Concurrent validity, test-retest reliability and minimal detectable change of an adaptive balance test on a medio-lateral stabilometer in patients with stroke

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Rafaël Brouwer

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ABSTRACT

Background

Balance evaluation is a vital part of stroke rehabilitation. Recently, an adaptive stabilometer balance test has been developed which uses a modified staircase test procedure. If this test is able to accurately quantify balance performance in stroke patients with mild to moderate impairments it could be a valuable addition to currently used balance measures.

Aim

To evaluate the concurrent validity, test-retest reliability and minimal detectable change of an adaptive balance test on a medio-lateral stabilometer in stroke patients.

Methods

A cross-sectional validation design was used to carry out this study. Validity measurements consisted of a stabilometer balance test, a Berg Balance Scale and a posturography measurement. Participants of the test-retest reliability sample performed an additional stabilometer balance test. Validity was analyzed based on Pearson correlation. Test-retest was analyzed with Intraclass Correlation Coefficients. Minimal detectable change was calculated both at group level and at individual level.

Results

The validity sample consisted of 86 participants. Twenty-three participants participated in the reliability sample. A correlation of r=0.384 (p=0.002) and r=0.123 (p=0.339) was found between the stabilometer measurement and posturography for 'sway' and 'curviness', respectively. A correlation of r=-0.591 (P<0.001) was found between the stabilometer measurement and the Berg Balance Scale.
The Intraclass Correlation Coefficient between both stabilometer measurements was 0.875. An ICC of 0.682 was found between the performance trails. Mean stabilometer balance test outcome (rotational stiffness) was 38.94Nm (±29.44). The minimal detectable change was calculated to be 20.996 and 4.378 at individual level and group level respectively.

Conclusion

The stabilometer balance test is a reliable measure, however it seems to measure a broader, more clinical concept of balance than just the theoretical construct. The stabilometer balance test is sensitive on group level, however it is not sensitive enough to be used on individual level.

Clinical Relevance

The stabilometer balance test can be used as balance evaluation tool within studies. It does not have a strong ceiling effect that some other balance measures do have. Furthermore the test outcome can be used as benchmark for further stabilometer balance training.

Keywords: Stroke, Stabilometer, Balance Board, Balance, Test

INTRODUCTION

Stroke is one of the leading causes of death and disability worldwide.[1] In 2014, the prevalence of stroke and transient ischemic attack (TIA) was 411.100 of which 41.100 cases of stroke were newly registered in the Netherlands.[2] About 32 percent of all new stroke patients died within four days, which makes stroke the fourth cause of death.[2] People who survive stroke often have sequelae with permanent disabilities, resulting in a loss of autonomy and quality of life.[3] These disabilities can be both physical and mental. In the Netherlands, stroke is the third cause of burden of disease, which is quantified in 'Disability Adjusted Life Years' (DALY'S).[2]

Loss of balance is one of the most frequent impairments after stroke and causes difficulty with sitting, standing and walking activities.[4] In humans, balance can be defined as "a multidimensional concept, referring to the ability of a person not to fall".[5] Balance is closely related to postural control, which can be defined as "the act of maintaining, achieving or restoring a state of balance during any posture or stability".[5] In order to maintain balance in standing position one has to keep the center of mass within his base of support.[5] This implies that balance will be reinforced when the center of mass is positioned lower or the base of support is enlarged. Since human walking is passively unstable in the lateral direction, the ability to walk safely depends on active lateral stabilization.[6]

An extensive amount of research has been published on the topic of training and evaluating balance in patients with stroke. In patients with stroke the perceived orientation of center of mass is altered and the ability to restore a state of balance is often impaired.[7] Research shows that the severity of balance impairment after stroke is related to the side and site of the lesion.[4,8] Stroke survivors with impaired balance have a relatively high energy cost for maintaining balance when compared to their healthy peers.[9,10] Therefore, training and evaluating balance in patients with stroke is a vital aspect of rehabilitation. However, although physiotherapy can alleviate balance impairments after stroke, no single approach has proven to be superior.[8,11,12]

