

## Supplementary file.

### Protocol and administration form of the Functional Gait Assessment (FGA)

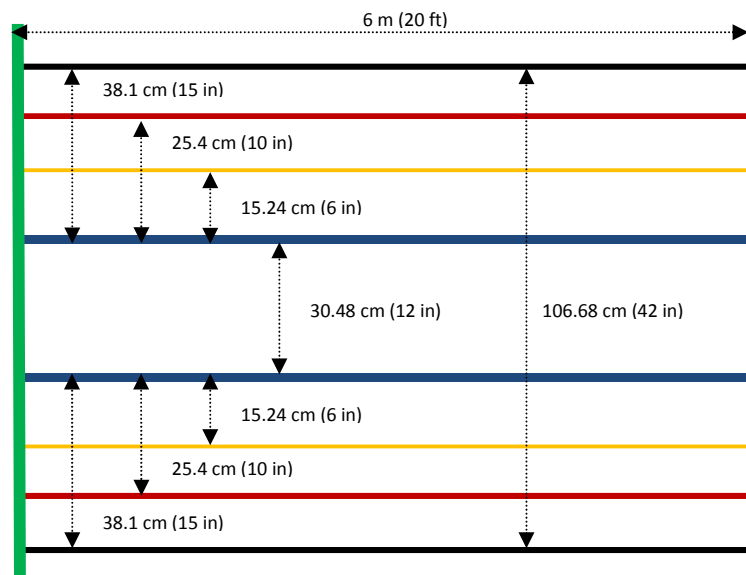
This protocol is based on the instructions described by Wrisley et al. (Phys Ther. 2004). In the formulation of the instructions for subjects, the stroke-specific disabilities are taken into account (i.e., paresis of the upper extremity and reduced cognitive ability to understand test instructions). A footnote is added when a test instruction is only applicable to subjects with unilateral impairments.

#### Purpose of the FGA

To evaluate walking balance performance.

#### Requirements

- Marked 6-m (20-ft) walkway (Fig. 1);
- Two cones;
- Administration form (included in this protocol);
- Stopwatch;
- Two boxes of any material or shoe boxes (l x d x h = 39.37 x 17.78 x 11.43 cm = 15.5 x 7.0 x 4.5 in);
- Stairs with rails;
- Any assistive devices and/or orthotics when required for the subject to walk;
- Chair present for resting; and
- Blindfold (optional).



**Fig 1. Schematic representation of a marked walkway with cones for the Functional Gait Assessment. The thick vertical lines are the starting and stopping lines. We used different colours for the lines and measured the distances from the interior side of a line to the interior side of the next line to make administration easier. (Optional: Every 1.5 m [5 ft] for item 2 and 3.6 m [12 ft] for item 7 can also be marked on the wall or floor.)**

### Instructions for the assessor

The subject stands between the first cone and the starting line and starts walking from the starting line to beyond the stopping line (6 meters). Cones are standing 2 meters outside the walkway. The assessor starts the stopwatch when the subject crosses the starting line and stops the time when the subject crosses the stopping line. When needed to ensure safety, the assessor accompanies the subject by walking slightly behind and to the affected side of the subject (supervision). The tasks are verbally instructed and demonstrated when necessary. During the test further encouragement is avoided. A task may be repeated but only when the instructions were misunderstood, or there is another reason why the test performance is below expectation. Use of an orthosis is allowed on all items (but is scored as a mild gait deviation). Deviations from the walkway width are defined as standing on or passing the longitudinal line. Assistance is defined as physical assistance or reaching for a wall. All 10 items have a minimum score of 0 and a maximum of 3 points.

### Items (extensive description)

Instruction beforehand: *“Walk to the cone at all items. Start after the command ‘3, 2, 1, start’.”*

#### 1. GAIT LEVEL SURFACE

Specific requirements: Stopwatch.

