

Abstracts

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Treatment and Effectiveness of treatment: Ada, Andrews, Barbeau, Barreca, Boyd, Byl, Cambier, Cauraugh, Craig, Di Lauro, Duncan, Fang, Francisco, Gillot, Karnath, Katz-Leurer, Kerkhoff, Krutulyte, Langhammer, Lin, Maravita, Meek, Michel, Moreland, Paci, Page, Page, Pollock, Pomeroy, Rodgers, Steultjens, Teasell, Van Der Lee, Wade, Winstein

Abstracts alphabetically ordered by author

Ada L, Canning Cg, Low Sl.

Stroke patients have selective muscle weakness in shortened range.

Brain, 126(Pt 3), 724-731 2003.

Weakness is recognized as a major problem after stroke. This study examined the torque-angle curves of stroke individuals and compared them with those of neurologically normal controls to determine (i) if stroke patients were selectively weak when their muscles were placed in a shortened range and (ii) whether contracture influenced any selective weakness. This descriptive research study measured elbow flexor and extensor torque-angle curves and contracture. Twenty-two stroke subjects who had suffered a stroke 5 months to 6 years ago and 11 neurologically normal controls of similar age participated. Torque-angle curves of the elbow flexors and extensors were determined by measuring maximum isometric torque at 0, 20, 40, 60, 80, 100 and 120 degrees of elbow flexion (0 degrees being full elbow extension), where possible. Contracture of the elbow flexors and extensors was measured as the loss of passive elbow joint range of motion. Repeated measures analysis of variance revealed that the torque-angle curves of stroke subjects (with or without contracture) were significantly different from those of the control subjects for both the elbow flexors ($P < 0.05$) and extensors ($P < 0.05$). The stroke subjects appeared relatively weaker when the muscles were in their shortened range. This study confirms that selective weakness exists at short muscle lengths after stroke. The findings of this study help to explain why people after stroke have difficulty functioning when their muscles are in their shortened range. Therefore, strength training should be targeted specifically at muscles at their shortened lengths in order to promote the recovery of function after stroke.

Ada L, Dean Cm, Hall Jm, Bampton J, Crompton S.

A treadmill and overground walking program improves walking in persons residing in the community after stroke: a placebo-controlled, randomized trial.

Arch Phys Med Rehabil, 84(10), 1486-1491 2003.

OBJECTIVE: To evaluate the effectiveness of a treadmill and overground walking program in reducing the disability and handicap associated with poor walking performance after stroke. **DESIGN:** Randomized, placebo-controlled clinical trial with a 3-month follow-up. **SETTING:** General community. **PARTICIPANTS:** A volunteer sample of 29 ambulatory individuals (less 2 dropouts) who were living in the community after having suffered a stroke more than 6 months previously. **INTERVENTIONS:** The experimental group participated in a 30-minute treadmill and overground walking program, 3 times a week for 4 weeks. The control group received a placebo consisting of a low-intensity, home exercise program and regular telephone contact. **MAIN OUTCOME MEASURES:** Walking speed (over 10 m), walking capacity (distance over 6 min), and handicap (stroke-adapted 30-item version of the Sickness Impact Profile) measured by a blinded assessor. **RESULTS:** The 4-week treadmill and overground walking program significantly increased walking speed ($P=.02$) and walking capacity ($P<.001$), but did not decrease handicap ($P=.85$) compared with the placebo program. These gains were largely maintained 3 months after the cessation of training ($P</.05$). **CONCLUSIONS:** The treadmill and overground walking program was effective in improving walking in persons residing in the community after stroke. This suggests that the routine provision of accessible, long-term, community-based walking programs would be beneficial in reducing disability after stroke.

Andrews Aw, Bohannon Rw.

Short-term recovery of limb muscle strength after acute stroke.

Arch Phys Med Rehabil, 84(1), 125-130 2003.

OBJECTIVES: To document, by using norm-referenced strength measures, the recovery of limb muscle strength of patients undergoing stroke rehabilitation and to examine the relation between comorbidities and the recovery of strength after stroke. **DESIGN:** Retrospective analysis of data from a consecutive convenience sample of patients examined clinically between 1994 and 1997. **SETTING:** Acute inpatient rehabilitation unit. **PARTICIPANTS:** Fifty patients with stroke who were able to follow commands and were examined during acute rehabilitation by a single examiner (AWA). **INTERVENTIONS:** Stroke rehabilitation emphasizing early movement, exercise with resistance, and daily functional activities. **MAIN OUTCOME MEASURE:** The strength at discharge of 7 muscle actions (shoulder abduction, elbow flexion, elbow extension, wrist extension, hip flexion, knee extension, ankle dorsiflexion) measured bilaterally with a hand-held dynamometer and compared with norm-referenced values. **RESULTS:** Differences in strength between admission and discharge were significant



for all muscle actions on the weaker side and for 4 of the 7 muscle actions on the stronger side. At discharge, the bilateral strength of all muscle actions was weaker than predicted by data from healthy individuals of comparable age, sex, and weight ($F > 17.000$, $P < .001$). Strength did not differ between subjects who did and did not have a previous stroke or comorbidities. **CONCLUSIONS:** Subjects undergoing inpatient rehabilitation soon after stroke experienced an increase in limb muscle strength bilaterally. This increase was not influenced by previous stroke or comorbidities.

Au-Yeung Ss, Ng Jt, Lo Sk.

Does balance or motor impairment of limbs discriminate the ambulatory status of stroke survivors?

Am J Phys Med Rehabil, 82(4), 279-283 2003.

OBJECTIVE: This study was performed to determine if ambulatory function is governed by motor impairment of limbs or balance ability in subjects with hemiplegia caused by stroke. **DESIGN:** Seven patients who walked with physical assistance (FIM 4) after stroke and 13 who walked independently with assistive devices (FIM 6) were compared with 13 healthy subjects. Motor impairment of limbs was evaluated with the Fugl-Meyer Assessment. The Berg Balance Scale and limit of stability test of the Smart Balance Master were used to evaluate balance ability. **RESULTS:** The FIM 6 group and the controls were best differentiated by motor impairment of the paretic limbs and limit of stability in the backward direction. Motor impairment of the upper limb and limit of stability in direction toward the paretic side separated the FIM 4 from the FIM 6 group. Upper limb motor impairment and the Berg Balance Scale consistently separated the three subject groups. **CONCLUSIONS:** Motor impairment in the paretic upper limb and balance dysfunction should be addressed in treatments working toward independent ambulation.

Azouvi P, Olivier S, De Montety G, Samuel C, Louis-Dreyfus A, Tesio L.

Behavioral assessment of unilateral neglect: study of the psychometric properties of the Catherine Bergego Scale.

Arch Phys Med Rehabil, 84(1), 51-57 2003.

OBJECTIVE: To assess the psychometric properties of a scale for spatial neglect in everyday life. **DESIGN:** Validation study. **SETTING:** A neurologic rehabilitation unit in a university hospital. **PARTICIPANTS:** Eighty-three consecutive right-hemisphere stroke patients. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** The Catherine Bergego Scale (CBS) was used to assess neglect behavior and anosognosia. Its sensitivity was compared with that of 3 conventional tests. The inner structure of the scale was studied by principal component analysis. In addition, linearity, unidimensionality, and reliability of the scale were tested through Rasch analysis. **RESULTS:** Behavioral assessment correlated significantly to, but was more sensitive than, conventional tests. Anosognosia correlated significantly with neglect severity, although individual dissociations occurred. Factorial analysis disclosed a single underlying factor, explaining 65.8% of total variance. Rasch analysis also revealed that the 10 items defined a common, single ability continuum with widespread measurement range and quite regular item distribution, and showed a satisfactory reliability. **CONCLUSION:** Behavioral assessment proved to be more sensitive than conventional paper and pencil tasks. Both conventional statistics and Rasch analysis suggest that the CBS is reliable and valid, and that the 10 items define a homogeneous construct.

Bakheit Am, Maynard Va, Curnow J, Hudson N, Kodapala S.

The relation between Ashworth scale scores and the excitability of the alpha motor neurones in patients with post-stroke muscle spasticity.

J Neurol Neurosurg Psychiatry, 74(5), 646-648 2003.

BACKGROUND: The modified Ashworth scale (MAS) is the most widely used method for assessing muscle spasticity in clinical practice and research. However, the validity of this scale has been challenged. **OBJECTIVES:** To compare the MAS with objective neurophysiological tests of spasticity. **METHODS:** The MAS was recorded in patients with post-stroke lower limb muscle spasticity and correlated with the excitability of the alpha motor neurones. The latter was evaluated by measuring the latency of the Hoffmann reflex (H reflex) and the ratio of the amplitude of the maximum H reflex (H(max)) to that of the compound action motor potential of the soleus muscle (M(max)). **RESULTS:** Data on 24 randomly recruited patients were analysed. Patients were divided into two groups according to their MAS score: 14 had a MAS score of 1 (group A) and 10 scored 2 (group B). The two groups were comparable with respect to age and sex, but in group A there was a longer period since the stroke. The H reflex latency was reduced and the H(max):M(max) ratio was increased in both groups. The H(max):M(max) ratio values were higher for group B but the differences were not statistically sig-



nificant. CONCLUSIONS: There is a relation between the MAS scores and alpha motor neurone excitability, although it is not linear. This suggests that the MAS measures muscle hypertonia rather than spasticity.

Barbeau H, Visintin M.

Optimal outcomes obtained with body-weight support combined with treadmill training in stroke subjects.

Arch Phys Med Rehabil, 84(10), 1458-1465 2003.

OBJECTIVES: To identify stroke patients who are most likely to benefit from locomotor training with body-weight support (BWS), to determine the extent of carryover from treadmill training to overground locomotion, and to determine the variables that are most likely to influence the recovery of locomotion. **DESIGN:** A randomized clinical trial. **SETTING:** Inpatient rehabilitation hospital. **PARTICIPANTS:** Of 100 stroke subjects, 50 were randomized to receive locomotor training with BWS (BWS group), and 50 were randomized to receive locomotor training with full weight bearing (no-BWS group). The subjects were stratified according to their initial overground walking speed and endurance, initial treadmill speed and endurance, functional balance, motor recovery, side of the lesion, and age. **INTERVENTION:** Fifty subjects were trained to walk on a treadmill with up to 40% of their body weight supported by a BWS system with an overhead harness (BWS group), and 50 subjects were trained to walk while bearing their full weight (no-BWS group). **MAIN OUTCOME MEASURES:** Clinical outcome measures included overground walking speed and endurance, functional balance, and motor recovery. The effect of confounding variables such as age, comorbidity, and depression on locomotor outcome was also investigated. **RESULTS:** After 6 weeks of locomotor training, the BWS group scored significantly higher in all clinical outcomes. When the subjects were stratified according to their initial overground walking speed, endurance, balance, and motor recovery, a significant statistical difference in gait and balance dysfunction of all outcomes occurred in the more severely impaired subjects. An important transfer from treadmill speed to overground walking speed was observed in subjects in the BWS group. Finally, a significantly greater effect was observed in older subjects (65-85y) in the BWS group. **CONCLUSIONS:** Retraining gait in severely impaired stroke subjects with a percentage of their body weight supported resulted in better walking and postural abilities than did gait training in patients bearing their full weight. It appears that subjects with greater gait impairments benefited the most from training with BWS, as did the older patients with stroke. There is evidence of transfer from treadmill training to overground locomotion.

Barnes Mp, Kent Rm, Semlyen Jk, Mcmullen Km.

Spasticity in multiple sclerosis.

Neurorehabil Neural Repair, 17(1), 66-70 2003.

The objective of this article is to establish the prevalence of spasticity in a random selection of people with multiple sclerosis (MS) in the city of Newcastle upon Tyne in the Northeast of England. A secondary aim was to assess the adequacy of current pharmacological intervention for spasticity and assess the relationship between spasticity and overall disability. The study design was a simple comparison that examined differences in functional independence in 2 random groups of people with MS subdivided by the presence of clinically significant spasticity. A total of 68 adults with a diagnosis of clinically definite MS were included in the study. Their level of functional independence was assessed using the Newcastle Independence Assessment Form (NIAF), the Functional Independence Measure (FIM), and the Kurtzke Extended Disability Status Scale (EDSS). Spasticity was assessed using the Modified Ashworth Scale. A subjective analysis was made of the appropriateness of oral antispastic medication by a rehabilitation physician. Thirty-two people (47%) had clinically significant spasticity (Modified Ashworth Score of 2, 3, or 4). Seventy-eight percent of the population were receiving some oral antispastic medication, but 50% were deemed to require some drug adjustment or additional treatment. Individuals with spasticity were found to have significantly higher levels of disability than those who had no spasticity or clinically insignificant spasticity. This study has confirmed that spasticity is highly prevalent in the MS population and is significantly associated with a reduced level of functional independence. Treatment of spasticity is suboptimal in a large proportion of the population, and the need for further information and education to health professionals and to people with MS is highlighted.

Barreca S, Wolf Sl, Fasoli S, Bohannon R.

Treatment interventions for the paretic upper limb of stroke survivors: a critical review.

Neurorehabil Neural Repair, 17(4), 220-226 2003.

Despite a threefold increase in treatment interventions studies during the past 10 years, "best practice" for the rehabilitation of the paretic upper limb is still unclear. This review aims to lessen uncertainty in the management



of the poststroke upper limb. Two separate searches of the scientific literature from 1966-2001 yielded 333 articles. Three referees, using strict inclusion and exclusion criteria, selected 68 relevant references. Cohort studies, randomized control trials, and systematic reviews were critically appraised. Mean randomized control trial quality ($n = 33$) was 17.1/27 (SD = 5.2, 95% CI = 15.2-19.0, range = 6-26). Mean quality of cohort studies ($n = 29$) was 11.8/27 (SD = 3.8, 95% CI = 10.4-13.2, range = 4-19). Quantitative syntheses were done using the Z-statistic. This systematic review indicated that sensorimotor training; motor learning training that includes the use of imagery, electrical stimulation alone, or combined with biofeedback; and engaging the client in repetitive, novel tasks can be effective in reducing motor impairment after stroke. Furthermore, careful handling, electrical stimulation, movement with elevation, strapping, and the avoidance of overhead pulleys could effectively reduce or prevent pain in the paretic upper limb. Rehabilitation specialists can use this research synthesis to guide their selection of effective treatment techniques for persons with impairments after stroke.

