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125

Outi Pyöriä

Reliable Clinical Assessment of Stroke Patients' Postural Control and Development of Physiotherapy in Stroke Rehabilitation

JYVÄSKYLÄN YLIOPISTO

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Esitetään Jyväskylän yliopiston liikunta- ja terveystieteiden tiedekunnan suostumuksella
julkisesti tarkastettavaksi yliopiston liikunnan salissa L 304
syyskuun 1. päivänä 2007 kello 12.

Academic dissertation to be publicly discussed, by permission of
the Faculty of Sport and Health Sciences of the University of Jyväskylä,
in Auditorium L 304, on September 1, 2007 at 12 o'clock noon.

UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2007

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Publishing Unit, University Library of Jyväskylä

URN:ISBN:9789513929121
ISBN 978-951-39-2912-1 (PDF)

ISBN 978-951-39-2895-7 (nid.)
ISSN 0356-1070

Jyväskylä University Printing House, Jyväskylä 2007

ABSTRACT

Outi Pyöriä
Reliable clinical assessment of stroke patients' postural control and development of physiotherapy in stroke rehabilitation.
Jyväskylä: University of Jyväskylä, 2007, 94 p.
(Studies in sport, Physical Education and Health
ISSN 0356-1070; 125)
ISBN 978-951-39-2912-1 (PDF), 978-951-39-2895-7 (nid.)
Finnish Summary
Diss.

The main goal of the long-standing clinical research project in the district of East-Savo was to develop an active role in physiotherapy for patients with stroke. A novel assessment instrument, the Postural Control and Balance for Stroke (PCBS) test, was developed side by side with the activating treatment. This thesis includes reliability and validity studies of the Postural Control and Balance for Stroke (PCBS) test developed during the project, and the results of the controlled follow-up study concerning the influence of activating physiotherapy on stroke patients' cognitive and physical functions and independent coping at home compared with traditional treatment. This thesis also reports the results of the investigation into how physiotherapists use test results in counselling sessions.

The PCBS test contains three subscales: items for postural changes, sitting balance and standing balance. In all 137 (age 42-89) stroke patients were measured to assess the reliability and validity of the PCBS test. Intra- and interrater reliability was assessed by using videotaped test performances of the patients. The construct validity of the PCBS test was investigated by comparing measurements obtained using the scores of the PCBS test with values obtained for the Barthel Index (BI) and for the four neuropsychological domains most widely studied in the literature: memory, language, visuospatial functions and visual inattention. The ability of the PCBS test at an early stage in rehabilitation to predict functional capacity measured by the BI, and risk for falls at 90 days after stroke was also studied. The criterion validity of the standing balance tasks of the PCBS test was evaluated by comparing the results obtained with those for postural sway velocity measured on a force platform.

Eighty (age 47– 89) stroke patients participated in the 12-month follow-up study: 40 patients received activating physiotherapy and 40 patients received traditional therapy. Patients' physical functional capacity was measured one week and 12 months post stroke with the Barthel Index (BI), the PCBS test, 10-meter gait speed, walking distances and patients' abilities to cope without institutional help. Cognitive capacity was measured with specific neuropsychological tests: language, visuospatial functions, visual inattention and memory. Three physiotherapists and 7 patients participated in the counseling study. The content of communication in the counseling sessions was explored using discourse analysis.

The PCBS test showed an acceptable level of reliability and the results confirm that the PCBS test has good construct validity. The score for postural changes predicted functional capacity and standing balance predicted falls at the 3-month follow-up. The standing balance items of the PCBS test have good criterion validity. The follow-up study showed that activating therapy can contribute more than traditional physiotherapy to patients' independent living at home and also improve patients' cognitive function. In particular improvement in memory in the intervention group differed significantly from that in the control group. The counseling study showed that successful counseling with reference to the results of the balance test calls for physiotherapists to develop dialogic communication skills to help patients in co-constructing their home exercise together with their social network.

The results suggest that the PCBS test is a reliable and valid method of measuring balance ability in different phases after stroke. With respect to validity, the improvement is an ongoing process. The results of this study support the idea that activating physiotherapy can lead a comprehensive functional recovery after stroke.

Key words: balance, stroke, balance measurement for stroke, physiotherapy, physical functions, cognitive functions, counseling.

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ACKNOWLEDGEMENTS

The project "The development of activating and emancipating physiotherapy in stroke rehabilitation. A physiotherapy developmental project in the public health service of East Savo" started in 1998 in the district of East Savo and, comprising several phases, lasted until 2004. The project was made possible by the Ministry of Labor, the Finnish Slot Machine Association, the Social Insurance Institution of Finland (Kela), and the Central Hospital of Savonlinna. As my thesis is part of this project, these stakeholders have also made my work possible, for which I am most grateful.

This thesis was also supported by personal grants from the Cultural Foundation of South Savo, the Finnish Association of Physiotherapists and the Finnish Konkordia Fund.

I wish to thank my supervisor, Ulla Talvitie, PhD, from the University of Jyväskylä, who recruited me to the above-mentioned project. I am grateful to her for encouraging me to write this thesis as part of the above-mentioned study, as otherwise it would not exist. I did experience some desperate moments along the way, doubting my ability to bring the work to a close. I highly esteem your expertise, which you so generously shared during our constructive and enjoyable discussions. They encouraged me to continue on this sometimes very rocky path.

I also wish to thank my supervisors, docents Timo Pohjolainen, MD, PhD, and Pertti Era, PhD. Docent Timo Pohjolainen's support during the follow-up study was extremely valuable. I am grateful for his constructive criticism and expert advice. Docent Pertti Era gave me expert advice on balance measures; his constructive criticism helped me write my first article and supported me in the final preparation stage for my thesis.

Furthermore, I am grateful to my official referees, Sarah Tyson, PhD, and Catherine Dean, PhD, for their devoted efforts in providing constructive criticism. The process was a true learning experience that helped me improve my thesis.

I particularly appreciate the expertise and guidance of our statisticians: Hannu Kautiainen, BA., and Jari Villberg, MSc. Your uncompromising criticism on statistical methods gave me confidence with writing the manuscript. Warm thanks are also due to Michael Freeman, for his work in editing the English language of this thesis.

I also wish to express my sincerest thanks to all of the participants in the study, including patients and staff at the care facilities of Savonlinna Central Hospital's neurological department, who generously took part in the study and helped with the practical arrangements of the intervention. My very special thanks go to head physiotherapist Hilkka Kupiainen, of the physiotherapy department. Your response and practical arrangements were very important to me. I wish to express my warmest gratitude to all physiotherapists who took part in the project. Your approach and your willingness to let me in your work were exemplary. Research assistant physiotherapist Virpi Kasper, your help and patience were commendable. You were my right hand during these years. I also owe special thanks to Merja Reunanen, Lic.HSc: cooperation with you has been priceless, not to mention your friendship.

I would like to express my warmest gratitude to the staff at Kruunupuisto Punkaharju Rehabilitation Center. Their competence was of crucial importance in the organization of the follow-up study. My warmest gratitude for his help, constructive criticism and expert advice as concerns the cognitive deficits of stroke patients goes to neuropsychologist Hannu Nyrkkö, PhD. Moreover, I wish to extend my sincerest thanks to Ms. Mirja Kokkonen and Maarit Tervonen, PT, for their invaluable help.

I wish to dedicate this thesis – with expressions of my deepest gratitude – to my parents Jussi and Niina Sipilä, who have supported me in so many ways during these years. Most importantly, you gave me a loving home and a happy childhood. That foundation has carried me through many difficulties and has given me thrust in life.

I very warmly thank my husband Esa for his love and support. During these years our profound discussions have encouraged me to continue on this adventure. Your sense of humor has been stimulating and relaxing. My son Jussi I thank for tolerating the sometimes hectic schedules. Your peaceful attitude has spoken to me many times.

And finally, I thank Him in whose hands our time is. He gives us faith and hope.

LIST OF ORGINAL PUBLICATIONS

The thesis is based on the following articles, which are referred to in the text by their Roman numerals:

I Pyöriä, O., Era, P., Talvitie, U. 2004. Relationships between standing balance and symmetry measurements in patients following recent strokes (≤ 3 weeks) or older strokes (≥ 6 months). Physical Therapy 84, 128-136.

II Pyöriä, O., Talvitie, U., Villberg, J. 2005. The reliability, distribution and responsiveness of the Postural Control and Balance for Stroke test. Archives of Physical Medicine and Rehabilitation 86, 296-302.

III Pyöriä, O., Talvitie, U., Kautiainen. H., Nyrkkö, H., Pohjolainen, T. Validity of the Postural Control and Balance for Stroke test. (Physiotherapy Research International, in press)

IV Pyöriä, O., Talvitie, U., Nyrkkö, H., Kautiainen, H., Pohjolainen, T., Kasper,V. 2007. The effect of two physiotherapy approaches on physical and cognitive functions and independent coping at home in stroke rehabilitation. A preliminary follow-up study. Disability and Rehabilitation 29, 503-11.

V Talvitie, U., Pyöriä, O. 2006. Discourse analytic study of counseling sessions in stroke physiotherapy. Health Communication 20, 187-196.

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1 INTRODUCTION

Every year about 14 000 persons experience disorders of the brain circulatory system in Finland. Every third patient is under 65 and every other is over 75 years of age. As the population ages morbidity is predicted to increase up to 21 000 patients per year until the year 2020, if preventive actions is not taken. In the acute phase of stroke nearly half of all patients need rehabilitation services. The content and length of rehabilitation is determined by the type of stroke and degree of disability, symptoms such as the severity of hemiplegia, aphasias, cognitive deficits, age and functional capacity pre stroke, social networks and patient motivation. Successful rehabilitation needs to be persistent and well planned, and its implementation involves various occupational groups and organisations.

There is a general agreement on the importance of physiotherapy in stroke rehabilitation**.** Loss of independent living is clearly a debilitating consequence of stroke. Therefore one of the most important goals in physiotherapy is to enable for patients to continue as independent living as long as possible. In most cases physiotherapy is considered useful in treating patients' physical problems, and postural control and locomotion retraining are essential components of stroke rehabilitation. Physiotherapy services are supplied by different organisations depending on the phase of rehabilitation. For rehabilitation services to be effective systematic follow-up between the different organisations supplying those physiotherapy services is essential. In current practice physiotherapy starts during the first days post stroke. Further plans for rehabilitation are made in most cases during the first week after stroke as hospitals aim at discharging stroke patients, either to their homes or to rehabilitation centres, as soon as possible. To be able to specify appropriate goals for rehabilitation assessment tools are required which help to predict functional and movement capacity in the initial phase of stroke.

The main subject of this thesis is the outcomes of the author's studies on the reliability and validity of the Postural Control and Balance for Stroke (PCBS) test and its sensitivity to change in balance during a one-year follow-up. The early development work on the PCBS test started at the beginning of the 1990s during a physiotherapy developmental project in the Jorvi hospital in Finland (Talvitie et al. 1996). The study of the distribution of working time and the content of physiotherapy activities carried out during this early phase of the project showed that physiotherapists spent very little of their working time on evaluation in stroke rehabilitation, and that they did not use a systematic way of assessing patients' functional capacity and balance (Talvitie & Salenius

1994). During the instructional intervention the physiotherapists read the research literature on the existing balance scales, observed and evaluated their own working activities and held group discussions. Three years later a test for measuring post-stroke postural control capacity was constructed. The purpose of the test was to estimate the patients' progress in two ways, i.e. progress in independent activities, and the ability to perform more and more difficult activities in more complicated postures.

A project "The development of activating and emancipating physiotherapy in stroke rehabilitation. A physiotherapy developmental project in the public health service of East Savo" started in 1998 and in it the Jorvi instrument was developed further. The main purpose of the project was to increase the effectiveness of independent training so that the patients learn to transfer their training outside treatment sessions. At that time, the assessors started focusing on the ways in which patients tried to perform their tasks. Studies have found that people with moderate to severe balance impairments had additional ways of performing tasks to compensate for motor deficits and that the performance of people with mild impairments tended to resemble that of healthy people (Cirstea & Levin 2000, Cirstea et al. 2003). Jorvi's scale, based on the need for assistance, was changed with regard to sections measuring sitting and standing balance, so that the scale could be used to assess strategies used for maintaining balance during the tasks.

Several studies show that physiotherapists mainly use manual techniques in directing treatment and that insufficient attention is paid to patient participation in the course of the treatment process. A recent survey study has drawn attention to the lack of independent practice and the continuing use of facilitation techniques that require little independent action from the patient, who is assigned a "relatively passive" role (Tyson & Selley 2007). The second purpose of this thesis is to report on a controlled follow-up study of the influence of activating physiotherapy on stroke patients' cognitive and physical functions and independent coping at home over a 12-month follow-up compared with traditional treatment. The above mentioned developmental project in the district of East Savo started with a three-year educational programme for the physiotherapists practicing in this area. The physiotherapists, together with researchers at the University of Jyväskylä, developed a system of treatment designed to support patients' independent and task-oriented training.

The treatment, based on motor relearning principles, was named activating physiotherapy and emphasizes the active role of patients in their rehabilitation. Positing the patient as an active learner challenges physiotherapists to develop both evaluation and physiotherapy accordingly. Approaches based on motor relearning principles in physiotherapy with the main stress on an active patient learning process obviously need to take into account the level of cognitive capacity and extent of cognitive deficiency in physiotherapy.

Traditionally the main objective in physiotherapy has been to help therapists to set goals for therapy and solve patients' functional problems. However, evaluation should also offer information understandable to patients about their level of functional capacity as well as enable their more conscious participation on rehabilitation. In that case we considered that the physiotherapists might be able to help patients to understand the results of PCBS test so that the patients realized the meaning of exercises to getting through with their house keeping. In this respect this thesis reports the results of the investigation into how physiotherapists use test results in counseling sessions. The knowledge obtained from this developmental project can be used in organising the regional rehabilitation of stroke patients.

2 REVIEW OF THE LITERATURE

2.1 Stroke – incidence and consequences

According to the world health organization (WHO) stroke is defined as “rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours” (Aho et al. 1980). Cerebral infarction (CI) is responsible for about 80 % of all first-ever stroke, and intra cerebral (ICH) and subarachnoid (SAH) haemorrage for about 20 % (Kaste et al. 2001). Stroke is one of the leading causes of death in Europe (Aboderin & Venables 1996) and the third most common cause of death in Finland (Aivohalvaus- ja dysfasialiitto ry 2005). The population-based FINSTROKE register listed 5 650 stroke patients (Sivenius et al. 2004). The average annual decline during 1983-1997 in the age-standardized incidence of first stroke events was 2 % among men and 1.7 % among women. Although the incidence as well as the mortality of stroke events declined significantly in Finland during the 15-year period, the prevalence is stable or it may even be increasing as the population ages (Numminen et al. 1996, Sivenius et al. 2004).

Stroke is not only one of the leading cause of death in Western countries, but it is also an important contributor to the incidence of temporary or stable disabilities and handicap. It has been found that in unselected acute stroke patients 19 % of cases are very severe, 14 % severe, 26 % moderate, and 41 % mild-impaired (Jorgensen et al. 1999). It has been estimated that after rehabilitation has been completed half of all stroke patients are left with some level of disability and that for some patients this disability remains severe (Dombovy et al. 1986, Jorgensen et al. 1999). Dombovy et al. (1986) estimated that out of every 100 stroke survivors only ten return to normal working life with few or no problems, 40 have to cope with moderate disabilities, 40 with severe disabilities, and ten need permanent nursing and care. The neurological outcome of the interruption of the blood flow to the cerebrum depends on the etiology, location, size and extent of the infarct or hemorrhage. Studies show that patients with stroke generally suffer from motor, sensory, cognitive, behavioural and emotional problems. (Kotila et al. 1984, Sandin et al. 1994, Wagner & Cushman 1994). Many stroke patients who need prolonged rehabilitation services have both motor and neuropsychological consequences.

2.2 Stroke deficits

2.2.1 Cognitive deficits

Cognition is generally defined as the ability to process, sort, retrieve, and manipulate information. Several studies show that stroke has a massive effect on many cognitive processes, indicating that the effects of stroke upon cognitive functioning lead to far-reaching changes with a general slowing in information processing and attentional deficits (Tatemichi et al. 1994, Hochstenbach et al. 1998). According to Tatemichi et al. (1994) memory, orientation, linguistic functions and attention are the most vulnerable cognitive functions affected by stroke. In the literature over 60 % of patients with stroke are reported to have cognitive deficits (Hoffmann 2001, Kalashnikova et al. 2005).

The following cognitive deficits are relevant to this study: aphasias, visuospatial deficits, visual neglect (visual inattention) syndrome and memory. Aphasia is a linguistic deficit and affects not only the production and understanding of language but also reading, writing and counting. Roughly, aphasias are divided into fluent and non-fluent aphasias. In fluent aphasias the understanding of language is deficient although the stroke patient speaks at a fast pace. The patient's speech may exhibit wrong choices of words or the wrong structure of words. In non-fluent aphasias, the patient has more difficulties in producing language than understanding it. Aphasia is usually associated with a lesion in the left hemisphere of the brain. In the acute stage of stroke aphasia occurs in 25-34 % of the patients (Kauhanen et al. 2000, Hoffmann 2001).

Memory disorders are common among stroke patients, and since memory is a complex phenomenon, memory disorders may occur in patients with a lesion in almost any part of the brain (Ylinen & Sirviö 1997). Patients with memory disorders are separated from their social environment and are no longer able to profit from the information available to them; the world loses its order and its potential to shape behaviour (Hochstenbach & Mulder 1999). The capacity to store information and to use information for learning is one of the basic features of life. Hence learning skills are totally dependent on memory, on the capacity to hold information about ongoing actions and events (Hochstenbach & Mulder 1999). Relatively few studies exist on the memory disorders of stroke patients. This may partly be due to the fact that conceptual as well as practical differentiation between specific deficits and memory disorders is difficult. However studies have found that about half of all stroke patients have memory disorders (Kotila et al. 1984, Hochstenbach et al. 1998).

Stroke may cause various disorders in spatial perception and processing. In disorders of spatial perception the patient has difficulties in, e.g., finding places, recognizing time from a clock, estimating distances and localizing details (Kuikka et al. 1991). According to Pohjasvaara et al. (1998) 37 % of stroke patients have visuospatial disorders.

One of the best known and most recalcitrant of the specific cognitive deficits is the neglect syndrome. Neglect implies difficulties in reacting or orienting to new significant stimuli on the opposite side of the brain lesion, and this difficulty cannot be explained by sensory or motor deficits (Heilman 1979).

The patient may run into objects on the side contra lateral to the lesion, neglect this side of the body in washing and dressing. Reading, writing and drawing often become difficult. Another important symptom is avoiding use of the hand on the side opposite to the lesion, although there may be no evidence of paresis of the hand. Often, neglect is associated with a lesion in the right rather than the left hemisphere. Pedersen et al. (1997) recorded neglect in 23 % of patients in the acute stage of stroke: when the lesion was in the right hemisphere 43 % of the patients had neglect and when it was in the right hemisphere 8 % had neglect.

2.2.2 Motor deficits

Patients with stroke frequently demonstrate an initially low level of physical functional ability. Lesion in the central nervous system (CNS) produces primary neuromuscular impairments, such as paresis, abnormalities in muscle tone and abnormal timing of muscle activation. Disruption in the timing of muscle activation contributes to movement problems in people with stroke. Initiation of movement is delayed, the rate of force development is slowed, muscle contraction time is prolonged, and the timing of the activation of antagonists relative to agonists can be disrupted in patients with stroke. (Lundy-Ekman 1998) In the literature some 80 % of patients with stroke are reported to have symptoms of so called hemiplegia or hemiparesis (Barker & Mullooly 1997). Unilateral muscle weakness can vary in severity from total, termed hemiplegia, or severe loss of muscle activity, termed hemiparesis.

Muscle weakness is considered a cardinal feature and there has been increased attention to muscle weakness as an important factor limiting recovery of physical function. Unilateral muscle weakness together with sensation has been found to have the most impact on balance (Tyson et al. 2006 a). In the regression analysis Tyson et al. (2006 b) found that both sensation and neglect were significantly associated with unilateral muscle weakness. However, none of the demographic variables such as age, sex and pre-morbid disability, or stroke pathology factors, like side and type of stroke significantly influenced the degree of weakness (Tyson et al. 2006 b).

Abnormalities in muscle tone are found after stroke. Muscle tone is the amount of tension in resting muscle. Clinically, muscle tone is usually assessed by passive range of motion. Low resistance to passive stretch in muscles is called hypotonia and abnormally strong resistance to passive stretch is called hypertonia, as in spasticity (Lundy-Ekman 1998). Sommerfeld et al. (2004) found that spasticity was present in 19 % of patients at three months post stroke. Watkins et al. (2002) found that spasticity was present in 38 % of patients 12 months after stroke. Although spasticity has been considered one of the main factors to disabilities after stroke, severe disabilities have been seen in almost the same number of nonspastic as spastic patients (Sommerfeld et al. 2004). Ada et al. (2006) found that the major independent contributor to contracture in the elbow flexors was spasticity in the first four months after stroke. However, the only independent contributor to limitations in physical activity during 12 months post stroke was weakness.

2.2.3 Sensory deficits

Sensory information about our own body and environment is an important aspect when planning movement in different situations. Sensory information is obtained from the visual, somatosensory and vestibular systems. A common visual problem following stroke to the cerebral cortex is homonymous hemianopsia, or the loss of visual information in one hemifield. Visual deficits restrict a patient's ability to see objects in half of the visual field, affecting reach and grasp in the contralesional hemifield (Jeannerod 1990). Somatosensory impairments, such as in tactile (light touch, vibration, temperature) and proprioseptive (joint position) sensation, together with motor impairments, occur most commonly following stroke. Somatosensory impairment is usually contra-lateral to the lesion and is reported in up to 60 % of the patients with stroke (Feigenson et al. 1977). The vestibular system provides sensory information regarding head movements and position with reference to gravity. Disorders of the central nervous system can cause typical peripheral vestibular symptoms such as dizziness, nausea and vomiting, imbalance, and/or gait abnormalities (Baloh 2002, Kumral et al. 2002).

