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SITTING UP AND TRANSFERRING TO A CHAIR: TWO FUNCTIONAL TESTS FOR PATIENTS WITH STROKE

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Objective: **The aim of the study was to evaluate the reliability of two clinical tests of mobility for stroke patients.**

Design: **The study took place in a university hospital with a case control design.**

Subjects: **A sample of convenience including 31 subjects: a group of patients with prior stroke ($n = 19$); a control group ($n = 12$).**

Methods: **The time(s) for sitting up from a supine position and transferring from an examination table to a chair were measured and inter- and intra-rater reliability were assessed. The source of variation in the test results as well as intra-class correlations were estimated.**

Results: **The largest source of variation in the supine position was between subjects, and the between-tester variability was very low, with similar results for the transfer from table to chair. The intra-class correlations are all high (range 0.77–0.98). This indicates that it is of little importance which tester is performing the tests.**

Conclusion: **Sitting up on an examination table and transferring from an examination table to a chair seem to be reliable timed clinical tests of mobility in stroke research.**

Key words: stroke, functional tests, rehabilitation, physical therapy.

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INTRODUCTION

Almost all patients who have had a stroke develop motor and balance problems. The main aim of rehabilitation in the initial period after a stroke is to address these problems. After a stroke, neural and musculoskeletal reorganization and adaptation occur to meet the cortical changes caused by the cerebrovascular lesion (1–3). Flexibility and adaptability of neural elements are referred to as plasticity, which implies that it is possible for anatomical and physiological changes, and thus a relearning of motor function, to take place after a brain lesion. Relearning is said to be associated with the functional demands with which the person is confronted after stroke (4). In the fields of rehabilitation medicine and physical therapy, functional tests, with the body in activity, have been used as an evaluative tool for the purpose of assessing the functional capacity of patients with stroke in clinical practice. Outcome assessments play an important role in both clinical practice and in research.

Outcome measures are used in clinical conditions to evaluate stroke patients' motor capacity (5, 6). Motor function is often described in terms of synergistic motion (7). However, in real life situations, the subject needs a complex motor function in order to perform an activity. Functional and task-related exercises in the early stage after stroke have been shown to give the best improvements in motor performance (8). Measures that evaluate daily living activities give an overall impression of a patient's status. These measures may well be used to follow the course of rehabilitation (9, 10). We need, therefore, to have reliable functional tests of common activities to be able to measure a subject's complex motor function.

Reliability is defined by Cole et al. (11) as a "measure's repeatability when administered on more than one occasion or by more than one rater". Random errors may affect the reliability and give misleading information. It is important to conduct and administer the measure under similar circumstances. An outcome measure shows high reliability when the same or similar results are obtained on different occasions. Intra-rater reliability describes the consistency between the results that a single observer reports on different occasions. Test-retest is used within a certain time interval to show the stability of the measure over time. Inter-rater reliability is the degree to which a measure applied by a single observer gives results that are consistent with those obtained by another observer, which shows the degree of a measure's stability between observers (12).

Commonly employed functional tests are: (i) transferring from supine to sitting; or (ii) transferring from a sitting position on an examination table to a chair. There is no available information about the reliability of these tests. Loewen & Anderson (13) examined the transfer from supine to sitting within a study investigating the reliability of the Modified Motor Assessment Scale (MAS) and concluded that both inter-rater and intra-rater for the total score and this individual item rating were acceptable statistically.

The aim of this study was to assess intra-rater and inter-rater reliability of two functional tests. The first test examines patient transfer from supine to sitting (SST) and the second the transfer from sitting on an examination table to a chair (TTCT). These

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tests were chosen as they are performed in various ways by staff and patients numerous times in a day.

