Measurement tools in chronic stroke patients


- A descriptive research -

Professional Assignment Project of Marius Kappeler and Lars Jäger

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Foreword / Words of gratitude

We, the performers of this research, Marius Kappeler and Lars Jäger, experienced the challenge of conducting a research during the last month with various highs and lows and we were grateful to receive help and support by several people in most different ways:

Jarmo Perttunen agreed to be the client for our Professional Assignment Project, which turned out to have more effect on our work, then expected previously. The decision of asking Jarmo Perttunen to be our client was based on his huge experience in the field of research and on the fact that he is an extraordinary skillful teacher, who would be able to understand difficulties in the progress of our research, see through them and thus, be a client who is able to put the work performed into perspective. Yet, having an internationally known researcher as our client turned out to be a major factor in terms of motivation, during the whole period of our research. Since he agreed to our request, we rewrote and revised our project plan again and again, in order to eliminate mistakes, avoid difficulties, and exclude bias, where possible. In short: we wanted to show off with the skills we learned during our study at the Hogeschool van Amsterdam and we wanted to live up to the professional expectations we imagined Jarmo to have. In fact, we set our self-expectation on a higher level due to his participation in our Professional Assignment Project as a client.

Due to the fact that this research was conducted by two students who are not related to an institution, the quest of a suitable patient population had to be established with little contacts and knowledge about the difficulties, which were to come. In fact, our credulous and optimistic expectations were confronted with reality very soon.
Finding stroke patients in a huge city like Amsterdam did not bear any difficulties itself. Finding stroke patients, which were willing to participate in our research was hard. Finding a physiotherapist who treats chronic stroke patients was harder, but finding physiotherapists or clinical doctors who would agree on our bid to examine patients turned out to be almost impossible. In case even if the latter turned out to be positive, insurance matters came up, the doctor in charge was unexpectedly unavailable (for the duration of weeks) or phone calls were left unanswered. The first disappointing experience of our research therefore, was that it is extremely hard to find clinics or physiotherapists, who are willing to participate, simply for the sake of it. However, between the lines we were told that it would be “normal” to pay allowance for special expenditure.
A major help was the offer of Jos den Hollander, who invited us to his praxis in Aarau, Switzerland. Here we conducted the practical part of our research. Jos den Hollander did not only let us ‘take over’ his praxis, during the actual testing period, he also established the first contact with participants and was open minded towards the idea of our Professional Assignment Project.

During our stay, in Switzerland, we were, as if naturally, kindly put up by Mr and Mrs Kappeler, who we would like to thank for enabling us to stay in Switzerland - which finally brought our research to live again.

Jaap Bakker, did a great part in leading the research into the ‘right direction’ and getting us back on the path, when we missed relevant aspects in structure,
planning and practical progress. In various occasions we were only able to understand his reasons for giving certain advises after practical experiences made - which in fact was due to the gapping difference of our idea of the research and it’s actual progress.

We would like to thank Rania Lahdo for checking and revising the final report with respect to grammatical correctness, sayings and ‘to the point formulations’.

Moreover, we would like to thank Jesse Aarden, who gave us inside knowledge into the use of statistical data analysis and enabled us not only to understand the meaning of each outcome in detail, but furthermore taught us mathematical formulas, it’s relationships and it’s rationales.
Furthermore, we would like to thank Bas Moed who helped us during difficult times in data analysis. We are very grateful for that!

Last but not least, we would like to thank all participants who, of course, represent the “heart” of our study. In contrast to the difficulties experienced at the very beginning of our research, the implicitness of their participation surprised us positively and made the practical part of the research very pleasant.

Other people and institutions we would like to thank, due to various reasons are: “SRK (Schweizerisches Rotes Kreuz) - Tageszentrum für Behinderte und Betagte“ and its staff.

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Abstract

Objective: The goal of this research was to determine the inter and intra rater-reliability of the Berg Balance Scale (BBS), The Fugl-Meyer Test (F-M) and the Motricity Index test (MI) in chronic stroke patients and further discuss its causes and relevance.

Research question: What is the inter and intra rater-reliability of the BBS, F-M and the MI in chronic stroke patients?

Design: The design of the research is a descriptive research.

Setting: Rehabilitation center, practice, inpatient center, elderly homes, private homes.

Participants: the number of participants was 17, consisting of ten women and seven men.

Results: The results show high intra rater-reliability (>0.93) and high inter rater-reliability (>0.94) for all three tests.

Conclusion: The tools showed to be highly reliable as to inter-and intra rater-reliability, but applicability into clinical practice has to be considered critically. The small sample size and the ‘floor ceiling’ effect in the patient population may affect transferability.

Key Words: Stroke; assessment tool; balance; mobility; intra rater-reliability; inter-reliability; test; Fugl-Meyer (F-M); Berg Balance Scale (BBS); Motricity Index (MI)

Introduction
Currently six million stroke survivors live in the EU, Iceland, Switzerland and Norway. In the same countries, an estimated 1.1 million new strokes occur, annually. Within the next 17 years, this number is thought to increase to 1.5 million new strokes per year, but already today cost are likely to exceed €21,895,000,000 per annum - for European stroke patients only. (Andlin-Sobocki et al. 2007)
With an ageing population in most European countries, not only insurance companies, but also the Governmental health care systems are strongly affected and thus, declare a huge interest in the controllability of treatment progresses. Furthermore, more realistic predictions on possible treatment outcomes would enable employers to pre-plan, and health care professionals to specify their treatment, most effectively. All this, is based on the reliability of measurement scales, of which some can be found in guidelines.

Objective measurement of function in the assessment of stroke patients is central to Rehabilitation (National clinical guidelines for stroke, Second edition; Royal college of physicians, 2004) and it is of high importance, that the outcome is reliable, yielding consistent and reproducible results within and across both subjects and raters (Cipriany-Dacko et al., 1997). Moreover, it is not only of high importance to train physiotherapists in the application of scales, but to ensure their understanding of the functions and limitations of scales (National clinical guidelines for stroke, Second edition; Royal college of physicians, 2004). In order to be clinically useful a scale must be scientifically sound with regards to three psychometric properties: reliability, validity and responsiveness (Mao, 2002). Another point to consider is that with new treatment options, which are under investigation in stroke rehabilitation, measurement of recovery of stroke is becoming increasingly important (Gladstone, 2002).

Therefore, more studies need to be conducted on the usefulness of diagnostic and prognostic test (Riddle, 1999)

Measuring balance and mobility is important, as it assists the clinician in diagnosis, selection of the most appropriate therapy and outcome measurement (Mao, 2002). Scales that are widely used are the Fugl-Meyer Test (F-M) (10;16), the Berg Balance Scale (BBS) (9;10) and the Motricity Index (MI). The F-M scale has even been reported to have gained international acceptance (6;16). Not only that these tests have obtained a broad acceptance by its extensive clinical use, the BBS is even seen to be a clinical criterion standard by which to measure balance (Kornetti, 2004).

All three scales have been researched and the BBS was considered to be of high reliability (4;5;9;10;16,18), as well as the F-M (6;10;11;16,) and the MI (7;8).

Furthermore, in different sections of the KNGF-guidelines physiotherapists are advised to make use of all three tests mentioned above. However, it should be remembered that guidelines only recommend the use of the best tools available - which puts the actual quality of tools into perspective. Moreover, the guideline suggests the use of the three tests related to stroke patients and differentiates between intake, immobilization and mobilization phase. The aim of this study was to focus on finding the best balance and mobility - assessment tool for chronic stroke patients, solely. The authors find this of high importance, as the continuous
evaluation of abilities in chronic stroke patients is of the same importance, as in the acute stroke population.

