Function Focused Gait Assessment

Director:
Everett Hills, MD, MS, FAAPMR
Jon Lahr, DPT
Nicole Osevala, MD, FACP
Get to know your local PTs!

INDICATIONS FOR PHYSICAL THERAPY REFERRAL

- Strengthening
- ROM
- Pain of mechanical origin
- Balance re-training: sitting/standing
- Functional mobility
- Vestibular Therapy
- Gait training
- Sports injury prevention/recovery
- DME needs - ambulatory device vs. orthotic

DURABLE MEDICAL EQUIPMENT (DME)

- Life Expectancy
  - 5 years
    - Unless lost, stolen, or accidentally damaged beyond repair (includes natural disasters)
    - Sooner if change in patient's condition
      - Will pay for repairs if worn out before end of its lifetime
- Eligibility
  - Medically Necessary
  - Needed for home use

CANES

- **Single Point Cane** (SPC): Mild balance deficit
- **Quad Cane**: Narrow or Small Base (NBQC/SBQC), Wide or Large Base (WBQC/LBQC)
  1. Neuropathic gait – s/p CVA or BI
  2. Generally decreased balance
    - Improved stability, but sacrificed mobility/maneuverability vs. SPC
    - Challenging to navigate stairs
- **All Terrain Cane**: “Hurry Cane”
  1. Provides increased stability compared to single point cane
  2. Provides more maneuverability compared to quad cane

- Fit: the handle should reach the crease of wrist when standing with hand relaxed at their side
- Proper hand to use: opposite of involved leg

WALKING POLES

- Uneven terrain
WALKERS
- **Hemi-Walker**: unilateral device, hemiplegia, early gait trainer
- **Standard Walker**: no wheels, step-to gait pattern (often for orthopedic injuries)
- **Rolling Walker (RW or FWW)**: 2 front wheels, reciprocal gait pattern, ~ 5-7 lbs.
- **Rolling Walker with Platform Attachment**: useful if NWB of wrist/hand
- **Rollator Walker**: 4 wheels, seat, brakes, typically 11-21 lbs.
- **Upright Walker**: rollator walker with platforms, can help with posture, heavier, can be tippy
- **Reverse or Posterior Walker**: CP/diplegic gait, rear locking brakes
- **Knee Scooter**: if NWB in ankle/foot, extended time standing/walking

CRUTCHES
- **Axillary Crutch**: adjustment - start with tips ~6 inches forward and lateral, top of crutch is 2-3 finger widths between crutch and axilla, handle at height of wrist
- **Knee Crutch**: can be hands free, requires very good stability/mobility
- **Forearm (Lofstrand) Crutch**: Less likely to drop

ORTHOTICS
- **Molded Ankle Foot Orthosis (MAFO)**:
  - Eligibility:
    - Expected need is > 6 months
    - Need to control the knee, ankle, or foot in > 1 plane
    - Could not be fitted with prefabricated orthotic
  - Pros: Custom, modifiable after fabrication, multi-plane control, more stability
  - Cons: Little energy return, doesn’t allow for fluctuating edema, less mobility, heavier than carbon fiber AFO
- **Carbon Fiber (AFO)**:
  - Eligibility:
    - Ambulatory
    - Diagnosis of weakness/deformity of foot & ankle – need for stabilization
    - Potential to benefit functionally
    - Condition is permanent or longstanding duration
  - Pros: Stronger, lighter, minimalist design, increased kinetic energy
  - Cons: Less custom, generally less medial/lateral support, generally not modifiable after fabrication
- **Bilateral Metal Uprights**:
  - Pros: Allows for fluctuating edema, stronger to help with high tone/spasticity
  - Cons: Heavy, bulky, isolated to one pair of shoes
- **Functional Electrical Stimulation**:
  - Bioness L300 (Go) or Walk Aide
### Pathologic Gait Descriptions