2.3 General factors in functional recovery after stroke

All rehabilitation interventions aim at functional recovery after stroke. However there is no general consensus among therapists and thus the different views on functional recovery influence in clinical work. A stringent definition of recovery requires the functional goal to be achieved as before the injury, that is, using the same means as prior to the injury. Although several approaches suggest that compensatory movements may potentially inhibit a return to normal neurological functioning and should be discouraged, evidence for this assumption is lacing (Kwakkel et al. 2004). Less stringent definitions define recovery as the ability to achieve task goals using effective and efficient means but not necessarily those used before the injury (Shumway-Cook & woollacott 2001). There are strong indications that functional recovery is not only a matter of restoration or restitution, but also a matter of compensation by the use of alternative movement strategies to achieve the intended goal (Shelton & Reding 2001). However, the compensatory strategies developed by patients are not always optimal. Thus, functional recovery may be achieved by improving the efficiency of compensatory strategies used to perform functional tasks. In this thesis functional recovery following stroke is seen as described by Shumway-Cook and Woollacott (2001): "an ability of a patient to develop movement patterns that meet the demands of functional tasks in the face of perceptual, motor, and cognitive impairments".

Obviously, the time and extent of functional recovery since stroke onset determine the individual plateau phase from six months onwards. With therapy, functional gains can continue years later, but several studies of outcome in patients with stroke have shown that their level of independence may either worsen or improve over time (Paolucci et al. 2001). Paolucci et al. (2001) studied 155 patients with first stroke mobility status at one-year follow-up. After one-year, 37 % of the patients maintained the mobility level they had achieved during their inpatient rehabilitation, 20 % improved on that level, and the remaining 43 % experienced a decline. In several studies both motor and cognitive factors have also been associated with poor functional recovery. Recently, the cognitive factor was found to be the third in order of importance, after motor and perceptual factors, in explaining the variance in functional autonomy after stroke (Tatemichi et al. 1994, Malouin et al. 2004). Tatemichi et al. (1994) found in their study that functional impairment was greater with cognitive impairment, and dependent living after discharge either at home or in a nursing home was more likely (55 % with and 33 % without cognitive impairment) after three months post stroke. Previous studies suggest that long-term, even if limited, improvements in cognitive functions can occur after stroke (Hochstenbach et al. 2003).

Innumerable determinants have been proposed individually or in combination to predict functional recovery after stroke. After reviewing 33 prognostic studies, Jongbloed (1986) concluded that the following six determinants relate to a poor functional recovery: severe disability on admission, urinary and bowel incontinence, previous stroke, advanced age and visuospatial deficits. One of the most important individual factors for recovery is the initial severity of the stroke (Jorgensen et al. 1999). It should be kept in mind that in the initial phase of stroke the main pattern of recovery is determined by certain unknown biological process often characterized as "spontaneous recovery". Arboix et al. (2003) found that of 1473 ischemic stroke patients, 16,2 % were classified as spontaneous neurological improvement or good outcome whereas 68,5 % were classified as no improvement or poor outcome. It can be expected that patients with mild or few symptoms are more susceptible to spontaneous recovery. For example, dysarthria-clumsy hand syndrome has been found to be a significant predictor of spontaneous in-hospital recovery (Arboix et al. 2003). High functional measure scores, such as the Barthel Index (BI) score, at admission are seen to predict good functional outcome in stroke patients and the cut-off point at 7/20 BI points is supported in several studies (Kalra & Crome 1993, Sommerfeld & von Arbin 2001). Obviously the degree of recovery after stroke is largely defined within the first weeks post stroke (Kwakkel et al. 2004). Kwakkel et al. (2003) found that patients with middle cerebral artery infarct showing greater improvements within the first weeks post stroke reached higher plateaus at six months than those with later improvements measured with the BI.

2.4 Stroke physiotherapy

Physiotherapy was not systematically used in stroke rehabilitation until the 1940s and 1950s, when treatments based on neurophysiological knowledge were first introduced (Gordon 1987). In the late 1950s and early 1960s, the so-called neurofacilitation approaches were developed, resulting in a dramatic change in clinical interventions directed at patients with neurological impairments (Gordon 1987). However a feature common to all these approaches based on neurophysiological knowledge is their limited association with scientific theories.

The best known and the most widely used the neurofacilitation approaches is the Bobath therapy developed by Berta and Karel Bobath (Ashburn 1995). This approach has received popular acceptance on an empirical basis and it has influenced physiotherapy practice world-wide. It is also the most frequently used treatment in Finland. The treatment centres round the facilitation of corrected movement by a physiotherapist who handles the body with manually. Emphasis is placed on the facilitation of normal afferent inputs and normal movement patterns while minimising the experience of abnormal movement (Bobath 1990). It means that primitive reflexes, patterns and associated reactions are inhibited and are not used to facilitate movement. Manual handling techniques are a very important aspect of this therapy and the physiotherapist has a central role in implementing the treatment.

In recent years, physiotherapists themselves have began critically to study treatments developed since the Second World War, as modern neurophysiological and neuropsychological studies have questioned the theoretical basis for these treatments (Stachura 1994). Lack of knowledge about what really happens inside the therapy session has been a cause of criticism of stroke physiotherapy research and clinical practice for years. Lennon and Ashburn (2000) explored how the Bobath concept had changed since 1990 and what the main theoretical assumptions were among experienced therapists in the UK. The study highlighted changes in theory, terminology, and techniques. All the therapists agreed that Bobath was defined by the following methods: analysis of normal movement, control of tone and facilitation of movement. Neuroplasticity was described as the primary rationale for treatment. Tone remained a major problem in rehabilitation management. Both facilitation of normal movement components and task specific practice using manual guidance were considered crucial elements of the Bobath concept. By manually guiding task-specific practice therapists ensured the normal movement components inside the tasks. Although physiotherapists confirmed that patients needed to practice activities outside therapy as well, they were concerned that practice without supervision would promote abnormal tone and movement (Lennon 2003). Tyson and Selley (2006) described the content of rehabilitation of postural control and found that interventions to encourage independence or activity outside the treatment session were rarely used (4 %) in stroke rehabilitation. Physiotherapists' clinical work focused on therapist-led interventions. The most frequent interventions were "preparation for treatment" (43 %), "practising balance and walking" (34 %) and "practising functional tasks" (15 %). Tyson and Selley (2007) concluded that although most physiotherapists perceived themselves to be "eclectic" their actual practice followed the traditional Bobath method. Physiotherapists were categorized as "eclectic" if their work was based on the Bobath concept but they also used other methods, or if their work was based on other methods but only slightly influenced by the Bobath concept, or if they did not use the Bobath concept in their work. Tyson and Shelley (2007) concluded that when a new intervention fitted into the model of hands-on contact with patients, it would be rather easy to adapt that intervention in clinical practice. Difficulties arise when physiotherapists are obliged to develop new clinical reasoning processes which have been traditionally viewed as "undesirable", such as using equipment, exercise and encouraging independent practice.

In the 1980s Carr and Shephard (1985) began to develop new clinical methods which they called motor relearning. One such approach to retraining is the task-oriented approach (Woollacott & Shumway-Cook 1990) to clinical intervention, which is based on new theories of motor control and learning. Previous publications have referred to this approach as a system approach. These approaches based on motor learning differ from those underlying the neurofacilitation techniques. The motor relearning approach to intervention assumes that patients learn by actively attempting to solve the problems inherent in a functional task rather than repeatedly practising normal patterns of movement. Adaptation to changes in the environmental context is a critical component of recovery of function. In this context, patients are helped to learn a variety ways to solve the task goal rather than a single muscle activation pattern (Shumway-Cook & Woollacott 2001). In acute patients, Langhammer and Stanghelle (2000) compared Bobath therapy with the motor relearning programme. The results showed that the patients who were treated with the motor relearning programme, stayed in the hospital for less time and improved their motor performance significantly more than the patients treated with Bobath therapy (Langhammer & Stanghelle 2000). Dean et al. (2000) found that task-related training improved the performance of locomotors tasks in patients with chronic stroke.

In the neurofacilitation approaches, the influence of cognitive factors on motor control is not addressed (Conolly & Montgomery 1991). In planning and implementing treatment neither the patients' own activity or perception in controlling their postural balance nor neuropsychological problems with perception, attention and memory are taken into account (Talvitie & Reunanen 2002). Several studies have found that the neuropsychological consequences of stroke play an important role in rehabilitation. (Sundet et al. 1988, Galski et al. 1993, Reding et al. 1993, Paolucci et al. 1996). The nature and extent of the cognitive deficiency must be considered in physiotherapy if stroke rehabilitation is to be a learning process where the goal is the patients' own activity outside therapy sessions**.** Motor learning involves not only the learning of muscle or movement control but the reacquisition of the knowledge and skills needed to move adequately in a continuously changing environment.

2.5 Balance after stroke

The ability to control our body's position in space is fundamental to everything we do. Postural control can be defined as the act of maintaining, achieving or restoring a state of balance during any posture or activity (Pollock et al. 2000). The recent view of postural control implies that balance control can be considered to be fundamental motor skill learnt by the central nervous system. Thus, like any other motor skill, postural control strategies can become more efficient and effective with training and practice. Multiple neural and biomechanical factors interact to achieve the goal of balance: to maintain the centre of gravity (CoG) over the base of support (BoS) during static positions, moving and activities of daily life (Woollacott & Shumway-Cook 1990, Maki & McIlroy 1997). During quiet standing, the CoG moves constantly within the BoS causing continuous postural sway. Everyday activities such as sitting down and reaching involve controlling the CoG within a moving BoS (Collen 1995). Postural control during static position and moving is a complicated process which depends on the spatial and temporal integration of sensory (visual, somatosensory and vestibular) and motor systems to allow continual interaction between the task, individual and the environment. This view of postural control and movement demands a dynamic interplay between the motor, perceptual and cognitive systems, which means that cognitive aspects of postural control are the bases for adaptive and anticipatory aspects of postural control (Shumway-Cook & Woollacott 2001). Shumway-Cook and Woollacott (2001, 166) have described the adaptive and anticipatory aspects as follows: "Adaptive postural control involves modifying sensory and motor systems in response to changing task and environmental demands. Anticipatory aspects of postural control prepare sensory and motor systems for postural demands based on previous experience and learning".

Impaired postural control is a key characteristic of the mobility problems presented in patients with stroke and is caused by a complex interplay of motor, sensory, and cognitive impairments. Because of these impairments people with stroke have greater postural sway during quiet standing and voluntary movement than age-matched, healthy controls (Shumway-Cook et al.1988, Sackley 1991, Lamontagne et al. 2003, Corriveau et al. 2004, de Haart et al. 2004). Shumway-Cook et al. (1988) compared the postural control of 16 patients with stroke and 34 normal elderly subjects with a static force plate system. They found that postural sway abnormalities in patients with stroke included significant mean lateral displacement of sway towards the nonaffected leg and increased total sway area. Lee et al. (1997) examined sit-to-stand transfer in 14 patients with right-side hemiplegia and 9 healthy controls. Subjects were asked to stand up with their feet on the force platform. The results showed that the area of CoP sway pattern in the patients was much larger than in the controls, which implies that the bodies of stroke patients have a larger tendency to sway during movement especially in the mediolateral direction (Lee et al. 1997). Previous studies in stroke patients have identified also reduced loading on the paretic lower limb (Goldie et al. 1996, Sackley & Lincoln 1997, Nichols 1997, Laufer et al. 2000). It has been documented that patients with stroke shift 60-90 % of their body weight to the non-paretic limb (Sackley & Lincoln 1997, Laufer et al. 2000). They also make smaller excursions when moving their weight around the BoS, especially in the direction of the weaker leg (Goldie et al. 1996, Nichols 1997).

2.5.1 Relationship between balance and function

Several studies have found that changes in the balance ability of patients with stroke correlate significantly with changes in function (Sandin & Smith 1990, Sackley 1990, Hsieh et al. 1996, Wu et al. 1996, Juneja et al. 1998, Duarte et al. 2002), such as transfer, walking, stair climbing (Bohannon & Leary 1995) and risk of falls (Teasell et al. 2002, Yates et al. 2002, Lamb et al. 2003). Balance ability in postural changes, in sitting and standing positions have been found to correlate with functional ability and moving. Duarte et al. (2002) examined connection between postural changes in bed and sitting balance ability on the one hand and independent activities in daily living, gait velocity and centre of gravity symmetry on the other. They found that postural changes and sitting balance ability correlated with the discharge Functional Independent Measure scores (FIM) (rs=0.738), gait velocity (rs=0.654) and centre of gravity symmetry (rs=0.601). Bohannon and Leary (1995) compared static standing balance ability and functional activities like chair-to-mat transfer, locomotion, and stair climbing by using FIM scores. They found that changes in FIM scores correlated with changes in static balance (rs=.413 to .595). Poor weight-bearing ability on the affected side in the standing position has also been found to be related to functional tasks like reaching or sit-to-stand tasks (Hyndman et al. 2002, Eng & Chu 2002) maximum gait speed (Titianova & Tarkka 1995) and risk for falls in the direction of the paretic side (Ikai et al. 2003). The risk of falling increases with increasing motor impairment or with both increasing motor and sensory impairments (Yates et al. 2002). In particular poor coordination between extremities and trunk, and an impaired ability to control lateral stability (Maki & McIlroy 1997) together with decreased activity of the hip abductors are associated with an increased risk for falls (Lord et al. 1999, Rogers & Mille 2003).

2.5.2 Balance and recovery of functional capacity

Balance status is also one of the more significant predictors of length of stay in in-patient rehabilitation (Brosseau et al. 1996, Wee et al. 1999) and stroke rehabilitation outcome (Franchignoni et al. 1997, Juneja et al. 1998). Sommerfeld and Arbin (2001) found that the ability to rise from a chair in less than 15 seconds and remain erect for 15 seconds with or without aid, 10 days after onset, had the greatest impact on early discharge home after acute stroke, together with normal bladder function, normal sensory ability and living with another person. In the acute phase of stroke, especially, the status of postural changes and of sitting balance has been found to be important predictor of rehabilitation outcome (Feigin et al.1996, Franchignoni et al. 1997, Hsieh et al. 2002). Feigin et al. (1996) found that sitting equilibrium 2 weeks post stroke was a predictor of walking ability 6 months post stroke. In addition balance ability is one important factor when predicting patients' risk for falling (Teasell et al. 2002, Rosendahl et al. 2003).

2.5.3 Balance and cognitive factors

Clinical experience suggests that cognitive deficits like visual inattention and difficulties in memory functions have an adverse effect on postural control and balance. For example, impairments in attention may have an impact on the ability to safely carry out activities such as gait and postural changes. According to the findings of Hyndman and Ashburn (2003), in patients with stroke the balance and function of those with normal attention were better than those with abnormal scores ($p<0.01$). In particular, patients who had impaired sustained and / or divided attention had more problems with ADL functions and more falls than patients with normal attention ($p<0.01$). Cherney & Halper (2001) found that subjects with visual neglect had significantly more days from onset to admission and longer in-patient rehabilitation. Brosseau et al. (1996) suggested that functional status together with balance and perceptual status were significant predictors of length of stay. In contrast Tyson et al. (2006 a) found that although visual neglect appeared to correlate with balance ability when it was entered into an individual analysis, the apparent significance was lost when it was entered into a multifactorial model with other significant impairments such as weakness and sensory loss.

2.5.4 Changes in strategies to control balance after stroke

As soon as patients with stroke start to move independently they start to develop strategies which they utilize in doing tasks despite their balance impairments. Patients develop these strategies when they attempt to respond, immediately after the lesion, on the basis of the best neural system available (LeVere 1980). However these strategies are not always optimal (Carr & Shepherd 2000, Shumway-Cook & Woollacott 2001). This occurs when a person attempts to achieve a goal using movement patterns or strategies which differ from those that would normally be used, such as using the nonaffected upper limb for support in performing a task, which would normally be performed without extending the BoS. In these cases the normal pattern of muscular activity is altered to compensate for the weak side (Lee et al. 1997, Kirker et al. 2000 a). Kirker et al. (2000 a) found that patients with stroke are more stable when standing, i.e. they maintain their postural control better, as soon as the center of pressure is successfully shifted above the unaffected limb. This finding suggests that the asymmetrical stance of people with hemiparesis may be a compensatory strategy to overcome muscle weakness and existing perceptual deficits (Eng & Chu 2002, Garland et al. 2003, Dickstein 2004). For example patients who find it difficult to shift their weight onto the paretic side during reaching tasks use a variety of strategies, such as reaching sideways by lateral movement of the spine, or rotating the legs (Carr & Shepherd 2000), or by stepping and grasping movements of the limbs (Maki & McIlroy 1997). Although the normal pattern of muscular activity is altered to compensate for the weak side, the early post-stroke use of compensatory strategies does not necessary prevent the later return of normal muscle activation patterns (Kirker et all. 2000 a, Kirker et all. 2000 b). In the study by Kirker et al. (2000 b) hip muscle activity in thirteen acute hemiplegic patients was EMG response tested as soon as they could stand after stroke (median six weeks) and serially during recovery. Four patterns of hip muscle activity were seen: no response at all; no response in hemiparetic muscles but compensation by contralateral muscles; an appropriate, if delayed, response in the hemiparetic abductor but not adductor muscles; and a relatively normal pattern in both hemiparetic muscles. During recovery nine out of 13 patients showed a change in their pattern of hip muscle activity. All patients who initially resisted the sideways pushes solely with muscles of the unaffected leg later regained use of the hemiparetic hip abductors. The pattern of hip muscle activation changed towards normal during recovery in most patients. Use of compensatory strategies early post stroke in these subjects did not prevent return of normal patterns of muscle activation later. Previous studies in moderately to severely impaired subjects have also described excessive trunk or hemiparetic shoulder girdle movement in pointing and in reaching-to-grasp movements, rather than trying to achieve restitution of the original arm function (Cirstea & Levin 2000, Michaelsen et al. 2001). In helping to identify patients' with stroke balance problems during movement, physiotherapists need scales with which to predict patients' ability to cope with everyday tasks needed in their home lives and their risk for falls.

2.6 Existing balance scales used in stroke rehabilitation

Because a number of different aspects of balance impairment following stroke need to be considered, several tests, both simple and sophisticated, methods of assessing have been developed for the clinical measurement of balance. Hayes (1990) classifies the methods of assessing balance problems according to the sophistication of the measures and what they are measuring: 1) global, clinical measures of balance dysfunction, 2) sophisticated instrumented perturbation techniques (e.g. the Sensory Organisation Balance Test (SOT), Shumway-Cook & Horak

1986), and 3) simple quantitative tests of static postural instability measured on a force platform (Sackley et al. 1992). The first group of measures are used to guide therapy and evaluate therapeutic outcomes like timed balance tests or functional tests (e.g. the Get Up and Go test, Mathias et al. 1986). The second group of measures are used to differential diagnoses or specific therapeutic intervention. They are systems that move the base of support or systems that move the centre of gravity relative to the base of support (Duncan et al. 1990 a). In the third group some of the commonly used existing measures, such as instrumented perturbation techniques and force platform measures are sophisticated and easy to quantify but are often expensive and remote from the realities of the clinical situation (Collen 1995). In this section we concentrate on the patient-related factors and psychometric properties, such as reliability, validity and sensitivity of the clinical balance measures used in stroke rehabilitation.

Most of the clinical balance tests have been developed to measure either static or dynamic balance ability. Static balance tests have been developed to measure the ability of a person to maintain the body's centre of gravity within the base of support and to maintain a series of sitting or standing positions of increasing difficulty when the balance of that person is not perturbed (Bohannon & Leary 1995, Franchignoni et al. 1997). The scoring of these tests is mainly based on the time the subject can maintain the requested position. In addition the symmetry of the static position can be evaluated by measuring the distribution of the weight of the lower extremities on two digital scales (Bohannon & Waldron 1991). Other tests, often referred to as dynamic or functional balance tests, are used to assess balance in response either to self-initiated movements or to external perturbations (Dicstein & Dvir 1993). These tests encompass functional tasks including items related to daily living, like switching from sitting to standing or picking up an object from the floor or in front. The scoring of functional balance tests is mostly ordinal and is usually based on the amount of assistant.

Although several balance scales are used in stroke rehabilitation, there are few measures which could be used to evaluate balance ability throughout the rehabilitation process without a floor or ceiling effect. A number of factors can be considered when choosing a balance instrument for patients with stroke. Patient-related factors, such as patients' age or level of function must be considered to avoid floor or ceiling effects. Floor effects result when a chosen test is too difficult for the patient; thus, scores are all uniformly too low. Alternatively, a test that is too easy will result in scores that are all uniformly too high, creating a ceiling effect. There are several valid, reliable and sensitive balance measures but these are only suitable for use with patients with a narrow range of abilities. One example of such a measure is the Forward Reach Test (Duncan et al. 1990 b), which is suited only to patients who can stand and reach unaided but whose standing balance is not within normal limits (Tyson et al. 2006 a). Bernhardt et al. (1998) measured changes in static and functional balance in people with recent stroke. They found that during the 4-week experimental period, the static balance tests exhibited ceiling effects, whereas the functional tests of balance exhibited floor effects. Therefore, they recommended combining the tests to avoid these problems. One example of this kind of measure is the Postural Assessment Scale for Stroke Patients (PASS) (Benaim et al. 1999). The PASS was elaborated in accordance with 3 main ideas: 1) the ability to maintain a given posture and to ensure equilibrium in changes of position; 2) a useful scale should be applicable to all patients, even those with very poor postural performance; and 3) a sensible scale should contain items with increasing levels of difficulty. The PASS contains 12 four-level items of varying difficulty for assessing the ability to maintain or change a given lying, sitting, or standing posture with or without outside support (Benaim et al. 1999). Studies have shown that the PASS is reliable and valid in clinical use (Benaim et al. 1999, Mao et al. 2002). Mao et al. (2002) studied the frequency distribution of the PASS scores and found that the PASS did not suffer from floor or ceiling effects at 14 days (floor effect 8,1 %, ceiling effect 3,3 %) and 180 days (floor effect 3,8 and ceiling effect 17,5 %) after stroke. On the other hand Benaim et al. (1999) found inconsistent results, suggesting that the PASS is suitable for the assessment of stroke survivors during the first three months, but after that it suffers from ceiling effects because as nearly 40 % of patients scored 36/36 at three months.