Instructions: *“Walk at your comfortable speed from here to the cone. Time is measured.”*

Grading: Mark the highest category that applies.

- 3      *Normal* – Walks 6 m (20 ft) in less than 5.5 seconds, no assistive devices, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.
- 2      *Mild impairment* – Walks 6 m (20 ft) in 5.5–7 seconds, uses an assistive device, mild gait deviations, or deviates 15.24–25.4 cm (6–10 in) outside of the 30.48-cm (12-in) walkway width.
- 1      *Moderate impairment* – Walks 6 m (20 ft) in more than 7 seconds, abnormal gait pattern, evidence for imbalance, or deviates 25.4–38.1 cm (10–15 in) outside of the 30.48-cm (12-in) walkway width.
- 0      *Severe impairment* – Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside of the 30.48-cm (12-in) walkway width or reaches and touches the wall.

## 2. CHANGE IN GAIT SPEED

Instructions: *“Begin walking at your comfortable pace.”* (for 1.5 m [5 ft]). *“When I tell you ‘quick’, walk as fast as you can.”* (for 1.5 m [5 ft]). *“When I tell you ‘slow’, walk as slowly as you can.”* (for 1.5 m [5 ft]).

Grading: Mark the highest category that applies.

- 3 *Normal* – Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between comfortable, fast, and slow speeds. Deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.
- 2 *Mild impairment* – Is able to change speed but demonstrates mild gait deviations, deviates 15.24–25.4 cm (6–10 in) outside of the 30.48-cm (12-in) walkway width, or no gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.
- 1 *Moderate impairment* – Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, deviates 25.4–38.1 cm (10–15 in) outside the 30.48-cm (12-in) walkway width, or changes speed but loses balance but is able to recover and continue walking.
- 0 *Severe impairment* – Cannot change speeds, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width, or loses balance and has to reach for wall or be caught.

## 3. GAIT WITH HORIZONTAL HEAD TURNS

Instructions: *“Walk from here to the cone. Begin walking at your comfortable pace. Keep walking straight; after 3 steps, turn your head to the right and keep walking straight while looking to the right. After 3 more steps, turn your head to the left and keep walking straight while looking left. Continue alternating looking right and left every 3 steps until you have completed 2 repetitions in each direction. I will indicate when to turn the head ‘right’ and ‘left’. Turn your head maximally.”*

Grading: Mark the highest category that applies.

- 3 *Normal* – Performs head turns smoothly with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.
- 2 *Mild impairment* – Performs head turns smoothly with slight change in gait velocity (e.g., minor disruption to smooth gait path), deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width, or uses an assistive device.
- 1 *Moderate impairment* – Performs head turns with moderate change in gait velocity, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.

- 0      *Severe impairment* – Performs task with severe disruption of gait (e.g., staggers 38.1 cm [15 in] outside 30.48-cm [12-in] walkway width, loses balance, stops, or reaches for wall).

#### 4. GAIT WITH VERTICAL HEAD TURNS

Instructions: *“Walk from here to the cone. Begin walking at your comfortable pace. Keep walking straight; after 3 steps, tip your head up and keep walking straight while looking up. After 3 more steps, tip your head down, keep walking straight while looking down. Continue alternating looking up and down every 3 steps until you have completed 2 repetitions in each direction. I will indicate when to look ‘up’ and ‘down’. Tip your head maximally.”*

Grading: Mark the highest category that applies.

- 3      *Normal* – Performs head turns with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.
- 2      *Mild impairment* – Performs task with slight change in gait velocity (e.g., minor disruption to smooth gait path), deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width or uses an assistive device.
- 1      *Moderate impairment* – Performs task with moderate change in gait velocity, slows down, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.
- 0      *Severe impairment* – Performs task with severe disruption of gait (e.g., staggers, 38.1 cm [15 in] outside 30.48-cm [12-in] walkway width, loses balance, stops, reaches for wall).