One specific approach that has been used extensively both in research and in physiotherapy practice is balance evaluation and training by means of balance boards (stabilometers).[13] Multiple types of stabilometers are used, ranging from simple mechanical stabilometers up to the digital WII balance boards. These stabilometers are convenient to use because of the low costs, ease of use and because they can be used in various levels of balance impairment. Although some studies show favourable results regarding the reliability and validity of the WII balance boards, the validity and reliability of the mechanical balance boards in tests and training remains unclear.[14,15]

Recently, research has been conducted on dual task interference in stroke patients by Kal et al. (2015) at Heliomare Research and Development (Wijk aan Zee, the Netherlands).[16,17] This study used a medio-lateral stabilometer in which the resistance to lateral movement can be augmented and balance performance can be measured. To quantify balance performance, the patients' sway (i.e. lateral movement of the stabilometer) is

measured at different resistance levels. The outcome of the test is a resistance level in which the patient can successfully keep the board's deviation below 2.5 degrees for 70% of the trial. The premise is that this stabilometer can accurately quantify the level of lateral balance performance and therefore can be used for training and evaluating balance in stroke patients.

If the stabilometer provides a reliable and valid measure of balance performance it will provide clinicians with a low-cost instrument to quantify a patients' balance, and hence train this patient more appropriately. Furthermore, if the stabilometer balance test is also accurate in patients with mild to moderate balance impairments it could be a valuable addition to currently used clinical balance measures. Therefore, this study aims to evaluate the concurrent validity, test-retest reliability and minimal detectable change of an adaptive balance test on a medio-lateral stabilometer in stroke patients.

METHODS

A cross-sectional validation study was performed at Heliomare Research & Development (the Netherlands). The study protocol was approved by the medical ethics committee of the VU University Medical Center Amsterdam (the Netherlands, protocol ID: 2015/354)

Participants

NQuery software (Statistical Solutions Ltd, Ireland) was used to calculate sample size. The study sample size was determined as n=52 for validity measures and n=24 for reliability measures. Sample size analysis of validity measurements was based upon an expected correlation coefficient r=0.8, α=0.05 and 95% confidence interval (95%CI) of ±0.1. Sample size analysis of reliability measurements was based upon an expected ICC=0.8, α=0.05 two sided with a 95%CI of ±0.15 and number of measurements of k=2.

All eligible inpatient adult stroke patients recovering at two clinical rehabilitation units at Heliomare between January and June 2017 were approached to participate in this study. Patients were eligible for inclusion if they met the following criteria: 1) first-time/recurrent stroke in the last six months; 2) ≥18 years of age; 3) able to walk five steps unsupported with/without walking aid; 4) able to stand independently for at least one minute. A participant was excluded in case of: 1) cognitive impairments resulting in difficulties to understand instructions (as judged by a neuropsychologist); 2) uncorrected hearing impairments; 3) secondary neurological impairments; 4) orthopedic impairments.
All included participants were scheduled for validity measurements, the last twenty-five participants were also scheduled for additional reliability measurements.

Data Collection

Eligible patients were contacted by the researcher (RB) to discuss participation in the study and to hand over an information letter. After at least two days of consideration patients gave their decision. Patients who were willing to participate and signed informed consent were scheduled for measurements. The measurement protocol consisted of one measurement for the validation sample and two measurements on two subsequent days for the reliability sample.

During the first appointment, a posturography measurement and a stabilometer balance test was conducted. After this measurement, we determined the rotational stiffness ($RStiff_{2.5}$) of the stabilometer in which the participant is just able to maintain balanced ≥70% of the trial time. The stabilometer measurement was followed by two 30 second trials on the calculated $RStiff_{2.5}$ value. Subsequently, the Berg Balance Scale (BBS)[18] was administered as well as a Dutch version of the Movement-Specific Reinvestment Scale.[19] Furthermore, the participants' total length, leg length and weight were measured.
Participants of the reliability sample were scheduled for a second appointment in which the stabilometer balance test was repeated, followed by two 30 second trials on the $RStiff_{2.5}$ value

as calculated after the first stabilometer test.
Furthermore, participants Functional Ambulation Categories (FAC) scores[20,21], diagnosis, medical history, age, education level and cognitive functioning were obtained from the patient records.

