If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the PowerPoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
Physical Therapy Examination for an Ankle Foot Orthosis

3/23/2018

Jennifaye V. Brown, PT, PhD, NCS

Liability/Disclosure Statement

The information presented in this course has been developed by, and power point content and any additional handouts are sole property of Jennifaye V. Brown, PT, PhD, NCS. Every attempt has been made to present accurate information by the speaker. No one may reproduce all or any part of the power point, any additional handouts and anything said or demonstrated in the course by video, audiotape, or digital recording without the expressed written consent of the Jennifaye V. Brown, PT, PhD, NCS. The speaker may choose to make exceptions at her discretion. Observing, listening, and participating in the course in its entirety or any portion thereof is not a substitute for verifying the information and demonstrating clinical proficiency before applying it to patient care. Jennifaye V. Brown, PT, PhD, NCS hereby disclaims any and all responsibility or liability that may be asserted or claimed arising from, or claimed to have arisen from, and reliance upon the use of information by observing, listening, and participating in this course by any person.
Objectives

Describe

Identify at least three of the components comprising a patient-focused examination for an AFO based on evidence presented.

Accurately interpret

Accurately interpret at least two findings of objective measures used to assess impairments qualifying the need for an AFO.

Identify

Identify at least three of the results of the subjective examination portion and at least three outcome measures to recommend an AFO based on a case study.

Outline

1. Review of Learner Outcomes & Course Background
2. AFO: Assessment Matters!
3. Patient-Centered Care & the Social Determinants of Health
4. AFO Examination Components
5. Critical Appraisal of Subjective Information & Outcome Measurements
6. Knowledge Summary
7. Q & A
How many of you have had a continuing education course in AFO fabrication? Yes or No

Poll Question 1

In which setting have or do you currently work?

a. Acute hospital
b. Inpatient rehab
c. Outpatient rehab
d. Subacute rehab
e. Home health

Poll Question 2
How did I arrive at the prototype to have an AFO look like these?
After 28 years……

- Observation
- Assessment/Evaluation
- Questioning/Hypothesizing
- Discernment
- Clinical Intuition & Experience
- Patient/Caregiver Discussion
- Orthotist Collaboration

Patient-Centered Care &
Social Determinants of Health
Physical Therapy....

- “has yet to adopt and integrate the construct [PCC] in research”\(^1\)\(^{(p.120)}\) & clarify its definition in practice

- Outcome studies have measures that assess patient perspectives, but are we really asking, gathering & applying client perspectives in clinical practice?

- I say NO: all custom AFOs tend to look the same & require that a client buys a shoe half size larger & wider for brace accommodation

---

To Improve PCC\(^1\)

<table>
<thead>
<tr>
<th>Research</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Consensus: PCC definition</td>
<td>- Communication</td>
</tr>
<tr>
<td>- Operationalize PCC</td>
<td>- Shared Decision-making</td>
</tr>
<tr>
<td>- Establish methodology: evidence for practice</td>
<td>- Client Education</td>
</tr>
<tr>
<td></td>
<td>- Client Empowerment</td>
</tr>
</tbody>
</table>
Social Determinants of Health

- Neighborhood & Built Environment
- Health & Health Care
- Economic Stability
- Education
- Social & Community Context

SDOH Model applied to these pictures in terms of AFO fabrication²
ICF = International Classification of Functioning, Disability and Health

A biopsychosocial model = medical + social models

Definitions

Body Functions: physiological and psychological functions of the body systems
Body Structures: anatomical parts organs, limbs and their components
Impairment: problems in body fxn or structures - damage
Activity: is the execution of a task or action by an individual
Participation: is involvement in life situation
Activity Limitation: difficulties executing activities
Participation Limitation: problems or difficulties being involved in life situations
Environmental Factors: physical, social and attitudinal environment in which people live and engage in life
Personal Factors: background/features of the individual and how they live
What comprises the physical therapy examination for ankle foot orthosis (AFO) prescription post-stroke?