Boyd La, Winstein Cj.

Impact of explicit information on implicit motor-sequence learning following middle cerebral artery stroke.

Phys Ther, 83(11), 976-989 2003.

BACKGROUND AND PURPOSE: Recovery of motor skills following stroke is supported, in part, by the implicit memory system. However, attempts to guide learning commonly use explicit instructions concerning "how to" perform a movement task. The purpose of this work was to systematically investigate the impact of explicit information (EI) on implicit motor-sequence learning using the ipsilesional arm in people with damage in the middle cerebral artery (MCA) distribution. **SUBJECTS AND METHODS:** Ten people with unilateral stroke in the MCA distribution affecting the sensorimotor cortical areas and 10 people with no known pathology or impairment (control participants) were randomly divided into 2 groups. One group was provided with EI and one group was not (EI and No-EI groups, respectively) as the participants practiced an implicit motor-sequencing task over 3 days, with a retention test on day 4. **RESULTS:** A 3-way interaction demonstrated that, across days of practice, EI had opposite effects on implicit motor-sequence performance for the 2 groups. Post hoc tests confirmed that EI facilitated the performance of the control participants in the EI group but interfered with the performance of the participants with stroke in the EI group. This interference effect persisted, and was evident during the retention test in the participants with stroke in the EI group. **DISCUSSION AND CONCLUSION:** Explicit information was detrimental for implicit motor-sequence learning following MCA stroke. Rehabilitation outcomes may benefit from consideration of stroke location when determining the degree to which EI can augment implicit motor skill learning.

Butler Aj, Wolf Sl.

Transcranial magnetic stimulation to assess cortical plasticity: a critical perspective for stroke rehabilitation.

J Rehabil Med(41 Suppl), 20-26 2003.

Transcranial magnetic stimulation has gained increasing visibility as an evaluative and interventional tool during the past 15 years. Within the context of rehabilitation, transcranial magnetic stimulation has been applied to differentiate excitatory and inhibitory mechanisms and to assess cortical reorganization following specific interventions. This article reviews some of the more salient features of transcranial magnetic stimulation applications relevant to stroke rehabilitation, highlighting the strengths and weaknesses in this approach. Data derived from such studies may be profoundly over-interpreted. Information is provided showing the importance of utilizing fundamental principles of electrode placement and kinesiological electromyography to more accurately reflect and interpret data emerging from transcranial magnetic stimulation mapping studies, particularly as they apply to the interpretation of cortical reorganization following application of neurorehabilitative procedures.

Byl N, Roderick J, Mohamed O, Hanny M, Kotler J, Smith A, et al.

Effectiveness of sensory and motor rehabilitation of the upper limb following the principles of neuroplasticity: patients stable poststroke.

Neurorehabil Neural Repair, 17(3), 176-191 2003.

Based on the principles of neuroplasticity, the purpose of this crossover study was to determine if improvement in upper extremity (UE) function and independence could be achieved in patients 6 months to 7 years poststroke following an outpatient rehabilitation program (supervised 1.5 hours per week for 8 weeks reinforced with home gloving unaffected side and attended, graded, repetitive sensory and motor training activities). Twenty-one subjects (right or left hemiparesis; able to walk 100 feet with or without a cane; partially opened and closed the



hand; partially elevated the shoulder and elbow against gravity) were randomly assigned to Group A (sensory training 4 weeks, motor training 4 weeks) or Group B (motor training 4 weeks, sensory training 4 weeks). Greater than 20% ($P < 0.01$) improvement was measured in functional independence and UE function (fine motor, sensory discrimination, and musculoskeletal performance). Gains were hemispheric and training specific and maintained over 3 months. This study provides evidence documenting significant improvement in function in the late poststroke recovery period following 12 hours of supervised learning based sensory motor training.

Calautti C, Baron Jc.

Functional neuroimaging studies of motor recovery after stroke in adults: a review.

Stroke, 34(6), 1553-1566 2003.

BACKGROUND: The precise mechanisms of and biological basis for motor recovery after stroke in adults are still largely unknown. Reorganization of the motor system after stroke as assessed by functional neuroimaging is an intriguing but challenging new field of research. Provocative but equivocal findings have been reported to date. **SUMMARY OF REVIEW:** We present an overview of functional neuroimaging studies (positron emission tomography or functional MRI) of motor tasks in patients recovered or still recovering from motor deficit after stroke. After a brief account of the connectivity of motor systems and the imaging findings in normal subjects, the literature concerning stroke patients is reviewed and discussed, and a general model is proposed. **CONCLUSIONS:** Both cross-sectional and longitudinal studies have demonstrated that the damaged adult brain is able to reorganize to compensate for motor deficits. Rather than a complete substitution of function, the main mechanism underlying recovery of motor abilities involves enhanced activity in preexisting networks, including the disconnected motor cortex in subcortical stroke and the infarct rim after cortical stroke. Involvement of nonmotor and contralesional motor areas has been consistently reported, with the emerging notion that the greater the involvement of the ipsilesional motor network, the better is the recovery. This hypothesis is supported by the enhanced activity of the ipsilesional primary motor cortex induced by motor training and acute pharmacological interventions, in parallel with improved motor function. Further longitudinal studies assessing the relationships between such changes and actual recovery, as well as manipulating such changes by rehabilitation or pharmacological maneuvers, should provide further information on these fundamental questions. This review closes with some perspectives for future research.

Cambier Dc, De Corte E, Danneels La, Witvrouw Ee.

Treating sensory impairments in the post-stroke upper limb with intermittent pneumatic compression. Results of a preliminary trial.

Clin Rehabil, 17(1), 14-20 2003.

OBJECTIVE: To evaluate the efficacy of intermittent pneumatic compression (IPC) in treating sensory impairments in the hemiplegic upper limb in stroke patients. **DESIGN:** Twenty-three stroke patients were enrolled in a randomized, controlled preliminary trial that compared the application of intermittent pneumatic compression with a passive treatment strategy. **SETTING:** Four Belgian day centres for treatment of neurological disabilities. Four acute and rehabilitation care wards specialized in neurological treatment. **SUBJECTS:** Twenty-three stroke patients. **INTERVENTIONS:** The experimental group ($n = 11$) received standard physiotherapy combined with intermittent pneumatic compression treatment (10 cycles of 3 minutes with a peak of 40 mmHg) for their hemiplegic upper limb. The control group ($n = 12$) received supplementary to their conventional physiotherapy a placebo treatment, namely sham short-wave therapy on the hemiplegic shoulder for 30 minutes. **MAIN OUTCOME MEASURES:** Sensory impairments were clinically assessed at three occasions over a period of four weeks using the Nottingham Sensory Assessment scale. **RESULTS:** Both groups improved in somatosensation over time, but the experimental group improved more than the control group ($p = 0.036$) or 81.1% improvement versus 30.9%. **CONCLUSIONS:** The use of intermittent pneumatic compression in the rehabilitation of stroke patients may be of clinical importance for the restoration of sensory function.

Cauraugh Jh, Kim Sb.

Chronic stroke motor recovery: duration of active neuromuscular stimulation.

J Neurol Sci, 215(1-2), 13-19 2003.

Active neuromuscular stimulation is an effective behavioral intervention for motor recovery improvements after a stroke. However, the most effective active neuromuscular stimulation durations have not been determined. The present experiment investigated active stimulation durations (0, 5, and 10 s) coupled with bilateral movements on progress toward motor recovery in wrist and finger extension. Twenty-six stroke survivors with chronic hemiparesis were randomly assigned to the stimulation duration groups, and subjects completed 4 days of reha-



bilitation training over a 2-week period. Mixed design analyses of variance on the Box and Block scores, chronometric reaction times, and force modulation of the sustained muscle contraction task revealed distinct motor recovery improvements for both the 5 and 10 s stimulation duration groups in comparison to the 0 s duration control group. Further, the number of blocks moved by the 10-s duration group exceeded those moved by the 5-s duration group. In conclusion, the 5 and 10 s duration active stimulation/bilateral movement groups decreased residual motor dysfunctions that persisted beyond 12 months post stroke.

Chen Cl, Chen Hc, Tang Sf, Wu Cy, Cheng Pt, Hong Wh.

Gait performance with compensatory adaptations in stroke patients with different degrees of motor recovery.

Am J Phys Med Rehabil, 82(12), 925-935 2003.

OBJECTIVE: Gait patterns vary among stroke patients. This study attempted to discover gait performance with compensatory adaptations in stroke patients with different degrees of motor recovery. **DESIGN:** Data were gathered from 35 stroke patients and 15 healthy subjects. Gait performance and motor recovery were assessed 6 mos after stroke. Stroke patients further were divided into poor and good groups. The walking velocity was correlated with Brunnstrom's stages, and the temporal stride and motion variables of the two groups were compared. **RESULTS:** Walking velocity was positively correlated with the Brunnstrom's stages of the proximal lower limb. The poor group displayed slower walking velocity and shorter single-support time compared with the good group. Both groups displayed low maximum excursion of hip extension and ankle plantarflexion during the stance phase and low maximum excursion of hip and knee flexion and ankle dorsiflexion during the swing phase. Moreover, both groups displayed excessive pelvic tilts during the stance and swing phases. However, the poor group displayed different pelvic motion and timing sequences to each peak joint angle from normal subjects and the good group. Peak hip and knee angles of the affected limb during the stance phase occurred almost simultaneously in this group. **CONCLUSIONS:** Selective control of the proximal lower limb may be the main determinant of walking velocity. The compensatory adaptations were similar, except for pelvic motion, in stroke patients with different levels of motor recovery, whereas the poor group walked with synergistic mass patterns and reduced stability.

Craig J, Young Ca, Ennis M, Baker G, Boggild M.

A randomised controlled trial comparing rehabilitation against standard therapy in multiple sclerosis patients receiving intravenous steroid treatment.

J Neurol Neurosurg Psychiatry, 74(9), 1225-1230 2003.

BACKGROUND: There is evidence to support both the use of intravenous methylprednisolone (IVMP) in multiple sclerosis (MS) relapse and physiotherapy in the management of MS, but no studies have investigated the combination of steroids and rehabilitation together. **OBJECTIVES:** To evaluate the benefits of IVMP with planned, comprehensive multidisciplinary team (MDT) care compared to IVMP with standard care. **METHODS:** In this randomised controlled trial, patients confirmed to have had a definite MS relapse severe enough to warrant IVMP (1 g daily for three days) were randomised to two groups. The control group was managed according to the standard ward routine; the treatment group received planned coordinated multidisciplinary team assessment and treatment. Baseline assessments, including demographics and Expanded Disability Status Scale (EDSS) were carried out on both groups. The primary outcome measures were Guy's Neurological Disability Scale (GNDS), and Amended Motor Club Assessment (AMCA). The secondary measures were the Barthel Index (BI), Human Activity Profile (HAP), and Short Form Item 36 Health Survey (SF-36). All measures have published data on reliability and validity. Measures were administered at one and three months. **RESULTS:** Forty subjects, including 27 females, completed data collection. There were no significant differences between the two groups at baseline. Results showed statistically significant differences in GNDS ($p = 0.03$), AMCA ($p = 0.03$), HAPM ($p < 0.01$), HAPA ($p = 0.02$), and BI ($p = 0.02$) at three months in favour of planned MDT care. **CONCLUSION:** This study indicates that combining steroids with planned MDT care is superior to administering them in a standard neurology or day ward setting. Further research is necessary in order to confirm this finding.

Di Lauro A, Pellegrino L, Savastano G, Ferraro C, Fusco M, Balzarano F, et al.

A randomized trial on the efficacy of intensive rehabilitation in the acute phase of ischemic stroke.

J Neurol, 250(10), 1206-1208 2003.

Sixty patients admitted to hospital for hemispherical ischemic stroke causing severe disabilities were enrolled in the study. The patients were divided in two groups: A and B. The patients in group A were given intensive reha-



bilitative treatment; those in group B were given ordinary rehabilitative treatment. Both treatments lasted 14 days. At the end of that period, the patients of both groups were sent to the same rehabilitation center to continue treatment, using the same methods for all. The patients were evaluated by means of the modified N. I. H. Stroke Scale and the Barthel-Index on the day of enrollment, on the 14(th) and 180(th) day. The results obtained from intensive treatment were no better than those obtained from ordinary treatment. This study shows that there is no point in adopting an intensive rehabilitative treatment for an ischemic stroke in its acute phase: a more expensive and time-consuming effort does not in any way lead to a better outcome.

Dietz V.

Spinal cord pattern generators for locomotion.

Clin Neurophysiol, 114(8), 1379-1389 2003.

It is generally accepted that locomotion in mammals, including humans, is based on the activity of neuronal circuits within the spinal cord (the central pattern generator, CPG). Afferent information from the periphery (i.e. the limbs) influences the central pattern and, conversely, the CPG selects appropriate afferent information according to the external requirement. Both the CPG and the reflexes that mediate afferent input to the spinal cord are under the control of the brainstem. There is increasing evidence that in central motor diseases, a defective utilization of afferent input, in combination with secondary compensatory processes, is involved in typical movement disorders, such as spasticity and Parkinson's disease. Recent studies indicate a plastic behavior of the spinal neuronal circuits following a central motor lesion. This has implications for any rehabilitative therapy that should be directed to take advantage of the plasticity of the central nervous system. The significance of this research is in a better understanding of the pathophysiology underlying movement disorders and the consequences for an appropriate treatment.

Duncan P, Studenski S, Richards L, Gollub S, Lai Sm, Reker D, et al.

Randomized clinical trial of therapeutic exercise in subacute stroke.

Stroke, 34(9), 2173-2180 2003.