One of the most widely used clinical balance scales is the Berg Balance Scale (BBS) (Berg et al. 1989). It was originally developed for use with elderly people, but the psychometric properties of the BBS used in stroke patients have been examined with positive results (Mao et al. 2002). The BBS evaluates a person's performance on 14 items (1 sitting and 13 standing items) related to balance function that are frequently encountered in everyday life. A 5-point ordinal scale of 0 to 4 is used. The scoring system of the BBS is based on the length of time a position can be maintained or the time taken to complete a task and on the amount of assistance required for effective balance control (Berg et al. 1992). The BBS has been found to suffer from floor effects in the initial phase of stroke, thus limiting its use among patients with very poor postural performance (Mao et al. 2002).

There are also several functional tests, which include also balance tasks, such as the Fugl-Meyer Sensorimotor Assessment (FMA) (Fugl-Meyer et al. 1975) and the Motor Assessment Scale (MAS) (Carr et al. 1985). The FMA is based on the appearance of stereotyped synergies observed during early recovery following stroke. It was developed by Fugl-Meyer and co-workers (Fugl-Meyer et al. 1975), who standardized the Brunström assessment method, describing the stages of motor recovery as follows: reflex activity, stereotyped synergy patterns, movements that deviate from synergy, and normal movement. The Balance subscale (FM-B) is one of 6 subscales of the FMA, which was designed to evaluate impairment after stroke. The FM-B contains 7 three-point items, 3 for sitting and 4 for standing. The total score ranges from 0 to 14. Results of previous studies investigating the reliability and validity of the FM-B have been controversial (Mao et al. 2002). Some studies found the sitting balance items, especially the 2 parachute reaction items, to be unreliable and invalid (item to total, r=-0.03). The test also includes an item measuring postural reactions to external perturbations. Manually induced perturbations have proved difficult to standardize (Berg et al. 1989, Malouin et al. 1994).

The Motor Assessment Scale (MAS) (Carr et al. 1985) was designed to measure the functional capacities of stroke patients. The recent updated version consists of eight quantified motor activities, i.e. rolling, sitting balancing, sitting-to-standing, walking, upper-arm function and hand movements. It is seven-point ordinal scale, so these items are scaled from 0 to 6. The criteria for scoring are provided together with general rules for administering the scale. The MAS, like some other scales (Nieuwboer et al. 1995), addresses postural reactions in response to voluntary movement from a sitting position, e.g. leaning forwards and sideward, and performing trunk rotation.

2.6.1 Reliability of balance scales

In the case of a new measurement tool it is reliability that should be tested first, since an unreliable tool will never be valid (Atkinson & Nevill 1998). Reliability reflects the dependability or consistency of a test, that is, its ability to measure accurately and predictably without variation when no true change has occurred. Consistency is reflected through both interrater and intrarater reliability. Interrater reliability indicates a high degree of agreement among multiple raters. If more than one therapist is to examine a patient over time, interrater reliability is critical to accurate data collection (Guccione 1991). If trained testers cannot agree, the assessment procedure lacks objectivity utility. Intrarater reliability indicates a high degree of correlation when performance is measured by the same therapist over repeated applications of the test. In many studies videotaped performances have been used to evaluate inter- and intrarater reliability among patients with stroke (Berg et al. 1989, Dalley 1999). In the acute phase of stroke in particular a patient's condition can vary during the course of one day and test-retest measures are problematic. Although videotape measures present some problems they are justified in clinical conditions. Besides internal consistency, the reliability of a measure provides an assessment of how the items in the scale relate to each other and measure as a whole.

Irrespective of the aspect of reliability, 2 components of variability are associated with each measurement error: systematic bias and random error (Atkinson & Nevill 1998). Systematic bias refers to a general trend for a measurement to be different in a particular direction between repeated tests (e.g. learning and fatigue effects). Random error can occur due to inherent biological or medical variation or inconsistencies in the measurement protocol. Random error is usually larger than systematic bias.

2.6.2 Validity of balance scales

When a new instrument is compared with a "gold standard", the resulting validity is called concurrent or criterion validity. It is a degree to which the instrument agrees with other instruments that measure the same factors (Mao et al. 2002, Wang et al. 2002) For example, the criterion validity of the PASS was studied by comparing the measure to the BBS and the FM-B. The Spearman's p correlation coefficient ranged from 0.80 to 0.97, indicating good criterion validity of the PASS. Several studies have also established a correlation between laboratory tests of postural sway and clinical balance measures (Berg et al. 1992, Stevenson & Garland 1996, Niam et al. 1999). Niam et al. (1999) found the strongest negative correlation between the BBS and CoP speed (r=-.57) in the anterior-posterior direction in subjects with stroke. This study indicated that those patients with greater sway measured by movement of CoP had a lower clinical balance score. However the moderate correlation between the clinical and laboratory measures of balance indicated that different aspects of balance seem to be captured by these tests. The amount of postural sway a patient demonstrated seems to reflect only a portion of the control needed during the more functional measure of balance. Hence, both of these measures may be needed during a complete assessment of balance (Niam et al. 1999)

A new instrument is also frequently compared with an established construct, i.e., the performance of an instrument is compared with other measures that might be related but not identical. Several balance measures have been compared, for example, with the functional tests like the Barthel Index (BI) and the Functional Independence Measure (FIM) (Franchignomi et al. 1997, Benaim et al. 1999, Mao et al. 2002). In the present study the term construct validity is used to refer to this type of validity. Another method of validating an instrument is to measure its ability to predict health outcomes such as functional status or risk for falling. This kind of validity is called predictive validity. Franchignoni et al. (1997) studied the construct and predictive validity of the Trunk Control Test (TCT) in post acute patients with stroke by comparing TCT scores at admission and discharge with the FIM. The construct validity of the TCT was confirmed by the correlation between this test and the FIM scores ($p<.0001$) and TCT at admission alone explained 71 % of the variance in motFIM score at discharge. The TCT examines four axial movements: rolling from a supine position to the weak side and to the strong side, sitting up from a supine position, and sitting in a balanced position on the edge of the bed with feet off the ground for 30 seconds. Finally, sensitivity is an important attribute of an instrument. Sensitivity is the degree to which a diagnostic test detects a disorder or dysfunction when it is present. Sensitivity to change over time, often called also responsiveness, is also important when selecting instruments in clinical work.

3 PURPOSE AND PROBLEMS OF THE STUDY

The research and developmental work was carried out with physiotherapists in the public health service of East Savo, in Finland. The purpose of the project was to develop an uniform method of assessment and activating and emancipating therapy between organizations supplying rehabilitation services for stroke patients. The purpose of this thesis was to develop a reliable and valid Postural Control and Balance for Stroke (PCBS) test which could be used in stroke physiotherapy to monitor balance ability across the whole rehabilitation period. The biggest difference between the PCBS test and the other balance scales is the scoring, which was designed to evaluate patients' own attempts to control their balance during task performance and how safe and optimal these strategies are.

In addition this thesis presents the controlled follow-up study on the influence of activating physiotherapy on stroke patients' cognitive and physical functions and independent living at home compared with the effects of traditional treatment. An activating physiotherapy intervention was constructed to support the principle of post stroke functional recovery as a learning process which requires both physical and cognitive actions. Action comprises not only motor factors but also cognitive and perceptual factors.

This thesis also reports the results of the investigation into how physiotherapists use the PCBS test results in counselling sessions.

More specifically the aims were as follows:

to determine (a) the *reliability* of the PCBS test assessing, intra-rater reliability by comparing the repeat ratings of videotaped test performances by each of the raters and inter-rater reliability by comparing the ratings of the videotaped test performances between the raters and (b) to assess the *distribution and responsiveness* of the PCBS test to changes during a 12-month follow-up (II);

to evaluate the *criterion validity* of the PCBS test (I) by examining the relationship of the measurements obtained with the standing balance items of the PCBS test with those obtained for postural sway by the use of a force platform and by examining the relationship between the symmetry of weight distribution measured using digital scales and lateral symmetry as measured with a force platform;

to determine (a) the *construct validity* of the PCBS test by comparing the initial PCBS test scores with initial values obtained for the Barthel Index (BI) and cognitive deficits, (b) the *predictive validity* of the PCBS test by studying the significance of the test at an early stage in predicting functional status and tendency to falls at 90 days after stroke, and (c) the *sensitivity* of the PCBS test by comparing the changes between the initial and 90 days' measures and by examining the ability of the test to discriminate between healthy people and stroke patients (III);

to examine the *influence of activating physiotherapy* on stroke patients' cognitive and physical functions and independent living at home compared with traditional treatment over a 12-month follow-up (IV).

to investigate the *content of communication* in counseling sessions where physiotherapists and patients with stroke and, were necessary, their caregivers discussed about the patients' PCBS test results, which had been tested and videotaped at different stages of the rehabilitation process (V).

4 SUBJECTS AND METHODS

4.1 Study design

The development procedure and study design for the proposed PCBS test battery are presented in Figure 1. Before the reliability and validity studies a study of the literature in order to select a preliminary test battery and system of scoring, and was followed by a pilot study to test for feasibility. The proposed test items are presented in Figure 3. The schedule of the controlled study of activating vs. traditional therapy is presented in Figure 2.

4.2 Development of Postural Control and Balance for Stroke (PCBS) Test

The early work on developing the PCBS test started at the beginning of the 1990s during the physiotherapy development project in conducted the hospital of Jorvi in Finland (Talvitie et al. 1996). In the late 1990s the research group continued the developmental work on the PCBS test with the physiotherapists working at the Central Hospital of Savonlinna. They noticed that the system of scoring, which was based on the amount of assistance needed, did not support the planning of therapy where the emphasis is on the intensive independent balance training of stroke patients.

When observing the independent performance of patients with stroke which required balance control, Cirstea and Levin (2000) found that people with moderate to severe balance impairments had additional ways of performing tasks to compensate for motor deficits and that the performance of people with mild impairments tended to resemble that of healthy people. These findings run parallel to the empirical experience of the present research group and physical therapists. For this reason a new classification for sitting and standing posture was developed for the assessment of the strategies used by patients to control their posture during task performance. The scoring of the postural change items of the PCBS test is based both on the amount of assis-

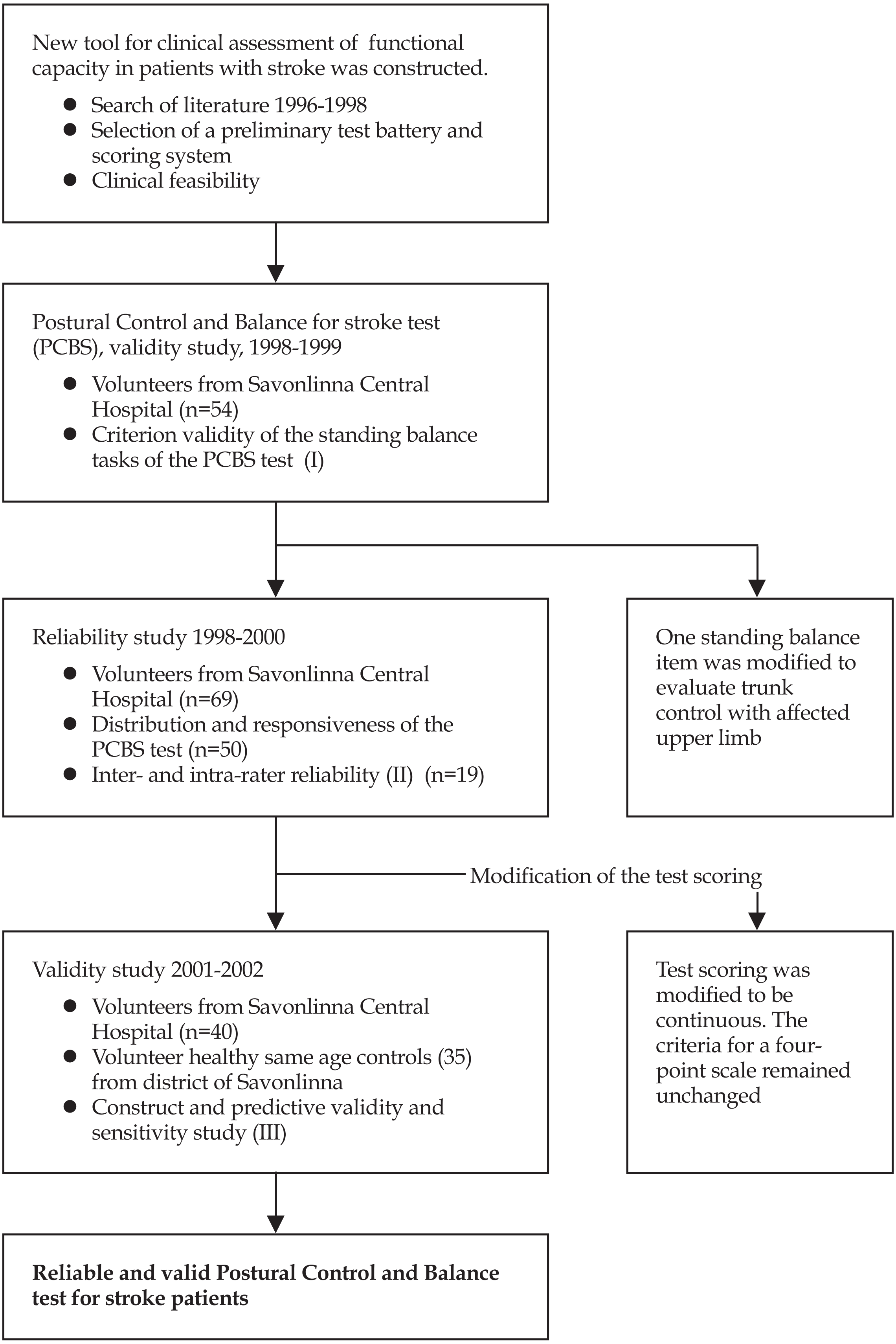

FIGURE 1 The development procedure and study design for the proposed PCBS test battery.

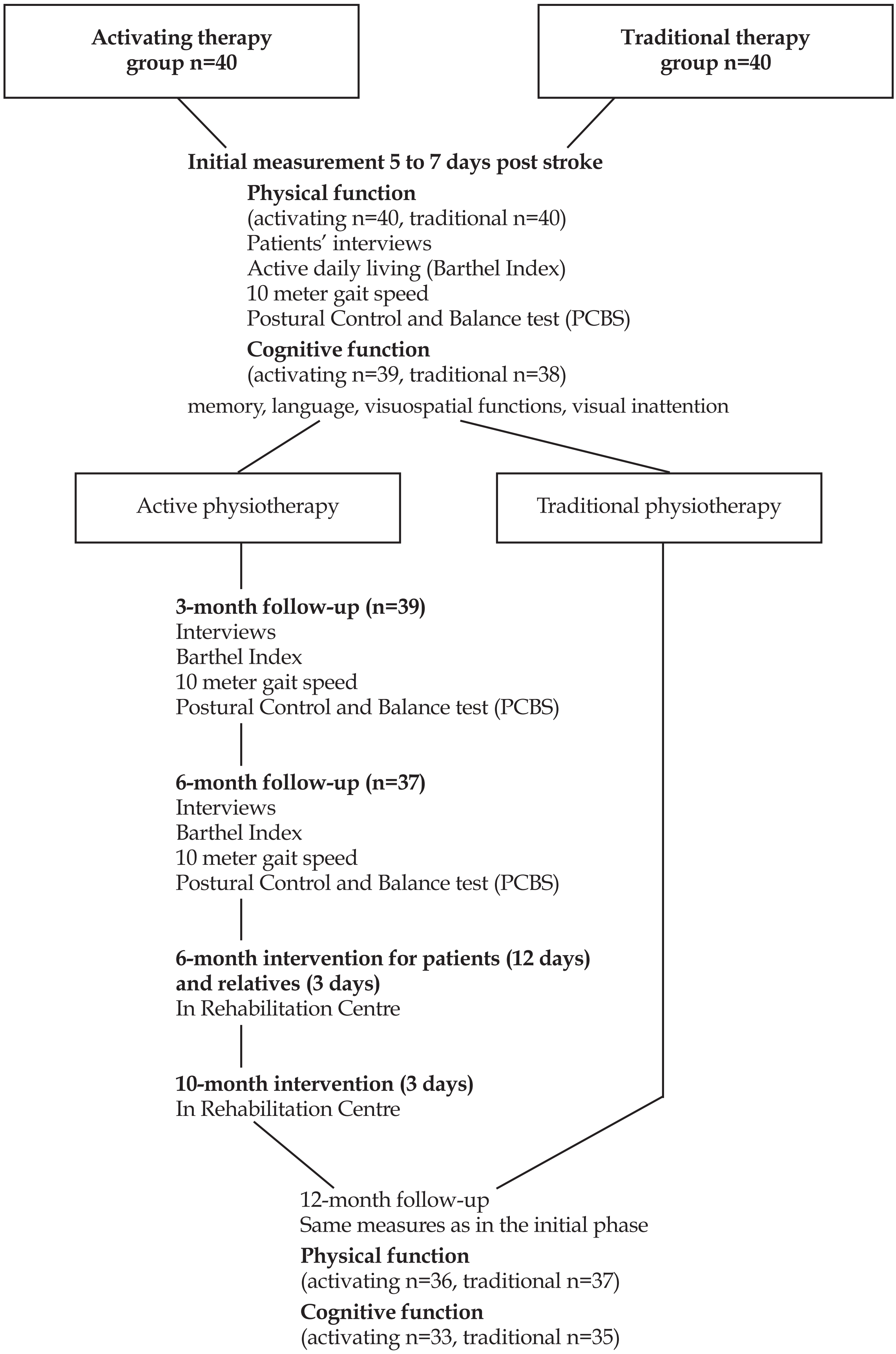

FIGURE 2 Schedule of the controlled study of activating vs. traditional therapy.

tance needed by patients and on qualitative criteria at each level of the classification. Particularly in the acute phase of stroke, the amount of assistance patients need is essential for both physical therapists and nursing staff.

The components, items and the scoring in the PCBS test battery are given in Figure 3. The PCBS test contains 26 items divided among three subscales: 7 items for postural changes, 5 items for sitting balance and 14 items for standing balance. The scoring is on a 4-point scale, except for the static standing balance items where a 3-point scale is used. In all the studies except study III the scoring started from 1; however in study III it was changed to run from 0-3 because of the question regarding the continuous nature of scoring raised by the reviewers. However the criteria for the scale remained unchanged. Hence the maximum test score in the final test battery is 62, as in study III.

The postural change items provide information about movements, such as the ability to get out of bed, which are needed in everyday life. The level of independence in performing the postural change items is measured. The balance tasks in the sitting position assess balance ability in the context of performing a task, such as touching a marked place on the bed with the elbow, reaching forward horizontally for an object or picking up an object from the floor. The standing balance tasks are divided into weight distribution tasks, and static and dynamic tasks. The symmetry of weight distribution and weight shifting was measured (in kilograms) in using 2 digital bathroom scales. Adjoining (i.e. side-by-side) scales were built into a frame. Each scale had a footprint silhouette on its surface to ensure consistent foot placement by the subjects.

The dynamic tasks require the subject to bring the centre of gravity closer to the edges of the base of support by actively shifting the body forward, as in reaching up for an object or from side to side as in touching a marked spot on the right or left side. In the original test the item "Placing an object with the left arm onto a chair" was changed because we found that the lifting tasks were more effective for assessing the ability of people with strokes to grasp an object than for assessing trunk control during reaching for an object. Hence we changed the task to "Touching a marked place with the right elbow on the right 30 cm from the hip".

The new four-point scale used to measure the sitting and standing balance items was developed to capture the strategies used by patients to control their posture during task performance. The static balance tasks, which are evaluated on a time-based three-point scale, evaluate the ability to maintain a position of increasing difficulty by diminishing the base of support from standing feet apart to feet together to standing on one leg. Detailed information about the process of developing the PCBS test is presented in original papers I-III.

Postural Changes

* Turning onto right side when supine…………………………………….. ……. points
* Turning onto left side when supine……………………………………….. ……. points
* Sitting up on the right-hand side of the bed…………………………….. ……. points
* Sitting up on the left-hand side of the bed……………………................ ……. points
* Moving in a sitting position from bed to a chair and back to bed
    * moving to the right…………………………………………….…... …..... points
    * moving to the left………………………………………………....... …..... points
* Standing up without using the hands……………………………...... ……. points

Classification of Postural Changes:

3 = Independent
    * The performance is carried out safely and in a controlled way without assistance or aid.
2 = Independent but decreased control
    * The performance is carried out independently but there is some weakness in controlling movements and in the fluency of the performance.
1 = Takes part actively but needs assistance
    * The patient needs either verbal or manual guidance at some stage in the performance.
0 = Total dependent
    * The patient is dependent on assistance throughout the performance.

Sitting Balance

* Sitting unsupported 1 minute   0 = can not sit
    1 = can sit .... ……. points

* Touching a marked place with the right elbow on the right 30 cm from hip ...…. points
* Touching a marked place with the left elbow on the left 30 cm from hip ...…. points
* Reaching forward horizontally for an object
    * with the better hand, forehead to point of knees……………….............. ……. points
* Bending down to pick up an object from the floor 20 cm from toes
    * with the better hand……………………………………………….......... ……. points

Weight distribution

* Standing on digital scales for 30 seconds
    * Right leg ….. ....… kg
    * Left leg …... .... kg
* Weight shifting
    * On the right leg …………………………………………..................... …….. kg
    * On the left leg ……………………………………….......................... …….. kg

Standing Balance

* Standing feet apart for 30 seconds   0 = can not
    1 = can stand .... ……. points
* Standing feet together (max. 15 sec.)   0 = 0 - 5 sec.
    1 = 6 - 10 sec.
    2 = 11- 15 sec. .... ……. points
* Standing on one leg (max. 15 sec.)   0 = 0 – 5 sec.

* right leg 1 = 6 - 10 sec. ……. points
* left leg 2 = 11- 15 sec. ……. Points

* Bending down to pick up an object from the floor
  * with the better hand 20 cm from toes……………………........……......... ……. points
* Touching a marked place with the right elbow on the right 30 cm from hip ….… points
* Touching a marked place with the left elbow on the left 30 cm from hip ……. points
* Reaching up for an object with the better arm, feet in walking position
  * right foot in front…...………........... .....… points
  * left foot in front…..………............ .....… points
* Turning 360 degrees on the spot
  * right side leading.…...………......... ……. points
  * left side leading…...………............ ……. points

Classification of Sitting and Standing Balance

3 = good control of balance
  * control of balance during performance as demanded by the task. The performance is fluent and economic.

