Intervention

- Range of motion
- Strength and motor control
- Neuroplasticity
- External supports

CSM 2019

- Sports Medicine Secrets: **Ankle and Foot Strength, Mobility, and Coordination** Deficits. S. Bell, M. LeMoine, D. Marcos. *(AOPT)*
- PT from head (motor learning, **pain psychology**) to toe (**foot & ankle** mechanics). M. Hastings, R. Chimenti, B. Fisher (AOPT)
- The Athlete In Pain, Moving Beyond The Tissues to the Person. Z. Christopherson, M. Gist, T. Lentz, J.W. Matheson, B. Ness, H. Tao, K. Zimney (AASPT)
- The **Brain** has an **ACL** Problem. T. Grindstaff, D. Grooms, D. Lorenz (AASPT)
- Science Meets Practice: **Neuroplasticity** Following **ACL** Injury and ACL Reconstruction. R. Zarzycki, D. Grooms (AASPT)
- **Neurocognitive & Motor Control Strategies** in **ACL** Rehab. M. Sherry, PT, D. Cobian, K. Wittman (AASPT)
- The **Frozen Shoulder** Has A **Brain**. A. Louw, S. Schmidt, P. Mintken (AHUEPT)
- Dealing with the Dark Side of Neuroplasticity: **Pain** In **Neurorehabilitation**. S. Schmidt, A. Low. (ANPT)

Experienced-Based Plasticity

Neuromotor

Cortical-Body Matrix

- the cortex's multisensory representation of the body and peripersonal space.
- develops in a predictable manner, but development is based on experience
- highly plastic based on experience, even after development is complete

Cortical-Body Matrix (Body Map)

1

Experienced-Based Plasticity
Neuromotor

Neuroplastic Changes: Self-Efficacy

Low self-efficacy
- Worry, kinesiophobia, anxiety, fear of injury
- Impaired:
  - Motor skill performance
  - Postural control
  - Gait parameters
  - Range of motion
- Increased falls

High self-efficacy
- Higher performance
- Higher rehabilitation outcomes after neurological injury

Nott 2021, Jones 2011, Korpershoek 2011

Experienced-Based Plasticity
Neuromotor

Neuroplastic Changes: Self-Efficacy

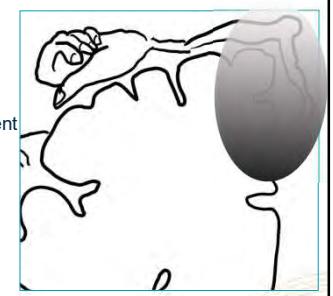
Verbal suggestion can be more powerful than conditioning for performance.

Corsi, 2019
- When words hurt: Verbal suggestion prevails over conditioning in inducing the **motor nocebo effect.**

Experienced-Based Plasticity
Neuroplastic Changes: Sensory

Hyperperception
- Amplified perception of afferent information
- Hypervigilance of area
- Decreased ability to differentiate types of afferent information

Hypoperception
- Dampened perception of afferent information
- Decreased awareness of area
- Decreased ability to differentiate afferent information from area

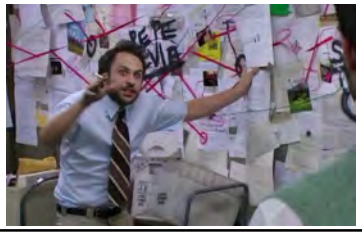


Experienced-Based Plasticity
Neuroplastic Changes: Motor

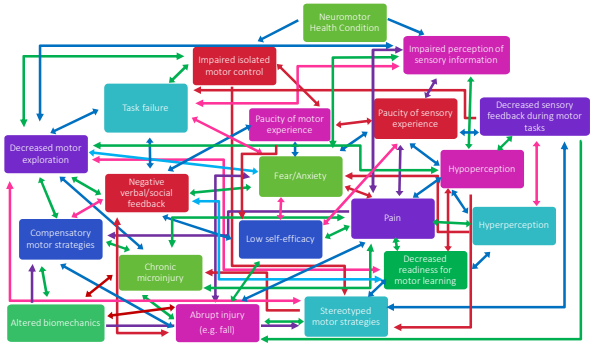
Changes Impact:
- Readiness for motor learning
- Motor control
- Postural control
- Fall frequency
- Motor skill performance

Experience-Based Plasticity
Neuroplasticity: Neuromotor Health Conditions

- When a patient experiences a neuromotor health condition, their motor skills are often impacted not only by the primary health condition, but also by experience-dependent cortical reorganization.



Neuroplasticity:
Meta-effects on neuromotor health conditions



Experience-Based Plasticity
Neuroplasticity in Neuromotor Health Conditions

Impaired isolated motor control

- Paucity of motor experience
- Task failure
- Low self-efficacy
- Decreased motor exploration
- Negative verbal/social feedback
- Pain
- Fear/anxiety
- Compensatory motor strategies
- Stereotyped motor strategies

Impaired sensory perception

- Paucity of sensory experience
- Decreased sensory feedback during motor tasks
- Hypoperception
- Hyperperception
- Chronic microinjuries
- Abrupt injuries (e.g. falls)
- Decreased readiness for motor learning

Experience-Based Plasticity
Neuroplasticity in Neuromotor Health Conditions

Neuromotor Health Condition

- Impaired isolated motor control
- Impaired perception of sensory information

Neuroplastic Changes

- Further impair:
  - Motor function
  - Sensory perception

Experience-Based Plasticity
Neuroplasticity in Neuromotor Health Conditions

- Natural history: neuroplastic changes will magnify the effects of neuromotor health conditions
- Impaired motor control and related sequelae that we traditionally attribute to neuromotor health conditions are actually amplified by experience-dependent neuroplastic changes.