MATERIAL AND METHODS

Subjects

The material used was a sample of convenience of 31 subjects. Group A comprised 19 patients (7 women, 12 men) with a lower extremity disability after stroke. The mean age was 54 years (SD 1.2 years). Ten subjects were weak on the right side and 9 on the left. Time since onset of stroke varied 1–10 months (median 3 months). Patients in group A were both inpatients and outpatients in a rehabilitation program. The reference group (group B) comprised 12 subjects (5 women, 7 men) who considered themselves healthy. The mean age in group B was 37 years (SD 3.9 years). Subjects in group B were all personnel or students recruited from Sahlgrenska University Hospital/Högsbo in Göteborg, Sweden. Men and women were included, and an age limit was set between 18 and 65 years (which are the ages that were admitted to the rehabilitation centre). General health and heart statuses were checked by a physician and motor capacity in the lower extremities by a physiotherapist. The height of the persons had to be at least 160 cm (due to the height of examination tables and chairs).

Inclusion criteria for group A were: first stroke event $\leq$12 months earlier, hemiparesis with a lower extremity disability, being ambulatory in the ward (either in a wheelchair or walker with or without an assistive device) and no cognitive deficit or aphasia. Exclusion criteria for group A were: cognitive deficit that included a short memory deficit, visual defects of clinical importance, severe heart failure, co-morbidities that would affect their mobility, such as arthrosis, rheumatoid arthritis or back problems.

Inclusion criteria for group B were: being in their own opinion in generally good health and independent walkers. Exclusion criteria for that group were chronic pain, significant visual defects, stroke, severe heart failure or any other disease that could affect the measurements.

The study was approved by the Ethics Committee at Göteborg University. All subjects provided informed consent.

Methods

Measurements were taken of the equipment using a standard tape measure to standardize the test equipment and distances between objects. The adjustable examination table was 70 cm wide and 2 metres long. The height of the examination table varied according to the leg length of the subject. The chair had a seat to floor height of 43 cm, the height from the top of the seatback to the floor was 78 cm, and the seat width was 48.5 cm.

Functional tests

Two examiners were assigned to each subject for data collection and established a standard method for asking questions and recording data. The investigators initially contacted each subject through inquiries regarding incoming patients to the hospital. Potential subjects were interviewed after they had given their informed consent to participate in the study. Each subject was briefly interviewed before testing took place and asked to give background information. Then one of the examiners explained the procedure to the patient, requesting the subject to perform the motions at normal pace. The study design is shown in Table I.

The results were calculated for each side. The 2 occasions were consecutive days at approximately the same time of day. The result from effort 1 was never used in the calculations, but was intended to familiarize the patient with the procedure.

Test 1: SST

The subject was told in simple terms to lie supine in the anatomical position but with the palms facing downwards on the examination table. The subject was told to sit up from supine position to a comfortable sitting position with the soles of both feet flat on the floor. The stopwatch was started after the examiner prompted the subject to commence the test and the subject lifted his/her head off the table. The stopwatch was stopped after the subject had achieved the aforementioned comfortable position. The test was carried out 3 times on the right side of the subject and 3 times on the left.

Test 2: TTCT

This test involved the subject moving to a chair from a 90° hip/knee angle sitting position on the examination table with the soles of both feet on the floor and with approximately a third to a half of the femur resting comfortably off of the examination table. The examiner then proceeded to measure the distance from the edge of the chair to the space between the origin and insertion of the lateral collateral ligament on the patient. The distance had to fall within the predetermined range of 10–15 cm. The chair was placed on grip material to prevent it from moving during the procedure. The patient was instructed in simple terms to transfer from the examination table to the chair, which was standardized as mentioned above. Timing began when the patient initiated the movement and was stopped when the patient's back relaxed against the back of the chair. The test was carried out 3 times on the right side of the subject and 3 times on the left.

