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Reliability of test procedures for postural reactions in people with acute stroke

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Abstract

Background/Aims: Regaining and maintaining balance requires postural reactions such as righting reactions, equilibrium reactions, and protective reactions. There is a lack of uniform, standardised, and reliable testing procedures for postural reactions. The aim of the present study was to examine the intra- and interrater reliability of a newly developed postural reactions assessment for use in people with acute stroke.

Methods: The Postural Reactions Test was developed based on the literature, on previous tests, and on input from an expert panel. A total of 10 physiotherapists assessed a total of 20 video recordings of people with acute stroke performing each postural reaction. These assessments were carried out on two occasions at least 2 weeks apart. The study thus included 400 ratings.

Findings: For intrarater reliability, the overall proportion of agreement was 86 – 93% for the different postural reactions. For interrater reliability, the most common score for each participant and the number of physiotherapists giving that score were noted. A median of 9–10 out of 10 physiotherapists scored the same value.

Conclusions: The results indicate that the Postural Reactions Test can be used to reliably assess function in people with acute stroke and that the test can complement the existing assessments for people with affected postural control.

Key words: Postural reactions, Reliability, Reproducibility of results, Stroke

Introduction

Postural reactions, which automatically assist in regaining and maintaining balance by changing muscle tone alone or by moving body parts (Edwards, 2002; Batra et al, 2011), are classified as involuntary movement reaction functions in domain b755 of the International Classification of Diseases 11th revision. (World Health Organization, 2018). Equilibrium reactions provide balance when the centre of gravity is disturbed and include counter-movements of the head, trunk, and extremities away from the direction of displacement. Righting reactions support head and trunk positioning vertically in space, a motion that involves both the head, trunk, and extremities and that aligns the eyes with the horizon. Protective reactions are needed if balance cannot be restored via equilibrium reactions either via an executive stepping reaction to prevent a fall, or by using the arms to protect the body from injury (Edwards, 2002; Batra et al, 2011; Corbeil et al, 2013).

Older people frequently fall and risk injury, particularly after stroke (Weerdesteyn et al, 2008; Simpson et al, 2011; Zheng et al, 2017). Stroke may result in a variety of dysfunctions, including impaired postural stability (Peurala et al, 2007) and impaired reactive balance control (Lakhani et al, 2011; Mansfield et al, 2012; Inness et al, 2014). Muscle onset latencies after exposure to balance perturbations are significantly longer in patients with stroke than in people who have not had a stroke (de Kam et al, 2017), which results in an increased risk of falling (Marigold and Eng, 2006). Notably, impaired control of balance recovery steps are related to increased fall rates during inpatient stroke rehabilitation and post discharge (Mansfield et al, 2013; Mansfield et al, 2015a). Specific tests that assess the ability to perform balance recovery steps may be important for identifying people at risk for falls and for directing appropriate intervention strategies (Inness et al, 2014), such as perturbation-based training, which is effective in preventing falls (Mansfield et al, 2015b).

Assessing postural reactions has been a part of clinical assessments of neurological function for decades (Bobath and Bobath, 1964). In the first edition of the Fugl-Meyer Assessment of Motor Recovery after Stroke (Fugl-Meyer et al, 1975), protective reactions while sitting are assessed as ‘impaired’ or ‘normal’ without defining these words. The Birgitta Lindmark assessment (Lindmark and Hamrin, 1988) added a level to indicate no function at all. Compared to these tests, the Postural Reactions Test has an added clarification of what reactions to assess as ‘impaired’ or ‘normal’. The Balance Evaluation Systems Test (BESTest) contains procedures for testing protective reactions while standing (Horak et al, 2009). In the BESTest, the person being assessed needs to understand the test instructions and actively lean toward the test leader’s hand. Compared to BESTest, the protective reaction in standing in the Postural Reactions Test can also be assessed in people with limited abilities to follow instructions. None of the tests mentioned above assess equilibrium and righting reactions. The Postural Reactions Test is unique in gathering uniform assessments of all the postural reactions in one test but each specific reaction can also be assessed separately.

The aim of the present study was to examine the intra- and interrater reliability of a newly developed postural reactions assessment for use in people with acute stroke.

