

Development of innovative training solutions in the field of functional evaluation aimed at updating of the curricula of health sciences schools



MODULE BIOMECHANICS OF GAIT

Didactic Unit C: How do I assess gait?

C.2 What clinical scales exist to assess gait performance?



C.2 WHAT CLINICAL SCALES EXIST TO ASSESS GAIT PERFORMANCE?

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C.2 WHAT CLINICAL SCALES EXIST TO ASSESS GAIT PERFORMANCE?

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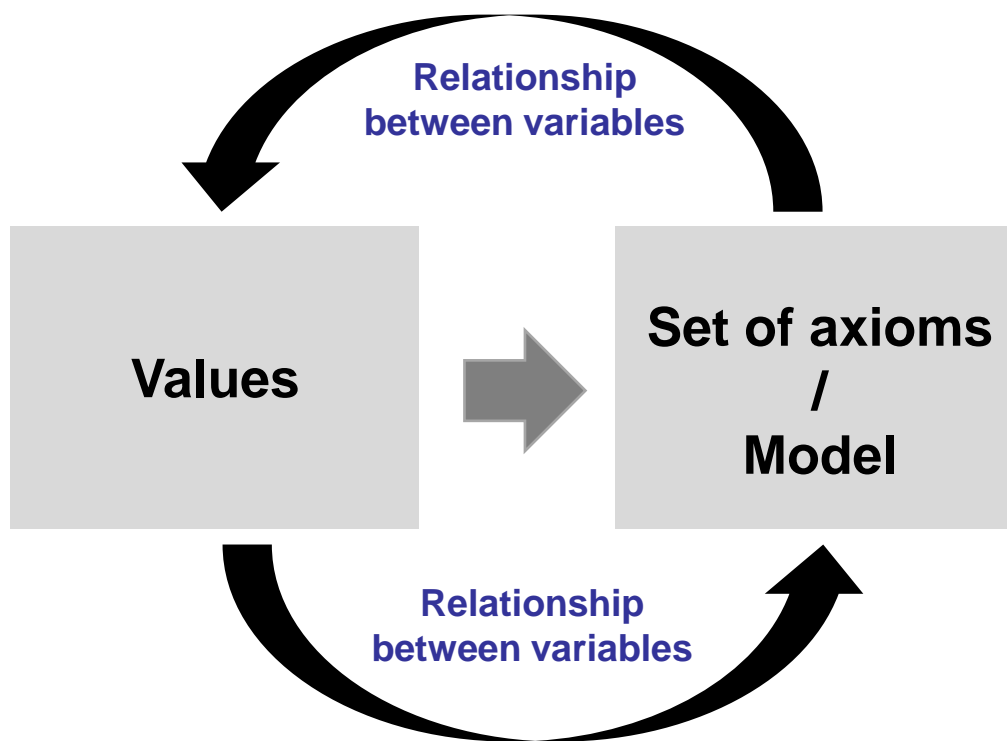
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C.2 What clinical scales exist to assess gait performance?

1. Definition of rating scale

1. DEFINITION OF RATING SCALE

A rating scale is understood as a set of categories described to obtain information about a quantitative or qualitative attribute.