#### 5. GAIT AND PIVOT TURN

Specific requirements: Stopwatch.

Instructions: *“Begin with walking at your comfortable pace. When I tell you, ‘turn and stop’, turn as quickly as you can to face the opposite direction and stop. Time of turning is measured.”*

Grading: Mark the highest category that applies.

- 3      *Normal* – Pivot turns safely within 3 seconds and stops quickly with no loss of balance. No use of an assistive device.
- 2      *Mild impairment* – Pivot turns safely in >3 seconds and stops with no loss of balance, or pivot turns safely within 3 seconds and stops with mild imbalance, requires small steps to catch balance.
- 1      *Moderate impairment* – Turns slowly (>3 seconds), requires verbal cueing, or requires several small steps to catch balance following turn and stop.
- 0      *Severe impairment* – Cannot turn safely, requires assistance to turn and stop.

## 6. STEP OVER OBSTACLE

Specific requirements: Two boxes (39.37 x 17.78 x 11.43 cm [5.5 x 7.0 x 4.5 in] each).

Instructions: *“Begin walking at your comfortable speed. When you come to the box, step over it, not around it, and keep walking.”*

Grading: Mark the highest category that applies.

- 3 *Normal* – Is able to step over 2 boxes together (22.86 cm [9 in] total height) without changing gait speed. No evidence of imbalance and no use of an assistive device.
- 2 *Mild impairment* – Is able to step over one box (11.43 cm [4.5 in] total height) without changing gait speed; no evidence of imbalance.
- 1 *Moderate impairment* – Is able to step over one box (11.43 cm [4.5 in] total height) but must slow down and adjust steps to clear box safely. May require verbal cueing.
- 0 *Severe impairment* – Cannot perform without assistance.

## 7. GAIT WITH NARROW BASE OF SUPPORT

Instructions: *“Walk on the floor with one<sup>1</sup> or two arms folded across the chest, feet aligned heel to toe in tandem.”* (for a distance of 3.6 m [12 ft]). *“The number of steps taken in a straight line are counted for a maximum of 10 steps.”*

Grading: Mark the highest category that applies.

- 3 *Normal* – Is able to ambulate for 10 steps heel to toe with no staggering.
- 2 *Mild impairment* – Ambulates 7–9 steps.
- 1 *Moderate impairment* – Ambulates 4–6 steps.
- 0 *Severe impairment* – Ambulates less than 4 steps heel to toe or cannot perform without assistance or uses an assistive device.

## 8. GAIT WITH EYES CLOSED

Specific requirements: Stopwatch and blindfold (optional).

Instructions: *“Walk at your comfortable speed from here to the cone with your eyes closed/with blindfold. I will tell you when to stop. Time is measured.”*

Grading: Mark the highest category that applies.

- 3 *Normal* – Walks 6 m (20 ft) in less than 7 seconds, no assistive devices, no evidence of imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.
- 2 *Mild impairment* – Walks 6 m (20 ft) in 7–9 seconds, uses an assistive device, mild gait deviations, deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width.

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<sup>1</sup> One arm folded is only applicable to subjects with unilateral impairments.

- 1     *Moderate impairment* – Walks 6 m (20 ft) in more than 9 seconds, abnormal gait pattern, evidence for imbalance, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width.
- 0     *Severe impairment* – Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.

## 9. AMBULATING BACKWARDS

Instructions: *“Walk backwards on a comfortable walking speed until I tell you to stop.”*

Grading: Mark the highest category that applies.

- 3     *Normal* – Walks 6 m (20 ft), no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.
- 2     *Mild impairment* – Walks 6 m (20 ft), uses an assistive device, slower speed, mild gait deviations, deviates 15.24–25.4 cm (6–10 in) outside 30.48-cm (12-in) walkway width.
- 1     *Moderate impairment* – Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, deviates 25.4–38.1 cm (10–15 in) outside 30.48-cm (12-in) walkway width.
- 0     *Severe impairment* – Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.