Methods

Test procedures for the Postural Reactions Test were developed by one of the authors (HS) based on the literature, on other tests (Fugl-Meyer et al, 1975; Lindmark and Hamrin, 1988; Horak et al, 2009), on clinical experience, and in collaboration with patients and physiotherapists at the stroke unit at Ryhov County Hospital, Jönköping, Sweden. The test procedures were pilot-tested and face validity was evaluated in two phases. In the first phase, systematic feedback was obtained from nine clinically active and experienced physiotherapists within the area of neurological disorders at three meetings, where interpretations of the test instructions and assessments procedures were discussed and documented. In the second phase, physiotherapists at the stroke unit used the test in their clinical work during a 1-year period and further reviewed the clarity and completeness of the instructions. The test instructions were modified according to the results of the pilot testing. Standardisations that were not necessary to distinguish between different scores were discarded. Some further instructions and clarifications that made it safer and easier to trigger and score the reactions were added.

The Postural Reactions Test

The Postural Reactions Test assesses equilibrium reactions and righting reactions while sitting, and protective reactions while sitting and standing. The four reactions are possible to be assessed and scored independently of each other. The assessments while sitting can be performed while the patient is sitting on a bed or an examining table, with the hands in the lap, and the feet either supported or unsupported. Leg crossing is not allowed. If the test leader is uncertain whether there is a postural reaction, the lowest score, which is equal to 'no reaction', is given.

Equilibrium reactions and righting reactions are assessed by the test leader while leaning the patients to the side; alternatively, the patients leans by themselves. If no reaction is observed, the test leader instructs the patient to return to an upright position and provides some resistance to this movement. This will provoke a reaction if there is one. Equilibrium reactions are observed as a movement of the opposite side arm and/or leg. Righting reactions are observed as a movement of the head to the opposite side. There are two possible outcomes:

- No reaction or an uncertain reaction is observed (score=0)
- A definite reaction is observed (score=1).

To assess the protective reactions while sitting, the test leader gives the patient a hard push to the side while standing behind the patient. The push must move the centre of gravity outside the support area of the patient. Protective reactions are observed in the arm on the side toward which the patient is pushed. There are three possible outcomes:

- No active reaction of the shoulder or arm to prevent a fall (score=0)
- A slow movement to prevent a fall by putting out the hand or more than the hand, although balance might not be regained (score=1)

- A fast movement to prevent a fall by putting out only the hand, and balance is regained by doing so (score=2).

Protective reactions while standing are more easily triggered if the patient is standing with the feet together. The test leader gives the patient a push to the side hard enough to move the centre of gravity outside the patient's support area. Protective reactions are observed in the legs. There are three possible outcomes:

- The patient does not take any steps with either leg before the test leader has to catch the patient to prevent a fall (score=0)
- The patient takes more than one step to regain balance or takes only one step but does not regain balance, so that the test leader has to catch the patient to prevent a fall (score=1)
- The patient takes one step with the right or left leg and successfully regains balance (score=2) (*Appendix*).

Design of the reliability study

Consecutive patients were recruited at the stroke unit at Ryhov County Hospital, Jönköping, Sweden between March and November 2013. Every recruited patient performed the items that they were able to perform. Since some participants could sit but not stand, some did not want to perform all items, and some videos could not be analysed, in total 36 patients had to be recruited until all the postural reactions had been performed by 20 participants. The inclusion criteria for participation were a diagnosis of stroke and symptom onset within 14 days before testing. The exclusion criteria were traumatic brain injury, major orthopaedic problem, neurological problem other than stroke, no evident residual symptoms due to the current stroke onset, medical reasons for being unable to participate according to a physician, or need of professional interpreter to obtain informed consent. A flow chart of patients eligible for the study and the inclusion of participants to the different items are given in *Figure 1*. Informed consent was obtained from all participants. The study was approved by the Regional Ethical Review Board in Linköping, Sweden (approval number: dnr 2013/291).

