women treated by Bobath. There were no differences between the groups in NHP scores, use of assistive devices or accommodation after discharge. **INTERPRETATION:** This study indicates that physiotherapy according to the MRP is preferable to the Bobath programme in the rehabilitation of stroke patients.

Laufer Y., Dickstein R., Chefez Y. and Marcovitz E.

The effect of treadmill training on the ambulation of stroke survivors in the early stages of rehabilitation: a randomized study

J Rehabil Res Dev, 38 (2001) 69-78.

The objective of this study was to compare the effects of conventional over-ground gait training with treadmill training on the restoration of gait in people with hemiparesis following a stroke. Twenty-five individuals in the early stages of rehabilitation were alternately assigned to one of two treatment groups. In addition to conventional physical therapy, the experimental group participated in 15 treadmill-training sessions in which a handrail was used for external support. The control group received the same number of equal length sessions of over-ground ambulation. Treatment effects were established by pre- and posttreatment assessment of: 1) functional walking ability, 2) walking speed, 3) stride length, 4) temporal characteristics of gait, and 5) electromyographic activity of calf muscles. Normal values were obtained from eight healthy individuals of approximately the same age as the stroke survivors. The study demonstrates that individuals following a stroke are well able to tolerate treadmill training in the early stage of their rehabilitation process without the use of a weight support apparatus. Furthermore, the findings suggest that treadmill training may be more effective than conventional gait training for improving some gait parameters such as functional ambulation, stride length, percentage of paretic single stance period, and gastrocnemius muscular activity.

Lennon S.

Gait re-education based on the Bobath concept in two patients with hemiplegia following stroke

Phys Ther, 81 (2001) 924-35.

BACKGROUND AND PURPOSE: This case report describes the use of gait re-education based on the Bobath concept to measure the changes that occurred in the gait of 2 patients with hemiplegia who were undergoing

outpatient physical therapy. **CASE DESCRIPTION:** One patient ("NM"), a 65-year-old woman, was referred for physical therapy 6 weeks following a right cerebrovascular accident. She attended 30 therapy sessions over a 15-week period. The other patient ("SA"), a 71-year-old woman, was referred for physical therapy 7 weeks following a left cerebrovascular accident. She attended 28 therapy sessions over a 19-week period. Clinical indexes of impairment and disability and 3-dimensional gait data were obtained at the start of treatment and at discharge. Therapy was based on the Bobath concept. **OUTCOMES:** At discharge, NM demonstrated improvements in her hip and knee movements, reduced tone, and improved mobility. At discharge, SA demonstrated improved mobility. During gait, both patients demonstrated more normal movement patterns at the level of the pelvis, the knee, and the ankle in the sagittal plane. SA also demonstrated an improvement in hip extension. **DISCUSSION:** These cases demonstrate that recovery of more normal movement patterns and functional ability can be achieved following a cardiovascular accident and provide insight into the clinical decision making of experienced practitioners using Bobath's concept.

Lennon S., Baxter D. and Ashburn A.

Physiotherapy based on the Bobath concept in stroke rehabilitation: a survey within the UK
Disabil Rehabil, 23 (2001) 254-62.

PURPOSE: The Bobath concept is one of the most widely used approaches in stroke rehabilitation within Europe. This survey aimed to provide an expert consensus view of the theoretical beliefs underlying current Bobath practise in the UK. **METHOD:** Questionnaires (with sections related to: therapist background, physiotherapy management, theoretical beliefs and gait re-education strategies used) were posted to all senior level physiotherapists working in stroke care (n = 1,022). **RESULTS:** The majority of respondents had more than 10 year's experience overall and at least 5 years experience in stroke care. The Bobath concept was the preferred approach (n = 67%) followed by an 'eclectic' approach (n = 31%). Despite a high level of consensus between groups, there were 13 significant differences highlighted between Bobath and 'eclectic' groups related to recovery, control of tone, the analysis and facilitation of normal movement and function. In summary, Bobath therapists considered that patients needed to have normal tone and use normal movement patterns in order to perform functional tasks. They would delay patients from performing tasks independently if abnormal tone and movement would be reinforced by task practice. They were not opposed to the use of walking aids and orthotics. **CONCLUSIONS:** This survey has raised several issues for debate within physiotherapy such as the automatic translation of movement into function, carry over outside therapy, and the way in which tasks should be practiced. The dominance of the Bobath concept needs to be justified by establishing that it is both effective and efficient at achieving its treatment aims of: normalizing tone, improving intrinsic recovery of the affected side and function within everyday tasks.

Ma H.I. and Trombly C.A.

The comparison of motor performance between part and whole tasks in elderly persons
Am J Occup Ther, 55 (2001) 62-7.

OBJECTIVE: When teaching clients a multistep functional task, therapists tend to break down the task into part tasks with discrete movements. The purpose of this study was to compare the kinematic performance between part and whole tasks in elderly persons. **METHOD:** A counterbalanced repeated-measures design was used. Twenty elderly persons without motor problems (7 men, 13 women) performed a signature task in two conditions. For the part-task condition, the participants did the task in a step-by-step manner: (a) reach for a pen, (b) bring the pen to the paper, and (c) sign the name. For the whole-task condition, the participants performed the task in an integrated continuous flow. Kinematic performances for two movement segments (i.e., reaching for the pen, bringing the pen to the paper) were compared between conditions. **RESULTS:** Generally, the whole-task condition elicited a more efficient, more forceful, and smoother movement than the part-task condition. **CONCLUSION:** The results suggest the importance of keeping a multistep functional task whole.



Macko R.F., Smith G.V., Dobrovolny C.L., Sorkin J.D., Goldberg A.P. and Silver K.H.

Treadmill training improves fitness reserve in chronic stroke patients

Arch Phys Med Rehabil, 82 (2001) 879-84.

