

Abstracts 2002

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May 2003



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Abstracts alphabetically ordered by author

Ada L. and Foongchomcheay A.

Efficacy of electrical stimulation in preventing or reducing subluxation of the shoulder after stroke: a meta-analysis
Aust J Physiother, 48 (2002) 257-67.

After stroke, up to 81% of individuals develop shoulder subluxation, a condition frequently associated with poor upper limb function. Recently, electrical stimulation has been applied to shoulder muscles to treat shoulder subluxation. The purpose of this meta-analysis was to examine the efficacy of surface electrical stimulation for the prevention or reduction of shoulder subluxation after stroke. A meta-analysis of all eligible randomised or quasi-randomised trials of electrical stimulation for the treatment of shoulder subluxation identified by computerised and hand searches of the literature was carried out. The primary outcome measure of interest was subluxation. Seven (four early and three late) trials met the inclusion criteria. The mean PEDro score out of 10 for quality of the methods was 5.8 for the four early trials and 4.3 for the three late trials. Data were pooled when subluxation was measured in millimetres. Analysis found that, when added to conventional therapy, electrical stimulation prevented on average 6.5mm of shoulder subluxation (weighted mean difference, 95% CI 4.4 to 8.6) but only reduced it by 1.9mm (weighted mean difference, 95% CI -2.3 to 6.1) compared with conventional therapy alone. Therefore, evidence supports the use of electrical stimulation early after stroke for the prevention of, but not late after stroke for the reduction of, shoulder subluxation.

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

Follow-up services for stroke survivors after hospital discharge - a randomized control study
Clin Rehabil, 16 (2002) 593-603.

OBJECTIVE: To evaluate whether follow-up services for stroke survivors could improve functional outcome and reduce readmission rate. In this paper results of functional outcome are reported. **DESIGN:** Randomized controlled trial allocating patients to one of three different types of aftercare: (1) follow-up home visits by a physician, (2) physiotherapist instruction in the patient's home, or (3) standard aftercare. **SUBJECTS:** Stroke patients with persisting impairment and disability who, after completing inpatient rehabilitation, were discharged to their homes. **OUTCOME MEASURES:** Six months after discharge, functional outcome was assessed with Functional Quality of Movement, Barthel Index, Frenchay Activity Index and Index of Extended Activities of Daily Living. **RESULTS:** One-hundred and fifty-five stroke patients were included in the study. Fifty-four received follow-up home visits by a physician, 53 were given instructions by a physiotherapist in their home and 48 received standard aftercare only. No statistically significant differences in functional outcome six months after discharge were demonstrated between the three groups. However, all measurements showed a tendency towards higher scores indicating better function in both intervention groups compared with the control group. **CONCLUSION:** Follow-up services after stroke may be a way of improving functional outcome. The results of the present study should be evaluated in future trials. More research in this field is needed, especially studies of how to support stroke survivors to resume social and leisure activities.

Azouvi P., Samuel C., Louis-Dreyfus A., Bernati T., Bartolomeo P., Beis J.M., Chokron S., Leclercq M., Marchal F., Martin Y., De Montety G., Olivier S., Perennou D., Pradat-Diehl P., Prairial C., Rode G., Sieroff E., Wiart L. and Rousseaux M.

Sensitivity of clinical and behavioural tests of spatial neglect after right hemisphere stroke
J Neurol Neurosurg Psychiatry, 73 (2002) 160-6.

OBJECTIVES: The lack of agreement regarding assessment methods is responsible for the variability in the reported rate of occurrence of spatial neglect after stroke. The aim of this study was to assess the sensitivity of different tests of neglect after right hemisphere stroke. **METHODS:** Two hundred and six subacute right hemisphere stroke patients were given a test battery including a preliminary assessment of anosognosia and of visual extinction, a clinical assessment of gaze orientation and of personal neglect, and paper and pencil tests of spatial neglect in the peripersonal space. Patients were compared with a previously reported control group. A subgroup of patients (n=69) received a behavioural assessment of neglect in daily life situations. **RESULTS:** The most sensitive paper and pencil measure was the starting point in the cancellation task. The whole battery was more sensitive than any single test alone. About 85% of patients presented some degree of neglect on at least one measure. An important finding was that behavioural assessment of neglect in daily life was more sensitive than any other single measure of neglect. Behavioural neglect was considered as moderate to severe in 36% of cases. A factorial analysis revealed that paper and pencil tests were related to two underlying factors. Dissociations were found between extrapersonal neglect, personal neglect, anosognosia, and extinction. Anatomical analyses showed that neglect was more common and severe when the posterior association cortex was damaged. **CONCLUSIONS:** The automatic rightward orientation bias is the most sensitive clinical measure of neglect. Behavioural assessment is more sensitive than any single paper and pencil test. The results also support the assumption that neglect is a heterogeneous disorder.



Badics E., Wittmann A., Rupp M., Stabauer B. and Zifko U.A.

Systematic muscle building exercises in the rehabilitation of stroke patients

NeuroRehabilitation, 17 (2002) 211-4.

The effects of targeted strength training in patients with muscle weakness of central origin following cerebrovascular accidents has hardly been investigated to date. This prospective non-randomized study of 56 patients was designed to shed light on the effects of strength building exercises on muscle tone and on the gain in muscle strength achieved with them. All patients underwent a full residential neurologic rehabilitation program for 4 weeks, which included an exercise program for restoring the extensor strength of the legs and the supporting strength of the arms by leg and arm presses. Throughout the rehabilitation program muscle spasticity was evaluated clinically and maximal muscle strength on completion of the exercise program was compared to baseline. The extensor strength of the legs increased by 31.0 (+/- 26.7)% by 40.2 (+/- 15)%, significant for both variables. The extent of strength gain was positively correlated with the intensity and the number of exercising units. Muscle tone, which was abnormally high at baseline, did not further increase in any one case. The results of this study showed that targeted strength training significantly increased muscle power in patients with muscle weakness of central origin without any negative effects on spasticity.

Bautz-Holtert E., Sveen U., Rygh J., Rodgers H. and Wyller T.B.

Early supported discharge of patients with acute stroke: a randomized controlled trial

Disabil Rehabil, 24 (2002) 348-55.

PURPOSE: To evaluate the feasibility and effectiveness of early supported discharge (ESD) following acute stroke. **METHOD:** An ESD scheme was compared to conventional rehabilitation in a randomized controlled trial. All patients admitted with acute stroke were considered for inclusion. Eighty-eight (20.2%) were found to be eligible and 82 were randomized either to early supported discharge (n = 42) or conventional rehabilitation (n = 40). The primary outcome measure was the Nottingham Extended Activities of Daily Living Scale. The General Health Questionnaire, the Montgomery Aasberg Depression Rating Scale, mortality, placement and patient and carer satisfaction served as secondary outcome measures. **RESULTS:** Median length of stay was reduced from 31 days in the conventional hospital rehabilitation group to 22 days in the early supported discharge group (p = 0.09). No differences were found regarding primary outcome. The General Health Questionnaire score showed a significant difference in favour of the early supported discharge group at three months (19.5/24, p = 0.02), but not at six. At six months, the proportion of patients being dead or in institution showed a trend of being higher in the conventional rehabilitation group (OR 3.8, 95% CI 0.8-23). **CONCLUSIONS:** Early supported discharge after stroke is feasible and it is possible that it has benefits compared with conventional rehabilitation.

Booth J. and Hewison A.

Role overlap between occupational therapy and physiotherapy during in-patient stroke rehabilitation: an exploratory study

J Interprof Care, 16 (2002) 31-40.

The concept of role overlap between occupational therapy and physiotherapy has been the subject of debate for at least three decades. Stroke rehabilitation is an area where role overlap between occupational therapists and physiotherapists occurs. This article reports an exploratory study carried out with nine physiotherapists and nine occupational therapists working in a variety of in-patient stroke rehabilitation settings. Analysis of qualitative data collected through semi-structured interviews revealed that the majority of the participants recognised the existence of role overlap as inevitable within collaborative health care and felt it was of benefit to patients. However, it appeared that the concept was also perceived as a challenge to role security by many when considered from a professional perspective. Acceptance of role overlap depended upon the extent to which it occurred in the particular setting. Generic therapy was seen as an extreme form of overlap and regarded as an undesirable progression by most participants. The main strategy used to challenge this development was to emphasise professional uniqueness through role delineation. However, this strategy was found to be weak in the context of increasing demands for collaboration at a policy level.

Bowen A., Lincoln N.B. and Dewey M.

Cognitive rehabilitation for spatial neglect following stroke

Cochrane Database Syst Rev (2002) CD003586.

BACKGROUND: Unilateral spatial neglect is a failure to attend to one side of space. Various strategies have been used to treat these problems but evidence of their benefit has been lacking. **OBJECTIVES:** To determine the effects of cognitive rehabilitation for spatial neglect following stroke as measured on impairment and disability level assessments, and destination on discharge from hospital. To determine whether any effects persist at follow-up assessment. **SEARCH STRATEGY:** We searched the Cochrane Stroke Group Trials Register (last searched February 2001), MEDLINE (1966-December 2000), EMBASE (1980-February 2001), CINAHL (1983-January 2001), PSYCLIT and CLINPSYCH (1974-February 2001). We handsearched relevant journals, screened reference lists from relevant articles and tracked citations using SCISEARCH. **SELECTION CRITERIA:** Controlled trials of cognitive rehabilitation for



spatial neglect in stroke. Studies with mixed patient groups were excluded unless more than 75% of their sample were stroke patients or separate stroke data were available for stroke patients. DATA COLLECTION AND ANALYSIS: Two reviewers independently selected trials, extracted data, and assessed trial quality. MAIN RESULTS: We included 15 studies with 400 participants. A large number of different outcome measures were reported. Only six studies included a measure of disability and only four (111 participants) investigated persisting effects on any outcome. There was evidence that cognitive rehabilitation resulted in significant and persisting improvements in performance on impairment level assessments, although this varied depending on the test used. There was insufficient evidence to confirm or exclude an effect of cognitive rehabilitation at the level of disability or on destination following discharge from hospital. REVIEWER'S CONCLUSIONS: There is some evidence that cognitive rehabilitation for spatial neglect improves performance on some impairment level tests but its effect on disability is unclear. Further well-designed RCTs are warranted as well as basic research to develop valid outcome measures.

Brock K., Jennings K., Stevens J. and Picard S.

The Bobath concept has changed. (Comment on Critically Appraised Paper, Australian Journal of Physiotherapy 48: 59.)

Aust J Physiother, 48 (2002) 156-7; author reply 157.

Brock K.A., Goldie P.A. and Greenwood K.M.

Evaluating the effectiveness of stroke rehabilitation: choosing a discriminative measure
Arch Phys Med Rehabil, 83 (2002) 92-9.

OBJECTIVE: To evaluate the discriminative ability of several measures of physical disability used to determine quality of outcome for poststroke rehabilitation. DESIGN: A comparative study, using Rasch analysis, of the discriminative ability of functional status and mobility measures in rehabilitation patients with stroke. SETTING: A 26-bed rehabilitation unit, on site of a tertiary teaching hospital in Melbourne, Australia. PARTICIPANTS: A consecutive sample of 106 patients with acute stroke admitted for rehabilitation. INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Rasch analysis of the motor subscale of the FIM instrument, Motor Assessment Scale, Functional Ambulation Classification, gait velocity, and gait endurance. RESULTS: The more difficult items of the FIM motor scale adequately discriminated among higher functioning patients. The gait velocity measure further distinguished 9% of the sample, who functioned at a higher level than could be indicated by FIM motor subscale. The other measures did not add levels of discrimination to that provided by the FIM motor. Ability estimates provided by Rasch analysis of the FIM motor scale were a more accurate indication of ability than raw scores. Raw scores underestimated change in ability observed at higher levels of ability. CONCLUSION: Rasch estimates of the FIM motor subscale provide a discriminative measure for evaluating outcomes and change in ability achieved in stroke rehabilitation.

Brown L.A., Sleik R.J. and Winder T.R.

Attentional demands for static postural control after stroke
Arch Phys Med Rehabil, 83 (2002) 1732-5.

OBJECTIVE: To assess the attentional demands associated with postural control among people who have had a stroke. DESIGN: Nonrandomized matched case-control study. SETTING: University research laboratory in Canada. PARTICIPANTS: Six individuals who had suffered a left or right cerebral ischemic attack in the past year and a sample of 6 age- and gender-matched controls. Participants in the stroke group had a mean age of 64.17 \pm 13.14 years; control participants had a mean age of 64.00 \pm 13.91 years. Mean National Institute of Health Stroke Scale scores for these patients were 7.67 \pm 4.92 at the time of stroke and 1.66 \pm 1.36 at the time of testing. None of the patients were taking medications that would alter cognitive status or balance abilities. INTERVENTION: Participants performed a verbal reaction-time test while engaged in 3 postural tasks (sitting, standing, standing with feet together). MAIN OUTCOME MEASURE: Reaction time: latency between visual stimulus and verbal response. RESULTS: Reaction times in the stroke group differed significantly in all conditions from the controls (410 \pm 72 ms vs 320 \pm 54 ms, $P < .01$). A significant interaction was found between group and postural task ($P = .05$), with reaction-time scores showing a progressive increase in postural task difficulty among participants who had suffered a stroke. Post hoc comparisons revealed that sitting reaction-time scores were significantly slower than reaction-time scores for feet together standing ($P = .008$) among participants in the stroke group. CONCLUSION: Individuals who have suffered a stroke showed increased attentional demands for tasks of static postural control compared with healthy, age-matched participants.

Carey J.R., Kimberley T.J., Lewis S.M., Auerbach E.J., Dorsey L., Rundquist P. and Ugurbil K.

Analysis of MRI and finger tracking training in subjects with chronic stroke
Brain, 125 (2002) 773-88.

Hand movement recovery and cortical reorganization were studied in 10 subjects with chronic stroke using functional MRI (fMRI) before and after training with an intensive finger movement tracking programme. Subjects were



assigned randomly to a treatment or control group. The treatment group received 18-20 sessions of finger tracking training using target waveforms under variable conditions. The control group crossed over to receive the same treatment after the control period. For comparison with a healthy population, nine well elderly females were also studied; however, the well elderly controls did not cross over after the control period. The dependent variables consisted of a Box and Block score to measure prehensile ability (subjects with stroke only), a tracking accuracy score and quantification of active cortical areas using fMRI. For the tracking tests, the subjects tracked a sine wave target on a computer screen with extension and flexion movements of the paretic index finger. Functional brain images were collected from the frontal and parietal lobes of the subject with a 4 tesla magnet. Areas of interest included the sensorimotor cortex (SMC), primary motor area (M1), primary sensory area (S1), premotor cortex (PMC) and supplementary motor area (SMA). Comparison between all subjects with stroke and all well elderly subjects at pre-test was analysed with two-sample t-tests. Change from pre-test to post-test within subjects was analysed with paired t-tests. Statistical significance was set at $P < 0.05$. Stroke treatment subjects demonstrated significant improvement in tracking accuracy, whereas stroke control subjects did not until after crossover treatment. At pre-test, the cortical activation in the subjects with stroke was predominantly ipsilateral to the performing hand, whereas in the well elderly subjects it was contralateral. Activation for the stroke treatment group following training switched to contralateral in SMC, M1, S1 and PMC. The stroke control group's activation remained ipsilateral after the control period, but switched to contralateral after crossover to receive treatment. All well elderly subjects maintained predominantly contralateral activation throughout. Transfer of skill to functional activity was shown in significantly improved Box and Block scores for the stroke treatment group, with no such improvement in the stroke control group until after crossover. We concluded that individuals with chronic stroke receiving intensive tracking training showed improved tracking accuracy and grasp and release function, and that these improvements were accompanied by brain reorganization.

Carey L.M., Abbott D.F., Puce A., Jackson G.D., Syngeniotis A. and Donnan G.A.

Reemergence of activation with poststroke somatosensory recovery: a serial fMRI case study
Neurology, 59 (2002) 749-52.

The authors demonstrate the potential for poststroke return of activation in regions normally involved in touch discrimination in a serial, whole-brain fMRI study of a patient with marked sensory loss followed by good recovery. A return of activation in ipsilesional primary and bilateral secondary somatosensory cortices was observed at 3 months after stroke and was maintained at 6 months, indicating a reemergence of activation after the interval of somatosensory recovery. There was little evidence of neural plastic changes early after stroke (2 weeks), when sensory loss was severe.

Carod-Artal F.J., Gonzalez-Gutierrez J.L., Herrero J.A., Horan T. and De Seijas E.V.

Functional recovery and instrumental activities of daily living: follow-up 1-year after treatment in a stroke unit
Brain Inj, 16 (2002) 207-16.