Nicole Osevala MD (nosevala@pennstatehealth.psu.edu) ACP
IM Conference 2024

<table>
<thead>
<tr>
<th>Gait</th>
<th>Standing</th>
<th>Ambulating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hemiplegic</strong></td>
<td><strong>“Circumduction”</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Affected arm flexed, adducted, internally rotated.</td>
<td>- Affected arm loss of normal arm swing</td>
</tr>
<tr>
<td></td>
<td>- Affected leg extended, plantarflexed</td>
<td>- Weight shifted to the contralateral side.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Unable to flex hip and knee.</td>
</tr>
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<td></td>
<td>- Affected leg circumducts and hip hikes to clear ankle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>dorsiflexion weakness.</td>
</tr>
<tr>
<td><strong>Diplegic</strong></td>
<td><strong>“Scissoring”</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Tight hip adductors bilaterally resulting in genu valgum of knees.</td>
<td>- Forward posture of the upper body with arms in the flexed position.</td>
</tr>
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<td></td>
<td>- Hips and knees are in the flexed position</td>
<td>- The lower limbs swing outward and create a scissoring</td>
</tr>
<tr>
<td></td>
<td>- Ankles are internally rotated</td>
<td>pattern with legs crossing midline.</td>
</tr>
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<td></td>
<td></td>
<td>- Both legs will be dragged, toes will be scrapped</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Patients will toe walk.</td>
</tr>
<tr>
<td><strong>Neuropathic</strong></td>
<td><strong>“Steppage Gait”</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- No issues seen</td>
<td>- No dorsiflexion of the ankle.</td>
</tr>
<tr>
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<td></td>
<td>- To clear the toes there will be exaggerated knee and/or hip flexion.</td>
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Pathologic Gait Descriptions
Neyha Cherin, DO (ncherin@pennstatehealth.psu.edu)
ACP IM Conference 2022

<table>
<thead>
<tr>
<th>Myopathic</th>
<th>- Toes hit first, then heels = double-tap phenomenon.</th>
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<tbody>
<tr>
<td>“Trendelenburg” Or “Waddling Gait”</td>
<td>- No deficit.</td>
</tr>
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<td>Unilateral Issue:</td>
<td>- Trendelenburg sign → Contralateral pelvis drop and upper body weight is shifted to the weight-bearing limb.</td>
</tr>
<tr>
<td>Bilateral Issue:</td>
<td>- Waddling sign → Circumduction of BLE. Truncal lean to the weight-bearing side to allow circumduction of the opposite limb.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Choreiform Gait “Hyperkinetic Gait”</th>
<th>- Irregular, jerky, involuntary movements in all extremities.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>- Twisting movements of the trunk, head, arms, and legs.</td>
</tr>
<tr>
<td></td>
<td>- Unpredictable accelerations and decelerations in walking speed.</td>
</tr>
<tr>
<td></td>
<td>- Walking can worsen the baseline movements.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ataxic Gait “Cerebellar Gait”</th>
<th>- Titubation = body swaggers back and forth.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>- Clumsy gait, veer laterally.</td>
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<tr>
<td></td>
<td>- Lack of coordination, slow walking speed.</td>
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<tr>
<td></td>
<td>- Difficulty with stops and turns.</td>
</tr>
<tr>
<td></td>
<td>- Cannot walk in straight line.</td>
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## Pathologic Gait Descriptions

Neyha Cherin, DO (ncherin@pennstatehealth.psu.edu)
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<table>
<thead>
<tr>
<th>Gait</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Parkinsonian Gait</strong></td>
<td>- Poor balance, wide base of support.</td>
</tr>
<tr>
<td><strong>“Hypokinetic Gait”</strong></td>
<td>- Inconsistent arm swing.</td>
</tr>
<tr>
<td></td>
<td>- Slow, small shuffling steps.</td>
</tr>
<tr>
<td></td>
<td>- Rigidity and bradykinesia.</td>
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<tr>
<td></td>
<td>- Decreased arm swing.</td>
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<tr>
<td></td>
<td>- Difficulty initiating steps.</td>
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<tr>
<td></td>
<td>- Increased number of steps to turn.</td>
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<tr>
<td></td>
<td>- Balance abnormality.</td>
</tr>
<tr>
<td><strong>Sensory Gait</strong></td>
<td>- Patient looking toward the ground to see where their feet are in space.</td>
</tr>
<tr>
<td><strong>“Stomping Gait”</strong></td>
<td>- The affected foot slams onto the ground to provide sensory feedback.</td>
</tr>
<tr>
<td></td>
<td>- High leg lift, with excessive knee flexion.</td>
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<tr>
<td></td>
<td>- Symptoms exacerbated when patients cannot see their feet (i.e. darkness).</td>
</tr>
</tbody>
</table>
This handout is a compilation of objective measures that can be employed in any clinical setting and by any trained observer. The point is not to use all of them for each patient encounter, but to incorporate those specific objective measures that can be followed in a serial fashion if warranted. When more detailed objective measures are needed, consider referring the patient to a physical or occupational therapist who is equipped to perform additional objective measures, including those that take longer time to perform than is available in a typical clinic visit.