OBJECTIVE: To investigate the hypothesis that treadmill training will improve peak fitness, while lowering the energy cost of hemiparetic gait in chronic stroke patients. **DESIGN:** Noncontrolled exercise intervention study with repeated-measures analysis. **SETTING:** Hospital-based senior exercise research center. **PARTICIPANTS:** Twenty-three patients (mean age +/- standard deviation [SD] 67 +/- 8 yr) with chronic hemiparetic gait after remote (>6 mo) ischemic stroke. **INTERVENTION:** Three 40-minute sessions of treadmill exercise weekly for 6 months. **MAIN OUTCOME MEASURES:** Peak exercise capacity (VO₂peak) and rate of oxygen consumption during submaximal effort treadmill walking (economy of gait) by open circuit spirometry and ambulatory workload capacity before and after 3 and 6 months of training. **RESULTS:** Patients who completed 3 months of training (n = 21) increased their VO₂peak +/- SD from 15.4 +/- 2.9 mL x kg⁻¹ x min⁻¹ to 17.0 +/- 4.4 mL x kg⁻¹ x min⁻¹ (p < .02) and lowered their oxygen demands of submaximal effort ambulation from 9.3 +/- 2 mL x kg⁻¹ x min⁻¹ to 7.9 +/- 1.5 mL x kg⁻¹ x min⁻¹ (p = .002), which enabled them to perform the same constant-load treadmill task using 20% less of their peak exercise capacity (62.3% +/- 17.2% vs 49.9% +/- 19.3%, p < .002). Gains in VO₂peak and economy of gait plateaued by 3 months, while peak ambulatory workload capacity progressively increased by 39% (p < .001) over 6 months. **CONCLUSIONS:** Treadmill training improves physiologic fitness reserve in chronic stroke patients by increasing VO₂peak while lowering the energy cost of hemiparetic gait, and increases peak ambulatory workload capacity. These improvements may enhance functional mobility in chronic stroke patients.

Morris D.M., Uswatte G., Crago J.E., Cook E.W., 3rd and Taub E.

The reliability of the wolf motor function test for assessing upper extremity function after stroke

Arch Phys Med Rehabil, 82 (2001) 750-5.

OBJECTIVE: To examine the reliability of the Wolf Motor Function Test (WMFT) for assessing upper extremity motor function in adults with hemiplegia. **DESIGN:** Interrater and test-retest reliability. **SETTING:** A clinical research laboratory at a university medical center. **PATIENTS:** A sample of convenience of 24 subjects with chronic hemiplegia (onset >1yr), showing moderate motor impairment. **INTERVENTION:** The WMFT includes 15 functional tasks. Performances were timed and rated by using a 6-point functional ability scale. The WMFT was administered to subjects twice with a 2-week interval between administrations. All test sessions were videotaped for scoring at a later time by blinded and trained experienced therapists. **MAIN OUTCOME MEASURE:** Interrater reliability was examined by using intraclass correlation coefficients and internal consistency by using Cronbach's alpha. **RESULTS:** Interrater reliability was .97 or greater for performance time and .88 or greater for functional ability. Internal consistency for test 1 was .92 for performance time and .92 for functional ability; for test 2, it was .86 for performance time and .92 for functional ability. Test-retest reliability was .90 for performance time and .95 for functional ability. Absolute scores for subjects were stable over the 2 test administrations. **CONCLUSION:** The WMFT is an instrument with high interrater reliability, internal consistency, test-retest reliability, and adequate stability.

Morris S., Morris M.E. and Ianssek R.

Reliability of measurements obtained with the Timed "Up & Go" test in people with Parkinson disease

Phys Ther, 81 (2001) 810-8.

BACKGROUND AND PURPOSE: The Timed "Up & Go" Test (TUG) is used to measure the ability of patients to perform sequential locomotor tasks that incorporate walking and turning. This study investigated the retest reliability, interrater reliability, and sensitivity of scores obtained with the TUG in detecting changes in mobility in subjects with idiopathic Parkinson disease (PD). **SUBJECTS:** The performance of 12 people with PD was compared with that of 12 age-matched comparison subjects without PD. **METHODS:** The subjects with PD completed 5 trials of the TUG after withdrawal of levodopa for 12 hours ("off" phase of the medication cycle) as well as an additional 5 trials 1 hour after levodopa was administered ("on" phase of the medication cycle). They were scored on the Modified Webster Scale at both sessions. The comparison subjects also performed 5 TUG trials. All trials were videotaped and timed by 2 experienced raters. The videotape was later rated by 3 experienced clinicians and 3 inexperienced clinicians. **RESULTS:** For the subjects with PD, within-session performance was

highly consistent, with correlations (r) ranging from .80 to .98 for the "off" phase and from .73 to .99 for the "on" phase. The performance of the comparison subjects across the 5 trials was also highly consistent (r = .90-.97). Comparisons showed differences between trials 1 and 2 on the TUG for both groups. Removal of data for trial 1 (the practice trial) further enhanced retest reliability. There was close agreement in TUG scores among raters despite different levels of experience (intraclass correlation coefficient [3,1] = .87-.99). Mean TUG scores were different between the "on" and "off" phases of the levodopa cycle and between subjects with PD and comparison subjects during the "on" phase. **CONCLUSION AND DISCUSSION:** Retest reliability and interrater reliability of the TUG measurements were high, and the measurements reflected changes in performance according to levodopa use. The TUG can also be used to detect differences in performance between people with PD and elderly people without PD.

Nelles G., Jentzen W., Jueptner M., Muller S. and Diener H.C.

Arm training induced brain plasticity in stroke studied with serial positron emission tomography
Neuroimage, 13 (2001) 1146-54.

We used serial positron emission tomography (PET) to study training-induced brain plasticity after severe hemiparetic stroke. Ten patients were randomized to either task-oriented arm training or to a control group and scanned before and after 22.6 +/- 1.6 days of treatment using passive movements as an activation paradigm. Increases of regional cerebral blood flow (rCBF) were assessed using statistical parametric mapping (SPM99). Before treatment, all stroke patients revealed bilateral activation of the inferior parietal cortex (IPC). After task-oriented arm training, activation was found bilaterally in IPC and premotor cortex, but also in the contralateral sensorimotor cortex (SMC). The control group only showed weak activation of the ipsilateral IPC. After treatment, the training group revealed relatively more activation bilaterally in IPC, premotor areas, and in the contralateral SMC. Five normal subjects showed no statistical significant differences between two separate PET studies. In this group of patients, task-oriented arm training induced functional brain reorganization in bilateral sensory and motor systems.