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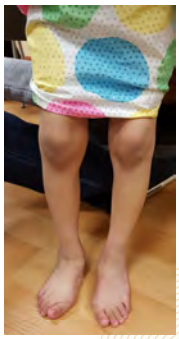
Experience-Based Plasticity
Neuroplasticity in Neuromotor Health Conditions

Example: Foot Intrinsics ("foot core" Mckeon, 2015)

- Intrinsic muscles of the foot are advantageously positioned to provide immediate sensory information about changes in the foot posture, via stretch response
- Key for balance and fall prevention
- Excessive pronation leads to a loss of this information



Experience-Based Plasticity
Neuroplasticity in Neuromotor Health Conditions

NM health condition →
→Altered neuromotor function
→Excessive pronation
→ Loss of key afferent information from the foot intrinsics
→ Negative neuroplastic changes
→ Additional balance/gross motor impairment

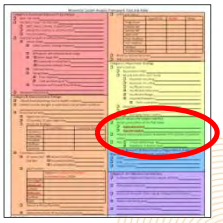
Neuromotor and Motor Control Findings

- ❑Muscle activation and timing
  - ❑Impaired recruiting _____
  - ❑Excessive recruiting _____
  - ❑Insufficient Force_____
  - ❑Insufficient Endurance _____
  - ❑Insufficient Range_____
  - ❑Impaired Relaxation _____
    - ❑ Tonic contraction _____
- ❑Atypical habitual patterns of movement _____
- ❑Inconsistent Motor Patterns_____
  - ❑Emerging Motor Control_____
- ❑Balance Strategies_____

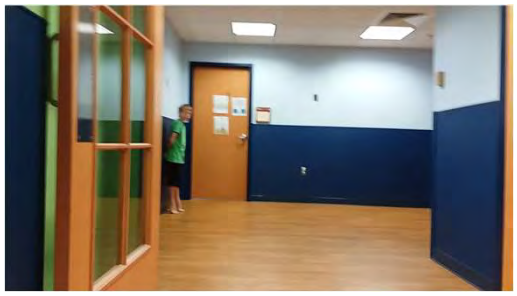
5

Sensory Perception and Pain

- ❑Perception of the foot/ankle
  - ❑Hyperperceptive
  - ❑Hypoperceptive
- ❑Altered sensory/perception elsewhere in the greater movement system
- ❑Pain ❒Amplified?
  - ❒In foot/ankle/lower leg
  - ❑Elsewhere in kinetic chain



Sensory Perception and Pain



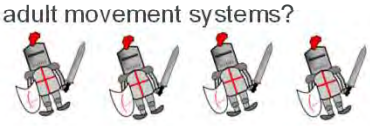
Neuroplasticity: Impact of Experience

Neuromotor health conditions:

- motor skills are impacted not only by the primary health condition, but also by ***experience-dependent*** cortical reorganization.

Developmental Movement System Model

- How do kinesiopathologic and neuroplastic influences impact individuals with pediatric health conditions?
- Do children with pediatric health conditions have special protections against the forces that impact adult movement systems?



Developmental Movement System Model

Kinesiopathologic Model

- Repeated movements and sustained alignments influence structure and function

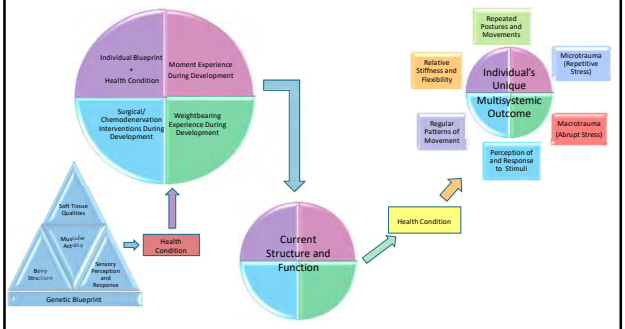
Developmental Movement System Model (Kinesioplasticity)

- Repeated movements and sustained alignments during development will influence structural and functional outcomes

Developmental Movement System Model

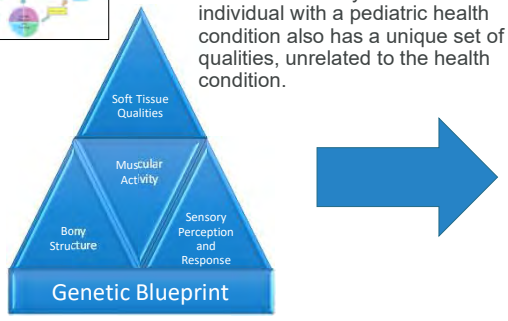
- Function of the movement system is multifactorial and depends not just on the health condition, but on the influence of multiple internal and external factors.
- The structure and function of the mature movement system will be impacted by movement experiences during development.

Developmental Movement System Model (DMSM)

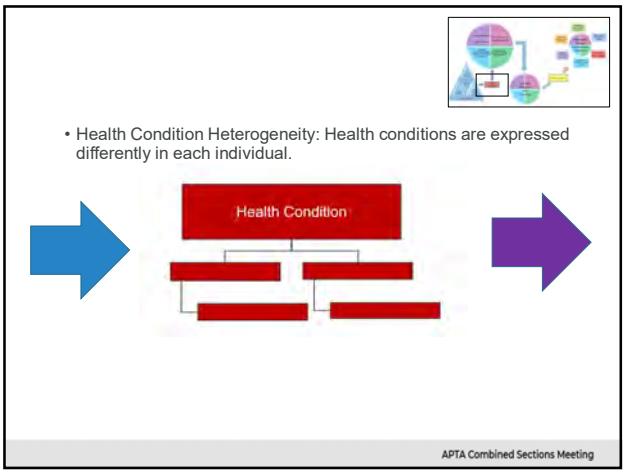


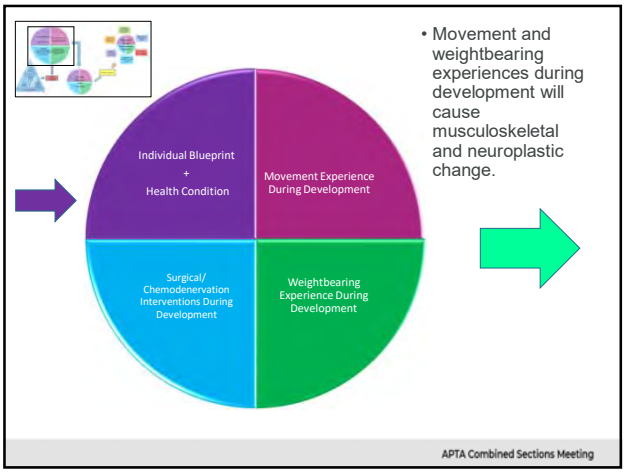
APTA Combined Sections Meeting

- The movement system of each individual with a pediatric health condition also has a unique set of qualities, unrelated to the health condition.