1. DEFINITION OF RATING SCALE

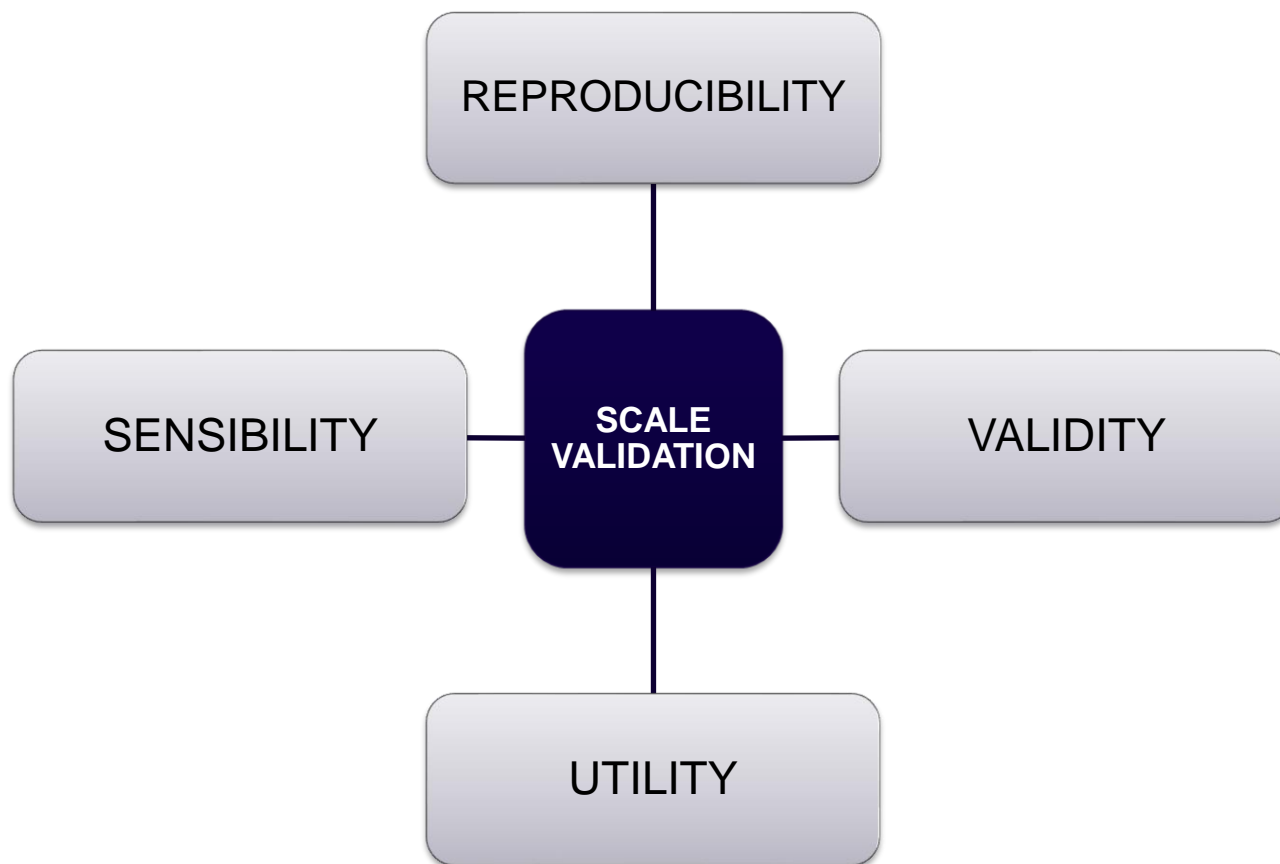
What has been achieved with the creation of rating scales:

- Important socio-cultural /scientific progress.
- To unite scientific criteria.
- Internationalization of scientific criteria.
- Technical and economic accessibility for researchers

C.2 What clinical scales exist to assess gait performance?

2. Characteristics for validation

2. CHARACTERISTICS FOR VALIDATION



2. CHARACTERISTICS FOR VALIDATION

CRITERION	PROPERTY	STADISTICS	SATISFACTORY RESULT
REPRODUCIBILITY	Reliability	Cronbach's alpha	$\geq 0,7$
	Internal consistency	Pearson, Spearman or Kuder-Richardson correlation	$\geq 0,4$ (if ≥ 0.9 would indicate measurements are equal)
	Discriminating power	Pearson or Spearman correlation	Less than the correlation of the items with their dimension (<0.3)
	Intra-rater reliability or test-retest	Pearson correlation, Spearman or intraclass	$\geq 0,80$ or $0,85$
	Reliability inter-rater	Pearson correlation, Spearman or intraclass	$\geq 0,80$ or $0,85$

Table 1. Rating scale reproducibility properties and stadistical requeriments.