Statistics

Spearman's rank correlation coefficient (r_s) was used to describe the association between results of tester 1 and 2 (day 1) as well as the association between results within the same tester on 2 different occasions (day 1 compared with day 2). A correlation coefficient more than 0.7 is thought of as high. In order to investigate a systematic shift between testers 1 and 2 and between measurement occasions within tester, the Wilcoxon-Mann-Whitney U test and the Wilcoxon signed ranks test were used. The Wilcoxon-Mann-Whitney U test was also used for other pairwise tests. Statistics were performed using Statview (Abacus Concepts, Berkley, CA). Statistical significance was set as $p < 0.05$.

In addition, a variance component analysis was performed in order to examine the sources of variation. A random effect model was used to estimate the between-subject variability, the between-tester variability, the interaction between subject and tester and the error term. The results are presented in terms of standard deviations. The analysis was performed in SAS 8.0, proc mixed using restricted maximum likelihood. Also the intraclass coefficient (14), ICC (2, 1), has been calculated. This was performed using the mean of the 2 measurements by each tester on each subject. The analysis was performed in SAS 8.0, proc GLM.

RESULTS

There were no significant differences between men and women in either of the two tests in the control group. There seem to be a high consistency between the results for both the SST and the TTCT when the same test was performed twice by the same subject, indicating high intra-rater reliability (Table II). When the 2 different testers were compared, again the measurements were highly consistent for both the SST and the TTCT, which indicates high inter-rater reliability (Table III).

The source of variation in the test results is presented in Table IV. The largest source of variation for SST was between

Table I. *Design of the functional tests*

Day and side	Effort and tester		
Day 1	Effort 1	Effort 2	Effort 3
Right	Tester 1	Tester 1	Tester 2
Left	Tester 2	Tester 2	Tester 1
Day 2	Effort 1	Effort 2	Effort 3
Right	Tester 2	Tester 2	Tester 1
Left	Tester 1	Tester 1	Tester 2

Table II. *Intra-rater reliability, correlation between the first and second test. Test supine to sitting* (n = *31)*

Tester	Right	*p*	Left	*p*
1	0.80	0.0001	0.85	0.0001
2	0.84	0.0001	0.81	0.0001
Test table to a chair (n = *31)*				
Tester	Right	*p*	Left	*p*
1	0.78	0.0001	0.67	0.0002
2	0.77	0.0001	0.72	0.0001

Table III. *Inter-rater reliability, correlation between the 2 raters on 2 occasions, both sides.*

Test supine to sitting (SST) (n = *31)*				
SST	Test 1	*p*	Test 2	*p*
Right	0.83	0.0001	0.85	0.0001
Left	0.95	0.0001	0.97	0.0001
Test table to a chair (TTCT) (n = *31)*				
TTCT	Test 1	*p*	Test 2	*p*
Right	0.80	0.0001	0.84	0.0001
Left	0.89	0.0001	0.73	0.0001

subjects, with an expected larger SD in the stroke population. The between-tester variability was very low, with an estimated variation of zero for the stroke population. The interaction was also very low, especially for the stroke population (SD = 0.000). The low estimate of the interaction should be interpreted as a tester not departing from his or her usual tendencies when confronted with a new subject. The residual variable had a large SD in all tests, however not larger than the between-subject variability in any situation. The variations in TTCT are shown in Table V. Again, there is a large variation between subjects, which has the highest SD. The stroke population has, as expected, a larger variation than the control population. The between-tester variability is very low (SD = 0.000) except for transferring to the right in the stroke population (SD = 0.246). The interaction was also very low. The residual variable has a high SD in all tests. Considering the results, both the between-tester variability and the interaction can be called "good" in the study. The ICCs are presented in Table VI. They are all high, in the range 0.77–0.98, meaning it is of little importance which tester is performing the test.

Table IV. *Source of variation in the supine to sitting*

		Source of variation			
		BI	BT	BIT	Unexplained
Left side	Control	0.408	0.127	0.000	0.333
	Stroke	3.938	0.000	0.000	1.187
Right side	Control	0.433	0.000	0.000	0.399
	Stroke	5.659	0.000	0.000	2.578

BI = between individuals; BT = between testers; BIT = interaction between individuals and testers.