Stabilometer balance test protocol

Participants performed 16 trials of 30 seconds on the stabilometer (Figure 1). Before the start of the measurement the participant was secured with a safety harness. Next, a 2-down-1-up modified staircase procedure as proposed by Taylor and Creelman (1967) was used to determine the threshold rotational stiffness at which patients were just able to remain in balance (i.e., keep the deviations of the board <2.5 degrees) for at least 70% of trial duration.[22,23] First, patients performed one familiarization trial of 30 seconds (at 150 Nm/rad). Next, patients subsequently performed 16 trials of 30 seconds each. The first trial was consistently performed at a rotational stiffness of 150 Nm/rad. Patients' performance was then evaluated using the criteria outlined in Table 1. In case the patient was successful on two consecutive trials the stiffness was reduced with 50 Nm/rad. However, if a patient failed once, the rotational stiffness was increased with 40 Nm/rad. Based on the rules described by Taylor and Creelman (1967)[22], these step sizes were halved with every reversal (down to a minimum of -3.125 Nm/rad and +2.5 Nm/rad). Also, step sizes were doubled in case of four consecutive successful/failed trials (up to a maximum of -50 and +40 Nm/rad). This procedure was followed for a fixed number of 16 trials. A regression line (of the form: $C + A(1-e^{kt})$) was fit through the obtained 16 data points, to establish the threshold rotational stiffness at which the patient successfully managed to keep the board's deviation below 2.5 degrees for 70% of the trial. This so-called $RStiff_{2.5}$ value served as the outcome of the stabilometer test, the benchmark value in which the participant was just able to maintain balance.

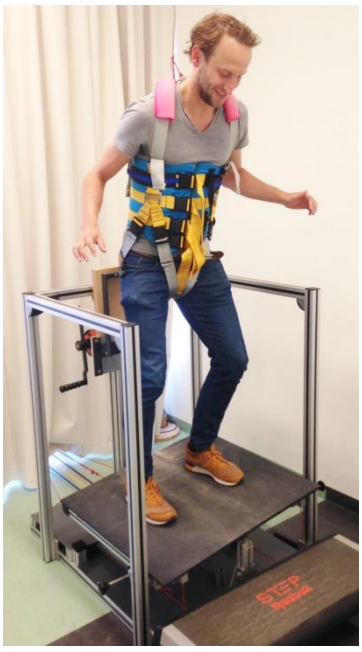

Figure 1: Experimental set-up

Posturography measurement

Participants were instructed to stand as still as possible with hands alongside their body for thirty seconds on a force plate (P6000, BTS Bioengineering Corp., New York, USA) which recorded their center of pressure (COP) at a frequency of 800 Hz. The measures 'total path length of COP' (sway) and 'normalized path length of COP' (curviness) were derived from the posturography. These measures are widely accepted measures for posturography measurement.[9,24,25] Sway measures the total COP trajectory and therefor quantifies the

amount of movement. The measure curviness quantifies the amount of twisting and turning. Therefore, these two measures complement each other in measured balance properties.[9,24,26]

Berg Balance Scale

The BBS consists of 14 items that measure different aspects of balance (e.g., sit-to-stand, standing on one leg). Items are scored in a five-point ordinal scale (0-4), yielding a possible maximum score of 56 points in total. A score ≤45 is indicates an increased risk of falls.[27] The BBS is validated for the elderly and stroke population.[18]

Table 1: Criteria for evaluating success during stabilometer test sessions.

Performance criteria for test sessions		
% of trial duration that board deviates < 2.5 degrees	***Number of times participant grabbed handrail for support***	***Outcome***
>70%	0	Success
>70%	1 or 2	Redo Trial[a]
<70%	any number	Failure
>70%	> 2[b]	Failure

[a] If a patient scored "Redo trial" on two consecutive trials, this counted as a failure.
[b] When a patient grabbed the handrail more than twice, we multiplied the number of times that patients grabbed the rail with -10%, and subtracted this from patients' scores (i.e., when a patient scored 95% but grabbed the handrail 4 times, the resulting score would be 95-40%=55%). Handrail support was scored by observation by the experimenter.