BACKGROUND AND PURPOSE: Rehabilitation care after stroke is highly variable and increasingly shorter in duration. The effect of therapeutic exercise on impairments and functional limitations after stroke is not clear. The objective of this study was to determine whether a structured, progressive, physiologically based exercise program for subacute stroke produces gains greater than those attributable to spontaneous recovery and usual care. **METHODS:** This randomized, controlled, single-blind clinical trial was conducted in a metropolitan area and 17 participating healthcare institutions. We included persons with stroke who were living in the community. One hundred patients (mean age, 70 years; mean Orpington score, 3.4) consented and were randomized from a screened sample of 582. Ninety-two subjects completed the trial. Intervention was a structured, progressive, physiologically based, therapist-supervised, in-home program of thirty-six 90-minute sessions over 12 weeks targeting flexibility, strength, balance, endurance, and upper-extremity function. Main outcome measures were postintervention strength (ankle and knee isometric peak torque, grip strength), upper- and lower-extremity motor control (Fugl Meyer), balance (Berg and functional reach), endurance (peak aerobic capacity and exercise duration), upper-extremity function (Wolf Motor Function Test), and mobility (timed 10-m walk and 6-minute walk distance). **RESULTS:** In the intention-to-treat multivariate analysis of variance testing the overall effect, the intervention produced greater gains than usual care (Wilk's $\lambda=0.64$, $P=0.0056$). Both intervention and usual care groups improved in strength, balance, upper- and lower-extremity motor control, upper-extremity function, and gait velocity. Gains for the intervention group exceeded those in the usual care group in balance, endurance, peak aerobic capacity, and mobility. Upper-extremity gains exceeded those in the usual care group only in patients with higher baseline function. **CONCLUSIONS:** This structured, progressive program of therapeutic exercise in persons who had completed acute rehabilitation services produced gains in endurance, balance, and mobility beyond those attributable to spontaneous recovery and usual care.

Fang Y, Chen X, Li H, Lin J, Huang R, Zeng J.

A study on additional early physiotherapy after stroke and factors affecting functional recovery.

Clin Rehabil, 17(6), 608-617 2003.

OBJECTIVE: To investigate whether additional early physiotherapy after stroke improved functional recovery in stroke patients. **DESIGN:** A prospective, randomized, controlled study. **SETTING:** One stroke ward and an acute stroke unit in a large teaching hospital, southern China. **SUBJECTS:** Patients with first-onset stroke consecutively admitted to the stroke centre. **INTERVENTIONS:** One group (n = 78) received additional early



physiotherapy (AEP) for 45 minutes, five days a week for four weeks starting within the first week since stroke onset; the routine therapy (RT) group (n = 78) received no professional rehabilitation therapy. MAIN OUTCOME MEASURES: Glasgow Coma Scale, Mini-Mental State Examination, Fugl-Meyer Assessment of Motor Recovery, Clinical Neurological Deficit Scale and Modified Barthel Index (MBI). RESULTS: Patients from the AEP group had a high drop-out rate (n = 28), but those remaining made relatively better functional recovery at 30 days than those from the RT group if measured by MBI. Multiple linear regression analysis revealed that cognitive disturbance, aphasia, double incontinence, site of lesion and sensory impairment might affect functional recovery after stroke. CONCLUSIONS: Additional early physiotherapy might improve independence of patients after stroke but failed to show benefit in other aspects in our study. Cognitive disturbance, aphasia, double incontinence, site of lesion as well as sensory impairment might affect functional outcome after stroke.

Francisco Ge, Boake C.

Improvement in walking speed in poststroke spastic hemiplegia after intrathecal baclofen therapy: a preliminary study.

Arch Phys Med Rehabil, 84(8), 1194-1199 2003.

OBJECTIVE: To explore whether intrathecal baclofen (ITB) therapy improves ambulation in stroke survivors. DESIGN: Case series. SETTING: Tertiary care center. PARTICIPANTS: Ten adults with poststroke hemiparesis who were ambulatory at the time of pump implantation. INTERVENTIONS: Implantation of ITB pump after inadequate control of spasticity with other interventions. Time from stroke onset to implantation averaged 28.6 months (range, 9-55mo). MAIN OUTCOME MEASURES: Customary walking speed was measured from the time required to walk 50ft (15m) at a self-selected pace. Evaluators rated spastic hypertonia and functional mobility. RESULTS: Statistically significant improvements occurred in walking speed, functional mobility ratings, and spasticity ($P < .05$) at a follow-up interval that averaged 8.9 months. Mean walking speed over 50ft improved from 36.6 to 52cm/s. Mean Modified Ashworth Scale scores in the muscles of the affected lower limb improved from 2.0 to 0.4. Normal muscle strength (5/5) was preserved in the unaffected limbs. CONCLUSIONS: This preliminary study suggests that ITB therapy, in combination with physical therapy, may improve walking speed and functional mobility in ambulatory individuals with poststroke spastic hemiplegia.

Garland Sj, Willems Da, Ivanova Td, Miller Kj.

Recovery of standing balance and functional mobility after stroke.

Arch Phys Med Rehabil, 84(12), 1753-1759 2003.

OBJECTIVE: To examine the extent to which recovery of functional balance and mobility is accompanied by change in a few specific physiologic measures of postural control. DESIGN: Longitudinal prospective study. SETTING: Laboratory setting in Ontario. PARTICIPANTS: Twenty-seven volunteers (age, 64.2 \pm 13.7y) undergoing 4 weeks of rehabilitation after stroke participated. At initial testing, patients were 32.7 \pm 18.4 days poststroke and exhibited a moderate level of motor recovery (lower-extremity and postural control, stages 3-4 on the Chedoke-McMaster Stroke Assessment Impairment Inventory). INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Three functional measures (Berg Balance Scale, Clinical Outcome Variables Scale, gait speed) were assessed. Three physiologic measures (electromyographic data of hamstrings and soleus muscles bilaterally, postural sway, arm acceleration) were taken while subjects stood quietly on a force platform and while they performed a rapid shoulder flexion movement of the nonparetic upper extremity. RESULTS: After 1 month of rehabilitation, there was an overall significant improvement in all outcome measures (functional, physiologic). However, 10 patients failed to show any improvement in the electromyographic activation of hamstrings muscle on the paretic side in response to the rapid arm movement. These patients compensated by increasing the anticipatory activation of the nonparetic hamstrings. CONCLUSION: After stroke, patients showed improvement in both physiologic and functional measures of balance and mobility over a 1-month period. We have identified some patients who may be using compensatory strategies to increase function. The factors that may predict those patients who are likely to use compensatory strategies awaits further study.

Gillot Aj, Holder-Walls A, Kurtz Jr, Varley Nc.

Perceptions and experiences of two survivors of stroke who participated in constraint-induced movement therapy home programs.

Am J Occup Ther, 57(2), 168-176 2003.

The purpose of this study was to explore and describe the perceptions and experiences of two survivors of stroke who participated in constraint-induced movement therapy (CIMT) home programs. Data sources were analyzed with a phenomenological approach, and common themes were identified. Themes were translated using the Oc-



cupational Adaptation frame of reference as a template. Three themes were generated from the data: (a) motivational factors and expectations represented personal desires to increase functional ability and environmental demands that created a press to participate in CIMT; (b) neurorehabilitation as an ongoing process suggested that rehabilitation should continue as long as functional deficits exist; and (c) perceived changes in function represented perceived changes in efficiency, effectiveness, and satisfaction after CIMT. CIMT was found to help the participants in this study become more satisfied with performance and to increase efficiency and effectiveness of function in daily activities.

Hartman-Maeir A, Soroker N, Oman Sd, Katz N.

Awareness of disabilities in stroke rehabilitation--a clinical trial.

Disabil Rehabil, 25(1), 35-44 2003.

PURPOSE: To investigate the frequency of unawareness of disabilities after stroke during the rehabilitation stage, the relationship of unawareness with neuroanatomical variables, and the impact of unawareness on functional outcomes. **METHOD:** Sixty consecutive patients (36 with right, 24 with left hemisphere damage) admitted to rehabilitation hospital with a first, single, unilateral stroke were evaluated at admission, discharge and at 1-year post onset of stroke. Unawareness of disabilities was operationally defined as the discrepancy between therapist and patient's rating on the motor scale of the functional independence measure (FIM). Functional outcomes included FIM, instrumental activities of daily living (IADL) scale, activity card sort (ACS) and safety rating scale. **RESULTS:** Unawareness of disabilities was found in 44/60 patients at admission and 24/57 at discharge. There was no significant difference between the hemisphere groups in the frequency of unawareness at both times. Discharge unawareness in the right hemisphere group was significantly associated with lesions in the frontal and temporal lobes, and with lesion size. Unawareness in the left hemisphere damaged group was not associated with any neuroanatomical variables. A negative impact of unawareness at admission on functional outcomes was not found, but it was found that unawareness at discharge was a negative predictor of activity level (ACS score) at follow up, after controlling for the severity of initial disability level. **CONCLUSIONS:** Unawareness of disabilities is a significant issue in stroke rehabilitation. Unawareness that persists to discharge from rehabilitation correlates with neuroanatomical variables in right hemisphere damaged patients, and is a negative predictor for some rehabilitation outcomes at follow-up.

Hendricks Ht, Pasman Jw, Merx JI, Van Limbeek J, Zwarts Mj.

Analysis of recovery processes after stroke by means of transcranial magnetic stimulation.

J Clin Neurophysiol, 20(3), 188-195 2003.

The objective of this study was to use motor evoked potentials (MEPs) to analyze the integrity of fast corticospinal functions as the neurophysiologic basis for motor recovery in stroke patients. This was a cohort study including 44 acute stroke patients with paralysis of the upper or the lower extremity. Motor evoked potentials of the abductor digiti minimi, the biceps brachii, the vastus medialis, and the tibialis anterior were performed within 10 days (mean, 6.9 days; range, 3 to 10 days) and 40 days (mean, 27.8 days; range, 14 to 40 days) after stroke onset. A separate score was defined for proximal and distal motor functions of the upper and lower extremity within the original Fugl-Meyer motor assessment. Motor performance was evaluated simultaneously with the MEP assessments and 26 weeks after stroke. For all the muscles in which a response was present during the first investigation, obvious recovery of the fast corticospinal functions occurred. For the abductor digiti minimi amplitude ratio and the vastus medialis MEP amplitude the differences between the two investigations were significant. An MEP response could be elicited in more cases at the second than on the first MEP assessment. A present MEP response during the first registration indicated nearly always subsequent motor recovery, both for proximal and distal motor functions of the upper and lower extremity. However, motor recovery was also observed in some patients for whom no MEP response could be elicited. Regression analysis showed significant relationships between the abductor digiti minimi ($P = 0.020/0.004$ [t_1/t_2]) and biceps brachii ($P = 0.020/0.004$ [t_1/t_2]) MEP amplitude parameters and the 26-week hand and arm motor scores. No relationship existed between the tibialis anterior and the vastus medialis MEP parameters and the leg motor scores. Motor recovery manifests neurophysiologically often as the recovery of fast corticospinal functions. In many cases, assessment by MEPs is more sensitive than clinical examination to detect residual corticospinal functions, which forms the pathophysiologic basis for the predictive value of MEPs for motor recovery after stroke.

Hochstenbach Jb, Den Otter R, Mulder Tw.

Cognitive recovery after stroke: a 2-year follow-up.

Arch Phys Med Rehabil, 84(10), 1499-1504 2003.



OBJECTIVES: To determine (1) whether long-term improvement of cognitive function takes place after stroke and (2) which clinical factors influence cognitive recovery. **DESIGN:** Cohort study with patients who were assessed at 2.3 and 27.7 months after stroke. **SETTING:** Home-based stroke patients. **PARTICIPANTS:** From a group of 229 stroke patients, 92 were approached to participate. Sixty-five (43 men, 22 women; mean age, 56.4y) agreed, and they were neuropsychologically assessed at 72.2 days after stroke. A group of 33 controls (12 men, 21 women; mean age, 52.4y) was used as a reference sample. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Orientation, memory, attention, visuospatial, visuoconstructive, language, and arithmetic abilities were assessed with an extensive neuropsychologic test battery. **RESULTS:** Significant improvements across time were noted for all cognitive domains. The biggest improvement was found in the attentional domain; the least, in the memory domain. In addition, a small subset of patients accounted for the significant improvement in all cognitive domains; most patients showed no improvement or declined. Factors influencing recovery were side of the stroke and incidence of lowered consciousness on admission. Patients with right-side brain damage performed better than those with left-side brain damage and showed more improvement over time. Patients with lowered consciousness on admission performed worse than patients without lowered consciousness. No significant effect was found for gender, type of stroke, cortical versus subcortical lesions, having 1 stroke or multiple strokes, or the interval between the stroke and the neuropsychologic assessment. **CONCLUSION:** There was room for improvement in all cognitive domains, although this improvement was gained by only a small number of patients. Hence, most patients must cope with serious permanent cognitive decline after stroke.

Hsu Al, Tang Pf, Jan Mh.

Analysis of impairments influencing gait velocity and asymmetry of hemiplegic patients after mild to moderate stroke.

Arch Phys Med Rehabil, 84(8), 1185-1193 2003.

OBJECTIVE: To identify the most important impairments determining gait velocity and asymmetry in patients with mild to moderate stroke. **DESIGN:** Descriptive analysis of convenience sample. **SETTING:** Outpatient rehabilitation clinic of a hospital in Taiwan. **PARTICIPANTS:** Twenty-six subjects with mild to moderate spastic hemiparesis after a single onset of stroke, all able to walk independently without any assistance or device. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Subjects' maximal muscle strength (isokinetic peak torque, total work), motor and sensation function, and ankle plantarflexor spasticity of the affected lower extremity were examined using the Cybex 6000 dynamometry, Fugl-Meyer Assessment, and Modified Ashworth Scale, respectively. Gait velocity, as well as temporal and spatial asymmetry, were evaluated when subjects walked at their comfortable and fast speeds by using the GaitMatII. **RESULTS:** Regression analyses revealed that the total work isokinetic measures of the affected hip flexors and knee extensors were the most important independent determinants of the comfortable and fast gait velocities, respectively ($R(2)=.57$, $R(2)=.72$). Spasticity of the affected plantarflexors was the most important independent determinant of temporal and spatial gait asymmetry during comfortable-speed ($R(2)=.76$ for temporal asymmetry; $R(2)=.46$ for spatial asymmetry) and fast-speed ($R(2)=.75$ for temporal asymmetry; $R(2)=.45$ for spatial asymmetry) walking. **CONCLUSIONS:** Gait velocity and asymmetry of patients with mild to moderate stroke were affected by different physical impairments. Whereas gait velocity was mainly affected by weakness of the affected hip flexors and knee extensors, gait asymmetry was influenced primarily by the degree of the spasticity of the affected ankle plantarflexors. Therapeutic interventions aiming to improve different aspects of gait performance of these patients may emphasize treatment of different impairments.

Hyndman D, Ashburn A.