Nieuwboer A., De Weerd W., Dom R., Truyen M., Janssens L. and Kamsma Y.

The effect of a home physiotherapy program for persons with Parkinson's disease
J Rehabil Med, 33 (2001) 266-72.

The purpose of this study was to evaluate the effect of a home physiotherapy program for persons with Parkinson's disease. Thirty-three patients took part in the study using a within-subject controlled design. Functional activities including walking and carrying out transfers were measured at home and in the hospital before and after a 6-week baseline period, after 6 weeks home physiotherapy and after 3 months follow-up. Spatiotemporal and plantar force variables of gait were determined with video and pododography. Treatment provided by community physiotherapists consisted of teaching cueing and conscious movement control 3 times a week. The study revealed that patients had significantly higher scores on a functional activity scale after treatment in the home setting and to a lesser degree in hospital, a result, which was partly sustained at follow-up. However, duration of the transfer movements, spatiotemporal and plantar force variables were not significantly improved except for stride length. The results support application and development of the treatment concept and highlight that physiotherapy aimed at improving function in Parkinson's disease is best provided in the home situation.

Nilsson L., Carlsson J., Danielsson A., Fugl-Meyer A., Hellstrom K., Kristensen L., Sjolund B., Sunnerhagen K.S. and Grimby G.

Walking training of patients with hemiparesis at an early stage after stroke: a comparison of walking training on a treadmill with body weight support and walking training on the ground
Clin Rehabil, 15 (2001) 515-27.

OBJECTIVE: To compare the effect of walking training on a treadmill with body weight support (BWS) and walking training on the ground at an early stage of rehabilitation in patients with hemiparesis after stroke. **DESIGN:** Randomized controlled experimental study. **SETTING:** Multicentre design; three departments of rehabilitation medicine. **SUBJECTS:** Seventy-three consecutive first stroke patients admitted to a rehabilitation clinic were randomized into a treatment group and a control group. **INTERVENTIONS:** The treatment group received walking training on a treadmill with BWS for 30 minutes, 5 days a week. The control group received

walking training according to the Motor Relearning Programme (MRP) on the ground for 30 minutes 5 days a week, not including treadmill training. During the time in the rehabilitation department (about two months), all patients in the study also received professional stroke rehabilitation besides the walking training in the two groups. **MAIN OUTCOME MEASURES:** Functional Independence Measure (FIM), walking velocity for 10 m, Functional Ambulation Classification (FAC), Fugl-Meyer Stroke Assessment and Berg's Balance Scale. The assessments were performed at admission, at discharge and at 10-month follow-up. **RESULTS:** There were no statistically significant differences between the groups at discharge or at the 10-month follow-up with regard to FIM, walking velocity, FAC, Fugl-Meyer Stroke Assessment, and Berg's Balance Scale. Patients in both groups improved in these variables from admission to the 10-month follow-up. **CONCLUSIONS:** Treadmill training with BWS at an early stage of rehabilitation after stroke is a comparable choice to walking training on the ground.

Page S.J., Levine P., Sisto S. and Johnston M.V.

A randomized efficacy and feasibility study of imagery in acute stroke
Clin Rehabil, 15 (2001) 233-40.

OBJECTIVE: To compare the feasibility and efficacy of a programme combining imagery and occupational therapy with a programme of therapy only. **DESIGN:** Randomized, controlled case series. **SETTING:** Subacute outpatient clinic. **SUBJECTS:** Thirteen consecutively admitted patients between four weeks and one year post stroke exhibiting stable motor deficits in their affected upper limbs. **INTERVENTION:** All patients received an hour of therapy three times a week for six weeks administered by the same physical and occupational therapists. During the same period, eight patients participated in 10-minute guided imagery sessions after each therapy session, as well as practising imagery at home twice each week. Five patients participated in a control intervention consisting of exposure to stroke information. **MAIN OUTCOME MEASURES:** The Fugl-Meyer Assessment of Motor Recovery (Fugl-Meyer) and Action Research Arm Test (ARA). **RESULTS:** After intervention, Fugl-Meyer and ARA scores of patients in the therapy only group remained virtually the same; therapy plus imagery group scores improved by 13.8 and 16.4 points, respectively, on the Fugl-Meyer and ARA. **CONCLUSIONS:** Imagery is a clinically feasible, cost-effective complement to therapy that may improve outcomes more than participation in therapy only.

Page S.J., Sisto S.A., Levine P., Johnston M.V. and Hughes M.

Modified constraint induced therapy: a randomized feasibility and efficacy study
J Rehabil Res Dev, 38 (2001) 583-90.

This case series examined the feasibility and efficacy of a modified constraint induced therapy (CIT) protocol administered on an outpatient basis. The Fugl-Meyer Assessment of Motor Recovery After Stroke (Fugl), Action Research Arm Test (ARA), Wolf Motor Function Test (WMFT), and Motor Activity Log (MAL) were administered to six patients between 2 and 6 months poststroke (CVA) exhibiting stable motor deficits and learned nonuse of the affected limb. Two patients then participated in half-hour physical and occupational therapy sessions three times/week for 10 weeks. During the same period, their unaffected arms and hands were restrained 5 days/week during 5 hours identified as times of frequent use. Two other patients received regular therapy and two control patients received no therapy. The ARA, Fugl, WMFT, and MAL were again administered after 10 weeks. Patients receiving modified CIT exhibited substantial improvements on the Fugl, ARA, and WMFT, as well as increases in amount and quality of use of the limb using the MAL. Patients receiving traditional or no therapy exhibited no improvements. Results suggest that modified CIT may be an efficacious method of improving function and use of the affected arms of patients exhibiting learned nonuse.

Pandyan A.D., Price C.I., Rodgers H., Barnes M.P. and Johnson G.R.

Biomechanical examination of a commonly used measure of spasticity
Clin Biomech (Bristol, Avon), 16 (2001) 859-65.