**CLINICAL QUESTION**

- Entry level DPT 1st trained clinician to address all aspects of gait & gait-related impairments

- US education programs & literature fail to have best practice statement for preorthotic AFO assessment

- Preorthotic AFO assessment: Pt-oriented – SDOH, goals, activity/participation levels of ICF & contextual factors (environment & personal factors) of ICF

- Teaching the “art” & “science” of preorthotic AFO assessment – lack of evidence-based practice
**Case Study Defn:**
- provides exploratory, descriptive or explanatory purpose of an event or situation.⁴

**Descriptive:**
- considers details of a
  the PT exam for AFO prescription post-stroke

**Case Content: AFO Evaluation⁵**

**Functional Transfers - STS**

**Gait Assessment**
1. Posture
2. Alignment
3. Symmetry
4. Speed
5. Control during all phases of:
   a. Weight acceptance
   b. Single limb support
   c. Swing limb advancement
Alignment

Structural Deformities

- Bony deformity
- Soft tissue shortening
- Muscle contracture

Flexible Deformities

- Muscle imbalance due to weakness
- Muscle stiffness
- Dominant neuromuscular activity (spasticity)
- Abnormal tone
- Improper muscle length-tension relationship after kinetic moment at joint during movement

Case Study Analysis

STRENGTHS

1. Addresses lower quarter gait impairments in detail
2. Provides LE biomechanics
   - Variety of static positions
   - Orthopedic tests, procedures & outcomes

WEAKNESSES

1. No neuromuscular tests, procedures & outcomes
2. Neglects distal malalignment/neuromuscular impairments relationship trunk dyscontrol/proximal malalignment
3. No resources related to neuromuscular assessment & treatment
Clinical Conclusion

- Literature Answers Question, But Skewed
  1. Orthopedic focus
  2. Trunk dyscontrol/pelvis and proximal malalignment may be cause of distal foot & ankle problems requiring AFO
  3. Interventions for trunk dyscontrol/pelvis & proximal malalignment optimize effectiveness, function & acceptance of AFO

- What Dr. Brown thinks is missing…..
  1. Assessment of neuromuscular components as primary factors
  2. Consider other contributing systems
  3. Consider comorbidities, SDOH & PCC approach

According to the ICF model, an individual’s background or features & how the individual lives is a definition of _____________.

a. activity levels
b. participation
c. environmental factors
d. personal factors

Poll Question 3
AFO Examination Components


---

Key Components for AFO Examination

1. Postural Observation: Compare to Normal foot in WB & NWB
2. Assess Foot Appearance & Subsequent Compensations; Musculoskeletal Abnormalities
3. ROM: Open Chain & Close Chain
4. Strength & Voluntary Control
5. Spasticity & Tone
6. Sensation: Proprioception, Kinesthesia, Monofilament Testing
7. Balance
8. Edema
9. Pain
Key Components for AFO Examination

10. Vision
11. Functional Mobility Assessment: STS & Falls
12. Gait: Speed & Quality
13. Personal Effects
14. Level of Function: Prior & Current
15. Goals

---

You have to Look, Listen & Feel.....

I. Postural Observation
The Normal Foot

1. Lateral border WB except area under cuboid
2. WB on medial calcaneus, longitudinal arch, first MTH
3. Second toe is ⊥ to ankle joint
4. Anterior & ⊥ to tibia is a crease convex on the dorsum of midfoot

The Normal Foot ➞ Resting Position

- At rest, it is natural for the foot to point down & out to the side (because of hip lateral rotation)

- The resting position of the ankle is 10° plantarflexion midway between inversion and eversion
Primary Functions of the Foot 6-7

<table>
<thead>
<tr>
<th>STJ=Subtalar Jt</th>
<th>MTJ= Midtarsal Jt</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Mobile Adapter: LR → MSt</td>
<td>II. Rigid Base for Propulsion During Gait: TSt → PSw</td>
</tr>
<tr>
<td>A. Adapt to ground surface</td>
<td>For propulsion, STJ is supinated &amp; MTJ becomes rigid</td>
</tr>
<tr>
<td>B. Facilitate shock absorption</td>
<td></td>
</tr>
</tbody>
</table>

STJ pronated - allows foot mobility, which ↑s MTJ motion, allowing adaptation to different surfaces, therefore mobile adaptor

HOW?

1. Bone Congruency
2. Capsular Tension
3. Muscle Mechanics

---

**Picture=IC; LR → MS**

Left: Mobile Adapter
Right: Rigid Base for Propulsion: 60 degrees of MTH hyperextension needed at PreSwing, these 3 things must happen:
1. 60 degrees of toe hyperextension
2. passive knee flexion to 40 degrees at preswing
3. a supinated foot need for rigid propulsion

---

**TS → PSw**
II. Foot Appearance

Pronator

Supinator
Foot Appearance & Subsequent Compensations


### II. Musculoskeletal Abnormalities

**Hallux Valgus & Claw Toes**

**Hammer Toes**
What Looks Abnormal?

II. Neuromuscular Abnormalities

Pathological Reflexes – LE[^1]

1. Toe Grasping (A)
2. Inversion (B)
3. Eversion (C)
4. Dorsiflexion (D)
III. Range of Motion

- AFO will be used in WB, therefore measure Ankle ROM in WB
  1. Loading Response
  2. Terminal Stance

SUPINE Ankle ROM

R1 = 1st resistance to passive movement
R2 = final position of foot - no more range to be gained
0-3 degree change or less consider contracture
III. Range of Motion

hind- or forefoot
- Immobility or compensatory varus or valgus

The client’s hindfoot is in neutral, but 1\textsuperscript{st} ray cannot touch the surface. You describe this as a ________.