People with stroke living in the community: Attention deficits, balance, ADL ability and falls. Disabil Rehabil, 25(15), 817-822 2003.

PURPOSE: To describe levels of attention deficits among people with stroke living in the community and explore relationships between attention, balance, function and falls. **METHOD:** Forty-eight mobile community-dwelling people with stroke (30 men, 18 women, mean age 68.4 +/- 11.2) were recruited to this cross-sectional investigation through General Practitioners. Twenty-six participants had a right, 21 a left hemisphere infarction and one had a brain stem lesion; mean time since stroke was 46 months (range five to 204). Participants' were interviewed about fall-events; attention, balance and function were assessed using standardised tests. **RESULTS:** Visual inattention was identified in five participants (10%), deficits of sustained attention in 15 (31%), auditory selective attention in nine (19%), visual selective attention in 17 (35%) and divided attention deficits in 21 participants (43%). Sustained and divided attention scores correlated with balance, ADL ability and fall-status ($p < 0.01$). The balance and function of subjects with normal attention were better than those with abnormal scores (p



< 0.01). Analysis of variance revealed differences between repeat-fallers and non-fallers with no near-falls for divided attention, balance and ADL ability ($p < 0.01$). CONCLUSIONS: Attention deficits were common among this sample; sustained and divided attention deficits correlated with functional impairments and falls, highlighting that attention deficits might contribute to accident prone behaviour and falling.

Jang Sh, Kim Yh, Cho Sh, Lee Jh, Park Jw, Kwon Yh.

Cortical reorganization induced by task-oriented training in chronic hemiplegic stroke patients.

Neuroreport, 14(1), 137-141 2003.

We investigated the effect of task-oriented training (TT) on the cortical activation pattern in four chronic hemiparetic stroke patients. A TT program, consisting of six tasks, which were designed to improve hemiparetic upper extremity function, was performed for 40 min/day, 4 days/week for 4 weeks. The functional status of the affected hand and fMRI were assessed before and after the TT program. fMRI was performed at 1.5 T in parallel with timed finger flexion-extension exercises at a fixed rate. The main cortical activation changes with functional recovery were a decrease in the unaffected and an increase in the affected primary sensorimotor cortex activities. In conclusion, it seems that cortical reorganization was induced by the TT program in chronic hemiparetic stroke patients.

Karnath Ho, Broetz D.

Understanding and treating "pusher syndrome".

Phys Ther, 83(12), 1119-1125 2003.

"Pusher syndrome" is a clinical disorder following left or right brain damage in which patients actively push away from the nonhemiparetic side, leading to a loss of postural balance. The mechanism underlying this disorder and its related anatomy have only recently been identified. Investigation of patients with severe pushing behavior has shown that perception of body posture in relation to gravity is altered. The patients experience their body as oriented "upright" when the body actually is tilted to the side of the brain lesion (to the ipsilesional side). In contrast, patients with pusher syndrome show no disturbed processing of visual and vestibular inputs determining visual vertical. These new insights have allowed the authors to suggest a new physical therapy approach for patients with pusher syndrome where the visual control of vertical upright orientation, which is undisturbed in these patients, is the central element of intervention.

Katz-Leurer M, Shochina M, Carmeli E, Friedlander Y.

The influence of early aerobic training on the functional capacity in patients with cerebrovascular accident at the subacute stage.

Arch Phys Med Rehabil, 84(11), 1609-1614 2003.

OBJECTIVE: To investigate the effect of early aerobic training on the aerobic and functional abilities of patients in the subacute stage of cerebrovascular accident (CVA). DESIGN: Randomized controlled trial. SETTING: Rehabilitation unit in Israel. PARTICIPANTS: Ninety-two patients who had a first CVA were randomly assigned to an exercise-training group or to a control group. INTERVENTION: Aerobic training with a leg cycle ergometer for 8 weeks. MAIN OUTCOME MEASURES: Workload, exercise time, resting and submaximal blood pressure and heart rate, and functional abilities. RESULTS: A trend toward improvement was found in all aerobic parameters for the experimental group, but only heart rate at rest ($P=.02$), workload, and work time ($P<.01$) improved significantly. A trend for improvement was also found in all parameters of function for the experimental group, but only stair climbing was significantly better ($P<.01$). An interaction (95% confidence interval, 1.7-17.21) was found between age and aerobic training on walking distance. Although no significant effect was found in the group of younger patients (aged <65y), a significant difference in favor of training was noted in the group of older patients. CONCLUSIONS: Patients with CVA in the subacute stage improved some of their aerobic and functional abilities after submaximal aerobic training.

Kerkhoff G.

Modulation and rehabilitation of spatial neglect by sensory stimulation.

Prog Brain Res, 142, 257-271 2003.

After unilateral cortical or subcortical, often parieto-temporal lesions, patients exhibit a marked neglect of their contralateral space and/or body side. These patients are severely disabled in all daily activities, have a poor rehabilitation outcome and therefore require professional treatment. Unfortunately, effective treatments for neglect are just in the process of development. The present chapter reviews three aspects related to the rehabilitation of



neglect. The first part summarizes findings about spontaneous recovery in patients and experimental animals with neglect. The second part deals with techniques and studies evaluating short-term sensory modulation effects in neglect. In contrast to many other neurological syndromes spatial neglect may be modulated transiently but dramatically in its severity by sensory (optokinetic, neck proprioceptive, vestibular, attentional, somatosensory-magnetic) stimulation. In part three, current treatment approaches are summarized, with a focus on three novel techniques: repetitive optokinetic stimulation, neck vibration training and peripheral somatosensory-magnetic stimulation. Recent studies of repetitive optokinetic as well as neck vibratory treatment both indicate significantly greater as well as multimodal improvements in neglect symptomatology as compared to the standard treatment of neglect. This clear superiority might result from the partial (re)activation of a distributed, multisensory vestibular network in the lesioned hemisphere. Somatosensory-magnetic stimulation of the neglected or extinguishing hand provides another feasible, non-invasive stimulation technique. It may be particularly suited for the rehabilitation of somatosensory extinction and unawareness of the contralesional body side. Finally, pharmacological approaches for the treatment of neglect are shortly addressed. Isolated drug treatment of neglect is currently no successful rehabilitation strategy due to inconsistent results as well as possible side effects. However, combined behavioural and drug treatments might yield better results. This has to be tested empirically in patient studies. In conclusion, the findings obtained in short-term sensory stimulation studies led to the development of effective techniques for the long-term rehabilitation of neglect. Future rehabilitation studies should evaluate effective treatment combinations considering all possible techniques and devices (behavioural, pharmacological, prosthetic or physiological).

Kim Cm, Eng Jj.

The relationship of lower-extremity muscle torque to locomotor performance in people with stroke.

Phys Ther, 83(1), 49-57 2003.

BACKGROUND AND PURPOSE: Improved walking is a common goal after stroke. The purpose of this study was to examine the relationship between the torque generated by the muscles of both lower extremities and 2 locomotor tasks: gait on level surfaces and stair climbing in people who had strokes. **SUBJECTS:** Twenty community-dwelling individuals (mean age=61.2 years, SD=8.4, range=52-82) who had strokes and who were able to walk independently participated in the study. The mean time since stroke was 4.0 years (SD=2.6, range=1.5-10.0). **METHODS:** Pearson correlations and multiple regression were used to measure the relationship between concentric isokinetic torque of the flexor and extensor muscles of the hip, knee, and ankle bilaterally and locomotor performance (gait on level surfaces and stair-climbing speed). **RESULTS:** The isokinetic torques of the paretic ankle plantar flexors, hip flexors, and knee flexors had moderate to high correlations ($r=.5-.8$) with gait and stair-climbing speeds. Muscle force could explain 66% to 72% of the variability in gait and stair-climbing speeds. Correlations for the nonparetic side were as high as or higher than those for the paretic side for some muscle groups. **DISCUSSION AND CONCLUSION:** Muscle performance measurements of both limbs should be included in the evaluation of locomotion and treatment of people following a stroke.

Krutulyte G, Kimtys A, Krisciunas A.

[The effectiveness of physical therapy methods (Bobath and motor relearning program) in rehabilitation of stroke patients].

Medicina (Kaunas), 39(9), 889-895 2003.

The purpose of this study was to examine whether two different physiotherapy regimes caused any differences in outcome in the rehabilitation after stroke. We examined 240 patients with stroke. Examination was carried out at the Rehabilitation Center of Kaunas Second Clinical Hospital. Patients were divided into 2 groups: Bobath method was applied to the first (I) group (n=147), motor relearning program (MRP) method was applied to the second (II) group (n=93). In every group of patients we established samples according to sex, age, hospitalization to rehab unit as occurrence of CVA degree of disorder (hemiplegia, hemiparesis). The mobility of patients was evaluated according to European Federation for Research in Rehabilitation (EFRR) scale. Activities of daily living were evaluated by Barthel index. Analyzed groups were evaluated before physical therapy. When preliminary analysis was carried out it proved no statically reliable differences between analyzed groups (reliability 95%). The same statistical analysis was carried out after physical therapy. The results of differences between patient groups were compared using chi(2) method. Bobath method was applied working with the first group of patients. The aim of the method is to improve quality of the affected body side's movements in order to keep both sides working as harmoniously as possible. While applying this method at work, physical therapist guides patient's body on key-points, stimulating normal postural reactions, and training normal movement pattern. MRP method was used while working with the second group patients. This method is based on movement science,



biomechanics and training of functional movement. Program is based on idea that movement pattern shouldn't be trained; it must be relearned. **CONCLUSION.** This study indicates that physiotherapy with task-oriented strategies represented by MRP, is preferable to physiotherapy with facilitation/inhibition strategies, such the Bobath programme, in the rehabilitation of stroke patients ($p < 0.05$).

Kwakkel G, Kollen Bj, Van Der Grond J, Prevo Aj.

Probability of regaining dexterity in the flaccid upper limb: impact of severity of paresis and time since onset in acute stroke.

Stroke, 34(9), 2181-2186 2003.

BACKGROUND AND PURPOSE: To improve the accuracy of early postonset prediction of motor recovery in the flaccid hemiplegic arm, the effects of change in motor function over time on the accuracy of prediction were evaluated, and a prediction model for the probability of regaining dexterity at 6 months was developed. **METHODS:** In 102 stroke patients, dexterity and paresis were measured with the Action Research Arm Test, Motricity Index, and Fugl-Meyer motor evaluation. For model development, 23 candidate determinants were selected. Logistic regression analysis was used for prognostic factors and model development. **RESULTS:** At 6 months, some dexterity in the paretic arm was found in 38%, and complete functional recovery was seen in 11.6% of the patients. Total anterior circulation infarcts, right hemisphere strokes, homonymous hemianopia, visual gaze deficit, visual inattention, and paresis were statistically significant related to a poor arm function. Motricity Index leg scores of at least 25 points in the first week and Fugl-Meyer arm scores of 11 points in the second week increasing to 19 points in the fourth week raised the probability of developing some dexterity (Action Research Arm Test ≥ 10 points) from 74% (positive predictive value [PPV], 0.74; 95% confidence interval [CI], 0.63 to 0.86) to 94% (PPV, 0.83; 95% CI, 0.76 to 0.91) at 6 months. No change in probabilities of prediction dexterity was found after 4 weeks. **CONCLUSIONS:** Based on the Fugl-Meyer scores of the flaccid arm, optimal prediction of arm function outcome at 6 months can be made within 4 weeks after onset. Lack of voluntary motor control of the leg in the first week with no emergence of arm synergies at 4 weeks is associated with poor outcome at 6 months.

Lackner E, Hummelsheim H.

Motor-evoked potentials are facilitated during perceptual identification of hand position in healthy subjects and stroke patients.

Clin Rehabil, 17(6), 648-655 2003.

OBJECTIVE: To delineate the facilitatory and/or inhibitory influence of relevant and irrelevant sensory afferent information to the motor cortex. The study is based on the assumption that sensorimotor coupling is crucial for motor learning and recovery. **DESIGN:** The interaction of a standard transcranial magnetic stimulus (TMS) with the facilitatory and/or inhibitory influence that proprioceptive afferent information exerts on the motor cortex was investigated. **SETTING:** A neurological rehabilitation hospital. **SUBJECTS:** Sixteen healthy subjects and 14 stroke patients. **MAIN OUTCOME MEASURES:** Amplitudes and latencies of motor-evoked potentials (MEPs) recorded from the extensor carpi radialis muscle. The influence of a sensory discrimination task was compared with the influence of a sensory input irrelevant for the task and to a verbal memory task. Recordings were taken after the hand had been moved passively in one of four different positions. **RESULTS:** In the first trial, TMS was applied without any demand on the subjects. In the second trial, subjects were asked to identify the respective hand position and in the third trial a noun presented at a respective hand position had to be memorized and reproduced after TMS. The sensory discrimination task exerted by far the most prominent facilitatory effect on MEP amplitudes and latencies. An unspecific, albeit reproducible influence on MEP amplitudes was observed when a noun presented at a respective hand position had to be remembered. **CONCLUSIONS:** Using a neurophysiological approach the study demonstrates that a sensory discrimination task based on relevant afferent information to motor centres of the brain forms a prominent facilitatory intervention for those muscle groups that are involved in the task. This holds true for healthy subjects and for hemiparetic stroke patients.

Lamb Se, Ferrucci L, Volapto S, Fried Lp, Guralnik Jm.

Risk factors for falling in home-dwelling older women with stroke: the Women's Health and Aging Study.

Stroke, 34(2), 494-501 2003.

BACKGROUND AND PURPOSE: Much of our knowledge of risk factors for falls comes from studies of the general population. The aim of this study was to estimate the risk of falling associated with commonly accepted and stroke-specific factors in a home-dwelling stroke population. **METHODS:** This study included an analysis of



prospective fall reports in 124 women with confirmed stroke over 1 year. Variables relating to physical and mental health, history of falls, stroke symptoms, self-reported difficulties in activities of daily living, and physical performance tests were collected during home assessments. **RESULTS:** Risk factors for falling commonly reported in the general population, including performance tests of balance, incontinence, previous falls, and sedative/hypnotic medications, did not predict falls in multivariate analyses. Frequent balance problems while dressing were the strongest risk factor for falls (odds ratio, 7.0). Residual balance, dizziness, or spinning stroke symptoms were also a strong risk factor for falling (odds ratio, 5.2). Residual motor symptoms were not associated with an increased risk of falling. **CONCLUSIONS:** Interventions to reduce the frequency of balance problems during complex tasks may play a significant role in reducing falls in stroke. Clinicians should be aware of the increased risk of falling in women with residual balance, dizziness, or spinning stroke symptoms and recognize that risk assessments developed for use in the general population may not be appropriate for stroke patients.