BACKGROUND: An increase in the prevalence of neurological disability puts pressure on service providers to restrict costs associated with rehabilitation. Spasticity is an important neurological impairment for which many novel and expensive treatment options now exist. The antispastic effects of these techniques remain unexplored due to a paucity of valid outcome measures. **AIM:** To develop a biomechanical measure of resistance to passive movement, which could be used in routine clinical practice, and to examine the validity of the modified Ashworth



scale. **STUDY DESIGN:** Repeated measure cross-section study on 16 subjects who had a unilateral stroke one-week previously and had no elbow contractures. **OUTCOME MEASURES:** Simultaneous measurement of resistance to passive movement using a custom built measuring device and the modified Ashworth scale. Passive range of movement and velocity were also measured. The "catch", a phenomenon associated with the modified Ashworth scale, was identified by the assessor using a horizontal visual analogue scale and biomechanically quantified using the residual calculated from a linear regression technique. **RESULTS:** Half the study population had a modified Ashworth score greater than zero. The association between the two measures was poor ($\kappa=0.366$). The speed and range of passive movement were greater in subjects with modified Ashworth score "0" ($P<0.05$). Resistance to passive movement was higher in the impaired arm ($P<0.05$) and tended to decrease with repeated measures and increasing speeds. **CONCLUSIONS:** A device to measure resistance to passive movement at the elbow was developed. The modified Ashworth scale may not provide a valid measure of spasticity but a measure of resistance to passive movement in an acute stroke population. **RELEVANCE:** Spasticity is an important neurological impairment for which many novel and expensive treatment options are being made available. There is a paucity of clinically usable outcomes to measure spasticity. A device to measure resistance to passive movement at the elbow, which was more reliable than the modified Ashworth scale was developed. This device may provide a much needed objective clinical measure to evaluate the efficacy of antispasticity treatment.

Panturin E.

The Bobath concept

Clin Rehabil, 15 (2001) 111-3.

Park J., Hopwood V., White A.R. and Ernst E.

Effectiveness of acupuncture for stroke: a systematic review

J Neurol, 248 (2001) 558-63.

BACKGROUND: Acupuncture has been suggested as a treatment for stroke rehabilitation, but the question whether it is effective has not been answered satisfactorily. **PURPOSE:** To summarise and critically review all randomised controlled trials of the effectiveness of acupuncture as a treatment for stroke. **METHODS:** Four independent computerised literature searches (in MEDLINE, Cochrane Controlled Trials Register, Embase, and CISCOM data bases) were conducted in June 1999. All randomised-controlled trials that compared any form of needle insertion acupuncture to any form of non-acupuncture control intervention in the treatment of human stroke patients were included. Data were extracted independently by two authors and arbitrated by a third. The methodological quality of the included studies was assessed using the Jadad score. **RESULTS:** Nine randomised controlled trials with a total sample size of 538 patients were included. Two studies were assessor blind, one was subject blind, and one was assessor and subject blind. Two studies exclusively used manual acupuncture, five only electroacupuncture, and two used both. Outcome measures used were Scandinavian Stroke Scale, Chinese Stroke Scale or Recovery Scale, Barthel index, Nottingham Health Profile, Motor function, balance, and days in hospital. Of the nine studies, six yielded a positive result suggesting that acupuncture is effective, and three produced a negative finding implying that acupuncture is not superior to control treatment. Only two studies obtained a Jadad score of more than 3. These methodologically best trials showed no significant effect of acupuncture. **CONCLUSION:** Based on the evidence of rigorous randomised controlled trials, there is no compelling evidence to show that acupuncture is effective in stroke rehabilitation. Further, better- designed studies are warranted.

Perennou D.A., Leblond C., Amblard B., Micallef J.P., Herisson C. and Pelissier J.Y.

Transcutaneous electric nerve stimulation reduces neglect-related postural instability after stroke

Arch Phys Med Rehabil, 82 (2001) 440-8.

OBJECTIVE: To test the existence of a neglect-related component of postural imbalance in some stroke patients to determine whether neglect patients (1) show worse postural control compared with nonneglect patients and healthy subjects and (2) have latent postural capacities that could be unmasked by an appropriate somatosensory manipulation. **DESIGN:** Intervention study with and without transcutaneous electric nerve stimulation (TENS). **SETTING:** Rehabilitation center research laboratory. **PARTICIPANTS:** Twenty-two stroke patients (mean age,

Educational Committee of IBITA
July 2002

58.3 +/- 2.5yr; average days since stroke, 83.2d) and 14 age-matched healthy subjects. Stroke patients were subdivided into 3 groups: 6 with spatial neglect and 16 without (8 with left lesion, 8 with right lesion). INTERVENTIONS: All participants were subjected to a dynamic balance task, performed while sitting for 8 seconds on a laterally rocking platform. Seated on this mobile support, they were asked to maintain actively an erect posture, sitting as still as possible. In patients, TENS was applied on the contralesional side of the neck during the postural task. An effective stimulation (intensity corresponding to the threshold of perception, TENS+) was compared with a placebo stimulation (.01 x threshold of perception, TENS-). MAIN OUTCOME MEASURES: Postural performance in each trial was monitored by using 2 criteria: the number of aborted trials caused by loss of balance, and the angular dispersion of the support oscillations in roll. The latter criterion, which increased with body instability, was defined as 2 standard deviations of the angular distribution. RESULTS: Patients showing neglect displayed pronounced postural instability compared with other patients and controls. Although dramatic postural instability in the neglect patients was spectacularly and systematically reduced with TENS, no effect was observed in patients without neglect. CONCLUSION: This is among the first studies to provide clinical evidence supporting the "postural body scheme" concept.

Price C.I. and Pandyan A.D.

Electrical stimulation for preventing and treating post-stroke shoulder pain: a systematic Cochrane review
Clin Rehabil, 15 (2001) 5-19.

