An Orthotic Assessment for the Neurologic Client

Presented by Abigail Uribe PT, DPT

BELIEVE IN WE™ OhioHealth

Course Objectives

The learner will:

1. Understand assessment of the neurologic foot to determine primary impairments adversely affecting gait mechanics, efficiency, balance.
2. Recognize the impact spasticity has on functional gait, determine indications for referral for spasticity management.
3. Identify key considerations and specific indications for recommending appropriate orthotic appliance.
4. Identify various types of AFO's and their impact on gait.

2

BELIEVE IN WE™ OhioHealth

Agenda/Outline

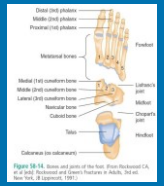
- Normal Foot
  - Anatomy
  - Function in gait
- Client Assessment/Foot Assessment
  - Observation of functional activities
  - Assessment of foot with and without shoes on
  - Gait assessment
- Orthotic Considerations
  - Short term vs long term goals
  - Timing: acute vs chronic
  - Custom vs off the shelf
  - Design and materials
- Shoe Considerations
- Process for obtaining orthotics
- Questions

3

BELIEVE IN WE™ OhioHealth

What is a Normal Foot?

- Forefoot
  - Made up of the five metatarsals, fourteen phalanges, and two sesamoid bones (21 bones total)
  - Adapts to the ground and last to leave the ground when walking
- Midfoot
  - Made up of the navicular, cuboid, and three cuneiforms
  - Transmits movement from hindfoot to forefoot
  - Promotes stability and acts as shock absorber
- Hindfoot
  - Made up of the talus and calcaneus
  - Converts torque of LE
  - Influences function and movement of the midfoot and forefoot



4

BELIEVE IN WE OhioHealth

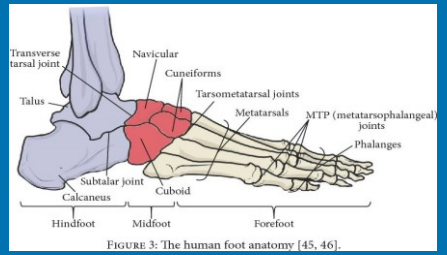


FIGURE 3: The human foot anatomy [45, 46].

5

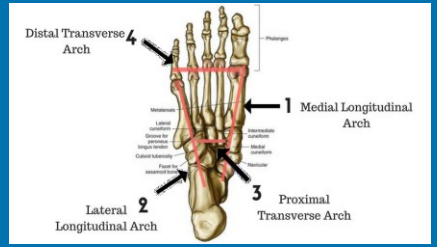
BELIEVE IN WE OhioHealth

Arches of the Foot

- Provide functions of shock absorption, base of support, and acts as a rigid lever during gait propulsion
- Three arches
  - Medial longitudinal arch
    - Primary load bearing and shock absorbing structure in the foot
  - Lateral longitudinal arch
    - Load bearing and shock absorbing
    - Flatter than the medial longitudinal arch
    - More solid with less mobility
  - Transverse arch
    - Provides transverse stability
    - Allows body weight shared across all five metatarsal heads

6

BELIEVE IN WE OhioHealth

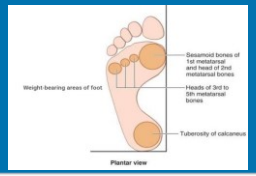


7

BELIEVE IN WE OhioHealth

ARCHES OF FOOT

WEIGHTBEARING AREAS OF FOOT



8

BELIEVE IN WE OhioHealth

Client Assessment

- Observe the client attempting a variety of functional activities
  - Look at posture and overall stability
  - Examples: sit to stands, normal gait, stairs
- Complete a detailed gait assessment
  - Focus on the stance phase and the stability when in single limb support

9

BELIEVE IN WE OhioHealth

Client Assessment

- What direction of movement needs to be limited and/or assisted?
- When is the limitation in movement needed or when is assistance needed?
  - What phase of gait is the problem occurring?
  - What activities is the client limited in?
- What happens when you limit or allow a particular movement?