APTA Combined Sections Meeting





Musculoskeletal Plasticity During Development

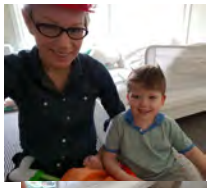
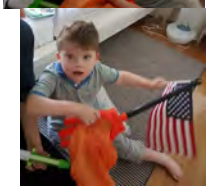
Kinesiopathologic Model
- Repeated movements and sustained alignments lead to adaptations in body tissues.

Wolff's Law
- Bone adapts in both internal architecture and external shape based on stress (weightbearing and muscle pull).

Physical Stress Theory
- All biological tissue adapts to physical stress.

How do these forces impact the development of the musculoskeletal system?

Musculoskeletal Plasticity During Development

Neuroplasticity During Development

Neuroplasticity
- Experience of the movement system impacts the brain leading to changes in function.

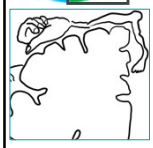
Developmental Movement System Model
- Experience of the movement system impacts the brain during development, leading to changes in long- term functional outcomes.
- Due to the increased plasticity of growing brains, neuroplastic changes during development will compound the magnification of deficits

Neuroplasticity During Development

Causes of negative neuroplastic change:

Paucity of motor experience	Decreased sensory feedback during motor tasks
Task failure	Chronic microinjuries
Low self-efficacy	Abrupt injuries (e.g. falls, sprains)
Negative verbal/social feedback	Pain
Altered motor strategies	Fear/anxiety
Paucity of sensory experience	

Neuroplasticity
During Development

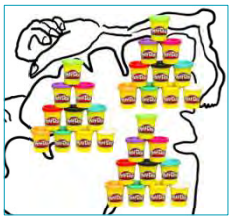


Pediatric Brain

- Neuroplasticity is greatest before specialization
- There are critical windows for certain skills
- Massed practice is required for skill development

Developmental Movement System Model

- DMSM hypothesis: Growing brains are by definition more plastic, and therefore even ***more*** susceptible to neuroplastic changes based on experiences.



Neuroplasticity
During Development

NM health condition →
→Altered neuromotor function
→Excessive pronation
→ Loss of key afferent information from the foot intrinsics
→ Negative neuroplastic changes
→ Additional balance/gross motor impairment

- How developing in the context of overstretched foot intrinsics impact the **development** of the cortical matrix for balance?

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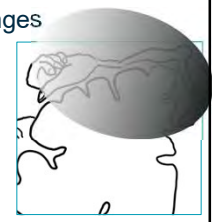
Developmental Neuroplastic Changes will impact long-term outcomes



Motor outcomes:
- Postural control
- Gross motor skill level
- Capacity for new motor learning
- Fall risk

Long-term perceptual abilities:
- Environmental information
- Body information
- Feedback during motor tasks & proprioception

Functional pain perception

Neuroplasticity
During Development

Developmental Movement System Model

- Impaired motor control and related sequelae that we traditionally attribute to pediatric health conditions are actually compounded by experience-dependent changes.

Neuroplasticity: Neuromotor Health Conditions

Intervention:

protect against:

Paucity of motor experience	Decreased sensory feedback during motor tasks
Task failure	Chronic microinjuries
Low self-efficacy	Abrupt injuries (e.g. falls, sprains)
Negative verbal/social feedback	Pain
Altered motor strategies	Fear/anxiety
Paucity of sensory experience	

Neuroplasticity: Neuromotor Health Conditions

Intervention:

provide:

Abundance of motor experience	Decreased micro and microinjuries
Task success	Improved perceptual skills
High self-efficacy	Improved biomechanics
Confidence	Protective strategies
Improved & varied motor strategies	Increased readiness for motor learning
Abundance of sensory experiences	Decreased pain
Enhanced sensory feedback during motor tasks	Pain coping strategies
	Positive verbal/social feedback

Neuroplasticity: Neuromotor Health Conditions

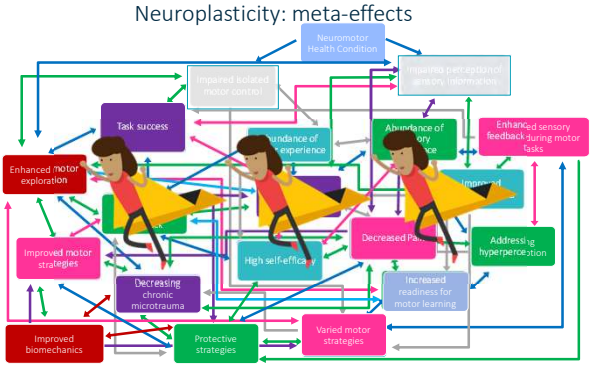
Neuroplastic intervention can improve:

Ability to perceive:
- environmental information
- body information
- Feedback during motor tasks & proprioception

Functional pain perception

Motor skills:
- Postural control
- Gross motor skill level
- Capacity for new motor learning
- Fall risk
- Sports performance

Neuroplasticity: meta-effects



Developmental Movement System Model **Intervention**

If movement and weightbearing experiences during development of the movement system impact long-term structure and function

then

we will influence long-term movement system outcomes with interventions during development.

Developmental Movement System Model

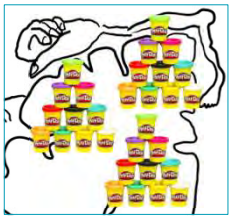
Neuromotor Development

Pediatric Brain

- Neuroplasticity is greatest before specialization
- There are critical windows for certain skills
- Massed practice is required for skill development

Neuroplasticity: Impact of Experience

- Pediatric health conditions:
  - increased plasticity of the developing system ***compounds the magnification*** of experience on cortical organization

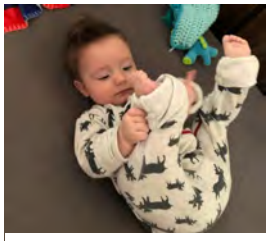


Neuroplasticity: Pediatric Health Conditions

Neuroplastic intervention can impact long term outcomes:

Ability to perceive:	Motor outcomes:
• environmental information • body information • Feedback during motor tasks & proprioception	• Postural control • Gross motor skill level • Capacity for new motor learning • Fall risk • Sports performance
Functional pain perception	

How does the developing movement system create a useful cortical matrix of the foot and ankle?