Participants were tested by one of the four physiotherapists working at the stroke unit according to the instructions written by the first author. Videos of the tests were recorded. Ten physiotherapists (median work experience: 16 years, range: 6 – 43 years, all with working experience in the field of neurology) assessed a total of 20 video recordings of people with acute stroke performing the test. These assessments were carried out at two assessment sessions at least 2 weeks apart. The study thus included 400 ratings. The physiotherapists watched the videos together; if a physiotherapist was unable to attend these meetings, he or she was allowed to assess the videos at a later date. The order in which the videos were observed was random and was not the same at the two sessions. The physiotherapists did not have access to their previous scores when performing the second test assessment. They could choose to watch the videos once or twice during each assessment session. All physiotherapists read the test protocol and were given the test instructions by one author (HS) immediately

before watching the videos. They were not allowed to discuss their scores with each other. The physiotherapists' experience with the tests varied before performing the assessments.

Figure 1. Flow chart of people eligible for the study and the inclusion of participants to the different items

Statistical analyses

The medians and quartiles of the two test sessions were calculated for intrarater reliability, and the overall proportions of agreement (in percentage) between the two test sessions was determined. For interrater reliability, we noted the most common score for each participant and the number of physiotherapists who gave that score. Next, the median and quartiles were calculated for how many physiotherapists had scored the most common value for all participants (*Table 1*). Analyses were performed using the Statistica 12 software package (StatSoft Inc., USA). The drop-outs were compared to the participants using the Mann-Whitney U-test (age and days since stroke onset) and Fisher's exact test (sex). A *P* value <0.05 was considered significant.

Table 1. A shortened example (with three patients) of how the number of PTs scoring the most common value was calculated to assess the interrater reliability of the postural reactions in people with acute stroke ($n=20$)

Equilibrium reaction, leaning to the right side, 10 physiotherapists scoring videos of 20 patients											
Patient	PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9	PT10	Number of PTs scoring the most common value
1	1	1	1	1	1	1	1	1	1	1	10
2	1	1	1	1	0	1	1	1	1	1	9
3	0	0	0	0	0	0	0	1	0	0	9
											Median (q1–q3): 10 (9 – 10)

PT = physiotherapist; q = quartile

Findings

A total of 20 participants were included in each item (36 participants were included in at least one of the items). For equilibrium and righting reactions, 11 women and 9 men with a median age of 80 (range 51–91) years and a median of 5 (range 0–11) days since stroke onset were included. For protective reactions while sitting, 8 women and 12 men with a median age of 78 (range 51–91) years and a median of 4 (range 0–13) days since stroke onset were included. For protective reactions while standing 7 women and 13 men with a median age of 75 (range 51–91) years and a median of 5 (range 1–13) days since stroke onset were included. The descriptive data about the participants from journals and the Riksstroke Collaboration are given in (Table 2).

No significant differences were found between the 36 participants and the 14 patients not included in the study (Figure 1) with respect to sex, age, or time since stroke onset.

For intrarater reliability, the overall proportion of agreement was 86 – 93% for the different postural reactions, indicating that the physiotherapists assessed the videos with high agreement (Table 3). For interrater reliability, the medians indicated that 9–10 out of 10 physiotherapists scored the same value (Table 4).

Discussion

The Postural Reactions Test standardised the testing procedures for postural reactions. This test can complement the existing assessments for people with affected postural control and was found to be reliable in people with acute stroke.

Table 2. Background characteristics of study participants ($n=36$) and the general stroke population in Sweden.

	Study participants	General stroke population*
Age, years, mean (range)	75 (51–91)	75
Sex, men/women, % (n)	58/42 (21/15)	53/47
Living alone, yes/no, % (n)	42/58 (14/19)**	48/52
ADL dependent before stroke onset, yes/no, % (n)	12/88 (4/29)**	13/87
First stroke, yes/no, % (n)	73/27 (24/9)**	78/22
Days since stroke onset, median (range)	4 (0–13)	
Stroke type		
Haemorrhage, % (n)	14 (5)	13
Infarction, % (n)	64 (23)	86
Not specified, % (n)	22 (8)	1
Stroke location***		
Right, n	15	
Left, n	3	
Brainstem, n	6	
Cerebellum, n	5	
Not specified, n	8	
Aids		
Independent walker, % (n)	44 (16)	
Walking aid, % (n)	50 (18)	
Wheel chair, % (n)	6 (2)	
NIHSS, median (range)	3 (0–15)**	3 (0–42)
Pares		
Right side, % (n)	22 (8)	
Left side, % (n)	61 (22)	
No pares, % (n)	17 (6)	
Cognitive impairment, yes/no, % (n)	61/39 (22/14)	
Impaired attention to one side, yes/no, % (n)	22/78 (8/28)	
Equilibrium reaction, median (range)	1 (0–1)	
Righting reaction, median (range)	1 (0–1)	
Protective reaction in sitting, median (range)	2 (0–2)	
Protective reaction in standing, median (range)	1 (0–2)	

* Data collected from Riksstrokes Årsrapport 2016 (Riksstroke Collaboration 2017).