Despite the widespread use of the tests, recent discussions have renewed the question on what the best measurement tool may be. In fact, one might come to the conclusion that within the last years the high undoubted status of the scales has come to falter - due to various reasons. Katherine Salter (Katherine Salter et al., June 2007) states that the high values for internal consistency of the BBS may be due to “item redundancy”. In addition to that, the BBS do not have the required criteria to remain the gold standards they were in the 1990s, as reported by Pérennou (D. Pérennou et al., 2005). Diana L. Kornetti (Diana L. Kornetti 2004) suggests that “modification of the BBS test procedure should be considered”. In fact, the different scores, which have different meanings may not be appropriate and the outcome may provide very little information about the individual functional abilities is given (Katherine Salter et al., June 2007). (see discussion)

In a study, conducted by Ching-Ljn Hsieh (7;10) the reliability and validity of the F-M has been shown to be questionable - especially with regards to the balance section (7;10;16). Further testing of the modification of the BBS is required. (Katherine Salter et al., June 2007).

The purpose of the present study was to examine the inter and intra rater reliability of the BBS, F-M and MI in chronic stroke population solely. A study comparing all three tests has not been found by the authors. It was hypothesized that the BBS and F-M have a high inter and intra rater reliability (ICC > 0.8), as the tasks and grading system in both tests are described glaringly. Based on the available evidence, both tests are recommended highly as a clinical tool (KNGF stroke guidelines 2006). The inter-and intra-rater reliability of the MI was expected to be lower (ICC < 0.8) due to its vague and ambiguous description of the tasks and its inapprehensible scoring system.

Materials and methods

Subjects

Seventeen subjects from the ‘daytime-center for aged and disabled people’ of the ‘Red Cross Switzerland’ (SRK (Schweizerisches Rotes Kreuz) - Tageszentrum für Behinderte und Betagte) in Aarau, Switzerland were recruited. The patient population consisted of 10 women (62.5%) and 7 men (37.5%) aged 57.3 years in average (SD=10.02). The time elapsed after stroke had a mean of 3.84 years. Procedures followed standard research conventions in order to ensure subject well-being, including a detailed explanation of the study and informed consent. After the testing, one participant was excluded and makes up the only drop out. The inclusion criteria for this patient population was the occurrence of a stroke, at least three month prior to the testing. Exclusion criteria were the use of medicine, which had influence on balance or mobility, pain which had influence on the movement, physiotherapy treatment in between the sessions and suffering from a second neurological disease. Furthermore, a change of medication in between the sessions, a subjective change of physical or mental condition in between the two sessions or suffering from additional vestibular dysfunction were reasons for exclusion. (Appendix A;B)
Procedures

In order to ensure that the patient population met the inclusion criteria, all participants filled in a questionnaire prior to the testing (Appendix A). Additionally, prior the second trial, the participants filled in a different questionnaire (Appendix B), in order to detect changes which might have influence on a change in performance, during the second trial. All subjects were tested twice in a non-distracting environment and graded by both assessors. During both testing sessions, all three tests were performed after each other. Participants were allowed a break between each test, for as long as they wished for.

The order of the tests was randomly assigned, using Research Randomizer® (Urbaniak et al. 2007). No feedback was given to the patient’s performance, so that the patient would not be enabled to evaluate on his or her own performance and willingly try to change it in the second trial.

The time intervals between the first and the second testing did not exceed three days, but was at least one day, in order to allow sufficient recovery. In addition to that factor, the possibility of memorizing the test outcomes by the assessors was minimized.

As the patient population consisted of chronic stroke patients (three or more months after stroke), no significant change in performance could be expected, due to a change in the course of disease or a sudden significant enhancement, with regard to the patients condition.

All tests were performed with the participants wearing the same pair of shoes during the first and second testing session. Patients did not participate in physiotherapy interventions in between the two measurements in order to assure, that differences in the outcome were not due to treatment. Furthermore, no changes in medication, which might have altered the performance of the tests, were undertaken.

During the whole testing period, one particular rater read out the activity, and demonstrated it once (picture 2). Hereupon, the subject performed the activity with the affected (weaker) side. Thus, the possibility of a variance in outcome, caused by the actual guidance or instruction of the physiotherapist was minimized.

In order to ensure, that the exact same task was graded by both raters, participants were scored on their first attempt to perform each task. For the BBS, F-M and MI the raters followed a standard protocol. After grading the separate tasks, the grading papers were collected, the assessors were not allowed to discuss sole gradings and the total score of each test wasn’t calculated until the very end of the testing period.
During the second testing session, new grading forms were used, therefore the assessors were not biased by previous results.

**Raters**
Two third year physiotherapy students (n=2) studying physiotherapy at the Hogeschool van Amsterdam in the ESP programme performed the testing-procedures. Both assessors have used and were acquainted with all three scales before, with regard to chronic stroke patients. Prior to the study both raters discussed the BBS, MI and F-M extensively, with an experienced physiotherapist and performed all three tests on a tentative patient at the Hogeschool van Amsterdam.

**Instruments**

**BBS**
The BBS was originally developed by Katherine Berg in 1998 and intended for use in monitoring the clinical status of patients, balance skills, risk of falling and effectiveness of treatment interventions over time (Schädler et al. 2006).
It includes 14 functional activities which are performed in a standard order screening 12 ICF-sections of functionality and activity (Schädler et al. 2006). The tests range from rather simple (transitioning from standing to sitting) to more complex (standing on one foot) tasks. It measures various aspects of balance by static and dynamic tasks. All tests primarily assess lower extremity skills. Some of the tests combine lower extremity skills with general balance, however the upper extremity is not involved significantly.
Each task is scored on a five-point ordinal scale (0-4). The subjects are graded on the quality of the performance, the time taken to complete the task, and/or the time the subject can maintain a given posture. The maximum score for the BBS is 56 points. Equipment requirements include a chair, a step, a stopwatch and a yardstick. (Appendix G)

**F-M**
The F-M is a widely used tool, assessing motor function, balance, coordination, sensation and reflex-activity (Gladstone et al, 2000). The method of development of the F-M has not been outlined by its authors, but the ’75 published original report, described the purpose, target population for the scale and instructions for scoring (Gladstone et al, 2000). As hemiparesis is the ‘most common disabling deficit, affecting 70% to 80% of stroke survivors’, the F-M was created to fill the lack of a specific and quantitative method for measuring recovery from hemiplegia (Gladstone et al, 2000).
In order to allow a meaningful comparison between the three tests we only included the motor assessment portion of the F-M. This part of the test contains 100 points.
The motor assessment part of the F-M consist of multiple items, which can be scored on a 3-point ordinal scale (0 = cannot perform, 1 = performs partially, 2 = performs fully). The motor score ranges from 0 (no performance) to a maximum of 100 points (normal motor performance), divided into 66 points for the upper extremities and 34 points for the lower extremities. Equipment requirements include a chair, a reflex hammer and a treatment bench. (Appendix I - the ‘motor assessment portion’ consists of sections A until F, inclusively) A quick overview of movements which have to be performed in the ‘motor assessment portion’, can be found in Appendix F.
**MI**
The MI is a short test which includes six motor performances, divided into three tasks for the upper extremities and three tasks for the lower extremities. It was first introduced by Demeurisse in 1980 (Demeurisse et al. 1980) and then again by Collen in 1990. The grading system is based on the ‘strength grading system’, which was invented by the Medical Research Council (MRC). The MRC grades as follows: 0 points for no movement, 9 points for palpable movement, 14 points for visible movement, 19 points for full ROM against gravity, 25 points for movement against resistance and 33 points for normal power. Yet, for the scoring of upper extremity tasks in the MI, variations have been made. (Appendix H) The maximum score is 100 points, with the division of points being equally divided between the upper and the lower extremities. Thus, the average of the scores gives an overall impression of the entire affected side.