2. CHARACTERISTICS FOR VALIDATION

CRITERION	PROPERTY	STADISTICS	SATISFACTORY RESULT
VALIDITY	Face	None. Applicability and Acceptability	Does not apply
	Content	Exploratory factor analysis	Coefficients λ or factor loads ≥ 0.3
	Criterion	Pearson or Spearman correlation	$\geq 0,80$
	Convergent	Pearson or Spearman correlation	Between 0.4 and 0.70
	Construct	Confirmatory factor analysis.	Coefficients $\lambda \geq 0.3$, statistics of goodness of adjustment ≥ 0.05 .

Table 2. Rating scale validity properties and stadistical requeriments

2. CHARACTERISTICS FOR VALIDATION

CRITERION	DEFINITION	STADISTICS	SATISFACTORY RESULT
SENSIBILITY	Ability of an instrument to detect changes over time	Hypothesis testing	$V_p < 0,05$
UTILITY	The scale is easy to apply, complex and low cost	None	Does not apply

Table 3. Rating scale sensibility stadistical requeriments

C.2 What clinical scales exist to assess gait performance?

3. Tinetti Mobility Test (TMT)

3. TINETTI MOBILITY TEST (TMT)

- Scale to analyze gait disturbance and balance.
- Evaluates the risk of fall.
- Scale used in:
 - Healthy adult population.
 - Geriatric population.
 - Neurological disordered population.
 - Stroke.
 - Huntington's disease (HD).
 - Parkinson's disease (PD).
- Score evaluation:
 - Score between 19-24 points represents moderate risk of falls.
 - Score <19 points represents high risk of falls.

3. TINETTI MOBILITY TEST (TMT)

3.1. Statistical analysis

Reliability in PD population

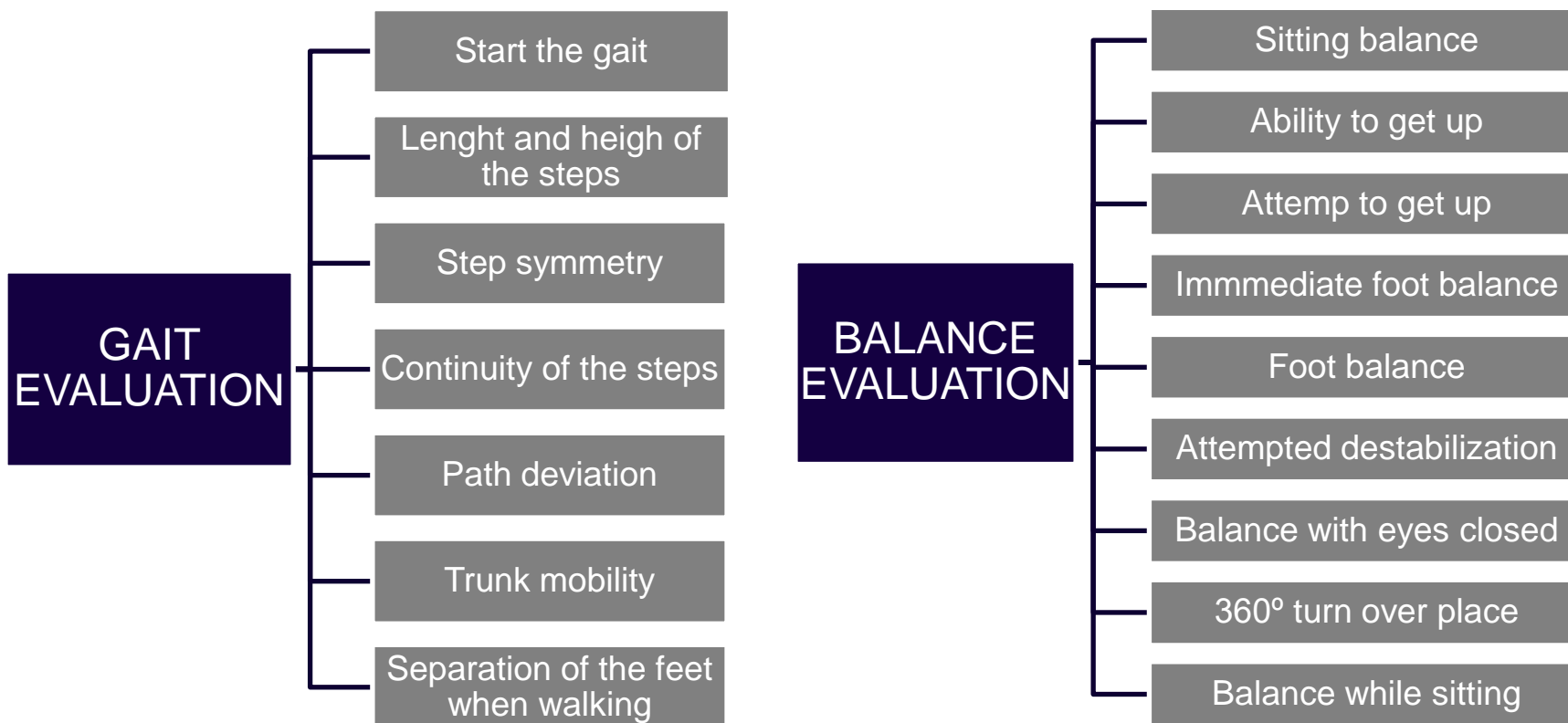
- Intra-rater = 0.96
- Inter-rater = 0.88