Langhammer B, Stanghelle Jk.

Bobath or motor relearning programme? A follow-up one and four years post stroke.

Clin Rehabil, 17(7), 731-734 2003.

OBJECTIVE: The purpose of this follow-up one and four years post stroke was to find out whether the initial physiotherapy approach had had any long-term effects on mortality, motor function, postural control, activities of daily living, life quality, follow-up from community services and living conditions. **DESIGN:** A randomized controlled trial of first time ever stroke patients. Group 1 (n = 33) and group 2 (n = 28) had initial physiotherapy according to the Motor Relearning Programme and Bobath, respectively. **MAIN OUTCOME MEASURES:** The Motor Assessment Scale (MAS), the Sodrting Motor Evaluation Scale (SMES), the Barthel ADL Index, the Nottingham Health Profile (NHP) and Berg Balance Scale were used. The following parameters were also registered: incidence of new strokes, other diseases, use of assistive devices, the patient's accommodation and use of services from the community. **RESULTS:** The mortality rates were similar in the two groups. In both groups the motor function, postural control and ADL had decreased rapidly, leaving many of the patients dependent and with a high risk of falling. Life quality had increased compared to the acute stage, but was still low in comparison with healthy persons. Patients in both groups lived at home, but were dependent on help from relatives and community services. Physiotherapy as follow-up service was seldom used. The initial physiotherapy approach did not seem to have a major influence on the patients' ability to cope in the long-term. **CONCLUSION:** This follow-up at one and four years post stroke showed no major influence of two different initial physiotherapy regimens on long-term function. The study confirmed a rapid deterioration of ADL and motor function and an increased dependence on relatives. The study reveals a gap between the intense treatment in the acute phase and little or no follow-up of physiotherapy treatment or other rehabilitation activities later.

Lannin Na, Herbert Rd.

Is hand splinting effective for adults following stroke? A systematic review and methodologic critique of published research.

Clin Rehabil, 17(8), 807-816 2003.

BACKGROUND: Upper limb hemiplegia after stroke is common and disabling. Hand splints are widely used to prevent contracture and reduce spasticity. **OBJECTIVE:** To assess the effectiveness of hand splinting on the hemiplegic upper extremity following stroke. **SEARCH STRATEGY:** A search was conducted of the Cochrane Central Register of Controlled Trials; the electronic databases MEDLINE, EMBASE, CINAHL, PEDro, SCI, SSCI; websites of professional associations; reference lists in trial reports and other relevant articles. **SELECTION CRITERIA:** Studies of the effect of upper extremity splinting on motor control, functional abilities, contracture, spasticity, or pain in the hand or wrist. **DATA COLLECTION AND ANALYSIS:** Validity of studies was assessed systematically and a content analysis was conducted of the methodologies used. Methodological quality of randomized trials was rated by two independent assessors using the PEDro scale. **RESULTS:** Nineteen studies were appraised for content. Of these, most (63%) were reports of case series. Four studies (21%) were randomized controlled trials. Methodological scores of trials ranged from 2 to 8 (maximum possible score 10). One trial of nominally 'medium' quality reported that inflatable arm splinting makes no difference to hand function (mean difference on Fugl-Meyer Assessment -0.12, 95% confidence interval (CI) -9.8 to 9.6). The remaining trials investigated effects of thermoplastic splints; one trial of 'high quality' reported no difference in contracture formation in the wrist and finger flexor muscles after wearing a hand splint which positioned the wrist in the traditional functional position for 12 hours each night for four weeks (mean difference in range of movement after four weeks was 1 degree, 95% CI -3.7 degrees to 6.1 degrees; power >80%). All remaining trials were of poor methodological quality. Limited research and lack of a no-splint control group in all trials to date limit the



usefulness of these results. REVIEWER'S CONCLUSION: There is insufficient evidence to either support or refute the effectiveness of hand splinting for adults following stroke.

Laufer Y.

The effect of walking aids on balance and weight-bearing patterns of patients with hemiparesis in various stance positions.

Phys Ther, 83(2), 112-122 2003.

BACKGROUND AND PURPOSE: Standard and quad canes are often prescribed to patients with hemiparesis, yet their effect on postural control remains unclear. Thus, the objective of this study was to examine the effects of standard and quad canes on postural sway and on weight-bearing patterns in patients with hemiparesis. **SUBJECTS:** Thirty subjects with a diagnosis of unilateral hemiparesis following a stroke (patient group; mean age=71.2 years, SD=7.0) and 20 age-matched, community-dwelling volunteers without hemiparesis (comparison group; mean age=72.1 years, SD=5.2) participated in the study. **METHODS:** Postural sway and percentage of body weight (%BW) borne by each extremity were measured in 3 positions: with the heels aligned with each other (aligned position) and in staggered foot positions with either the affected or unaffected extremity placed forward (affected FW and unaffected FW positions). All subjects were tested in each position with no cane, a standard cane, and a quad cane. The order of tests was randomized, and analysis of data included use of an analysis of variance and adjusted Tukey-Kramer tests. **RESULTS:** In both the aligned and unaffected FW positions, postural sway was reduced only with the quad cane. Both types of canes reduced postural sway in the affected FW position; however, the quad cane had a greater effect. An asymmetrical weight distribution between the lower extremities did not change in the patient group across positions, even with walking aids. **DISCUSSION AND CONCLUSION:** A quad cane appears to be more effective than a standard cane in decreasing postural sway in patients with moderate impairment secondary to hemiparesis during stance. The greatest effect on postural sway occurred when the assistive device was contralateral to the foot placed forward. The use of a cane does not appear to adversely affect the asymmetrical weight-bearing pattern during stance that is characteristic of patients with hemiparesis, even when balance is challenged by decreasing the base of support.

Laufer Y, Sivan D, Schwarzmann R, Sprecher E.

Standing balance and functional recovery of patients with right and left hemiparesis in the early stages of rehabilitation.

Neurorehabil Neural Repair, 17(4), 207-213 2003.

The objective was to determine the effects of the side of brain lesion on recovery of functional abilities and balance control among subjects 2 months following a stroke. There were 104 patients admitted consecutively to a geriatric rehabilitation center following their first stroke to the anterior brain circulation who were followed for 2 months. Fifteen age-matched individuals with no known impairments served as the control group. Functional ability was assessed with the Barthel Index and the Functional Ambulation Category. Posturographic testing was used to determine total sway and symmetry of weight distribution with eyes open and closed. Tests were performed 1 and 2 months poststroke. The results show that lesion side affects the recovery of independent stance 2 months following a stroke, with more patients with right hemiparesis able to reach this milestone. However, no difference was found in functional ability and balance control between patients with left and right hemiparesis who are able to stand independently by 1 month poststroke. Function and mobility improve during the 2nd month of rehabilitation ($P = 0.001$), but stance unsteadiness and asymmetry do not. The side of brain lesion seems to affect recovery of independent stance with an advantage to patients with right hemiparesis. However, there is no difference between balance control of individuals with left versus right hemiparesis in patients who reach independent stance by the end of the 1st month following their stroke.

Lennon S.

Physiotherapy practice in stroke rehabilitation: a survey.

Disabil Rehabil, 25(9), 455-461 2003.

OBJECTIVE: This survey aimed to provide an expert consensus view of the theoretical beliefs underlying physiotherapy practice in stroke rehabilitation the United Kingdom. **METHOD:** Questionnaires (with sections related to: therapist background, physiotherapy management, theoretical beliefs and gait re-education strategies used) were posted to all senior level physiotherapists working in stroke care ($n=1022$). **RESULTS:** The majority of respondents had more than 10 years experience overall, and at least 5 years experience in stroke care. The Bobath concept was the preferred approach ($n=67\%$) followed by an 'eclectic' approach ($n=31\%$). This survey identified four theoretical themes underlying current practice in neurological physiotherapy: the promotion of



normal movement, the control of tone, the promotion of function, and the recovery of movement with optimization of compensation. **CONCLUSIONS:** A consensus was obtained on 16 theoretical beliefs; however the evidence base underlying these beliefs remains sparse. Many of these beliefs require further debate within the physiotherapy profession such as the amount of time spent on preparation for function, the automatic translation of movement into function, carry over outside therapy, and the way in which tasks should be practised.

Lin Lc, Wang Sc, Chen Sh, Wang Tg, Chen My, Wu Sc.

Efficacy of swallowing training for residents following stroke.

J Adv Nurs, 44(5), 469-478 2003.

BACKGROUND: The presence of dysphagia is associated with an increased risk of mortality, malnutrition, dehydration, compromised pulmonary function, and disability. Appropriate swallowing training can establish optimal nutritional status and eliminate or reduce the risk of developing medical complications associated with swallowing impairment. **AIM(S) OF THE STUDY:** The aim of this study was to examine the functional swallowing and nutritional outcomes of swallowing training in institutionalized stroke residents with dysphagia. **DESIGN AND METHODS:** A quasi-experimental parallel cluster design was used. Seven institutions with similar bed sizes were selected. All subjects in the experimental group received a structured swallowing training programme. The subjects in the experimental group (n = 40) received 30 minutes of swallowing training each day for 6 days per week for 8 weeks. The control group (n = 21) did not receive any training. **RESULTS:** After swallowing training, mean differences in volume per second, volume per swallow, mid-arm circumference and body weight between pre- and post-training of the experimental group were significantly higher than for the control group, while mean differences in neurological examination and choking frequency during meals for the experimental group were significantly lower than in the control group. **CONCLUSION:** This study used objective timed swallowing tests, a swallowing questionnaire, and a neurological examination to evaluate the effects of swallowing training. However, videofluoroscopy is generally considered the best method for evaluating the pharyngeal and esophageal stages of swallowing, and introducing this technique is recommended for future studies. Furthermore, it is recommended that nursing professionals should conduct swallowing training protocols in stroke patients to help prevent aspiration from dysphagia.

Lo Sf, Chen Sy, Lin Hc, Jim Yf, Meng Nh, Kao Mj.

Arthrographic and clinical findings in patients with hemiplegic shoulder pain.

Arch Phys Med Rehabil, 84(12), 1786-1791 2003.

OBJECTIVES: To identify the etiology of hemiplegic shoulder pain by arthrographic and clinical examinations and to determine the correlation between arthrographic measurements and clinical findings in patients with hemiplegic shoulder pain. **DESIGN:** Case series. **SETTING:** Medical center of a 1582-bed teaching institution in Taiwan. **PARTICIPANTS:** Thirty-two consecutive patients with hemiplegic shoulder pain within a 1-year period after first stroke were recruited. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURES:** Clinical examinations included Brunnstrom stage, muscle spasticity distribution, presence or absence of subluxation and shoulder-hand syndrome, and passive range of motion (PROM) of the shoulder joint. Arthrographic measurements included shoulder joint volume and capsular morphology. **RESULTS:** Most patients had onset of hemiplegic shoulder pain less than 2 months after stroke. Adhesive capsulitis was the main cause of shoulder pain, with 50% of patients having adhesive capsulitis, 44% having shoulder subluxation, 22% having rotator cuff tears, and 16% having shoulder-hand syndrome. Patients with adhesive capsulitis showed significant restriction of passive shoulder external rotation and abduction and a higher incidence of shoulder-hand syndrome (P=.017). Those with irregular capsular margins had significantly longer shoulder pain duration and more restricted passive shoulder flexion (P=.017) and abduction (P=.020). Patients with shoulder subluxation had significantly larger PROM (flexion, P=.007; external rotation, P<.001; abduction, P=.001; internal rotation, P=.027), lower muscle tone (P=.001), and lower Brunnstrom stages of the proximal upper extremity (P=.025) and of the distal upper extremity (P=.001). Muscle spasticity of the upper extremity was slightly negatively correlated with shoulder PROM. Shoulder joint volume was moderately positively correlated with shoulder PROM. **CONCLUSIONS:** After investigating the hemiplegic shoulder joint through clinical and arthrographic examinations, we found that the causes of hemiplegic shoulder pain are complicated. Adhesive capsulitis was the leading cause of shoulder pain, followed by shoulder subluxation. Greater PROM of the shoulder joint, associated with larger joint volume, decreased the occurrence of adhesive capsulitis. Proper physical therapy and cautious handling of stroke patients to preserve shoulder mobility and function during early rehabilitation are important for a good outcome.



Lum Ps, Burgar Cg, Shor Pc.

Evidence for strength imbalances as a significant contributor to abnormal synergies in hemiparetic subjects.

Muscle Nerve, 27(2), 211-221 2003.

Abnormal synergies in the paretic shoulder and elbow of hemiparetic subjects were quantified during maximal voluntary contractions (MVCs) in 27 subjects with a history of stroke and 8 age-matched control subjects. A six-axis load cell allowed simultaneous measurement of the primary torque the subject was attempting to maximize and the secondary torques at other joint actions. For example, during MVC of shoulder flexion, shoulder flexion is the primary torque and the secondary torques are internal/external rotation, abduction/adduction, and elbow flexion/extension. In general, the stroke subjects had increased secondary torques compared to controls, resulting in abnormal joint torque coupling within the set consisting of elbow flexion, internal rotation, adduction, shoulder flexion. Unlike previous studies, abnormal secondary torques in several cases were due to strength imbalances, which occur when the strength deficit for a particular joint action is greater than the strength deficit in the opposite joint action. This hypothesis was supported by electromyographic recordings and by the finding that subjects with larger strength imbalances tended to produce larger secondary torques. Possible mechanisms and consequences for rehabilitative treatments are discussed.

Maravita A, Mcneil J, Malhotra P, Greenwood R, Husain M, Driver J.

Prism adaptation can improve contralesional tactile perception in neglect.

Neurology, 60(11), 1829-1831 2003.

The authors show that prismatic adaptation can reduce tactile inattention in stroke patients with unilateral neglect. Four patients with visuospatial neglect and tactile extinction underwent 10-minute application of 20 degrees right-shifting prismatic lenses during pointing. This improved contralesional tactile perception in all patients, even for a task requiring no exploration or spatial motor responses. This finding suggests a potential role for prismatic adaptation in the rehabilitation of multiple sensory modalities in patients with neglect.