The objective of the study was to assess the utility of the Frenchay Activities Index (FAI) to measure instrumental activities of daily living (IADL) and functional recovery in stroke patients compared to other measures such as Barthel Index (BI) and Scandinavian Stroke Scale (SSS). A cross-sectional descriptive analysis design was done. Ninety stroke survivors (41 women, 49 men; mean age 68 years) discharged from the Stroke Unit at San Carlos Hospital, Madrid, were assessed by BI at discharge and by BI and FAI 1-year after stroke. At discharge, 40% had total or severe disability ($BI < \text{or} = 60$) and at 1-year 11.1%. FAI (mean value 36 ± 11) correlated with Barthel index, capacity for walking, strength in upper limb and total SSS 1-year after stroke ($p < 0.0001$). Fifty-two per cent of stroke patients became independent in their ADL during the first year. BI was the strongest predictor of independence in FAI Social activities-category.

Cauraugh J.H. and Kim S.

Two coupled motor recovery protocols are better than one: electromyogram-triggered neuromuscular stimulation and bilateral movements
Stroke, 33 (2002) 1589-94.

BACKGROUND AND PURPOSE: Overcoming chronic hemiparesis from a cerebrovascular accident (CVA) can be challenging for many patients, especially after the first 12 months after the CVA. With the use of established motor control theories, the present study investigated electromyogram (EMG)-triggered neuromuscular stimulation and bilateral coordination training. **METHODS:** Twenty-five CVA subjects volunteered to participate in this motor recovery protocol study. Subjects were randomly assigned to 1 of 3 groups: (1) coupled protocol of EMG-triggered stimulation and bilateral movement ($n=10$); (2) EMG-triggered stimulation and unilateral movement ($n=10$); or (3) control ($n=5$). All participants completed 6 hours of rehabilitation during a 2-week period according to group assignments. Motor capabilities of the wrist and fingers were evaluated on the basis of 3 categories of motor tasks in a pretest-posttest control group design. **RESULTS:** Significant findings for the (1) number of blocks moved in a functional task, (2) chronometric reaction times to initiate movements, and (3) sustained muscle contraction capability all favored the coupled bilateral movement training and EMG-triggered neuromuscular stimulation protocol group. In addition, the unilateral



movement/stimulation group exceeded the control group in the number of blocks moved and rapid onset of muscle contractions. **CONCLUSIONS:** This new evidence is convincing in that subjects in the coupled protocol group were able to demonstrate enhanced voluntary motor control across 3 categories of tasks. Chronic hemiparesis decreased considerably in the wrist and fingers as CVA patients expanded their motor repertoire.

Chen I.C., Cheng P.T., Chen C.L., Chen S.C., Chung C.Y. and Yeh T.H.

Effects of balance training on hemiplegic stroke patients

Chang Gung Med J, 25 (2002) 583-90.

BACKGROUND: The purpose of this study was to evaluate the delayed effects of balance training program on hemiplegic stroke patients. **METHODS:** A total of 41 ambulatory hemiplegic stroke patients were recruited into this study and randomly assigned into two groups, the control group and trained group. Visual feedback balance training with the SMART Balance Master was used in the trained group. Bruunstrom staging of affected limb scores and Functional Independent Measure (FIM) scores of each patient were recorded. Quantitative balance function was evaluated using the SMART Balance Master. Data were collected before training and 6 months after completing the training program. **RESULTS:** Significant improvements in dynamic balance function measurements were found for patients in the trained group at 6 months after completing the training program. The ability of self-care and sphincter control also improved for patients in the trained group. On the other hand, no significant differences were found in static balance functions between the trained group and control group at 6 months of follow up. The locomotion and mobility scoring of FIM also revealed no differences between the groups. **CONCLUSION:** Dynamic balance function of patients in the visual feedback training group had significant improvements when compared with the control group. Activities of daily living (ADL) function in self-care also had significant improvements at 6 months of follow up in the trained group. The results showed that balance training was beneficial for patients after hemiplegic stroke.

Dancause N., Pfito A. and Levin M.F.

Error correction strategies for motor behavior after unilateral brain damage: short-term motor learning processes

Neuropsychologia, 40 (2002) 1313-23.

In order to identify the mechanisms underlying motor impairments and motor learning following stroke-related brain damage, we analyzed correction strategies used by hemiparetic individuals to produce precise elbow flexion movements of the paretic arm and compared them to those of healthy individuals. Participants made rapid elbow flexion movements to a 6 degrees wide target and were instructed to correct movement errors as quickly as possible when a spring-like load was unexpectedly introduced. Angular positions and torques before correction were used to identify error patterns. Results showed that participants with mild hemiparesis minimized movement errors within three trials, as did healthy participants. In contrast, severely affected individuals needed more trials to diminish errors and their movements were inconsistent. Participants with a moderate motor disability used both typical and atypical correction strategies. The differences in correction behaviors likely reflect deficits in arm motor function ($r=0.79$) and executive function ($r=0.58$) rather than levels of intellectual function (IQ ratings). Results indicate that the deficits that individuals with stroke experience when adapting their movements to changed load conditions may be due to difficulty in rapidly integrating visual and proprioceptive information. Deficits in executive function could also contribute to problems in producing accurate and consistent movements from trial to trial. Taken together, these results imply that all hemiparetic individuals would not benefit equally from the same motor re-training approaches.

Dannenbaum R.M., Michaelsen S.M., Desrosiers J. and Levin M.F.

Development and validation of two new sensory tests of the hand for patients with stroke

Clin Rehabil, 16 (2002) 630-9.

OBJECTIVE: To establish validity and reliability of two new sensory tests evaluating moving (MTP) and sustained (STP) touch-pressure and their relationship to hand function for patients with stroke. The STP had four components in which a light or heavy ball was applied passively or held actively. **PARTICIPANTS:** Twenty-eight participants with hemiparesis (1-109 months) from rehabilitation hospitals or outpatient programmes. **DESIGN:** Content validity was established. Then reliability and concurrent and construct validity were determined. Sensation was compared with hand functional ability using the Modified Moberg recognition task, the Box and Block test and one task of the TEMPA test. **RESULTS:** Reliability: Both types of reliability were significant for MTP (ICC = 0.92) and all components of STP (ICC = 0.62 to 0.92). Concurrent validity: MTP and STP correlated significantly ($r = -0.39$ to -0.83) with the Semmes-Weinstein Monofilament test used as a 'gold standard' comparison. Construct validity: MTP was significantly related to Moberg ($r = 0.49$). Three of four components of STP correlated with TEMPA ($r = 0.49-0.53$) and Moberg ($0.45-0.71$). Only STP (heavy ball) correlated with Box and Block ($0.42-0.48$). Of the four components of STP, only the passive STP (light ball) was not related to hand function. **CONCLUSION:** The new sensory tests of moving, and three components of sustained touch-pressure were reliable. The passive STP (light ball) was discarded. All but this test were relevant to the two functional roles of sensation: exploration for MTP and dexterity during holding for STP.



de Kroon J.R., van der Lee J.H., MJ I.J. and Lankhorst G.J.

Therapeutic electrical stimulation to improve motor control and functional abilities of the upper extremity after stroke: a systematic review

Clin Rehabil, 16 (2002) 350-60.

BACKGROUND: Therapeutic electrical stimulation (TES) is a therapeutic strategy aimed at improving impairments of the upper extremity in stroke. **OBJECTIVE:** Assessment of the available evidence on the effect of TES of the affected upper extremity in improving motor control and functional abilities after stroke. **METHODS:** A systematic literature search was performed to identify randomized controlled trials (RCTs) that have studied the effect of TES on motor control and functional abilities. The methodological quality of the studies was assessed systematically by two raters. The reported outcomes were examined to evaluate the effect of TES and to identify a possible relationship with patient characteristics, method of stimulation and methodological quality. When possible, effect sizes were calculated (Hedges' g). **RESULTS:** Six RCTs were included. The methodological scores ranged from 7 to 16 (maximum 19). All studies assessed the effect on motor control, and four reported a positive effect. Effect sizes calculated in three studies ranged from 0.55 to 1.46. Only two studies assessed the effect on functional ability, one reported a positive effect. Sub-group analyses in two studies suggest a better response to stimulation in less severely affected patients. Apart from this, no relationship between effect and patient characteristics, method of stimulation or methodological quality could be detected. **CONCLUSIONS:** The present review suggests a positive effect of electrical stimulation on motor control. No conclusions can be drawn with regard to the effect on functional abilities.

Dewey H.M., Thrift A.G., Mihalopoulos C., Carter R., Macdonell R.A., McNeil J.J. and Donnan G.A.

Informal care for stroke survivors: results from the North East Melbourne Stroke Incidence Study (NEMESIS)

Stroke, 33 (2002) 1028-33.

BACKGROUND AND PURPOSE: Informal caregivers play an important role in the lives of stroke patients, but the cost of providing this care has not been estimated. The purpose of this study was to determine the nature and amount of informal care provided to stroke patients and to estimate the economic cost of that care. **METHODS:** The primary caregivers of stroke patients registered in the North East Melbourne Stroke Incidence Study (NEMESIS) were interviewed at 3, 6, and 12 months after stroke, and the nature and amount of informal care provided were documented. The opportunity and replacement costs of informal care for all first-ever-in-a-lifetime strokes (excluding subarachnoid hemorrhages) that occurred in 1997 in Australia were estimated. **RESULTS:** Among 3-month stroke survivors, 74% required assistance with activities of daily living and received informal care from family or friends. Two thirds of primary caregivers were women, and most primary caregivers (>90%) provided care during family or leisure time. Total first-year caregiver time costs for all first-ever-in-a-lifetime strokes were estimated to be A\$21.7 million (opportunity cost approach) or A\$42.5 million (replacement cost approach), and the present values of lifetime caregiver time costs were estimated to be A\$171.4 million (opportunity cost approach) or A\$331.8 million (replacement cost approach). **CONCLUSIONS:** Informal care for stroke survivors represents a significant hidden cost to Australian society. Because our community is rapidly aging, this informal care burden may increase significantly in the future.

Donkervoort M., Dekker J. and Deelman B.G.

Sensitivity of different ADL measures to apraxia and motor impairments

Clin Rehabil, 16 (2002) 299-305.

OBJECTIVE: To determine whether specifically designed activities of daily living (ADL) observations can measure disability due to apraxia with more sensitivity than the Barthel ADL Index, a conventional functional scale. **DESIGN:** Cross-sectional study. **SETTING:** Rehabilitation centres and nursing homes. **SUBJECTS:** One hundred and six left hemisphere stroke patients with apraxia, hospitalized in rehabilitation centres and nursing homes. **MEASURES:** ADL observations, Barthel ADL Index, an apraxia test, Motricity Index, Functional Motor Test. **RESULTS:** Multivariate analyses showed that the specific ADL observations were associated with severity of apraxia (and not with motor impairments). The Barthel ADL Index was associated with motor impairments (and not with severity of apraxia). **CONCLUSION:** The assessment of disability in stroke patients with apraxia cannot rely only on the Barthel ADL Index. In addition, the specific ADL observation procedure is needed to measure disability due to apraxia.

Doyle P.J.

Measuring health outcomes in stroke survivors

Arch Phys Med Rehabil, 83 (2002) S39-43.

Stroke frequently results in psychologic distress and activity limitations across multiple domains of functioning. However, most stroke outcome measurement tools and clinical trial endpoints are narrowly focused on neurologic symptom status and physical aspects of functioning, and rarely assess other important components of health. In this article, I discuss the limitations in the measurement of nonfatal stroke outcomes; propose a minimum set of fundamental assessment domains comprising a comprehensive assessment of health status in stroke survivors; and describe the con-



ceptual development of the Burden of Stroke Scale, a comprehensive, patient-reported measure of functioning and well-being for stroke survivors.

Duarte E., Marco E., Muniesa J.M., Belmonte R., Diaz P., Tejero M. and Escalada F.

Trunk control test as a functional predictor in stroke patients

J Rehabil Med, 34 (2002) 267-72.

The purpose of this study was to evaluate prospectively the Trunk Control Test (TCT) correlation at admission to rehabilitation with length of stay, functional independence measure (FIM), gait velocity, walking distance and balance measured at discharge in 28 hemiparetic patients. FIM and TCT were registered on admission. Outcome measures at discharge were: FIM, gait velocity, walking distance and balance assessed with the Berg Balance Scale and computerized posturography. TCT was significantly correlated with length of stay ($r = -0.722$), discharge FIM ($r = 0.738$), discharge motor FIM ($r = 0.723$), gait velocity ($r = 0.654$), walking distance ($p = 0.003$), centre of gravity symmetry $r = 0.601$ and Berg Balance Scale ($r = 0.755$). Initial TCT predicts the 52% of the variation in length of stay and 54% in the discharge FIM. The predictive value of a compound variable (TCT and admission FIM) reaches 60% of the variation in length of stay and 66% in the FIM at discharge.

Duncan P.W., Horner R.D., Reker D.M., Samsa G.P., Hoenig H., Hamilton B., LaClair B.J. and Dudley T.K.

Adherence to postacute rehabilitation guidelines is associated with functional recovery in stroke

Stroke, 33 (2002) 167-77.

BACKGROUND AND PURPOSE: The purpose of this study was to determine if compliance with poststroke rehabilitation guidelines was associated with better functional outcomes. **METHODS:** An inception cohort of 288 stroke patients in 11 Department of Veteran Affairs Medical Centers hospitalized between January 1998 and March 1999 were followed prospectively for 6 months. Data were abstracted from medical records and telephone interviews. The primary study outcome was the Functional Independence Motor Score (FIM). Secondary outcomes included Instrumental Activities of Daily Living (IADL), SF-36 physical functioning, and the Stroke Impact Scale (SIS). Acute and postacute rehabilitation guideline compliance scores (range 0 to 100) were derived from an algorithm. All outcomes were adjusted for case-mix. **RESULTS:** Average compliance scores in acute and postacute care settings were 68.2% (SD 14) and 69.5% (SD 14.4), respectively. After case-mix adjustment, level of compliance with postacute rehabilitation guidelines was significantly associated with FIM motor, IADL, and the SIS physical domain scores. SF-36 physical function was not associated with guideline compliance. Level of compliance with rehabilitation guidelines in acute settings was unrelated to any of the outcome measures. **CONCLUSION:** Greater levels of adherence to postacute stroke rehabilitation guidelines were associated with improved patient outcomes. Compliance with guidelines may be viewed as a quality-of-care indicator with which to evaluate new organizational and funding changes involving postacute stroke rehabilitation.

Fahle M. and Daum I.

Perceptual learning in amnesia

Neuropsychologia, 40 (2002) 1167-72.

Evidence from experiments on perceptual learning, accumulated during the last few years, increasingly indicates that the relative 'front end' parts of the visual system are more plastic even in adults than was previously expected. Hence, it might be possible that perceptual learning is similar in several respects to procedural learning and may be achieved even without (declarative) memory traces present. Results on six patients suffering from global amnesia due to damage to hippocampal-diencephalic systems demonstrate, for the first time, that at least some amnesic patients are able to significantly improve performance in a visual hyperacuity task as a result of training, showing improvement as good as the observers in the control group. This result corroborates the notion of a relatively 'front end' location of at least some forms of perceptual learning.

Fasoli S.E., Trombly C.A., Tickle-Degnen L. and Verfaellie M.H.

Effect of instructions on functional reach in persons with and without cerebrovascular accident

Am J Occup Ther, 56 (2002) 380-90.

OBJECTIVE: Verbal instructions comprise an important element of clinical practice, however, their effectiveness in promoting movement organization in persons with cerebrovascular accident (CVA) has not been well investigated. **METHOD:** A counterbalanced, repeated-measures design was used to examine the effects of externally focused (task-related) versus internally focused (movement-related) instructions on movement kinematics during three functional reaching tasks. Participants included 16 persons with stroke who were able to perform the tasks with their affected arm and 17 age-matched adults without neurological impairments. **RESULTS:** Significantly shorter movement time and greater peak velocity were evident when reaching under the external-focus condition of all tasks than for the internal-focus condition. **CONCLUSION:** One clinical implication is that internally focused instructions can contribute to slower and less forceful reach in adults with and without CVA. This research reinforces the need for therapists to consider their use of instruction during the evaluation and treatment of movement disorders.



Feigin V.L., Anderson C.S., Rodgers A., Anderson N.E. and Gunn A.J.

The emerging role of induced hypothermia in the management of acute stroke

J Clin Neurosci, 9 (2002) 502-7.

Current treatment of acute stroke remains unsatisfactory. This review presents experimental and clinical data which suggest that mild induced hypothermia could be a potent and practicable neuroprotective treatment of acute ischaemic stroke and intracerebral haemorrhage. Hypothermia, if proven to be safe, effective and widely practicable in patients with acute stroke, could have an enormous positive impact on reducing the burden of stroke worldwide. Critical issues that will need to be considered in a well designed randomised controlled trial of induced hypothermia in acute stroke patients are discussed.

Fisk G.D., Owsley C. and Mennemeier M.