- a. forefoot valgus
- b. rearfoot valgus
- c. forefoot varus
- d. rearfoot varus

Poll Question 4
IV. Strength/Voluntary Control

**Extensor Synergy Patterns**

**Force Control: Generate Movement in Different Postures**

- **Hislop & Montgomery**
  - With CNS lesion, innervations to mm not impaired but control of mm impaired
  - “MMT was (and is) designed to evaluate patients with a lower motor neuron disorder manifested by flaccid weakness or paralysis”
  - Authors suggest Upright Motor Control Test for individuals with Selective Control or Pattern Motion

- **Selective Control:** move a single jt without activating mov’t in adjacent or neighboring jt of same extremity

- **Pattern Motion:** inability to perform fractionated mov’t e.g. wrist extension w/o mov’t at elbow & fingers or knee extension w/o pftx & inversion – stereotypical synergy patterns
Force Control: Generate Movement in Different Postures

**Upright Motor Control Test**:\n- Incorporate effects of upright posture & WB
- Simulates walking activity
- Inter-tester reliability 96% for flexion portion of test & 90% for extension portion of test
- Latest version in Hislop & Montgomery\(^3\) Chapter 8
Assessment of Force Control

Dynamometry

Figure 1. Measurement of plantar and dorsal flexion strength by hand-held dynamometer Lafayette Manual Muscle Test System

https://www.researchgate.net/figure/284190078_fig1_Figure-1-Measurement-of-plantar-and-dorsal-flexion-strength-by-hand-held-dynamometer
V. Spasticity & Tone

Spasticity Definition

1. Velocity-dependent increase in resistance of a mm or mm grp to passive stretch
2. Changes in mm bc of UMN lesion and/or prolong positioning known as myoplasticity

Non-Instrumented Measurement Scales
1. Tardieu Scale
2. Ashworth Scale
3. Multi-Item Scales
   a. Tone Assessment Scale
   b. Tone & Visual Analogue Scale
   c. Ankle PF Tone Scale

Instrumented Measurement Scales
1. Tonic stretch reflex threshold via electrogoniometry & EMG
2. Surface EMG w/ mm stretch (wrist) ~ Maximum Voluntary Contraction
3. Pendulum Test
4. Force/Torque Measurements
   1. NeuroFlexor™
   2. Force transducer & electrogoniometer
   3. Force transducer with manual mm stretch
Spasticity after CVA

Evaluation Focus: 15
1. Identify clinical pattern of motor dysfxn & source
2. Identify clients’ ability to control mm in clinical pattern
3. Differentiate mm stiffness versus contracture

Scales: 16
- MAS: Modified Ashworth Scale
- Modified Tardieu Scale
- King’s Hypertonicity Scale
- Tone Assessment Scale
- Daily Fxnl Assessment Scales
  1. Barthel Index
  2. Patient’s Disability Scale
  3. Carer Burden Rating Scale
- Electrophysiology Measures
  1. EMG: H-reflex, F wave, Tendon Reflex & polysynaptic responses

Spasticity Assessment:
- Assess available ROM*
- Choose a position so that muscle is relaxed (not impacted by high tone)
- Place muscle in optimal length (mid-range), then give a quick stretch to the muscle
- Mark “yes” if there is a clasp-knife phenomenon
- Determine if it is interfering with function. If so, what is best way to manage it based on its origin.

Umphred p. 767, Carr & Shepherd, 287
Tone Definition & Concepts:

**Definition:** “…the resistance or ‘stiffness’ in a limb to passive movement” 18

Various definitions:

- **Flaccidity:** complete loss of mm tone13 (p.110)
- **Hypotonia:** reduction in stiffness or mm to lengthening – spinocerebellar lesions13 (p.113)
- **Hypertonia:** increase in mm tone compared to normal; manifested as spasticity or rigidity; based on the clinical presentation & origin13
- **Rigidity:** extrapyramidal tract pathology (basal ganglia & midbrain nuclei); ↑d tone in opposing mm groups on both sides of the limb and it is not velocity dependent13