2 = moderate control of balance
  * can perform the task, but the control of the movement and the fluency of the performance is insufficient.

1 = difficulties in controlling balance
  * difficulties in controlling balance during the task (lurches, extra footsteps, grips support at some stage during performance) compensatory movement of upper limbs and / or trunk.

0 = unable to control balance.
  * difficulties in settling in the start position demanded by the task and maintaining balance during performance without the risk of falling.

FIGURE 3 PCBS Test Items and Criteria for Scoring

4.3 Development of activating physiotherapy

At an early stage of the activating physiotherapy project current practice in stroke physiotherapy was studied by interviewing physiotherapists and videotaping treatment sessions given in the district of Savonlinna Central Hospital (Talvitie & Reunanen 2002, Reunanen 2003). The interviews with the physiotherapists showed that they highlighted patient-centered values, but in practice had difficulty in giving their patients a voice in their treatment. The studies showed further that the physiotherapists lacked methods of assessment and almost exclusively used verbal and manual techniques in stroke rehabilitation (Talvitie & Reunanen 2002, Reunanen 2003). Fourteen physiotherapists from the administrative district of Savonlinna Central Hospital participated in the three-year educational intervention, during which the activating physiotherapy programme was developed. During this time the researchers carried out 20 training interventions and counseled the physiotherapists in their therapeutic practices.

During the educational process the physiotherapists in collaboration with the researchers developed activating therapy methods in clinical work (Talvitie & Reunanen 2002, Reunanen 2003). The activating physiotherapy programme was based on the idea that functional recovery after stroke is a learning process (Wishart et al. 2000, Hochstenbach & Mulder 1999). Activating therapy means a reduction in the use of passive handling techniques and a new emphasis on manual, verbal and visual guidance (Talvitie 1996). The training of the patients was designed to emphasize control of balance and posture during the first three months followed by progressive strength and endurance training (Potempa et al. 1996, Weiss et al. 2000).

The main problem encountered among the physiotherapists was how to get patients to learn during the therapy sessions so that they could transfer their learned skills outside the therapy session. Learning requires patients to take an active role in planning and carrying out therapy, which calls not only for physical but also cognitive and mental actions (Hochstenbach & Mulder 1999).

One important aspect when developing activating therapy was to plan tasks of an appropriate level of difficulty so that patients could practise safely and manage to perform the tasks without manual guidance by the therapist. Small modifications to the task or environment can enable a person to move independently for example, to stand up from a seat if its height is raised. This kind of training is task-focused, not therapist-focused. Small modifications to the task or environment can also activate patients' problem solving skills (Shephard & Carr 2006). Studies support the idea that setting tasks with inherent feedback can be desirable, as it encourages self-control of performance, which has been found to enhance learning in healthy subjects (McCombs 1989). In addition a systematic follow-up and evaluation was implemented to support the patients' rehabilitation process. Table 1 shows the principles underlying activating therapy vs. traditional therapy.

4.4 Subjects

The study population consisted of a total of 212 subjects: 177 patients with stroke and 35 healthy controls. Some of the subjects (n=66) participated in more than one study (Table 2). The study was approved by research ethics committee of the Hospital District of East Savo. All the participants gave their informed consent before the commencement of the study, in accordance with the requirements of the hospital's research ethics committee. All subjects were initially diagnosed with computerized tomography. The common inclusion criteria for admission to all the studies (I-V) were primary diagnosis of cerebrovascular accident, symptoms of stroke lasting over 24 hours (to exclude very slight stroke symptoms), and the ability to understand simple instructions. The subjects fulfilling the inclusion criteria were selected from the patient material of the Neurological Department and policlinic of Savonlinna Central Hospital in Finland between the years 1998–2003. The patients for the activating and traditional follow-up study were selected between the years 2001–2003.

TABLE 1 Comparison of activating and traditional physiotherapy

	Activating therapy	**Traditional therapy**
Approach	Therapy supports patient's own decision-making and participation in problem-solving	Therapy is therapist-centred with therapist setting targets and choosing methods
Planning of therapy	Systematic assessment of functional capacity and follow-up of therapy Progressive training suited for different stages of rehabilitation. Systematic use of training diaries	No systematic assessment of functional capacity
Training methods	Task-centred training - training of posture control and balance Functional exercises - strength training - endurance training	Training normal patterns of movement - normal movement with facilitation techniques - preventing spasticity with inhibition techniques
Methods of guidance	Effecting cognitive and motor learning by means of planned use of verbal, visual and manual guidance	Therapy is based on manual technique - inhibition of abnormal movement patterns and uncontrolled tension in muscles
Training environment	Therapist-inducted responses are replaced by patient-initiated interactions with objects in the environment. Training environment supports patient's active participation in their exercises	Therapist-induced responses are commonly used. Rehabilitation units do not function as learning environments

TABLE 2 Characteristics of study population (range)

Study		n	age (years)	gender (m/f)
I	Patients	54	62.5 (46-84)	36/18
II	Patients	69	69.6 (42-89)	41/28
III	Patients	40	72 (51-89)	12/28
	Healthy controls	35	69.5 (49-90)	12/23
IV	Activating therapy group	40	72 (51-89)	10/26
	Traditional therapy group	40	72 (47-85)	15/22
V	Patients	7	75 (68-87)	0/7
	Physiotherapists	3	40.5 (36-45)	0/3

* Patients in studies III, IV (activating therapy group) and V were from the same group of 40 patients and in studies I and II 26 patients participated in both studies

4.4.1 Reliability study (II)

For the inter- and intrarater reliability study nineteen patients were measured and video-taped one to eight weeks after stroke. Fifty patients met the common inclusion criteria and were measured 7 days, 120 days and 360 days after stroke for the study of distribution and responsiveness. The demographic data on the subjects with stroke are shown in Table 3.

Five physical therapists experienced in neurological physiotherapy (mean 12.5 years, range 5-18 years) participated as raters in the reliability study (II). Before the reliability study all the raters underwent a training session and read the PCBS test manual, which was drawn up with the aim of securing uniformity in the testing procedure and standardizing the measurement criteria. They practiced using the PCBS test and scored 12 demonstration videotapes in order to clarify the test scoring criteria with a physical therapist experienced in the use of the test.

TABLE 3 Subject characteristics, side of lesion, and stroke characteristics in study II

	Distribution and responsiveness study (n=50)	Reliability study (n=19)
Mean age, years (SD)	69.6 (11.4)	69.7 (8.8)
Range of age, years	42-89	55-85
Sex, male	31	10
Lesion side, left/right	18/26	6/10
Lesion side, both	2	0
Ataxia, dizziness	4	3
Infarct	36	15
Haemorrhage stroke	14	4

4.4.2 Validity study (I, III)

Fifty-four patients took part in the criterion validity study (study I), 26 with acute stroke (1-3 weeks post stroke) and 28 with chronic stroke (6 months - 13 years post stroke). In addition to the common inclusion criteria for admission to this study was the ability to maintain a standing position, eyes open for 30 seconds, without support. The demographic data on the subjects are shown in Table 4. Forty-five (83 %) of the 54 patients were cases of first stroke. Eight (15 %) of the 54 patients also felt dizzy, which interfered with their ability to maintain a standing position, especially with their eyes closed.

Forty patients were measured 7 days and 90 days post stroke for the study of the construct and predictive validity (study III). In addition to the common inclusion criteria were patients had to have been living independently at home pre stroke. Patients were excluded if they had mild disability (scored 18 points or more on the Barthel Index, scoring from 0 to 20) and did not need physiotherapy services 5 days after stroke onset or if they had morbid conditions such as cancer or diagnosed dementia. The demographic data on the subjects are shown in Table 5.

Thirty-five healthy controls, 12 men (mean age 64) and 23 women (mean age 75) were selected from the district of Savonlinna. The healthy controls for this study were recruited from two courses (n=19) for elderly community-dwelling people and their relatives held in a rehabilitation centre while the remainder (n=16) were recruited by asking for volunteers resident in the district of Savonlinna. Subjects were considered eligible for participation in the study if they were same age as the stroke subjects and if they were living at home without help and had no history of stroke or falls or any other morbid condition. Subjects' health status was determined during an interview by the physiotherapist who performed the measurements.

TABLE 4 Characteristics of patients with stroke in study I

	Acute stroke (n=26)	Chronic stroke (n=28)
Mean of age, years (SD)	65 (10.0)	60 (8.0)
Range of age, years	49-84	46-77
Sex, male	19	17
Side of lesion, left	7	17
Infarct	20	23
Haemorrhagic stroke	4	3
Subarachnoid haemorrhage	2	0

TABLE 5 Characteristics of patients with stroke in study III

	Male (n=12)	Female (n=28)	All (n=40)
Mean age (SD)	64 (11)	75 (8)	72 (10)
Side of lesion, n (%):			
Right	4 (33)	12 (43)	16 (40)
Left	6 (50)	15 (54)	21 (52)
Bilateral	2 (17)	1 (3)	3 (8)
Type of stroke, n (%):			
Ischemic	9 (75)	24 (86)	33 (82)
Haemorrhagic	3 (25)	4 (14)	7 (18)
Stroke severity †, n (%):			
Mild disability (BI, 15-20)	0 (0)	1 (3)	1 (2)
Moderate disability (BI, 10-14)	4 (33)	15 (54)	19 (48)
Severe disability (BI, 0-9)	8 (67)	12 (43)	20 (50)
Cognitive deficits ‡, n (%):			
Memory	8 (67)	27 (100)	35 (90)
Language	5 (42)	17 (63)	22 (56)
Visuospatial functions	8 (67)	24 (89)	32 (82)
Visual inattention	7 (58)	18 (67)	25 (64)
Not known	0	1	1

† Ebselen classification for Barthel-index at 7 days post-stroke

‡ Cognitive deficits have been measured at 30 days post-stroke.

4.4.3 Activating physiotherapy follow-up study (IV)

The inclusion criterion for the activating (n=40) and traditional physiotherapy group (n=40) was patients' independent living at home pre stroke. Patients were excluded if they had mild disability (scored 18 points or more on the Barthel Index, scoring from 0 to 20) and did not need physiotherapy services 5 days after stroke onset or if they had morbid conditions such as cancer or diagnosed dementia.

The demographic data on the subjects are shown in Table 6. In this study the patients were divided into an activating or traditional therapy group according to their local healthcare centre. The administrative district of Savonlinna Central Hospital contains seven local healthcare centres. Patients for the activating therapy group were recruited from the three centres whose physiotherapists were participating in the present project aimed at developing activating treatment for stroke rehabilitation. Participants for the traditional therapy group were recruited from the four centres where the physiotherapists were not participating in the project but carrying out traditional physiotherapy. The subjects were interviewed to elicit their professional and educational status. The educational and professional status of the patients in the different healthcare centres was very similar. The stroke subjects were screened for eligibility on admission to the central hospital and were recruited into the groups in chronological order.

TABLE 6 Baseline demographic and clinical data of the patients in the activating and traditional therapy groups in study IV.

Variables	Activating (n=40)	Traditional (n=40)	p value between groups
Number of females (%)	28 (70)	22 (55)	0.17
Mean age, years (range)	72 (51–89)	72 (47-85)	0.79
Education years (%)			0.24
≤ 9 years	35 (84)	31 (78)	
>9 years	5 (16)	9 (22)	
Previous stroke (%)	6 (15)	1 (2)	0.048
Previous heart infarct (%)	17 (47)	23 (62)	0.18
Diabetes (%)	11 (30)	9 (24)	0.61
Type of stroke (%)			1.00
Ischemic	33 (82)	33 (82)	
Haemorrhagic	7 (18)	7 (18)	
Side of lesion (%)			0.25
Right	16 (40)	17 (42)	
Left	21 (52)	19 (48)	
Bilateral	3 (8)	1 (2)	
No findings in CT	0 (0)	3 (8)	

4.4.4 Counseling study V

For study V seven patients were participated in different phases of rehabilitation. One counseling session took place during the test assessment conducted two weeks post stroke and one session in connection with the one-year follow-up. Two sessions were linked with the three-month and three sessions with the six-month assessment. All the patients were women, and their ages ranged from 68 to 87 years, with a mean of 75 years. Six patients lived at home, and one patient was in the central hospital. Three patients suffered from hemiplegia on the right side and three from hemiplegia on the left side. One patient had an infarct of the cerebellum in consequence of which her son attended the counseling session with her. All the patients with hemiplegia on the right side had aphasia and two of them had relatives present at the counseling session.

Three physiotherapists participated in counseling sessions where physiotherapists and patients with stroke and, as needed, their caregivers discussed the patients' postural control and balance, which had been tested and videotaped at different stages of the rehabilitation process. All these physiotherapists were women, and each had five to ten years experience in neurological physiotherapy.

4.5 Measurements

The measurements of balance, physical and cognitive capacity and other variables reported in the original papers are listed in Table 7.

4.5.1 Procedure of the PCBS test

Detailed directions for performing each item of the PCBS test are presented in the test manual, which physiotherapists used to standardize the performances (Appendix). All subjects received the same verbal instructions. All the tests followed a standard sequence, postural changes being measured first, followed by the sitting balance and finally standing balance tasks. Subjects were allowed to rest between tasks for a few minutes. All patients performed the postural change items. In the present study the static sitting (one minute) and standing (half a minute) items were used to assess whether the patients' posture balance was good enough to proceed with further testing. Subjects had to sit for one minute without support before being asked to perform other sitting balance tasks and, likewise, stand for half a minute before moving on to perform the other standing balance tasks. Smith and Baer (1999) used simple standardized clinical tests of mobility as inclusion criteria for more exacting tasks. It is essential that the level of independent performance can be assessed by means of a simple task to insure against unnecessary testing.

In the acute phase, all the postural change and sitting balance tasks and the standing balance threshold task (standing feet apart for 30 s) were performed in the ward of Savonlinna Central Hospital and took approximately 15 minutes to complete. The remaining standing balance tasks were performed in the hospital's functional capacity laboratory and took 15 minutes to complete. At the follow-up all the tests included in the PCBS test were tested in the outpatient department of physiotherapy in the hospital's functional capacity laboratory. Patients who were inpatients in the health centers of the Savonlinna district were tested there.

TABLE 7 The measures used in the data collection

Variables	Studies	Reference/method
Balance measurements		
PCBS test	I-V	
Postural changes	II-V	
Sitting balance	II-V	
Standing balance	I-V	
Standing balance test	I	Good Balance, Metitur Oy
1 Normal standing eyes open (EO)	I	
2 Normal standing eyes closed (EC)	I	
3 Feet together EO	I	
4 Feet together EC	I	
Anthropometry		
Body height	I	A scale on the wall
Body mass	I	Calibrated mechanic scale
Video tapes	II	Video camera
Interview		
Institutional care	IV	
Amount of outside home care	IV	
Walking distances outdoors	IV	
Fall surveillance	III	
Physical function		
Barthel Index (BI)	III, IV	Mahoney & Barthel 1965
10-meter gait speed	IV	
Cognitive function		
Memory	III, IV	Rosen et al. 1984, Wechsler 1996
Language	III, IV	Lezak 1995, Laine et al. 1997
Visuospatial functions	III, IV	Rosen et al. 1984
Visual inattention	III, IV	Lezak 1995, Schenkenberg et al. 1980

4.5.1 Reliability study (II)

The physiotherapists who participated as raters in the reliability study of the PCBS test (II), did not administer the tasks performed by the subjects. Instead the tasks were administered by a physiotherapist experienced in the use of the PCBS test. The measurements required a video camera and stopwatch, a beanbag and a measuring tape, and coloured tapes for the purpose of standardizing the conditions under which the measurements were performed. The test performances were videotaped for the reliability study. Each rater scored the patients' performances from the videotapes on the same day on two separate occasions. The interval between the two assessments was five to eight weeks. The intrarater reliability of the sum scores and of individual items was assessed by comparing the repeat ratings of the videotaped test performances by each of the five raters. Interrater reliability was assessed by comparing the ratings of the videotaped test performances between the five raters.

4.5.2 Validity study (I, III)

For the criterion validity study (I) of the standing balance tasks of the PCBS test two digital bathroom scales and the Good Balance force platform (Metitur Ltd, Jyväskylä, Finland) were used. The standing balance items and force platform measures were both performed on the same day. The force platform measurements were carried out first with every other subject, while the standing balance items of the PCBS test were administered first to the others. The standing balance items of the PCBS test were performed in the following order: standing on the digital bathroom scales, static balance, and finally the dynamic balance tasks.

The bathroom scales were calibrated prior to use by loading with certified weights. Adjoining (side-by-side) scales were built into a frame. Each scale had a footprint silhouette on its surface to ensure consistent foot placement by the subjects. The subjects were instructed to "step on to the scales", and stand with their feet 20 cm apart on the footprints and their arms in front of their body with one hand gripping the wrist of the other hand. They were told to direct their gaze at a fixed point at eye level on the opposite wall. After placing their feet on the silhouettes they were given the instruction "Stand as straight as possible for 30 seconds". After 20 seconds the load on each of the scales was recorded.

The Good Balance force platform used in this study is an equilateral triangle (800 mm), connected to a three-channel DC amplifier. Signals from the amplifier are converted into digital form using a 12-byte converter (sampling frequency 50 Hz), and stored on the hard disc of a personal computer. The X and Y coordinates of the center of pressure (COP) are defined on the basis of the data. The following variables are calculated: the extent of the medial-lateral movement of the COP (X movement); the extent of the anterior-posterior movement of the COP (Y movement); and the mean value of all the measurement points in relation to the midline of the platform (lateral displacement). When the test subject stands on the footprints marked symmetrically in relation to the midline of the force platform (feet 20 cm apart and feet together) the mean value (positive or negative) indicates the relative loading of the left and right legs. A negative mean value indicates a higher loading on the left leg and, correspondingly, a positive mean value indicates a higher loading on the right leg. Finally, the mean velocity of the X and Y movement of the COP is achieved by dividing the extent of the X and Y movements by time in seconds (Era et al. 1996).

The first test of postural sway on the force platform was normal standing with eyes open: the subject stood on the platform feet 20 cm apart on the footprints with the position of the arms and direction of gaze the same as in the weight-bearing test on the bathroom scales. The second test was conducted in the same way except that the eyes were kept closed throughout. The tests were carried out for 30 seconds and commenced only after the subject had achieved a relaxed stance. In the third test the subject stood on the platform feet together with arms and hands held in same manner as in the first and second tests. The fourth test was as the third except that the eyes were kept closed throughout. In the third and fourth test the measurements were carried out for 15 seconds. Lateral symmetry (mean X value) was analyzed only for the first test.

In study III, the PCBS test scores in the initial phase of stroke were compared with the initial values obtained for the initial Barthel Index (BI) and cognitive deficits to determine the construct validity of the test. In addition the initial PCBS test scores were compared with values obtained for the BI and fall accidents at 90 days after stroke to determine the predictive validity of the test (III). Both the PCBS test and the Barthel Index were performed at 7 and 90 days post stroke. All the measurements were performed during the same day by two experienced physiotherapists. Fall data were collected at the 90 days follow-up by asking the patients, or their relatives, in cases of aphasic patients, if the patients had fallen during the previous 90 days. The scale was dichotomous: 1=falls during the 90 days, 0=no falls. The neuropsychological examinations were performed 30 days post stroke onset by the same neuropsychologist.

The BI is considered by some authors to be a yardstick against which new instruments should be evaluated (Ahmed et al. 2003). It is composed of 10 items: feeding, transfer, grooming, toileting, bathing, ambulation, stair climbing, dressing, bowel control, and bladder control. In the BI, the total score for functional capacity runs from a minimum of 0 (completely dependent) to a maximum of 20 (completely independent) (Tilling et al. 2001). The BI is commonly scored from 0 (completely dependent) to 100 (completely independent). However, the 0 to 20 format is used in some European countries. In this study the Ebselen Acute Ischemic Stroke classification was used to classify stroke disability (15-20 points = mild disability, 10-14 points = moderate disability, 0-9 points = severe disability) (Yamaguchi et al. 1998). Reliability and validity of the BI have been found to be good (Tilling et al. 2001, Mahoney and Barthel, 1965). The ceiling effect of the BI has been documented previously as one of the limitations of this measure (Tilling et al. 2001, Ahmed et al. 2003).

The four neuropsychological domains most widely studied in the literature were tested in this study: memory, language, visuospatial functions and visual inattention.

Each neuropsychological domain was tested with several different measures. The test results for the same neuropsychological domain were combined to yield sum score.

The raw scores of the Wechsler Memory Scale (Wechsler 1996), a verbal learning and recall test and recall of the four pictures of the ADAS Test (Rosen et al. 1984) were combined to form a sum score for memory (Cronbach's alpha .93). The raw scores of the Token Test, Verbal Fluency Test (Lezak 1995) and Boston Naming Test (Laine et al. 1997) were combined to form a sum score for language (Cronbach's alpha .87). The raw scores of a clock perception test, the so called Greek cross test and recall of the four pictures of the ADAS Test (Rosen et al. 1984) were combined to form a sum score for visuospatial function (Cronbach's alpha .84). The error scores of the Line Bisection Test (Schenkenberg et al. 1980) and the Letter Cancellation Test (Lezak 1995) were combined to form a sum score for visual inattention (Cronbach's alpha .77).

4.5.3 Activating physiotherapy intervention (IV)

In this study the outcome measures of physical functional capacity used were the Barthel Index (BI), 10-meter gait speed and the Postural Control and Balance for Stroke (PCBS) test. Information was also collected on demographic variables and on patients' abilities to cope with every-day routines without external assistance, and walking distances outdoors. Cognitive function was evaluated by testing four neuropsychological domains: language, visuospatial functions, visual inattention and memory, as in study III.

Gait speed was timed over 10 m. Several researchers have demonstrated the reliability of gait speed measurements obtained in a clinical setting with a stop-watch over distances of 5 m, 6 m, 8 m, and 10 m (Green et al. 2002).