** Data was only available for 33 participants.

*** One patient had two stroke locations.

Table 3. Intrarater reliability for the Postural Reactions Test in persons with acute stroke ($n=20$).

Variable	First test session, median (q1–q3)	Second test session, median (q1–q3)	Overall proportion of agreement (%)
Equilibrium reaction, leaning to the right side	1 (0–1)	1 (0–1)	92
Equilibrium reaction, leaning to the left side	1 (1–1)	1 (1–1)	91
Righting reaction, leaning to the right side	1 (1–1)	1 (1–1)	86
Righting reaction, leaning to the left side	1 (1–1)	1 (1–1)	89
Fall protection reaction, push to the right side while sitting	2 (1–2)	2 (1–2)	91
Fall protection reaction, push to the left side while sitting	2 (1–2)	2 (1–2)	93
Fall protection reaction, push to the right side while standing	1 (1–1)	1 (1–1)	91
Fall protection reaction, push to the left side while standing	1 (1–1)	1 (1–1)	92

q: quartile

The procedures of the Postural Reactions Test in the current study assess all postural reactions in a uniform way which, to our knowledge, is unique. The reliability is similar to the previously reported reliability of the balance tasks in the Fugl-Meyer Test (Fugl-Meyer et al, 1975), the total score of the Birgitta Lindmark assessment (Lindmark and Hamrin, 1988), and the postural responses in the BESTest (Horak et al, 2009). The Fugl-Meyer Test specifically assesses protective reactions while sitting as one of seven balance tasks (Fugl-Meyer et al, 1975). The intrarater reliability coefficients for the balance tasks of the Fugl-Meyer Test are reported to range between 0.89 – 0.98 in people after a stroke (Duncan et al, 1983), but the validity has been shown to be poor (Malouin et al, 1994). The interrater reliability agreement for the Birgitta Lindmark assessment, which assesses protective reactions as one of many motor tasks, is 96%, and the intrarater reliability agreement is 98% in people with stroke (Lindmark, 1988). The BESTest (Horak et al, 2009) assesses 36 balance tasks divided into six sections. Protective reactions while standing comprise three out of five items in the section postural responses and are assessed to the sides, backward, and forward, with criteria similar to those used in the present study. The interrater reliability for this section has been assessed in community-dwelling older people (Horak et al, 2009) and Parkinson's disease (Leddy et al,

2011) with intraclass correlation coefficients of 0.92 and 0.91 respectively. Thus the Postural Reactions Test is unique, having reliability confirmed for each item so that the different postural reactions can be used together or separately, depending on what is most relevant.

Table 4. Interrater reliability for the postural reactions test in persons with acute stroke (n=20)

Variable	Number of physiotherapists scoring the most common value, median (q1–q3)*
Equilibrium reaction, leaning to the right side*	10 (9–10)*
Equilibrium reaction, leaning to the left side	10 (9–10)
Righting reaction, leaning to the right side	9 (8–10)
Righting reaction, leaning to the left side	9 (8–10)
Fall protection reaction, push to the right side while sitting	9 (8–10)
Fall protection reaction, push to the left side while sitting	10 (9–10)
Fall protection reaction, push to the right side while standing	10 (9–10)
Fall protection reaction, push to the left side while standing	10 (9–10)

q: quartile.

*Table 1 shows how the ‘number of physiotherapists scoring the most common value’ was calculated.

Since an exact standardisation is not possible when humans give resistance or pushes, the standardisations were restricted to what was necessary to distinct between the different scores. To use human resistance and pushes instead of technical equipment makes the test easier and faster to use in clinical practice.