Vision, attention, and self-reported driving behaviors in community-dwelling stroke survivors

Arch Phys Med Rehabil, 83 (2002) 469-77.

OBJECTIVE: To elucidate the relationships among vision, attention, driving status, and self-reported driving behaviors in community-dwelling stroke survivors. **DESIGN:** A cross-sectional design to compare stroke survivors to older adults without stroke on visual measures, attentional measures, and self-reported driving behaviors. **SETTING:** Rehabilitation center at a university hospital. **PARTICIPANTS:** Fifty stroke survivors and 105 older adults without neurologic or visual impairment. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Visual acuity, contrast sensitivity, peripheral vision, useful field of view (UFOV), Behavioral Inattention Test, and a driving habits questionnaire. **RESULTS:** Stroke survivors had impaired contrast sensitivity, peripheral vision, and UFOV compared with older adults in good visual and neurologic health. Driving stroke survivors typically had less attentional impairment than nondrivers. Stroke survivors who returned to driving reported difficulty in challenging driving conditions, drove less, and relied more on other people for transportation than older adults without stroke. **CONCLUSIONS:** These results suggest that vision and attention, both of which are important for driving, are often impaired in stroke survivors. The severity of these deficits could be an influence on driving status and driving behavior. Stroke survivors who return to driving strategically limit their driving exposure and rely on others for transportation, which suggests that they may deliberately self-regulate their driving behavior.

Forsberg-Warley G., Moller A. and Blomstrand C.

Spouses of first-ever stroke patients: their view of the future during the first phase after stroke

Clin Rehabil, 16 (2002) 506-14.

BACKGROUND: A partner's stroke can be perceived as a critical event by a spouse. Previous studies have focused primarily on the impact of stroke on spouses' psychosocial well-being over the long term. However, the experience of spouses in the first phase after stroke is not well known. **AIM:** To investigate spouses' perception of their future daily life after stroke and the association between this perception and the objective characteristics of the stroke. **METHOD:** Eighty-three consecutively enrolled spouses of first-ever stroke patients < 75 years admitted to Sahlgrenska University Hospital in Goteborg, Sweden participated. The mean age of the spouses was 57 years. Sixty-two of the spouses were women and 21 men. Interviews about their experiences 10 days after onset were generally made at the hospital. The interviews were analysed, categorized and combined with statistical analyses of variables such as ages and sex of the spouses, type of lesion and presence of neurological impairments in the stroke patient. **RESULTS:** Four different categories of the concept 'view of the future' were developed on the basis of the interviews. Of the different characteristics of the stroke, the severity of the sensorimotor impairment seemed to have the greatest impact on the spouses' view of the future. The spouses of stroke patients with pure sensorimotor impairment were more likely to have an optimistic view of the future than when the sensorimotor impairment was combined with cognitive deficits. There was a broad distribution of the different characteristics of stroke between the four categories. **CONCLUSIONS:** Although the perception of future daily life varied, it was possible to categorize the spouses' cognitive image of future life according to degree of optimism. While the severity of stroke was of importance, the individual perception of the disease, impact on future activities and the spouses' own coping capacity was of great significance for the perception of future daily life.

Fraser C., Power M., Hamdy S., Rothwell J., Hobday D., Hollander I., Tyrell P., Hobson A., Williams S. and Thompson D.

Driving plasticity in human adult motor cortex is associated with improved motor function after brain injury

Neuron, 34 (2002) 831-40.

Changes in somatosensory input can remodel human cortical motor organization, yet the input characteristics that promote reorganization and their functional significance have not been explored. Here we show with transcranial magnetic stimulation that sensory-driven reorganization of human motor cortex is highly dependent upon the frequency, intensity, and duration of stimulus applied. Those patterns of input associated with enhanced excitability (5 Hz, 75% maximal tolerated intensity for 10 min) induce stronger cortical activation to fMRI. When applied to acutely dysphagic stroke patients, swallowing corticobulbar excitability is increased mainly in the undamaged hemisphere, being strongly



correlated with an improvement in swallowing function. Thus, input to the human adult brain can be programmed to promote beneficial changes in neuroplasticity and function after cerebral injury.

Gamble G.E., Barberan E., Laasch H.U., Bowsher D., Tyrrell P.J. and Jones A.K.

Poststroke shoulder pain: a prospective study of the association and risk factors in 152 patients from a consecutive cohort of 205 patients presenting with stroke

Eur J Pain, 6 (2002) 467-74.

BACKGROUND AND PURPOSE: Shoulder pain is known to retard rehabilitation after stroke. Its causes and prognosis are uncertain. This study describes the incidence of poststroke shoulder pain prospectively, in an unselected stroke population in the first 6 months after stroke and identifies risk factors for developing pain. **METHODS:** 297 patients with possible stroke were screened and stroke diagnosed in 205 cases. The 152 patients entered the study of which 123 patients were assessed up to 6 months. This cohort, with a mean age of 70.6 years, was examined at 2 weeks, 2, 4, and 6 months. A history of shoulder pain, Barthel score, anxiety and depression score were recorded. Full neurological and rheumatological examination was undertaken, using the contralateral side as a control. Pain outcome and stroke outcome was recorded at subsequent visits. **RESULTS:** 52 (40%) patients developed shoulder pain on the same side of their stroke. There was a strong association between pain and abnormal shoulder joint examination, ipsilateral sensory abnormalities and arm weakness. Shoulder pain had resolved or improved at 6 months in 41 (80%) of the patients with standard current treatment. **CONCLUSIONS:** Shoulder pain after stroke occurred in 40% of 123 patients surviving, consenting and not too unwell to participate. This included 52 patients of an original cohort of 205 patients presenting with stroke. Eighty percent of patients made a good recovery with standard treatment. Patients with sensory and or motor deficits represent at risk sub-groups.

Glader E.L., Stegmayr B. and Asplund K.

Poststroke fatigue: a 2-year follow-up study of stroke patients in Sweden

Stroke, 33 (2002) 1327-33.

BACKGROUND AND PURPOSE: Fatigue is common among stroke patients. This study determined the prevalence of fatigue among long-term survivors after stroke and what impact fatigue had on various aspects of daily life and on survival. **METHODS:** This study was based on Riks-Stroke, a hospital-based national register for quality assessment of acute stroke events in Sweden. During the first 6 months of 1997, 8194 patients were registered in Riks-Stroke, and 5189 were still alive 2 years after the stroke. They were followed up by a mail questionnaire, to which 4023 (79%) responded. Patients who reported that they always felt depressed were excluded. **RESULTS:** To the question, "Do you feel tired?" 366 (10.0%) of the patients answered that they always felt tired, and an additional 1070 (29.2%) were often tired. Patients who always felt tired were on average older than the rest of the study population (74.5 versus 71.5 years, $P < 0.001$); therefore, all subsequent analyses were age adjusted. Fatigue was an independent predictor for having to move into an institutional setting after stroke. Fatigue was also an independent predictor for being dependent in primary activities of daily living functions. Three years after stroke, patients with fatigue also had a higher case fatality rate. **CONCLUSIONS:** Fatigue is frequent and often severe, even late after stroke. It is associated with profound deterioration of several aspects of everyday life and with higher case fatality, but it usually receives little attention by healthcare professionals. Intervention studies are needed.

Gladstone D.J., Danells C.J. and Black S.E.

The Fugl-Meyer assessment of motor recovery after stroke: a critical review of its measurement properties

Neurorehabil Neural Repair, 16 (2002) 232-40.

Measurement of recovery after stroke is becoming increasingly important with the advent of new treatment options under investigation in stroke rehabilitation research. The Fugl-Meyer scale was developed as the first quantitative evaluative instrument for measuring sensorimotor stroke recovery, based on Twitchell and Brunnstrom's concept of sequential stages of motor return in the hemiplegic stroke patient. The Fugl-Meyer is a well-designed, feasible and efficient clinical examination method that has been tested widely in the stroke population. Its primary value is the 100-point motor domain, which has received the most extensive evaluation. Excellent interrater and intrarater reliability and construct validity have been demonstrated, and preliminary evidence suggests that the Fugl-Meyer assessment is responsive to change. Limitations of the motor domain include a ceiling effect, omission of some potentially relevant items, and weighting of the arm more than the leg. Further study should test performance of this scale in specific subgroups of stroke patients and better define its criterion validity, sensitivity to change, and minimal clinically important difference. Based on the available evidence, the Fugl-Meyer motor scale is recommended highly as a clinical and research tool for evaluating changes in motor impairment following stroke.



Gosman-Hedstrom G., Claesson L., Blomstrand C., Fagerberg B. and Lundgren-Lindquist B.

Use and cost of assistive technology the first year after stroke. A randomized controlled trial

Int J Technol Assess Health Care, 18 (2002) 520-7.

OBJECTIVE: The objective was to compare and evaluate assistive technology given to patients treated in a stroke unit and patients treated in a general medical ward. **METHOD:** Use and cost of assistive technology was evaluated in a randomized study comprising 249 patients during a 12-month period. **RESULT:** Acute stroke unit care was associated with a higher prescription of assistive devices during the first 3 months. There was no difference in use and total mean cost per patient of assistive technology during the first year after stroke. **CONCLUSION:** There was no difference in use or cost of assistive technology during the first year, but a beneficial effect was found on supplementary prescription of assistive devices during the first 3 months. The cost during the first year after stroke was a small fraction of the total costs for care and rehabilitation. It is not expensive for the community to equip these patients and their caregivers with assistive technology, and economic resources should be available to this vulnerable group of elderly patients.

Green J., Forster A., Bogle S. and Young J.

Physiotherapy for patients with mobility problems more than 1 year after stroke: a randomised controlled trial

Lancet, 359 (2002) 199-203.

BACKGROUND: Community physiotherapy is often prescribed for stroke patients with long-term mobility problems. We aimed to assess the effectiveness of this treatment in patients who had mobility problems 1 year after stroke. **METHODS:** We screened 359 patients older than 50 years for a single-masked, randomised controlled trial to assess the effects of community physiotherapy. Assessments were made at baseline, 3, 6, and 9 months in 170 eligible patients assigned treatment or no intervention. The primary outcome measure was mobility measured by the Rivermead mobility index. Secondary outcome measures were gait speed, number of falls, daily activity (Barthel index scores), social activity (Frenchay activities index), hospital anxiety and depression scale, and emotional stress of carers (general health questionnaire 28). Analyses were by intention to treat. **FINDINGS:** Follow-up was available for 146 patients (86%). Changes in scores on the Rivermead mobility index (score range 0-15) differed significantly between treatment and control groups at 3 months ($p=0.018$), but only by a median of 1 point (95% CI 0-1), with an interpolated value of 0.55 (0.08-1.04). Gait speed was 2.6 m/min (0.30-4.95) higher in the treatment group at 3 months. Neither treatment effect persisted at 6-months' and 9-months' follow-up. Treatment had no effect on patients' daily activity, social activity, anxiety, depression, and number of falls, or on emotional stress of carers. **INTERPRETATION:** Community physiotherapy treatment for patients with mobility problems 1 year after stroke leads to significant, but clinically small, improvements in mobility and gait speed that are not sustained after treatment ends.

Hellstrom K., Lindmark B. and Fugl-Meyer A.

The Falls-Efficacy Scale, Swedish version: does it reflect clinically meaningful changes after stroke?

Disabil Rehabil, 24 (2002) 471-81.

PURPOSE: The overall aim of this prospective investigation was to evaluate the ability of the Falls Efficacy Scale (Swedish version) (FES(S)) to reflect clinically meaningful changes over time. **METHOD:** Changes on the FES(S) scale were compared with changes in two different standardized measures of observer-assessed balance, the Berg Balance Scale (BBS), the Fugl-Meyer balance subscale (FMB), and of motor function and ambulation in 62 stroke patients. Assessments took place on admission for rehabilitation, at discharge and 10 months after the stroke. Indices of effect size were used to evaluate responsiveness of the instruments. Three time periods were studied: admission to discharge (early response), discharge to 10 month follow-up (late response) and admission to follow-up (overall response). **RESULTS:** The main findings are that the FES(S) is as responsive as BBS and FMB in detecting changes during the early and overall response periods. Changes in FES(S) scores between admission and discharge correlated significantly with changes in observer-assessed balance, motor function and ambulation scores. **CONCLUSIONS:** The present results suggest that measurement of perceived confidence in task performance using the FES(S) scale is responsive to improvement in patients with hemiparesis at an early stage after stroke.

Hendricks H.T., van Limbeek J., Geurts A.C. and Zwartz M.J.

Motor recovery after stroke: a systematic review of the literature

Arch Phys Med Rehabil, 83 (2002) 1629-37.

OBJECTIVE: To collect and integrate existing data concerning the occurrence, extent, time course, and prognostic determinants of motor recovery after stroke using a systematic methodologic approach. **DATA SOURCES:** A computer-aided search in bibliographic databases was done of longitudinal cohort studies, original prognostic studies, and randomized controlled trials published in the period 1966 to November 2001, which was expanded by references from retrieved articles and narrative reviews. **STUDY SELECTION:** After a preliminary screening, internal, external, and statistical validity was assessed by a priori methodologic criteria, with special emphasis on the internal validity. **DATA EXTRACTION:** The studies finally selected were discussed, based on the quantitative analysis of the outcome



measures and prognostic determinants. Meta-analysis was pursued, but was not possible because of substantial heterogeneity. **DATA SYNTHESIS:** The search resulted in 174 potentially relevant studies, of which 80 passed the preliminary screening and were subjected to further methodologic assessment; 14 studies were finally selected. Approximately 65% of the hospitalized stroke survivors with initial motor deficits of the lower extremity showed some degree of motor recovery. In the case of paralysis, complete motor recovery occurred in less than 15% of the patients, both for the upper and lower extremities. Hospitalized patients with small lacunar strokes showed relatively good motor recovery. The recovery period in patients with severe stroke was twice as long as in patients with mild stroke. The initial grade of paresis was the most important predictor for motor recovery (odds ratios [OR], >4). Objective analysis of the motor pathways by motor-evoked potentials (MEPs) showed even higher ORs (ORs, >20). **CONCLUSIONS:** Our knowledge of motor recovery after stroke in more accurate, quantitative, and qualitative terms is still limited. Nevertheless, our data synthesis and quantitative analysis comprises data from many methodologically robust studies, which may support the clinician in the management of stroke patients. With respect to early prognosis of motor recovery, our review confirms clinical experience that the initial grade of paresis (as measured on admission in the hospital) is the most important predictor, although the accuracy of prediction rapidly improves during the first few days after stroke. Initial paralysis implies the worst prognosis for subsequent motor recovery. Remarkably, the prognostic accuracy of MEPs appears much higher than that of clinical examination for different subgroups of patients.

Hsieh C.L., Sheu C.F., Hsueh I.P. and Wang C.H.

Trunk control as an early predictor of comprehensive activities of daily living function in stroke patients
Stroke, 33 (2002) 2626-30.

BACKGROUND AND PURPOSE: Prediction of activities of daily living (ADL) functions at an early stage after a stroke is critical because it enables clinicians to set treatment programs and goals. The objective of this study was to assess the relationship between trunk control at an early stage and comprehensive ADL function (as assessed by combining basic ADL and instrumental ADL [IADL]) in patients at 6 months after stroke. **METHODS:** A total of 169 stroke patients participated in this prospective study. Trunk control was measured with the use of the trunk control items of the Postural Assessment Scale for Stroke Patients (PASS-TC). In addition to the PASS-TC score, age, sex, type of stroke, side of hemiparesis, urinary incontinence, limb paresis (measured by the Fugl-Meyer motor test), balance (measured by the Fugl-Meyer balance test), and basic ADL (measured by the Barthel Index) were also selected as predictor variables. These variables were assessed at 14 days after stroke or earlier. The Barthel Index and Frenchay Activities Index (measuring IADL) were administered at 6 months after stroke. The sum of the standardized Barthel Index and standardized Frenchay Activities Index scores was used to assess comprehensive ADL function. **RESULTS:** Multi-variable stepwise linear regression analysis showed that PASS-TC score, age, Fugl-Meyer motor test score, and Barthel Index score (listed by the order of forward selection) were the strongest predictors of comprehensive ADL function. These results were internally validated with the use of the bootstrap resampling technique. The PASS-TC score alone accounted for 45% of the variance in predicting comprehensive ADL function. Results also indicated that the PASS-TC score had slightly more power in predicting comprehensive ADL function than either the Fugl-Meyer motor test score or Barthel Index score. **CONCLUSIONS:** The findings of this study provide strong evidence of the predictive value of trunk control on comprehensive ADL function in stroke patients. The results imply that early assessment and management of trunk control after stroke should be emphasized.

Hsueh I.P., Lin J.H., Jeng J.S. and Hsieh C.L.