**Continuum:**

- Flaccidity ↔ hypotonia ↔ normal ↔ spasticity ↔ rigidity 13 (p.110)

Tone Assessment

- Varies in clinical practice: concept of tone vs spasticity
- Modified Ashworth Scale19 Supine, but alter position to get mm/pt to relax; assess available ROM; passively move joint so that mm moves from a shorten to lengthen position

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No increase in mm tone</td>
</tr>
<tr>
<td>1</td>
<td>Slight ↑ in mm tone, manifested by a catch &amp; release or minimal resistance @ the end ROM when affected part moved in flexion or extension/abduction or adduction, etc.20(p.24)</td>
</tr>
<tr>
<td>1+</td>
<td>Slight ↑ in mm tone manifested by a catch f/b minimal resistance through the remainder (less than half) of the ROM</td>
</tr>
<tr>
<td>2</td>
<td>More marked ↑ mm tone through most of the ROM, but affected part(s) easily moved</td>
</tr>
<tr>
<td>3</td>
<td>Considerable ↑ in mm tone, passive movement difficult</td>
</tr>
<tr>
<td>4</td>
<td>Affected part(s) rigid in flex or ext (abd or add, etc.)20(p.24)</td>
</tr>
</tbody>
</table>
V. Tone, Spasticity vs Voluntary Control

Rigidity is a sign extrapyramidal tract pathology including damage to the basal ganglia & midbrain nuclei.

a. True
b. False

Poll Question 5
VI. Sensation

**Proprioception**
- Grasp toe by sides - pull away from other toes
- Demonstrate "up" & "down"

**Kinesthesia**
- Move the hemi extremity & pt has to duplicate the movement with opposite extremity

**Limb Ataxia vs Discoordination Problem**
- [https://www.youtube.com/watch?v=fWG6CUD6PuW](https://www.youtube.com/watch?v=fWG6CUD6PuW)
- Ataxia general term which means incoordination of mov’t & often applied to gait
- Discoordination: proprioceptive deficits NOT weakness
Diabetic???

Monofilament Testing

VII. Balance Assessment

Romberg
BERG
Ankle, Hip & Stepping Strategies
Rehabmeasures.org
VIII. Edema

0+ No pitting edema
1+ Mild pitting edema. 2mm depression that disappears rapidly.
2+ Moderate pitting edema. 4mm depression that disappears in 10-15 seconds.
3+ Moderately severe pitting edema. 6mm depression that may last more than 1 minute.
4+ Severe pitting edema. 8mm depression that can last more than 2 minutes.

IX. Pain Perception

The Pain Pathway

This Photo by Unknown Author is licensed under CC BY-SA
X. Vision

Hemianopsia

Peripheral Vision

XI. Functional Mobility Assessment

Observe STS & Falls Assessment
XII. GAIT Observation

http://www.google.com/search?q=pictures+of+gait+analysis&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwi4pKm

XII. GAIT Observation

GAIT

GAIT
Unilateral assistive devices may reinforce WB away from hemi side – WB is important for modifying sensory input & motor output of impaired LE

Evidence Across Studies

Middleton, Fritz, Lusardi JAPA, 2015

- Extremely frail
- Risk of death, hospitalization, & falls
- Functional impairments; severe walking disability
- Mortality, mobility & ADL disability at 2 years increased AD by 7 years, 1x probability of frailty if >15 yrs
- Highly dependent
- Household walker
- Limited community ambulator
- Community ambulator
- Cross street

Intervention to reduce falls, 4x risk for LE initiation & for death & hospitalization in 1 year, 1.6 personal care
Cognitive decline in 5 years
Carry groceries & light yard work
Extremely fit, clerking, many tasks
90% discharged from home
Increased independence in self-care

6 mph 0.4 mph 0.0 mph 1.0 mph 1.8 mph 2.2 mph
10 meter walk time 50 sec 11.7 sec 7.6 sec 12.7 sec 10.2 sec 3.3 sec
10 foot walk time 11 sec 5 sec 2 sec 3.5 sec 2 sec

m/s 70
## Speed of Gait

- 2 Minute Walk Test
- 3 Minute Walk Test
- 6 Minute Walk Test
- 10-M Walk Test
- 10 Foot Walk Test
- **Observation**
- Gait Analysis: Full Body
  - RLA National Rehab. Ctr.
  - PT Dept.\(^{26}\)

## Balance & Dual Task

- **TUG**: Timed Up & Go Test
- **TUG Manual**: carry a full cup of water
- **TUG Cognitive**: counting backward from a randomly selected # between 20-100
- Walking While Talking Test
- Dynamic Gait Index
  - [Rehabmeasures.org](https://rehabmeasures.org)