Patients (and if necessary relatives and nurses) were interviewed about their living conditions, amount of assistance at home and walking distances outdoors. Patients were classified as in institutional care if they were in long-term in-patient care, or in a nursing or old people's home or lived at home with a lot of assistance per day. A lot of assistance at home was defined as assistance on at least two occasions daily (dressing, washing, eating) and having a daily home-delivered meal. In Finland three assistance visits per day costs more than one day of residence in a nursing home (Kinnunen 2002).

One experienced physiotherapist performed the initial and final measurements in both the activating and traditional therapy groups. The same neuropsychologist performed all the initial and final neuropsychological measurements. He did not participate in the rehabilitation of the patients in the activating and traditional therapy groups. To further patients' active participation in the activating therapy group, the physiotherapists were directed to use various technological devices (interactive computerized systems, treadmills, bathroom scales, training boards) and to plan carefully the verbal instructions, manual and visual guidance they gave. All the patients in each group received the same comprehensive, multidisciplinary treatment for stroke patients according to the Finnish recommendations for stroke rehabilitation. In addition the activating therapy group received a period of intensive rehabilitation, where the idea was to support patients' independent training at home, at 6 months (12 days) and 10 months (3 days) in the rehabilitation centre.

4.5.4 Counselling study V

For study V the physiotherapists videotaped the patients' measurement sessions. The counseling sessions, during which the participants watched the measurement video, were held immediately after the measurements. The counseling sessions in turn were videotaped for the later analyses. The mean recording time per session was 15 minutes (range 7-35 minutes). The physiotherapists showed the last test performance and, in two cases, part of the performance before that as well. The PCSB test used in this study contained items on postural change and on sitting and standing balance. Additionally, a 10-meter walk and step walk were shown in five cases. The instruction given to the physiotherapists was to talk about the patient's performance as seen on video with the patients and their caregivers. All the videotapes were transcribed word-for-word by the researchers.

4.6 Statistical analyses

All the descriptive results are presented as percentages, mean or median, with standard deviation (SD) or interquartile range (IQR), and 95 per cent confidence intervals (95 % CI). In studies I and II statistical analyses were carried out using SPSS 8.0 for Windows.

In studies III and IV we conducted all the analyses using STATA version 9.2 (StataCorp, College Station, Texas).

In the reliability study (II) internal consistency was measured by Cronbach's alpha (α). The data consisted of the variables of the three scales and α coefficients were calculated to estimate the internal consistency within each scale separately and between the scales. Interrater reliability between the five raters was estimated by an interclass correlation coefficient (ICC). The appropriate statistical model for this purpose was considered to be two-way analysis of variance with the raters considered as random effects. Finally, the agreement between two consecutive ratings by the same rater was also measured by calculating the ICC. In addition the intrarater reliability of the total score of the test was analyzed with the weighted *k* statistic.

The range and distribution of the PCBS scores were examined as whole and separately for the postural change, sitting balance, and standing balance items. The floor and ceiling effects, which indicate the limited ability of a measurement to discriminate between subjects, are shown by the percentages of the sample scoring the minimum and maximum possible scores, respectively. In this study, floor and ceiling effects greater than 20 % were considered significant.

The Wilcoxon matched-pairs signed-rank statistic was used to determine the statistical significance of the change in the PCBS scores during 7 to 120, 120 to 360, and 7 to 360 days post stroke.

In the validity study (I) the relationships between the standing balance scores of the PCBS test and the measurements of postural sway using the force platform were analyzed by means of the Spearman rank-order correlation. Symmetry of weight distribution on the digital scales and lateral symmetry on the force platform was compared using the Pearson product moment correlation. In the validity study (III) variables with normal distribution descriptive values were expressed by mean and standard deviations (SD), and statistical comparisons between groups were done by using t-test. For variables with an ordinal or where a normal distribution was not assumed, descriptive values were expressed by median and interquartile ranges (IQR); statistical comparisons between groups were done by using the permutation test (Monte Carlo p-value) and Hodges-Lehmann estimation of the median difference. Measures with a discrete distribution were expressed as counts (%) and analysed by chi-square or Fischer's exact test, as appropriate. The normality of continuous variables was evaluated by the Shapiro-Wilk test. The most important descriptive values were expressed with a 95 per cent confidence interval (95 % CI). Median regression analysis (least-absolute value models) was used to model the relationship between the Barthel index and the predictor variables (PCBS subscales). Logistic regression analysis was used to model the relationship between falls and the predictor variables (PCBS subscales). Correlations were estimated with Spearman's correlation coefficients, using Sidak-adusted probabilities due to multiple testing.

In the activating physiotherapy follow-up study (IV) statistical comparison between the groups was done by using the t-test and analysis of covariance (ANCOVA). Variables with ordinal or non-normal descriptive values were expressed as medians and interquartile ranges (IQR), and statistical comparison between groups was done by using the Mann-Whitney test, median regression (also known as least absolute value models) and the Hodges-Lehmann estimation of median shift. Measures with a discrete distribution were expressed as counts (%) and analysed by chi-square (c2), Fisher's exact test or Mantel-Haenszel estimates. The normality of variables was evaluated by Shapiro-Wilk test. The logistic regression model with a robust estimate of variance was used to estimate adjusted risks for independent living at home. Survival analysis was based on the Kaplan-Meier estimate of the survival function. Internal consistency was estimated by calculating Cronbach's alpha coefficients. The most important descriptive values were expressed using a 95 per cent confidence interval (95 % CI). The ± level was set at 0.05 for all tests.

Qualitative analysis in the counceling study (V), utilizing discourse analysis, was used to gain a deeper understanding of the interactive behaviour that occurred between the physiotherapists and their patients. Co-constructed interaction is a social practice (Potter, 1996; Potter, 1998). Discourse analysis concentrates on how interlocutors construct meanings using language (Potter, 1996). By focusing on discourse as social practice, researchers are able to analyze discourse from the viewpoint of its entry into everyday conversation and texts (Wetherell & Potter, 1992). In the present instance, we first categorized the discourse according to the nature of the participants' verbal involvement in the counseling process. We were interested in the extent to which the encounters would show shared participation. Shared participation refers to the participants' ability to converse with each other, make comments and express their views on test performances, take the initiative in discussion and ask questions.

A detailed analysis of the extracts was undertaken to provide insight into the ways in which meanings were constructed by the participants. Our interest focused on how the participants responded to each other's speech in counseling sessions and the nature of the versions of social reality that they constructed. In the final analysis, verbal interaction related to the test performances was classified into different discourse categories.

5 RESULTS

5.1 Reliability study

Descriptive data for the reliability of the PCBS test are presented in original article II. The results of the interrater and intrarater reliability assessments are presented in Table 8 and 9.

TABLE 8 Interrater reliability of the sum variables for the Postural Changes, Sitting Balance, and Standing Balance items and the PCBS test as whole

Sum variables of the PCBS Test	Inter Rater Reliability									
	Rating 1					Rating 2				
	M	SD	ICC	Min ICC	Max ICC	M	SD	ICC	Min ICC	Max ICC
Postural Changes	22.12	6.69	.87	.84	.91	22.1	6.41	.86	.84	.91
Sitting Balance	14.70	4.82	.91	.76	1.00	14.63	4.67	.92	.76	1.00
Standing Balance	23.61	13.55	.95	.47	1.00	22.96	13.26	.92	.42	1.00
PCBS Test	60.43	25.06	.94	.47	1.00	59.69	24.34	.94	.42	1.00

TABLE 9 Intrarater reliability of the sum variables for the Postural Changes, Sitting Balance, and Standing Balance items and the PCBS test as whole

Sumvariables of the PCBS Test	Intra Rater Reliability			
	ICC	Min ICC	Max ICC	Kappa
Postural Changes	.91	.79	1.00	.75
Sitting Balance	.94	.64	1.00	.77
Standing Balance	.96	.37	1.00	.86
PCBS Test	.96	.37	1.00	.82

Internal consistency. The Cronbach's alpha for all the items of the PCBS test combined was .96: for the postural change items the alpha was .98, for sitting balance .77 and for standing balance .94. An alpha of .70 or higher was deemed indicative of internal consistency, although if the measure is to be clinically useful, an alpha of .90 is desirable.

Inter- and intrarater reliability. The ICC values for the inter- and intrarater reliability coefficients were estimated for the total PCBS test (.94 and .96) and separately for the postural change (.87 and .91), sitting balance (.91 and .94) and standing balance (.95 and .96) items. The weighted ***k*** statistics for the total PCBS scores was .82, indicating excellent intrarater agreement. Each item was scored at two points in time and the ICC values for interrater reliability ranged from .42 to 1. A poor ICC was found in one standing balance task: Touching a marked place on the right- and left-hand side (.42 and .46). To demonstrate intrarater reliability the scores of the ratings at two separate points in time should not be significantly different. The intrarater reliability coefficients ranged from .37 to 1. A poor ICC was found in one standing balance task: Touching a marked place on the left-hand side. (Table 8 and 9)

Distribution and responsiveness. The distribution of the PCBS test scores at 7, 120 and 360 days after stroke are displayed in Figure 4. The results show that the total PCBS test had limited floor or ceiling effects at 7 days (floor effect 10 % and ceiling effect 9 %), 120 days (floor effect 6 % and ceiling effect 13 %) and 360 days (floor effect 5 % and ceiling effect 16 %) after stroke. The different sections of the PCBS test, however, did show floor or ceiling effects (<20 %), postural change and sitting balance items showing ceiling effects and the standing balance items floor effects.

The responsiveness of the PCBS test at the different stages of recovery showed that the mean score 120 days after stroke was significantly higher than the mean score 7 days after stroke (57/85 and 46/85, $p<.0001$). The mean score 360 days after stroke was higher (61/85) than the mean score 120 days after stroke (57/85), but not significantly. These results indicate that the PCBS test was sensitive to the changes occurring during the first four months after stroke.

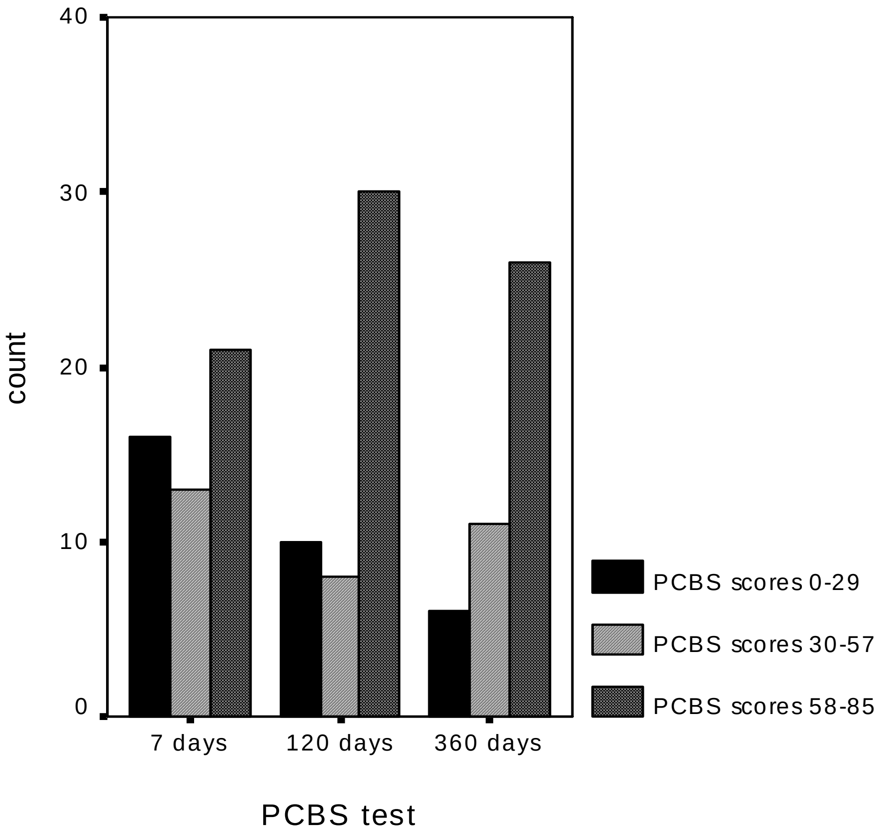

FIGURE 4 Distribution of PCBS test scores at 7, 120, and 360 days post stroke

5.2 Validity study

The descriptive data for the validity study is presented in original articles I and III.

5.2.1 Criterion validity

Relationship between performance of the standing balance tasks in the PCBS test and sway speed. The relationship between the results of the balance tests and sway velocity on the force platform was analyzed with the Spearman rank-order correlation (Table 10). A negative correlation was found between the sum variables for the balance tasks and mediolateral and anteroposterior sway velocity, especially with the subjects' feet apart and eyes open. The correlations ranged from -.53 to -.70 for the subjects with acute stroke and from -.44 to -.91 for the subjects with chronic stroke. The highest negative correlations were found between the standing balance scores of the PCBS test and the measurements of anteroposterior sway velocity in the subjects with chronic stroke when their feet were apart and their eyes open (r=-.74 to -.91). This negative correlation means that the lower the subjects' scores in both types of standing balance tests, the higher their sway velocity on the force platform.

In the subjects with acute stroke, the correlation between the results of the balance tasks and lateral sway velocity on the force platform when measured with the feet together and eyes closed was lowest (*r*=.04). In the case of seven subjects with recent stroke and 6 subjects with stroke of long duration, who were unable to maintain a stable stance on the force platform in the feet together/eyes closed condition without grabbing the handrail or moving the position of their feet or opening their eyes, measurement in this position had to be interrupted.

Relationship Between Weight Distribution and Lateral Symmetry. The relationship between the values for weight distribution obtained using 2 digital scales and the value for lateral symmetry (mean X movement value) obtained on the force platform was compared by dividing the total weight of each subject by 2, and comparing the weight distribution recorded on the scales with

TABLE 10 Relationship between the sum variables of the balance tasks and anteroposterior sway velocity and mediolateral sway velocity for subjects in the acute and chronic stroke groups in eyes-open (EO), eyes-closed (EC), feet together/eyes open (FTEO), and feet together/eyes closed (FTEC) conditions analyzed using Spearman rank-order correlation

		EO		EC	
Sum Variables	**n**	Lateral sway velocity	Ant.post sway velocity	Lateral sway velocity	Ant.post sway velocity
Static balance					
Acute group	24	-.63	-.68	-.53	-.59
Chronic group	27	-.52	-.74	-.54	-.44
Functional balance					
Acute group	21	-.70	-.67	-.68	-.68
Chronic group	18	-.66	-.91	-.76	-.47

		FTEO		FTEC	
Sum Variables	**n**	Lateral sway velocity	Ant.post sway velocity	Lateral sway velocity	Ant.post sway velocity
Static balance					
Acute group	20	-.64	-.52	.08	-.41
Chronic group	25	-.52	-.69	-.59	-.62
Functional balance					
Acute group	20	-.51	-.66	.04	-.46
Chronic group	17	-.34	-.63	-.70	-.73

that value. The difference between the values was converted to a percentage. The correlation between the values for weight distribution and lateral symmetry on the force platform was .44 for the subjects with recent stroke and .52 for the subjects with stroke of long duration. The more weight a subject maintained on the left or right leg on the digital scales, the greater the mean left or right value on the force platform.

5.2.2 Construct and predictive validity and sensitivity

Construcy validity. The relationship between the initial scores of the PCBS test, the Barthel Index and cognitive deficits are presented in table 11. The initial results of the PCBS test were not significantly correlated with age, diagnosis or side of lesion. A significant correlation was found between the Barthel Index and the items for postural change (r=0.79), sitting balance (r=0.69) and standing balance (r=0.56**).** A negative correlation was found between the sum variables for visual inattention and the items for postural change (r=-0.39) and sitting balance (r=-0.55).

Predictive validity. Table 12 shows the relationship between the initial subscale scores of the PCBS test and age, sex and functional capacity measured by the BI and falls at 90 days after stroke. The PCBS test score for postural change was the strongest predictor of functional capacity ($p<0.002$) when the initial subscale score of the PCBS test was compared with functional capacity measured by the BI at 90 days after stroke. The score for standing balance was the strongest predictor of falls at the 90-day follow-up ($p<0.007$).

Sensitivity. The PCBS test was sensitive to change over time: the median change in the total PCBS score for the stroke patients during the 90-day follow-up was 6.1 (95 % CI: 4.8 to 7.4). The changes found for the subscales were: postural change 2.1 (95 % CI: 1.4 to 2.6), sitting balance 1.7 (95 % CI: 0.8 to 2.5) and standing balance 3.7 (95 % CI: 3.0 to 4.0).

In addition sensitivity was studied by examining the ability of the PCBS test to discriminate between balance control in healthy people and balance control in stroke subjects. Thirty-five controls, 12 men (mean age 64) and 23 women (mean age 75) were selected for the study. The differences in age and gender between the control and stroke groups were not statistically significant. The healthy controls mostly obtained maximum scores. The median (IQR) for postural change was 10 (10, 10), for sitting balance 10 (10, 10) and for standing balance 10 (8.6, 10). In the stroke group the median for the items of the PCBS test at 7 and 90 days after stroke onset is shown in figure 5.

5.3 Activating physiotherapy intervention

In the activating physiotherapy follow-up study there were no statistically significant differences between groups by education, type of stroke, side of lesion, previous cardiac infarct or diabetes; however, the patients in the activating therapy group had more often a previous stroke ($p=0.048$). At one year, 7 patients (8.6 %) had been lost from the follow-up, 6 patients (7.5 %) had died, 4 [survival rate 90 % (95 % CI: 76 to 96)] in the activating therapy group and 2

TABLE 11 The correlations between initial subscale scores of the PCBS test and age, the initial BI, and cognitive deficits

PCBS at 7 days	Postural change (95 % CI)	Sitting balance (95 % CI)	Standing balance (95 % CI)
Age	0.27 (-0.04 to 0.53)	0.08 (-0.25 to 0.38) (-0.25 to 0.38)	0.34 (0.06 to 0.60) (0.06 to 0.60)
Barthel index at 7 days	0.79*** (0.66 to 0.90)	0.69*** (0.50 to 0.85)	0.56*** (0.31 to 0.77)
Cognitive deficits at 30 days			
Memory	0.19 (-0.11 to 0.43)	0.20 (-0.12 to 0.48)	-0.08 (-0.37 to 0.25)
Language	0.10 (-0.23 to 0.38)	0.21 (-0.10 to 0.49)	-0.02 (-0.35 to 0.29)
Visuospatial functions	0.13 (-0.19 to 0.10)	0.30 (-0.01 to 0.56)	-0.09 (-0.38 to 0.23)
Visual inattention	-0.39* (-0.67 to -0.10)	-0.55*** (-0.74 to -0.30)	-0.11 (-0.41 to 0.20)

*p<0.05, ***p<0.001; statistical significance calculated using Sidak-adjusted probabilities.

[95 % (95 % CI: 81 to 99)] in the traditional therapy group, and one patient in the traditional therapy group refused to participate in the final physical measures. The final physical measures were performed for 36 patients in the activating and 37 in the traditional therapy group. The initial neuropsychological measures were performed for 39 patients in the activating and 38 patients in the traditional therapy group. Two patients in the activating therapy group and one patient in the traditional therapy group refused to participate in the final neuropsychological measures. The final neuropsychological measures were performed for 33 patients in the activating and 35 patients in the traditional therapy group.

Physical functions. Comparison between the initial and 12-month follow-up physical function assessments shows that the changes in the BI and PCBS test scores and in 10-meter gait speed were statistically significant within the groups (p< 0.001), whereas the differences between the groups were not significant (Table 13). After 12 months post stroke 24 (67 %) patients in the activating therapy group and 17 (46 %) in the traditional therapy group had achieved nearly full recovery (BI score = 19-20) (p=0.079). In the activating therapy group 19 (53 %) patients and in the traditional therapy group 9 (24 %) patients were able to walk over 1 kilometre at the 12-month follow-up (p=0.012).

TABLE 12 Median and logistic regression models for the Barthel Index and falls at 90-day follow-up.

Predictors	Model †			
	Barthel index		Falls	
	Coefficient (95 % CI ‡)	P value	OR (95 % CI ‡)	P value
Age	-0.03 (-0.26 to 0.10)	0.69	1.11 (0.97 to 1.25)	0.11
Female sex	0.62 (-3.73 to 3.66)	0.75	0.19 (0.02 to 2.44)	0.20
Postural change	1.98 (1.42 to 3.34)	0.002	1.57 (0.97 to 2.54)	0.061
Sitting balance	0.21 (-1.56 to 0.39)	0.66	0.90 (0.63 to 1.31)	0.57
Standing balance	-0.71 (-1.85 to 0.24)	0.23	0.51 (0.31 to 0.82)	0.007
Constant	6.66			

†Barthel index estimated using median regression model, falls estimated using logistic regression model.

‡95% confidence interval obtained by bias corrected and accelerated bootstrapping.

Independent living at home. At the 12-month follow up eleven (30 %) patients in the activating therapy group were living in an institution or home with a lot of assistance (3 in hospital care, 3 in a nursing home and 5 at home with a lot of assistance). In the traditional therapy group 20 (54 %) patients were dependent on outside help (3 in hospital care, 10 in a nursing home and 7 at home with a lot of assistance). The difference between the groups was significant (p =0.042), RR=1.77 (95 % Cl: 1.02 to 3.20), sex- and age-adjusted RR=1.90 (95 % Cl: 1.07 to 3.37).

Cognitive function. At the baseline neuropsychological assessment no significant differences were found between the activating and traditional therapy groups in any of the cognitive sum scores. At the follow-up assessment the activating therapy group showed a statistically significant improvement in memory (p<0.001), language (p<0.004), visuospatial (p<0.016) and visual inattention (p<0.012), while no improvements were observed in the traditional therapy group. The change in memory function between the groups was statistically significant (p<0.001). (Table 14).