In the equilibrium and righting reactions, there are only two possible outcomes; ‘no or uncertain reaction’ or ‘reaction is present’. In the manual of the Postural Reactions Test it is stated that ‘the test leader instructs the patient to return to an upright position and provides some resistance to this movement’ (see *Appendix*). This means the resistance must be large enough to slow down the movement. According to our experience, there will be an equilibrium and righting reaction, if the patient has these reactions intact, when the resistance is strong enough to slow down the movement of the patients body. It’s not possible to give too much resistance since there is no higher score than ‘reaction is present’. If a patient leans themselves it will also be obvious which score to give, since a patient with no reaction will fall if not caught by the test leader.

For protective reactions, there are three different levels to differ between: 'no', 'impaired' and 'well functioning' reaction. It is stated in the manual that the test leader gives the patient a push to the side hard enough to move the centre of gravity outside the patient's support area (see *Appendix*). The push needs to be at least this great, and if so there will be a reaction if the reaction is intact. It can be hard to decide if the arm falls out as a result of gravity or is moved on purpose in patients with arm pares, but in our experience, this is possible to judge in most cases and therefore it is seldom a problem to differentiate the scores 'no reaction' from 'impaired reaction'. Since the test leader will be concerned not to frighten or harm the patient, it is, according to our experience, possible but not a great risk that the push will be too hard so that the patient is scored as 'impaired' when it should be 'well functioning'. We have not experienced any patients falling while performing this test and as stated in the manual, it is important that the test leader(s) and/or assistants are prepared to prevent the patient from falling.

When conducting the Postural Reactions Test in general practice, as the risk of affecting the score is judged to be small, it is sometimes allowed to perform an item in two alternative ways to enable more patients to complete the item. In the equilibrium and righting reactions, the patient is allowed both to lean by oneself and to be brought into the testing position by the examiner, in order to increase the number of patients able to cooperate in a correct way to trigger a reaction. These items can also be performed on the bed and the feet may be supported or not. Verbal patient instructions are not standardised since different patients may need individually adjusted instructions to perform the test correctly.

In this study, all possible scores were observed among the participants who performed the Postural Reactions Test. Most participants received a score of 1 for the equilibrium ($n=15$ to the right and $n=19$ to the left) and righting reactions ($n=17$ on both sides). Four of six participants with a score of 0 for equilibrium or righting reactions lacked the ability to walk. It is difficult to simultaneously observe the trunk, arms, and legs; therefore, in these test procedures, only leg or arm movements are assessed for the judgment of equilibrium reactions, and only head movements are assessed in the judgement of righting reactions. However, the trunk is also involved in these reactions (Batra et al, 2011), and the righting reaction cannot be observed without a simultaneous equilibrium reaction in adults (Edwards, 2002). The protective reactions have three possible scores, but the equilibrium and righting reactions only have two scores because it was technically challenging to standardise the criteria that differentiated between 'impaired' and 'normal' for these reactions. On both the left and right side, 12 participants received a score of 2 for protective reactions while sitting, and 15 participants received a score of 1 for the more physically demanding protective reactions while standing.

The exclusion criteria were selected so that stroke was the primary medical condition of the participants. Douiri et al (2013) reported disturbed cognitive performance in 22% of patients 3 months after stroke. The study population criteria were chosen to be representative of the real-world population. Therefore, people with cognitive dysfunction were included.

The performance of people with stroke considerably varies over time, for example worsening due to fatigue, or improving due to improved function. To account for this variability, we

assessed intraobserver reliability by videotaping the participants and requesting two separate test scores from separate assessment sessions from the observing physiotherapists, as recommended by Streiner et al (2015). To reduce the risk that the first outcome could influence the second outcome due to physiotherapists remembering their previous assessments, at least 2 weeks passed between the first meeting and the second meeting. Streiner and Norman (2015) recommended 1–2 weeks. In realworld clinical situations, the test can be repeated if it is hard to judge the patient's performance; therefore, the physiotherapists in our study were given the opportunity to watch the test videos twice at each assessment session.

A limitation of the assessment of the protective reactions is that the outcome depends on the patient being able to relax. In the assessment of the equilibrium and righting reactions, there will be no outcome if the patient is being totally relaxed in the arms of the test leader instead of trying to keep the balance by themselves.