**Inspection/Observation:**

Gait Pattern? ☐ Normal ☐ Ataxic ☐ Antalgic ☐ Other ______________

Assistive Device? ☐ None ☐ Rolling walker ☐ Standard walker ☐ Quad Cane ☐ Single Point Cane ☐ Crutches ☐ Other ______________

Orthotics? (circle) Left Right ☐ Ankle-Foot ☐ Knee-Ankle-Foot ☐ Shoe Insert ☐ Other ______________

Leg Length Discrepancy?
Leg length measured from anterior iliac spine to medial malleolus in supine position:
( Normal < 2 cm side-to-side difference)  

**Examination**

**Active Range of Motion**

<table>
<thead>
<tr>
<th></th>
<th>Flexion</th>
<th>Extension</th>
<th>Abduction</th>
<th>Adduction</th>
<th>Right</th>
<th>Flexion</th>
<th>Extension</th>
<th>Abduction</th>
<th>Adduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Knee</td>
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<tr>
<td>Ankle</td>
<td></td>
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</tbody>
</table>

**Isolated Strength**

<table>
<thead>
<tr>
<th></th>
<th>Left</th>
<th>Right</th>
<th>Instructions to patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps</td>
<td>/5</td>
<td>/5</td>
<td>“Stand on one leg and then the other”</td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>/5</td>
<td>/5</td>
<td>“Stand on one leg and swing other leg out from body”</td>
</tr>
<tr>
<td>Tibialis Anterior</td>
<td>/5</td>
<td>/5</td>
<td>“Rock back on your heels”</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>/5</td>
<td>/5</td>
<td>“Stand on your toes”</td>
</tr>
</tbody>
</table>

**Sensation (Present / Absent)**

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<thead>
<tr>
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<th>Left</th>
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<tbody>
<tr>
<td>Light Touch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Toe Proprioception</td>
<td></td>
<td></td>
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<tr>
<td>Vibration Perception</td>
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</tbody>
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**Deep Tendon Reflexes**

<table>
<thead>
<tr>
<th></th>
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</tr>
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<tbody>
<tr>
<td>Patellar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achilles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Functional**

<table>
<thead>
<tr>
<th>Standing Time (seconds)</th>
<th>Feet together touching =</th>
<th>One Foot advanced -</th>
<th>Feet Tandem -</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal &gt; 10 seconds</td>
<td>sec</td>
<td>sec</td>
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**Timed Up and Go**

Mark a line 3m (10ft) from patient’s chair. Patient sits in chair. “When I say go, stand up and walk to line, turn around and return to your seat. Walk at your usual pace. You may use your (assistive device).”

Time measured from moment patient stands to sitting down: sec
### Age 60-69 70-75 76-80 81-85 86-99

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<thead>
<tr>
<th>Age</th>
<th>Men</th>
<th>Women</th>
</tr>
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<tr>
<td>60-69</td>
<td>7.3</td>
<td>8.1</td>
</tr>
<tr>
<td>70-75</td>
<td>8.6</td>
<td>9.8</td>
</tr>
<tr>
<td>76-80</td>
<td>9.4</td>
<td>10.7</td>
</tr>
<tr>
<td>81-85</td>
<td>10.3</td>
<td>12.4</td>
</tr>
<tr>
<td>86-99</td>
<td>11.1</td>
<td>13.2</td>
</tr>
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</table>

### Five Times Sit to Stand
Patient sits in armless chair. “When I say go, stand up and sit down 5 times in a row as quickly as you can. Be sure to stand up fully and try not to let your back touch the chair back between each repetition. Do not use or push your legs against the back of the chair.” Time measured from moment patient begins to stand to last sitting down:

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### 4-Meter Walking Speed Test
Mark a total distance of 6 meters, place markers at end, make internal markers 1 meter in. Patient stands at the 0-meter mark. There are two trials performed measuring time to walk both directions.