BACKGROUND: Shoulder pain after stroke is common and disabling. The optimal management is uncertain, but electrical stimulation (ES) is often used to treat and prevent pain. **OBJECTIVES:** The objective of this review was to determine the efficacy of any form of surface ES in the prevention and/or treatment of pain around the shoulder at any time after stroke. **SEARCH STRATEGY:** We searched the Cochrane Stroke Review Group trials register and undertook further searches of Medline, Embase and CINAHL. Contact was established with equipment manufacturers and centres that have published on the topic of ES. **SELECTION CRITERIA:** We considered all randomized trials that assessed any surface ES technique (functional electrical stimulation (FES), transcutaneous electrical nerve stimulation (TENS) or other), applied at any time since stroke for the purpose of prevention or treatment of shoulder pain. **DATA COLLECTION AND ANALYSIS:** Two reviewers independently selected trials for inclusion, assessed trial quality and extracted the data. **MAIN RESULTS:** Four trials (a total of 170 subjects) fitted the inclusion criteria. Study design and ES technique varied considerably, often precluding the combination of studies. Population numbers were small. There was no significant change in pain incidence (odds ratio (OR) 0.64; 95% CI 0.19-2.14) or change in pain intensity (standardized mean difference (SMD) 0.13; 95% CI -1.0-1.25) after ES treatment compared with control. There was a significant treatment effect in favour of ES for improvement in pain-free range of passive humeral lateral rotation (weighted mean difference (WMD) 9.17; 95% CI 1.43-16.91). In these studies ES reduced the severity of glenohumeral subluxation (SMD -1.13; 95% CI -1.66 to -0.60), but there was no significant effect on upper limb motor recovery (SMD 0.24; 95% CI -0.14-0.62) or upper limb spasticity (WMD 0.05; 95% CI -0.28-0.37). There did not appear to be any negative effects of electrical stimulation at the shoulder. **REVIEWERS' CONCLUSIONS:** The evidence from randomized controlled trials so far does not confirm or refute that ES around the shoulder after stroke influences reports of pain, but there do appear to be benefits for passive humeral lateral rotation. A possible mechanism is through the reduction of glenohumeral subluxation. Further studies are required.

Pulvermuller F., Neininger B., Elbert T., Mohr B., Rockstroh B., Koebbel P. and Taub E.

Constraint-induced therapy of chronic aphasia after stroke
Stroke, 32 (2001) 1621-6.

Patients with chronic aphasia were assigned randomly to a group to receive either conventional aphasia therapy or constraint-induced (CI) aphasia therapy, a new therapeutic technique requiring intense practice over a relatively short period of consecutive days. CI aphasia therapy is realized in a communicative therapeutic environment constraining patients to practice systematically speech acts with which they have difficulty. Patients in both groups received the same amount of treatment (30 to 35 hours) as 10 days of massed-practice language exercises for the CI aphasia therapy group (3 hours per day minimum; 10 patients) or over a longer period of approximately 4 weeks for the conventional therapy group (7 patients). CI aphasia therapy led to significant and pronounced improvements on several standard clinical tests, on self-ratings, and on blinded-observer ratings of the patients' communicative

effectiveness in everyday life. Patients who received the control intervention failed to achieve comparable improvements. Data suggest that the language skills of patients with chronic aphasia can be improved in a short period by use of an appropriate massed-practice technique that focuses on the patients' communicative needs.

Rowat A.M.

What do nurses and therapists think about the positioning of stroke patients?

J Adv Nurs, 34 (2001) 795-803.

BACKGROUND: At present, there are a number of different positioning strategies for stroke patients, but these are mainly based on clinical experience rather than research. Prior to developing a study to evaluate the effect of positioning on outcome after stroke, it was important to establish if nurses in our hospital had given much thought to the positioning of stroke patients. **AIM OF THE STUDY:** This study aimed to explore whether nurses working on the stroke unit at a Scottish teaching hospital held different views on the positioning of conscious and unconscious stroke patients to nurses working on other wards with stroke patients and therapists. **METHODS:** Questionnaires on various aspects of patient positioning were sent to 150 nurses and 25 therapists working in five specialities where stroke patients are cared for in a large teaching hospital. **FINDINGS:** Overall, the majority of nurses and therapists (74%) believed that the best position for conscious stroke patients was sitting in a chair. Also, 80% of them believed that the best position for unconscious stroke patients was lying on the nonparetic side. There was less of a consensus between nurses and therapists working in the five specialities as to whether it was appropriate for conscious or unconscious stroke patients to lie on their paretic side, lie supine or sit propped-up in bed in either a 30 or 70 degrees angle. **CONCLUSIONS:** The lack of consensus between nurses working in the five specialities is probably because at present there is little research to guide nursing practices for the positioning of stroke patients. Therefore, research to confirm which positions improves or hinders outcome after stroke is essential. Indeed, positioning is a simple inexpensive strategy, which could have a substantial public health impact, as stroke is so common.

Ruckenstein M.J.

Therapeutic efficacy of the Epley canalith repositioning maneuver

Laryngoscope, 111 (2001) 940-5.

OBJECTIVES/HYPOTHESES: The hypotheses of the current study are as follows: 1) That if the Epley canalith repositioning maneuver is an effective treatment for benign positional vertigo (BPV), relief from the vertigo should occur virtually immediately after the performance of the maneuver; 2) that the Epley canalith repositioning maneuver does provide almost immediate relief in BPV and should be the established treatment of choice for this disorder in both primary and tertiary care settings; and 3) that residual symptoms of lightheadedness and imbalance do persist after the resolution of the vertigo. The distinction of these symptoms from the vertigo is required for the accurate evaluation of the efficacy of positional maneuvers. **STUDY DESIGN:** Prospective cohort study in a tertiary care balance center. **METHODS:** Eighty-six patients (95 cases) with a history and physical examination consistent with active BPV were entered in the study. Patients were treated with a modified Epley canalith repositioning maneuver. A modified 360 degrees roll was used to treat those patients with horizontal canal BPV. Patients were provided with a preprinted diary in which they were to circle the answer most relevant to their symptoms for 14 days after the maneuver. Patients were then re-evaluated in the office at 2 weeks after the maneuver. **RESULTS:** The mean duration of the BPV before treatment was 9 weeks. Seventy-four percent of cases that were treated with one or two canalith repositioning maneuvers had a resolution of vertigo as a direct result of the maneuver. A resolution attributable to the first intervention was obtained in 70% of cases within 48 hours of the maneuver. An additional 14% of cases that were treated had a resolution of vertigo; however, it is not possible to say that these patients definitely benefited from the canalith repositioning maneuver. Only 4% of cases (three patients) manifested BPV that persisted after four treatments. Residual symptoms of lightheadedness or imbalance, or both, were frequent (47% of cases) but rarely required formal intervention with vestibular rehabilitation physical therapy. **CONCLUSIONS:** The Epley canalith repositioning maneuver results in a resolution of vertigo in the majority of patients (70% of cases) immediately after one treatment. It is safe and requires no special equipment or investigations. It should be established as the treatment of choice for BPV in both primary and tertiary care settings.