Data analysis

Data analysis was conducted using IBM SPSS statistics version 22 (IBM corporation, New York, USA).
Before analyses were conducted, the data was checked for outliers and normality of the distribution. Next the concurrent validity was determined by comparing the $RStiff_{2.5}$ value (absolute values as well as those corrected for weight) with the posturography measures and the Berg Balance Score. For the posturography the measures 'sway' (absolute path length of COP) and 'curviness' (normalized path length of COP) were derived.[9,24] The validity analyses were conducted with a Pearson correlation.
The test-retest reliability was determined by comparing the first $RStiff_{2.5}$ value with the

second $RStiff_{2.5}$ value and by comparing the mean of the two trials at the first $RStiff_{2.5}$ value between measurement day one and two. The reliability analyses were conducted using an Intraclass Correlation Coefficient ((ICC) 2-way random, consistency).[28]
Minimal Detectable Change (MDC) scores were calculated for the stabilometer balance test at individual level and at group level. This was done at 95% confidence interval level using the formulas $MDC_{individual}$ = SEM x 1.96 x √2 and MDC_{group} = SEM x 1.96 x √2/√n.[28,29]

Assessment of validity and reliability

To evaluate concurrent validity three hypotheses were defined: 1) the correlation between the calculated $RStiff_{2.5}$ value and sway (absolute path length of COP) on the force plate is r=≥0.5; 2) the correlation between the $RStiff_{2.5}$ value and curviness (normalized path length of COP) on the force plate is r=≥0.5; 3) the correlation between the $RStiff_{2.5}$ value and the Berg Balance Scale is r=≥0.5.[30]
To evaluate test-retest reliability two hypotheses were defined: 1) the ICC between the calculated $RStiff_{2.5}$ value at baseline and retest is ICC=≥0.75; 2) the ICC between the percentage scores of the performance trials during baseline and retest is ICC=≥0.75.[31]

RESULTS

Recruitment/response

A total of 88 participants were included (Figure 2). 86 participants completed concurrent validity measurements. Twenty-three of these participants performed additional measurements for test-retest reliability. Two participants dropped out of the study after inclusion because of incomplete measurements caused by fatigue or cognitive impairments resulting in an inability to follow instructions.