**Normal Pace:** “When I say go, walk at normal pace past the far mark.” Patient turns around and stops at the 6-meter mark. “When I say go, walk at normal pace back to the starting mark.”

Time is measured from moment patient crosses the 1-meter and stops when crossing the 5-meter marks: \( T_1 \) sec

Time is measured in same format coming back: \( T_2 \) sec

Take the average of both times. \( \frac{T_1 + T_2}{2} = T_{avg} \) sec

Divide 4 by the average time to get walking speed in m/sec: \( \frac{4 \text{ m}}{T_{avg}} = \text{Walking Speed} \) m/sec

**Fast Pace:** “When I say go, walk at your fastest pace past the far mark.” Patient turns around and stops at the 6-meter mark. “When I say go, walk at your fastest pace back to the starting mark.”

Time is measured from moment patient crosses the 1-meter and stops when crossing the 5-meter marks: \( T_1 \) sec

Time is measured in same format coming back: \( T_2 \) sec

Take the average of both times. \( \frac{T_1 + T_2}{2} = T_{avg} \) sec

Divide 4 by the average time to get walking speed in m/sec: \( \frac{4 \text{ m}}{T_{avg}} = \text{Walking Speed} \) m/sec

Walking speed is compared over time with each new measurement compared to the previous one. Multiply by 2.24 to convert to mph for patient’s understanding: Walking Speed (m/s) x 2.24 = Walking Speed (miles per hour)

Clinically significant decline in walking speed over time \( > 0.10 \text{ m/sec} \)
Negligible decline in walking speed over time \( < 0.05 \text{ m/sec} \)

### References:
2. Makizato, H et al, Predictive Cutoff Values of the Five-Times Sit-to-Stand Test and the Timed “Up-and Go” Test for Disability Incidence in Older People Dwelling in the Community, Physical Therapy, vol. 97, No. 4, 2017
3. Martinez, BP et al, Accuracy of the Timed Up and Go Test for predicting sarcopenia in elderly hospitalized patients, Clinics (Sao Paulo, Brazil), vol. 70, No. 5, 2015

Comments/Questions/Suggestions:
Everett Hills MD – Function Focused PMR Care+, LLC
ehills343@gmail.com
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  - 5 years
  - Unless lost, stolen, or accidentally damaged beyond repair (includes natural disasters)
  - Or, change in patient’s condition
  - Will pay for repairs if worn out before end of its lifetime

- **Eligibility**
  - Medically Necessary
  - Needed for home use

CANES

- **Quad Cane**: Narrow Base or Small Base vs. Wide Base or Large Base (NBQC or SBQC vs. WBQC or LBQC)
  - Neuropathic Gait – s/p CVA or BI
  - Improved stability – sacrificed mobility/maneuverability vs. SPC
  - Challenging to navigate stairs
- **All Terrain Cane**: “Hurry Cane”
  - Provides increased stability compared to single point cane
  - Provides more maneuverability compared to quad cane
- **Single Point Cane (SPC)**: Mild balance deficit, not much of any weight bearing
- **Fit**: to crease of wrist when standing with hand relaxed at their side
- **Which hand?**: Opposite of involved leg

WALKERS

- **Standard Walker**: no wheels, step to gait pattern
- **Rolling Walker with Platform Attachment**: useful if NWB of wrist/hand or hemiplegia
- **Rolling Walker (RW or FWW)**: 2 front wheels, reciprocal gait pattern, ~ 5-7 lbs.
- **Rollator Walker**: 4 wheels, seat, brakes, typically 11-21 lbs.
- **Hemi-Walker**: unilateral device, hemiplegia, early gait trainer