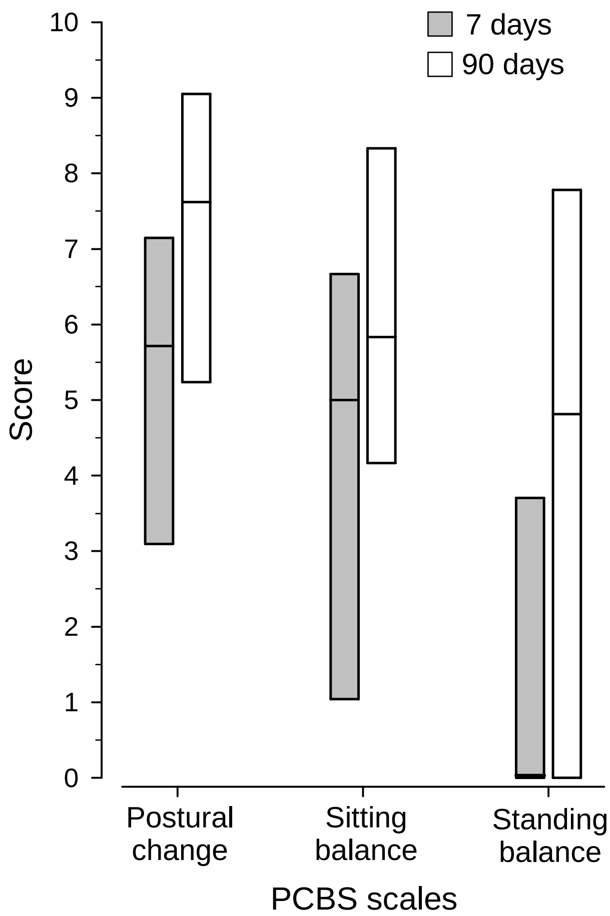

FIGURE 5 Medians with interquartile ranges for the items of the PCBS test at 7 and 90 days after stroke onset.

5.4 Counseling study

Structure of Communication

The analysis of the data identified two communication formats, an information-giving format and an interview format, which were constructed in the course of the interaction between the physiotherapists and the patients. The information-giving format consisted of statements that imparted information to the patient and caregiver regarding the patient's performance. The physiotherapists' utterances expressed opinions and facts which they verified by reference to the video. Utterances about practice at home included a lot of recommendations regarding the exercises to be carried out at home. The interview format was found when the physiotherapist asked the patient or caregiver for their opinions of a test performance or ideas about exercises at home. The patients asked the physiotherapist's opinion of their test performance and home exercise programme.

The video showed the patient's performance in chronological sequence, progressing from easier to more difficult tasks. The test began with postural changes followed by sitting and standing balance. The discourses connected with the test

TABLE 13 Comparison between initial physical function assessment and change after 12 months in the activating and traditional therapy groups.

Variables	Baseline		Change after 12 months		P-value Between groups*
	Activating (n=36) Mean (SD)	Traditional (n=37) Mean (SD)	Activating Mean (95 % CI)	Traditional Mean (95 % CI)	
Barthel index†	9.1 (4.4)	9.2 (4.2)	7.8 (6.2 to 9.4)#	6.9 (5.6 to 8.4)#	0.42
PCBS‡	42 (18)	42 (19)	21 (16 to 25)#	17 (10 to 24)#	0.34
10-meter gait speed, m/s	0.38 (0.36)	0.36 (0.40)	0.41 (0.27 to 0.55)#	0.35 (0.22 to 0.48)#	0.44

†Measured on scale 0 to 20, higher score indicated better function.
‡ Measured on scale 9 to 85, higher score indicated better function.
* Analysis of covariance (ANCOVA), baseline as covariate.
# p-value within group: p<0.001.

TABLE 14 Comparison between initial assessment of cognitive function and change after 12-month follow-up in the activating and traditional therapy groups.

Variables	Baseline		Change after 12 months		P-value Between groups*
	Activating (n=33) Median (IQR)	Traditional (n=35) Median (IQR)	Activating Median (95 % CI)[1]	Traditional Median (95 % CI)[1]	
Memory	31 (9, 46)	37 (21, 59)	8 (3 to 8) [p<0.001]	-1 (-5 to 3) [p=0.50]	0.001
Language	54 (11, 60)	48 (38, 63)	6 (2 to 10) [p=0.004]	2 (-1 to 5) [p=0.22]	0.078
Visuospatial functions	16 (8, 20)	15 (6, 22)	3 (1 to 5) [p=0.016]	-1 (-5 to 3) [p=0.18]	0.17
Visual inattention	7 (1, 26)	12 (2, 30)	-4 (-10 to -1) [p=0.012]	1 (-1 to 2) [p=0.21]	0.45

1 Hodgess-Lehmann estimator of median difference
* Median regression analysis, baseline as covariate.

performances consisted of either short comments on what was seen on the video without moving on to intensive discussion or critical assessments of the difficulties encountered by the patient during the performance. The physiotherapists used the first type of talk at the beginning of the sessions when the test performances were not so demanding, such as turning onto the right or left side and sitting up on the bed. This type of talk also emerged in cases where the physiotherapists commented on the exercise task and the patients responded with stories of their health problems, or where the patients had difficulties in attending to their performances, or where they had aphasia. In the second type of talk the physiotherapists discussed the test performances thoroughly and linked them to exercising at home. The discussion took the following course: either the patient or caregiver stated the problem, which was acknowledged by the physiotherapist, the quality of the performance was discussed by the participants, and the exercise was named or discussed in detail.

Passing over Test Performances

Positive cues. When the physiotherapists passed over test performances with just a few words without stopping the video, they opened the discussion with open or leading questions and made the decision to terminate the discussion on a performance. The physiotherapists also made short comments on performances while the video played on (Extract 1). The whole episode proceeded under the physiotherapist's direction with closed questions and short hints at domestic tasks and falling, with the patient using phatic expressions.

Extract 1: Test items of Postural Change and Sitting Balance.

PT: So, now look at this reaching, it is not easy.
Can you put dishes into the cupboard at home?
P: Yes.
PT: Yes, you do. Look these went very well. You show a high speed in these sitting up and moving tasks,
P: Hehh
PT: but those are rather fluid. You have hardly any problems or have you?
P: No, I haven't.
PT: You haven't fallen off the bed due to speed.
P: No, I haven't.
PT: So let's move on from these performances, which went well. And you haven't fallen, have you?
P: No, I haven't.

Raising a new topic. In those cases where the physiotherapists stopped the video, and then asked the patients to name situations in everyday life where they would need the movement in question or recommended the exercise, the discussion did not progress to a deeper analysis of the quality of the performance; neither did it address the matter of home exercise. Extract 2 provides an example of a case where the patient was in the early phase of stroke rehabilitation and had difficulty in concentrating on the conversation. The physiotherapist started with a comment and the patient made an excuse by returning to her memories and telling stories about her personal life. The patient's son (CG) participated in the session.

Extract 2: Standing on one leg.
PT: Now those are balance tasks. Take a little look at this, you can see if it shows such unsteadiness.
P: Mm, well there's unsteadiness there
PT: That standing on one leg now, of course.
P: that's something I have not done really ever, ever.
PT: Aha.
P: I have of course never had time, that's right, I'll tell you later on.
PT: No you can now, tell me about it now.

The patient gave a colourful account of her childhood, of how she started working on the family farm (40 s) after which the caregiver commented on her story and later on her performance.

CG: You have no time to stand on one leg, it has never happened.
P: No, you have no time for that.
PT: Well.
CG: Now these are very fluent performances.

In this case, the patient repeated the appraisal given by the physiotherapist and then changed the topic. She was able to communicate, but not ready to talk about her performances. The conversation was carried on only two weeks after she had been taken sick. The relative present did not continue the discussion either.

No ability to talk. The discourses connected with the test performances did not progress to intensive discussion either, when the patients had aphasia or were unable to speak or understand speech.

In these cases, the physiotherapists would start the discussion by pointing to the problems shown on the video and use leading questions which included propositions as to alternative symptoms. The patients' withdrawal from the conversation was perceivable in their gestures and in their way of answering in the negative.

Constructing Joint Understanding of Performances

Directing patients' understanding of their performances. When the physiotherapists wanted to discuss the test performances thoroughly, they stopped the video and asked the patients for an appraisal of their performance. They directed the patient to see precisely where her performance was weak by progressing step by step, watching and talking about the performance The discussion about what kinds of training could be done at home was preceded by talk about the problems noticed in the test performances. In these cases, the physiotherapist directed the discussion toward home exercise by emphasizing her role as a giver of advice. Extract 3 shows how she sought to indicate the problem shown on the video; however, the patient showed difficulty in understanding the message by asking a question in return.

Extract 3a: Step walk.
P: Where was there a weak point that should be improved?
PT: so what you could, exercise, you needn't necessarily to do gymnastic

exercises, but the exercise would take place as part of your household chores. I'll rewind this a little.

The patient was not able to describe her exercises by herself so the physiotherapist rewound the video to the place where the patient's balance problems could be viewed and remedial exercises connected with household chores suggested. When the physiotherapist stopped the video where the patient was on the point of reaching up for an object, the patient expressed her fear of doing the reaching task.

Extract 3b: Reaching up for an object with the better arm, feet in walking position.

P: It's reaching that I am afraid of because of my head, it my head is not in a good state either, there are still those knots in it after that stroke.

PT: But that's why it would be good now to do this exercise. I mean mainly reaching ((winds the video back and watches the videotape)) (5) reaching in that direction went very well, but then you dared to go on tiptoe to the right. (3) Now you watch now_when that left leg comes

P: You don't know

PT: that weaker (leg) to the front.

P: as if that arm was shorter. What is it that it's not quite?

PT: Can you think now, let's see where this is this the stop button ((rewinds the video)) surely your arms are the same length but?

P: Then when the distance between the feet got a little shorter.

PT: Yes, we shortened it on purpose here. Look a little more closely, in the distance, look how your arm reaches well but a small hint, look at your legs, just wait a moment, while I rewind ((rewinds the video)) are you starting to go on tiptoe, are you starting on that side now, did you go on tiptoe?

P: No, almost not at all.

PT: Well a little, but now surely you feel that the arm is shorter but should there now be a shift of the weight on your feet, so that you dare to reach? So would you have any idea of an exercise that could you do at home, just so that the left side is first?

P: Yes, there are places for this kind of exercise, as I said a cupboard is one such.

The aforementioned example shows the key cues used to direct the patient's attention to accomplish the desired outcome. The physiotherapist explained the problem with the patient's performance in her following speech, but the patient did not understand the cue. The physiotherapist rewound the video again and again to those point where the patient's problem in shifting of the weight on her feet could be seen. The patient's utterances reveal her gradual understanding of the problem and what would be a suitable exercise.

Co-constructing the reasons for home exercise. The discussions of test performances did not always progress directly to handling the problems brought up by the participants. In these cases, the physiotherapists went on with the video and returned to the subject later on either after the critical appraisal given by the patient or after finding a suitable test performance that demonstrated the problem.

When the caregivers brought their experiences into the discussion, they extended it by reference to their own findings at home. They raised problems like the use of the affected arm or balance problems in walking and domestic chores. Extract 4 illustrates how the physiotherapist first passed over the balance problem raised by the caregiver by making a short statement about falling and went on to the next task on the video.

Extract 4: Bending down to pick up an object from the floor while standing.
CG: Balance is still a little difficult.
PT: Yeah, so it is good that there's been no falling,

Touching a marked place with the elbow on standing.
PT: now that reaching sideways, it's also going well. Tell me something Seija, how does it look (14) ((looks at the video)) what about when you're walking amongst the traffic, this turning and seeing cars and so on, does it look all right or do you still need to check it before you start crossing the road?
CG: No, it goes well.

When watching the next task reaching up for an object while standing, the physiotherapist asked if the stiff ankle caused the patient a problem with her balance.

PT: And you didn't lose your balance, those went very nicely, too. Here can you say ifthat stiff ankle disturbs you when the weight doesn't move along?
CG: It is just that right leg
PT: Yes, it's that stiffer leg.

The physiotherapist pointed out that the stiff ankle was the reason for the balance difficulties mentioned by the caregiver, and she recommended home exercises like putting clothes and linen in the closet and hats on the rack. The role of the exercises in relation to the stiff was not talked about any further.

6 DISCUSSION

The main goal of the long-standing clinical research project in the district of East-Savo was to promote an active role for patients with stroke in their physiotherapy. A special assessment tool, Postural Control and Balance for Stroke (PCBS) test, was developed side by side with the activating treatment. The PCBS test was constructed to support physiotherapists in planning task specific interventions and in following up rehabilitation. This thesis finds that the PCBS test is reliable, valid and sufficiently sensitive to measure patients' balance during the first 120 days after stroke.

In promoting an active role for patients in their own physiotherapy it is also of crucial importance to know how physiotherapists use test results in counselling sessions. Counseling has great potential in furthering the active participation of patients in their treatment. However, physiotherapists need to be fully aware of the communication problems caused by stroke, and no only allow patients to participate more actively in but also ensure that discussions about their treatment are more firmly anchored in their social life. During the research project an activating physiotherapy programme was developed on the basis of the idea that functional recovery after stroke is a learning process, which calls not only for physical but also for cognitive and mental actions. This thesis examined whether, compared with traditional physiotherapy, the new activating physiotherapy programme would have different effects on stroke patients' recovery of their physical and cognitive functions and ability to live independently at home over a one-year follow-up. The results indicate that activating therapy could lead to considerable improvements in both cognitive and motor capacity.

6.1 Reliability

There are a number of general limitations inherent in clinical measures which evaluate balance and functional capacity. In particular, the scoring of most functional measures is based on the amount of assistant patients need during the performance of certain tasks. This kind of scoring does not support the planning of stroke therapy where the emphasis is on safety, independent moving and intensive balance training. In the PCBS test the method of scoring changes as the items make increasing demands on postural control. The scoring of the postural change items of the PCBS test is based both on the amount of assistance needed by patients and on qualitative criteria at each level of the classification. Particularly in the acute phase of stroke, the amount of assistance patients need is essential for both physical therapists and nursing staff. The method of scoring of the sitting and standing balance items of the PCBS test focuses on the assessment of the compensatory postural strategies which patients utilize in doing tasks. Tasks demanding variable amplitude in the body's center of gravity in relation to the base of support and movement strategies to control instability were developed for the scale. Patients develop these strategies during the early stages of recovery when they attempt to respond, immediately after the lesion, in accordance with the best neural system available to them (LeVere 1980). However, these strategies are not always optimal (Carr & Shepherd 2000, Shumway-Cook & Woollacott 2001).

The responsiveness of this study indicates that the PCBS test is sensitive to changes in balance during the first 120 days after stroke. However no significant difference emerged between the mean scores 120 and 360 days after stroke. The scale of the PCBS test is ordinal. Although ordinal scales are widely used in clinical measures they have been found sensitive only to short-term changes (Tyson & DeSouza 2004). Even if motor and ADL functions have been reported to reach a plateau after 90 days after stroke (Kotila et al. 1984, Wilkinson et al. 1997), there are promising interventions, which indicate improvement in balance and motor function status even in the later stages of stroke recovery (Dean & Shephard 1997, Flick 1999). Measures which can also show changes in postural control in the later stages of stroke rehabilitation are needed. In recent years Tyson and DeSouza (2004) have developed a new balance scale named the Brunel Balance Assessment for stroke patients. The items of the test provide information about sitting and standing balance and walking ability. They recommend the use of interval- or ratio-level data to increase sensitivity to long-term changes.

In the PCBS test independent static sitting (one minute) and standing (half a minute) were used as the inclusion criteria for the more exacting balance tasks. Smith and Baer (1999) used simple standardized clinical tests of mobility as inclusion criteria for more exacting tasks. It is essential that the level of independent performance can be assessed by means of a simple task to insure against unnecessary testing. The static sitting and standing items proved to work well in assessing whether the patients' postural balance was good enough to proceed with further testing. The idea of the PCBS test was that it could be hierarchical. If the test items are in the correct order the number of subjects accomplishing each item would decrease progressively as the items became more difficult (Tyson & DeSouza 2004). However, in the PCBS test several items measuring of postural changes were more difficult than the sitting balance tasks such as the items Moving in a sitting position from bed to a chair and back to bed and Standing up without using the hands. Before we can recommend the PCBS test for wider clinical use more research is needed to build up the hierarchy of the PCBS test. Tyson and De Souza (2004) concluded that a scale that combines a hierarchical series of functional performance tests might overcome the problems of the lack of sensitivity to change.

The interrater and intrarater reliabilities for the PCBS test as the whole and for the sum variables of the postural change, sitting balance and standing balance items proved to be high. The inter- and intrarater reliabilities for the sitting balance items varied from moderate to high. The minimum value for intrarater reliability was .63 in the task Touching a marked place on the right-hand side. The inter- and intrarater reliabilities for the standing balance items varied from poor to high (. 37 to 1). The minimum values for both the inter- and intrarater reliabilities were for the items touching a marked place on the left- and on the right-hand side and reaching up for an object. These tasks require the subject to bring the center of gravity closer to the edges of the base of support by actively shifting the body sideways or forward. There are many strategies, such as reaching sideways by lateral movement of the spine or rotating the legs (Carr & Shepherd 2000) or by stepping and grasping movements of the limbs (Shumway-Cook & McCollum 1990), which patients use to increase the base of support when trying to reach out on the affected side. To properly administer this test, which calls for complex skill in controlling balance, requires training**.** The scoring of the PCBS test was new way to evaluate patients' balance. That is why the training period given to the physiotherapists who participated in the reliability study might have been too short. A new study would be needed to clarify the reliability of these items Touching a marked place on the left- and on the right-hand side. Alternatively, these items could be removed. The reliability results were obtained from the examination of a relatively small number of patients (n=19). However, several previous studies have used a similar number of patients to study the reliability of tests (Duncan et al. 1983, Carr et al. 1985, Berg et al. 1995).

Overall, the PCBS test had limited floor and ceiling effects at 7 days, 120 days and 360 days after stroke. The results indicate that the test as a totality has an adequate distribution for following up rehabilitation for one year after stroke. Several studies have shown that many balance scales which have only sitting or standing balance items are sensitive to floor or ceiling effects at some stage of the recovery process (Sandin & Smith 1990, Feigin et al. 1996, Benaim et al. 1999). In this study the postural change and sitting balance items of the PCBS test suffered from ceiling effects as early as 7 days after stroke, and after 120 days and 360 days this effect increased considerably. Sandin & Smith (1990) and Feigin (1996) have also reported a ceiling effect for static and dynamic sitting balance in the early stages of recovery. In both studies 65 % of the patients scored the maximum points in the test only one week after the first evaluation. The standing balance items of the PCBS test suffered from floor effects after 7 days; however, the number of patients who after 120 days and 360 days achieved moderate scores for standing balance gradually increased. Mao et al. (2002) reported that the Berg Balance Scale (BBS) and the balance subscale of the Fugl-Meyer test (FM-B), which includes several standing balance items, showed a notable floor effect (35 % and 29 %) at 14 days after stroke.

6.2 Criterion validity

The main purpose of the criterion validity investigation was to explore the validity of the data obtained with the standing balance items of the PCBS test in acute and chronic groups of stroke patients. The results suggest that the standing balance items of the PCBS test provide the same kind of information as that obtained from the measurement of postural sway velocity on a force platform in both people with recent stroke and those with stroke of long derivation. Some of our subjects, however, were unable to stand on the force platform with their feet together and their eyes closed. In addition, under the same conditions, in the patients with acute stroke there was a low correlation between the scores obtained for the standing balance items and measurements of sway velocity on the force platform. Several studies indicate that many patients, especially those with recent stroke, seem to rely on visual input (Corriveau et al. 2004, Yelnik et al. 2002). Due to various motor and somatosensory deficits in patients with stroke affected individuals must compensate for these impairments during standing by a greater dependence on vision. However it seems that as soon as improvement in somatosensory integration takes place, the proprioceptive and exteroceptive signals from the paretic lower limb are gradually but increasingly used in the control of standing balance. (De Haart et al. 2004). It is possible that the feet together/eyes closed position was too difficult for many of our subjects with recent stroke, when the nervous system had no choice but to use somatosensory and vestibular information. In the eyes-closed condition, the acute patients might not yet have acquired a consistent ability to use somatosensory information effectively in controlling the motion of their center of mass relative to their limited base of support.

One component of the PCBS test is the measurement of body weight distribution using two digital scales. The aim of our study was to explore the relationship between weight distribution as measured with the PCBS test and lateral symmetry (mean value in millimeters) measured on a force platform. A moderate correlation was found between weight distribution as measured with the PCBS test and lateral symmetry as determined with the force platform in both the groups of subjects, but the correlation was stronger for the subjects with stroke of long duration. The subjects stood on the digital scales for 30 seconds and the weight distribution values were recorded during the last 5 seconds, whereas on the force platform the lateral mean value was measured for 30 seconds. Because the reading of digital scales fluctuates continuously, a more reliable result might be obtained by recording the weight distribution values more often than once during the 30 seconds spent standing on the scales. Bohannon and Waldron (1991) demonstrated good reliability in measurements of weight bearing on digital scales used to weigh the paretic and nonparetic lower extremities. More research is needed, however, to clarify the accuracy of measurements obtained with digital scales, especially during the acute phase of stroke.

6.3 Construct and predictive validity

The construct and predictive validity of the PCBS test for the postural change, sitting balance and standing balance items at 2 specific time points during the 90 days after stroke onset was examined. All the subscale scores of the PCBS test showed a correlation with the Barthel Index. This study is generally in accordance with the findings of previous studies which have focused on the relations between various balance and functional capacity and mobility measures among stroke patients (Hsieh et al. 2002, Duarte et al. 2002, Hsueh et al. 2003). Mao et al. (2002) found a high correlation (r=.86 to r=.94) between three clinical balance measures, i.e., the Berg

Balance Scale (BBS), the Balance subscale of the Fugl-Meyer test (FM-B), and the Postural Assessment Scale for Stroke Patients (PASS), and the Barthel Index when they were compared at 4 time points during 180 days post stroke.

In this study we found a negative connection between the initial subscale scores for postural change and sitting balance and those for visual inattention, indicating that the lower the subjects' scores for both the postural change and sitting balance tests, the higher their visual inattention scores. The results of this study are in agreement with the findings of other studies on the importance of visual perception during balance control. Several studies report the importance of visual inputs in controlling balance, especially among older people (Perrin et al. 1997, Speers et al. 2002). Poor cognitive status in stroke patients has been shown to be connected with poor balance control and fall history (Teasell et al. 2002) and visual neglect with poor functional recovery (Jehkonen et al. 2000, Cherney et al. 2001). Cherney et al. (2001) found that subjects with visual neglect had significantly more days from onset to admission and a longer in-patient rehabilitation.