Equipment requirements include a chair and a treatment bench. (Appendix H)

**Data analysis**
Two aspects of reliability were tested. By comparing the measurement outcomes of both assessors against each other outcomes were tested for inter-rater reliability. As both assessors measured each patient twice, all results were compared with each other.

Furthermore, intra rater reliability was tested for, by comparing the results gained from the first trial with the second trial of one assessor and each test separately. Subject performance data were calculated using SPSS 15.0 for descriptive statistics. To analyse the inter and intra rater-reliability for each test, the Spearman rank correlation coefficient was used. As all three tests are ordinal data scales, the Spearman rank correlation coefficient was used for the BBS, F-M and MI, separately.

The significance level adopted for the statistical tests was 5% (p<0.05) for the inter and intra-reliability.

The outcome and thus the inter and intra-rater reliability will be rated as high, moderate or low. An ICC below 0.6 meaning ‘low’, an ICC between 0.6 and 0.8 meaning ‘moderate’ and an ICC above 0.8, meaning ‘high’ (Aufdemkampe, 2000).

**Results and Statistics**
Initially 17 subjects were recruited to test the reliability of the BBS, F-M and MI, over a period of one week. The number of patients was decreased to sixteen (n=16), as a result of exclusion of one participant (drop out: n=1), after the assessors concluded that her psychological instability, her depression and listlessness were the reasons for broadly varying results and even a “no show” of the second BBS, despite of 16 points (assessor A) and 20 points (assessor B) in the first testing. The results were excluded for statistical analysis, after it emerged that the results were not changed, when including or excluding this patients’ data. (Appendix C,D)

**Intra-rater reliability**
In both assessors (n=2), the intra-rater reliability showed to be surprisingly high in all three tests, examined. This becomes apparent, when considering the high Intra Class Correlations (ICC) of both assessors (Table1; Table 2 and Graph 1; Graph 2 and Graph 3)
The BBS shows ICCs of 0.933 (assessor A) and 0.983 (assessor B) and thus represented a very high reliability. The ICCs of the F-M test were even higher with an ICC of 0.983 in the results of assessor A and an ICC of 0.984 in assessor B. The ICCs of the MI were only slightly lower - but still enormously high - with an ICC of 0.939 in assessor A and 0.929 in assessor B. The highest range of points given by one assessor from the first to the second test, was a discrepancy of 12 points in the BBS, 7 points in F-M and 14 points in MI. The high consistency in outcomes with regard to intra rater reliability are depicted in Table 1. and Table 2. Moreover, Graph 1, Graph 2 and Graph 3 figuratively depict the relationship between the

Table 1. Intrarater-reliability of assessor A for all three test

<table>
<thead>
<tr>
<th>Assessor</th>
<th>ICC</th>
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<tr>
<td>1st; BBS; A</td>
<td>0.933</td>
</tr>
<tr>
<td>2nd; BBS; A</td>
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</tr>
<tr>
<td>1st; F-M; A</td>
<td>0.983</td>
</tr>
<tr>
<td>2nd; F-M; A</td>
<td></td>
</tr>
<tr>
<td>1st; MI; A</td>
<td>0.939</td>
</tr>
<tr>
<td>2nd; MI; A</td>
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Table 2. Intrarater-reliability of assessor B for all three test

<table>
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<th>Assessor</th>
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</tr>
<tr>
<td>2nd; BBS; B</td>
<td></td>
</tr>
<tr>
<td>1st F-M; B</td>
<td>0.984</td>
</tr>
<tr>
<td>2nd; F-M; B</td>
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<tr>
<td>1st; MI; B</td>
<td>0.929</td>
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<tr>
<td>2nd; MI; B</td>
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Graph 1. Relationship between first trial and second trial in the BBS for Assessor A and B

Graph 2. Relationship between first trial and second trial in the F-M for Assessor A and B

Graph 3. Relationship between first trial and second trial in the M-I for Assessor A and B

Graph 4. Relationship between first grading (assessor B) and second grading (assessor B) in the BBS
grading of the first and the second trial. Graph 4. illustrates the relationship of the first gradings to the second gradings from assessor B for the BBS, as a paradigm. However, the biggest discrepancy of ICCs within one test being examined amongst both assessors is 0.06 and thus neglectable. The ICC of the BBS is 0.990 being almost 100%, the ICC of the F-M test is even slightly higher with 0.992 and the ICC of the MI is 0.948.

**Inter rater reliability**

The biggest discrepancies with regards to the outcomes of one assessor to the other were 12 points for the BBS, 14 points for the F-M and 21 points for the MI. Graph 5 illustrates the relationship between the first grading of assessor B and the second grading of assessor A in the F-M exemplarily.

On the one hand, the high correlation between the two gradings is depicted by the adjacency of all gradings to the (imaginary) angle bisector. On the other hand the ‘ceiling floor effect’ in the grading becomes obvious.