Comparison of the psychometric characteristics of the functional independence measure, 5 item Barthel index, and 10 item Barthel index in patients with stroke

J Neurol Neurosurg Psychiatry, 73 (2002) 188-90.

OBJECTIVES: To compare the reliability, validity, and responsiveness of the motor subscale of the functional independence measure (FIM), the original 10 item Barthel index (BI), and the 5 item short form BI (BI-5) in inpatients with stroke receiving rehabilitation. **METHODS:** 118 inpatients with stroke at a rehabilitation unit participated in the study. The patients were tested with the FIM motor subscale and original BI at admission to the rehabilitation ward and before discharge from the hospital. The distribution, internal consistency, concurrent validity, and responsiveness of each measure were examined. **RESULTS:** The BI and FIM motor subscale showed acceptable distribution, high internal consistency (alpha coefficient ≥ 0.84), high concurrent validity (Spearman's correlation coefficient, $r(s) \geq 0.92$, intraclass correlation coefficient (ICC) ≥ 0.83), and high responsiveness (standardised response mean ≥ 1.2 , $p < 0.001$). The BI-5 exhibited a notable floor effect at admission but this was not found at discharge. The BI-5 showed acceptable internal consistency at admission and discharge (alpha coefficient ≥ 0.71). The concurrent validity of the BI-5 was poor to fair at admission ($r(s) = 0.74$, ICC ≤ 0.55) but was good at discharge ($r(s) \geq 0.92$, ICC ≥ 0.74). It is noted that the responsiveness of the BI-5 was as high as that of the BI and the FIM motor subscale. **CONCLUSIONS:** The results showed that the BI and FIM motor subscale had very acceptable and similar psychometric characteristics. The BI-5 appeared to have limited discriminative ability at admission, particularly for patients



with severe disability; otherwise the BI-5 had very adequate psychometric properties. These results may provide information useful in the selection of activities of daily living measures for both clinicians and researchers.

Hyndman D., Ashburn A. and Stack E.

Fall events among people with stroke living in the community: circumstances of falls and characteristics of fallers
Arch Phys Med Rehabil, 83 (2002) 165-70.

OBJECTIVES: To describe the frequency and circumstances of falls among a community sample of people with stroke and to compare characteristics of fallers and nonfallers. **DESIGN:** Cross-sectional, observational study. **SETTING:** Community. **PARTICIPANTS:** Forty-one community-dwelling people with stroke (26 men, 15 women; mean age, 69.7 +/- 11.6y), of which 23 had right-hemisphere infarction, 16 left-hemisphere infarction, and 2 had a brainstem lesion. Time since onset of stroke ranged from 3 to 288 months (mean, 50mo). **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Standardized tests were used to measure mobility, upper limb function, activities of daily living (ADL ability), and mood. Information about fall events was collected by using a questionnaire. **RESULTS:** Twenty-one participants (50%) were classed as fallers, of whom 10 had fallen repeatedly. No significant differences were found between fallers and nonfallers on any of the measures used. However, those who had 2 or more falls (n = 10) had significantly reduced arm function (P = .018) and ADL ability (P = .010), compared with those who had not fallen or experienced near falls (n = 5). Loss of balance, misjudgment, and foot dragging during walking, turning, and sit to stand were reported by fallers as the suspected causes and activities leading to falls. **CONCLUSIONS:** The high risk of falling among people with stroke was evident in this community-based sample. Repeat fallers had greater mobility deficits and significantly reduced arm function and ADL ability than those who did not report any instability.

Jobges E.M., Elek J., Rollnik J.D., Dengler R. and Wolf W.

Vibratory proprioceptive stimulation affects Parkinsonian tremor
Parkinsonism Relat Disord, 8 (2002) 171-6.

Previous research on tremor pathophysiology showed that tremor can be affected, e.g. by electrical stimulation of the peripheral nerve, mechanical perturbation of the limb and by transcranial magnetic stimulation of the motor cortex. This report is focused on possible effects of muscle vibration (MV) on resting tremor in Parkinson's Disease (PD). Vibratory stimulation was applied to the tendons of M. extensor carpi radialis longus and M. flexor ulnaris in 27 subjects with moderate PD resting tremor. The following effects were observed: (1) tremor stopped or started time-locked to MV onset and offset, (2) tremor persisted during MV but its frequency pattern changed. These results are discussed with specific emphasis to effects of MV on spinal and supraspinal levels.

Jung H.Y., Yoon J.S. and Park B.S.

Recovery of proximal and distal arm weakness in the ipsilateral upper limb after stroke
NeuroRehabilitation, 17 (2002) 153-9.

Conservation of the ipsilateral upper limb function is important in stroke subjects with contralateral hemiplegia, because often it must serve as a compensatory tool for activities of daily livings (ADLs). However, the amount of functional loss and/or the recovery pattern of the ipsilateral upper limb are not well known. We plan to investigate how to measure the progress of the ipsilateral upper limb function after the onset of stroke. Once a week we used the Manual Function Test (MFT) to evaluate the ipsilateral upper limb weakness of 72 stroke subjects with contralateral hemiplegia until maximum recovery. Proximal and distal arm weaknesses in the ipsilateral upper limb were maximally recovered within one month following the onset of hemispheric stroke, but their weakness was not to be completely recovered. Also the amounts of their recoveries were different from each other. These results indicate that the ipsilateral upper limb weakness in stroke is not a temporary event and that motor function of the proximal and distal arm might be mediated by different neuronal circuits.

Karnath H.O., Johannsen L., Broetz D., Ferber S. and Dichgans J.

Prognosis of contraversive pushing
J Neurol, 249 (2002) 1250-3.

Stroke patients with 'pusher syndrome' actively push away from the non-hemiparetic side leading to a loss of postural balance and falling towards the paralysed side. The behaviour is due to an altered perception of the body's orientation in relation to gravity. Here, we studied the prognosis of the disorder. Twelve pusher patients first investigated immediately after the stroke were re-examined 6 months later. Pusher symptoms had nearly completely recovered. The aim for physiotherapy of patients with contraversive pushing thus is to shorten the period of necessary treatment and enable earlier discharge from residential care.



Karnath H.O. and Niemeier M.

Task-dependent differences in the exploratory behaviour of patients with spatial neglect
Neuropsychologia, 40 (2002) 1577-85.

The present study analysed task-dependent effects on the exploratory behaviour of neglect patients during their spontaneous search of the surroundings. We were asking whether different tasks would be associated with different structuring of the visual display and, therefore, would result in different forms of neglect in one and the same brain-damaged subjects. Neglect patients' eye and head movements were recorded when they searched for a target within a homogeneous stimulus array surrounding the subjects. Subsequently, they explored the same array which was now segmented into different areas. When the patients' attention was allocated to the whole surrounding space, all patients completely neglected the left hemispace and spontaneously attended to the right hemispace. No significant left-right asymmetry was detected in a selected segment located in the periphery of the attended, right hemispace. However, all patients completely ignored the left part of this segment when they had to concentrate visual search on this segment alone. The results suggest an important influence of task-dependent effects on the exploratory behaviour of neglect patients. They show that one and the same physical stimulus at one and the same location in a scene might be attended or, in another situation, neglected, just depending on the behavioural goal of the subject. The findings support the idea that the brain organises and reorganises continuously the representation of the same physical input according to the changing task requirements.

Katz N., Fleming J., Keren N., Lightbody S. and Hartman-Maeir A.

Unawareness and/or denial of disability: implications for occupational therapy intervention
Can J Occup Ther, 69 (2002) 281-92.

Occupational therapy focus on client-centred, occupational performance intervention may become complicated by the phenomena of self-awareness. The problem of awareness deficits in clients with neurological disorders may be attributed to neurological impairment of self-awareness and/or psychological denial of disability. These phenomena present themselves more commonly in combination than dichotomously and have implications for treatment outcomes. Individuals with impaired self-awareness or denial face difficulties with motivation and participation in therapy, and the adoption of compensatory strategies, which ultimately impacts on rehabilitation outcome. The extent of unawareness versus denial can be assessed by observation of a client's behavior and this information can be very useful in directing the treatment approach. The purpose of this paper is, therefore, to discuss the phenomenon of unawareness and/or denial of disability and its importance to successful rehabilitation outcomes, current thinking and research conducted in different countries. Also, detailed case examples of three clients representing three major populations of traumatic brain injury, stroke and schizophrenia who may exhibit unawareness and/or denial of disability will be presented, including intervention strategies for both phenomena.

Kwakkel G., Kollen B.J. and Wagenaar R.C.

Long term effects of intensity of upper and lower limb training after stroke: a randomised trial
J Neurol Neurosurg Psychiatry, 72 (2002) 473-9.

OBJECTIVE: To assess long term effects at 1 year after stroke in patients who participated in an upper and lower limb intensity training programme in the acute and subacute rehabilitation phases. **Design:** A three group randomised controlled trial with repeated measures was used. **METHOD:** One hundred and one patients with a primary middle cerebral artery stroke were randomly allocated to one of three groups for a 20 week rehabilitation programme with an emphasis on (1) upper limb function, (2) lower limb function or (3) immobilisation with an inflatable pressure splint (control group). Follow up assessments within and between groups were compared at 6, 9, and 12 months after stroke. **RESULTS:** No statistically significant effects were found for treatment assignment from 6 months onwards. At a group level, the significant differences in efficacy demonstrated at 20 weeks after stroke in favour of the lower limb remained. However, no significant differences in functional recovery between groups were found for Barthel index (BI), functional ambulation categories (FAC), action research arm test (ARAT), comfortable and maximal walking speed, Nottingham health profile part 1 (NHP-part 1), sickness impact profile-68 (SIP-68), and Frenchay activities index (FAI) from 6 months onwards. At an individual subject level a substantial number of patients showed improvement or deterioration in upper limb function (n=8 and 5, respectively) and lower limb function (n=19 and 9, respectively). Activities of daily living (ADL) scores showed that five patients deteriorated and four improved beyond the error threshold from 6 months onwards. In particular, patients with some but incomplete functional recovery at 6 months are likely to continue to improve or regress from 6 months onwards. **CONCLUSIONS:** On average patients maintained their functional gains for up to 1 year after stroke after receiving a 20 week upper or lower limb function training programme. However, a significant number of patients with incomplete recovery showed improvements or deterioration in dexterity, walking ability, and ADL beyond the error threshold.



Kwakkel G. and Wagenaar R.C.

Effect of duration of upper- and lower-extremity rehabilitation sessions and walking speed on recovery of interlimb coordination in hemiplegic gait

Phys Ther, 82 (2002) 432-48.

BACKGROUND AND PURPOSE: The effects of different durations of rehabilitation sessions for the upper extremities (UEs) and lower extremities (LEs) on the recovery of interlimb coordination in hemiplegic gait in patients who have had a stroke were investigated. **SUBJECTS AND METHODS:** Fifty-three subjects who had strokes involving their middle cerebral arteries were assigned to rehabilitation programs with (1) an emphasis on the LEs, (2) an emphasis on the paretic UE, or (3) a condition in which the paretic arm (UE) and leg (LE) were immobilized with an inflatable pressure splint (control treatment). The 3 treatment regimens were applied for 30 minutes, 5 days a week, during the first 20 weeks after onset of stroke. All subjects also participated in a rehabilitation program 5 days a week that consisted of 15 minutes of UE exercises and 15 minutes of LE exercises in addition to a weekly 1 1/2-hour session of training in activities of daily living. A repeated-measures design was used. Differences among the 3 treatment regimens were evaluated in terms of comfortable and maximal walking speeds. In addition, mean continuous relative phase (CRP) between paretic arm and leg (PAL) movements and nonparetic arm and leg (NAL) movements and standard deviations of CRP of both limb pairs as a measurement of stability (variability) were evaluated. **RESULTS:** Comfortable walking speed improved in the group that received interventions involving the LEs compared with the group that received interventions involving the UEs and the group that received the control treatment. No differences among the 3 treatment conditions were found for the mean CRP of NAL and PAL as well as the standard deviation of CRP of both limb pairs. **DISCUSSION AND CONCLUSION:** With the exception of an improved comfortable walking speed as a result of a longer duration of rehabilitation sessions, no differential effects of duration of rehabilitation sessions for the LEs and UEs on the variable we measured related to hemiplegic gait were found. Increasing walking speed, however, resulted in a larger mean CRP for both limb pairs, with increased stability and asymmetry of walking, indicating that walking speed influences interlimb coordination in hemiplegic gait.

Landau W.M. and Sahrman S.A.

Preservation of directly stimulated muscle strength in hemiplegia due to stroke

Arch Neurol, 59 (2002) 1453-7.

BACKGROUND: Hemiplegia, or hemiparesis, severe impairment of purposeful activation of striated musculature, is the most conspicuous and often most disabling symptom of acute cerebrovascular lesions. Spontaneous improvement of voluntary strength may extend over many months. **OBJECTIVE:** In this archetypical upper motor neuron syndrome we wish to ascertain the degree of functional impairment due to direct contractile impairment of the affected striated musculature. **DESIGN:** Maximal tetanic muscle contraction was elicited by electrical stimulation applied directly to the tibialis anterior of the paretic and nonparetic limbs. Maximal forces of the normal limbs were compared with the afflicted limbs both early and late after vascular lesions of the pyramidal tract. Maximal voluntary force of foot dorsiflexion in the same limbs was also determined. Similar measurements were made in healthy control participants. **SETTING:** Acute hospital, rehabilitation, and outpatient units of a clinical research center. **PATIENTS:** Patients with unilateral stroke were studied a few or many weeks after the ictus. **MAIN OUTCOME MEASURES:** Comparison was made between contraction strengths induced by maximal tetanic electrical stimulation of the dysfunctional and contralateral unaffected muscles. Maximal voluntary strength of the foot dorsiflexion forces was also measured. **RESULTS:** Compared with the range of electrically evoked contractile force of tibialis anterior between the limbs of healthy participants, the directly elicited force in stroke-impaired tibialis anterior was not significantly impaired. **CONCLUSIONS:** Modes of exercise therapy focused primarily on direct strengthening of striated musculature, as in resistive exercise training, are strategically questionable. Whether other approaches may be more effective remains to be proved. The central disability of the upper motor neuron syndrome is failure of rapid coordinated adjustment of graded high-frequency motoneuron firing in purposeful complex synergies.

Laufer Y.

Effects of one-point and four-point canes on balance and weight distribution in patients with hemiparesis

Clin Rehabil, 16 (2002) 141-8.

OBJECTIVE: To examine the effects of one-point and four-point canes on postural sway and on the distribution of weight between the lower extremities and the walking aids in hemiparetic patients. **SETTING:** Flieman Geriatric Rehabilitation Hospital, Haifa, Israel. **SUBJECTS:** Thirty hemiparetic patients following a unilateral stroke, with moderate functional impairment, and 20 age-matched healthy subjects. **INTERVENTION:** Subjects were tested on two forceplates, which were placed at a 30 degrees angle from each other with the heel end of the plates separated by 3 cm. Each subject was tested under three conditions: with no cane, with a one-point cane, and with a four-point cane. Testing time was 30 seconds, and order of testing was randomized. **OUTCOME MEASURES:** Weight borne by the lower extremities and by the walking aids expressed as a percentage of overall body weight, and Sway Index indicating vertical pressure fluctuations over both feet. **RESULTS:** In both subject groups, the one-point cane did not reduce sway signifi-



cantly in comparison with no cane, while the four-point cane reduced sway significantly in comparison with both no cane and one-point cane. Neither cane type affected weight-bearing on the paretic leg, while significantly reducing weight-bearing on the uninvolved extremity. Mean percentage of body weight on the four-point cane was significantly higher than on the one-point cane. CONCLUSIONS: A four-point cane increases stability of moderately involved hemiparetic patients during stance more than a one-point cane. The noted shift of weight toward the walking aid does not adversely affect weight-bearing on the paretic limb.

Lee C.D. and Blair S.N.

Cardiorespiratory fitness and stroke mortality in men

Med Sci Sports Exerc, 34 (2002) 592-5.

PURPOSE: We examined the association between cardiorespiratory fitness and stroke mortality in men. **METHODS:** This is a prospective cohort study. We followed 16,878 men, ages 40-87 yr, who had a complete medical evaluation including a maximal treadmill exercise test and self-reported health habits. There were 32 stroke deaths during an average of 10 yr of follow-up (167,961 man-yr). **RESULTS:** After adjustment for age and examination year, there was an inverse association between cardiorespiratory fitness and stroke mortality ($P = 0.005$ for trend). This association remained after further adjustment for cigarette smoking, alcohol intake, body mass index, hypertension, diabetes mellitus, and parental history of coronary heart disease ($P = 0.02$ for trend). High-fit men (most fit 40%) had 68% (95% CI: 0.12, 0.82) and moderate-fit men had 63% (95% CI: 0.17, 0.83) lower risk of stroke mortality when compared with low-fit men (least fit 20%), respectively. **CONCLUSIONS:** Moderate and high levels of cardiorespiratory fitness were associated with lower risk of stroke mortality in men in the Aerobics Center Longitudinal study population.