Visual Exploration

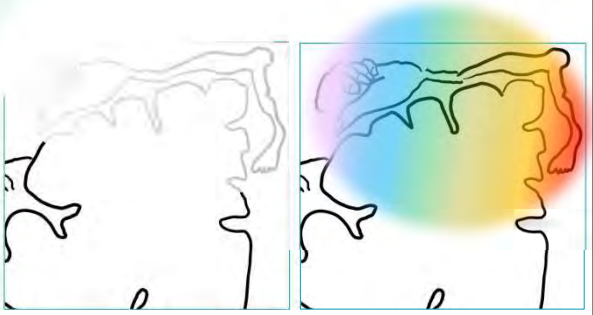
Sensory exploration with upper extremities (and mouth)

Bilateral LE sensory exploration

Motor exploration with sensory experiences with the environment

Neuroplasticity: Intervention

- How can we provide ***age-appropriate*** map-building information to the movement systems in the context of a neuromotor health condition?



Improving Cortical Mapping
Auditory Activities

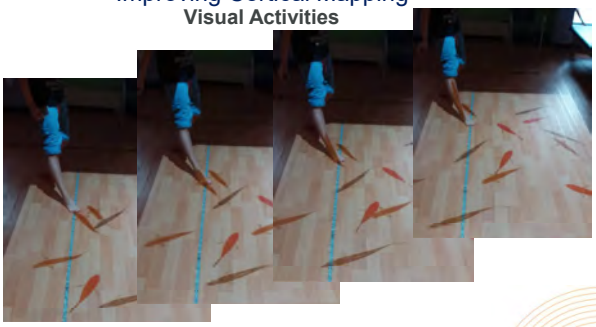
- **Songs or guided visualization**

BOA CONSTRICTOR

Oh, I'm being eaten
By a boa constrictor,
A boa constrictor,
A boa constrictor,
I'm being eaten by a boa constrictor,
And I don't like it—one bit.
Well, what do you know?
It's nibblin' my toe.
Oh, gee,
It's up to my knee.
Oh my,
It's up to my thigh.
Oh, fiddle,
It's up to my middle.
Oh, heck,
It's up to my neck.
Oh, dread,
It's upmmmmmmmmmmffffffffff. . .

Silverstein, S. (1974). Where the sidewalk ends: The poems & drawings of Shel Silverstein. Harper and Row.

Improving Cortical Mapping
Visual Activities



Improving Cortical Mapping
Direct Stimulation

- Assisted
- Self-exploration
- Comparison– helping the patient "calibrate" by comparing the sensation to a more familiar area of the body

Improving Cortical Mapping
Direct Stimulation

Example: vibration

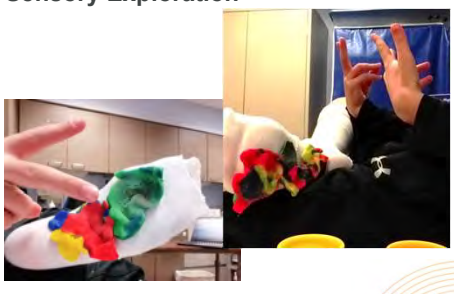
Improving Cortical Mapping
Sensory Exploration

FEETCRAFT

Improving Cortical Mapping
Sensory Exploration

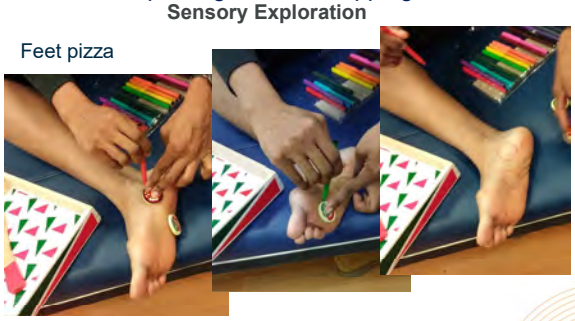
ABSTRACT ART

FEET GRAFFITI



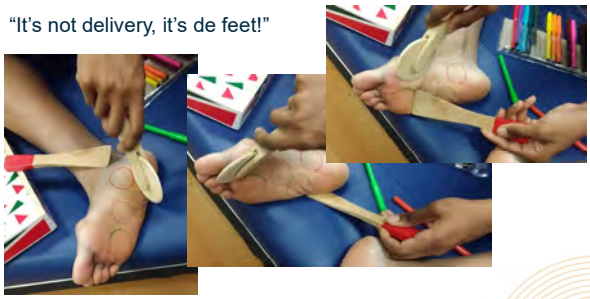
Improving Cortical Mapping
Sensory Exploration

Feet pizza

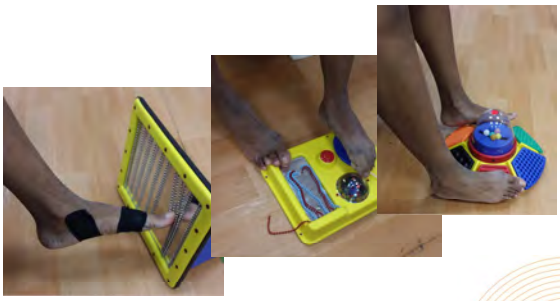


Improving Cortical Mapping
Sensory Exploration

"It's not delivery, it's de feet!"



Improving Cortical Mapping
Enhanced Sensory-Motor Activities



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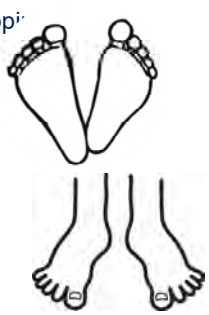
Improving Cortical Mapping
Mapping Activities*