Validity in PD population

- Comfortable walking speed correlation = 0.53
- Sensitivity of identifying the risk of fall = 76%

3. TINETTI MOBILITY TEST (TMT)

3.2. Scale items



3. TINETTI MOBILITY TEST (TMT)

3.3. Procedure

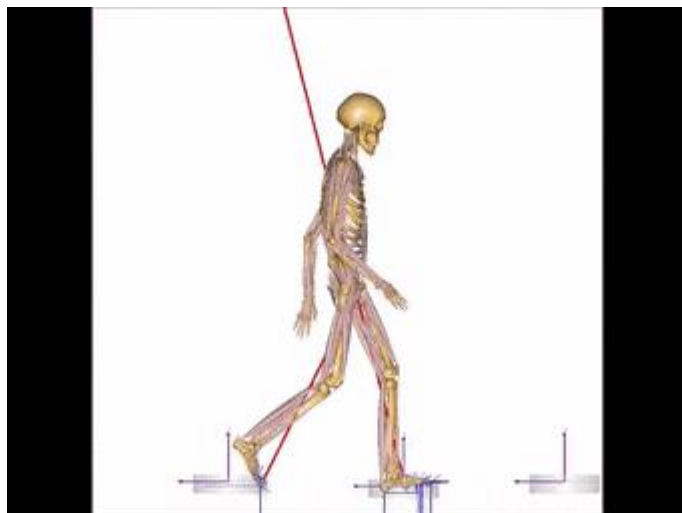


Figure 1. Gait cycle scheme example.

1. The subject starts the test sit.
2. The subject stands up and follows the balance indications of the evaluator.
3. The subject walks along a plain corridor at its usual pace.
4. She/ He will return along the same path and repeat until the evaluator stops the evaluation.
5. The evaluator observe and evaluate.

C.2 What clinical scales exist to assess gait performance?

4. Time Up and Go Test (TUG)

4. TIME UP AND GO TEST (TUG)

- Scale to analyze the performance of lower limb function, mobility.
- Evaluates the risk of fall.
- Scale used in:
 - Healthy elderly population.
 - Neurological disordered population.
 - Stroke.
 - Parkinson's disease (PD)
- Time Evaluation:
 - Performance of >13,5 seconds suggest moderate risk of fall.

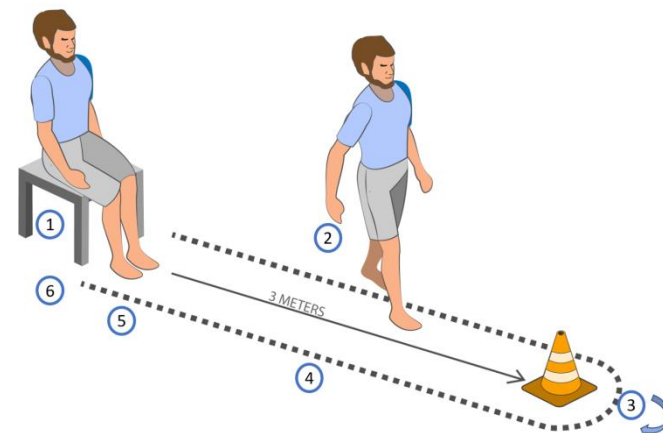


Figure 2. Basic scheme of TUG test.