Test performances are usually not assessed by videos in real-life clinical applications. This introduces a potential difference in the testing situation in the context of the study versus in the clinical testing setting. For example, in a clinical testing setting, the test leader can move and observe the patient from different angles, which is impossible when watching videos. Each assessor's professional and clinical experience in neurology and test protocols might also have affected the results. These factors varied among our panel of physiotherapists, most of whom had limited experience in using the test. We wanted the test to be reliable regardless of viewing angle and assessor experience, and the results confirmed that the test was reliable even under these circumstances.

For both intra- and interrater reliability, the weighted kappa was calculated but rejected. Skewed variable distributions generated low kappa values despite high agreement (Portney and Watkins, 2015). For example, a median of 10 of 10 physiotherapists scored the most common value for the equilibrium reactions on both the right and left sides. When tested to the right side, 15 of 20 patients were given a score of 1, which resulted in a kappa value of 0.71. In contrast, when tested to the left side, 19 of 20 patients were given a score of 1, which resulted in a kappa value of 0.31. Considering the high overall proportion of agreement, identical medians and quartiles, and the high number of physiotherapists scoring the same value, we believe that the test is reliable.

Compared to data from The Swedish Stroke National Association (Riksstroke Collaboration, 2017) background characteristics for the participants in this study were similar to the general stroke population. However, 22 % of the participants had pareses on the right side and 61% to the left, but the reliability results were similar for both sides.

Test reliability was confirmed only for people with acute stroke. The test may be useful for other groups, but the test reliability must be confirmed for those groups. Assessing intra- and interrater reliability based on videos is advantageous when studying instrumental aspects of intraobserver reliability, as the performance of people with acute stroke considerably varies over time. Further research is needed to evaluate the reliability of the test, including the

aspects of physiotherapist performance and patient variability as well as other aspects of validity.

Conclusion

The results indicate that the Postural Reactions Test can be used to reliably assess function in people with acute stroke and that the test can complement the existing assessments for people with affected postural control. Further research is needed to evaluate the reliability of the test, including the aspects of physiotherapist performance and patient variability as well as other aspects of validity

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Conflict of interest

None declared.

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Appendix. The Postural Reactions Test. Four postural reactions to be assessed and scored separately or together

1. Equilibrium reaction: compensatory movement in arm and leg

Starting position: The patient sits on a bed or examining table with hands in the lap and the feet supported or unsupported. Leg crossing is not allowed.

The test leader holds the shoulders of the patient and leans the patient to the side. Alternatively, the patient leans themselves to the side. If no equilibrium reaction is observed, the test leader instructs the patient to return to an upright position and provides some resistance to this movement. Equilibrium reactions are observed as a movement of the opposite side arm and/or leg. If the test leader is uncertain whether there is a reaction, a score of 0 is given.

The patient might need to be informed that the test leader wants to see how well they can adjust to leaning. This can be clarified by instructing the patient that arm and leg movements are allowed if needed for balance, but they are not allowed to hold on with their hands.

Leaning to the right (please tick ONE box in this column)	Leaning to the left (please tick ONE box in this column)
(0) ☐ No reaction or uncertain equilibrium reaction in the left arm or the left leg	(0) ☐ No reaction or uncertain equilibrium reaction in the right arm or the right leg
(1) ☐ Equilibrium reaction is present in the left arm and/or the left leg	(1) ☐ Equilibrium reaction is present in the right arm and/or the right leg

The patient was:	☐ brought into the position	☐ leaning by themselves
The tests were performed:	☐ on a bed	☐ on an examining table
The feet were:	☐ supported	☐ unsupported

If equilibrium reactions are observed both to the right and the left, any side differences should be noted below. If an equilibrium reaction is observed explicitly in the arm or leg, this should also be noted below.

Comments:

2. Righting reaction: striving to orient the eyes in a horizontal line

Starting position: The patient sits on a bed or examining table with hands in the lap and feet supported or unsupported. Leg crossing is not allowed.

The test leader holds the patient's shoulders and leans them to the side. Alternatively, the patient leans themselves to the side. If no righting reaction is observed, the test leader instructs the patient to return to an upright position and provides some resistance to this movement. Righting reactions are observed as a movement of the head to the opposite side. While assessing this, it might be useful to note if the angle between the head and the shoulder changes during the righting reaction. If the test leader is uncertain whether there is a reaction, a score of 0 is given.