ORTHOTICS

- **Molded Ankle Foot Orthosis (MAFO)**:
  - **Eligibility**:
    - Expected need is > 6 months
    - Need to control the knee, ankle, or foot in > 1 plane
    - Could not be fitted with pre-fabricated orthotic
  - **Pros**: Custom, modifiable after fabrication, multi-plane control, more stability
  - **Cons**: Little energy return, doesn’t allow for fluctuating edema, less mobility
- **Carbon Fiber (AFO)**:
  - **Eligibility**:
    - Ambulatory
Diagnosis of weakness/deformity of foot & ankle – need for stabilization
- Potential to benefit functionally
- Condition is permanent or longstanding duration
  - Pros: Stronger, lighter, minimalist design, increased kinetic energy
  - Cons: Less custom, generally less medial/lateral support, generally not modifiable after fabrication

**Functional Electrical Stimulation:**
- Helps to lift the foot during swing phase if there is drop foot
- Not covered by Medicare
- Common Peroneal Nerve needs to be intact
- Bioness L300 (Go) or Walk Aide
## Pathologic Gait Descriptions

Jonathan Lahr, DO (jlahr@pennstatehealth.psu.edu)
ACP IM Conference 2024

<table>
<thead>
<tr>
<th>Gait</th>
<th>Causes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Not all-inclusive</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Standing</strong></td>
<td><strong>Ambulating</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Hemiplegic</strong>&lt;br&gt;“Circumduction”&lt;br&gt;Lesion in CNS ie. (Stroke)</td>
<td>- Affected arm loss of normal arm swing</td>
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<td><strong>Diplegic</strong>&lt;br&gt;“Scissoring”&lt;br&gt;Bilateral corticospinal tract dysfunction ie. (CP, spinal cord injury)</td>
<td>- Forward posture of the upper body with arms in the flexed position.</td>
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<td>- Patients will toe walk.</td>
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<td></td>
<td><strong>Neuropathic</strong>&lt;br&gt;“Steppage Gait”&lt;br&gt;Any damage to pathway of the peroneal nerve ie. s/p TKA, L5 radic, central problem (CMT, DM, ALS.)</td>
<td>- No dorsiflexion of the ankle.</td>
</tr>
<tr>
<td></td>
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## Myopathic Gait

- **“Trendelenburg”**
  - Weak pelvic girdle muscles.
  - Or
  - “Waddling Gait”
  - Ie. (Pregnancy, congenital hip dysplasia, muscular dystrophies, spinal muscular atrophy, myopathies)

### Unilateral Issue:
- Trendelenburg sign → Contralateral pelvis drop and upper body weight is shifted to the weight-bearing limb.

### Bilateral Issue:
- Waddling sign → Circumduction of BLE. Truncal lean to the weight-bearing side to allow circumduction of the opposite limb.

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### Bilateral Issue:
- Waddling sign → Circumduction of BLE. Truncal lean to the weight-bearing side to allow circumduction of the opposite limb.

## Choreiform Gait

- **“Hyperkinetic Gait”**
  - Basal ganglia disorders.
  - Ie. (Sydenham’s chorea, Huntington’s disease, Athetosis)

### Unilateral Issue:
- Irregular, jerky, involuntary movements in all extremities.

### Bilateral Issue:
- Unpredictable accelerations and decelerations in walking speed.
- Walking can worsen the baseline movements.

## Ataxic Gait

- **“Cerebellar Gait”**
  - Cerebellar disease.
  - Ie. Alcohol intoxication, multiple system atrophy.