**Graph 5.** Relationship between first grading (assessor B) and second grading (assessor A) in the F-M

**Graph 6.** Inter rater reliability in the F-M

```
Table 3. Intra Class Correlation Coefficients (ICC) of the BBS

<table>
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<tr>
<th></th>
<th>ICC</th>
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<tr>
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<tr>
<td>1st; BBS; B</td>
<td>0.979</td>
</tr>
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<td>1st; BBS; A</td>
<td>0.943</td>
</tr>
<tr>
<td>2nd; BBS; B</td>
<td>0.961</td>
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**Graph 7.** Inter rater reliability in the BBS
Patients either scored high or low points, but barely intermediate results. The ICCs for inter rater reliability are enormous: The ICC for the BBS ranges from 0.943 to 0.990 (table 3); the ICC for the F-M ranges from 0.979 to 0.994 (table 4) and the ICC for the MI 0.932 to 0.996 (table 5).

The high reliability is also depicted in graph6, graph 7 and graph 8, where the results almost make up the angle bisector, when connecting the results. Thus, the graphs figuratively depict the extremely high Intra Class Correlations, which is almost 100%.

The significance level adopted for the statistical tests was 5% (p<0.05) for the inter- and intra-reliability and in all tests the difference within subjects outcomes is significant. This is true for the inter rater reliability, as well as for the intra rater reliability.

**Discussion**

As hypothesized, the BBS and F-M showed excellent results as to inter and intra rater reliability. However, the MI showed almost as reliable results, with regards to inter and intra rater reliability.

As stated above, the highest discrepancies in the outcomes of two gradings by the same assessor (intra-rater range) are 12 points in the BBS, 7 points in the F-M and 14 points in the MI. With regards to the outcomes of one assessor to the other (inter-rater range), the biggest discrepancies found were 12 points for the BBS, 14 points for the F-M and 21 points for the MI.

However, the different amount of points has to be put into perspective. When considering the five point scale of the BBS (0-4 points) and a total of 14 well described tasks, a discrepancy of 12 points (range=12) is rather high. As for the grading it would mean that on 12 of the fourteen tasks graded a discrepancy of one point prevailed or - even more likely - that in some tasks graded, markings differed by two points. A seven point discrepancy (range=7) of the F-M is rather low, considering the three point scale and the 50 tasks, the participants were graded on.

When taking a look at the 14 points discrepancy (range=14) of the MI, it has to be understood, that the grading consists of either 0, 14, 19, 22, 26 or 33 points per task, which is divided by two, subsequently (see methods/instruments). However, most of the tasks are ‘all or nothing’ tasks. A difference of 16 points could thus be reasoned with a different grading on a single task.
When considering the results, depicted in Graph 1, it becomes clear that the patient population consisted of either patients with high or low results. Patients showing a medium performance were barely found amongst those, tested. The high inter rater and intra rater reliability can therefore, at least partly, be explained by this ‘ceiling-floor effect’. Most patients received distinct grades and those performances with a debateable performance were seldom.

Despite the fact, that numbers were calculated only after the completion of the testing period, both assessors could remember the performance outcomes of those patients, who had a full point result. This was especially the case due to the short intervals between the sessions. Both assessors agree that the high expectation on the patients’ performance may have biased the grading.

In some cases patients new some of the tests performed. Whether the outcome represents the patients’ actual skills, or a specific skill trained is not accounted for, using these tests. However the research did not aim at this feature.

It has to be stressed that despite being graded similarly by the two assessors, in individual cases the outcomes might not represent the actual condition of the patient. One patient was suspected to suffer a slight form of neglect, but was not diagnosed on it. If this were the case, the tests would enunciate a decreased motor and balance performance which in fact, would be due to neglect.

In case of cognitive impairments it was, at times, hard to distinguish weather the failing of performance was due to physical inability or mental factors. This is true for patients with a generally decreased cognitive ability, but is especially the case in patients with an affected left hemisphere. Misunderstanding of tasks - caused by impairments in language-processing areas could easily lead to the wrong conclusion. When assessing the “finger-to-nose-task” in the Fugl-Meyer test, one patient put his index finger straight to his mouth. According to the grading of this part of the test the outcome would be “one point for dysmetria” and thus, would not only lead to misinterpretation of the patients’ ability but also not mirror the patients true condition.

When assessing ‘dysmetria’ in the F-M, a clear definition on what a ‘one-point’ and what a ‘two point’ dysmetria is characterized by, is missing.

In two patients, separate movements could not be performed, whilst the movement asked for could be performed in combination with other movement-patterns. Grading on these performances was understood differently by the assessors.

A different patient was not able to relax (possibly due to cognitive impairment) and thus reflexes could not be tested in the F-M assessment.

Looseness in the grading system of the MI became obvious during grading: For example 14 points are given for “less then full range of dorsiflexion”. Consequently applying this definition would mean that a movement of 1 degree would suffice to obtain 14 points - just as a full ROM would. Due to this vague definition grading outcomes supply the reader with a very low significance.

In several cases, predictions could be made from the result of one test to the outcome of the other tests. The results of ‘patient number 2’ explicitly depict this fact (Appendix C;D; patient 2). A low score in F-M predicts a low score in MI (and vice versa), due to the fact that both tests assess upper and lower extremity skills. The BBS solely assesses lower extremity skills, which makes a high outcome possible. In fact, patient number 2 had a severely affected arm, due to which he scored very little points in the upper extremity section of the F-M and MI. The lower extremity section allowed him to gain some points, which lead to low overall results (Appendix C;D; patient 2). This is especially true for the F-M,
where the upper extremity tests make up 66% and the lower extremity tests make up only 34% of the points available. In the MI the division of points is 50% for the upper and 50% for the lower extremity. Thus, an even lower result for the F-M, compared to the MI (Appendix C;D; patient 2) can be reasoned by the different division of points for upper and lower extremity.

A low score in the BBS, means that the patient will only score in the upper extremity sections of the F-M and MI. Thus, only a medium result can be reached, if the upper extremity functions well. If a patient scores low on the BBS, a low outcome for F-M and MI can be predicted, if the upper extremity has severe restrictions. Due to the fact that the MI consists of only six tasks, predictions are easier compared to the elaborate testing of the F-M, where patients have more opportunities to score points. On the other hand, a ‘scoring’ in the MI means a gain of up to 1/6 of the total score.

After all, it has to be considered that the predictability with regard to F-M test could only be made, due to the fact that only the ‘motor assessment portion’ of the test was included. This clearly made the tests more comparable, but also increased the predictability on each other.

