Objective Measurement of Ambulation in Hemiplegia: Implications for Therapeutic Intervention and Outcome Assessment

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CURRENT ASSESSMENT TOOLS

1. **Observational Gait Analysis**
   Rancho Los Amigos

2. **Visual Assessment of Hemiplegic Gait**:
   - Section A General characteristics of gait – head posture, trunk posture, upper limb position, asymmetrical movement, step length, step characteristics (temporal)
   - Section B Swing phase (affected side) – hip/pelvis, knee, ankle/foot
   - Section C Stance phase (affected side) – early stance: hip/pelvis, knee, ankle/foot
   - late stance: hip/pelvis, knee, ankle/foot

3. **Functional Ambulation Category**
   Six levels defined as:
   - Level 0 patient cannot walk at all or requires the help of two or more people
   - Level 1 patient needs continuous support from one person who helps to carry the patient’s weight and helps with balance
   - Level 2 patient is dependent on the continuous or intermittent support of one person to help with balance or coordination
   - Level 3 Patient needs only verbal supervision
   - Level 4 help is required on stairs and uneven surfaces
   - Level 5 patient can walk independently anywhere
   Levels do not take into account any aid used. Test is performed with a cane, but without orthoses for walking distance of 15 m.

4. **Classification of disturbed locomotion control**
   - Type I hyperactive stretch reflexes (spasticity) – early activation of calf muscle in stance phase retards forward movement of tibia at the ankle and knee hyperextension
   - Type II lack of adequate muscle activation (paresis) – knee hyperextension for stability seen throughout most of the stance phase or at the end of stance phase
   - Type III excessive coactivation of antagonist muscles (loss of sequential activations)
   - Type IV complex disorder (combination of the three types above)

5. **Tinetti Gait Tests** #10 – 16 of “Balance and Mobility Assessment”
   Initial Instructions: Subject stands with the examiner, walks down hallway or across room, first at usual pace, then back at rapid but safe pace (with usual walking aids)
   - 10. Initiation of Gait (immediately after told to go)
   - 11. Step length and height
   - 12. Step symmetry
   - 13. Step continuity
   - 14. Path
   - 15. Trunk
   - 16. Walking stance
6. **Dynamic Gait Index**  
   Equipment needed: 2 cones or pylons, shoe box or object of similar size, stairs  
   Grading: For each of the following tests mark the lowest category which applies:  
   3 Normal  
   2 Mild impairment  
   1 Moderate impairment  
   0 Severe impairment  
   - Gait level surface  
   - Change in gait speed  
   - Gait with horizontal head turns  
   - Gait with vertical head turns  
   - Gait and pivot turn  
   - Step over obstacles  
   - Step around obstacles  
   - Steps  

7. **Rivermead Motor Assessment Score**

8. **Walking velocity**  
   Suggested by Richards and Malouin as an outcome measure in hemiparetic locomotor disorders

**MEASUREMENT OF THE TEMPORAL GAIT PARAMETERS**  
Measurements can be undertaken with a multimemory stopwatch.  
1. **Measurement of walking speed**  
   - Time subject walking 6 m  
   - Start stopwatch as subject enters the central region of the walkway  
   - Stop stopwatch as subject exits the central region of walkway  
   - Divide time by 6 to determine walking speed  

2. **Measurement of stride time**  
   - Start stopwatch at the first right heel contact in the central 6 meters of the walkway  
   - Click the lap button at each subsequent right heel contact within the central 6 meters of the walkway  
   - Stop the stopwatch at the last right heel contact within the central 6 meters of the walkway  
   - Recall the average lap time (Stride Time)  
   - Stride length is obtained by multiplying walking speed by stride time

3. **Measurement of step time**  
   - Start the stopwatch on the first right heel contact in the central 6 meters of the walkway  
   - Click the lap button on each subsequent heel contact (both left and right) within the central 6 meter walkway  
   - Stop the stopwatch on the last heel contact within the central 6 meters of the walkway  
   - Recall each lap time  
   - The odd numbered laps will be left step times and the even ones right step times

**References**  
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7. Richards CL, Malouin F. Evaluation and therapy of disturbed motor control in spastic paresis; Therapeutic considerations for locomotor disorders. Neurology Report 1997; 21(3); 85-90
8. Turnbull GI, Wall JC. The development of a system for the assessment of gait following stroke. Physiotherapy. 1985; 71: 294