### Unilateral Issue:
- Titubation = body swaggers back and forth.

### Bilateral Issue:
- Clumsy gait, veer laterally.
- Lack of coordination, slow walking speed.
- Difficulty with stops and turns.
- Cannot walk in straight line.
- Poor balance, wide base of support.
- Inconsistent arm swing.
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<td>Neyha Cherin, DO (<a href="mailto:ncherin@pennstatehealth.psu.edu">ncherin@pennstatehealth.psu.edu</a>)</td>
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<td>ACP IM Conference 2023</td>
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</table>

**Parkinsonian Gait**

**“Hypokinetic Gait”**

- Basal ganglia dysfunction
  - I.e. (Parkinson’s disease, drug effects)
  - **Parkinson’s signs:**
    - Masked faces, tremors.
  - Slow, small shuffling steps.
  - Rigidity and bradykinesia.
  - Decreased arm swing.
  - Difficulty initiating steps.
  - Increased number of steps to turn.
  - Balance abnormality

**Sensory Gait**

**“Stomping Gait”**

- Dysfunction of dorsal columns.
  - I.e (infectious, autoimmune, metabolic, toxic, hereditary, vascular)
  - Decreased proprioception
  - Patient looking toward the ground to see where their feet are in space.
  - The affected foot slams onto the ground to provide sensory feedback.
  - High leg lift, with excessive knee flexion.
  - Symptoms exacerbated when patients cannot see their feet (i.e. darkness).
Function-Focused Gait Assessment

Nicole Osevala, MD, FACP, Harry Albertman Chair in Geriatric Medicine, Associate Professor, Department of Medicine; Chief, Division of Geriatric Medicine, Penn State University College of Medicine and Milton S. Hershey Medical Center

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Understand basic gait concepts
Create framework for observing key features of gait abnormalities on clinic presentation
Optimize physical therapy services referrals and mobility assessment needs

Hands-on Practicum:
Practice function-focused gait assessments
Practice using mobility aids and orthotics

What is Function-Focused Gait Assessment All About?

Universal activity generally taken for granted until altered or impaired
Walking falters for many reasons
Falls and predicting life expectancy

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"Gait Speed and Survival in Older Adults" Studenski et al, JAMA 2011
Walking speed: the “6th vital sign”

- **> 1.0 m/sec (2.2 mph)**
  - Cross streets safely

- **< 0.8 m/sec (1.8 mph)**
  - Household ambulatory
  - Need assistive device
  - High risk for hospitalization

- **< 0.2 m/sec (0.4 mph)**
  - Discharge to SNF
  - Extremely frail

**Important Gait Concepts**

- Center of Gravity (Mass)
- Step vs Stride
- Gait Cycle
- Primary Muscle Involvement
- Joint Range of Motion

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Rasmussen et al: JAMA Network Open, Oct. 11, 2019
Center of Gravity

Step versus Stride
“Unequal Step and Stride”

Gait Cycle
Gait Cycle: Primary Muscles in Stance Phase

Gait Cycle: Primary Muscles in Swing Phase
Trendelenberg Gait

“Compass” Gait
Foot drop

Circumduction Gait
“Swing Gait”

Wide-based Gait
Spastic Diplegic Gait
End of Part 1

Function-Focused Gait Assessment

Clinical Gait Assessment

ACP
Parameters for the clinical gait evaluation

- Sitting unaided
- Standing up from a sitting position (unaided and with/wiithout use of upper limbs)
- Posture (trunk, neck and head; upright, bent or asymmetric)
- Base of support
- Gait initiation (stepping)
- Walking (smooth, stiff, insecure, asymmetrical, limping)
- Step length, foot contact, contact with ground, wide/narrow base
- Squat
- Arm swing
- Freezing
- Turning
- Postural reflexes (heel or push test)
- Sitting down (“motor response test”)
- Complex tests of stance and gait
- Tablets stance
- Tandem gait
- Puska’s test (standing with eyes closed and narrow base)
- Blind gait
- Walking backwards
- Walking test
- Walking slowly (in a deliberate manner)
- Running
- Turning quickly
- Turning on the spot
- Undercarriage’s test (walking on the spot with eyes closed)
- Standing and walking on heels
- Standing and walking on toes
- Hopping on one foot
- Dual task maneuver (walking while blinking or carrying object)
- Functional reach
Requirements to perform a focus-functioned gait assessment

**Range of Motion**

- **Hip Flexion**: 120 - 125°
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- **Abduction**: 35 - 45°
- **IR/ER**: 45°

- **Knee Flexion**: 135 - 145°
- **Extension**: 0 - 5°

- **Ankle Plantarflexion**: 45 - 55°
- **Dorsiflexion**: 15 - 25°
Balance

Tests of Balance
Five Times Sit to Stand Test

Assessment
Time to perform
Instructions
Measurement
Normative values

Lower limb strength
~30 seconds
“Sit in a chair with arms across chest, stand up, then return to sitting position. Repeat 5 times.