Mark Vw.

Acute versus chronic functional aspects of unilateral spatial neglect.

Front Biosci, 8, e172-189 2003.

This article reviews the impact of unilateral spatial neglect on daily living ("functional") activities. Its disturbances on basic functional activities, such as feeding, grooming, and locomotion, are easily identifiable. Patients with neglect frequently lack insight into their disorder and do not initiate compensatory behaviors, which probably impedes recovery. Simple standard tests of neglect during visual exploration correlate with impaired recovery of functional skills acutely following brain injury. However, unilateral neglect resolves in most individuals, yet many patients remain chronically impaired during daily living activities. This suggests that some other disorder associated with neglect may contribute to the failure to regain functional independence. A candidate disorder is general (non-spatial) inattention. However, cognitive studies in stroke are biased toward assessing neglect and are usually insensitive to other disorders that may accompany stroke, such as general inattention and executive dysfunction. Therefore, the contribution of unilateral neglect toward functional status relative to diverse other cognitive disorders after stroke is unclear. Treatments for unilateral neglect have been largely unsuccessful or impractical, or they were not evaluated in controlled studies. Intensive practice of scanning appears to benefit, but this observation needs to be replicated in a controlled manner. A recently developed treatment that involves wearing prisms to shift the view ipsilaterally has been associated with transfer of training effects to untreated spatial activities and prolonged improvement of neglect. However, despite some promising lines of investigation in neglect rehabilitation, further research is required to understand where neglect stands in relation to other cognitive disturbances that follow stroke with respect to functional significance and recovery, to decide what disorders should be targeted for rehabilitation.

Matteis M, Vernieri F, Troisi E, Pasqualetti P, Tibuzzi F, Caltagirone C, et al.

Early cerebral hemodynamic changes during passive movements and motor recovery after stroke.

J Neurol, 250(7), 810-817 2003.

Recovery from hemiplegia is a complex phenomenon that depends on various adaptive processes involving both the affected and the unaffected hemisphere. Our aim in this study was to investigate changes in cerebral perfusion in hemiplegic stroke patients during passive movements and their correlation with the subsequent motor recovery. The study included 30 patients with single, subcortical ischemic cerebral lesions. Within 14 days



(range 8 to 14 days) from stroke onset, all patients were examined for the effects of passive elbow movements on cerebral blood flow in the middle cerebral arteries (MCAs) by means of bilateral transcranial Doppler (TCD) ultrasonography. On the same day as TCD assessment, they were also evaluated clinically with the Canadian Neurological Scale (CNS) and with Medical Research Council (MRC) scale for motor deficit of the affected arm. A clinical evaluation using the same scales was repeated after two months of motor rehabilitation therapy. We investigated the relationship between changes of Mean Flow Velocity (MFV) during passive movements and degree of recovery after stroke. The logistic regression procedure indicated that out of all factors considered as possibly related to a good clinical motor deficit recovery of the affected arm, evaluated by means of MRC, only the MFV percentage increase played a predictive role. In particular, for each additional point of contralateral MFV percentage increase during passive movement of the affected arm, the relative probability of good clinical recovery increased 5.68 times (95% CI=1.76-18.40; $p=0.004$). Similar results were found when the clinical recovery was measured by means of the CNS (slope=0.40, $p<0.001$). Passive movements in hemiplegic stroke patients before clinical recovery elicit activation patterns that may be critical for the restoration of motor function. In particular, early and consistent activation of the affected hemisphere, as detected with TCD, seems to predict the positive evolution of a motor deficit.

Mcginley JI, Goldie Pa, Greenwood Km, Olney Sj.

Accuracy and reliability of observational gait analysis data: judgments of push-off in gait after stroke.

Phys Ther, 83(2), 146-160 2003.

BACKGROUND AND PURPOSE: Physical therapists routinely observe gait in clinical practice. The purpose of this study was to determine the accuracy and reliability of observational assessments of push-off in gait after stroke. **SUBJECTS:** Eighteen physical therapists and 11 subjects with hemiplegia following a stroke participated in the study. **METHODS:** Measurements of ankle power generation were obtained from subjects following stroke using a gait analysis system. Concurrent videotaped gait performances were observed by the physical therapists on 2 occasions. Ankle power generation at push-off was scored as either normal or abnormal using two 11-point rating scales. These observational ratings were correlated with the measurements of peak ankle power generation. **RESULTS:** A high correlation was obtained between the observational ratings and the measurements of ankle power generation (mean Pearson $r=.84$). Interobserver reliability was moderately high (mean intraclass correlation coefficient [ICC (2,1)]=.76). Intraobserver reliability also was high, with a mean ICC (2,1) of .89 obtained. **DISCUSSION AND CONCLUSION:** Physical therapists were able to make accurate and reliable judgments of push-off in videotaped gait of subjects following stroke using observational assessment. Further research is indicated to explore the accuracy and reliability of data obtained with observational gait analysis as it occurs in clinical practice.

Meek C, Pollock A, Potter J, Langhorne P.

A systematic review of exercise trials post stroke.

Clin Rehabil, 17(1), 6-13 2003.

OBJECTIVE: To perform a systematic review of exercise trials post stroke. **DESIGN:** A systematic review of controlled clinical trials. **SEARCH STRATEGY:** MEDLINE, EMBASE, CINAHL, Amed, Sports Discus, Cochran controlled trials register and PEDro were searched for relevant trials. **INCLUSION CRITERIA:** Studies--randomized or quasi-randomized controlled clinical trials. Participants--Adults of any age with a clinical diagnosis of stroke. Interventions--Any cardiovascular exercise intervention aimed at improving cardiovascular fitness and/or function. **OUTCOMES:** Impairment: gait speed, strength, endurance, balance, flexibility, tonus and exercise capacity. Disability: global dependency, functional independence. Extended activities of daily living. Quality of life. Death. **DATA COLLECTION AND ANALYSIS:** Two independent reviewers categorized selected trials, documented the methodological quality and extracted the relevant data. Comparisons of cardiovascular exercise interventions versus no cardiovascular intervention were made. Statistical comparisons were carried out using a random effects model to calculate standardized mean differences. **RESULTS:** We identified three eligible trials. Small numbers and heterogeneous outcomes limited the analyses and comparisons. Based on the limited data available, we found that cardiovascular exercise post stroke was no better than no exercise with respect to disability, impairment, extended activities of daily living, quality of life and death. **CONCLUSION:** Insufficient evidence was identified to establish if cardiovascular exercise has a positive effect on disability, impairment, extended activities of daily living, quality of life and case fatality post stroke.



Michel C, Pisella L, Halligan Pw, Luauté J, Rode G, Boisson D, et al.

Simulating unilateral neglect in normals using prism adaptation: implications for theory.

Neuropsychologia, 41(1), 25-39 2003.

Rightward deviation on line bisection is considered one of the most classic clinical signs of unilateral visual neglect--a cognitive disorder of spatial processing that commonly follows right brain damage. Recently, short-term adaptation to wedge prisms has been shown to significantly reduce neglect on this and other conventional diagnostic tasks. Our previous study has shown that visuomotor adaptation in normals produces a similar pattern of directional bias on a line bisection task. Based on the good working knowledge of how neglect patients perform on different versions of the standard diagnostic task, we showed here that using leftward-deviating prisms in normals, it is possible to produce: (1) a reliable bias on line bisection, (2) a rightward specific deviation, (3) a modulation of rightward deviation, which depends on the relative spatial location of the target lines and (4) a line length effect. A final experiment confirmed that these after-effects are specific to prism adaptation rather than passive prism exposure. Collectively, these findings confirm that adaptation to left-deviating prisms in normals produces a reliable right-sided bias and as shown by a previous visuospatial judgement task, these findings cannot be adequately explained by the symmetric sensori-motor effects of prism adaptation. Taken together with the improvement of spatial neglect shown by right-deviating prisms only, the present study suggests that low level sensori-motor adaptations play a greater role in right hemisphere organisation for spatial cognition than previously thought.

Miyai I, Yagura H, Hatakenaka M, Oda I, Konishi I, Kubota K.

Longitudinal optical imaging study for locomotor recovery after stroke.

Stroke, 34(12), 2866-2870 2003.

BACKGROUND AND PURPOSE: We sought to investigate cerebral mechanisms underlying locomotor recovery after stroke. **METHODS:** We measured cortical activities during hemiparetic gait on the treadmill before and after 2 months of inpatient rehabilitation in 8 patients with initial stroke (5 men, 3 women; 4 with right and 4 with left hemiparesis; aged 57 years; 3 months after stroke on average), using an optical imaging system. **RESULTS:** On the initial evaluation, hemiparetic gait was associated with increased oxygenated hemoglobin levels in the medial primary sensorimotor cortex (SMC) that were greater in the unaffected hemisphere than in the affected hemisphere as well as in the premotor cortex (PMC) and supplementary motor area. On the second examination, the asymmetry in SMC activation significantly improved, and there was enhanced PMC activation in the affected hemisphere. Improvement of the asymmetrical SMC activation significantly correlated with improvement of gait parameters. **CONCLUSIONS:** Locomotor recovery after stroke may be associated with improvement of asymmetry in SMC activation and enhanced PMC activation in the affected hemisphere.

Moreland Jd, Goldsmith Ch, Huijbregts Mp, Anderson Re, Prentice Dm, Brunton Kb, et al.

Progressive resistance strengthening exercises after stroke: a single-blind randomized controlled trial.

Arch Phys Med Rehabil, 84(10), 1433-1440 2003.

OBJECTIVE: To determine the effectiveness of progressive resistance strengthening exercises to improve gross motor function and walking in patients receiving intensive rehabilitation after stroke. **DESIGN:** Randomized controlled trial. **SETTING:** Five inpatient rehabilitation programs affiliated with teaching hospitals. **PARTICIPANTS:** Inclusion criteria included less than 6 months poststroke and recovery of the leg stages 3 to 5 on the Chedoke-McMaster Stroke Assessment (CMSA). **INTERVENTIONS:** Both groups received conventional physical therapy programs. In addition, the experimental group performed 9 lower-extremity progressive resistance exercises 3 times a week for the duration of their stay, whereas the control group did the same exercises and for the same duration but without resistance. **MAIN OUTCOME MEASURES:** The Disability Inventory of the CMSA and the 2-minute walk test (2MWT) at baseline, 4 weeks, discharge, and 6 months after discharge. **RESULTS:** Over the length of stay, the rate of change in the Disability Inventory was .27 points per day in the experimental group and .29 points per day in the control group; the between-group difference was -.02 points per day (95% confidence interval [CI], -.10 to .06; P=.62). At discharge, the rate of change in the 2MWT was -.01 m in the experimental group and .15m in the control group; the between-group difference was -.16 m (95% CI, -.37 to .05; P=.14). **CONCLUSIONS:** Progressive resistance strengthening exercises as applied in our study were not effective when compared with the same exercises given without resistance.



Nudo Rj.

Adaptive plasticity in motor cortex: implications for rehabilitation after brain injury.

J Rehabil Med(41 Suppl), 7-10 2003.

It is now widely recognized that the cerebral cortex of adult human and non-human mammals is capable of widespread functional and structural plasticity. During the learning of new skills, cortical regions associated with sensorimotor function of the body parts most utilized for the skilled task come to be represented over larger cortical territories. More recent studies have shown that functional and structural changes take place in the cerebral cortex after injury, such as occurs after stroke or trauma. These two modulators of cortical function, sensorimotor learning and cortical injury, interact. Thus, after cortical injury, the structure and function of undamaged parts of the brain are remodeled during recovery, shaped by the sensorimotor experiences of the individual in the weeks to months following injury. These recent neuroscientific findings suggest that new rehabilitative interventions, both physiotherapeutic and pharmacotherapeutic, may have benefit via modulation of neuroplastic mechanisms.

Paci M.

Physiotherapy based on the Bobath concept for adults with post-stroke hemiplegia: a review of effectiveness studies.

J Rehabil Med, 35(1), 2-7 2003.

The Bobath concept, also known as neurodevelopmental treatment, is a widely used approach in the rehabilitation of hemiparetic subjects in many countries. Despite 50 years of clinical use its effectiveness is questionable. This paper aims to examine whether there is evidence to accept neurodevelopmental treatment as an effective approach. A systematic literature search was undertaken. Fifteen trials have been selected and classified according to a 5-level hierarchic scale of evidence for clinical interventions. Results show no evidence proving the effectiveness of neurodevelopmental treatment or supporting neurodevelopmental treatment as the optimal type of treatment, but neither do methodological limitations allow for conclusions of non-efficacy. Methodological aspects of selected studies are discussed and requirements for further research are suggested.

Page Sj.

Intensity versus task-specificity after stroke: how important is intensity?

Am J Phys Med Rehabil, 82(9), 730-732 2003.

Recent evidence suggests that intense training regimens can increase the use and function of the more affected limbs of stroke patients. The efficacy of these intense regimens has led some to conclude that intense training regimens should be more widely applied clinically and has caused some physicians to attempt implementation of more intense training regimens with stroke patients. However, intense protocols may not be needed to produce positive motor changes in some patients and may not be plausible in some environments or with some patients. In this commentary, we review the evidence supporting the efficacy of less intense, task-specific training regimens emphasizing the use of the more affected limb. We submit that intensity does not need to be altered to induce substantial clinical improvements, as some have suggested. Rather, the results of the studies suggest that the nature of stroke motor therapy itself can be altered to be more task-specific while remaining within the typical contact time parameters (i.e., 30-45 min/session), yet can be more efficacious than more traditional motor rehabilitative approaches.

Page Sj, Elovic E, Levine P, Sisto Sa.

Modified constraint-induced therapy and botulinum toxin A: a promising combination.

Am J Phys Med Rehabil, 82(1), 76-80 2003.

Modified constraint-induced therapy and chemodenervation with botulinum toxin A are each efficacious in managing stroke-induced motor disorders; however, the application of these two promising modalities in combination is yet to be examined. This case study describes a 44-yr-old man who experienced a right middle cerebral artery infarct 14 mo before participating in modified constraint-induced therapy. After modified constraint-induced therapy completion, the patient exhibited substantial improvement in affected upper limb use and function but retained difficulty with finger extension secondary to hypertonicity and spasticity in the forearm flexor muscles. Selective chemodenervation of these muscles with botulinum toxin A greatly improved the patient's self-reported hand function and his scores using objective measures. The authors of this paper present this case to raise the idea of increasing treatment efficacy by combining these two modalities.