Due to the small sample size and the short period of time this experiment was conducted in, the authors suggest repeating this study with a larger number of assessors and a greater patient population. This clearly would enhance the transferability of the outcome.

Moreover, the authors were under the impression that not all results represent the patients actual condition and thus amendments on grading definitions should be reconsidered. In further studies, the validity of the tests should be investigated.

**Conclusion:**

All three tests, have proven to be reliable assessment tools for the evaluation of mobility and balance in chronic stroke patients. The Intra Class Correlation Coefficient of all three tests are high (Aufdemkampe et al. 2000) for inter and intra-rater reliability. According to the intra and inter-rater reliability, all three tests are recommendable. Yet, a high reliability does not mirror the applicability and quality of the tests, which was not investigated in this research.

**Acknowledgements:**

The authors would like to thank Jaap Bakker, who did a great part in leading the research into the ‘right direction’ and getting us back on the path, when we missed relevant aspects in structure, planning and practical progress. We would like to thank Jesse Aarden, who gave us inside knowledge into the use of statistical data analysis.

Moreover we would like to thank Rania Lahdo for checking and revising the final report with respect to grammatical correctness. Furthermore, we would like to thank Jarmo Perttunen for being the client of this project. A major help was the offer of Jos den Hollander, who invited us to his practice in Aarau, Switzerland. Finally, we would like to thank to all participants for showing so much enthusiasm for our research.
Summary

Stroke is the third most common cause of death in the developed countries (Engelen, 2007) and the most common physical consequence of stroke are hemiplegia or hemiparesis (Stokes, 2004). Thus, assessment tools, measuring balance and mobility are of high importance. During the last ten years a small number of assessment tools has gained general acceptance and are frequently used in daily practice. Among the most researched assessment tools for balance and mobility in stroke patients are the Berg Balance Scale (BBS), the Fugl-Meyer Test (F-M) and the Motricity Index (MI). All three tests have been found to be of high reliability and their use is recommended on the KNGF-Guidelines for stroke. This guideline differentiates between intake, immobilization and mobilization phase in stroke patients. However, in this current research, the aim was to determine the inter and intra rater-reliability of chronic stroke patients. Especially for the long-term treatment of chronic stroke patients, reliable measurement tools are of high importance for the adjustment and optimization of treatments and the patient’s motivation. Moreover, due to financial reasons, governmental health care system and insurance companies declare a high interest in the controllability of treatment progress.

In the past numerous studies have been conducted on the BBS, F-M and MI, with a positive feedback. However, in recent studies, the high and undoubted status of these three tests has come to falter. Due to this uncertainty in terms of reliability and the fact that no research investigated the inter and intra rater-reliability of all three tests for chronic stroke patients in one study, this investigation was inevitable.

Due to the particular condition of stroke survivors a specific investigation of these three assessment tools in this patient population was necessary. The research was conducted an intensive “one week trial” in a practice in Switzerland. Seventeen chronic stroke patients, consisting of ten women and seven men, were tested and graded by two assessors. Each test was performed twice in random order and graded by both assessors. The outcome of the study showed high intra rater-reliability (ICC > 0.93) and high inter rater-reliability (ICC > 0.94) for all three tests. Yet, due to a small sample size and a ‘floor - ceiling effect’ in the results, the outcomes have to be interpreted critically. Transferability may be limited due to the very same reasons. When considering the results solely, all three tests are recommendable for the assessment of balance and mobility in chronic stroke population. Still it has to be remembered that a high reliability does not mirror the applicability and quality of the tests, which was not investigated in this research.
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Medical College of Virginia Campus, Virginia Commonwealth
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PW Stratford, is Associate Professor, School of Rehabilitation Science, and
Associate Member, Department of Clinical Epidemiology and Biostatistics,
McMaster University, Hamilton, Ontario, Canada.
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Appendix
**Volunteer questionnaire**

Name of participant:…………………………………………………………………………………………
Number of participant:…………………………………………………………………………………………

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<td>I will change medication in between the test sessions</td>
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<td>I do have pain, which might influence my abilities to perform the tasks</td>
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<td>I do not suffer from additional vestibular dysfunction</td>
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<td>I do suffer from additional neurological disease</td>
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What other neurological condition do you suffer from?
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What kind of pain do you suffer from? Where is the pain?
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What medication do you take?
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Would you like to tell us something else?
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2nd Volunteer questionnaire

Name of participant:………………………………………………………………………
Number of participant:……………………………………………………………………

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<td>I changed medication since the first test session</td>
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<td>My physical or mental condition has changed since the first session</td>
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<td>I do have pain, which might influence my abilities to perform the tasks</td>
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<td>I did undergo physiotherapy treatment since the last session.</td>
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Did you experience any changes which might influence the performance of the tests, since the first session?
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### Abbreviation key for the excel sheet (SDSS)

- Participant = Name of the patient
- Number / ID = Random number, given to patient
- 1st = first trial
- 2nd = second trial
- A = Assessor A
- B = Assessor B
- BBS = Berg Balance Scale
- F-M = Fugl-Meyer Test
- MI = Motricity Index
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<td>0</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>16</td>
<td>22</td>
<td>21</td>
<td>25</td>
<td>23</td>
<td>21</td>
<td>26</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>17</td>
<td>54</td>
<td>96</td>
<td>96</td>
<td>55</td>
<td>95</td>
<td>96</td>
<td>55</td>
<td>96</td>
</tr>
</tbody>
</table>

**Key for table:** BBS = Berg Balance Scale, F-M = Fugl-Meyer Test, MI = Motricity Index, Patient/number = number of patient

- Berg Balance Scale
- Fugl-Meyer
- Motricity Index
- Not performed
- Drop out
Participant contract

I hereby agree to participate in the research conducted by Lars Jäger and Marius Kappeler on the reliability of balance measurement tools. Marius Kappeler and Lars Jäger are students of the Hogeschool van Amsterdam. The research is part of their bachelor degree. All data obtained will be handled under the terms of the Data Protection Act. The testing will be performed twice.