Sticker matching: contralateral

Improving Cortical Mapping
Mapping Activities*

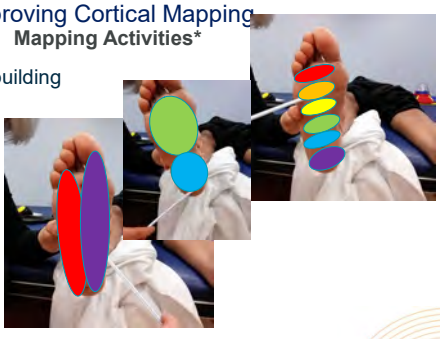
Sticker matching: paper map



Improving Cortical Mapping
Mapping Activities*

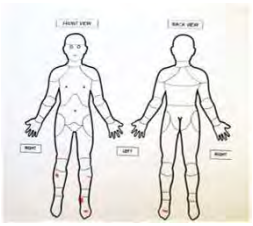
Assisted map building

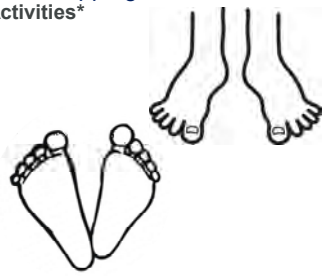
Color zones



Improving Cortical Mapping
Mapping Activities*

Left/right, medial/lateral



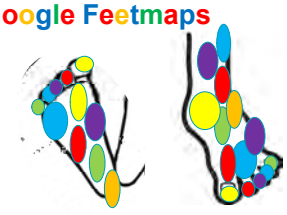


Improving Cortical Mapping
Mapping Activities

Google Feetmaps

Improving Cortical Mapping
Mapping Activities

Google Feetmaps



Improving Cortical Mapping
Mapping Activities*

2 point discrimination

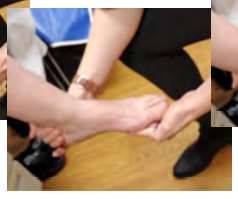



Improving Cortical Mapping
Mapping Activities*

Stereognosis


Improving Cortical Mapping
Use of Resistance

Use of resistance to improve kinesthesia and motor response


Activity

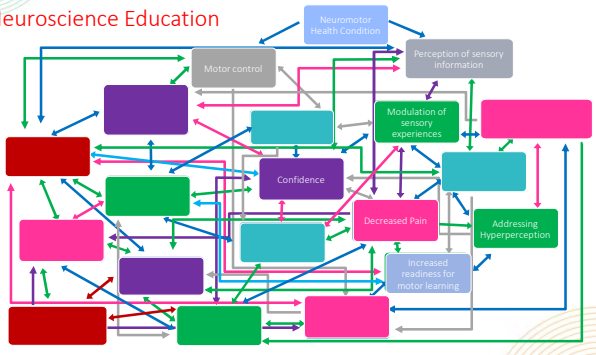
1. Type in the chat or demonstrate (for extra credit) a cortical mapping activity for the feet using items available in your home or clinic

   The problem with rice and shaving cream

   Meaningful activity→ neuroplastic changes

2. How you adapt these activities for someone with limited hip range of motion?

Neuroscience Education



Pain Neuroscience Education (PNE)

- **Pain Neuroscience Education: State of the Art and Application in Pediatrics.** (Robins 2016)
- **The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature.** (Louw 2016)
- **The clinical application of teaching people about pain.** (Louw 2016)
- **Use of Pain Neuroscience Education, Tactile Discrimination, and Graded Motor Imagery in an Individual With Frozen Shoulder.** (Sawyer 2018)
- **Know Pain, Know Gain? A Perspective on Pain Neuroscience Education in Physical Therapy.** (Louw 2016)

Neuroplastic Changes: Pain

Nociplastic Pain

- Microglia cause changes in peripheral and/or central nervous system
- Amplified perception of afferent information
- Decreased ability to differentiate types of afferent information
- Hypervigilance of area

Amplified symptom severity
Treatment resistance

Pain (Therapeutic) Neuroscience Education (PNE)

According to the PNE research, individuals experiencing amplified pain need:

- To be heard
- Validation of their experience
- Reassurance
- Realistic *but optimistic* expectations
- Education regarding pain mechanisms

Pain (Therapeutic) Neuroscience Education (PNE)

Functional changes have demonstrated after intervention of pain neuroscience education programs

With as little as 30 minutes, x 1 of pain neuroscience education:

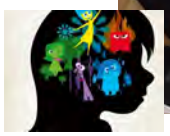
- Positive shift in psychometric measures
- Improved range of motion
- Changes in fMRI

Understanding the role of neuroplasticity in the pain experience *in and of itself* can decrease the experience of pain

Addressing Nociplastic pain

Emoji therapy: direct

- Acknowledging pain and emotional experience



D-PNE

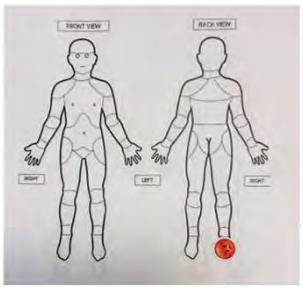
Emoji therapy: direct

- Acknowledging pain

25

D-PNE

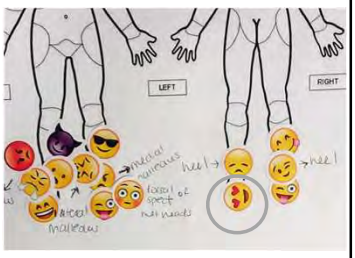
Emoji therapy: indirect
- Acknowledging pain
- Directing attention



Addressing Nociplastic Pain

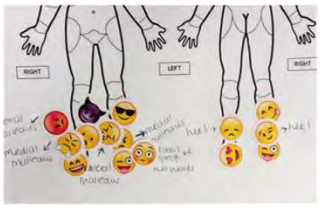
Emoji therapy: indirect

Transitioning emotional experience toward positivity



D-PNE

Emoji therapy: indirect
- Acknowledging pain
- Directing attention

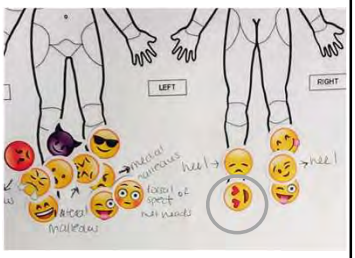


D-PNE

Emoji therapy: indirect
- Acknowledging pain
- Directing attention

PNE

Sending positive emojis



Addressing Nociplastic Pain

Progressing input
Ball Rolling (Adriaan Louw, PT, PhD)
- Finding the borders of pain
- *Anxiety with loss of pain

Addressing Nociplastic Pain

Addressing Nociplastic Pain

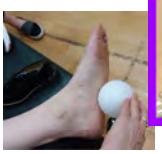
Central De-Sensitization

- Positive sensory experiences
- Positive movement experiences
- Positive emotional experiences
- Coping strategies
- Building resilience
- Building confidence
- Seeing experiences in perspective
- Understanding of pain mechanisms

=> positive neuroplastic changes

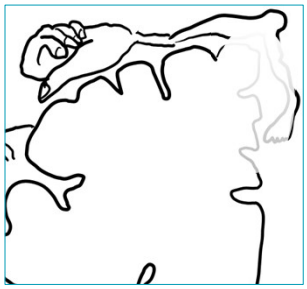
D-PNE

Emoji therapy: direct
- Acknowledging pain



Neuroplastic Changes: Pain

Hypoperception of pain



Developmental Pain Neuroscience Education (D-PNE)