10

BELIEVE IN WE OhioHealth

Foot Assessment

- Shoe wear pattern

- If you can complete it safely, look at gait with AND without shoes on
- Assess the foot with shoe off and with varying degrees of weight
  - Closed chain sitting (PWB)
  - Open chain sitting
  - Standing (FWB)

11

BELIEVE IN WE OhioHealth

Foot Assessment

- What is the structural integrity of the foot?
  - Is the architecture of the foot intact to optimize stance activity?
- Where does the foot need more stability or movement limited?
- Where does the foot need movement enhancement or assisted?

12

BELIEVE IN WE OhioHealth

Orthotics Considerations: Short Term vs Long Term Goals

- Can an AFO help with early mobility/safer participation in rehabilitation?
- Can an off the shelf AFO be used temporarily?
- Will the client need the AFO long term?
- What are the clients' goals and expected functional levels?
- Is an AFO needed during all mobility or only certain activities?

13

BELIEVE IN WE OhioHealth

Orthotic Considerations- Timing

- Acute Injury
  - Need to consider if it will be used temporarily vs long term
  - Need to consider custom vs off the shelf
  - Consider:
    - Motor recovery
    - Spasticity
      - Is it being managed or does it need managed?
    - Safety/potential for injury

14

BELIEVE IN WE OhioHealth

Orthotic Considerations- Timing

- Chronic Injury
  - Complete assessment WITHOUT AFO
    - Neuromotor- synergy, emerging selective movement, or full selective movement
    - PROM- limitations can oftentimes be the cause of gait deviations
  - Assess gait WITHOUT AFO
    - Determine if gait deviations are due to a learned strategy
  - Determine potential changes to gait with treatment intervention/gait training

15

BELIEVE IN WE OhioHealth

Orthotic Consideration- Timing

- Nikamp et al.
  - Two groups: early intervention group vs delayed intervention group
    - Early intervention group received an off the shelf AFO on week 1
    - Delayed intervention group received an off the shelf AFO on week 9
  - Early intervention group showed:
    - Higher outcome measure scores during the first 11-13 weeks
    - Could walk unsupported up to 10 weeks earlier
    - Showed balance test results related to less fall risk and improved walking speeds 4-6 weeks earlier
  - By 26 weeks, no detectable differences noted between the two groups

16

BELIEVE IN WE® OhioHealth

Orthotic Consideration- Timing

- Nikamp et al.
  - Two groups: early intervention group vs delayed intervention group
    - Early intervention group received an AFO on week 1
    - Delayed intervention group received an AFO on week 9
  - Early intervention group showed:
    - Greater number of falls in the first 8 weeks
      - 63.6% of falls occurred when the AFO was not worn (during transfers and standing tasks)
    - Higher levels of activity earlier in rehabilitation
    - Higher functional levels earlier in rehabilitation (greater independence with gait and balance tasks)
  - By weeks 9 to 52, no difference in the number of falls between the two groups
  - Considerations: Take the cognitive level of the client into consideration early after a stroke

17

BELIEVE IN WE® OhioHealth

Orthotic Consideration- Timing

- After AFO is obtained, generally complete additional therapy for gait training
  - Continue to address ongoing impairments
  - Recognize the limitations that the new AFO may impose on gait pattern
  - Take advantage of what the AFO enhances in gait/take advantage of all capabilities
  - Recognize that the most appropriate device for an individual may change, and reassessments should be completed to ensure the device continues to meet the client's needs

18

BELIEVE IN WE® OhioHealth

Prerequisites to Orthotic Fitting

- ROM limitations must be resolved as best as possible
- Spasticity MUST be managed
  - Research shows that AFOs should not be used to decrease spasticity