Name of the participant:

Number of the participant:

Phone number:

Email:

Date:

Signature participant: __________________ Signature researchers: __________________
Motions in the Fugl-Meyer test

<table>
<thead>
<tr>
<th>Upper Extremity (66 points)</th>
<th>Lower Extremity (34 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder retraction</td>
<td>Hip flexion</td>
</tr>
<tr>
<td>Shoulder elevation</td>
<td>Hip extension (supine)</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>Hip adduction (supine)</td>
</tr>
<tr>
<td>Shoulder abduction to 90 degrees</td>
<td>Knee flexion (supine)</td>
</tr>
<tr>
<td>Shoulder adduction/ internal rotation</td>
<td>Knee flexion (sitting)</td>
</tr>
<tr>
<td>Shoulder external rotation</td>
<td>Knee flexion (standing)</td>
</tr>
<tr>
<td>Shoulder flexion 0–90 degrees</td>
<td>Knee extension (supine)</td>
</tr>
<tr>
<td>Shoulder flexion 90–180 degrees</td>
<td>Ankle dorsiflexion (supine)</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>Ankle dorsiflexion (sitting)</td>
</tr>
<tr>
<td>Elbow extension</td>
<td>Ankle dorsiflexion (standing)</td>
</tr>
<tr>
<td>Forearm supination</td>
<td>Ankle plantar flexion (supine)</td>
</tr>
<tr>
<td>Forearm pronation</td>
<td>Heel-shin speed</td>
</tr>
<tr>
<td>Forearm supination/pronation (elbow at 0 degrees)</td>
<td>Heel-shin tremor</td>
</tr>
<tr>
<td>Forearm supination/pronation (elbow at 90 degrees, shoulder at 0 degrees)</td>
<td>Heel-shin dysmetria</td>
</tr>
<tr>
<td>Hand to lumbar spine</td>
<td>Knee reflex</td>
</tr>
<tr>
<td>Wrist flexion/extension (elbow at 0 degrees)</td>
<td>Hamstring reflex</td>
</tr>
<tr>
<td>Wrist flexion/extension (elbow at 90 degrees)</td>
<td>Ankle reflex</td>
</tr>
<tr>
<td>Wrist extension against resistance (elbow at 0 degrees)</td>
<td></td>
</tr>
<tr>
<td>Wrist extension against resistance (elbow at 90 degrees)</td>
<td></td>
</tr>
<tr>
<td>Wrist circumduction</td>
<td></td>
</tr>
<tr>
<td>Finger flexion</td>
<td></td>
</tr>
<tr>
<td>Finger extension</td>
<td></td>
</tr>
<tr>
<td>Extension of MCP joints, flexion of PIPs/DIPs</td>
<td></td>
</tr>
<tr>
<td>Thumb adduction</td>
<td></td>
</tr>
<tr>
<td>Thumb opposition</td>
<td></td>
</tr>
<tr>
<td>Grasp cylinder</td>
<td></td>
</tr>
<tr>
<td>Grasp tennis ball</td>
<td></td>
</tr>
<tr>
<td>Finger-nose speed</td>
<td></td>
</tr>
<tr>
<td>Finger-nose tremor</td>
<td></td>
</tr>
<tr>
<td>Finger-nose dysmetria</td>
<td></td>
</tr>
<tr>
<td>Finger flexion reflex</td>
<td></td>
</tr>
<tr>
<td>Biceps reflex</td>
<td></td>
</tr>
<tr>
<td>Triceps reflex</td>
<td></td>
</tr>
</tbody>
</table>

(Table from: Gladstone et al, 2000)
### Berg Balance Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Datum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Vom Sitzen zum Stehen Aufstehen vom Stuhl</td>
<td></td>
</tr>
<tr>
<td>2 Freies Stehen während 2 Minuten</td>
<td></td>
</tr>
<tr>
<td>3 Freies Sitzen während 2 Minuten, Füße am Boden</td>
<td></td>
</tr>
<tr>
<td>4 Vom Stehen zum Sitzen Absitzen auf den Stuhl</td>
<td></td>
</tr>
<tr>
<td>5 Transfer vom Stuhl auf das Bett</td>
<td></td>
</tr>
<tr>
<td>6 Stehen mit geschlossenen Augen, 10 Sekunden</td>
<td></td>
</tr>
<tr>
<td>7 Stehen mit geschlossenen Füßen 1 Minute</td>
<td></td>
</tr>
<tr>
<td>8 Vorwärts reichen mit ausgestreckten Armen (Functional Reach)</td>
<td></td>
</tr>
<tr>
<td>9 Gegenstand vom Boden aufheben</td>
<td></td>
</tr>
<tr>
<td>10 Über die linke / rechte Schulter nach hinten sehen</td>
<td></td>
</tr>
<tr>
<td>11 Drehen an Ort 360 Grad</td>
<td></td>
</tr>
<tr>
<td>12 Füße abwechselnd auf eine Stufe</td>
<td></td>
</tr>
<tr>
<td>13 Tandemstand Ein Fuss vor den andern gestellt</td>
<td></td>
</tr>
<tr>
<td>14 Einbeinstand</td>
<td></td>
</tr>
</tbody>
</table>

Total Punkte: 56 Punkte
### Berg Balance-Scale, Kriterien zur Einschätzung

<table>
<thead>
<tr>
<th>Item</th>
<th>Punktzahl</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sicher, ohne Abstützen</td>
<td>Selbständig mit Abstützen</td>
<td>mit Abstützen, mehrere Versuche</td>
<td>braucht wenig Fremdhilfe fürs aufstehen oder Gleichgewicht</td>
<td>braucht mittlere oder maximale Unterstützung</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 Min. sicher stehen</td>
<td>2 Min. mit Supervision</td>
<td>30 Sek. ohne Halten</td>
<td>30 Sek. mehrere Versuche, ohne Halten</td>
<td>ohne Fremdhilfe nicht möglich für 30 Sek.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2 Min. sicher freies Sitzen</td>
<td>2 Min. mit Supervision</td>
<td>freies Sitzen 30 Sek.</td>
<td>freies Sitzen, 10 Sek.</td>
<td>ohne Fremdhilfe kein freies Sitzen für 10 Sek.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>sich setzen ohne Abstützen</td>
<td>sitzt sich mit Kniekehle am Stuhl</td>
<td>ohne Hilfe, aber unkontrolliert</td>
<td>mit Fremdhilfe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>sicher mit wenig Hilfe der Arme</td>
<td>sicher mit viel Hilfe der Arme</td>
<td>braucht verbale Unterstützung und/ oder Supervision</td>
<td>mit 1 Hilfsperson</td>
<td>mit 2 Hilfspersonen</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10 Sek. ohne sich zu halten</td>
<td>10 Sek. mit Supervision</td>
<td>3 Sek.</td>
<td>nicht möglich, Augen 3 Sek. zu schliessen, behält aber das Gleichgewicht</td>
<td>braucht Hilfe, um nicht zu fallen</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>während 1 Min.</td>
<td>1 Min. mit Supervision</td>
<td>weniger als 30 Sek.</td>
<td>braucht Hilfe für Position, kann aber 15 Sek. stehen</td>
<td>braucht Hilfe für Position, steht wenigstens 15 Sek.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>&gt; 25 cm</td>
<td>&gt; 12,5 cm</td>
<td>&gt; 5 cm</td>
<td>Hält sich fest und braucht Supervision</td>
<td>braucht Hilfe, um nicht zu fallen</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>gut möglich ohne Gefahr</td>
<td>mit Supervision</td>
<td>kann nicht aufheben, Abstand bis 5 cm, fällt nicht um</td>
<td>kann nicht aufheben/ braucht Supervision</td>
<td>nicht durchführbar / braucht Hilfe</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>beide Seiten gut, Rumpf dabei mit</td>
<td>nur eine Seite gut, Rumpf dabei mit</td>
<td>Kopfdrehung ohne Rumpf</td>
<td>mit Supervision</td>
<td>braucht Hilfe</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Drehung sicher, max. 4 Sek. Ja Richtungen</td>
<td>max. 4 Sek. in eine Richtung</td>
<td>Drehung i.e. beide Richtungen, mehr als 4 Sek.</td>
<td>braucht Supervision oder verbale Instruktion</td>
<td>braucht Hilfe</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>8 x in 20 Sek.</td>
<td>8 x in mehr als 20 Sek.</td>
<td>4 x mit Supervision</td>
<td>mit Hilfe mindestens 2 x</td>
<td>braucht Hilfe</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Fuss mit der Ferse gegen die Zehen 30 Sek.</td>
<td>Schritt vor Standfluss, normale Spur 30 Sek.</td>
<td>kleiner Schritt, nicht vor Standfluss 30 Sek.</td>
<td>braucht Hilfe für den Schritt, halt Position 15 Sek.</td>
<td>verliert das Gleichgewicht</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>&gt; 10 Sek.</td>
<td>5 – 10 Sek.</td>
<td>3 Sek.</td>
<td>&lt; 3 Sek., aber fällt nicht um</td>
<td>nicht ausführbar / braucht Hilfe</td>
<td></td>
</tr>
</tbody>
</table>
Richtlinien zur Durchführung
Rehab-Fortbildung Januar 2005

Wichtiges!

- Pat. hat max 2 Versuche!
- Mit Schuhe und/oder Fusschiene testen, ohne Gehhilfsmittel
- Tipp: zusammen mit Tineti testen (Zeiteinsparung?)
- Postoperative Belastungslimiten und Vorsichtsmassnahmen beachten!
  Wenn nicht testbar: 0 und Vermerk
- > 45 Punkte: Pat. hat kein Sturzrisiko.
- < 45 Punkte: Pat. hat ein erhöhtes Sturzrisiko

Postoperative Belastungslimiten und Vorsichtsmassnahmen:

- Hüfttotalprothesen, Kopfprothesen:
  Aufgabe 1 und 4 (Aufstehen, Absetzen); wenn Sitzerhöhung ergibt dies max Wert 3
  Aufgabe 7 (geschlossene Füsse): erlaubt
  Aufgabe 12 (Stufe): Test ab 50% Körpergewicht erlaubt
  Aufgabe 13 (Tandemstand): nicht erlaubt
  Aufgabe 14 (Eindeinbeinstand): auf nicht operiertem Bein erlaubt