---

## Prepare for Ambulation

- **serial cast w/ rocker bottom**
- **foot drop=foot slide**

↑ ankle ROM
Improve balance reactions

- KineMedic Concepts, Inc.
- Fun Slides Carpet Skate
XIII. Personal Effects

A. Shoe Wear Observations

B. Social Determinants of Health

C. Client Perspectives
XIV. Level of Function: Prior & Current

XIV. Patient & Caregiver/Family Goals
The client lives in a trailer. You record the 10 foot walk test as 7 seconds. You document in the chart that the client is a _________?

a. community ambulator  
b. subacute ambulator  
c. limited community ambulator  
d. household ambulator

Poll Question 6

Critical Appraisal of:

1. Subjective Information
2. Outcome Measurements
Scheets et al\textsuperscript{31}

- **Fractionated movement deficit** (did not display isolated movements-synergistic patterns severe motor deficits)
- Prognosis for “normal” movement unlikely
- Therefore, focus was on postural stability when performing compensatory movement strategies and during overall functional activities such as transfers and gait

**Associated Signs - Related to Task Analysis**\textsuperscript{31}

- Stiffness of involved limbs & slow
- No dissociation of mov’t, 1-2 jts
- Associated reactions in attempt to move
- Less A-G mov’t, may be unable to stand
- Gait: compensatory strategies associated w/ ext synergy of LE; however stands w/ hip & knee flex
- UE hand closure; limited reach range
- Postural control: able to sit but asymmetrical
- Stability may improve with practice but not symmetry
Synergistic Patterns

- Damage at or above red nucleus, impacting input to the rubrospinal tract (corticorubrospinal tract)\(^{32}\)
- Spasticity & variations in tone hallmark signs of lesion in subcortical region\(^{32-33}\)
- Gait w/ extensor synergy pattern; foot PF; difficulty clearing swing; compensate: pelvic hike, circumduction

What questions do we want to ask….

1. Do you have a brace?
2. How is it helpful?
3. How is it limiting?
4. What is your perception of your walking?
   a. Slow vs fast?
   b. Quality of how your body moves?
5. Have you had any falls? If yes….
   a. When was the last fall
   b. What were you doing?
6. Do you get out of the house a lot?
What questions do we want to ask….

1. Tell me about your home environment; community
2. Who and how is your support system? CG, friends visit
3. What do you do for exercise?
4. What do you do for fun/enjoyment?
5. What are your goals for walking?
6. Are these the shoes you typically wear with the brace?
7. What shoes did you typically wear prior to the stroke?
8. Did you bring them with you?

---

Outcome Measures

1. **10 MWT**: unable
2. **TUG**: 26 sec
3. **10' Walk Test**: 14.8 sec
4. Assessed gait with platform rw to ↑ spd of gait - impacts gait quality
5. What gait impairments would you suspect during:
   1. swing phase
   2. stance phase
6. **Tone**: MAS (3 quads & pflx);
   King’s Hypertonicity Scale;
   Tone Assessment Scale
7. **Spasticity**: (+)
8. **Fxnl Mobility Assessment**: 
   5x STS: 42 secs requiring use of RUE; leans to R
9. Observe shoe for wear & tear; look at WB surface inner sole
Outcome Measures

5. ROM:
- Knee ext: R1: -15 & R2: -5
- Knee flex 90°: R1: -5 & R2: -3

6. MTH: great toe upgoing; 1st ray pflx; 2-5 ext at MTH & PIP & DIP flex

7. Foot & Ankle Assessment: rockers (absent); Babinski (+); pathological reflexes (+ inversion response); compensatory motion due to lack of dflx (forefoot contact at IC; lateral heel whip at TSt w/ early heel rise)

8. Pain: sharp - 4/10 midstance at infrapatellar & general knee ache at rest

AFO Recommendations

Goal of an AFO (Barber, CPO)

To provide security, stability & control w/o interfering too much with movement at the foot & ankle.

To meet the functional requirements of the client with minimal restriction
Knowledge Summary

1. AFO Assessment Matters
2. Patient-Centered: Social Determinants of Health
3. Critical Exam Components – Lesion Location, Severity & Size
4. Objective Measures: Cortical, Subcortical, Cerebellum
5. Psychosocial Aspects of Gait

Question and Answer Period
Part 2 of this course....

- How to fabricate a training AFO

Thank you for your attention & participation!

Please complete the course eval
Test Time

References


AFO Assessment


AFO Assessment


Supplementary Information