In this study we examined the ability of the initial PCBS test scores to predict patients' functional capacity and safe moving at 90 days post stroke. The initial subscale scores for the postural change items correlated moderately with the BI. The initial standing balance scores and falls measured at 90 days post stroke correlated moderately, indicating the ability of the standing balance items to discriminate patients who did not fall from patients who fell once or more. Poor standing balance ability has been found to be connected with number of falls (Teasell et al. 2002); however, the risk of falling is not linearly related to the number of impairments. Yates et al. (2002) reported that individuals with motor, sensory and visual impairments are less mobile and less likely to sustain falls than individuals with motor deficits only or with motor and sensory deficits.

In this study we examined the correlation between the PCBS test and functional capacity test measured by the BI and other constructs like cognitive deficits. With respect to validity, the improvement is an ongoing process. Before the PCBS test can be recommended for wider use its correlations with other clinical balance scales, such as the Berg Balance Scale, the PASS and the Brunel Balance Assessment scale should be examined.

6.4 Effect of activating therapy

A new approach to stroke treatment was developed and a preliminary study carried out to provide information about the outcome of applying activating treatment in the course of patients' rehabilitation. It should be noted that in the present study both groups received similar occupational therapy and neuropsychological rehabilitation.

A number of randomized trials have suggested that more therapy input results in a better outcome (Kwakkel et al. 2004). In this study the activating therapy group received more physiotherapy than the traditional therapy group, which may partially explain the results. However research has provided little evidence of a relation between different therapy services other than neuropsychological rehabilitation and cognitive outcome at rehabilitation discharge among neurological patients (Cifu et al. 2003). Intensity of physiotherapy has not been found to relate to cognitively mediated physical skills (Spivack et al. 1992) or cognitive outcome (Heinemann et al. 1995). However, in this study the activating therapy group showed a significantly improved cognitive sum score at the follow-up, while in the traditional therapy group all the cognitive domains remained either unchanged or were further impaired over time. It is notable that the change in memory function in the activating therapy group differed significantly from that in the traditional therapy group. Memory is the capacity to hold information about ongoing actions and events, and it is a crucial function when learning skills (Howard 1995, Hochstenbach & Mulder 1999). Recovery from cognitive deficits usually takes place within six months of the stroke (Pedersen et al. 1995). Hochstenbach et al. (2003) demonstrated recovery in all cognitive domains in some patients, but most patients showed no improvement or even a decline.

As far as motor learning principles are concerned the manual techniques most commonly used in stroke treatment have widely been criticized as making treatment too passive (Lettinga et al. 1999, Carr & Shepherd 2000, Reunanen 2003, Tyson & Shelley 2007). In the initial phase of the development process the physiotherapists mostly used hands-on techniques. In the final stage of the project the physiotherapists' treatment was videotaped, showing a decreased use of manual handling techniques and a more systematic use of verbal and visual guidance, enabling patients to adopt a more active role in planning and carrying out therapy. Several studies have found that patients treated with the Motor relearning programme (MRP) or a Task-oriented approach improved their motor performance and sitting balance significantly more than patients treated with Bobath therapy (Langhammar & Stanghelle 2000, Mudie et al. 2002, Krutulyte et al. 2003). The MRP emphasises the performance of functional tasks and the importance of relearning real-life activities that have meaning for patients.

Recently, both motor and cognitive factors have been found to be important predictors of functional autonomy after stroke (Tatemichi et al. 1994, Malouin et al. 2004). Tatemichi et al. (1994) found in their study that functional impairment was greater with cognitive impairment, and dependent living after discharge either at home or in a nursing home was more likely (55 % with and 33 % without cognitive impairment) after three months post stroke. In our study physical functional capacity improved significantly in both groups, but the patients in the activating therapy group moved outdoors more and coped better by themselves or with family support and with less outside help than the patients in the traditional therapy group, thereby using less societal resources.

The promising and partly surprising results of this study argue for further research to obtain more detailed knowledge of what stroke patients would primarily gain from activating therapy in different phases of rehabilitation. The limitation of this study was that the patients were divided into experimental and control groups according which some healthcare centres participated in the present activating physiotherapy project and some healthcare centres did not. Two experienced physiotherapists performed the initial and final measurements in both the activating and traditional therapy groups. Because of the selection of patients not all the measures could be performed blinded. In any case, randomised participation would need to be done to provide reliable evidence on the value of activating therapy. In order to compare two groups it is also necessary that they are homogeneous. In this study the incidence of previous stroke was greater in the activating therapy group. However, previous stroke should be an exclusion criterion owing to its complicating nature.

6.5 Content of communication in counseling sessions

The focus of this study was to find out how physiotherapists and patients co-constructed a counseling session that centered on measurements of the patient's postural control. The data comprised videotaped discussion sessions with stroke patients in different phases of rehabilitation and in some cases with their caregivers. The objective was to obtain knowledge of the kinds of teaching situations encountered in stroke treatment by physiotherapists. It was to this end that these counseling sessions were specifically arranged.

The central meanings of the physiotherapists' discourse seemed to be closely related to the evaluation of test performances and finding exercises suitable for practice at home. The meanings of the patients' discourses were first of all related to their ability to understand the quality of their test performances, but in some cases their discourses also had meanings that concerned the translation of elements of the test performance into home exercise. The caregiver contributed to the discourse of coping with home practice. Two main categories of discourse were found. In the first type of discourse, the physiotherapists passed over the test tasks quickly, and in the second the interaction progressed toward an understanding of the quality of the test performances through co-construction by the participants.

Wiles et al. (2002) emphasized the need to develop a more equal partnership between physiotherapists and patients by empowering patients to take a more active role both in goal setting and in the therapy process. The dominant role played by health care providers in asking questions and giving information has been noted in several studies (Street 1992, Heath 1992, Peräkylä 1998, Adams 2001). This study shows that the participants often co-constructed a mutually satisfactory interpretation of patients' problems in performance, and even, at times, achieving a good shard understanding. In this respect the course of the discussion resembled that described by Eggly (2002), who found that physicians facilitated the chronological ordering of events by asking questions and co-constructing interpretation. However, this study shows how the discussion revolved around the physical aspects of test performance when the patients or caregivers raised the issue of the manifestation of balance problems in everyday life. The discrepancy in joint understanding came over the different perceived needs for balance control: the physiotherapists recommended an exercise based on the problems noted in the test performance, whereas the patients and caregivers were worried about the patient's ability to cope with her environment.

The chief value of this study lies in identifying the nature of the social interaction that physiotherapists, patients and caregivers co-constructed with language. The results illuminated the problems of interaction that occur when patients are physically unable to communicate and demonstrated the great importance of the presence of caregivers at the counseling sessions. Joint understanding was not achieved when the institutional counseling discourse came into conflict with patients' and caregivers' discourses which concerned the patients' problems in everyday life. The strength of this approach is in identifying discursive constructions that show how important the role of good communication skills is in health care settings that focus on the physical aspects of patient treatment.

7 SUMMARY AND CONCLUSIONS

(II) The PCBS test was designed to identify the problems typically faced by people with stroke. In particular, the scale was developed to measure postural control during the performance of tasks. The PCBS test differs from other balance scales in the classification of the sitting and standing balance items, which focus on the assessment of strategies. The interrater and intrarater reliabilities for the PCBS test as the whole proved to be high. The inter- and intrarater reliabilities for the standing balance items varied from poor to high. In some reaching tasks, evaluation of the strategies of postural control is problematic, and thus these tasks need to be further investigated. To properly administer this test, which calls for complex skill in controlling balance, requires training. The present study showed also that the PCBS test had limited floor or ceiling effects at 7 days, 120 days and 360 days after stroke.

(I) We contend that there is a need in physiotherapy for clinical balance assessment tools that can be used to measure patients' balance skill from the acute to chronic phases of stroke. The correlation between the standing balance scores of the PCBS test and measurements of postural sway velocity and lateral symmetry obtained with a force platform in people with recent stroke and those with stroke of long duration indicated that the standing balance items of the PCBS test may be useful for measuring balance during different phases after stroke. Before the test can be recommended for wide clinical use, the lifting task component of the PCBS test that requires the use of an affected upper extremity needs further development.

(III) The present results indicate that the PCBS test has good construct and predictive validity: the postural change items were able to predict functional status and the standing balance items risk for falling. The test was also shown to be sensitive to change in balance. Before the PCBS test can be recommended for wider use its correlations with other clinical balance scales, such as the Berg Balance Scale and the PASS should be examined.

(IV) The present study indicates that activating therapy might lead to considerable improvements in both cognitive and motor capacity. These promising results argue for further research to obtain more detailed knowledge of what stroke patients would primarily gain from activating therapy in different phases of rehabilitation. In this study the patients were divided into experimental and control groups according their local healthcare centre, but randomised participation would need to be done to provide reliable evidence on the value of activating therapy. In order to compare two groups it is also necessary that they are homogeneous. In this study the incidence of previous stroke was greater in the activating therapy group. However, previous stroke should be an exclusion criterion owing to its complicating nature.

(V) Counseling has great potential to further the active participation of patients in their treatment, but physiotherapists should understand the communication problems caused by stroke, and allow patients to participate more actively as well as see that discussions are more firmly anchored in their social life. An exploration of the interaction between physiotherapist and patient during counseling can help in improving physiotherapy education and physiotherapist – patient communication. The present study points to the ultimate need of enhancing the cooperation between physiotherapists oriented towards physical aspects and other experts oriented towards mental and social aspects in stroke research and rehabilitation.

YHTEENVETO

Aivoverenkiertohäiriöpotilaiden toimintakyvyn luotettava kliininen mittaaminen ja fysioterapian kehittäminen Itä-Savon sairaanhoitopiirin alueella

Johdanto

Suomessa aivoverenkiertohäiriöön (AVH) sairastuvien määrä tulee kasvamaan väestön ikääntyessä. Sairastuneista lähes puolet tarvitsee kuntoutusta akuuttivaiheessa. Kuntoutuksen sisältö ja kesto määräytyy aivohalvauksen tyypistä ja vaikeusasteesta sekä sen aiheuttamista puutosoireista. Alkuvaiheessa aivoverenkiertohäiriö aiheuttaa fyysisen toimintakyvyn alenemista, mikä ilmenee toispuolihalvauksena eli hemiplegiana. Potilailla on usein erilaisia asennon- ja tasapainonhallinnan vaikeuksia, joita ovat vartalon huojunnan lisääntyminen seistessä, kehonhallinnan heikentyminen ja painon epätasainen jakautuminen. Huonon asennonhallinnan seurauksena potilailla on suuri riski kaatua liikkumisten ja siirtymisten yhteydessä.

Aivoverenkiertohäiriö voi aiheuttaa myös monenlaisia muutoksia sairastuneen henkilön kognitiivisissa toiminnoissa. Häiriöt saattavat liittyä kielen alueella puheen tuottamiseen tai ymmärtämiseen (afasia). Potilaalla voi olla tunnistamishäiriö (agnosia), joka voi esiintyä eri aistipiirien alueilla tuntoaistiin tai näköhavaintoihin liittyvänä. Vaurio voi myös aiheuttaa opittujen tahdonalaisten liikesarjojen, kuten pukeutumisen tai esineiden käytön häiriön (apraksia). Erityisen hankala kuntoutumisen kannalta on neglect-häiriö, jolloin henkilö ei kykene tiedostamaan halvaantuneen puolen toimintaa.

Tutkimuksen tarkoitus

Jyväskylän yliopiston tutkijaryhmä aloitti vuonna 1998 yhdessä Itä-Savon sairaanhoitopiirin alueella toimivien fysioterapeuttien kanssa tutkimus- ja kehittämishankkeen ”Aktivoiva ja omatoimisuutta tukeva fysioterapia aivoverenkiertohäiriöpotilaiden kuntoutuksessa”. Tässä projektissa kehitettiin aivohalvauspotilaiden aktiivista osallistumista tukevia terapiamenetelmiä sekä yhdenmukaista arviointikäytäntöä aivohalvauspotilaiden kuntoutuksesta vastaavien organisaatioiden välille. Tavoitteena oli saada kuntoutusta toteuttavat tahot työskentelemään läheisessä yhteistyössä toistensa kanssa. Tämän väitöskirjan aiheena oli tutkia projektiin kehitetyn asennonhallintamittarin validiteetti- ja reliabiliteetti ominaisuuksia sekä kykyä seurata aivohalvauspotilaiden tasapainossa tapahtuvia muutoksia. Kontrolloidulla seurantatutkimuksella tutkittiin aktivoivan terapian vaikutuksia aivohalvauspotilaiden fyysiseen ja kognitiiviseen toimintakykyyn sekä itsenäiseen selviytymiseen kotona. Tutkimuksessa verrattiin aktivoivan terapian tuloksia perinteistä fysioterapiaa saavien potilaiden tuloksiin. Lisäksi väitöskirjassa tutkittiin kuinka fysioterapeutit auttavat potilasta ymmärtämään tasapainomittarin tuloksen merkitystä heidän toimintakyvylleen.

Asennonhallinta- ja tasapainotestin kehittäminen

Itä-Savon alueen kehittämishankkeen aikana kehitettiin edelleen aivohalvauksen aiheuttamien asennonhallinnan- ja tasapainon vaikeuksien arvioimiseen soveltuvaa PCBS testiä (Postural Control and Balance for Stroke). Kehittämistyössä vietiin eteenpäin Jorvin sairaalan fysioterapeuttien työnkehittämisprojektin aikana (1993-1996) kehitettyä toimintakykytestiä. Aivohalvauspotilaiden testitilanteita analysoitiin kriittisesti arvioimalla potilaiden testitehtävistä suoriutumista ja erityisesti heidän suorituksiinsa käyttämiä toimintastrategioita. Arvioinnin seurauksena tarkennettiin tehtävien sisältöjä, suoritustapoja ja suoritusaikoja. Keskeisin muutos kohdistui istuma- ja seisomatasapainotehtävien arviointiasteikkoon, joka aikaisemmassa testissä perustui potilaiden itsenäisen suorituksen arvioimiseen. Uusi asteikko perustuu potilaiden käyttämien asennonhallinnan strategioiden arvioimiseen. Aivohalvauksen vaikeusasteen on todettu vaikuttavan siihen, minkälaisia strategioita potilaat käyttävät suoritusten aikana.

PCBS testin rakenne

Testi koostuu kolmesta osa-alueesta: asennon muutoksen arviointi, tasapainon hallinta istuen ja tasapainon hallinta seisten. Asennon muutoksia arvioivia tehtäviä on 6, ja ne mittaavat henkilön kykyä kääntyä vuoteessa, nousta istumaan ja siirtyä (pyörä)tuoliin. Arviointiasteikko on neliluokkainen (0-3) ja mittaa henkilön avuntarvetta suoritusten aikana.

Tasapainon hallinta istuen käsittää 4 tehtävää ja seisten 9 tehtävää. Testissä arvioidaan henkilön kykyä hallita asentoaan sellaisten suoritusten aikana, jotka edellyttävät istuen tai seisten tapahtuvaa esineeseen tarttumista kurkottamalla tai kumartumalla eteen tai sivulle ja sivuttaisen tasapainon hallintaa kyynärpään kosketustehtävissä. Arviointiasteikko on neliluokkainen (0-3). Tehtävien avulla arvioidaan henkilön asennonhallinnan strategioita, joita hän käyttää istuma- ja seisomatasapainoa vaativissa tehtävissä.

Kehon painon sivusuuntaista jakautumista tutkitaan vaakojen päällä seisoma-asennossa ja siirrettäessä kehon painoa jalalta toiselle. Suoritusta arvioidaan vaakojen antamina kilogrammoina. (Appendix)

PCBS testin luotettavuus

Kokonaisuudessaan PCBS testin luotettavuustutkimuksiin osallistui 172 42-89-vuotiasta henkilöä. Mittarin reliabiliteettitutkimuksessa tutkittiin mittaajien sisäinen ja välinen yhteneväisyys. Reliabiliteetin tutkimiseksi 19 potilaan testisuoritukset videoitiin 1-8 viikkoa sairastumisesta. Viisi neurologiseen fysioterapiaan perehtynyttä fysioterapeuttia osallistui reliabiliteettitutkimukseen (työkokemus 5–18 v). Tutkimukseen osallistuneet fysioterapeutit perehtyivät PCBS testin suoritusohjeisiin ja harjoittelivat mittarin käyttöä käytännössä ennen mittauksia.

PCBS testin rakenne-, ennuste- ja kriteerivaliditeetit tutkittiin. Validiteettimittauksiin osallistui yhteensä 94 henkilöä (ikäjakauma 46–89 vuotta). Koko PCBS testin rakennevaliditeetti tutkittiin vertaamalla PCBS testin tuloksia Barthelin Indeksiin (BI) ja neuropsykologisiin testeihin muistin, puhekyvyn, visuaalisen hahmottamisen ja huomiotta jättämisen alueilla.

PCBS testin osa-alueiden kykyä ennustaa potilaan selviytymistä päivittäisistä toiminnoista ja turvallista liikkumista tutkittiin vertaamalla sairastumisen alkuvaiheen testituloksia BI:iin ja kaatumisiin kolmen kuukauden kuluttua sairastumisesta.

PCBS testin kriteerivaliditeettia tutkittiin vertaamalla seisomatasapainotehtävien tuloksia voimalevyllä saatuihin tuloksiin huojunnan nopeudesta. Painonjakautumista vaaoilla verrattiin voimalevyn antamiin tuloksiin painopisteen sijoittumisesta tukipinnan päälle.

PCBS testin herkkyyttä osoittaa tasapainossa tapahtuvia muutoksia ja kykyä vastustaa katto- ja lattiaefektiä tutkittiin vuoden seurantatutkimuksen avulla, jossa 50 aivohalvauspotilaan (ikäjakauma 42-89 vuotta) tasapaino mitattiin viikon, 4 kuukauden ja vuoden kuluttua sairastumisesta. Lisäksi PCBS testi suoritettiin 35 terveelle, kotona itsenäisesti asuvalle, henkilölle (ikäjakauma 50-90 -vuotta). Tutkimuksessa verrattiin PCBS mittarin kykyä erotella terveiden henkilöiden ja aivohalvauskuntoutujien tasapainoa.

Tutkimuksen tulokset osoittivat, että PCBS testin mittaajien sisäinen ja mittaajien välinen reliabiliteetti kokonaisuudessaan oli varsin hyvä.

Sairastumisen alkuvaiheen PCBS testin asennonmuutos-, istumatasapaino- sekä seisomatasapainotehtävien tulokset olivat yhteydessä alkuvaiheen päivittäisiin toimintoihin mitattuna Barthelin Indeksillä (BI). Lisäksi negatiivinen yhteys löytyi PCBS testin asennonmuutos- ja istumatasapainotehtävien sekä visuaalisessa huomioinnissa saatujen testitulosten välillä. Tulos osoittaa, että mitä enemmän potilas sai virhepisteitä visuaalisessa huomioinnissa, sitä heikompi oli hänen kykynsä hallita asennon muutoksia ja istumatasapainoa.

Akuuttivaiheen PCBS testin asennonmuutostehtävien tulokset ennustivat potilaan päivittäisistä toiminnoista selviytymisen tasoa kolmen kuukauden kuluttua sairastumisesta mitattuna Barthelin Indeksillä. Lisäksi akuuttivaiheen seisomatasapainotehtävien tulokset ennustivat kaatumisriskiä kolmen kuukauden seurannan aikana.

PCBS testin seisomatasapainotehtävien ja voimalevyllä mitatun huojunnan nopeuden (mm/s) välillä löytyi negatiivinen yhteys. Suurin negatiivinen korrelaatio oli PCBS testin seisomatasapainotehtävien ja voimalevyllä mitatun eteen-taakse huojuntanopeuden välillä niillä koehenkilöillä, joiden sairastumisesta oli kulunut yli puoli vuotta. Negatiivinen korrelaatio osoittaa sitä, että mitä alhaisemmat pisteet koehenkilö saa PCBS testin seisomatasapainotehtävistä sitä todennäköisemmin hänen huojuntanopeutensa lisääntyy voimalevyllä. Painonjakautumista mitattiin vaaoilla ja voimalevyllä. Näiden lateraalista symmetriaa mittaavien tulosten välinen yhteys todettiin sekä äskettäin sairastuneilla että yli puoli vuotta sitten sairastuneilla.

Kaiken kaikkiaan PCBS testissä ei todettu lattia- ja kattoefektiä 7 päivän, 4 kuukauden ja vuoden seurantamittauksissa. Tämä osoittaa että PCBS testin vaikeustaso on sopiva kuntoutuksen seurantaan vuoden ajan sairastumisesta. Testi osoitti tasapainossa tapahtuvia muutoksia 4 kuukauden aikana sairastumisesta. Testi erotteli aivohalvaukseen sairastuneiden ja terveiden henkilöiden tasapainon hallinnassa ilmeneviä eroja.

Fysioterapian kehittäminen aivohalvauspotilaiden kuntoutuksessa

Fysioterapian käyttö aivoverenkiertohäiriöpotilaiden kuntoutuksessa alkoi 1940-1950 -luvuilla. Kyseisenä aikana kehitetyissä terapioissa menetelmien perusta on liikettä avustavissa tekniikoissa, joissa terapeutti avustaa manuaalisesti normaaleja liikemalleja ja estää samalla ns. epänormaaleja liikemalleja. Näitä neuroterapioiksi kutsuttuja menetelmiä fysioterapeutit ovat alkaneet tarkastella kriittisesti, koska niiden taustalla olevan tiedon on todettu muuttuneen erityisesti viimeaikaisen neurofysiologisen ja neuropsykologisen tutkimuksen kehittymisen myötä. Viime vuosina ovat yleistyneet oppimisen teorioihin perustuvat menetelmät, joissa korostetaan sitä, että psyykkiset ja fyysiset tekijät, ympäristötekijät ja suoritettavan tehtävän asettamat vaatimukset yhdessä vaikuttavat kuntoutumiseen. Keskeisin ero oppimiseen perustuvien menetelmien ja neuroterapioiden välillä on siinä, miten ne mahdollistavat kuntoutujan aktiivisen osallistumisen omaan kuntoutusprosessiinsa.