- Andere operative Versorgungen: gemäß Belastungs- und Bewegungslimiten

Anderes:

- Aufg. 1: Instruktion „Aufstehen ohne Hände zu gebrauchen“, „Arme hängen lassen“
- Aufg. 2: nicht erlaubt sind an den Stuhl anzulehnen, mit Pat. anfangen zu reden (i.O. wenn Pat. anfängt)
- Aufg. 4: ist automatisch 4 wenn Aufg. 2 auch 4 ist
- Aufg. 5: Stuhl (darf Lehne haben) – Liege und zurück
- Instruktionshilfe „möglichst wenig Arme gebrauchen“
- Aufg. 6: normale Spur
- Aufg. 8: Spurbreite normieren, Beginn mit getrockneten Armen
- Aufg. 9: Klettern Box
- Aufg. 10: Instruktion „über rei/ii Schulters zur… schauen, die Füsse stehen lassen“
- max Drehung mit Oberkörper (wenn unsicher, Vgl mit Drehung im Sitz)
- Aufg. 11: zwischen Drehung stehen bleiben ist erlaubt
- Aufg. 12: genormte Stufe verwenden
- Instruktion „abwechselungsweise re und li Fuss auf Stufe stellen“
- Aufg. 13: wenn nicht möglich, mit kleinerem Schritt versuchen
The Motricity Index for Motor Impairment After Stroke

Overview: The Motricity Index can be used to assess the motor impairment in a patient who has had a stroke.

Tests for Each Arm:

1. pinch grip: using a 2.5 cm cube between the thumb and forefinger
   - 19 points are given if able to grip cube but not hold it against gravity
   - 22 points are given if able to hold cube against gravity but not against a weak pull
   - 26 points are given if able to hold the cube against a weak pull but strength is weaker than normal

2. elbow flexion from 90° so that the arm touches the shoulder
   - 14 points are given if movement is seen with the elbow out and the arm horizontal

3. shoulder abduction moving the flexed elbow from off the chest
   - 19 points are given when the shoulder is abducted to more than 90° beyond the horizontal against gravity but not against resistance

Tests for Each Leg:

1. ankle dorsiflexion with foot in a plantar flexed position
   - 14 points are given if there is less than a full range of dorsiflexion

2. knee extension with the foot unsupported and the knee at 90°
   - 14 points are given for less than 50% of full extension
   - 19 points are given for full extension yet it can be easily pushed down

3. hip flexion with the hip bent at 90° moving the knee towards the chin
   - 14 points are given if there is less than a full range of passive motion
   - 19 points are given if the hip is fully flexed yet it can be easily pushed down
<table>
<thead>
<tr>
<th>MRC Grade</th>
<th>MRC Score</th>
<th>Points for Pinch Grip</th>
<th>Points for Other Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>no movement</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>palpable flicker but no movement</td>
<td>1</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>movement but not against gravity</td>
<td>2</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>movement against gravity</td>
<td>3</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>movement against resistance</td>
<td>4</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>normal</td>
<td>5</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

arm score for each side = SUM(points for the 3 arm tests) + 1

leg score for each side = SUM(points for the 3 leg tests) + 1

side score for each side = ((arm score for side) + (leg score for side)) / 2

Interpretation:
• minimum score: 0
• maximum score: 100

References:
instructielijst

BOVENSTE EXTREMITÉT.

A. SCHOUDER-ELLEBOOG-ONDERARM

Uitg.h.: de patient zit op een stoel of op de bedrand

I Reflexactiviteit is op te waken.
   a) Bicepsreflex
   b) Tricepsreflex
   c) Vingersreflex

II Willekeurige bewegingen zijn mogelijk in synergie.
   a) Flexiesynergie
      -schouder: retractie
      -abductie
      -elevatie
      -exorotatie
      -elleboog: flexie
      -onderarm: supinatie
      N.B. De opdracht aan de pt.: brang de hand naar het oor aan de aangedane zijde, met de handrug naar voren.

   b) Extensiesynergie
      -schouder: adductie,
      -endorotatie
      -elleboog: extensie
      -onderarm: pronatie
      N.B. Vanuit de volledige flexiesynkinesie wordt de pt. verzocht de arm naar de gezonde knie te brengen. Kan de flexorstand niet bereikt worden, dan moet de onderzoeker de arm passief in deze stand brengen. (Iet op compensatoire bewegingen.)

IIIa: 0=geen reflexactiviteit
       2=reflexactiviteit in de flexoren en extensoren

IIIb: 0=de beweging is onmogelijk
       1=de beweging kan ten dele uitgevoerd worden
       2=de beweging is volledig mogelijk
       N.B. De retractie, abductie, elevatie, exorotatie van de schouder, flexie elleboog en supinatie onderarm worden op bovenstaande manier afzonderlijk gescoord (max. score = 12 pnt.).
Instructielijst

III Willekeurige bewegingen met gedeeltelijk opbreken van de flexie/extensiesynergie.

a) Breng de handrug naar de lumbale rug en houd hem daar.

IIIa:
0°: er is geen beweging mogelijk
1°: de beweging is mogelijk tot bv. de spina iliaca ant.
2°: de beweging is volledig mogelijk

b) Schouderflexie van 0-90
Elleboog in extensie
Onderarm in de 0-stand, tussen pro-/supinatie.
Opdracht aan pt.: hef de arm tot schouderhoogte en houd de duim daarbij omhoog.

IIIb:
0°: bij het inzetten van de beweging treedt er abduction van de arm op
1°: flexie elleboog of abduction van de arm treden in een latere fase op
2°: de beweging is volledig mogelijk

c) Pro-/supinatie van de arm bij 90° flexie in de elleboog en 0-stand in de schouder.

IIIc:
0°: de uitg.h. in schouder en elleboog zijn niet in te nemen en/of de pro-/supinatie zijn niet mogelijk
1°: de uitg.h. is in te nemen en de pro-/supinatie kunnen uitgevoerd worden over een gering traject
2°: de beweging is volledig mogelijk

IV Willekeurige bewegingen zonder of met weinig beïnvloeding door synergieën.

a) Abductie van de schouder tot 90°, waarbij de elleboog in extensie en de onderarm in pronatie gehouden worden.
Opdracht aan de pt.: hef de arm zijwaarts tot schouderhoogte en houd de duim daarbij omhoog.

IVA:
0°: er treedt flexie in de elleboog op en/of de pronatie-stand kan niet gehouden worden
1°: de beweging is ten dele mogelijk
2°: de beweging is volledig mogelijk
instructie: lijst

IVb:
Idem als a

IVc:
Idem als IIIc

V Normale reflexactiviteit.

Deze reflexactiviteit wordt slechts getest indien de pt. in stadium IV een maximale score (>6) heeft behaald.

V:
0-terminale 2 of 3 reflexen zijn opvalend hyperactief
1=1 reflex is hyperactief of terminale 2 reflexen zijn levendig
2=geen reflex is hyperactief en niet meer dan 1 reflex is levendig

Maximale score van de schouder = 36.

B. POLS

3 verschillende functies worden getest, 2 van deze functies worden getest met een verschillende positie in de elleboog.

a) Polsstabiliteit met de pols in 15 dorsaalflexie.
Schouder 0
Elleboog 90

Onderarm pronatie
N.B. Indien de pt. de elleboog niet zelf in de gewenste positie kan brengen of houden, moet de onderzoeker assisteren.

a:
0=de pt. kan niet dorsaalflecteren tot 15
1=dorsaalflexie is mogelijk, echter de pt. kan geen weerstand weerstrijven
2=de pt. kan de positie behouden, ook tijdens (lichte) weerstand

3
instructielijst

b) Alteerende dorsaal- en palmaflexie.
   Schouder 0
   Elleboog 0
   Onderarm pronatie
   N.B. 90 Van de elleboog
evt. met assistentie
   van de onderzoeker.

   b:
   0=de uith.positie
   kan niet ingenomen
   worden
   1=de beweging is mo-
   gelijk, echter
   niet over het ge-
   hele traject
   2=de beweging is
   volledig mogelijk

   c:
   idem als a

c) Polsstabiliteit met de pols
   in 15 dorsaalflexie.
   Schouder in lichte flexie-/abductie stand
   Elleboog 0
   Onderarm pronatie
   N.B. 0 Van de elleboog evt.
   met assistentie van de
   onderzoeker.

d:
   idem als b

d) Alteerende dorsaal- en
   palmaflexie.
   Schouder in lichte flexie-/abductie stand
   Elleboog 0
   Onderarm pronatie
   N.B. Elleboog 0 evt. met
   assistentie van de onder-
   zoeker.

e) Circumductie van de pols.

c:
   0=circumductie kan
   niet uitgevoerd
   worden
   1=schokkende bewe-
   ging of incomplete
   circumductie
   2=de beweging is
   volledig mogelijk

Maximale score van
de pols = 10.
C. HAND