Time to complete

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Whitney, Physical Therapy, 2005
Timed Up and Go Test

Assessment: Fall risk and predictor of sarcopenia

Time to perform: ~12 seconds

Instructions: Sit in a chair. Mark a line 3 meters from patient. Instruct patient to stand up, walk to line at normal pace, turn around and return to seat.

Measurement: Time to complete

Normative values:

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Pondel & del Ser, Journal of Geriatric Physical Therapy, 2001
### 4 Meter Walking Speed Test

**Assessment**
Indicator of functional limitations

**Time to perform**
~60 seconds

(Mark 4 meters distance with additional 1 meter before and “Walk at normal pace from 1st to 2nd mark. Walk at fastest pace past both marks.”

**Measurement**
Time to walk 4 meters, both directions @ normal and fast pace

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Gill TM J Am Geriatric Soc. 2010;Oct;58:S308-S321
Questions?

The motor-linkage drive unit:

Thanks!

LinkedIn: linkedin.com/in/everett-c-hills-md-ms/

Facebook: facebook.com/everett.hills.1

Twitter: @hills_everett
Promoting a Functional Gait

Jonathan Lahr, PT, DPT
jlahr@pennstatehealth.psu.edu
Penn State Health therapy services, Hershey, PA
April 19-20, 2024

Disclosure of Financial Relationships

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**Objectives**

- Learn **when to refer** a patient to your local PT for gait evaluation
- Learn how to choose an **ambulatory device** or **orthotic** for a pathologic gait pattern in order to promote an improved functional gait
- Learn importance of getting to know your **local PT**

---

**Falls in adults 65 and over**

- 800,000+ patients/year hospitalized for fall injury
- 3 million ED visits/year
- $50 billion in medical costs of which 75% paid by Medicare/Medicaid in 2015

[Image: thestar.com]
Questions to Ask

- Have you fallen this past year?
- Do you use furniture, walls, or other people to help you walk?

Indications for Physical Therapy Referral

- Strengthening
- ROM
- Pain (musculoskeletal)
- Balance training
- Functional mobility
- Vestibular therapy
- Neuromuscular re-education
- Gait training/fall prevention
- DME needs – ambulatory device vs. orthotic
Durable Medical Equipment (DME)

Medicare Guidelines

DME Life Expectancy

• 5 years
• Unless lost, stolen, or accidentally damaged beyond repair (includes natural disasters)
• Or, change in patient’s condition
Hemiplegic Gait

- One sided deficit due to paresis
- Impaired natural swing at the hip and knee with leg circumduction

Hemiplegic Gait Devices

Platform Rolling Walker  Hemi-walker
Hemiplegic Gait Devices cont...

Quad Cane  |  HurryCane  |  Single Point Cane

Molded Ankle Foot Orthosis (MAFO)

Eligibility:
- Expected need is to be > 6 months
- Need for control > 1 plane of movement at the knee, ankle, or foot
- Could not be fitted with pre-fabricated orthotic
MAFO continued

Pros:
• Customized
• Modifiable after fabrication
• Controls multiple planes of movement
• More stability

Cons:
• Little energy return
• Doesn’t allow for fluctuating edema
• Less mobility

Hemiplegic Orthotic

Video: https://www.youtube.com/watch?v=rSieEx_x3F0
Neuropathic Gait

- Foot drop/Steppage Gait
- Weakness of muscles in the distal limb, typically dorsiflexors due to nerve damage
- AFO, MAFO, Functional Electrical Stimulation

Ankle Foot Orthosis (AFO)

Eligibility:
- Ambulatory
- Diagnosis of weakness/deformity of foot & ankle – need for stabilization
- Potential to benefit functionally
- Condition is permanent or longstanding duration
AFO continued

Carbon Fiber

Pros:
- Stronger
- Lighter
- Minimalist design
- Increased kinetic energy

Cons:
- Less customized
- Less medial/lateral stability
- Minimal to no modification after fabrication

Functional Electrical Stimulation (FES)

- Orthotic used in the treatment of foot drop
- Stimulates the common peroneal nerve
- Muscle contraction produced that lifts the foot during the swing phase of gait
- Indicated for LMN or UMN injury/disease?
Functional Electrical Stimulation

Stimulation Off  Stimulation On

Ataxic Gait

- Wide base of support
- Truncal sway
- Inaccuracy of limb movements – sometimes scissoring

Standard Cane
Ataxic Gait Devices cont...