19

BELIEVE IN WE | OhioHealth

Orthotic Considerations: Custom vs Off the Shelf

- Off the Shelf:
  - Tend to be cheaper
  - Can typically be obtained faster
  - Can be beneficial for temporary use during early phases of recovery or if future needs are unsure
  - Are not as specific to client's needs and may only address part of the client's needs but not all impairments
- Custom:
  - More customizable, can meet more needs
  - Increased cost if not covered by insurance
  - Can take longer to obtain

20

BELIEVE IN WE | OhioHealth

Orthotics Considerations: Material

- Two common options:
  - Polypropolene
  - Carbon fiber
- Considerations:
  - Weight of AFO
  - Fit of AFO
  - Stiffness/strength

21

BELIEVE IN WE | OhioHealth

Orthotics Considerations: Design

- Need to consider the following:
  - Client's activity levels/lifestyle
  - Willingness to wear AFO consistently
  - Extent/degree of control needed at the foot, ankle, and knee

22

BELIEVE IN WE OhioHealth

Impairment: Foot instability

- Orthotic Shoe Insert
  - Indications:
    - Client exhibits increased foot mobility
    - Collapse into pronation during midstance
    - Client demonstrates fully correctable foot position
    - Need greater support than what is possible with lower trim line shoe inserts


Cascade chipmunk


Cascade cricket


Cascade DAFO 5 (custom)

23

BELIEVE IN WE OhioHealth

Impairment: Foot instability

- Metatarsal arch pad
  - Indications:
    - Can reduce toe curling
    - Can help stabilize the arch
    - Good for over-pronation/flat feet
    - Can increase activation of foot intrinsic muscles
    - Provides extra proprioceptive input/sensory input

24

BELIEVE IN WE OhioHealth

Impairment: Ankle Instability

MalleoLoc
(Off the shelf)

Arizona Optima
(Custom)

Arizona Articulated
(Custom)

25

BELIEVE IN WE OhioHealth

Impairment: Foot and ankle instability

- Supramelleolar Orthosis (SMO)
  - Indications
    - Need to control the alignment of the calcaneus along with midfoot and forefoot
    - Client exhibits excessive pronation or supination
    - Provides greater ankle stability due to higher trim lines
    - Will not assist with DF or PF, but will help with medial/lateral stability

Cascade SMO (off the shelf)

Arizona SMO (custom)

26

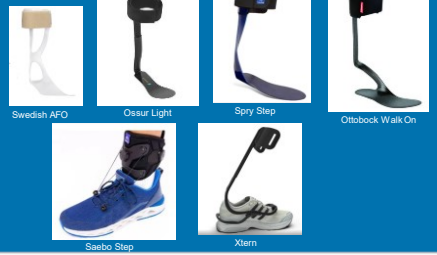
BELIEVE IN WE OhioHealth

Impairment: Decreased foot clearance

- Off the Shelf AFO
  - Indications
    - Decreased ankle DF, leading to decreased foot clearance
    - Client has good medial/lateral ankle stability and good knee control
    - Potential utilization early in recovery to allow for safer participation in mobility
    - High level client that needs assistance with specific tasks/activities

27

BELIEVE IN WE OhioHealth



28

BELIEVE IN WE OhioHealth

Impairment: Ankle instability AND decreased foot clearance

- Solid AFO
  - Completely limits the ankle joint movement
  - Used for:
    - Foot drop
    - Mild knee instability
    - Valgus/varus
- Posterior Leaf Spring
  - Solid AFO with trimline behind the ankle, thus decreased control of ankle instability
  - Allows for slight dorsiflexion in the mid and terminal stance phases
  - More suitable for clients with better balance and who are more active
- NOT COMMONLY USED

29

BELIEVE IN WE OhioHealth

Impairment: Ankle instability AND decreased foot clearance

- SMO with Posterior Upright
- Indications
  - Controls alignment of calcaneus
  - Controls midfoot and/or forefoot
  - Limits medial/lateral ankle instability
  - Aligns hindfoot, midfoot, and forefoot to restore architectural integrity of the foot
    - Helps develop intrinsic muscle activity in foot for balance
    - Allows alignment of hip, knee, and trunk over stable base