Lum P.S., Burgar C.G., Shor P.C., Majmundar M. and Van der Loos M.

Robot-assisted movement training compared with conventional therapy techniques for the rehabilitation of upper-limb motor function after stroke

Arch Phys Med Rehabil, 83 (2002) 952-9.

OBJECTIVE: To compare the effects of robot-assisted movement training with conventional techniques for the rehabilitation of upper-limb motor function after stroke. **DESIGN:** Randomized controlled trial, 6-month follow-up. **SETTING:** A Department of Veterans Affairs rehabilitation research and development center. **PARTICIPANTS:** Consecutive sample of 27 subjects with chronic hemiparesis (>6mo after cerebrovascular accident) randomly allocated to group. **INTERVENTIONS:** All subjects received twenty-four 1-hour sessions over 2 months. Subjects in the robot group practiced shoulder and elbow movements while assisted by a robot manipulator. Subjects in the control group received neurodevelopmental therapy (targeting proximal upper limb function) and 5 minutes of exposure to the robot in each session. **MAIN OUTCOME MEASURES:** Fugl-Meyer assessment of motor impairment, FIMtrade mark instrument, and biomechanic measures of strength and reaching kinematics. Clinical evaluations were performed by a therapist blinded to group assignments. **RESULTS:** Compared with the control group, the robot group had larger improvements in the proximal movement portion of the Fugl-Meyer test after 1 month of treatment ($P < .05$) and also after 2 months of treatment ($P < .05$). The robot group had larger gains in strength ($P < .02$) and larger increases in reach extent ($P < .01$) after 2 months of treatment. At the 6-month follow-up, the groups no longer differed in terms of the Fugl-Meyer test ($P > .30$); however, the robot group had larger improvements in the FIM ($P < .04$). **CONCLUSIONS:** Compared with conventional treatment, robot-assisted movements had advantages in terms of clinical and biomechanical measures. Further research into the use of robotic manipulation for motor rehabilitation is justified.

Macfarlane A., Turner-Stokes L. and De Souza L.

The associated reaction rating scale: a clinical tool to measure associated reactions in the hemiplegic upper limb

Clin Rehabil, 16 (2002) 726-35.

OBJECTIVE: To determine what items should be included in a clinical assessment tool developed to measure associated reactions in the hemiplegic upper limb and to assess the reliability of the resultant measure. **DESIGN:** Development through a structured consultative process using focus group methodology. Evaluation of inter- and intra-rater reliability between two independent observers. **SUBJECTS:** Nineteen consecutive hemiplegic patients admitted to Northwick Park Hospital for rehabilitation following stroke. **METHODS:** Focus groups were conducted in two centres, comprising physiotherapists experienced in the clinical management of brain injury. The groups identified four key characteristics related to severity of associated reactions, which became the items of the rating scale. Evaluation of inter- and intra-rater reliability was undertaken by comparison of agreement between ratings of associated reactions occurring during a single standardized task (sit-to-stand), by two senior physiotherapists in 19 subjects. **RESULTS:** There were good correlations between the two raters in total ($\rho = 0.89$, $p < 0.005$) and modal scores ($\rho = 0.88$, $p < 0.005$). Reliability testing of each item revealed moderate to very good inter-rater agreement (weighted kappa values 0.43-0.85) and good to very good intra-rater agreement (weighted kappa values 0.61-0.87). A slight tendency for one rater to score more severely than the other only reached significance for one item (excursion). Overall (modal) severity scores showed a good level of agreement (kappa 0.76-0.81) both between and within raters. **CONCLUSION:** Items to be included in a



clinical assessment tool to measure associated reactions in the hemiplegic upper limb were determined. Reliability of the resultant measure was found to be encouraging. These results however apply only to observations made during a specific standardized task (sit-to-stand) and further study of sensitivity to change and reproducibility in different tasks is required before the findings can be extrapolated into routine practice.

Mao H.F., Hsueh I.P., Tang P.F., Sheu C.F. and Hsieh C.L.

Analysis and comparison of the psychometric properties of three balance measures for stroke patients
Stroke, 33 (2002) 1022-7.

BACKGROUND AND PURPOSE: This study compared the psychometric properties of 3 clinical balance measures, the Berg Balance Scale (BBS), the Balance subscale of the Fugl-Meyer test (FM-B), and the Postural Assessment Scale for Stroke Patients (PASS), in stroke patients with a broad range of neurological and functional impairment from the acute stage up to 180 days after onset. **METHODS:** One hundred twenty-three stroke patients were followed up prospectively with the 3 balance measures 14, 30, 90, and 180 days after stroke onset (DAS). Reliability (intra-rater reliability and internal consistency) and validity (concurrent validity, convergent validity, and predictive validity) of each measure were examined. A comparison of the responsiveness of each of the 3 measures was made on the basis of the entire group of patients and 3 separate groups classified by degree of neurological severity. **RESULTS:** The FM-B and BBS showed a significant floor or ceiling effect at some DAS points, whereas the PASS did not show these effects. The BBS, FM-B, and PASS all had good reliability and validity for patients at different recovery stages after stroke. The results of effect size demonstrated fair to good responsiveness of all 3 measures within the first 90 DAS but, as expected, only a low level of responsiveness at 90 to 180 DAS. The PASS was more responsive to changes in severe stroke patients at the earliest period after stroke onset, 14 to 30 DAS. **CONCLUSIONS:** All 3 measures tested showed very acceptable levels of reliability, validity, and responsiveness for both clinicians and researchers. The PASS showed slightly better psychometric characteristics than the other 2 measures.

Maravita A., Clarke K., Husain M. and Driver J.

Active tool use with the contralesional hand can reduce cross-modal extinction of touch on that hand
Neurocase, 8 (2002) 411-6.

After a unilateral brain lesion, patients may show cross-modal, visual-tactile extinction. Such patients may fail to report tactile stimuli on the contralesional hand when presented together with competing visual stimuli near the ipsilesional hand. In this work we tested the hypothesis that this cross-modal extinction may be reduced when a patient has used a tool with the contralesional hand to reach for objects in the ipsilesional visual field. Consistent with previous work, we hypothesize that active use of a tool may extend cross-modal interactions between visual stimuli at the tip of the tool and tactile stimuli on the hand wielding the tool. In the new situation of a tool connecting the contralesional hand with ipsilesional visual space, competition between stimuli on these opposite sides may be reduced, so that extinction decreases. We studied patient BV, who showed reliable cross-modal, visual-tactile extinction after right-hemisphere stroke. In two separate sessions we showed that prolonged tool use (10-20 min) with the contralesional hand in ipsilesional space reduced cross-modal extinction for up to 60-90 min post-training. We propose that an actively used tool may be effective in linking cross-modal stimuli presented along its extension. This can then overcome competition between stimuli presented on opposite sides of the body midline, thus modulating extinction.

Mawson S.

Critiquing the literature is an essential part of evidence based practice
Synapse (Journal and Newsletter of ACPIN) (2002) 4-7.

This article is a very welcome response to the controversial article published in Clinical Rehabilitation by Langhammer and Stanghelle (2000).

The article is written as a guide to the process of critical review. The following flaws in the Langhammer and Stanghelle study were identified:

- The independent variables (Bobath and MRP) were both based upon outdated treatment manuals, compromising the internal validity of the study.
- A power calculation was not included, so that it was not possible to establish whether the change predicted was clinically significant.
- There was no randomisation, compromising the external validity of the research.
- Summing of ordinal data resulted in "meaningless" information.
- The statistical analysis was inappropriate, so that any significance could be an artefact of the analysis itself.
- Looking at the difference in baseline scores, on the basis of the data given, the Bobath group in fact improved more than the MRP group over the three months.

The conclusion was that the findings outlined in the original abstract are unsubstantiated and unjustified, they cannot be inferred to the wider population of stroke patients, and should not be used as evidence to underpin the use of the MRP.



The article is followed by a response from Langhammer and Stangheller (pages 7-8) and a final commentary by le Roux (pages 8-9). Le Roux demonstrates that the original study was incorrect in using the Barthel score as an interval scale measurement; hence their statistical analysis is invalid. The conclusion asserts that Mawson's assumption is correct.

Mayo N.E., Wood-Dauphinee S., Cote R., Durcan L. and Carlton J.

Activity, participation, and quality of life 6 months poststroke
Arch Phys Med Rehabil, 83 (2002) 1035-42.

OBJECTIVES: To estimate the extent of activity and participation of individuals 6 months poststroke and their influence on health-related quality of life (QOL) and overall QOL, information that would be useful in identifying services that stroke patients would need in the community. **DESIGN:** Inception cohort study. **SETTING:** Ten acute care hospitals in metropolitan areas of the province of Quebec. **PARTICIPANTS:** Persons with first-ever stroke, either ischemic or hemorrhagic. In parallel, a population-based sample of community-dwelling individuals without stroke, frequency matched in age and city district, were also recruited. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Stroke subjects were interviewed by telephone at 6-month intervals for 2 years of follow-up. The community-dwelling individuals without stroke were also followed. **RESULTS:** A total of 434 persons were interviewed approximately 6 months poststroke. Their average age +/- standard deviation was 68.4 +/- 12.5 years; the average age of the 486 controls was 61.7 +/- 12.4 years. The stroke group scored on average 90.6/100 on the Barthel Index; 39% reported a limitation in functional activities, 54% reported limitations with higher-level activities of daily living such as housework and shopping, and 65% reported restrictions in reintegration into community activities. By using the Medical Outcomes 36-Item Short-Form Health Survey (SF-36), persons with stroke rated their physical health 7 points lower than healthy peers; also, 7 of the 8 subscales of the SF-36 were affected by stroke. **CONCLUSION:** Almost 50% of the community-dwelling stroke population lived with sequelae of stroke such that, unless there was a full-time and able-bodied caregiver at home, they needed some form of home help. A large proportion also reported lack of meaningful activity, indicating a need for organized support groups for people with stroke; otherwise, boredom will lead to depression and worsening of function, affect, health status, and QOL.

Merians A.S., Jack D., Boian R., Tremaine M., Burdea G.C., Adamovich S.V., Recce M. and Poizner H.

Virtual reality-augmented rehabilitation for patients following stroke
Phys Ther, 82 (2002) 898-915.

BACKGROUND AND PURPOSE: Recent evidence indicates that intensive massed practice may be necessary to modify neural organization and effect recovery of motor skills in patients following stroke. Virtual reality (VR) technology has the capability of creating an interactive, motivating environment in which practice intensity and feedback can be manipulated to create individualized treatments to retrain movement. **CASE DESCRIPTION:** Three patients (ML, LE, and DK), who were in the chronic phase following stroke, participated in a 2-week training program (3 1/2 hours a day) including dexterity tasks on real objects and VR exercises. The VR simulations were targeted for range of motion, movement speed, fractionation, and force production. **OUTCOMES:** ML's function was the most impaired at the beginning of the intervention, but showed improvement in the thumb and fingers in range of motion and speed of movement. LE improved in fractionation and range of motion of his thumb and fingers. DK made the greatest gains, showing improvement in range of motion and strength of the thumb, velocity of the thumb and fingers, and fractionation. Two of the 3 patients improved on the Jebsen Test of Hand Function. **DISCUSSION:** The outcomes suggest that VR may be useful to augment rehabilitation of the upper limb in patients in the chronic phase following stroke.

Meshack R.P. and Norman K.E.

A randomized controlled trial of the effects of weights on amplitude and frequency of postural hand tremor in people with Parkinson's disease
Clin Rehabil, 16 (2002) 481-92.

OBJECTIVE: To evaluate the effects of weights on postural hand tremor related to self-feeding in subjects with Parkinson's disease (PD). **DESIGN:** In a repeated-measures design, postural hand tremor was recorded three times in each of three weight conditions in a single session for each subject. The order of all recording conditions was randomized. **SETTING:** Intervention was applied and measurement was conducted in a university-based motor performance laboratory. **SUBJECTS:** Fourteen men and two women diagnosed with PD and having hand tremor participated (mean age 67.1 years, mean duration of PD 4.6 years). All were community-dwelling. **INTERVENTION:** The control condition consisted of holding a built-up spoon (108 g). There were two experimental conditions: holding a weighted spoon (248 g); and holding the built-up spoon while wearing a weighted wrist cuff (470 g). **MAIN OUTCOME MEASURES:** Three measures of tremor amplitude and two measures of tremor frequency were calculated from recordings of displacement of the spoon obtained from laser displacement sensors. **RESULTS:** Repeated-measures analyses of variance revealed no significant differences across conditions in any measure of tremor amplitude or in either measure of tremor frequency. Correlational and Mann-Whitney U-test analyses revealed that none of age, disease dura-



tion or medication intake had any significant relationship with tremor amplitude in the control condition or with whether amplitude was altered by weights. **CONCLUSIONS:** The findings suggest that there is no support for the clinical recommendation of using weighted utensils or weighted wrist cuffs to alleviate postural hand tremor in PD.

Miyai I., Fujimoto Y., Yamamoto H., Ueda Y., Saito T., Nozaki S. and Kang J.

Long-term effect of body weight-supported treadmill training in Parkinson's disease: a randomized controlled trial
Arch Phys Med Rehabil, 83 (2002) 1370-3.

OBJECTIVE: To investigate whether body weight-supported treadmill training (BWSTT) is of long-term benefit for patients with Parkinson's disease (PD). **DESIGN:** Randomized controlled trial. **SETTING:** Inpatient rehabilitation unit for neurologic diseases in Japan. **PARTICIPANTS:** Twenty-four patients (Hoehn and Yahr stages 2.5 or 3) who were not demented (Mini-Mental State Examination score, >27). **INTERVENTIONS:** Patients were randomized to receive either a 45-minute session of BWSTT (up to 20% of body weight supported) or conventional physical therapy (PT) for 3 days a week for 1 month. **MAIN OUTCOME MEASURES:** Outcome measures were evaluated at baseline and at 1, 2, 3, and 6 months. Measures included the Unified Parkinson's Disease Rating Scale (UPDRS), ambulation speed (s/10 m), and number of steps taken for a 10-m walk as a parameter for stride length. **RESULTS:** Four patients needed modification of medications in the follow-up period. Twenty patients (BWSTT, n=11; PT, n=9) without modified medications were analyzed for functional outcome. Age, duration of PD, gender, and doses of medications were comparable. There was no difference in the baseline UPDRS (BWSTT=33.3; PT=32.6), speed (BWSTT=10.8; PT=11.5), and steps (BWSTT=23.4; PT=22.8). The BWSTT group had significantly greater improvement than the PT group (Mann-Whitney U test, Bonferroni adjustment for multiple comparison) in ambulation speed at 1 month (BWSTT=8.5; PT=10.8; P<.005); and in the number of steps at 1 (BWSTT=20.0; PT=22.7; P<.005), 2 (BWSTT=19.5; PT=22.4; P<.005), 3 (BWSTT=20.1; PT=23.1; P<.005), and 4 months (BWSTT=21.0; PT=23.0; P=.006). **CONCLUSIONS:** BWSTT has a lasting effect specifically on short-step gait in PD.

Monger C., Carr J.H. and Fowler V.

Evaluation of a home-based exercise and training programme to improve sit-to-stand in patients with chronic stroke
Clin Rehabil, 16 (2002) 361-7.

OBJECTIVE: To investigate the feasibility and efficacy of a task-specific home-based exercise protocol for improving sit-to-stand (STS), with additional exercises to strengthen lower limb extensor muscles in patients with chronic stroke. **DESIGN:** A pre-test, post-test design was used. **SUBJECTS:** Six subjects at least one year post stroke and discharged from all rehabilitation services for at least six months participated in the study. **OUTCOME MEASURES:** Functional performance of sit-to-stand was evaluated using the Standing Up item of the Motor Assessment Scale (MAS). Peak vertical ground reaction force, walking speed over 10 m and grip strength were also measured. **RESULTS:** Group MAS score was significantly higher at post-test than at pre-test with two subjects reaching the highest point on the scale and three subjects reaching the second highest point. Time-to-peak vertical ground reaction force occurred significantly closer to thighs-off, the critical time when the body mass is propelled into standing. Walking speed increased significantly over 10 m from a mean of 0.86 m/s to 1.10 m/s. Grip strength, which was not trained, did not change. **CONCLUSIONS:** This study demonstrates that a home-based task-specific exercise and training protocol for STS can induce improved performance of STS and increase walking speed more than one year after stroke.

Mudie M.H., Winzeler-Mercay U., Radwan S. and Lee L.

Training symmetry of weight distribution after stroke: a randomized controlled pilot study comparing task-related reach, Bobath and feedback training approaches
Clin Rehabil, 16 (2002) 582-92.