Table V. *Source of variation in the table to a chair*

		Source of variation			
		BI	BT	BIT	Unexplained
Left side	Control	0.319	0.000	0.000	0.331
	Stroke	2.107	0.000	0.000	0.935
Right side	Control	0.470	0.000	0.000	0.278
	Stroke	52.110	0.238	0.326	1.254

BI = between individuals; BT = between testers; BIT = interaction between individuals and testers.

DISCUSSION

Transferring is usually a part of patient assessment in clinical practice to evaluate the activity level. The present study showed that sitting up on an examination table (SST) and transferring from an examination table to a chair (TTCT) have high intra-rater and inter-rater reliability and seem to be reliable tests that can be used in stroke research.

Patients who were shorter than 160 cm were not included in the study. This is because when the examination table was at its lowest, shorter persons who sat on the table had to slide forward in order to have both feet on the ground. Therefore, we thought it might be unsafe to stress people to do this as fast as possible. We cannot say for certain that the results are representative for all patients with stroke. All patients available at the rehabilitation centre during the summer were included. However, the ages are below average for the general stroke population. A weakness of the design is that only ambulatory patients were included. Non-ambulatory patients could not transfer from table to chair in a safe manner without any help, which was a requirement for this study. Non-ambulatory patients probably could have carried out the sitting up test, but the design was such that the 2 tests were performed on all patients. Therefore, we cannot say whether the

Table VI. *Intraclass coefficient in supine to sitting and table to a chair*

Type	Side	Category	ICC
SST	L	Control	0.886
SST	L	Stroke	0.962
SST	R	Control	0.786
SST	R	Stroke	0.976
TTCT	L	Control	0.770
TTCT	L	Stroke	0.912
TTCT	R	Control	0.906
TTCT	R	Stroke	0.827

ICC = intraclass coefficient; SST = transfer from supine to sitting; TTCT = transfer from sitting on an examination table to a chair; L = left; R = right.

SST works properly for patients with a higher level of disability than those included in the study. At the time of the study, all patients who met the inclusion criteria were ambulatory or in a wheelchair. We decided to include them when their usual physiotherapist decided that they could transfer safely with only 1 person assisting.

Factors that may have had an influence on the results during testing were the positions of the test leaders during the test. The positions may have had the effect of giving the patients a sense of greater security when 2 persons measured and surrounded the patient during the whole testing procedure. Neither can an effect of patients having become familiar with the test be neglected, although the test represents a very natural activity of daily living. The patients on the ward were given the opportunity to go through the test once before the actual testing occasion in order to learn the testing procedure. Motivation among the patients was also high, which might influence the results. The reference group comprised members of staff and students, which may also have influenced the results. Nevertheless, the results would still be highly significant.

In outcome measurements measuring activities of daily living, there are many advantages in measuring and evaluating changes during a period of rehabilitation (9). These instruments give a complete evaluation of the patient, which is useful, when a patient is being transferred between institutions. The disadvantage may be that the test is time consuming. The most important matter is, however, that the outcome measurement being used has a high reliability so that it can be used by several members of the staff and still give the same information during the period of rehabilitation. In several of the above-mentioned outcome measures, sitting up or transferring to a chair is part of the total assessment of the patient.

In conclusion, the SST and TTCT are quick and easy tests that may be used as standardized measures to document the progress of the rehabilitation process in stroke patients. Moreover, in order to ensure the reliability and validity of the tests, the examiners need to be familiar with stroke and movement analysis. The examiners should be given the same training in the use of the evaluative tools to perform the task appropriately. The 2 tests have high inter-rater reliability and indicate high inter-rater reliability in this setting even with the limitations mentioned above. There is a need in the clinical setting for functional tests that are reliable in order to follow the outcome of patients. The SST and TTCT might be such tests.

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