30

BELIEVE IN WE OhioHealth


Cascade DAFO 2


Cascade Tami 2


Ottobock
Custom carbon fiber

31

BELIEVE IN WE OhioHealth

Types of Hinges

- Free Ankle with Dorsiflexion assist
  - Indications
    - Unable to DF the foot during swing phase, but may have initiation of selective DF
    - May have active PF
    - No significant PF or inversion spasticity
    - Tibia moves forward in stance, not back
    - Calcaneus doesn't need stabilized (doesn't need SMO)
  - Allows
    - Ankle movement into both PF and DF by providing dynamic DF assist and passive PF resistance
    - Smooth plantar flexion from initial contact at heel to foot flat
    - Tibial advancement in stance phase
    - Actively assists into 90 degrees of DF for swing phase when the foot is unloaded
  - Not commonly prescribed

32

BELIEVE IN WE OhioHealth

Types of Hinges

- Plantarflexion Stop
  - Indications
    - Client is unable to DF foot during swing phase
    - **Slow gait speed: limited household ambulatory or limited community ambulatory**
    - Increased fall risk
    - Spasticity or contracture in plantarflexors
    - Decreased proprioception, affecting foot placement during standing or gait
    - Tibia moves posteriorly in stance
    - Strong knee hyperextension moment
  - Allows free DF/tibial advancement while limiting PF
  - Not recommended for clients with weak quadriceps

33

BELIEVE IN WE OhioHealth

Types of Hinges

- 5 Degrees of PF allowed AND DF Assist
  - Indications
    - Client is unable to DF foot at initial/mid/terminal swing
    - Limited/Unlimited community ambulatory (higher level client, faster gait speed)
    - Has initiation of selective DF or active DF, but fatigues with distance
    - No significant PF/invertor spasticity
    - Needs allowable PF for more controlled transition from initial contact to loading response for more normal gait/2nd rocker
  - Allows
    - 5 degrees of PF moving from initial contact to loading response
    - Tibial advancement in stance
    - Actively assists into 90 degrees of DF for swing

34

BELIEVE IN WE OhioHealth

Types of Hinges

- Dorsiflexion Stop/Anterior Shell
  - Indications
    - Excessive ankle dorsiflexion/crouching caused by weakness of plantarflexors or quads (allows the ankle to enter dorsiflexion)
    - Client lacks full knee extension in stance phase
    - Knee instability noted during stance phase

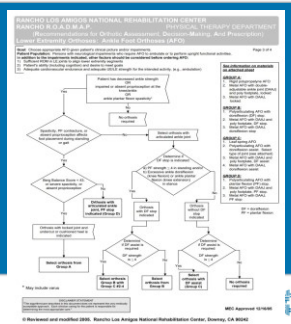
Ottobock Walk On Reaction Plus

Allard Toe Off

Custom AFO with DF stop

35

OhioHealth



RANCHO LOS AMIGOS NATIONAL REHABILITATION CENTER
RANCHO R.O.A.D.M.A.P. PHYSICAL THERAPY DEPARTMENT
(Recommendations for Orthotic Assessment, Decision-Making, And Prescription)
Lower Extremity Orthoses: Ankle Foot Orthoses (AFO)

36

OhioHealth

Shoe Considerations

- Common Problems
  - Not wide enough to accommodate AFO; AFO is "falling off" side of the shoe's sole (usually laterally)
  - Client cannot don shoe independently with AFO
  - Caregiver (elderly) struggles to don AFO
  - Shoe doesn't open wide enough down to the toes; AFO can't slide in

37

BELIEVE IN WE OhioHealth

Shoe Options

- Zeba shoes
  - Hands free
  - Slide foot in from the back
  - Will need some ankle strength/stability

- Kiziks
  - Hands free
  - Shoes have elastic slit on side to be able to slide on/off easier