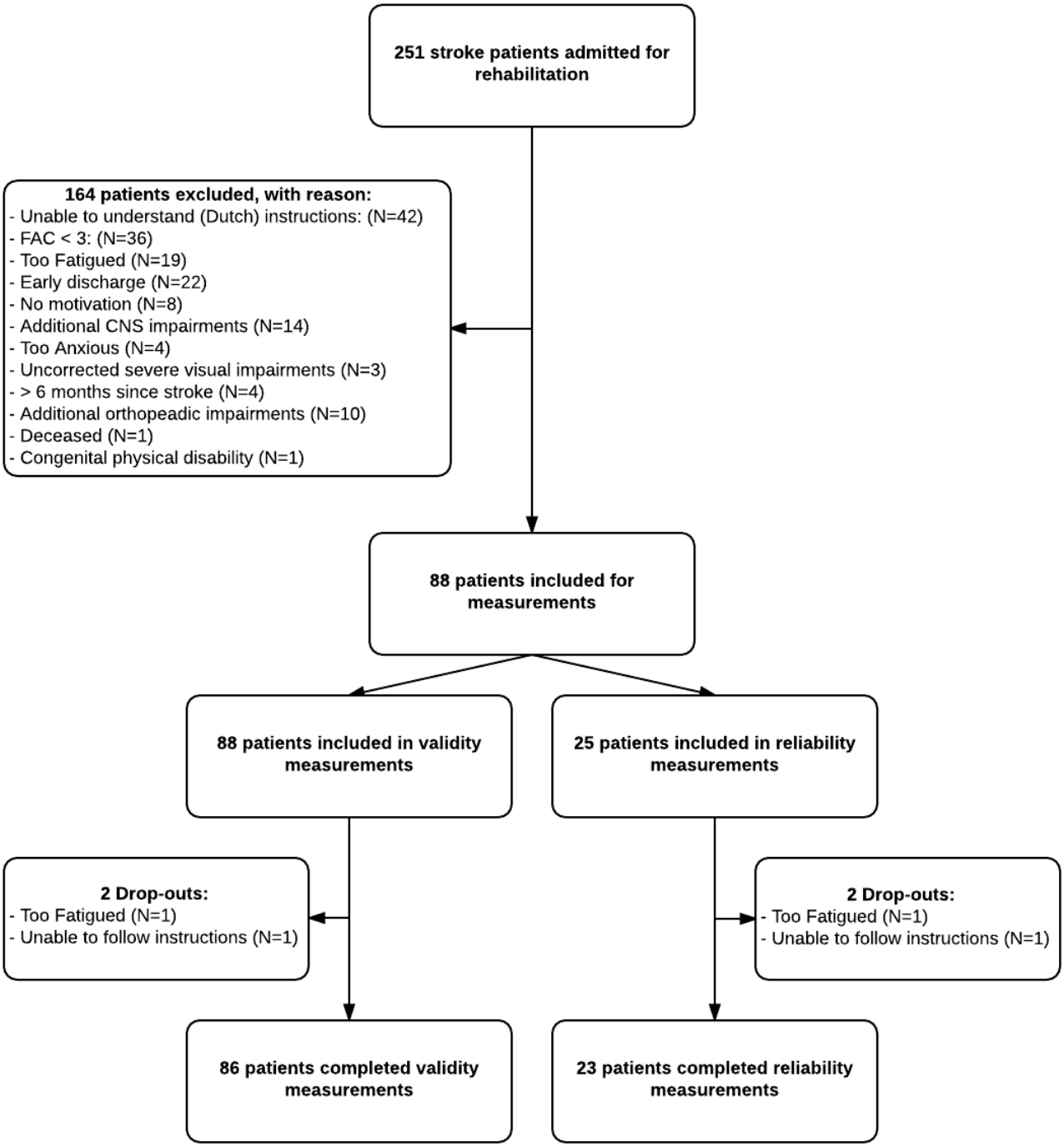

Figure 2: Flowchart of participant inclusion.

Sample characteristics

Descriptive information of the sample characteristics can be found in Table 2. Within the validity sample (n=86), mean age was 61 years (±10.49), 34.9% of the sample consisted of female participants. Average weight of participants was 79 kg (±14.48). Mean time since stroke was 33 days (±17.45). Mean Berg Balance score was 48 (±9.18).
Within the reliability sample (n=23) mean age was 66 years (±8.55), 43.5% of the sample consisted of female participants. Average weight of participants was 74 kg (±13.46). Mean time since stroke was 38 days (±18.47). Mean Berg Balance score was 48 (±10.22).

Concurrent validity

The validity and reliability results are presented in Table 3. Mean $RStiff_{2.5}$ value for the validity sample at baseline was 38.94Nm (±29.44). The correlation between the first $RStiff_{2.5}$ value and posturography was r=0.384 (p=0.002) and r=0.123 (p=0.339) for 'sway' and 'curviness', respectively. The Pearson's correlation between the first $RStiff_{2.5}$ value and the Berg Balance Scale was r=-0.591 (P<0.001). Because of a relatively high correlation between the found $RStiff_{2.5}$ value and participants weight (r=0.422, P<0.001) the concurrent validity analyses were also performed with the $RStiff_{2.5}$ value corrected for weight. In these analyses between the corrected $Rstiff_{2.5}$ value and the posturography we found a correlation of r=0.351 (P=0.005) and r=0.203 (P=0.117) on the 'absolute path length of COP' and 'normalized path length of COP' respectively. A correlation of r=-0.648 (P<0,001) was found on the analysis between the corrected $RStiff_{2.5}$ value and the Berg Balance Scale.