## 10. STEPS

Instructions: *“Walk up these stairs as you would at home. Use the rail if necessary. At the top turn around and walk down. Walk backwards down only if necessary<sup>II</sup>.”*

Grading: Mark the highest category that applies.

- 3     *Normal* – Alternating feet, no rail.
- 2     *Mild impairment* – Alternating feet, must use rail.
- 1     *Moderate impairment* – Two feet to a stair or is walking backwards.
- 0     *Severe impairment* – Cannot do safely.

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<sup>II</sup> Walking backwards down is only applicable to subjects with unilateral impairments.

### Administration form

NB. In this form we described the colours of the tape instead of the distances to make administering the FGA easier. Therefore, we used the colours of Fig. 1: yellow (15.24 cm; 6 in), red (25.4 cm; 10 in), and black (38.1 cm; 15 in). Score only a 3 when all the criteria are fully met. A lower score is obtained if one of the criteria is in a lower order. The administration form can be used as a decision tree. The assessor can mark the grade or mark aspects of the categories to come to the grade of an item. A blank space means that there is no criterion on the basis of that grade (the latter criterion also applies in that column for that row). 'N.a.' means that the deficit is not present or assistance is not needed (not applicable). Definitions follow after the administration form.

## Administration form Functional Gait Assessment (page 1/2)

<b>Item 1. Gait level surface (6 meter)</b>				
	<b>Gait speed</b>	<b>Imbalance</b>	<b>Gait deviations</b>	<b>Gait width</b>
<b>3</b> (normal)	<5.5 sec.	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	5.5–7 sec.	Assistive device	Mild	Until red line
<b>1</b> (moderate impairment)	>7 sec.	Evident	Evident	Until black line
<b>0</b> (severe impairment)		Severe	Severe	Crosses black line

<b>Item 2. Change in gait speed for every 1.5 meter</b>				
	<b>Adjustments in gait speed</b>	<b>Imbalance</b>	<b>Gait deviations</b>	<b>Gait width</b>
<b>3</b> (normal)	Significant	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	Moderate	Assistive device	Mild	Until red line
<b>1</b> (moderate impairment)	Minor	Evident	Evident	Until black line
<b>0</b> (severe impairment)	None	Severe	Severe	Crosses black line

<b>Item 3. Gait with horizontal head turns every 3 steps (2 alternating repetitions right and left)</b>			
	<b>Deviations in gait speed</b>	<b>Imbalance</b>	<b>Gait width</b>
<b>3</b> (normal)	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	Mild	Assistive device	Until red line
<b>1</b> (moderate impairment)	Evident	Evident	Until black line
<b>0</b> (severe impairment)	Stops during head turn	Severe	Crosses black line

<b>Item 4. Gait with vertical head turns every 3 steps (2 alternating repetitions up and down)</b>			
	<b>Deviations in gait speed</b>	<b>Imbalance</b>	<b>Gait width</b>
<b>3</b> (normal)	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	Mild	Assistive device	Until red line
<b>1</b> (moderate impairment)	Evident	Evident	Until black line
<b>0</b> (severe impairment)	Stops during head turn	Severe	Crosses black line

<b>Item 5. Gait and 180° pivot turn</b>		
	<b>Turning speed and imbalance during stopping</b>	<b>Assistance</b>
<b>3</b> (normal)	Pivot turns safely in ≤3 sec. and stops quickly with no loss of balance	n.a.
<b>2</b> (mild impairment)	Pivot turns safely in >3 sec. with no loss of balance	Pivot turns safely in ≤3 sec. turning but requires small steps to catch balance
<b>1</b> (moderate impairment)	Pivot turns in >3 sec. and requires several small steps to catch balance following turn and stop	Verbal cues
<b>0</b> (severe impairment)	Requires assistance to turn and stop	