Pandyan Ad, Price Ci, Barnes Mp, Johnson Gr.

A biomechanical investigation into the validity of the modified Ashworth Scale as a measure of elbow spasticity.

Clin Rehabil, 17(3), 290-293 2003.

OBJECTIVE: To investigate the criterion validity of the modified Ashworth Scale. **POPULATION:** Volunteers from a stroke population admitted to a district general hospital stroke unit diagnosed with a first ever stroke less than 26 weeks previously. **OUTCOME MEASURES:** Resistance to passive movement about the elbow was simultaneously quantified (biomechanically) and graded (modified Ashworth Scale). Passive range of movement and peak instantaneous velocity during passive movement were also measured. **ANALYSIS:** Criterion validity was investigated as convergent construct validity (using the Spearman's correlation coefficient) and concurrent validity (using analysis of variance). **RESULTS:** One hundred measurements were taken on 63 subjects. Correlation between the modified Ashworth Scale and resistance to passive movement was 0.511. Resistance to passive movement and velocity showed significant differences between the modified Ashworth score of '0' and a modified Ashworth score greater than '0' ($p < 0.01$). There were no significant differences between MAS '1', '1+' and '2'. Resistance to passive movement in the impaired arm was significantly higher than in the nonimpaired arm ($p < 0.01$). **CONCLUSION:** The modified Ashworth Scale does not provide a valid measure of spasticity at lower grades but it may provide a measure of resistance to passive movement.

Perry L, McLaren S.

Coping and adaptation at six months after stroke: experiences with eating disabilities.

Int J Nurs Stud, 40(2), 185-195 2003.

Stroke produces a range of enduring impairments and survivors' coping and adaptation styles are influential features of life after stroke. Many stroke-sequelae affect ability to eat but survivors' perceptions and responses to these have not been explored. **Methods.** Survivors of a cohort of patients admitted to hospital with acute stroke March 1998-April 1999 participated in semi-structured interviews in their homes at 6 months post-stroke. Interviews were tape recorded and transcribed; 113 interviews with eating-disabled subjects were entered onto QSR NUD*IST 4 for thematic analysis. **Findings.** Two major emergent themes of 'getting back to normal' and 'getting by' were revealed which encompassed a range of responses in relation to food and eating. A high level of congruence was demonstrated with pre-existent frameworks but with some unique features. Reportage demonstrated non-linear and inconsistent effects of impairments within patients' lives and the importance of this topic for survivors and healthcare professionals was clear.

Pollock A, Baer G, Pomeroy V, Langhorne P.

Physiotherapy treatment approaches for the recovery of postural control and lower limb function following stroke.

Cochrane Database Syst Rev(2), CD001920 2003.

BACKGROUND: There are a number of different approaches to physiotherapy treatment following stroke. Central to these are approaches based on 'neurophysiological' principles, 'motor learning' principles and 'orthopaedic' principles. **OBJECTIVES:** To determine if there is a difference in the recovery of postural control and lower limb function in patients with stroke if physiotherapy treatment is based on orthopaedic or neurophysiological or motor learning principles, or on a mixture of these treatment principles. **SEARCH STRATEGY:** This review drew on the search strategy developed by the Stroke Group as a whole. Relevant trials were identified in the Stroke Group Trials Register of Controlled Trials which was last searched in May 2001. We also searched the Cochrane Controlled Trials Register (Cochrane Library, Issue 4 1999), MEDLINE (1966-1999), EMBASE (1980-1999) and CINAHL (1982-1999) and contacted experts and researchers with an interest in stroke. **SELECTION CRITERIA:** Studies - randomised or quasi-randomised controlled trials. Participants - adults with a clinical diagnosis of stroke. Interventions - physiotherapy treatment approaches aimed at promoting the recovery of postural control and lower limb function. Outcomes - measures of disability, motor impairment or participation. **DATA COLLECTION AND ANALYSIS:** Two independent reviewers categorised the identified trials according to the inclusion/exclusion criteria, documented the methodological quality and extracted the data. **MAIN RESULTS:** Eleven trials were included in the review, three of which were included in two comparisons. Four trials compared a neurophysiological approach with another approach; four trials compared a motor learning approach with another approach; four studies compared a mixed approach with another approach; two trials reported comparisons of sub-groups of the same approach. A large number of heterogeneous outcome measures were used, limiting the comparison of trial results. No one type of approach had a significantly better outcome than any other type of approach. **REVIEWER'S CONCLUSIONS:** There is insufficient evidence to conclude



that any one physiotherapy treatment approach is more effective than another in promoting the recovery of postural control or lower limb function.

Pomeroy Vm, Mickelborough J, Hill E, Rodgers P, Giakas G, Barrett Ja.

A hypothesis: self-propulsion in a wheelchair early after stroke might not be harmful.

Clin Rehabil, 17(2), 174-180 2003.

BACKGROUND: There is often strong clinical resistance to patients self-propelling a wheelchair post stroke as this is believed to produce immediate increases in abnormal posture and movement. Research to support this viewpoint is limited. **OBJECTIVE:** To begin investigation of the immediate effects of self-propulsion on symmetrical sitting. **DESIGN:** Replicated single-case studies ABABA. **SETTING:** Movement analysis laboratory. **SUBJECTS:** Four patients, a maximum of eight weeks post stroke and six age-matched healthy volunteers. **INTERVENTIONS:** Subjects sat in the wheelchair during the A phases and self-propelled forwards during the B phases. The Manchester Active Position Seat (consists of 68 force transducers which transmit data at 10 Hz) measured the magnitude of peak force and the position of peak force on both sides of the seat. The mean symmetry index and standard deviation for each study phase were calculated and graphed for each subject. Interpretation was by visual inspection. **RESULTS:** Only one stroke patient and one volunteer increased asymmetry of magnitude of peak force following the two periods of self-propulsion. Only one of the stroke patients increased asymmetry of position of peak force following self-propulsion compared with three of the healthy volunteers. **CONCLUSIONS:** These results raise the hypothesis that self-propulsion early post stroke might not produce immediate detrimental effects on seated symmetry.

Pomeroy Vm, Pramanik A, Sykes L, Richards J, Hill E.

Agreement between physiotherapists on quality of movement rated via videotape.

Clin Rehabil, 17(3), 264-272 2003.

BACKGROUND: Although achieving quality of movement after stroke is an important aim of physiotherapy it is rarely measured objectively or described explicitly. **OBJECTIVE:** To test whether physiotherapists agree on a composite measure of quality of movement. **SETTING:** A movement analysis laboratory **SUBJECTS:** Ten stroke patients and 10 healthy age-matched volunteers. **DESIGN:** Prospective correlational. **PROCEDURE:** All subjects were videofilmed performing three trials of six standardized functional tasks. Two videotapes were made, each with a different randomized order of appearance of the trials. Ten senior physiotherapists independently rated the videotapes twice using a 100-mm visual analogue scale. **ANALYSIS:** Analysis of variance models were fitted to transformed data. Estimates of components of variance were calculated and presented as a percentage of the total variance for differences, within subjects (intra-subject), between raters (inter-rater) and within raters (intra-rater). An acceptable percentage was set at less than 10%. **RESULTS:** The percentage of intra-subject variance ranged from 1% (pick up box and walking) to 9% (step on block). The percentage of inter-rater variance ranged from 18% (pick up pencil) to 38% (sit to stand). The percentage of intra-rater variance was less than 1% for all tasks. **CONCLUSIONS:** Although physiotherapists disagreed with each other on quality of movement they were more consistent in their own scoring.

Post Mw, De Witte Lp.

Good inter-rater reliability of the Frenchay Activities Index in stroke patients.

Clin Rehabil, 17(5), 548-552 2003.

OBJECTIVE: To assess inter-rater reliability of the Frenchay Activities Index (FAI) when used by occupational therapists in stroke patients. **DESIGN:** Independent administration of the FAI by occupational therapists in 45 stroke outpatients. **SETTING:** Outpatient departments of two Dutch rehabilitation centres. **STATISTICS:** Agreement between pairs of raters was assessed at item level using weighted Kappa and the percentage absolute agreement and for the total score using intra-class correlations (ICC), Bland-Altman plots and computation of the smallest real difference (SMR). **RESULTS:** ICC of the total score was good (0.90; 95% confidence interval (95% CI): 0.82-0.94). The Bland-Altman plot did not reveal relationships between agreement and height of scores. Reliability at item level was good (kappa >0.60) in 11 out of 15 items. The item 'gainful work' showed high agreement but a low kappa due to an extremely skewed score distribution. Reliability was insufficient in three items: 'local shopping', 'social occasions' and 'actively pursuing hobby'. Clarification of scoring instructions of these items might further improve the inter-rater reliability of the FAI. **CONCLUSION:** The FAI is a reliable instrument to measure outcomes of outpatient rehabilitation in patients with stroke.



Roby-Brami A, Jacobs S, Bennis N, Levin Mf.

Hand orientation for grasping and arm joint rotation patterns in healthy subjects and hemiparetic stroke patients.

Brain Res, 969(1-2), 217-229 2003.

We previously demonstrated that the hand orientation for grasping (azimuth) is strongly coupled to arm movement direction in the horizontal plane. The question is whether this coupling is directly controlled or secondary to a regulation of the arm angular configuration. To this purpose, we quantified hand orientation and arm joint rotations during unconstrained reaching movements in healthy subjects and in patients with hemiparesis due to stroke since they use altered joint rotation patterns for reaching. Seven healthy subjects and eight patients with a right hemiparesis participated (four had a moderate and four had a mild disorder). Four electromagnetic sensors were used to measure hand orientation and to compute the wrist, elbow and shoulder joint angles. Hand azimuth at the time of grasping was correlated to arm movement direction in all the healthy and hemiparetic individuals. In healthy subjects, a regression analysis of the arm joint rotations suggested that the coupling between hand azimuth and movement direction was not due to a correlation with a particular degree of freedom. Patients used different hand orientations for grasping and different joint rotation patterns that varied according to their level of disability and the use of compensatory strategies. The findings observed in both healthy subjects and patients with stroke show that the coupling of hand azimuth for grasping to movement direction was controlled independently of the set of joint rotations used for reaching. This suggests that it is a basic synergy directly controlled by the motor system.

Rodgers H, Mackintosh J, Price C, Wood R, Mcnamee P, Fearon T, et al.

Does an early increased-intensity interdisciplinary upper limb therapy programme following acute stroke improve outcome?

Clin Rehabil, 17(6), 579-589 2003.

OBJECTIVE: To determine whether an early increased-intensity upper limb therapy programme following acute stroke improves outcome. **DESIGN:** A randomized controlled trial. **SETTING:** A stroke unit which provides acute care and rehabilitation for all stroke admissions. **SUBJECTS:** One hundred and twenty-three patients who had had a stroke causing upper limb impairment within the previous 10 days. **INTERVENTION:** The intervention group received stroke unit care plus enhanced upper limb rehabilitation provided jointly by a physiotherapist and occupational therapist, commencing within 10 days of stroke, and available up to 30 minutes/day, five days/week for six weeks. The control group received stroke unit care. **MAIN OUTCOME MEASURES:** The primary outcome measure was the Action Research Arm Test (ARAT) three months after stroke. Secondary outcome measures: Motricity Index; Frenchay Arm Test; upper limb pain; Barthel ADL Index; Nottingham E-ADL Scale; and costs to health and social services at three and six months after stroke. **RESULTS:** There were no differences in outcomes between the intervention and control groups three and six months after stroke. During the intervention period the intervention group received a median of 29 minutes of enhanced upper limb therapy per working day as inpatients. The total amount of inpatient physiotherapy and occupational therapy received by the intervention group was a median of 52 minutes per working day during the intervention period and 38 minutes per working day for the control group ($p = 0.001$). There were no differences in service costs. **CONCLUSIONS:** An early increased-intensity interdisciplinary upper limb therapy programme jointly provided by a physiotherapist and occupational therapist did not improve outcome after stroke. The actual difference in the amount of therapy received by intervention and control groups was less than planned due to a competitive therapy bias.

Spinazzola L, Cubelli R, Della Sala S.

Impairments of trunk movements following left or right hemisphere lesions: dissociation between apraxic errors and postural instability.

Brain, 126(Pt 12), 2656-2666 2003.

Stroke patients present with apraxic or postural deficits involving trunk movements. Praxis and posture control have been associated with the functions of the left and the right hemisphere, respectively. For the first time, in this study the occurrence of apraxic and postural components in trunk movement deficits following right and left hemisphere lesions were investigated in the same participants. Twenty-three patients with left (L/pt), 12 with right (R/pt) hemisphere lesion, and 30 healthy controls were evaluated with a 21-item test assessing the imitation of meaningless, symbolic and reaching movements presented twice on visual or proprioceptive modality. Erroneous, motor responses of the trunk were classified as postural (compensations to overcome stability or asymmetry deficits) or apraxic (execution errors not due to biomechanical constraints). Postural instability reactions were



significantly more frequent among the R/pts, whilst apraxic responses were overwhelming within the L/pts. The findings are consistent with the view that the left hemisphere is dominant for praxis and suggest that this dominance be extended to trunk praxis. The results also support the hypothesis that trunk postures are coded in relation to the environment by a representational system. A widespread network, mainly sitting in the right hemisphere, subserves this postural system. The distinction between praxic and postural deficits in executing trunk movements should be kept in mind when evaluating trunk movement difficulties shown by stroke patients, in following up their recovery or when tailoring rehabilitation programmes.

Steultjens Em, Dekker J, Bouter Lm, Van De Nes Jc, Cup Eh, Van Den Ende Ch.

Occupational therapy for stroke patients: a systematic review.

Stroke, 34(3), 676-687 2003.