Test-retest reliability

Mean $RStiff_{2.5}$ value for the reliability sample was 27.63Nm (±20.87) at baseline and 23.25Nm (±22.21) at retest. The One-Way ANOVA found no significant differences between baseline and retest values (F=2.135, p=0.158). Between the $RStiff_{2.5}$ values of the first and the second stabilometer test an Intraclass Correlation Coefficient (ICC) of 0.875 (95%CI=0.705-947) was found and a Standard Error of Measurement (SEM) of 7.575. An ICC of 0.682 (95%CI=0.233-0.868) was found between the mean percentages of the performance trails at $RStiff_{2.5}$ value at baseline and retest. MDC scores were calculated at group- and individual level (Table 3).

Table 2: participant characteristics

	Measurement Validity N=86	Measurement Reliability N=23‡
Male/female, n	56 / 30	13 / 10
Age (y)*	61±10.49 (30-82)	66±8.55 (44-82)
Weight (kg)*	79±14.48 (50-129)	74±13.46 (50-104)
Time since stroke (days)*	33±17.45 (9-111)	38±18.47 (17-83)
Time since admission (days)*	17±12.57 (3-71)	23±16.32 (8-71)
Stroke type		
Hemorrhagic, n (%)	22 (25.6%)	7 (30.4%)
Infarction, n (%)	64 (74.4%)	16 (69.6%)
Bamford Stroke Classification[32]		
TACS**, n (%)	3 (3.5%)	0 (0.0%)
PACS**, n (%)	38 (44.2%)	10 (43.5%)
POCS**, n (%)	17 (19.8%)	4 (17.4%)
LACS**, n (%)	28 (32.6%)	9 (39.1%)
Recurrent stroke, n (%)	12 (14.0%)	5 (21.7%)
BBS** Score*	48±9.18 (24-56)	48±10.22 (24-56)
FAC** score		
3, n (%)	23 (26.7%)	5 (21.7%)
4, n (%)	32 (37.2%)	7 (30.4%)
5, n (%)	31 (36.0%)	11 (47.8%)

*Values presented as $\overline{X}$±SD (range).
** TACS: Total Anterior Circulation Stroke, PACS: Partial Anterior Circulation Stroke, POCS: Posterior Circulation Stroke, LACS: Lacunar Syndrome, BBS: Berg Balance Scale, FAC: Functional Ambulation Categories.
‡ Sample consists of a subsample from the concurrent validity sample

Missing data

Data was missing completely at random in twenty-four of the posturography measurements, both within the 'sway' and 'curviness' measures. Missing data was caused by a temporary malfunctioning of the force plate. Missing data wat not imputed because the number of measurements still exceeded our sample size calculation and missing data did not cause any added risk of bias.
Furthermore, missing data was present not at random in one retest performance trial. This was caused by the participant being too fatigued to complete the retest measurement.
We applied available case analyses in all analyses in which missing data was present.

Table 3: validity and reliability measures

	Measurement	Value
Correlation (r)	$RStiff_{2.5}$* value and:	
	Absolute path length of COP	0.384 (p=0.002)
	Normalized path length of COP	0.123 (p=0.339)
	Berg Balance Scale	-0.591 (p<0.001)
Correlation (r)	$RStiff_{2.5}$ value (weight corrected) and:	
	Absolute path length of COP	0.351 (p=0.005)
	Normalized path length of COP	0.203 (p=0.117)
	Berg Balance Scale	-0.648 (p<0.001)
ICC*	$RStiff_{2.5}$ value (baseline) - $RStiff_{2.5}$ value (retest)	0.875 (95%CI=0.705-0.947)
	% performance trial (baseline) - % Performance trial (retest)	0.682 (95%CI=0.233-0.868)
ANOVA (F)	$RStiff_{2.5}$ value (baseline) - $RStiff_{2.5}$ value (retest)	2.135 (p=0.158)
SEM*	$RStiff_{2.5}$ value	7.575
MDC*	$RStiff_{2.5}$ value (individual level)	20.996
	$RStiff_{2.5}$ value (group level)	4.378
Balance performance (mean)	$RStiff_{2.5}$ value at baseline	38.94Nm (±29.44)
	% performance trials (total)‡	84.660% (±20.13)

*ICC=Intraclass Correlation Coefficient, SEM=Standard Error of the Mean, MDC=Minimal Detectable Change, $RStiff_{2.5}$=Rotational Stiffness of the balance board (stabilometer balance test outcome).