- Nike Pegasus Flyease
  - Velcro strap across the front allows wider opening

38

BELIEVE IN WE OhioHealth

Shoe Options

- Quikiks
  - Back opens outward
  - Hands free

- APEX Reina Runner and Rhino Runner
  - Has Velcro in back so that it opens farther to get foot in
- Nike Revolution 6 Flyease
  - Zipper around the side/back

39

BELIEVE IN WE OhioHealth

Shoe Options

- Propet Viator Strap
  - Velcro strap across the top

- Billy Footwear
  - Wrap around zipper

- Split Shoe Buying
  - See link below for options of where to buy different sized shoes. https://helpshoe.com/buying-split-sized-shoes/

40

BELIEVE IN WE OhioHealth

Orthotic Referral Process

1. Assess the client for AFO need
2. Obtain consent from client to proceed with referral
3. Choose orthotic company
4. PT documents justification for AFO and specific recommendations in daily treatment note or progress note
5. PT sends recommendations to MD and requests a script for AFO
6. PT faxes note with recommendations and script to orthotics company

41

BELIEVE IN WE OhioHealth

Questions??

- Contact me:
  - Abigail.uribe@ohiohealth.com
  - 614-788-9273

42

BELIEVE IN WE OhioHealth

References

- Bae DY, Shin JH, Kim JS. Effects of dorsiflexor functional electrical stimulation compared to an ankle/foot orthosis on stroke-related genu recurvatum gait. J Phys Ther Sci. 2019 Nov;31(11):865-868.
- Choo YJ, Chang MC. Commonly Used Types and Recent Development of Ankle-Foot Orthosis: A Narrative Review. Healthcare (Basel). 2021 Aug 13;9(8):1046. doi: 10.3390/healthcare9081046. PMID: 34442183; PMCID: PMC8392067.
- Johnston TE, Keller S, Denzer-Weller C, Brown L. A Clinical Practice Guideline for the Use of Ankle-Foot Orthoses and Functional Electrical Stimulation Post-Stroke. J Neurol Phys Ther. 2021 Apr 1;45(2):112-196.
- Nikamp CD, Buurke JH, van der Palen J, Hermens HJ, Rietman JS. Six-month effects of early or delayed provision of an ankle-foot orthosis in patients with (sub)acute stroke: a randomized controlled trial. Clin Rehabil. 2017 Dec;31(12):1616-1624.
- Nikamp CDM, Hobbelink MSH, van der Palen J, Hermens HJ, Rietman JS, Buurke JH. The effect of ankle-foot orthoses on fall/near fall incidence in patients with (sub-)acute stroke: A randomized controlled trial. PLoS One. 2019 Mar 12;14(3):e0213538.
- Ranchos Los Amigos National Rehabilitation Center Rancho R.O.A.D.M.A.P. Downey, CA: Rancho Los Amigos National Rehabilitation Center; 2005: 1-4. Available at: https://therapistsforarmenia.org/wp-content/uploads/2021/04/Rancho-ROADMAP.pdf
- Selves C, Sloquart G, Lejeune T. Gait rehabilitation after stroke: review of the evidence of predictors, clinical outcomes and timing for interventions. Acta Neurologica Belgica. 2020; 120:783-790
- Teasell R, Salbach NM, Foley N, Mountain A, Cameron JI, Jong A, Acerra NE, Bastasi D, Carter SL, Fung J, Halabi ML, Iruthayarajah J, Harris J, Kim E, Noland A, Pooyania S, Rochette A, Stack BD, Symcox E, Timpson D, Varghese S, Verrilli S, Gubitz G, Casaubon LK, Dowlatshahi D, Lindsay MP. Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Community Participation following Stroke. *Part One: Rehabilitation and Recovery Following Stroke*; 6th Edition Update 2019. Int J Stroke. 2020 Oct;15(7):763-788.

BELIEVE IN WE OhioHealth