7 Bewegingscomponenten worden getoetst, waarvan 5 grijpbewe- gingen zijn. Deze bestaan uit verschillende typen musculaire co-contracties. De onderzoeker mag indien nodig de ellboog in 90 flexie brengen/houden. Assistentie van de pols is niet toegestaan.

a) Totale flexie van de vingers.
   Elleboog 90 flexie
   Pols 0, tussen pro/sup.

b) Totale extensie van de vingers. Vanuit de volledige flexiestand wordt de pt. verzocht de vingers te strekken.
   Pols 0, tussen pro/sup.

c) Grijpbeweging A: de pt. wordt verzocht om:
   MCP II-IV te strekken
   PIP en DIP te buigen
   De beweging wordt tegen weerstand uitgevoerd.

d) Grijpbeweging B: de pt. moet een zuivere duimadduc- tie uitvoeren. Bij een
   0-stand van het CMP I en
   interphalangeale gewricht.

a: 0=geen flexie waar te nemen
   1=erige, echter geen volledige, actieve vingerflexie
   2=volledige actieve vingerflexie
   (vgl. gezonde zijde)

b: 0=er is geen strek-
   king waar te nemen
   1=de pt. is in staat de flexiestand te
   overwinnen
   2=maximale strekking
   is mogelijk

c: 0=de uitz.positie
   kan niet ingenomen
   worden
   1=zwakke grijpbe-
   weging, tegen lichte
   weerstand
   2=een behoorlijke
   weerstand kan wor-
   den weerstreven

d: 0=de beweging kan
   niet worden uitge-
   voerd worden
   1=een papiertje dus-
   tem duim en hand
   kan vastgehouden
   worden
   2=een papiertje kan
   zelfs tegen enige
   trek vastgehouden
   worden
instructielijst

a) Grijpbeweging C: oppositie
   van de duimtop naar de
   wijsvingertop.
   Er wordt een pen tussen
   geplaatst.

b) Grijpbeweging D: het grijp-
   pen van een rolletje.

f: idem als d

g) Grijpbeweging E: de pt.
   wordt verzocht een tennis-
   bal te omvatten, met een
   abductie stand van de duim.

g: idem als d

Maximale score van

de hand = 14.
instructielijst

D COORDINATIE EN Snelheid

Veel voorkomende klachten bij ptt. met een bijna herstelde motorische functie zijn:
- lichte coördinatie stoornis
- traagheid,
bij het uitvoeren van bewegingen. Daarom worden coördinatie en snelheid gecombineerd getoetst.

a) Vingertop-neusproef:
5x achteraan uitgevoerd,
zo snel mogelijk en met gesloten ogen. e tremor
gesloten ogen.
tremor:
0=duidelijke tremor
1=gerings tremor
2=geen tremor
dysemetrie:
0=duidelijke dysm.
1=gerings dysemtrie
2=geen dysemtrie

snelheid:
vol. met gezonde zijde
0= 6 sec. of meer verschil
! = 2-5 sec. verschil
2= 2 of minder sec. verschil

Maximale score van de coördinatie en snelheid = 6.
instructielijst

ONDERSTE EXTREMITEIT

E. HEUP-KNIE-SKOF
uitg.h.: de pt. ligt in ruglig

I. Reflexactiviteit is op te waken
   a) Kniepeesreflex
   b) Achillespeesreflex

I. Geen reflexactiviteit
   2-beide zijn opwakbaar

II. Willekeurige bewegingen zijn mogelijk in synergie.

   a) Flexiesynergie
      -heup: flexie
      -knie: flexie
      -enkel: dorsaalflexie
      N.B. De pt. wordt verzocht de heup en de knie te buigen en de voet op te trekken.

   b) Extensiesynergie
      -heup: extensie
      -adductie
      -knie: extensie
      -enkel: plantairflexie
      N.B. Vanuit de eindstand van de flexiesynergie wordt een totale extensie gevraagd. Een weerstand moet de zwaartekracht neutraliseren, zodat de beweging actief wordt uitgevoerd. Ook moet er weerstand tegen adductie gegeven worden.

IIa:
   0-de beweging kan niet worden volbracht
   1-de beweging kan gedeeltelijk worden volbracht
   2-de beweging is volledig mogelijk
   N.B. De flexie heup, flexie knie en dorsaalflexie enkel worden op bovenstaande manier afzonderlijk gecoloord (max. score = 6 pnt.).

IIb:
   Idem als a
   N.B. De extensie, adductie heup, extensie knie en plantairflexie enkel worden op bovenstaande manier afzonderlijk gecoloord (max. score = 8 pnt.).
III Willekeurige bewegingen met gedoelstelling opbreken van de flexie/extensiesynergie.
Uitd.h.: de pt. zit op de rand van de bank met vrijhangende knieën.

a) Knieflexie 90 of meer

IIIa:
0 = geen actieve beweging
1 = de knie kan licht actief gebogen worden, echter niet voorbij de 90 graden (palpatie van de Hamstringspieren)
2 = knie kan voorbij de 90 graden geflexeerd worden

b) Actieve dorsaalflexie van de enkel

IIIb:
0 = geen beweging
1 = geen volledige beweging
2 = gelijke bewegingsuitslag re./li.

IV Willekeurige bewegingen zonder of weinig beïnvloeding door synergieën.
Uitd.h.: de pt. staat naast of voor de bank en mag evt. steunen.

a) Knieflexie tot tenminste 90, heup 0 of lichte extensie.

IVA:
0 = kniebuiging alleen in samenhang met heupflexie
1 = enige beweging is mogelijk
2 = beweging is volledig mogelijk
b) Dorsoapflexie van de enkel

- FVB:
  0=geen bewegingsuitslag
  1=geringe bewegingsuitslag
  2=gevallige bewegingsuitslag re./li.

V Normale reflexactiviteit

- a) Kniepeesreflex
- b) Achillespeesreflex

V:
0=beide zijn hyperactief
1=1 is hyperactief of op z'n minst 2 zijn levensdig
2=geen reflex is hyperactief en niet meer dan 1 is levensdig

Maximale score van de heup-knie-enkel = 28.

F. COORDINATIE EN Snelheid

- a) Knie-hiel proef
  Uitd.i.h.: de pt. ligt in rug-
  lig. De beweging moet 5x achtereen uitgevoerd worden, zo snel mogelijk en met gesloten ogen.

Tremor
0=duidelijke tremor
1=geringe tremor
2=geen tremor

Dysmetrie
0=duidelijke dysm.
1=geringe dysm.
2=geen dysm.

Snelheid
Vgl. met de gezonde zijde
0=6 sec. of meer verschil
1=2-5 sec. verschil
2=2 of minder sec. verschil

Maximale score van de coördinatie en snelheid = 6.
instructielijst

G. BALANS
7 componenten worden getest
3 in zit en 4 in stand

a) zit zonder steun
8: de pt. kan niet
   zitten zonder
   steun
1: de pt. kan maar
   even zitten zon-
   der steun
2: de pt. tenminste
   5 min. zitten zon-
   der steun

b) Parachute-reactie (opvang-
   reactie) aan de niet aange-
   danse zijde. De pt. zit ge-
   blinddoekt, de onderzoeker
   geeft een plotselinge duw
   tegen de niet aangedane zij-
   de naar lateraal.

b1: geen abd. en ext.
   in de arm als op-
   vangreactie
   er is enige abd.
   en ext. in de arm
   waar te nemen
   de balansversto-
   ring wordt normaal
   opgevangen

b2: idem als b

c) Parachute-reactie (opvang-
   reactie) aan de aangedane
   zijde. Zie b.

c1: geen stand mogelijk
   veel hulp nodig
   de pt. kan tenmin-
   ste 1 min. rechtop
   staan met weinig
   of geen hulp

d) Stand met hulp.

d1: de pt. kan niet
   staan zonder hulp
   de pt. kan tenmin-
   ste 1 min. rechtop
   staan, of langer,
   maar dan met ge-
   stoorde balans
   de pt. kan dit langer
   dan 1 min. hand-
   haven

e) Stand zonder hulp.
f) Stand op het niet-aangedane been.

1. slechts gedurende enkele sec. mogelijk
2. stand gedurende 4-8 sec. mogelijk
3. stand langer dan 10 sec. mogelijk

Idem als f

H. SENSIBILITEIT

a) De lichte test wordt groot getest op enkele plaatsen op het lichaam. De pt. wordt gevraagd of hij aanraking van een watje voelt op:
1. onderarm
2. handpalm
3. onderbeen
4. voetpoot

Idem als a

b) Het positie-gevoel wordt getest voor:
1. duim
2. pols
3. elleboog
4. schouder
5. grote been
6. enkel
7. knie
8. heup

Idem als b

N.B. de onderzoeker plaatst het gewricht aan de aangedane zijde in een bepaalde positie. De pt. copieert de stand aan de gezonde zijde.

Maximale score van de sensibiliteit = 24.
instructielijst

J. GEWrichtsSonderZOEK

a) Gekroken wordt of er in de gewrichten een bewegingsbeperking aanwezig is d.w.z. passief bewegen.

0 = geringe bewegingsbeperking
1 = verminderde bewegingsbeperking
2 = normale passieve bewegingsuitvoering

b) Bovendien wordt op deze manier gewrichtspijn opgemeten.

0 = onduidelijke pijn tijdens volledige beweging of hevige pijn aan het einde van de beweging
1 = enige pijn
2 = geen pijn

De uit te voeren bewegingen zijn:

1 - schouder: flexie
2 - adductie tot 90
3 - exorotatie
4 - endorotatie
5 - elleboog: flexie
6 - extensie
7 - onderarm: pronatie
8 - supinatie
9 - pols: palmaflexie
10 - dorsalflexie
11 - vingers: flexie
12 - extensie
13 - heup: flexie
14 - adductie
15 - exorotatie
16 - endorotatie
17 - knie: flexie
18 - extensie
19 - enkel: dorsalflexie
20 - plantarflexie
21 - voet: pronatie
22 - supinatie

Maximale score van het gewrichtsonderzoek = 88.
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