Weighted Walkers

Full set (12lbs) $280
Half set (6lbs) $150

Myopathic Gait

• Waddling gait or Trendelenburg gait
• Due to hip weakness

- Lurch toward affected side
- Contralateral hemi-pelvis drop
Myopathic Gait Devices

Rolling walker

- 5-7 lbs.
- Typical max capacity: 300 lbs.
- Typical wheel size: 5” diameter

Rollator

- 11-21 lbs.
- Typical wheel size: 6-8” diameter

Offset Cane

- Allows for mild weight bearing

In Summary: Things to Consider When Ordering DME

- Lifting restrictions?
- Live alone?
- Stairs?
- Cognitive impairment?
- Be specific with your prescription:
  - Rollator walker with 4 wheels and a seat
  - Bariatric
  - Pediatric
  - Narrow based vs. wide based quad canes

When in doubt, consult your local PT:

“PT Eval for ambulatory device or PT eval and treat gait/balance/fall prevention”
Physical Therapy Referral

• According to Jennifer Joyce, M.D., “primary care physicians will refer more patients to physical therapists when they have more knowledge about physical therapy, recognize physical therapists’ capabilities to diagnose, and believe in the ... effectiveness of physical therapy intervention.” - *Am Fam Physician*. 2005 Oct 1; 72(7): 1183-1184.

Video: [https://www.youtube.com/watch?v=iV2YHn2JZC8](https://www.youtube.com/watch?v=iV2YHn2JZC8)
Thank You!
The Why, When, and What of Gait Assessment

Nicole Osevala MD, FACP
Chief, Geriatric Medicine
Associate Professor of Medicine Penn State College of Medicine
Medical Director Post-Acute Care Service

Disclosure of Financial Relationships

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Framing your perspective on gait assessment

• Like most diseases, risk of gait impairment increases with age and is associated with increased morbidity and mortality

• Slowed walking speed (along with weakness, low physical activity, low energy and weight loss) is one of the 5 phenotypic components manifest in frailty syndrome (physiologic state of heightened vulnerability for older adults)

• Identification of gait impairment creates an opportunity for further gait and functional assessment, education, and management of contributing conditions

Why perform a gait assessment?

• Gait and balance disorders increase with age from 10% at age 60-69 to more than 60% in those >80 years old

• Community-dwelling older adults with gait disorders, especially neurologically abnormal gait disorders, are at highest risk for institutionalization and death

• Gait impairment negatively impacts quality of life, threatens preservation of functional independence, and is associated with falls

• Complications from falls are the leading cause of death from injury in adults >65 years old
When to inquire about and assess gait?

- The “Welcome to Medicare” visit
- Annual visit
- After a surgery (elective or urgent)
- After hospitalization
- During and following an acute illness

What questions can indicate current or impending gait disturbances?

- Do you limit leaving your home due to difficulty walking?
- Do you hold onto furniture or walls when moving around your home?
- Do you use an assistive device?
- If you use an assistive device, was it prescribed by a physical therapist?
- Are you fearful of falling or have you fallen?
- Is it difficult to rise from a chair or walk across a room?

- A “yes” to any of these questions should prompt a formal gait assessment
Function-Focused Gait Assessment

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Osevala and Hills, Geriatric Review Syllabus, 11th Ed. 2022
Erin E Butler et al. Peer review at the Ministry of Silly Walks, Gait & Posture (2020)
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Gait disorders in adults and the elderly, 2017
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Merck Manual; NCBI
www.physio-pedia.com/Gait
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Measurement
Time to walk 4 meters, both directions @ normal and fast pace

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@hills_everett