4. TIME UP AND GO TEST (TUG)

4.1 Statistical analysis

Reliability in PD population

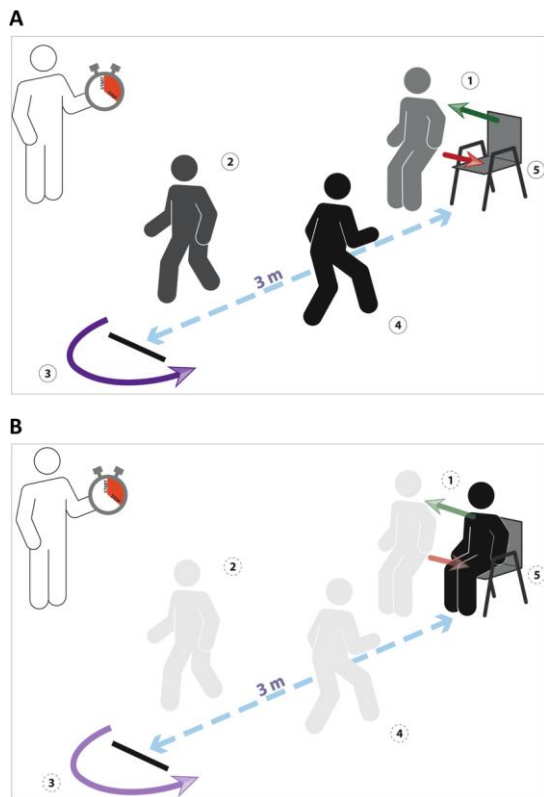
- Test-retest = 0.90
- Intra-rater = 0.97
- Inter-rater = 0.96

Validity in PD population

- Six-Minutes Walking Test correlation = 0.53
- Sensitivity of identifying the risk of fall = 87%

4. TIME UP AND GO TEST (TUG)

4.2 Procedure



1. The subject starts the test sit.
2. Evaluator says “start”. The subject stands up, with no hand use, and she/he start walking along 3 meters.
3. At the end-point, she/he Will return to the start-point.
4. The patient complete the test sitting at the start chair.

Figure 3. TUG test procedure.

C.2 What clinical scales exist to assess gait performance?

5. Six-Minutes Walking Test (6MWT)

5. SIX-MINUTES WALKING TEST (6MWT)

- Scale to analyze the gait disturbances.
- Scale used in:
 - Healthy adult population.
 - Cardio-pulmonar problems population.
- Distance and exertion evaluation.



Figure 4. 6MWT evaluation in a 30 m corridor.

5. SIX-MINUTES WALKING TEST (6MWT)

5.1. Statistical analysis

Reliability in Healthy population

- Test-retest = 0.95
- Intra-rater = 0.98
- Inter-rater = 0.98

Validity in Healthy population

- Performance / clinical measures of chair lift correlation = 0.67
- Foot balance correlation = 0.52
- Running speed correlation = 0.73

5. SIX-MINUTES WALKING TEST (6MWT)

5.2. Procedure

20-Grade Scale	
6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Figure 3. Borg scale for exertion.

1. The subject rests in a chair for 10 minutes.
2. The subject stands up.
3. The evaluator shows the Borg scale. The subject scores its subjective exertion.
4. To walk over 30 meter Surface is asked to the subject during 6 minutes.
5. When time is over, the evaluator shows again the Borg scale. The subject scores its subjective exertion.

C.2 What clinical scales exist to assess gait performance?