‡ Average percentage of trial time participants could keep the deviations of the board <2.5 degrees during performance trials at the calculated $RStiff_{2.5}$ value.

DISCUSSION

The purpose of this study was to evaluate the concurrent validity, test-retest reliability and minimal detectable change of an adaptive balance test on a medio-lateral stabilometer in stroke patients. The validity hypothesis of correlation r≥0.5 between the stabilometer balance test and the Berg Balance Scale was confirmed. However, bot hypotheses concerning the comparison with the posturography (r≥0.5) measures were rejected. Within the reliability analyses, the hypothesis concerning the ICC between the calculated $RStiff_{2.5}$ value at baseline and retest (≥0.75) was confirmed. The hypothesis of ICC between the percentage scores of the performance trials during baseline and retest (≥0.75) was rejected. The calculated minimal detectable change is 20.996Nm on individual level and 4.378Nm on group level.

The hypotheses concerning the correlation between the $RStiff_{2.5}$ value and the posturography measures were both rejected. This may have been caused by multiple factors contributing to the result of the stabilometer balance test, including participants' weight, cognitive impairments, fatigue and endurance. These factors seem to have less impact in the posturography measures, causing a difference in measured construct. Another explanation of the poor correlation might be that the chosen posturography parameters ('sway' and 'curviness') were not the best fitting measures to correlate to clinical balance measures like the $RStiff_{2.5}$ value. An indication for this is that the posturography measures also correlated poorly to the Berg Balance Scale, which is regarded to be the gold standard for clinical balance evaluation in stroke patients. These correlations were r=-0.314 (p=0.013) and r=-0.208 (p=0.104) for 'sway' and 'curviness', respectively. Future studies should also analyze with medio-lateral posturography analyses like sway amplitude.

The test-retest reliability of the stabilometer balance test is confirmed by our analysis and scores of the $RStiff_{2.5}$ value comparisons are well above the hypothesized scores of ICC≥0.75. The reliability of the performance trials was less than anticipated. The performance trials were measured on the calculated $RStiff_{2.5}$ value, in which the purpose is that the patient is just able to maintain balanced for 70% of trial time. This resulted in a broad range in the performance trials, in which participants sometimes failed but performed a perfect trial next time. The MDC scores show that the stabilometer measurement does provide an accurate measure on group level. On individual level the MDC is not sufficient to detect small changes.

Our study is the first to validate an adaptive balance test on a stabilometer in stroke patients. Several previous studies have validated the WII balance boards[14,15] for balance testing. These studies however aimed to validate the balance boards as a measure similar to posturography, not as a newly designed balance test and not with an adaptive test protocol. One study validated a wobble board[33], however, this was performed specifically for balance training purposes. Lei et al. (2007)[34] have validated a balance test on a stabilometer in stroke patients. In their study a stabilometer with a fixed resistance is used without an adaptive test protocol and a small study sample compared to our present study.

In this study a large sample was used for concurrent validity. Despite a relatively large amount of missing data within the posturography measures, the data still exceeded our

required sample size. In contrast, the reliability sample was relatively small. As a result, the found ICC values might be less exact, since the confidence intervals are relatively wide.
The sample used in this study is a good reflection of the population with a good representation of both sexes, different stages of mobility and differences in type and site of stroke. Therefore, study results can be generalized to the stroke population. The Berg Balance Scale and posturography, which we used as reference instruments, count as gold standard instruments in lab- and clinical settings for balance evaluation in stroke patients. Therefore, our results transfer well to both lab- and clinical settings. The chosen posturography parameters, however, might not have been the optimal fit to compare to the $RStiff_{2.5}$ value. Furthermore, the average calculated $RStiff_{2.5}$ value was lower on the second stabilometer tests. This implies a learning effect in participants between the first and second stabilometer performance test, however the repeated measures ANOVA we conducted showed that the difference between baseline and retest was not significant.