Said C.M., Goldie P.A., Patla A.E. and Sparrow W.A.

Effect of stroke on step characteristics of obstacle crossing

Arch Phys Med Rehabil, 82 (2001) 1712-9.

OBJECTIVE: To compare spatial and temporal measures during lead limb obstacle crossing between subjects with stroke and healthy subjects. **DESIGN:** Experimental, observational, with matched controls. **SETTING:** Geriatric rehabilitation unit in a tertiary referral hospital. **PARTICIPANTS:** Distance data were available for 19 subjects with stroke and 19 able-bodied subjects. Temporal data were available for 16 subjects with stroke and 16 able-bodied subjects. Subjects with stroke were inpatients and had to be able to walk 10 meters without assistance or gait aid. **INTERVENTION:** Subjects were required to step over high and wide obstacles, ranging from 1 to 8cm, and trials were videotaped. **MAIN OUTCOME MEASURES:** Toe clearance, preobstacle distance, postobstacle distance, step length, proportion of step length preobstacle, step time, preobstacle step time, postobstacle step time, and proportion of step time preobstacle were measured. **RESULTS:** Mann-Whitney U tests were performed to determine differences between the 2 groups. Subjects with stroke had significantly higher toe clearance, smaller postobstacle distances, and greater step times than healthy subjects. Subjects with stroke did not demonstrate a significant reduction in preobstacle distance. **CONCLUSION:** By modifying their lead limb trajectory during obstacle crossing, persons with stroke reduce the risk of a trip due to toe contact, but the modification may expose them to other safety risks.

Salbach N.M., Mayo N.E., Higgins J., Ahmed S., Finch L.E. and Richards C.L.

Responsiveness and predictability of gait speed and other disability measures in acute stroke

Arch Phys Med Rehabil, 82 (2001) 1204-12.

OBJECTIVES: To identify the most responsive method of measuring gait speed, to estimate the responsiveness of other outcome measures, and to determine whether gait speed predicts discharge destination in acute stroke. **DESIGN:** A prospective cohort study. **SETTING:** Five acute-care hospitals. **PATIENTS:** Fifty subjects with residual gait deficits after a first-time stroke. **INTERVENTIONS:** Five- (5mWT) and 10-meter walk tests (10mWT) at comfortable and maximum speeds, with 2 evaluations conducted an average +/- standard deviation (SD) of 8 +/- 3 and 38 +/- 5 days poststroke. **MAIN OUTCOME MEASURE:** Standardized response mean (SRM = mean change/SD of change) was used to estimate responsiveness for each walk test, the Berg Balance Scale, the Barthel Index, the Stroke Rehabilitation Assessment of Movement (STREAM), and the Timed Up and Go (TUG). **RESULTS:** The SRMs were 1.22 and 1.00 for the 5mWT, and .92 and .83 for the 10mWT performed at a comfortable and maximum pace, respectively. The SRMs for the Berg Balance Scale, the Barthel Index, the STREAM, and the TUG were 1.04, .99, .89, and .73, respectively. The probability of discharge to a rehabilitation center for persons walking at < or = 0.3m/s or > 0.6m/s at the first evaluation was .95 and .22, respectively. **CONCLUSIONS:** The 5mWT at a comfortable pace is recommended as the measure of choice for clinicians and researchers who need to detect longitudinal change in walking disability in the first 5 weeks poststroke.

Scheidtmann K., Fries W., Muller F. and Koenig E.

Effect of levodopa in combination with physiotherapy on functional motor recovery after stroke: a prospective, randomised, double-blind study

Lancet, 358 (2001) 787-90.

BACKGROUND: Functional disability is generally caused by hemiplegia after stroke. Physiotherapy used to be the only way of improving motor function in such patients. However, administration of amphetamines in addition to exercise improves motor recovery in animals, probably by increasing the concentration of norepinephrine in the central nervous system. Our aim was to ascertain whether levodopa could enhance the efficacy of physiotherapy after hemiplegia. **METHODS:** We did a prospective, randomised, placebo-controlled, double-blind study in which we enrolled 53 primary stroke patients. For the first 3 weeks patients received single doses of levodopa 100 mg or placebo daily in combination with physiotherapy. For the second 3 weeks patients had only physiotherapy. We quantitatively assessed motor function every week with Rivermead motor assessment (RMA). **FINDINGS:** Six patients were excluded from analyses because of non-neurological complications. Motor recovery was significantly improved after 3 weeks of drug intervention in those on levodopa (RMA improved by 6.4 points) compared with placebo (4.1), and the result was independent of initial degree of impairment ($p < 0.004$). The advantage of the levodopa group was maintained at study endpoint 3 weeks after levodopa was



stopped. At the end of the study the total RMA score gain for the levodopa group was 8.2 points compared with 5.7 in the placebo group ($p=0.020$). INTERPRETATION: A single dose of levodopa is well tolerated and, when given in combination with physiotherapy, enhances motor recovery in patients with hemiplegia. In view of its minimal side-effects, levodopa will be a possible add-on during stroke rehabilitation.

Stevenson T.J.

Detecting change in patients with stroke using the Berg Balance Scale

Aust J Physiother, 47 (2001) 29-38.

The Berg Balance Scale (BBS) was designed to help determine change in functional standing balance over time. The purpose of this paper was to estimate the minimum detectable change score (MDC) using the standard error of measure (SEM), thereby providing a means to decide if genuine change had occurred. Calculation of the agreement regarding the presence of change as determined by the MDC and clinicians' perceptions was performed to give an indication of the validity of this criterion value. Forty-eight subjects who were receiving inpatient rehabilitation after stroke were assessed on consecutive days by two raters using the BBS. The MDC analysis suggests that a change of ± 6 BBS points is necessary to be 90% confident of genuine change. Only 25/45 subjects showed agreement between the statistically derived presence of change and clinicians' perceptions of change. The lack of agreement may relate to the validity of the SEM/MDC methodology to determine the criterion BBS value, the heterogeneity of the subjects, or the use of clinician gestalt impressions of change.