Supporting the individual to develop a developmentally-appropriate, personal system for

- understanding
- processing
- differentiating
- communicating

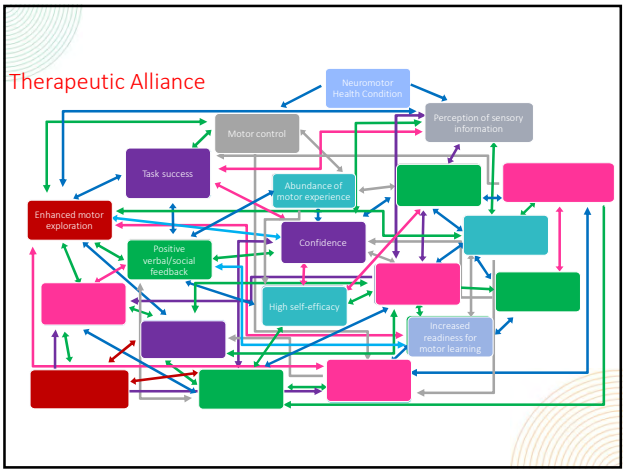
discomfort and pain.

Developmental Pain Neuroscience Education

- Compare expectations of pain tolerance and expression to those of neurotypical children
- Education on various kinds of pain
  - Stretch/"good hurt"
  - Damage/"bad hurt"
  - Muscle soreness
  - Amplified pain

Developmental Pain Neuroscience Education

- Talk to patient about functional pain perception: the body's warning system
- Functional pain or discomfort
  - Something in shoe
  - Brace needs adjustment
  - Need for weight shift
  - Spend guided time feeling these sensations
- Listen, believe, acknowledge, explore, educate, and learn



Health Condition Education

- Meet patient and caregivers where they are
- Use **positive**, developmentally appropriate language
- Help guide the patient and caregiver to a positive "story"
- Social model of disability
  - Medical model: people are disabled by their impairments or differences, the clinician should focus on fixing what is 'wrong' with the person. The clinician is the expert.
  - Social model: Disability is an individual difference. Problems come from society societal barriers. The individual and their family system are the experts, and can choose to consult professionals.

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Health Condition Education

Low self-efficacy
- Worry, kinesiophobia, anxiety, fear of injury
- Impaired:
  - Motor skill performance
  - Postural control
  - Gait parameters
  - Range of motion
- Increased falls

High self-efficacy is associated with higher performance

Verbal suggestion can be more powerful than conditioning for performance.

Therapeutic Alliance

- Nocebo Effect
- Verbal suggestion can be more powerful than conditioning for performance.

When words hurt: Verbal suggestion prevails over conditioning in inducing the motor nocebo effect. Eur J Neurosci. 2019; 50: 3311– 3326. (Corsi, N)

Self-efficacy, flow, affect, **worry** and **performance** in elite world cup ski jumping. (Sklett 2018)

Developmental Plasticity

- Promoting Self-Efficacy

Equinus	→	Plantarflexion Dorsiflexion restriction
Deformity Contracture	→	Structural variance Restriction Limiting structure Quality of end feel

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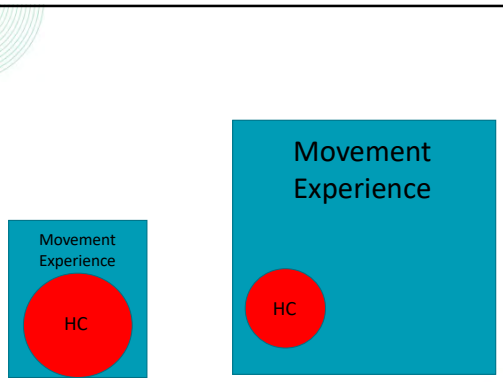
Health Condition Education

Sticky stories



Stories and Growth Mindset:

- Podcast:
  - Hidden Brain: Watch Your Mouth, 10/3/22
  - Hidden Brain: Healing 2.0 Change Your Story, Change Your Life, 10/30/23 (27:00)
  - Happiness Lab: How to Adopt a Growth mindset 11/23/2021

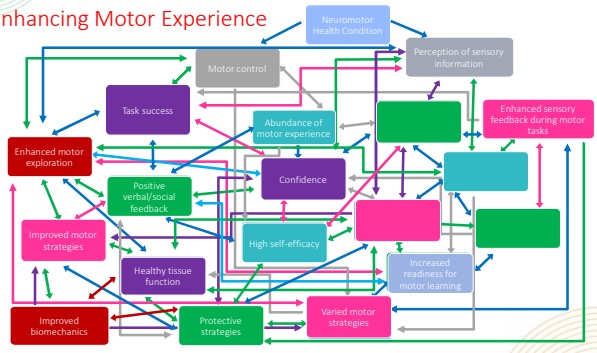
Neuroplasticity: Promoting Self-Efficacy

During a patient interaction:
- Can you use positive language ONLY
- Without patronizing

We know that negative verbal feedback is detrimental to motor learning, so why do we do so much of it?

"Believe in your child so much the world thinks you're crazy. Then believe more."

Enhancing Motor Experience



Enhancing Motor Experience for Neuroplastic Change

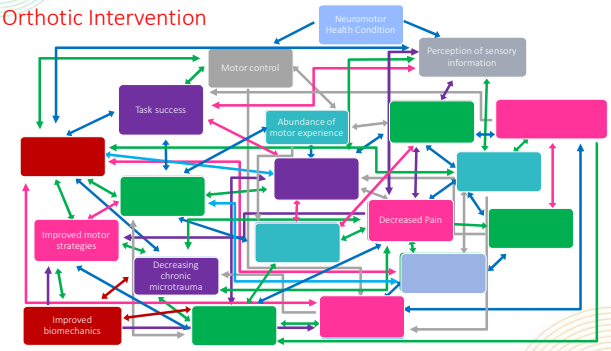
- Engagement
- Effort
- Error

Enhancing Motor Experience: Errors

- Errors are vital to motor learning
  - Reduced-error practice leads to increased errors in retention
  - Negative verbal feedback for errors decreases self-efficacy, performance, and retention
- Enhanced experience:
  - Create ***augmented*** errors that the nervous system can perceive
  - Structure the environment and task to allow for the motor response
- Experience with errors is vital for adaptability of motor skills to new tasks and new environments.