OBJECTIVE: To determine (1) the most effective of three treatment approaches to retrain seated weight distribution long-term after stroke and (2) whether improvements could be generalized to weight distribution in standing. **SETTING:** Inpatient rehabilitation unit. **DESIGN:** Forty asymmetrical acute stroke subjects were randomly allocated to one of four groups in this pilot study. Changes in weight distribution were compared between the 10 subjects of each of three treatment groups (task-specific reach, Bobath, or Balance Performance Monitor [BPM] feedback training) and a no specific treatment control group. One week of measurement only was followed by two weeks of daily training sessions with the treatment to which the subject was randomly allocated. Measurements were performed using the BPM daily before treatment sessions, two weeks after cessation of treatment and 12 weeks post study. Weight distribution was calculated in terms of mean balance (percentage of total body weight) or the mean of 300 balance points over a 30-s data run. **RESULTS:** In the short term, the Bobath approach was the most effective treatment for retraining sitting symmetry after stroke ($p = 0.004$). Training with the BPM and no training were also significant ($p = 0.038$ and $p = 0.035$ respectively) and task-specific reach training failed to reach significance ($p = 0.26$). At 12 weeks post study 83% of the BPM training group, 38% of the task-specific reach group, 29% of the Bobath group and 0% of the untrained group were found to be distributing their weight to both sides. Some generalization of symmetry training in sitting to standing was noted in the BPM training group which appeared to persist long term. **CONCLUSIONS:** Results should be



treated with caution due to the small group sizes. However, these preliminary findings suggest that it might be possible to restore postural symmetry in sitting in the early stages of rehabilitation with therapy that focuses on creating an awareness of body position.

Muellbacher W., Richards C., Ziemann U., Wittenberg G., Weltz D., Boroojerdi B., Cohen L. and Hallett M.

Improving hand function in chronic stroke

Arch Neurol, 59 (2002) 1278-82.

BACKGROUND: Recovery of function following stroke plateaus in about 1 year, typically leaving upper arm function better than that in the hand. Since there is competition among body parts for territory in the sensorimotor cortex, even limited activity of the upper arm might prevent the hand from gaining more control, particularly when the territory is reduced in size because of the stroke. Deafferentation of a body part in a healthy brain enhances cortical representations of adjacent body parts, and this effect is markedly increased by voluntary activity of the adjacent part. **OBJECTIVE:** To explore whether deafferentation of the upper arm, produced by a new technique of regional anesthesia during hand motor practice, helps recovery of hand function in patients with long-term stable weakness of their hand following stroke. **METHODS AND RESULTS:** Deafferentation, produced by a new technique of regional anesthesia of the upper arm during hand motor practice, dramatically improved hand motor function including some activities of daily living. The improvement was associated with an increase in transcranial magnetic stimulation-evoked motor output to the practice hand muscles. **CONCLUSION:** This is a novel therapeutic strategy that may help improve hand function in patients with long-term weakness after stroke.

Mulder T., Zijlstra W. and Geurts A.

Assessment of motor recovery and decline

Gait Posture, 16 (2002) 198-210.

Assessment of motor disorders forms an important ingredient of neurology, rehabilitation medicine and orthopaedics. Until now, however, many of the employed assessment tools are derived from empirical knowledge. Almost no relation exists with modern theoretical notions about motor control. In the present article, motor control theory is reviewed in the light of its potential contribution to understanding motor recovery. An attempt is made to present a theoretical framework for the assessment of motor disorders related to recent insights in motor control. The framework emphasizes the dynamical character of recovery. The principle of output optimization is discussed and it is stressed that compensation plays a permanent role in adapting to damage of the body or to changes in the environment. An assessment procedure is introduced to measure the (mental) costs of this compensation. It is argued that changes in the costs of compensation across time reflect recovery.

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

Stroke patients' and therapists' opinions of constraint-induced movement therapy

Clin Rehabil, 16 (2002) 55-60.

OBJECTIVE: To determine the opinions of patients with stroke and therapists about constraint-induced movement therapy (CIT). **SUBJECTS AND INTERVENTION:** Two hundred and eight patients with stroke in the northeastern USA responded to a self-report questionnaire administered through the mail and via telephone interviews. A similar questionnaire was administered to 85 physical and occupational therapists in the northeastern USA during their clinical staff meetings. The questionnaire described CIT to participants using excerpts from a recently published CIT study. Subjects then responded to various statements concerning their opinions of the protocol and supplied rationale for their opinions. **RESULTS:** Sixty-eight per cent of patients said they were not interested in participating in CIT, citing concerns with the practice schedule and the restrictive device schedule. Therapists cited concerns about patient adherence and safety, and speculated that facilities may not have the clinical resources to provide CIT. **CONCLUSIONS:** Patients with stroke and therapists in some environments may hold sceptical views about the utility of CIT. Although it has been shown to be effective in laboratory research, CIT may have low clinical practicality in some environments.

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

Modified constraint-induced therapy after subacute stroke: a preliminary study

Neurorehabil Neural Repair, 16 (2002) 290-5.

OBJECTIVE: To determine the efficacy of a modified constraint-induced therapy (mCIT) administered to patients with subacute stroke. **DESIGN:** Prospective, multiple-baseline, before-after, randomized clinical trial. **SETTING:** Subacute outpatient clinic. **SUBJECTS:** Fourteen patients with subacute stroke who exhibited learned nonuse and stable motor deficits in their affected upper limbs. **INTERVENTION:** Four patients participated in half-hour, structured physical and occupational therapy sessions that emphasized affected arm use in valued functional activities, 3 times per week for 10 weeks. Their less affected upper limbs were restrained 5 days per week during 5 hours identified as times of frequent use (mCIT). Five patients received regular therapy (TR) with similar therapeutic contact time to



mCIT and 5 patients received no therapy (CON). MAIN OUTCOME MEASURES: The Fugl-Meyer Assessment of Motor Recovery (Fugl), Action Research Arm (ARA) test, and Motor Activity Log (MAL). RESULTS: After intervention, Fugl, ARA, and MAL scores remained virtually the same for TR and CON groups; scores improved by 11.4 and 11.5 points, respectively, on the Fugl and ARA for the mCIT group. Amount and quality of arm use, as measured by the MAL, also improved for mCIT patients (2.49 and 0.47, respectively). CONCLUSIONS: mCIT may be an efficacious method of improving affected arm function and use in stroke patients exhibiting learned nonuse.

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

Modified constraint-induced therapy in subacute stroke: a case report

Arch Phys Med Rehabil, 83 (2002) 286-90.

OBJECTIVE: To determine the efficacy of a modified constraint-induced therapy (CIT) protocol administered to a patient with subacute stroke. DESIGN: Multiple-baseline, before-after trial. SETTING: Subacute outpatient clinic. PATIENT: A 68-year-old woman who had a left anterior cerebral artery infarct 5 months before study entry and who exhibited learned nonuse of the affected upper limb. INTERVENTION: Thirty minutes of structured physical therapy and 30 minutes of occupational therapy 3 times a week for 10 weeks, each session emphasizing affected arm use. During the same period, her unaffected arm and hand were restrained 5d/wk during 5 hours initially identified as a time of frequent use. MAIN OUTCOME MEASURES: The Fugl-Meyer Assessment of Motor Recovery (FMA), Action Research Arm Test (ARA), Wolf Motor Function Test (WMFT), and Motor Activity Log (MAL). RESULTS: The patient exhibited substantial improvements on the FMA and ARA. She also improved on the WMFT in her ability to perform tasks and in the time taken to complete the tasks. Amount and quality of arm use also improved, as measured by the MAL. CONCLUSIONS: Modified CIT may be an efficacious method of improving function and use of the affected arms of patients with learned nonuse.

Perennou D.A., Amblard B., Laassel el M., Benaim C., Herisson C. and Pelissier J.

Understanding the pusher behavior of some stroke patients with spatial deficits: a pilot study

Arch Phys Med Rehabil, 83 (2002) 570-5.

OBJECTIVE: To investigate whether pusher behavior (ie, a tendency among stroke patients with spatial deficits to actively push away from the nonparalyzed side and to resist any attempt to hold a more upright posture) affects only the trunk, for which gravitational feedback is given by somesthetic information, or the head as well, whose gravitational information is mainly given by the vestibular system (without vision). DESIGN: Description and measurement of clinical features. SETTING: Rehabilitation center research laboratory. PARTICIPANTS: Eight healthy subjects age matched to 14 patients with left hemiplegia resulting from right-hemisphere stroke (3 pushers showing a severe spatial neglect, 11 without pusher behavior). INTERVENTION: All participants were asked to actively maintain an erect posture while sitting for 8 seconds on a rocking, laterally unstable platform. The task was performed with (in light) and without (in darkness) vision. MAIN OUTCOME MEASURES: The number of trials needed to succeed in the task was monitored. In successful trials, head, shoulders, thoracolumbar spine, and pelvis orientation in roll were measured by means of an automated, optical television image processor. RESULTS: Compared with other patients and healthy subjects, the 3 pushers missed many more trials and displayed a contralesional tilt of the pelvis but kept a correct head orientation. This tilt was especially pronounced without vision. Spatial neglect was a key factor, explaining 56% of patients' misorientation behavior with vision and 61% without vision. CONCLUSION: This pilot kinematic analysis shows that pusher behavior does not result from disrupted processing of vestibular information (eg, caused by a lesion involving the vestibular cortex); rather, it results from a high-order disruption in the processing of somesthetic information originating in the left hemibody, which could be graviceptive neglect (extinction). This disruption leads pushers to actively adjust their body posture to a subjective vertical biased to the side opposite the cerebral lesion.

Pierce S.R. and Buxbaum L.J.

Treatments of unilateral neglect: a review

Arch Phys Med Rehabil, 83 (2002) 256-68.

OBJECTIVES: To review the existing literature on treatments of unilateral neglect, to synthesize findings, and to offer recommendations for future studies. DATA SOURCES: Computerized databases including MEDLINE and PsychINFO. STUDY SELECTION: All studies investigating treatment(s) of unilateral neglect. DATA EXTRACTION: Authors reviewed design and other methodologic issues. DATA SYNTHESIS: Unilateral neglect is a common consequence of right-hemisphere stroke. It is well recognized that the disorder is heterogeneous and has numerous subtypes. There have been numerous studies showing that arousal, hemispheric activation, and spatial attention treatments may all improve neglect, at least transiently. Despite these promising outcomes, little consensus exists as to whether 1 treatment is more efficacious than others, in part because cross-study differences in methodology render meta-analyses difficult, and in part because many studies fail to document duration of treatment effects or generalization to daily activities. One possibility is that these varied and diverse treatments may all be effective, reflecting redundancy in neural circuits devoted to attention and action in space, and consequent flexibility of the spatial processing system. It remains possible,



however, that different subtypes of neglect may respond differentially to treatment of various sorts. Most existing studies of neglect have relied on very small populations of neglect patients, whose neglect is characterized only generally. CONCLUSION: Methodologic shortcomings hinder assessment of the efficacy of various types of neglect treatment. In the future, these shortcomings could be addressed with larger studies of well-characterized patients that evaluate duration of treatment effects and include functional measures. In addition, the role of overarching variables, such as reduced arousal, requires consideration. The ultimate goal of these studies might be the development of triaging strategies wherein neglect patients are assigned to treatments of most likely benefit on the basis of neuroanatomic and behavioral profiles.

Pohl M., Mehrholz J., Ritschel C. and Ruckriem S.

Speed-dependent treadmill training in ambulatory hemiparetic stroke patients: a randomized controlled trial
Stroke, 33 (2002) 553-8.

BACKGROUND AND PURPOSE: A new gait training strategy for patients with stroke seeks to increase walking speed through treadmill training. This study compares the effects of structured speed-dependent treadmill training (STT) (with the use of an interval paradigm to increase the treadmill speed stepwise according to principles of sport physiology) with limited progressive treadmill training (LTT) and conventional gait training (CGT) on clinical outcome measures for patients with hemiparesis. **METHODS:** Sixty ambulatory poststroke patients were each randomly selected to receive 1 of the 3 different gait therapies: 20 subjects were treated with STT, 20 subjects were trained to walk on a treadmill with a 20% increase of belt speed over the treatment period (LTT), and 20 subjects were treated with CGT. Treatment outcomes were assessed on the basis of overground walking speed, cadence, stride length, and Functional Ambulation Category scores. **RESULTS:** After a 4-week training period, the STT group scored significantly higher than the LTT and CGT groups for overground walking speed (STT versus LTT, $P < 0.001$; STT versus CGT, $P < 0.001$), cadence (STT versus LTT, $P = 0.007$; STT versus CGT, $P < 0.001$), stride length (STT versus LTT, $P < 0.001$; STT versus CGT, $P < 0.001$), and Functional Ambulation Category scores (STT versus LTT, $P = 0.007$; STT versus CGT, $P < 0.001$). **CONCLUSIONS:** Structured STT in poststroke patients resulted in better walking abilities than LTT or CGT. This gait training strategy provides a dynamic and integrative approach for the treatment of gait dysfunction after stroke.

Pollock A.S., Durward B.R., Rowe P.J. and Paul J.P.

The effect of independent practice of motor tasks by stroke patients: a pilot randomized controlled trial
Clin Rehabil, 16 (2002) 473-80.

OBJECTIVE: To investigate the effect of independent practice of sitting balance as an addition to standard physiotherapy treatment for patients with stroke. **DESIGN:** Randomized controlled trial, using blocked randomization procedure with 2:1 ratio. **SUBJECTS:** Inpatients with diagnosis of stroke, having achieved one minute of independent sitting balance but not yet achieved 10 independent steps, and with no known previous disabilities, pathology or neurological deficit affecting mobility prior to stroke. **INTERVENTION:** A four-week regime of independent practice aimed at improving aspects of balance, as an addition to standard physiotherapy treatment based on the Bobath Approach. **MAIN OUTCOME MEASURE:** Proportion of patients achieving 'normal' symmetry of weight distribution during sitting, standing, rising to stand, sitting down, and reaching. **RESULTS:** Nineteen subjects were randomized to the control group; nine to the intervention group. There were no clinically significant differences in measured outcome between the groups. **CONCLUSIONS:** The regime of independent practice had no measured beneficial effect on the balance ability of patients with recently acquired stroke.

Popovic M.B., Popovic D.B., Sinkjaer T., Stefanovic A. and Schwirtlich L.

Restitution of reaching and grasping promoted by functional electrical therapy
Artif Organs, 26 (2002) 271-5.

Functional electrical therapy (FET) is a new term describing a combination of functional electrical stimulation that generates life-like movement and intensive exercise in humans with central nervous system lesions. We hypothesized that FET can promote a significant recovery of functioning if applied in subacute stroke subjects. The study included 16 stroke subjects divided into a low functioning group (LFG) and a high functioning group (HFG) based on their ability to control wrist and fingers and randomly associated into FET and controls. The FET consisted of 30 min daily sessions during 3 weeks. The exercise comprised functional use of daily necessary activities (e.g., writing, using a telephone receiver, and drinking from a can). The outcome presented in this article is the upper-extremity function test performed before and after the therapy. The change in performance of the HFG group was significant. The number of successful repetitive movements in 2 min was doubled and 1.6 times increased for controls, and the time to perform the movement was decreased by 71% percent and by 36% in controls. In the LFG FET group, the difference in performance was the following. First, the number of tasks was increased from 0 to 6 (total of 11 tasks). Second, the averaged number of successful repetitive movements was increased from 0 to 3. The functional improvement in the FET LFG is probably not sufficient to make the more affected arm/hand effective for daily necessities; thus, the FET effects could deteriorate



over a longer time. The subjects from the control LFG made only a marginal improvement. The follow-up for each subject will continue for 12 months after the beginning of the treatment.

Popovic M.R., Popovic D.B. and Keller T.

Neuroprostheses for grasping

Neurol Res, 24 (2002) 443-52.

In recent years a number of neuroprostheses have been developed and used to assist stroke and spinal cord injured subjects to restore or improve grasping function. These neuroprostheses clearly demonstrated that the targeted group of subjects can significantly benefit from this technology and that functional electrical stimulation (FES) is a viable method for restoring or improving grasping function. In this article the FES technology is briefly explained and some of the better known neuroprostheses for grasping are discussed. Furthermore, a typical population of subjects that can benefit from this technology is indicated as well as the methodology to select and train these subjects to apply the neuroprosthesis in daily living activities. This article also provides a brief summary of the achieved results with the existing neuroprostheses for grasping and discusses some of the challenges this technology is currently facing.

Rodriguez G.M. and Aruin A.S.

The effect of shoe wedges and lifts on symmetry of stance and weight bearing in hemiparetic individuals

Arch Phys Med Rehabil, 83 (2002) 478-82.