Aktivoiva terapia

Motorisen oppimisen alkuvaiheessa kognitiivisilla tekijöillä on keskeinen merkitys kuntoutuksessa. Fysioterapiassa pystytään edistämään kuntoutujan kognitiivisten toimintojen paranemista, kun kuntoutuja otetaan mukaan aktiivisesti oman harjoittelunsa suunnitteluun ja toteuttamiseen. Oleellista terapian onnistumisen kannalta on se, että fysioterapeutti on selvillä kuntoutujan sosiaalisesta elämäntilanteesta sekä fyysisestä ja henkisestä toimintakyvystä, jotka otetaan huomioon harjoittelutehtävien valinnassa ja harjoittelun ohjauksessa. Aivohalvauksen jälkeinen motorinen oppiminen ei siten merkitse vain lihas- ja liikekontrollin oppimista uudelleen, vaan sellaisen tiedon ja taidon saavuttamista, joka auttaa selviytymään jatkuvasti muuttuvassa ympäristössä.

Ihmisten välisessä kanssakäymisessä puheella on keskeinen merkitys ihmisen tietoisuuden rakentamisessa. Niinpä sanallinen ohjaus tekee mahdolliseksi rakentaa kuntoutujan kanssa yhdessä harjoitustilanne, jossa kuntoutujan omien mielipiteiden esiintuomisen ja käsittelyn avulla saavutetaan yhteinen ymmärrys harjoittelun merkityksestä ja toteutumisesta. Näön avulla kuntoutujalle voidaan luoda mielikuvaa tehtävän luonteesta ja suorituksen onnistumisesta.

Harjoitteluympäristöt rakennettiin tukemaan aktiivista harjoittelua ja mahdollistamaan kuntoutujan itsenäisen harjoittelun. Erilaisilla ympäristön ratkaisuilla mahdollistetaan sellaisten henkilöiden harjoittelu, joilla on aistitoimintojen, havaintotoimintojen, tarkkaavaisuuden ja tahdonalaisen toiminnan häiriöitä. Harjoitteluympäristön pitää toimia siten, että siinä voidaan nostaa tehtävien kuormitustasoa ja näin mahdollistaa nousujohteisen harjoittelun toteuttaminen. Kestävyysharjoittelussa voidaan käyttää mm. juoksumattoa, polkupyörä- ja käsiergometriä, kävelyä eri muodoissa kuten epätasaisella alustalla, maastossa liikkumista ja sauvakävelyä.

Tasapainoharjoittelun tavoitteena on lisätä kuntoutujan kykyä hallita molempia kehonpuoliskoja ja toimia hallitusti tukipinnan reuna-alueilla kaatumatta. Hän pystyy kontrolloimaan kehon keskipisteen siirtymistä suhteessa tukipintaan, raajojen geometriaa, pään stabilointia, näön suuntaamista ja vartalon ojennusta avaruudellisesti. Tehtäväkeskeinen harjoittelu tarkoittaa sitä, että harjoittelu viedään kuntoutujan omaan elinympäristöön, johon rakennetaan hänelle soveltuva peruskuntoharjoitteluohjelma ja päivittäisen elämän vaatimien taitojen harjoittelu arjen tilanteissa.

Aktivoivan terapian vaikuttavuustutkimus

Aktivoivan terapian vaikutuksia aivohalvauspotilaiden fyysiseen ja kognitiiviseen toimintakykyyn sekä itsenäiseen selviytymiseen kotona tutkittiin vertaamalla aktivoivan terapian tuloksia (n=40, ikäjakauma 51-89 vuotta) perinteistä fysioterapiaa saavien potilaiden (n=40, ikäjakauma 47-85 vuotta) tuloksiin vuoden seurantatutkimuksessa. Tämä tutkimus osoitti, että koeryhmän potilaiden fyysinen toimintakyky parani kontrolliryhmää enemmän, vaikkakaan ryhmien välillä ei ollut tilastollisesti merkitsevää eroa. Kuitenkin koeryhmän potilaat pystyivät selviämään kotona paremmin ilman ulkopuolista apua ja liikkuivat ulkona pidempiä matkoja. Vuoden seurannan aikana koeryhmän potilaiden kognitiiviset taidot paranivat ja muistitoiminnoissa ero koe- ja kontrolliryhmän välillä oli merkitsevä, kun vastaavasti kontrolliryhmässä kognitiivisten taitojen parantumista ei havaittu.

Fysioterapeutin ja potilaan välinen vuorovaikutustutkimus

Potilaan aktiivisen roolin kehittämiseksi oli tärkeää tietää, miten fysioterapeutit käyttivät PCBS testin tuloksia ohjatessaan potilaille tasapainoharjoitteita ja auttaessaan siirtämään harjoitteita potilaan omaan elinympäristöön. Kolme fysioterapeuttia videoi yhteensä 7 potilaan tasapainotestauksen. Välittömästi testin jäkeen he katsoivat yhdessä videoidun testisuorituksen ja keskustelivat tuloksista. Myös nämä ohjaustilanteet videoitiin myöhempää analysointia varten.

Ohjaustilanteiden analyysit osoittivat, että fysioterapeuttien tulee olla tietoisempia halvauksesta johtuvista kommunikaatio-ongelmista. Testaustulosten hyödyntäminen vaatii fysioterapeuteilta vuorovaikutuksellisia ohjaustaitoja voidakseen auttaa potilaita rakentamaan harjoittelua omaan sosiaaliseen ympäristöönsä.

Yhteenveto

Päätavoite Itä-Savon alueella toteutetusta tutkimus- ja kehittämishankkeessa oli edistää potilaiden aktiivista roolia fysioterapiassa. Tasapainon- ja asennonhallinnan (PCBS) testi kehitettiin yhdessä aktivoivan terapian kanssa. PCBS testi eroaa aikaisemmin kehitetyistä tasapainotesteistä istuma- ja seisomatasapainotestin arviointiasteikossa. Asteikko perustuu tehtävissä käytettyjen strategioiden arviointiin. PCBS testin reliabiliteetti- ja validiteettitutkimukset osoittivat, että mittari on luotettava arvioimaan aivohalvauspotilaiden tasapainoa kuntoutumisen eri vaiheissa.

Aktivoiva fysioterapia perustui ajatukseen, että aivohalvauksen jälkeinen toimintakyvyn paraneminen on oppimisprosessi, joka vaatii toteutuakseen sekä fyysisiä että kognitiivisia toimintoja. Tämä tutkimus antaa viitteitä siitä, että aktivoivalla fysioterapialla voitaisiin aktivoida sekä fyysisiä että kognitiivisia taitoja ja edistää potilaiden itsenäistä kotona selviämistä perinteistä fysioterapiaa tehokkaammin.

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APPENDIX 1 PCBS test and test manual in Finnish

AVH-potilaan fysioterapia
Jyväskylän yliopisto
Itä-Savon sairaanhoitopiiri
2007

PCBS testi

Testausaika .... Testaaja ....

Nimi .... Sos.tunnus …………………………………..

Koulutus ....

Ammatti .... Muut sairaudet ....

Dg. ....

....

....

Sairastumispäivä ....

TT .... Lääkitys ....
(jos oleellista merkitystä fysioterapiatilanteisiin)

....

.... Halvausoireet: _______ vas _______ oik

.... Käyttökäsi: _______ vas _______ oik

LUOKITUS A. ITSENÄINEN SELVIYTYMINEN

3 **Onnistuu itsenäisesti**

- suoritus onnistuu hallitusti ja turvallisesti ilman apuvälinettä tai ulkopuolista apua

2 **Onnistuu itsenäisesti, mutta kontrolli alentunut**

- suoritus onnistuu itsenäisesti, mutta liikkeiden kontrolloinnissa ja suorituksen sujuvuudessa on havaittavissa puutteita

1 **Osallistuu aktiivisesti, mutta tarvitsee apua**

- tarvitsee suorituksessa ulkopuolista avustusta, joko verbaalista tai manuaalista ohjausta
- avustus liittyy suoritukseen, mutta ei tarvitse välttämättä apua koko suorituksen ajan

0 **Täysin autettava**

- täysin toimintakyvytön, tarvitsee ulkopuolista apua koko suorituksen ajan

☐ **Ei testattu**

- selvitys, miksi ei

....

....

....

Asennon muutokset

	A
● Kääntyminen oikealle kyljelle	☐
● Kääntyminen vasemmalle kyljelle	☐
● Istumaannousu oikean kyljen puoleiselle reunalle	☐
● Istumaannousu vasemman kyljen puoleiselle reunalle	☐
● Siirtyminen (pyörä)tuoliin ja takaisin	
- oikean puolen kautta	☐
- vasemman puolen kautta	☐
● Seisomaannousu istumasta	☐

LUOKITUS B. TASAPAINON HALLINTA

3 **Tasapainon hyvä hallinta**
- hallitsee tasapainon suorituksen aikana tehtävän edellyttämällä tavalla

2 **Tasapainon kohtalainen hallinta**
- hallitsee tasapainon suorituksen aikana, mutta liikkeiden kontrolloinnissa ja suorituksen sujuvuudessa puutteita

1 **Vaikeuksia tasapainon hallinnassa**
- käyttää tasapainon hallintaan raajojen ja vartalon kompensoivia liikkeitä vaikeuksia tasapainon hallinnassa suorituksen aikana (horjahdukset, ylimääräiset askeleet, tuen ottaminen)

0 **Kykenemätön ylläpitämään tasapainoa**
- ei pysty suorittamaan tehtävää

☐ **Ei testattu**
- selvitys, miksi ei

....

....

....

Tasapainon hallinta istuen

- Istuminen tuetta (1 min.) 0 = ei pysty 1 = pystyy ☐

B

- Kyynärpään kosketus alustaan
  - oikealle puolelle .... ☐
  - vasemmalle puolelle .... ☐
- Esineen kurkotus edestä vaakatasosta: - paremmalla kädellä .... ☐
- Esineen kurkotus jalkojen edestä lattialta: - paremmalla kädellä .... ☐

Tasapainon hallinta seisten

- Seisominen ilman tukea (30 s) 0 = ei pysty 1 = pystyy ☐
- Seisominen jalat yhdessä (max 15 s) 0 = 0-5 s 1 = 6-10 s 2 = 11-15 s ☐
- Seisominen yhdellä jalalla (max 15 s) 0 = 0-5 s 1 = 6-10 s 2 = 11-15 s
  - oikealla jalalla ☐
  - vasemmalla jalalla ☐

B

- Esineen poimiminen lattialta
  - paremmalla kädellä .... ☐
- Kyynärpään kosketus sivulle
  - oikealle puolelle .... ☐
  - vasemmalle puolelle .... ☐
- Esineen kurkotus yläviistosta paremmalla kädellä
  - oikea jalka edessä .... ☐
  - vasen jalka edessä .... ☐
- Kääntyminen paikallaan 360°
  - oikean puolen suuntaan .... ☐
  - vasemman puolen suuntaan .... ☐
- Seisominen vaaoilla ilman tukea (20 s)
  - oikea jalka ....kg
  - vasen jalka ....kg
- Painonsiirto vaaoilla jalalta toiselle
  - oikealle jalalle ....kg
  - vasemmalle jalalle ....kg

ASENNONHALLINTA- JA TASAPAINOTESTIN SUORITUSOHJEET

Arviointiasteikot

Asennonhallinta- ja tasapainotestin arviointiasteikot ovat neliluokkaisia (0-3). Asennon muutostehtävissä arvioidaan omatoimisuutta, avun tarvetta sekä suoriutumisen sujuvuutta (Luokitus A. Itsenäinen selviytyminen). Istuma- ja seisomatasapainotehtävissä arvioidaan suoritusten sujuvuutta ja asennonhallinnan strategioiden käyttöä (Luokitus B. Tasapainon hallinta).

Luokitus A. Itsenäinen selviytyminen

3 Onnistuu itsenäisesti
- suoritus onnistuu hallitusti ja turvallisesti ilman apuvälinettä tai ulkopuolista apua ikä huomioiden

2 Onnistuu itsenäisesti, mutta kontrolli alentunut
- suoritus onnistuu itsenäisesti, mutta liikkeiden kontrolloinnissa ja suorituksen sujuvuudessa on havaittavissa puutteita

1 Osallistuu aktiivisesti, mutta tarvitsee apua
- tarvitsee suorituksessa ulkopuolista avustusta, joko verbaalista tai manuaalista ohjausta
- avustus liittyy suoritukseen, mutta ei tarvitse välttämättä apua koko suorituksen ajan

0 Täysin autettava
- täysin toimintakyvytön, tarvitsee ulkopuolista apua koko suorituksen ajan
- osallistuminen tehtävään minimaalista tai osallistuminen ei auta tehtävästä suoriutumisessa

X Ei testattu
- selvitys miksi testiä ei ole suoritettu (esim. nopea siirtyminen hoitopaikasta toiseen)

Luokitus B. Tasapainon hallinta

3 Tasapainon hyvä hallinta
- hallitsee tasapainon suorituksen aikana tehtävän edellyttämällä tavalla
- pystyy siirtämään painopistettä tukipinnan reuna-alueelle

2 Tasapainon kohtalainen hallinta
- hallitsee tasapainon suorituksen aikana, mutta liikkeiden kontrolloinnissa ja suorituksen sujuvuudessa puutteita
- käyttää vähäisessä määrin tasapainon hallinnassa raajojen ja vartalon kompensoivia liikkeitä

1 Vaikeuksia tasapainon hallinnassa
- käyttää tasapainon hallintaan raajojen ja vartalon kompensoivia liikkeitä
- vaikeuksia tasapainon hallinnassa suorituksen aikana (horjahdukset, ylimääräiset askeleet, tuen ottaminen)
- pyrkii hallitsemaan tasapainoa

0. Kykenemätön ylläpitämään tasapainoa
- ei pysty suoriutumaan tehtävästä
- vaikeuksia säilyttää tehtävän edellyttämä asento ja ylläpitää tasapaino ilman kaatumisriskiä.

X. Ei testattu
- selvitys miksi testiä ei ole suoritettu

Testauksessa tarvittavat välineet

- normaali sänky tai leveä plintti
- tuoli tai pyörätuoli
- baarijakkara, korkeus 70 cm
- koroke, jos potilaan jalat eivät yllä lattiaan
- jalankuvat
- sekuntikello
- hernepussi
- mittanauha
- väriteippi

Testauksen suorittaminen

Huonokuntoisen potilaan testaus suoritetaan potilashuoneessa. Selvitetään ymmärtääkö potilas verbaalisesti annetut ohjeet. Mahdollisuuksien mukaan kääntymiset ja siirtymiset suoritetaan ensin terveen ja sitten halvaantuneen puolen kautta. Siirtymisissä istumasta tuoliin, seisomaannousussa ja istuma- ja seisomatasapainotehtävissä potilaalla on kengät jalassa

Asennon muutokset

<u>Kääntyminen kyljelle</u>
Potilas on selinmakuulla, jalat vierekkäin ja kädet vartalon vieressä.
Pyydetään potilasta kääntymään.

<u>Istumaannousu</u>
Potilas on selinmakuulla. Pyydetään potilasta nousemaan istumaan sängyn reunalle.

<u>Siirtyminen (pyörä)tuoliin</u>
Potilas istuu tuolissa jalkapohjat lattiassa. (Pyörä)tuoli on sijoitettu sängyn viereen.
Potilasta pyydetään siirtymään tuoliin ja takaisin sänkyyn.

<u>Seisomaannousu</u>
Potilas istuu tuolilla jalkapohjat lattiassa.
Potilasta pyydetään nousemaan seisomaan tukeutumatta käsiin.

Tasapainon hallinta istuen

<u>Istuminen tuetta</u>
Potilas istuu sängyn laidalla, reidet alustalla, jalkaterät jalankuvien päällä (20 cm etäisyydellä toisistaan), kädet sylissä. Paino on mahdollisimman tasaisesti jakautunut ja vartalon liikkuminen vähäistä. Potilasta pyydetään ylläpitämään asento yhden minuutin ajan. Jos potilas ei pysty istumaan yhtä minuuttia ilman tukea sängyn laidalla, istumatasapainon testaamista ei jatketa ja potilas saa testistä tulokseksi
0 = ei pysty ylläpitämään istumatasapainoa.
Arviointiasteikko: 0 = ei pysty, 1 = pystyy

<u>Kyynärpään kosketus alustaan</u>
Potilas istuu sängyn laidalla jalat jalankuvien päällä. Häntä pyydetään koskettamaan kevyesti kyynärpäällä alustaan ja palaamaan kunkin suorituksen jälkeen lähtöasentoon. Suoritus toistetaan kolme kertaa. Kosketettava merkki on etuviistossa 30 cm etäisyydellä lonkasta. Tarkkaillaan vartalon kallistumista taakse tai sivulle ja tukeutumista käsiin. Seurataan myös jalkojen asentoa ja liikkeitä. Paremmalla kädellä voi tukea halvaantunutta kättä ranteesta ja ohjata kyynärpäätä alustaan.

<u>Esineen kurkotus edestä vaakatasosta</u>
Potilas istuu sängyn laidalla. Häntä pyydetään kurkottamaan esinettä (esim. hernepussia), joka on vaakatasossa baarijakkaran päällä 50 cm etäisyydellä jalkateristä. Kurkotus on riittä-

vä, kun potilaan otsa on polvien tasolla. Suoritus toistetaan kolme kertaa. Tehdään vain paremmalla kädellä. Tarkkaillaan vartalon liikettä (kiertoa), olkapään ja kyynärpään liikeratoja ja liikelaajuuksia.

Esineen kurkotus jalkojen edestä lattialta
Potilas istuu sängyn laidalla. Häntä pyydetään kurkottamaan edestään lattialta esinettä, joka on 20 cm päässä jalkateristä. Suoritus toistetaan kolme kertaa. Tehdään vain paremmalla kädellä. Tarkkaillaan vartalon liikettä (kiertoa), olkapään ja kyynärpään liikeratoja ja liikelaajuuksia.

Tasapainon hallinta seisten

Seisominen ilman tukea
Potilas seisoo jalankuvien päällä (20 cm etäisyydellä toisistaan), kädet sivuilla. Paino on mahdollisimman tasaisesti jakautunut ja vartalon liikkuminen vähäistä. Potilasta pyydetään ylläpitämään asento 30 sekunnin ajan. Jos potilas ei pysty seisomaan puolta minuuttia, seisomatasapainon testausta ei jatketa ja potilas saa tulokseksi 0 = ei pysty ylläpitämään seisomatasapainoa.
Arviointiasteikko: 0 = ei pysty, 1 = pystyy

Seisominen jalat yhdessä
Potilas seisoo jalat yhdessä, katse eteenpäin, ilman tukea, 15 sekunnin ajan.
Arviointiasteikko: 0-5 s = 0, 6-10 s = 1, 11-15 s = 2

Seisominen yhdellä jalalla
Potilas seisoo yhdellä jalalla, toinen jalka on koukussa ilmassa (ei kosketa tukijalkaa), katse eteenpäin, 15 sekunnin ajan.
Arviointiasteikko: 0-5 s = 0, 6-10 s = 1, 11-15 s = 2

Esineen poimiminen lattialta
Potilas seisoo jalankuvien päällä (20 cm etäisyydellä toisistaan). Häntä pyydetään nostamaan paremmalla kädellä esine, joka on asetettu 20 cm päähän jalkateristä. Suoritus toistetaan kolme kertaa. Tarkkaillaan suorituksen sujuvuutta, asennon symmetriaa ja tukeutumisen tarvetta (esim. selkeä tukeutuminen toisella kädellä polveen tai tukipinnan laajentaminen jalkojen asentoa vaihtamalla tai ottamalla tukea oman kehon ulkopuolelta).

Kyynärpään kosketus sivulle
Potilas seisoo jalankuvien päällä. Potilaan sivulle asetetaan 70 cm korkuinen baarijakkara 30 cm etäisyydelle saman puoleisesta isovarpaasta. Potilasta pyydetään koskettamaan kevyesti saman puoleisella koukistetulla kyynärpäällä jakkaran keskelle merkittyä kohtaa. Suoritus toistetaan kolme kertaa. Seurataan suorituksen sujuvuutta, painon sivusuuntaista siirtoa jalalta toiselle, lantion ja ylävartalon liikkeitä suorituksen aikana. Halvaantunutta kättä voi ohjata ja tukea paremmalla kädellä ranteesta.

Esineen kurkotus yläviistosta
Potilas seisoo käyntiasennossa jalankuvien päällä, etummainen jalka 70 cm etäisyydellä seinästä. Potilasta pyydetään ottamaan yläviistoon hyllylle asetettu esine, joka on sellaisella korkeudella, että hän joutuu kurkottamaan ja ojentamaan vartaloaan. Suoritus toistetaan kolme kertaa. Testi suoritetaan vain paremmalla kädellä. Tarkkaillaan painon siirtymistä etummaisen jalan varaan, etummaisen jalan puolella lonkan ojentumista ja vartalon kiertoa.

Kääntyminen paikallaan 360 astetta
Potilas seisoo jalankuvien päällä. Potilasta pyydetään kääntymään paikallaan täyden kierroksen 360 astetta kumpaankin suuntaan. Suoritus tapahtuu ilman tukea ja pysähtymättä. Tarkkaillaan suorituksen sujuvuutta, horjahduksia, tukipinnan laajentamista, jäykkyyttä ja askelten määrää.

Seisominen vaaoilla ilman tukea
Potilas seisoo kahdella vaa'alla (jalkaterien etäisyys 20 cm toisistaan). Katse on suunnattu edessä olevaan merkkiin. Pyydetään potilasta seisomaan mahdollisimman suorana ja tasaisesti molempien jalkojen päällä. Asento pyritään pitämään vakaana 20 sekunnin ajan. Viimeisten 10 sekunnin aikana katsotaan painon jakautuminen vaaoilla ja tulos merkitään kilogrammoina.

Painonsiirto vaaoilla jalalta toiselle
Potilas seisoo kahdella vaa'alla (jalkaterien etäisyys 20 cm toisistaan). Katse on suunnattu eteenpäin. Potilas siirtää painoa vuorotellen kummallekin jalalle siten, että painonsiirto tapahtuu lantiosta. Ei-varaavan jalan puolelle saa jäädä painoa 10-15 kg, ts. yhden raajan painon verran. Tulos merkitään kilogrammoina.