6. Wisconsin Gait Scale (WGS)

6. WISCONSIN GAIT SCALE (WGS)

- Scale to analyze the performance of lower limb function, mobility in affected motor gait skills.
- Scale used in:
 - Adult population.
 - Neurological disordered population.
 - Stroke.
 - With hemiplegic gait.
- Score evaluation:
 - High scores represents severe gait deficits.

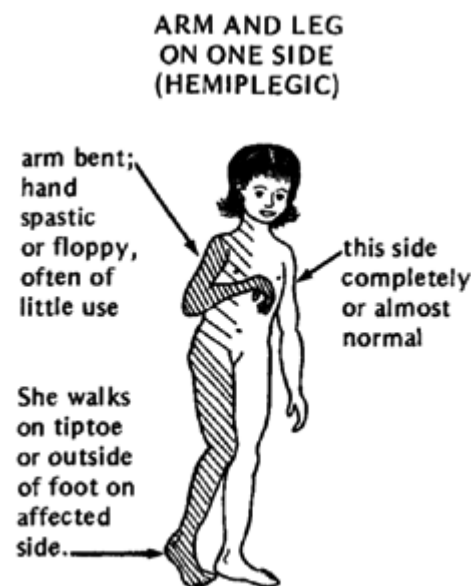


Figure 5. Hemiplegic characteristics scheme.

6. WISCONSIN GAIT SCALE (WGS)

6.1. Statistical analysis

Reliability in stroke population

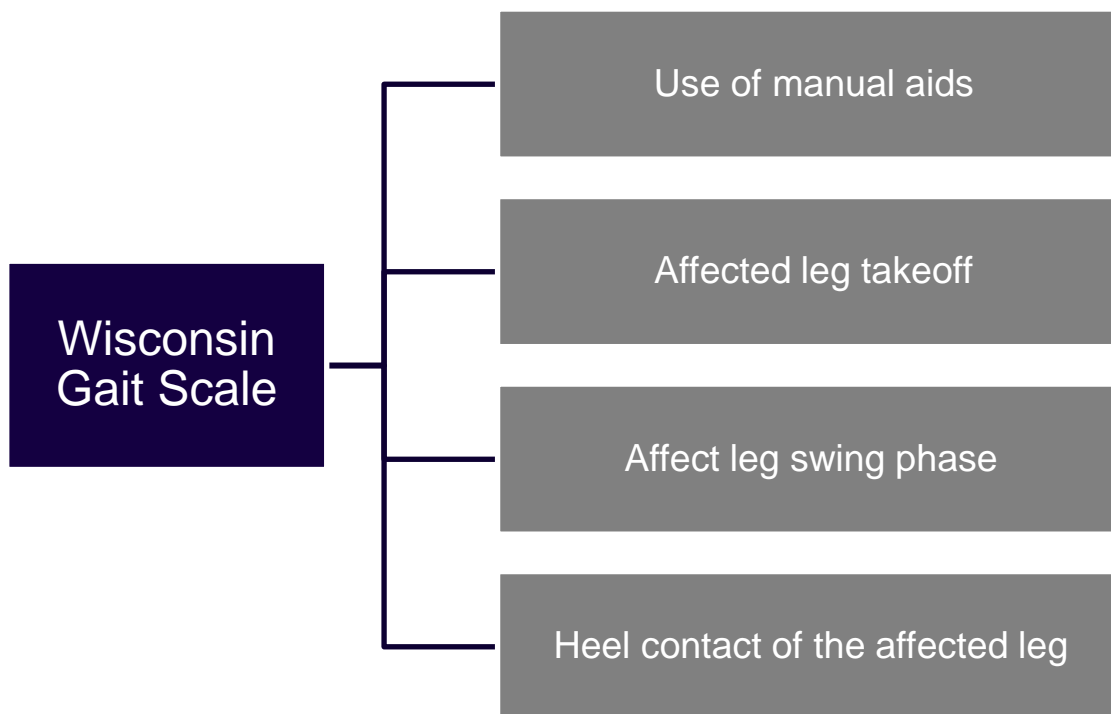
- Intra-rater = 0.961
- Inter-rater = 0.945