OBJECTIVE: To determine the effect of shoe wedges and lifts on symmetry of stance and weight bearing in hemiparetic individuals. **DESIGN:** Weight bearing on the paretic side was measured in patients with hemiparesis during quiet standing and in conditions of compelled weight shift. **SETTING:** Free-standing acute inpatient rehabilitation hospital. **PARTICIPANTS:** Nine individuals with hemiparesis as a result of unilateral stroke who were able to stand for 3 to 5 minutes without assistance or rest, and satisfied other inclusion criteria. **INTERVENTIONS:** Compelled shift of the body weight was induced with different shoe wedges (5 degrees, 7.5 degrees, 12.5 degrees) or shoe lifts (0.6, 0.9, 1.2cm), which extended under the entire shoe of the unaffected limb. Weight-bearing symmetry scores were used to characterize the symmetry of stance. **MAIN OUTCOME MEASURES:** Weight-bearing symmetry scores. **RESULTS:** Without a shoe wedge or a shoe lift, weight-bearing symmetry was characterized by underloading of the paretic limb (39.90% +/- .80% of body weight). Weight shift induced by shoe wedges or shoe lifts applied to the unaffected limb promoted improved symmetry of weight bearing and stance. A shoe wedge of 5 degrees provided the most symmetrical weight distribution (51.44% +/- 1.88% of body weight). **CONCLUSION:** Shoe wedges and shoe lifts under the unaffected limb induced compelled weight shift toward the paretic limb, resulting in improved symmetry of stance of individuals with mild hemiparesis. We suggest that improved symmetry of bipedal standing obtained with a shoe wedge or a shoe lift applied to the unaffected limb can help overcome the learned disuse of the affected limb. We further suggest that weight distribution induced by shoe wedges or shoe lifts may help in the treatment of ambulatory hemiparetic individuals with asymmetrical stance caused by unilateral stroke.

Rubinstein T.C., Giladi N. and Hausdorff J.M.

The power of cueing to circumvent dopamine deficits: a review of physical therapy treatment of gait disturbances in Parkinson's disease

Mov Disord, 17 (2002) 1148-60.

Gait disturbances are among the primary symptoms of Parkinson's disease (PD) and contribute significantly to a patient's loss of function and independence. Standard treatment includes antiparkinsonian drugs, primarily levodopa. In addition to the standard drug regime, physical therapy is often prescribed to help manage the disease. In recent years, there have been promising reports of physical therapy programs combined with various types of sensory cueing for PD. In this brief review of the literature, we summarize the evidence regarding the clinical efficacy of different physical therapy programs for PD, specifically with respect to improving gait. We also discuss the potential therapeutic mechanisms of sensory cueing and review the studies that have used cueing in the treatment of gait in PD. This review of the literature shows two key findings: (1) despite its relatively long history, the evidence supporting the efficacy of conventional physical therapy for treatment of gait in PD is not strong; and (2) although further investigation is needed, sensory cueing appears to be a powerful means of improving gait in PD.

Schaechter J.D., Kraft E., Hilliard T.S., Dijkhuizen R.M., Benner T., Finklestein S.P., Rosen B.R. and Cramer S.C.

Motor recovery and cortical reorganization after constraint-induced movement therapy in stroke patients: a preliminary study

Neurorehabil Neural Repair, 16 (2002) 326-38.

Constraint-induced movement therapy (CIMT) is a physical rehabilitation regime that has been previously shown to improve motor function in chronic hemiparetic stroke patients. However, the neural mechanisms supporting rehabilitation-induced motor recovery are poorly understood. The goal of this study was to assess motor cortical reorganization after CIMT using functional magnetic resonance imaging (fMRI). In a repeated-measures design, 4 incom-



pletely recovered chronic stroke patients treated with CIMT underwent motor function testing and fMRI. Five age-matched normal subjects were also imaged. A laterality index (LI) was determined from the fMRI data, reflecting the distribution of activation in motor cortices contralateral compared with ipsilateral to the moving hand. Pre-intervention fMRI showed a lower LI during affected hand movement of stroke patients (LI = 0.23 \pm 0.07) compared to controls (LI unaffected patient hand = 0.65 \pm 0.10; LI dominant normal hand = 0.65 \pm 0.11; LI nondominant normal hand = 0.69 \pm 0.11; $P < 0.05$) due to trends toward increased ipsilateral motor cortical activation. Motor function testing showed that patients made significant gains in functional use of the stroke-affected upper extremity (detected by the Motor Activity Log) and significant reductions in motor impairment (detected by the Fugl-Meyer Stroke Scale and the Wolf Motor Function Test) immediately after CIMT, and these effects persisted at 6-month follow-up. The behavioral effects of CIMT were associated with a trend toward a reduced LI from pre-intervention to immediately post-intervention (LI = -0.01 \pm 0.06, $P = 0.077$) and 6 months post-intervention (LI = -0.03 \pm 0.15). Stroke-affected hand movement was not accompanied by mirror movements during fMRI, and electromyographic measures of mirror recruitment under simulated fMRI conditions were not correlated with LI values. These data provide preliminary evidence that gains in motor function produced by CIMT in chronic stroke patients may be associated with a shift in laterality of motor cortical activation toward the undamaged hemisphere.

Seidel B. and Krebs D.E.

Base of support is not wider in chronic ataxic and unsteady patients

J Rehabil Med, 34 (2002) 288-92.

"Wide-based gait" is considered indicative of imbalance. No quantitative gait analyses, however, have related base of support to steadiness during gait. To determine whether patients with cerebellar or vestibular disorders had a wider base of support than matched healthy individuals, we analyzed 102 balance-impaired patients and healthy subjects during free and paced gait. Kinematic data were collected using a high-precision optoelectronic system. There were no significant differences in the base of support between unsteady and healthy subjects, nor between patients with vestibular and cerebellar diagnoses. The base of support correlated with the body mass index and waist circumference in all subject groups. These data suggest that base of support during gait fails to identify balance-impaired subjects and is related more to biomechanical than to neurological factors. Therefore, "wide-based gait" should no longer be considered the sine qua non of ataxic or unsteady gait. Clinicians should not focus on decreasing base of support as a therapeutic goal for chronic, unsteady patients.

Singer B., Dunne J., Singer K.P. and Allison G.

Evaluation of triceps surae muscle length and resistance to passive lengthening in patients with acquired brain injury

Clin Biomech (Bristol, Avon), 17 (2002) 152-61.

OBJECTIVE: To examine changes in muscle length and resistance to passive lengthening in the triceps surae muscles in patients with recently acquired brain injury. **BACKGROUND:** Increased passive resistance in the triceps surae muscles is common following acquired brain injury. Adaptive shortening secondary to relative immobility, and increased stiffness due to rheologic changes within the musculo-tendinous unit, may be exacerbated by plantarflexor muscle overactivity related to the brain injury itself. **DESIGN:** Three variables representing resistance to passive lengthening and soleus muscle length were compared between subjects with recent brain injury and age matched normal controls. Comparison between limbs was made for subjects with unilateral neurological impairment. **METHODS:** Slow passive dorsiflexion stretches were performed using a computer controlled dynamometer. Muscle stiffness in the initial and latter portion of the range, and the angles achieved at torques of 5 and 10 N m were determined from torque-angle curves. Maximal ankle dorsiflexion with the knee flexed was considered to reflect soleus muscle length. **RESULTS:** Significant differences were demonstrated for all variables, except passive stiffness near the end of available range. The limb ipsilateral to unilateral brain injury differed from control limbs in that significantly less passive range of dorsiflexion was available and initial resistance to passive stretch was significantly less. **CONCLUSIONS:** The reduction in soleus muscle length evident in subjects with recent acquired brain injury, even in neurologically unaffected limbs, may reflect the influence of relative immobility. Although plantarflexor muscle overactivity was found to be associated with increased resistance to slow passive stretch, the mechanism was unable to be elucidated from these data. The limb ipsilateral to unilateral neurological impairment cannot be considered to be a 'normal' control for comparative purposes. **RELEVANCE:** Adaptive shortening and increased resistance to passive lengthening limit active ankle dorsiflexion, and alter ankle biomechanics. Tonic muscle overactivity has the potential to exacerbate these changes. Prophylactic management of inappropriate muscle activity and maintenance of muscle length may facilitate the achievement of rehabilitation goals and reduce subsequent disability following acquired brain injury.

Slade A., Tennant A. and Chamberlain M.A.

A randomised controlled trial to determine the effect of intensity of therapy upon length of stay in a neurological rehabilitation setting

J Rehabil Med, 34 (2002) 260-6.



A randomised single-blind controlled trial was designed to determine whether intensity of therapy (physiotherapy and occupational therapy) shortened length of stay for patients in a rehabilitation unit. Patients were under 65, primarily with stroke, but also with other conditions such as traumatic brain injury, and multiple sclerosis. The experimental group were timetabled to receive 67% more therapy in any given week, than the control group. After controlling for confounders and case mix (as expressed by type of therapy required) patients in the experimental group showed a significant 14-day reduction in length of stay (<0.01). Concurrently average length of stay was increased for both groups by 16 days due to delays in discharge.

Stallibrass C., Sissons P. and Chalmers C.

Randomized controlled trial of the Alexander technique for idiopathic Parkinson's disease
Clin Rehabil, 16 (2002) 695-708.

OBJECTIVE: To determine whether the Alexander Technique, alongside normal treatment, is of benefit to people disabled by idiopathic Parkinson's disease. **DESIGN:** A randomized controlled trial with three groups, one receiving lessons in the Alexander Technique, another receiving massage and one with no additional intervention. Measures were taken pre- and post-intervention, and at follow-up, six months later. **SETTING:** The Polyclinic at the University of Westminster, Central London. **SUBJECTS:** Ninety-three people with clinically confirmed idiopathic Parkinson's disease. **INTERVENTIONS:** The Alexander Technique group received 24 lessons in the Alexander Technique and the massage group received 24 sessions of massage. **MAIN OUTCOME MEASURES:** The main outcome measures were the Self-assessment Parkinson's Disease Disability Scale (SPDDS) at best and at worst times of day. Secondary measures included the Beck Depression Inventory and an Attitudes to Self Scale. **RESULTS:** The Alexander Technique group improved compared with the no additional intervention group, pre-intervention to post-intervention, both on the SPDDS at best, $p = 0.04$ (confidence interval (CI) -6.4 to 0.0) and on the SPDDS at worst, $p = 0.01$ (CI -11.5 to -1.8). The comparative improvement was maintained at six-month follow-up: on the SPDDS at best, $p = 0.04$ (CI -7.7 to 0.0) and on the SPDDS at worst, $p = 0.01$ (CI -11.8 to -0.9). The Alexander Technique group was comparatively less depressed post-intervention, $p = 0.03$ (CI -3.8 to 0.0) on the Beck Depression Inventory, and at six-month follow-up had improved on the Attitudes to Self Scale, $p = 0.04$ (CI -13.9 to 0.0). **CONCLUSIONS:** There is evidence that lessons in the Alexander Technique are likely to lead to sustained benefit for people with Parkinson's disease.

Stevinson C. and Ernst E.

Risks associated with spinal manipulation
Am J Med, 112 (2002) 566-71.

The aim of this systematic review was to summarize the evidence about the risks of spinal manipulation. Articles were located through searching three electronic databases (MEDLINE, EMBASE, Cochrane Library), contacting experts ($n = 9$), scanning reference lists of relevant articles, and searching departmental files. Reports in any language containing data relating to risks associated with spinal manipulation were included, irrespective of the profession of the therapist. Where available, systematic reviews were used as the basis of this article. All papers were evaluated independently by the authors. Data from prospective studies suggest that minor, transient adverse events occur in approximately half of all patients receiving spinal manipulation. The most common serious adverse events are vertebrobasilar accidents, disk herniation, and cauda equina syndrome. Estimates of the incidence of serious complications range from 1 per 2 million manipulations to 1 per 400,000. Given the popularity of spinal manipulation, its safety requires rigorous investigation.

Sturm J.W., Dewey H.M., Donnan G.A., Macdonell R.A., McNeil J.J. and Thrift A.G.

Handicap after stroke: how does it relate to disability, perception of recovery, and stroke subtype?: the North East Melbourne Stroke Incidence Study (NEMESIS)
Stroke, 33 (2002) 762-8.

BACKGROUND AND PURPOSE: Knowledge of patterns of handicap after stroke and of the relationship among handicap, disability, perception of recovery, and stroke subtype is limited. The aim of this study was to assess handicap 3 and 12 months after first-ever stroke in a community-based study. **METHODS:** All strokes occurring in a population of 133 816 people were found and assessed. Patients were classified as having cerebral infarction (CI) or intracerebral hemorrhage (ICH) according to imaging or autopsy findings. Cases of CI were categorized using the Oxfordshire stroke classification. Handicap, disability, and perception of recovery were assessed 3 and 12 months after stroke using the London Handicap Scale, Barthel Index, and the question "Have you made a complete recovery from your stroke?" The association between disability and handicap was examined using Pearson's correlation. Differences in handicap among subtypes of CI were evaluated using one-way ANOVA. **RESULTS:** There were 264 cases of CI or ICH. Of surviving patients, 113 (59%) were assessed at 3 months and 107 (64%) at 12 months. The domains of handicap most affected were physical independence and occupation. Only half the variance in handicap was due to disability. Of patients without disability, those who claimed complete recovery were less handicapped than those who claimed incomplete recovery. Patients with total anterior circulation infarction were more handicapped at 3 and 12 months than



those with other subtypes of CI. **CONCLUSIONS:** Stroke patients were handicapped across many domains. Handicap is only partly explained by disability. Stroke subtype should be considered in the interpretation of outcome data.

Talar J.

Rehabilitation outcome in a patient awakened from prolonged coma

Med Sci Monit, 8 (2002) CS31-8.

BACKGROUND: This article describes the rehabilitation of a patient recovering from a prolonged coma (defined as lasting longer than 4 weeks). The case is noteworthy because it exemplifies the possibilities and difficulties entailed in treating these patients, who are often regarded as too severely impaired to justify intensive rehabilitation efforts. **CASE REPORT:** The patient is a 28-year old Polish male, unmarried, who suffered serious closed head injuries in an automobile accident in April of 1999. He was in a comatose state for more than two months, with a GCS score of 5. When admitted for rehabilitation he was bedridden, with global aphasia, agraphia, limb apraxia, and executive dysfunction. The rehabilitation program developed for him is described in detail. **RESULTS:** Over the course of rehabilitation, which began in December 1999 and continues to this writing, the patient has regained locomotion capabilities (though with impairments), and his speech has improved considerably. The apraxia has largely resolved, and he is able to write his name and copy words. He is now capable of performing many activities of daily living. **CONCLUSIONS:** A comprehensive program of rehabilitation characterized by a strategic, heuristic approach is capable of achieving a good outcome even in very difficult cases, such as prolonged coma.

Taub E., Uswatte G. and Elbert T.

New treatments in neurorehabilitation founded on basic research

Nat Rev Neurosci, 3 (2002) 228-36.

Recent discoveries about how the central nervous system responds to injury and how patients reacquire lost behaviours by training have yielded promising new therapies for neurorehabilitation. Until recently, this field had been largely static, but the current melding of basic behavioural science with neuroscience promises entirely new approaches to improving behavioural, perceptual and cognitive capabilities after neurological damage. Studies of phenomena such as cortical reorganization after a lesion, central nervous system repair, and the substantial enhancement of extremity use and linguistic function by behavioural therapy, support this emerging view. The ongoing changes in rehabilitation strategies might well amount to an impending paradigm shift in this field.

Thaut M.H., Kenyon G.P., Hurt C.P., McIntosh G.C. and Hoemberg V.

Kinematic optimization of spatiotemporal patterns in paretic arm training with stroke patients

Neuropsychologia, 40 (2002) 1073-81.

The effect of rhythmic cueing on spatiotemporal control of sequential reaching movements of the paretic arm was studied in 21 hemispheric stroke patients. Reaching movements were studied with and without rhythmic metronome cuing in a counterbalanced design. Metronome frequencies were entrained to the naturally selected frequency of the patient. Results indicate statistically significant ($P < 0.05$) improvements of spatiotemporal arm control during rhythmic entrainment. Variability of timing and reaching trajectories were reduced significantly. Time series analysis of sequential movement repetitions showed an immediate reduction in variability of arm kinematics during rhythmic entrainment within the first two to three repetitions of each trial. Rhythm also produced significant increases in angle ranges of elbow motion ($P < 0.05$). Analysis of acceleration and velocity profiles of the wrist joint showed significant kinematic smoothing during rhythmic cuing. The link between rhythmic sensory timing and spatiotemporal motor control was investigated using a mathematical optimization model with minimization of peak acceleration as criterion. Rhythmically cued acceleration profiles fit the predicted model data significantly closer ($P < 0.01$) than the self-paced profiles. Since velocity and acceleration are mathematical derivatives of position-time trajectories, the model data suggest that enhanced timing precision via temporal phase and period coupling of the motor pattern to the rhythmic timekeeper enhances the brain's computational ability to optimally scale movement parameters across time.