The stabilometer balance test has several advantages and disadvantages compared to known balance tests in stroke patients. First of all, it represents a quantifiable measure of balance performance in a way that is comparable to the way balance is often trained in clinical practice. Furthermore, it gives insight in the optimal training level for patients specified to their balance performance, as the $RStiff_{2.5}$ value that is used as test outcome could also be used as benchmark value for balance training. A disadvantage of the stabilometer balance test is the time consuming test procedure. Moreover patients with very poor balance, severe fatigue or severe cognitive impairments are not suitable for this test due to the difficulty of the test and the amount of trials they have to complete. On the contrary, the stabilometer balance test does not have a strong ceiling effect and could therefor provide a more reliable clinical balance measure for patients with minor balance impairments. It is also the first time an adaptive balance test like this has been validated, showing that adaptive testing might be of added value in future balance tests.
Future research should focus on the efficacy of the stabilometer balance test as a measure for training balance in stroke patients. Furthermore, the effects of training balance on a stabilometer with adjustable resistance to movement should be studied.

CONCLUSION

The stabilometer balance test provides a reliable measure for balance. However, it seems to measure a broader, more clinical concept of balance than just the theoretical construct. Balance related concepts such as fatigue, endurance and cognitive impairments as well as participants' weight seem to influence the performance in the stabilometer balance test. The minimal detectable change shows that that the stabilometer balance test is sensitive on group level, however, in stroke patients the test is not sensitive enough on individual level.

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SAMENVATTING

Achtergrond

Evaluatie van balans is een belangrijk aspect van revalidatie na een beroerte. Recentelijk is een adaptieve balanstest ontwikkeld welke gebruik maakt van een gemodificeerde staircase test procedure op een stabilometer. Als deze test de balans valide en precies meet bij patiënten met milde tot matige balansstoornissen dan kan het een waardevolle toevoeging zijn op bestaande balanstesten.

Doelstelling

Het doel van de studie is het bepalen van de concurrente validiteit, test-hertest betrouwbaarheid en het minimaal meetbare verschil van een adaptieve balanstest op een medio-laterale stabilometer bij patiënten met een beroerte.

Methode

In deze studie is gebruik gemaakt van een cross-sectioneel studie design. Validiteitsmetingen bestonden uit een stabilometer balanstest, de Berg Balance Scale (BBS) en een meting op een krachtenplaat. Participanten van de test-hertest betrouwbaarheid steekproef ondergingen een tweede stabilometer balanstest. Validiteit is geanalyseerd met Pearson correlatie. Test-hertest betrouwbaarheid is geanalyseerd met een Intraclass Correlatie Coëfficiënt. Het minimaal meetbare verschil is berekend op individueel niveau en groepsniveau.

Resultaten

In totaal hebben 86 participanten de metingen voor concurrente validiteit afgerond, drieëntwintig participanten hebben extra metingen gedaan voor test-hertest betrouwbaarheid. Een correlatie van $r=0.384$ ($p=0.002$) en $r=0.123$ ($p=0.339$) is gevonden tussen de balansmeting op de stabilometer en de krachtenplaat voor respectievelijk de 'sway' en de 'curviness'. Een correlatie van $r=-0.591$ ($p<0.001$) is gevonden tussen de balansmeting op de stabilometer en de BBS. De Intraclass Correlatie Coëfficiënt tussen de twee balansmetingen op de stabilometer was 0.875, tussen de prestatietests was deze 0.682. De gemiddelde stabilometer balanstest uitkomst was 38.94Nm (±29.44). Het minimaal meetbare verschil is 20.996 op individueel niveau en 4.378 op groepsniveau.

Conclusie

De stabilometer balanstest is een betrouwbare test. De meting lijkt een breder, meer klinisch concept van balans te meten dan het theoretische construct. De stabilometer balanstest is gevoelig voor verandering op groepsniveau, echter op individueel niveau is de test niet sensitief genoeg.

Klinische relevantie

De stabilometer balanstest kan gebruikt worden voor de evaluatie van balans binnen wetenschappelijk onderzoek. De test heeft geen sterk plafondeffect zoals sommige andere balanstesten hebben. De uitkomst van de test kan ook gebruikt worden als referentiemaat voor balanstraining op de stabilometer.