The patient might need to be informed that the test leader wants to see how well the patient can adjust to the leaning. This can be clarified by instructing the patient that arm and leg movements are allowed if needed for balance, but they are not allowed to hold on with their hands.

Leaning to the right (please tick ONE box in this column)	Leaning to the left (please tick ONE box in this column)
(0) ☐ No reaction or uncertain righting reaction	(0) ☐ No reaction or uncertain righting reaction
(1) ☐ Righting reaction is present	(1) ☐ Righting reaction is present

The patient was:	☐ brought into the position	☐ leaning by themselves
The tests were performed:	☐ on a bed	☐ on an examining table
The feet were:	☐ supported	☐ unsupported

If righting reactions are observed both to the right and the left, side differences are noted below.

Comments:

3. Protective reaction while sitting: preventing a fall by putting out the hand

Starting position: The patient sits on a bed or examining table with hands in the lap and feet supported or unsupported. Crossing the legs is not allowed.

The test leader gives the patient a hard push to the side while standing behind the patient. The push must move the center of gravity outside the support area of the patient. Protective reactions are observed in the arm on the side toward which the patient is pushed. If no active reaction is observed in the shoulder or arm, a score of 0 is given. If gravity makes the arm of the patient reach out, and thereby receive support of the elbow, arm or hand, score 0 is still given. If the test leader is uncertain whether there is a reaction, a score of 0 is given.

The patient might need to be informed that the test leader wants to see if they can put out their hands when being pushed. The patient might need to be instructed to relax their trunk so that the protective reaction can be triggered. If the patient is so tense that no reaction is triggered or a reaction is remarkably delayed, the test is to be repeated.

Push to the right (please tick ONE box in this column)	Push to the left (please tick ONE box in this column)	Clarification
(0) ☐ No protective reaction	(0) ☐ No protective reaction	No active reaction of the shoulder or arm to prevent a fall is observed
(1) ☐ Impaired protective reaction	(1) ☐ Impaired protective reaction	A slow movement to prevent a fall by putting out the hand or more than the hand is observed (balance might not be regained)
(2) ☐ Well-functioning protective reaction	(2) ☐ Well-functioning protective reaction	A fast movement to prevent a fall by putting out only the hand is observed and balance is regained by doing so

The tests were performed: ☐ on a bed ☐ on an examining table
The feet were: ☐ supported ☐ unsupported

Comments:

4. Protective reaction while standing: preventing a fall by taking one or more steps

Starting position: Protective reactions while standing are more easily triggered if the patient is standing with the feet as close together as possible.

The test leader gives the patient a push to the side hard enough to move the center of gravity outside the patient's support area. Protective reactions are observed in the legs. If the test leader is uncertain whether there is a reaction, score 0 is given. If the patient has a tendency to fall to the side, it is not always necessary to push to observe if there is a reaction.

The patient might need to be informed that the test leader wants to see how they adjust to a push by moving the feet. It is important that the test leader(s) and/or assistants are prepared to prevent the patient from falling. The test leader(s) must be observant not to act too quickly so that they can assess if the patient was able to regain balance by taking a step.

Push to the right (please tick ONE box in this column)	Push to the left (please tick ONE box in this column)	Clarification
(0) ☐ No protective reaction	(0) ☐ No protective reaction	Does not take any steps with either leg before the test leader has to catch the subject to prevent a fall
(1) ☐ Impaired protective reaction	(1) ☐ Impaired protective reaction	Takes more than one step to regain balance or takes only one step but does not regain balance, so that the test leader has to catch the subject to prevent a fall
(2) ☐ Well-functioning protective reaction	(2) ☐ Wellfunctioning protective reaction	Takes one step with the right or left leg and successfully regains balance

Comments:

Date: Subject:

Sjöholm H, Hägg S, Nyberg L, Kammerlind AS. Reliability of test procedures for postural reactions in people with acute stroke. *Int J Ther Rehabil*. 2018;25(11):576. doi.org/10.12968/ijtr.2018.25.11.576

Equilibrium and righting reaction

Starting position

Leaning to the side (eg: to the right)

Protective reaction while sitting

Starting position

Push to the side (eg: to the right)

Protective reaction while standing

Starting position

Push to the side (eg: to the right)