Trombly C.A. and Ma H.I.

A synthesis of the effects of occupational therapy for persons with stroke, Part I: Restoration of roles, tasks, and activities

Am J Occup Ther, 56 (2002) 250-9.

This article synthesizes research findings regarding the effects of occupational therapy on the restoration of role, task, and activity performance for persons who have had a stroke, with the purpose of guiding practice and research. It is the first of a two-part review of studies. Part II synthesizes research findings regarding the effects of occupational therapy on remediating impairments. Part I includes 15 studies involving 895 participants (mean age = 70.3 years). Of these studies, 11 (7 randomized controlled trials) found that role participation and instrumental and basic activities of daily living performance improved significantly more with training than with the control conditions. We conclude that occupational therapy effectively improves participation and activity after stroke and recommend that



therapists use structured instruction in specific, client-identified activities, appropriate adaptations to enable performance, practice within a familiar context, and feedback to improve client performance. Empirical research to verify these findings and to characterize the key therapeutic mechanisms associated with desired outcomes is needed.

Turner-Stokes L. and Jackson D.

Shoulder pain after stroke: a review of the evidence base to inform the development of an integrated care pathway
Clin Rehabil, 16 (2002) 276-98.

BACKGROUND: Shoulder pain is a common complication of stroke. It can impede rehabilitation and has been associated with poorer outcomes and prolonged hospital stay. This systematic review was undertaken to inform the development of an evidence-based integrated care pathway (ICP) for the management of hemiplegic shoulder pain (HSP). **AIMS AND OBJECTIVES:** 1) To provide a background understanding of the functional anatomy of the shoulder and its changes following stroke. 2) To review the literature describing incidence and causation of HSP and the evidence for factors contributing to its development. 3) To appraise the evidence for effectiveness of different interventions for HSP. **METHODS:** Data sources comprised a computer-aided search of published studies on shoulder pain in stroke or hemiplegia and references to literature used in reviews (total references = 121). **MAIN FINDINGS:** Although a complex variety of physical changes are associated with HSP, these broadly divide into 'flaccid' and 'spastic' presentations. Management should vary accordingly; each presentation requiring different approaches to handling, support and intervention. (1) In the flaccid stage, the shoulder is prone to inferior subluxation and vulnerable to soft-tissue damage. The arm should be supported at all times and functional electrical stimulation may reduce subluxation and enhance return of muscle activity. (2) In the spastic stage, movement is often severely limited. Relieving spasticity and maintaining range requires expert handling; overhead exercise pulleys should never be used. Local steroid injections should be avoided unless there is clear evidence of an inflammatory lesion. **CONCLUSIONS:** HSP requires co-ordinated multidisciplinary management to minimize interference with rehabilitation and optimize outcome. Further research is needed to determine effective prophylaxis and document the therapeutic effect of different modalities in the various presentations. Development of an integrated care pathway provides a reasoned approach to management of this complex condition, thus providing a sound basis for prospective evaluation of different interventions in the future.

Turton A. and Pomeroy V.

When should upper limb function be trained after stroke? Evidence for and against early intervention
NeuroRehabilitation, 17 (2002) 215-24.

Very little time is available for arm and hand training while patients are in hospital after stroke. Therapeutic strategies that use intensive practice in the early days and weeks after stroke may improve the recovery of upper limb function. This paper considers the physiology of the brain in acute stroke and evaluates the evidence for and against early intensive activity of the upper limb as an essential precursor to any decision to invest in increased activity.

Werner C., Bardeleben A., Mauritz K.H., Kirker S. and Hesse S.

Treadmill training with partial body weight support and physiotherapy in stroke patients: a preliminary comparison
Eur J Neurol, 9 (2002) 639-44.

Treadmill training with partial body weight support can restore the gait ability of chronic non-ambulatory hemiparetic subjects. A combination of physiotherapy and treadmill training may accelerate the rate of recovery. Therefore a randomized study was planned. Twenty-eight non-ambulatory hemiparetic patients were randomly assigned to group A or B. A 3-week baseline of conventional therapy was followed by 15 sessions of physiotherapy and treadmill training in patients of group A and by 15 sessions of treadmill training in patients of group B over a period of 3 weeks. Follow-up was 4 months later. The major outcome variables were gait ability and ground level walking velocity. Gait ability and velocity did not change during the baseline. In group B, five patients became independent walkers after the specific intervention, whereas 10 patients of group A regained independent walking ability in the same period ($P < 0.05$). Four months later group differences had waned. Three weeks of treadmill training plus physiotherapy accelerated the restoration of gait ability in hemiparetic subjects, however, the double amount of therapy in group A does not exclude a simple dose-response phenomenon.

Widar M., Samuelsson L., Karlsson-Tivenius S. and Ahlstrom G.

Long-term pain conditions after a stroke
J Rehabil Med, 34 (2002) 165-70.

The aim of this study was to classify and describe the characteristics of different long-term pain conditions after a stroke by clinical examination and pain assessment using the Pain-O-Meter and a Pain questionnaire. Pain was classified as central post-stroke pain ($n = 15$), nociceptive pain ($n = 18$), and tension-type headache ($n = 10$). In 65%, pain onset was within 1-6 months and the pain intensity revealed individual differences. Many pain descriptors was common, some were discriminating as burning in central and cramping in nociceptive pain, and pressing and worrying in headache. More than half with central or nociceptive pain had continuous or almost continuous pain. Cold was the



factor mostly increasing the pain in central, physical movements in nociceptive pain, and stress and anxiety in headache. More than one-third had no pain treatment and two-thirds of those with central pain had no or inadequate prescribed pain treatment. The clinical findings support the classification of pain and describe discriminating and common pain characteristics in pain conditions after a stroke.

Wiles R., Ashburn A., Payne S. and Murphy C.

Patients' expectations of recovery following stroke: a qualitative study

Disabil Rehabil, 24 (2002) 841-50.

PURPOSE: Patients and carers frequently express disappointment with the extent of recovery achieved at the point of discharge from physiotherapy. Research has suggested that high expectations of recovery may be encouraged by physiotherapists. This study examined the information exchanged between physiotherapists and patients in relation to recovery following stroke in order to explore this issue. **METHODS:** The study comprised in-depth longitudinal case studies of 16 patients with a first incident stroke. Qualitative interviews were conducted with patients and their physiotherapists to explore their understandings and expectations of recovery and of physiotherapy at three time points. Patients were assessed for deficits of movement, function and mood at the same three stages and observations of out-patient sessions were also conducted. Qualitative data were analysed using thematic analysis. The assessment data were analysed using descriptive and comparative statistics. **RESULTS:** Data indicated deficits of movement improved significantly between the first and third assessments. The qualitative data showed that physiotherapists did not encourage over-optimistic expectations of recovery through the verbal information they provided to patients. Nevertheless patients did maintain high expectations of recovery throughout the three-month post-stroke period. **CONCLUSION:** Improved communication strategies, informed by an evidence base of recovery, should be used to encourage realistic expectations of physiotherapy without destroying the process of active participation and skill acquisition.

Wilson S.J., Pressing J.L. and Wales R.J.

Modelling rhythmic function in a musician post-stroke

Neuropsychologia, 40 (2002) 1494-505.

The aim of this study was to model the components of rhythmic function in a case (H.J.) of acquired rhythmic disturbance. H.J. is a right-handed, amateur male musician who acquired arrhythmia in the context of a global amusia after sustaining a right temporoparietal infarct. His rhythmic disturbance was analysed in relation to three independent components using an autoregressive extension of Wing and Kristofferson's model of rhythmic timing. This revealed preserved error-correction and motor implementation capacities, but a gross disturbance of H.J.'s central timing system ("cognitive clock"). It rendered him unable to generate a steady pulse, prevented adequate discrimination and reproduction of novel metrical rhythms, and partly contributed to bi-manual co-ordination difficulties in his instrumental performance. The findings are considered in relation to the essential components of the cognitive architecture of rhythmic function, and their respective cerebral lateralisation and localisation. Overall, the data suggested that the functioning of the right temporal auditory cortex is fundamental to 'keeping the beat' in music. The approach is presented as a new paradigm for future neuropsychological research examining rhythmic disturbances.

Woldag H. and Hummelsheim H.

Evidence-based physiotherapeutic concepts for improving arm and hand function in stroke patients: a review

J Neurol, 249 (2002) 518-28.

In recent years, our understanding of motor learning, neuroplasticity and functional recovery after the occurrence of brain lesion has grown significantly. New findings in basic neuroscience provided stimuli for research in motor rehabilitation. Repeated motor practice and motor activity in a real world environment have been identified in several prospective studies as favorable for motor recovery in stroke patients. EMG initiated electrical muscle stimulation -- but not electrical muscle stimulation alone -- improves motor function of the centrally paretic arm and hand. Although a considerable number of physiotherapeutic "schools" has been established, a conclusive proof of their benefit and a physiological model of their effect on neuronal structures and processes are still missing. Nevertheless, evidence-based strategies for motor rehabilitation are more and more available, particularly for patients suffering from central paresis.

Yavuzer G., Ataman S., Suldur N. and Atay M.

Bone mineral density in patients with stroke

Int J Rehabil Res, 25 (2002) 235-9.

The objectives of this study were to investigate the development and pathogenesis of osteoporosis in stroke in-patients, to compare the bone mineral density (BMD) of the paretic and non-paretic sides, to study longitudinal changes during the period on the rehabilitation ward and to relate BMD to demographic, impairment and disability variables. Participants were 32 first-stroke in-patients (19 men), with an average age of 62.4 +/- 8.1 years. Demographic and clinical characteristics were documented. The BMD of lumbar spine, bilateral distal radius and femoral neck were measured and compared at admission and discharge. The associations between bone loss and age, sex, time since stroke, Brunn-



strom motor recovery scores and functional independence measure motor (mFIM) scores were assessed. The mean percentage differences in BMD between paretic and non-paretic arms at discharge were 12% ($P < 0.001$) and 3.5% ($P < 0.05$), respectively, and between paretic and non-paretic legs were 5% ($P < 0.01$) and 2% ($P < 0.05$), respectively. There was a statistically significant correlation between BMD loss and Brunnstrom stage ($r = -0.41$) and mFIM score at admission ($r = -0.42$). In conclusion, patients with hemiparesis due to stroke are at increased risk of developing osteoporosis on the paretic side. Higher motor impairment and functional dependency at admission increases the risk. New strategies are needed for stroke patients to prevent further decreases in BMD and reduce the risk of fractures.

Yelnik A.P., Lebreton F.O., Bonan I.V., Colle F.M., Meurin F.A., Guichard J.P. and Vicaut E.

Perception of verticality after recent cerebral hemispheric stroke

Stroke, 33 (2002) 2247-53.

BACKGROUND AND PURPOSE: Perception of the subjective visual vertical (SVV) is affected by cerebral hemispheric lesions. Knowledge of this disturbance is of interest for the study of its possible relation to balance disturbances. There is still uncertainty about the possible effects of a visual field defect and of the side and site of the lesion. This study was conducted to assess SVV with the head upright or tilted and to explore its relation to a visual field defect, visuospatial neglect, and the site of lesion. **METHODS:** Forty patients with hemiplegia after a recent hemispheric stroke (20 with left and 20 with right stroke) were studied. The site of the lesion was determined on CT scan, with special attention focused on the vestibular cortex. A neurological examination with determination of the visual field and visual neglect was conducted before SVV was tested. Subjects sat in a dark room and adjusted a luminous rod to the vertical position. Measures were repeated with binocular and monocular vision and with the head upright or tilted to the right or left. **RESULTS:** SVV was abnormally deviated in 23 of 40 patients (57%). The deviation was significantly greater among patients with a right or left hemispheric lesion than among healthy controls (-2.2 degrees and 1.5 degrees versus 0.2 degrees); the same applied to the range of uncertainty (7.6 degrees and 4.7 degrees versus 1.9 degrees). SVV deviation was not significantly related to the location of the lesion but was closely related to visuospatial neglect. The "E" effect observed in controls with the head tilted, ie, an SVV shift in the direction opposite to the head tilt, was not observed in hemiplegic patients with the head tilted toward the nonparetic side. **CONCLUSIONS:** Recent hemispheric stroke affects SVV perception, which is closely correlated to visuospatial neglect. It is suggested that the E effect might be mediated by the stretching of the somatosensory structure of the neck.

Zeloni G., Farne A. and Baccini M.

Viewing less to see better

J Neurol Neurosurg Psychiatry, 73 (2002) 195-8.

OBJECTIVE: To assess the efficacy, as well as the long term duration, of a new procedure for the rehabilitation of visuospatial neglect in patients with right hemisphere stroke. **METHODS:** Patients with right unilateral hemispheric damage identified with neglect were assigned to a treatment (T+) or a control (T-) group. The treatment consisted in abolishing all visual inputs from the right hemispace for one week by means of specially devised hemiblinding goggles. Patients' visuospatial abilities were tested and compared between groups immediately after the week of treatment. Both groups were further assessed one week after treatment suspension for evaluation of long term beneficial effects. **RESULTS:** Following the treatment, a substantial amelioration of visuospatial neglect symptoms was selectively observed in the T+ group. In contrast, untreated patients showed only weak signs of recovery. Most important, the amelioration obtained in the T+ group of patients was not ephemeral, being significantly maintained after a further period of one week, even after suspension of the treatment. **CONCLUSION:** The protracted efficacy of the proposed "hemiblinding technique" may have important implications for the recovery of visuospatial neglect and may be a very promising tool for investigating both the cognitive and the neural basis of neglect rehabilitation.

Zorowitz R.D., Gross E. and Polinski D.M.

The stroke survivor

Disabil Rehabil, 24 (2002) 666-79.

PURPOSE: This article reviews the physiological basis of stroke rehabilitation and describes the theories and interventions involved in the rehabilitation of the stroke survivor. **ISSUES:** Stroke remains the third most common cause of death in the Western World, and is the leading cause of adult disability and placement into extended care facilities. Stroke is not a disease of the old, but affects many people under the age of 65. Comprehensive rehabilitation may improve the functional abilities of the stroke survivor, despite age and neurologic deficit, and decrease long-term patient care costs. Rehabilitation not only involves restoring independence in mobility and activities of daily living, but maximizing compensatory strategies in linguistic and cognitive function. Strategies to reintegrate the stroke survivor into the community are discussed. Secondary complications of stroke are described, and interventions are suggested to prevent and treat potential medical issues. **CONCLUSION:** Stroke rehabilitation may be a lifetime endeavour, and requires proper medical resources to successfully address physical, linguistic, cognitive and psychosocial issues. Good commu-

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nication between the rehabilitation team, the patient and the family facilitates optimal care and provides the stroke survivor with the opportunity to reach his maximal functional potential.

Zwecker M., Levenkrohn S., Fleisig Y., Zeilig G., Ohry A. and Adunsky A.

Mini-Mental State Examination, cognitive FIM instrument, and the Loewenstein Occupational Therapy Cognitive Assessment: relation to functional outcome of stroke patients

Arch Phys Med Rehabil, 83 (2002) 342-5.

OBJECTIVES: To compare 3 cognitive tests, used on admission, for predicting discharge functional outcome and to assess the efficacy of these tests in predicting functional outcome at discharge in stroke patients undergoing rehabilitation. **DESIGN:** Cohort study. **SETTING:** Geriatric rehabilitation department of a tertiary care hospital in Israel. **PATIENTS:** Sixty-six patients undergoing acute inpatient comprehensive rehabilitation after first clinical stroke. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASUREMENTS:** Cognitive status was assessed with the Loewenstein Occupational Therapy Cognitive Assessment (LOTCA), the Mini-Mental State Examination (MMSE), and the cognitive subscale of the FIM instrument. The FIM motor subscale was used to assess functional outcome status. Functional gain was determined by the motor FIM gain (efficacy), and the relative (to potential) functional gain was determined by the Montebello Rehabilitation Factor Score. Efficiency was calculated by efficacy divided by the length of hospital stay. **RESULTS:** A significant increase in total FIM scores (34.8 points) occurred during rehabilitation mainly because of improvement in motor functioning (31.5 points). Significant improvement in global cognitive status was documented by all 3 tests. Intertest correlation coefficients ranged between .47 and .67. The LOTCA showed somewhat higher correlation coefficients with most of the parameters of functional motor outcomes. Correlation between the MMSE and FIM cognitive subscale and these outcome parameters were nearly identical. **CONCLUSION:** The LOTCA is slightly better than the MMSE and the FIM cognitive subscale in predicting functional status change after stroke rehabilitation but it is a time-consuming and exhausting instrument to use. The FIM cognitive subscale requires a better overall understanding of the patient's situation at time of administration and therefore is less convenient for the initial assessment. The similar correlation of all 3 tests with functional outcomes and the simplicity of administration of the MMSE suggests its use in the initial assessment of stroke patients.