## Administration form Functional Gait Assessment (page 2/2)

<b>Item 6. Step over obstacle</b>		
	<b>Number of boxes and gait and balance deviations</b>	<b>Assistance</b>
<b>3</b> (normal)	2 boxes without deviations	n.a.
<b>2</b> (mild impairment)	1 box without deviations	Assistive device
<b>1</b> (moderate impairment)	1 box but must slow down and/or adjust step to clear box safely	Verbal cues
<b>0</b> (severe impairment)	Cannot perform without assistance	

<b>Item 7. Gait with narrow base of support for 3.6 meter</b>	
	<b>Number of steps with feet aligned heel to toe in tandem</b>
<b>3</b> (normal)	10 steps
<b>2</b> (mild impairment)	7–9 steps
<b>1</b> (moderate impairment)	4–6 steps
<b>0</b> (severe impairment)	≤3 steps or cannot perform without assistive device or assistance

<b>Item 8. Gait with eyes closed (6 meter)</b>				
	<b>Gait speed</b>	<b>Imbalance</b>	<b>Gait deviations</b>	<b>Gait width</b>
<b>3</b> (normal)	<7 sec.	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	7–9 sec.	Assistive device	Mild	Until red line
<b>1</b> (moderate impairment)	>9 sec.	Evident	Evident	Until black line
<b>0</b> (severe impairment)		Severe	Severe	Crosses black line

<b>Item 9. Ambulating backwards (6 meter)</b>				
	<b>Gait speed</b>	<b>Imbalance</b>	<b>Gait deviations</b>	<b>Gait width</b>
<b>3</b> (normal)	Good	n.a.	n.a.	Until yellow line
<b>2</b> (mild impairment)	Slower	Assistive device	Mild	Until red line
<b>1</b> (moderate impairment)	Slow	Evident	Evident	Until black line
<b>0</b> (severe impairment)		Severe	Severe	Crosses black line

<b>Item 10. Steps</b>		
	<b>Mode of stair walking</b>	<b>Stair walking downstairs<sup>III</sup></b>
<b>3</b> (normal)	Alternating feet, no rail	Forwards
<b>2</b> (mild impairment)	Alternating feet, must use rail	
<b>1</b> (moderate impairment)	Two feet to a stair, must use rail	Backwards
<b>0</b> (severe impairment)	Cannot perform safely	

<sup>III</sup> Walking backwards down is only applicable to subjects with unilateral impairments.

## Definitions

The following definitions apply to a large number of items.

*Evident imbalance:* Subject loses balance but is able to recover (without assistance) and continues walking.

*Severe imbalance:* Subject loses balance and can only regain control by using assistance.

*Mild gait deviation:* The subject uses an orthotic device or small gait pattern deviations are observable which limit walking minimally (described according to Perry et al. [Slack Inc. 1992]). For example mid foot contact at initial contact, hyperextension of the knee during midstance, etc.

*Evident gait deviation:* Clear gait deviations whereby the subject is obviously hindered during walking (described according to Perry et al. [Slack Inc. 1992]). For example insufficient foot clearance, circumduction to obtain foot clearance, insufficient stability to stand well on the affected leg, clearly asymmetrical gait pattern, etc.

*Severe gait deviation:* Subject cannot perform the task due to severely limited gait (and/or imbalance).

*Moderate adjustment in gait speed (item 2):* There is a noticeable difference between the gait speeds 'comfortable' and the adjusted speeds 'slow' and 'fast' but this difference is smaller than normally expected.

*Minor adjustment in gait speed (item 2):* The difference between the gait speeds 'comfortable', 'fast' and 'slow' is minimal.

*Mild deviation in gait speed (items 3 and 4):* Performs head turns smoothly with slight change in gait velocity (e.g., minor disruption to smooth gait path).

*Evident deviation in gait speed (items 3 and 4):* Markedly reduced gait speed during head turn compared to the comfortable gait speed (gait speed item 1) without completely standing still.