@sailorkinsley

Orthotic Intervention



Orthotic Intervention: Neuroplasticity

Orthoses can guide forces during repetitive movement and sustained alignments in order to:

- provide stress and strain compatible with healthy movement patterns.
- reduce the system's tendency to experience microtrauma and macrotrauma.
- provide **massed practice** of target motor patterns.

Orthotic Intervention: Developmental Neuroplasticity

- Support for emerging neuromotor control
- Support for mass practice of motor skill
- Supporting repeated movements and sustained alignments that promote best possible structural development

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Orthotic Intervention: Neuroplasticity

Orthotic use can:
- Support foot posture and improve biomechanics
- Prevent tissue damage, pain

But it can also:
- Cause paucity of motor and sensory experience
- Restrict emerging motor skills
- How will you reduce this harm?

Orthotic Intervention: Neuroplasticity

NM health condition →
→Altered neuromotor function
-Orthosis-
→~~Excessive pronation~~
→ ~~Loss of key afferent information from the foot intrinsics~~
→ ~~Negative neuroplastic changes~~
→ ~~Additional balance/gross motor impairment~~

Intervention Orthotic Intervention

NM health condition →
→Altered neuromotor function
-Orthosis-
→Loss of key sensory information from plantar surface of foot
→Loss of kinesthetic information from ankle motion
→Negative neuroplastic changes
→Additional balance/gross motor impairment

Intervention
Orthotic Intervention

Orthosis use can:
- Support foot posture and improve biomechanics
- Prevent tissue damage, pain

But it can also:
- Cause paucity of motor and sensory experience
- Restrict emerging motor skills

Orthotic Intervention: Neuroplasticity

- Consider the cost of removing a degree of freedom
- Bracing, especially solid-ankle does not mean no other intervention to the foot and ankle
- We should always look for opportunities to mobilize, strengthen, support motor learning, and provide an enriched experience

Discussion

- Questions or comments?
- Show and tell:
  - foot club box

Make Your Own Foot Club Box

Rules

Do not talk about foot club.

- Only use clean glove or instrument in jars of skin emollients (no double dipping).
- Play-doh jars are one per patient, please label with initials once used.
- Clean IASTM instruments after use.

Possible Supplies

- Tennis-size ball
- Stickers
- Foot model
- Single-serve play doh/foam/gel
- Washable pens
- Massager
- Tools for IASTM
- Peg Blocks
- Toy Cars, dinosaurs, figurines
- Toe Puppets
- Forms: Exam, body maps, foot maps
- ***Use your imagination!***

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Orthotic Design Question 1, Coronal Plane: What support is required to correct alignment of hindfoot and midfoot in the coronal plane to allow dorsiflexion to occur **primarily** at the talocrural joint as the shank advances over the foot? (***Weightbearing Corrective Force Test***)

Tactile cues

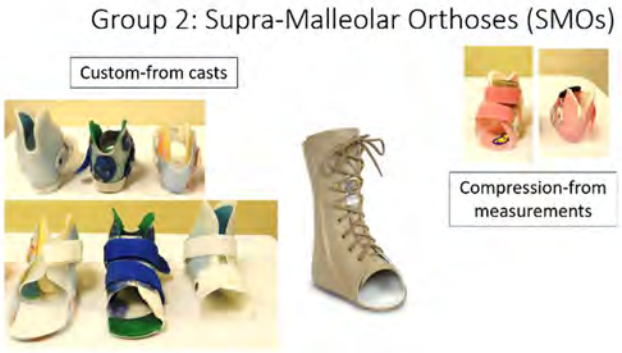
No Intervention/monitor/foot core training

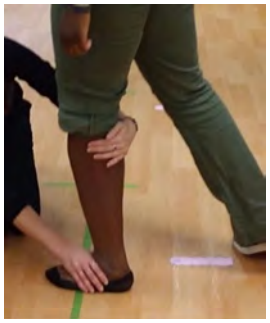
Support at the calcaneous, medial longitunidal arch

Support at the calcaneous, ST, medial longitunidal arch, shaft of the 5th metatarsal

Support at the calcaneous, medial longitunidal arch, shaft of the 5th metatarsal and around the dorsum of the ankle

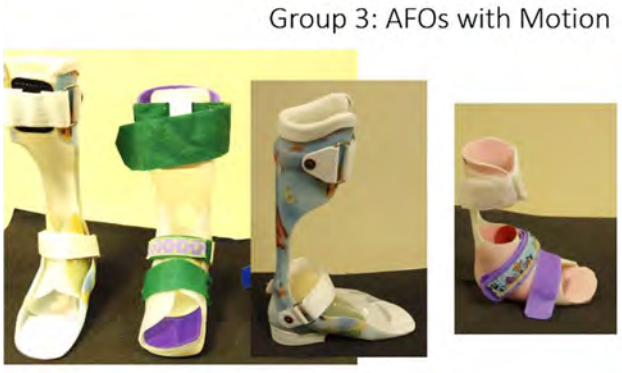
Group 2: Supra-Malleolar Orthoses
-wrap around control





Support at the calcaneus, medial longitudinal arch, shaft of the 5th metatarsal, around the dorsum of the ankle, at the tibia for a longer lever arm

Group 3: AFO with motion (with wrap-around)
-wrap around control with an extension proximal up the tibia for increased lever arm



Triplanar support at the calcaneous, medial longitunidal arch, shaft of the 5th metatarsal, around the dorsum of the ankle, and around tibia

Group 4: Solid AFO with wrap-around

Group 4D: Solid AFO with wrap-around and dynamic element

Question 2: What amount of support does the foot and ankle complex need in the ***sagittal*** plane to obtain 5-15 degree shank angle in midstance? ***How much assistance do you need to provide to the tibia (shank) to control flexion and extension forces during standing and walking?***

None/minimal assistance

None
Shoe insert
SMO
SMO with proximal strap

Moderate assistance

WITHOUT (or minimal) pronation or supination

Group 5: Sagittal Plan Only
-Flexible upright with no/minimal/non-specific mid/hindfoot control.