BACKGROUND AND PURPOSE: Occupational therapy (OT) is an important aspect of stroke rehabilitation. The objective of this study was to determine from the available literature whether OT interventions improve outcome for stroke patients. **METHODS:** An extensive search in MEDLINE, CINAHL, EMBASE, AMED, and SCISEARCH was performed. Studies with controlled and uncontrolled designs were included. Seven intervention categories were distinguished and separately analyzed. If a quantitative approach (meta-analysis) of data analysis was not appropriate, a qualitative approach (best-evidence synthesis), based on the type of design, methodological quality, and significant findings of outcome and/or process measures, was performed. **RESULTS:** Thirty-two studies were included in this review, of which 18 were randomized controlled trials. Ten randomized controlled trials had a high methodological quality. For the comprehensive OT intervention, the pooled standardized mean difference for primary activities of daily living (ADL) (0.46; CI, 0.04 to 0.88), extended ADL (0.32; CI, 0.00 to 0.64), and social participation (0.33; CI, 0.03 to 0.62) favored treatment. For the training of skills intervention, some evidence for improvement in primary ADL was found. Insufficient evidence was found to indicate that the provision of splints is effective in decreasing muscle tone. **CONCLUSIONS:** This review identified small but significant effect sizes for the efficacy of comprehensive OT on primary ADL, extended ADL, and social participation. These results correspond to the outcome of a systematic review of intensified rehabilitation for stroke patients. The amount of evidence with respect to specific interventions, however, is limited. More research is needed to enable evidence-based OT for stroke patients.

Takahashi Cd, Reinkensmeyer Dj.

Hemiparetic stroke impairs anticipatory control of arm movement.

Exp Brain Res, 149(2), 131-140 2003.

Internal models are sensory motor mappings used by the nervous system to anticipate the force requirements of movement tasks. The ability to use internal models likely underlies the development of skillful control of the arm throughout life. It is currently unknown to what extent individuals with hemiparetic stroke can form and implement such internal models. To examine this issue, we measured whether such individuals could learn to anticipate forces applied to their arms by a lightweight robotic device as they practiced reaching to a target. Thirteen subjects with post-stroke hemiparesis were tested. Forces were applied to the arm, which curved the hand path in either the medial or lateral direction, as the subjects reached repeatedly towards a target located in front of them at their workspace boundary. The subjects exhibited a decreased ability to adapt to the perturbing forces with their hemiparetic arms. That is, they did not straighten their reaching path as well, compared to their ipsilesional arms, and they exhibited smaller aftereffects when the perturbing force was unexpectedly removed. The ability to adapt to the force improved significantly with decreasing impairment severity, as quantified using both clinical scales and quantitative strength measurements. Some subjects with strength reductions as severe as 60% were able to adapt to the fields, generating significant aftereffects. We conclude that hemiparetic stroke impairs the ability to implement internal models used for anticipatory control of arm movement, although even some severely weakened subjects retain at least a partial ability to form and use internal models. Finding ways to fully restore this adaptive ability, or to make use of what adaptive ability remains during rehabilitation, is an important goal for improving functional motor recovery.

Teasell Rw, Bhogal Sk, Foley Nc, Speechley Mr.

Gait retraining post stroke.

Top Stroke Rehabil, 10(2), 34-65 2003.

A major component of stroke rehabilitation focuses on gait restoration. The purpose of this review is to examine the efficacy of a variety of gait retraining techniques currently in clinical use, including strength training, functional electrical stimulation, treadmill training, partial body-weight support, EMG biofeedback, and splinting of the lower extremity. Forty-eight studies evaluating six gait enhancement techniques were reviewed. There is



either strong or moderate evidence to support the use of strength training, EMG/biofeedback, and functional electrical stimulation as an adjunctive therapy in gait training, and there is either limited or conflicting evidence to support the use of ankle-foot orthosis, treadmill training, and partial body-weight support.

Teasell Rw, Foley Nc, Bhogal Sk, Speechley Mr.

Early supported discharge in stroke rehabilitation.

Top Stroke Rehabil, 10(2), 19-33 2003.

A systematic review of the randomized controlled trials published from 1970-2002 was conducted to assess the effectiveness of early supported discharge programs in the context of stroke rehabilitation. Ten studies, including 1,286 patients, were selected for detailed review. The methodological quality of the studies was assessed using the PEDro Scale. The outcome assessed included functional outcomes, cost analysis, and length of hospital stay. Although the majority of studies reported no statistically significant differences in functional outcomes between the two groups, there was a reduction in hospital stays for patients receiving home-based therapy. These results suggest that patients with milder strokes who receive home-based therapies have similar functional outcomes to patients who receive traditional inpatient rehabilitation.

Teasell Rw, Foley Nc, Bhogal Sk, Speechley Mr.

An evidence-based review of stroke rehabilitation.

Top Stroke Rehabil, 10(1), 29-58 2003.

A comprehensive evidence-based review of stroke rehabilitation was created to be an up-to-date review of the current evidence in stroke rehabilitation and to provide specific conclusions based on evidence that could be used to help direct stroke care at the bedside and at home. A literature search using multiple data-bases was used to identify all trials from 1968 to 2001. Methodological quality of the individual randomized controlled trials was assessed using the Physiotherapy Evidence Database (PEDro) quality assessment scale. A five-stage level-of-evidence approach was used to determine the best practice in stroke rehabilitation. Over 403 treatment-based articles investigating of various areas of stroke rehabilitation were identified. This included 272 randomized controlled trials.

Teasell Rw, Jutai Jw, Bhogal Sk, Foley Nc.

Research gaps in stroke rehabilitation.

Top Stroke Rehabil, 10(1), 59-70 2003.

The Stroke Rehabilitation Evidence-Based Review was designed to be a comprehensive review of the stroke rehabilitation literature. Despite a wealth of research, which included 272 randomized controlled trials (RCTs), many research questions remained unanswered. In the absence of strong evidence (at least two RCTs confirming the efficacy of a treatment), a research gap was identified. These gaps, in areas of research rehabilitation research considered to be of clinical significance, are presented in this article as unanswered research questions.

Tsuji T, Liu M, Hase K, Masakado Y, Chino N.

Trunk muscles in persons with hemiparetic stroke evaluated with computed tomography.

J Rehabil Med, 35(4), 184-188 2003.

OBJECTIVES: To analyse side difference in bilateral trunk muscles in patients with hemiparetic stroke, to relate it with impairment and disability variables and to evaluate longitudinal changes. **METHODS:** In a sample of 83 inpatients with hemiparetic stroke undergoing rehabilitation, we measured the cross-sectional area of the paravertebral muscle and thigh muscles using computed tomography at admission and discharge. Classifying them by paravertebral muscle side difference (group I: contralateral > ipsilateral; II: contralateral = ipsilateral; III: contralateral < ipsilateral) we analysed group difference in the Stroke Impairment Assessment Set, the Functional Independence Measure and walk velocity. **RESULTS:** In contrast to thigh muscles, the paravertebral muscle cross-sectional area was significantly greater on the side contralateral to the brain lesion. Discharge paravertebral muscle cross-sectional area increased significantly from admission values. The Stroke Impairment Assessment Set, Functional Independence Measure and walk velocity were significantly lower in group I. **CONCLUSION:** The contralateral paravertebral muscle cross-sectional area was larger than the ipsilateral ones, and this was related to the degree of impairment and functional limitations.

Tyson Sf, Desouza Lh.

A clinical model for the assessment of posture and balance in people with stroke.

Disabil Rehabil, 25(3), 120-126 2003.

PURPOSE: The lack of models to define and describe rehabilitation processes have often been identified as limiting research and the development of clinical practice. This study describes the development of a clinical model to address a key aspect of stroke physiotherapy--the assessment of posture and balance. **METHOD:** Twenty seven experienced neurological physiotherapists (PT) in six focus groups were used. Participants were shown photographs of a typical stroke patient in sitting and standing positions and were asked 'What would you note if you were assessing the posture and balance of this patient?' Answers were displayed on flip charts to allow immediate feedback about the accuracy and completeness of data. Thematic content analysis was then used. **RESULTS:** A complex reasoning process emerged to answer three main questions: What can the patient do? How does s/he do it? Why does s/he do it that way? To answer these questions physiotherapists established balance disability (by observing the patient's ability to perform a series of increasingly demanding balance tasks), identified postural and movement impairments (by observing alignment and movement of body segments relative to each other and to the expected norm for that patient) and assessed muscle activity (by observation and palpation). **CONCLUSIONS:** Focus groups have been used to elicit a clinical model for the assessment of posture and balance, the content of which will be used to inform a new outcome measure.

Van Der Lee Jh.

Constraint-induced movement therapy: some thoughts about theories and evidence.

J Rehabil Med(41 Suppl), 41-45 2003.

Constraint-Induced Movement Therapy (CIMT) is a type of treatment for hemiparetic stroke patients in which the patient is strongly encouraged to use the affected arm. One way of doing this is to immobilise the unaffected arm. This treatment is meant to help patients overcome 'learned non-use'. The learned non-use theory is based on deafferentation experiments in monkeys. In this review four randomised clinical trials are presented systematically. Although the authors of all four studies reported positive results, the effect sizes calculated without covariates yielded no statistically significant differences. In one of the studies a differential effect was found for patients with sensory disorders and hemineglect, leading to the hypothesis that learned non-use may be primarily related to afferent impairments. It is concluded that the learned non-use theory requires further exploration and that the evidence regarding the effectiveness of CIMT is not yet conclusive.

Wade Dt, Gage H, Owen C, Trend P, Grossmith C, Kaye J.

Multidisciplinary rehabilitation for people with Parkinson's disease: a randomised controlled study.

J Neurol Neurosurg Psychiatry, 74(2), 158-162 2003.

OBJECTIVE: To determine whether a programme of multidisciplinary rehabilitation and group support achieves sustained benefit for people with Parkinson's disease or their carers. **METHODS:** The study was a randomised controlled crossover trial comparing patients and carers who had received rehabilitation four months before assessment with those who had not. Patients were recruited from a neurology clinic, attended a day hospital from home weekly for six weeks using private car or hospital transport, and received group educational activities and individual rehabilitation from a multidisciplinary team. Patients were assessed at entry and at six months using a 25 item self assessment Parkinson's disease disability questionnaire, Euroqol-5d, SF-36, PDQ-39, hospital anxiety and depression scale, and timed stand-walk-sit test. Carers were assessed using the carer strain index and Euroqol-5d. **RESULTS:** 144 people with Parkinson's disease without severe cognitive losses and able to travel to hospital were registered (seven were duplicate registrations); 94 had assessments at baseline and six months. Repeated measures analysis of variance comparing patients at the 24 week crossover point showed that those receiving rehabilitation had a trend towards better stand-walk-sit score ($p = 0.093$) and worse general and mental health ($p = 0.002$, $p = 0.019$). Carers of treated patients had a trend towards more strain ($p = 0.086$). Analysis comparing patients before and six months after treatment showed worsening in disability, quality of life, and carer strain. **CONCLUSIONS:** Patients with Parkinson's disease decline significantly over six months, but a short spell of multidisciplinary rehabilitation may improve mobility. Follow up treatments may be needed to maintain any benefit.



Winstein Cj, Miller Jp, Blanton S, Taub E, Uswatte G, Morris D, et al.

Methods for a multisite randomized trial to investigate the effect of constraint-induced movement therapy in improving upper extremity function among adults recovering from a cerebrovascular stroke.

Neurorehabil Neural Repair, 17(3), 137-152 2003.

This article describes the study design, methodological considerations, and demographic characteristics of a phase III RCT to determine if 1) constraint-induced therapy (CI therapy) can be applied with therapeutic success 3 to 9 months after stroke across different sites, 2) gains that might occur persist over 2 years, 3) initial level of motor ability determines responsiveness to CI therapy, and 4) the treatment effect differs between those treated before 9 months and after 1 year. Six sites will screen and recruit poststroke survivors stratified on initial level of motor ability and after randomization allocate participants to immediate or delayed intervention. Primary outcomes include a laboratory-based measure of function (Wolf Motor Function Test [WMFT]) and a real-world participant-centered functional use measure (Motor Activity Log [MAI]). Secondary outcomes concern function, behavior, and compliance. This is the first multisite, single-blind RCT of a formal training intervention for upper extremity rehabilitation in subacute stroke in the United States.

Wittenberg Gf, Chen R, Ishii K, Bushara Ko, Eckloff S, Croarkin E, et al.

Constraint-induced therapy in stroke: magnetic-stimulation motor maps and cerebral activation.

Neurorehabil Neural Repair, 17(1), 48-57 2003.

Constraint-induced movement therapy (CI), a standardized intensive rehabilitation intervention, was given to patients a year or more following stroke. The goal was to determine if CI was more effective than a less-intensive control intervention in changing motor function and/or brain physiology and to gain insight into the mechanisms underlying this recovery process. Subjects were recruited and randomized more than 1 year after a single subcortical infarction. Clinical assessments performed before and after the intervention and at 6 months postintervention included the Wolf Motor Function Test (WMFT), the Motor Activity Log (MAL), and the Assessment of Motor and Process Skills (AMPS). Transcranial magnetic stimulation was used to map the motor cortex. Positron emission tomography was used to measure changes in motor task-related activation due to the intervention. MAL increased by 1.08 after CI therapy and decreased by 0.01 after control therapy. The difference between groups was significant ($P < 0.001$). Changes in WMFT and AMPS were not significantly different between groups. Cerebral activation during a motor task decreased significantly, and motor map size increased in the affected hemisphere motor cortex in CI patients but not in control patients. Both changes may reflect improved ability of upper motor neurons to produce movement.

Zemke Ac, Heagerty Pj, Lee C, Cramer Sc.

Motor cortex organization after stroke is related to side of stroke and level of recovery.

Stroke, 34(5), e23-28 2003.

BACKGROUND AND PURPOSE: The present study hypothesized that side of stroke and level of recovery influence motor system organization after stroke. **METHODS:** Functional MRI was performed on 14 control subjects and 21 patients with chronic stroke during index finger tapping (control subjects, right; patients, recovered side). **RESULTS:** On functional MRI, stroke patients with right arm involvement showed (1) significantly smaller activation in contralateral motor cortexes compared with control subjects; (2) smaller ipsilateral (non-stroke) premotor and larger contralateral (stroke-side) sensorimotor activation compared with patients with left arm involvement, although electromyogram across groups was similar; and (3) 2.7-fold-larger contralateral sensorimotor cortex activation, ventrally, in those with full recovery compared with those with partial recovery, despite similar tapping force, frequency, range of motion, and electromyogram between groups. Supplementary motor area activation was unrelated to level of recovery. **CONCLUSIONS:** After stroke that causes mild to moderate initial impairment and mild residual hand weakness, cortical organization varies with side of injury and with final motor status. The findings may have implications for treatment after stroke.