Validity in stroke population

	Acute	Subacute	Chronic
○ FAC = -0.773	▪ FAC = -0.878	• FAC = -0.905	
○ BSS = -0.676	▪ BSS = -0.882	• BSS = -0.817	
○ PASS = -0.657	▪ PASS = -0.847	• PASS = -0.892	
○ BI = -0.657	▪ BI = -0.842	• BI = -0.867	
○ FIM = -0.592	▪ FIM = -0.693	• FIM = -0.801	

6. WISCONSIN GAIT SCALE (WGS)

6.2. Scale items



6. WISCONSIN GAIT SCALE (WGS)

6.3. Procedure

1. Cones determine start and end points.
2. Videotape recording.
3. The subject walks along 10 meters plain corridor at its usual pace.
4. Two walk repetitions will be performed with the usual subject footwear.
5. Two walk repetitions will be performed with the subject barefooted.
6. Videotape post evaluation.

C.2 What clinical scales exist to assess gait performance?

7. Dynamic Parkinson Gait Scale (DYPAGS)

7. DYNAMIC PARKINSON GAIT SCALE (DYPAGS)

- Scale to analyze the performance of the gait in challenging tests.
- Scale used in:
 - Adult population.
 - Parkinson disease population (PD).
- Score evaluation:
 - High scores represent severe gait disorders related to PD.

7. DYNAMIC PARKINSON GAIT SCALE (DYPAGS)

7.1. Statistical analysis

Reliability in PD population

- Inter-rater = 0.94
- Internal consistency = 0.95

Validity in PD population

- FOG-Q correlation = 0.74
- PDQ-39 gait correlation = 0.58
- MDS-UPDRS gait correlation = 0.81
- TMT gait correlation = -0.71

7. DYNAMIC PARKINSON GAIT SCALE (DYPAGS)

7.2. Scale items

Walking 7m forwards.

Stepping over an imaginary obstacle with right leg.

Walking 3m backwards

Stepping over an imaginary obstacle with left leg.

Turning 360° to the right

Passing through tight quarters

Turning 360° to the left

Walking + cognitive dual task

7. DYNAMIC PARKINSON GAIT SCALE (DYPAGS)

7.3. Procedure

1. The subject starts the tasks at the evaluator signal.
2. Movements as fluid and smooth as the subject can.
 - 360° turn task may be in the minimum number of steps.
 - Obstacle tasks may be with the greatest stride possible.
 - Double task may name as many animals as the subject can.

C.2 What clinical scales exist to assess gait performance?

8. Gait Assessment and Intervention Tool (GAIT)

8. GAIT ASSESSMENT AND INTERVENTION TOOL (GAIT)

- Scale to analyze the coordination of movements and associated deficits during the gait phase.

- Scale used in:
 - Adult population.
 - Neurological disorder population
 - Stroke.

- Score evaluation:
 - High scores represent severe gait deficits related to stroke.

8. GAIT ASSESSMENT AND INTERVENTION TOOL (GAIT)

8.1. Statistical analysis

Reliability in stroke population

- Test-retest = 0.996
- Intra-rater = 0.98
- Inter-rater = 0.83

Validity in stroke population

- Correlation between knee flexion in the initial oscillation and motion capture information of the knee flexion in the initial oscillation = 0.65
- Correlation between mid knee oscillation and the motion capture information of the average knee oscillation = 0.75

8. GAIT ASSESSMENT AND INTERVENTION TOOL (GAIT)

8.2. Scale items

Stance and swing



Upper limbs

Trunk

Stance phase



Trunk

Pelvis

Hips

Knees

Ankles

Swing phase



Trunk

Pelvis

Hips

Knees

Ankles

8. GAIT ASSESSMENT AND INTERVENTION TOOL (GAIT)

8.3. Procedure

1. Videotape recording.
2. The subject is required to walk along 3 meter surface.
3. 6 steps are needed to the evaluation.
 - Start and end step not allowed.
4. Bilateral evaluation.
5. Videotape post evaluation.

C.2 What clinical scales exist to assess gait performance?

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