Swan L.

Unilateral spatial neglect

Phys Ther, 81 (2001) 1572-80.

Unilateral spatial neglect is a complex, but fascinating, deficit in attention that may occur following stroke. The phrase "unilateral spatial neglect" belies the complex mixture of disorders in representational memory, hypokinesia in the opposite hemisphere, and inattention to sensory stimuli in the opposite hemisphere. Unilateral spatial neglect occurs as a result of damage to the posterior parietal cortex, frontal lobe, cingulate gyrus, striatum, thalamus, or specific brain-stem nuclei. This neural network for attention is an excellent example of how different anatomic areas work together to produce a specific behavior. Traditional treatment strategies for USN have focused on training attention in the left hemisphere using a variety of techniques, including sensory awareness, visual scanning, and spatial organization. Recently, additional treatment strategies have emerged that focus on representational aspects of brain functioning. These strategies have included visual and movement imagery, manipulation of sensory input that conveys perception of the head in space, and manipulation of visual input using prisms and eye patches. The complex nature of USN provides numerous directions for future research. Continued research will play a pivotal role in devising effective treatment strategies for patients with USN.

Taub E. and Morris D.M.

Constraint-induced movement therapy to enhance recovery after stroke

Curr Atheroscler Rep, 3 (2001) 279-86.

A therapeutic approach to rehabilitation of movement after stroke, termed constraint-induced (CI) movement therapy, has been derived from basic research with monkeys given somatosensory deafferentation. CI therapy consists of a family of therapies; their common element is that they induce persons with stroke to greatly increase the use of a more-affected upper extremity (UE) for many hours a day over a 2- to 3-week period. These therapies have significantly improved quality of movement and substantially increased amount of use of a more-affected UE in the activities of daily living in life situations. A number of neuroimaging and transcranial magnetic stimulation studies have shown that the massed practice of CI therapy produces a massive use-dependent cortical reorganization that increases the area of cortex involved in the innervation of movement of the more-affected UE. The intensity and schedule of delivery of this very efficacious therapy is quite different from that of more traditional physical rehabilitation approaches. As a result, to be clinically applicable, the CI therapy approach to rehabilitation will likely require a paradigm shift in the delivery of physical rehabilitation services.

Tilikete C., Rode G., Rossetti Y., Pichon J., Li L. and Boisson D.

Prism adaptation to rightward optical deviation improves postural imbalance in left-hemiparetic patients

Curr Biol, 11 (2001) 524-8.

Left-hemiparetic patients show predominant postural imbalance as compared to right-hemiparetic patients. The right hemisphere is crucial for generating internal maps used for perceptual and premotor processing of spatial information. Predominant postural imbalance with right-brain damage could thus result from a distortion of an internal postural map. Well-known manifestations of distorted internal maps due to right-hemisphere lesions, such as hemineglect, may show improvement following prism adaptation shifting the visual field to the right. We therefore investigated the effect of prism adaptation on postural imbalance in left-hemiparetic patients. Three groups of five patients were either adapted to prisms deviating the visual field to the right or left or exposed to neutral prisms while performing reaching movements of the right arm. Postural imbalance was reduced only following prism adaptation to the right. Thus, brief adaptation (i.e., 3 min) to rightward-shifting prisms can dramatically improve postural imbalance. This result shows that the effect of exposure to prisms that horizontally shift the visual field to the right in a reaching task generalizes to the postural system, and it suggests an interaction between horizontal and vertical reference frames. This also supports the theory that predominant postural imbalance in patients with right- brain damage may be partly related to a distortion of an internal postural map.

Toffola E.D., Sparpaglione D., Pistorio A. and Buonocore M.

Myoelectric manifestations of muscle changes in stroke patients

Arch Phys Med Rehabil, 82 (2001) 661-5.

OBJECTIVE: To evaluate the development of myoelectric fatigue in paretic and healthy tibialis anterior muscles of stroke patients. **DESIGN:** Case series. **SETTING:** Occupational therapy and clinical neurophysiology unit. **PARTICIPANTS:** Eight patients with hemiparesis or hemiplegia 9 months to 10 years poststroke. **MAIN OUTCOME MEASURES:** Current pulses of 0.1-ms width and 40-Hz repetition rate were applied for 10 seconds with a monopolar technique; myoelectric signals (M waves) were detected with surface electrodes. **RESULTS:** Mean values and initial values of the median frequency (MDF) between paretic and healthy side were statistically different, with the values on the healthy side much higher than the paretic side. Changes of MDF showed a decreasing pattern for both the paretic and the healthy sides, with the downslope of the curve of the healthy side more evident. **CONCLUSIONS:** In paretic muscles of stroke patients, the tendency toward atrophy of type II fibers appears to be frequent. Our study suggests this muscle rearrangement uses techniques much less invasive than muscle biopsy, and gives useful information about muscle function. This kind of information can help identify rehabilitation strategies, particularly for chronic stroke survivors.

Trueblood P.R.

Partial body weight treadmill training in persons with chronic stroke

NeuroRehabilitation, 16 (2001) 141-53.

PURPOSE: A series of pilot studies were conducted to examine the effects of partial body weight (PBW) ambulation in people with chronic stroke. **METHODS:** First, we compared gait characteristics during 3 modes of walking: level ground ambulation; level ground ambulation with PBW; and treadmill ambulation with PBW. Second, we examined the effects of repeated PBW treadmill training during level ground ambulation. **RESULTS:** Improved symmetry in stance/swing times and sEMG activity of pre-tibialis and quadriceps muscle groups during PBW either over level ground or on the treadmill occurred in 10 chronic stroke subjects. Increased single limb support and decreased double limb support improved overall gait symmetry during level ground ambulation in 8 subjects following 6--8 weeks repeated PBW treadmill training. Tinetti Balance score also significantly improved. No changes in sEMG were observed. **CONCLUSION:** These results suggest that PBW treadmill may help normalize gait and improve balance in the person with chronic stroke.

van der Lee J.H.

Constraint-induced therapy for stroke: more of the same or something completely different?

Curr Opin Neurol, 14 (2001) 741-4.

The term "constraint-induced therapy" is used to denote a "family of treatment modalities" in which the common feature is discouraging the use of the unaffected or less affected arm, combined with intensive training

of the paretic arm. A systematic literature search revealed only three randomized controlled studies on the effectiveness of constraint-induced therapy. The results of several systematic reviews on exercise therapy in stroke rehabilitation indicate that more intensive (i.e. more time spent in) training may be beneficial. Therefore, it is not unlikely that any (as yet unproved) effect of constraint-induced techniques is the result of more training, and the answer to the question in the title of this review seems to be "More of the same".

van der Lee J.H., Snels I.A., Beckerman H., Lankhorst G.J., Wagenaar R.C. and Bouter L.M.

Exercise therapy for arm function in stroke patients: a systematic review of randomized controlled trials

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OBJECTIVE: Assessment of the available evidence for the effectiveness of exercise therapy to improve arm function in patients who have suffered from a stroke. **METHODS:** A systematic search of bibliographical databases and reference checking were performed to identify publications on randomized controlled trials (RCTs) which evaluated the effect of exercise therapy on arm function in stroke patients. The methodological quality was assessed systematically by two raters, based on a standardized list of methodological criteria. Study characteristics, such as the chronicity and severity of impairment of the patient population, the amount and duration of interventions, and specific methodological criteria, were related to reported effects. **RESULTS:** Thirteen RCTs were identified, six of which reported positive results on an arm function test. In five of these six studies there was a contrast in amount or duration of exercise therapy between groups. Methodological scores ranged from 5 to 15 (maximum possible score: 19 points). **CONCLUSION:** Insufficient evidence made it impossible to draw definitive conclusions about the effectiveness of exercise therapy on arm function in stroke patients. The difference in results between studies with and without contrast in the amount or duration of exercise therapy between groups suggests that more exercise therapy may be beneficial.

van Vliet P.M., Lincoln N.B. and Robinson E.

Comparison of the content of two physiotherapy approaches for stroke

Clin Rehabil, 15 (2001) 398-414.

OBJECTIVE: To identify similarities and differences between a Bobath-based (BB) and a movement science-based (MSB) approach. **DESIGN:** Direct observation by a trained observer was used to record behaviours during treatments. **SETTING:** An acute stroke ward. **SUBJECTS:** Twenty-two stroke patients. **INTERVENTIONS:** Behaviours were recorded during 12 treatment sessions by three therapists, for each treatment approach. Physical and communication behaviours were recorded in pre-defined categories. The equipment used was recorded and a semi-structured interview conducted with the therapist after treatment to identify follow-up actions by the therapist. **MAIN OUTCOME MEASURES:** Frequency of occurrence of each category was compared between the approaches. **RESULTS:** Treatment in the BB group contained more social conversation ($p = 0.004$), and more use of physiotherapy equipment ($p = 0.02$) and a physiotherapy assistant ($p = 0.01$). In the MSB group there was more detailed feedback given to the patient ($p = 0.002$) more use of everyday objects in training ($p = 0.001$), therapists more frequently listed specific components as the patient's main problems ($p = 0.003$) and relatives were involved more in positioning to stretch muscles ($p = 0.03$). Training walking was given more emphasis in the BB group and training of sit-to-stand in the MSB group. **CONCLUSIONS:** The study indicates that there are differences in content between the Bobath-based and movement science-based approaches to treatment.

Wade D.T.

Research into the black box of rehabilitation: the risks of a Type III error

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Type I and Type II errors in the interpretation of data from clinical trials concern statistical matters, and the probability of drawing erroneous conclusions from inadequate data. However in rehabilitation research a third possible error may arise. Successful rehabilitation depends upon the co-ordinated work of an expert multidisciplinary team, and can be considered as a network involving a whole system. Demonstrating that one part of that system looked at in isolation does not have the expected effect does not prove that the specific part is not necessary to the success of the whole system. The isolated intervention may still have an important effect when interacting with other variables or interventions. Failure to consider the interactive effects of an intervention might constitute a Type III interpretation error.

Welgampola M.S. and Colebatch J.G.

Vestibulospinal reflexes: quantitative effects of sensory feedback and postural task

Exp Brain Res, 139 (2001) 345-53.

Vestibulospinal and vestibulocollic reflexes evoked by galvanic stimulation were studied in 20 normal volunteers. In an initial "baseline" study, subjects stood unsupported on a flat surface and a narrow base with their eyes shut and with their heads rotated to the left. The effects of vision, external support and increasing stance width were examined both individually and in combination. In a second series, the effects of the same factors were examined while subjects stood on a compliant surface. Short latency (SL) and medium latency (ML) vestibulospinal reflex responses were evoked using 4 mA/20 ms galvanic vestibular stimulation (GVS) and measured from the right soleus muscle. Vestibulocollic reflexes to short duration galvanic stimulation (4 mA/2 ms) were also measured under similar conditions. Both SL and ML vestibulospinal reflexes decreased significantly and to a similar degree with vision, external support and increasing stance width on a flat surface. On the compliant surface, stance width did not result in a decrease in the ML reflex. Reflex amplitudes further decreased in a non-linear fashion with each additional sensory modality ("factor") that was made available; the degree of attenuation due to the addition of a second and third factor closely approximated the product of the effect of each factor in isolation. Standing on a compliant surface resulted in enhancement of average SL and ML reflexes under all conditions. Vestibulocollic reflexes in contrast showed no significant modulation with vision, external support and stance width. The dissociation between vestibulocollic and vestibulospinal reflexes indicates that the modulation of vestibulospinal reflexes with task occurs proximal to the primary vestibular afferents. Vestibulospinal reflexes were largest when subjects stood on a narrow base, on a compliant surface, deprived of vision and external support, consistent with the importance of vestibular function under these conditions. Although attenuated, vestibulospinal reflexes were preserved in most subjects even when vision and external support were available and a wider stance width was adopted. The combination of different factors caused a multiplicative attenuation of the initial response.