Anterior strut: better for knee buckling
Posterior strut: better for knee hyperextension

Lack of heelstrike
Toe Drop

Knee extension during LR

Knee collapse/buckling

Excessive flexion during LR

Anterior Shell | Posterior Shell

Moderate assistance

WITH significant pronation or supination

Group 3: AFO with flexible upright
-flexible upright with custom wrap-around

Group 3: AFOs with Motion

Excessively inclined shank (crouch)

Knee collapse/buckling

Excessively reclined shank (knee hyperextension)

Maximal assistance

Group 4: Solid AFO with wrap-around
Group 4D: Solid AFO with wrap-around and dynamic element
-work well when posting is required for shank kinematics
-removes ankle from variables
-focus of motor learning is at knee and hip

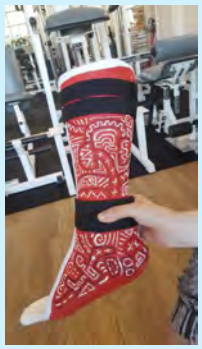
Dependent standing

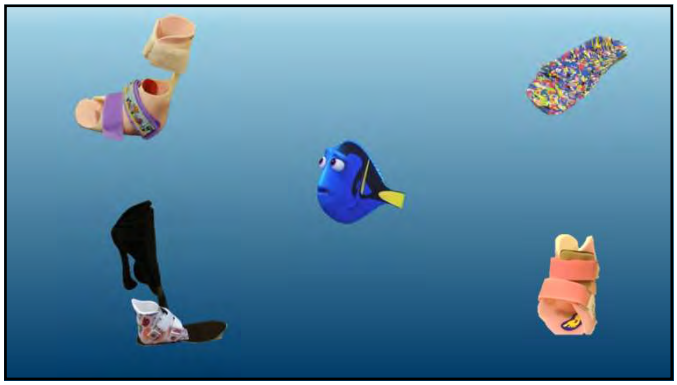
Non-weightbearing positioning

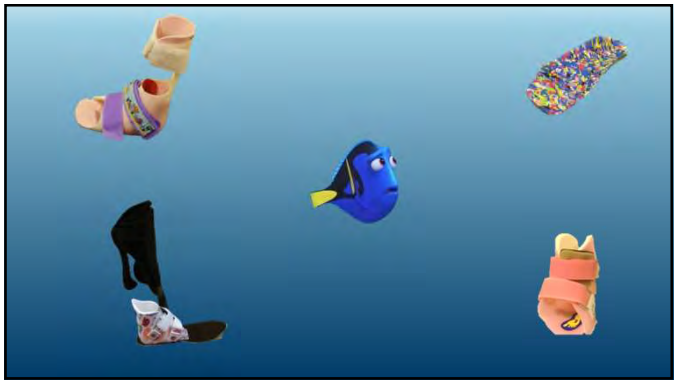
Group 4: AFOs – Solid
Group 4D: AFOs – Solid With Dynamic Element

Intervention

- Range of motion
- Strength and motor control
- Neuroplasticity
- External supports

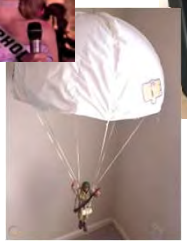






External Supports

Evidence based practice?



Why the difference in recommendations?

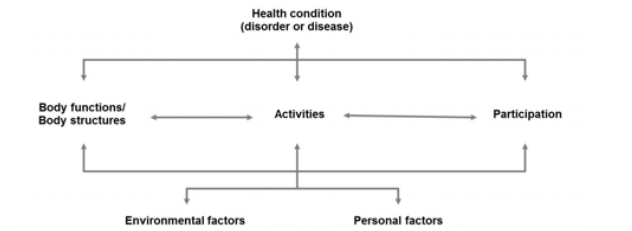
Challenges to EBP

- ICF Model
- Heterogeneity
- Terminology
- Cultures of Intervention

Challenges to EBP:

What is your idea of the perfect brace?

Perfect Brace: ICF Model



World Health Organization. (2001). International classification of functioning, disability and health : ICF. World Health Organization.

Challenges to EBP: ICF Model

- Prioritizing Body Functions and Structures versus Activity and Participation may lead to different recommendations
- Each clinician filters the impact of Environmental and Personal Factors through the lens of their own values and experiences
- Use of a movement system approach can help to facilitate these complex conversations

Goals

Body Structure and Function

- Lessen the impact of cumulative micro-trauma due to sustained alignments or repeated movements
- Externally support hypermobile structures in the movement system which have become the path of least resistance for ground reaction forces
- Direct forces toward target structures to increase their relative flexibility

Goals

Body Structure and Function

- Restrict or resist motions in planes not compatible for healthy biomechanics
- Influence neuromuscular activation patterns during gait and other weightbearing activities

Goals

Activities

- Improve
  - Function
  - Efficiency
  - Safety

Goals

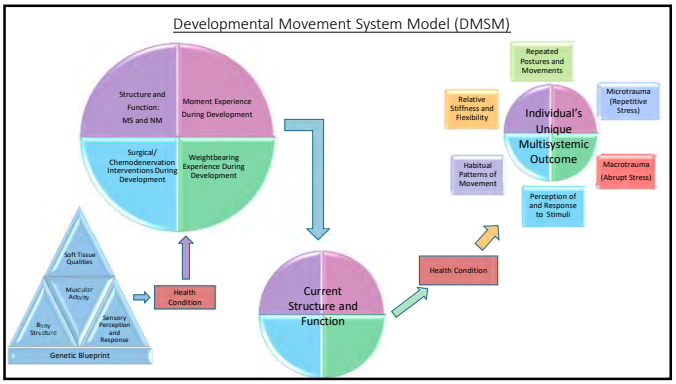
Environment

- Increase ***direct access*** to goal environments and structures

Goals

Participation & Personal Factors

- Social acceptance
- Self acceptance
- Fit in
- Stand out
- Appear neurotypical
- Celebrate differences
- Be cool



Goals

Developmental Movement System Model

For the patient as an **adult**:

- Minimize negative sequelae of developing in the context of a pediatric health condition
- Minimize **pain**
- Maximize **structural resilience** of the movement system
- Maximize neuromotor function and **access to varied movement** options

Goals

Developmental Movement System Model

For the patient as an adult:

- Maximize the **environments and activities** the patient can access with their movement system
- Maximize **acceptance** of individual differences
- Maximize the ability to **self-advocate** and access appropriate resources
- Maximize work and social **engagement** as an adult

Challenges to EBP: "Efficacy" of Orthoses

What outcome does each study value?

What level of the ICF are they focusing on?

Which bracing option is most "effective"?

Challenges to EBP: Heterogeneity

Krzak JJ, Corcos DM, Damiano DL, Graf A, Hedeker D, Smith PA, Harris GF. ***Kinematic foot types in youth with equinovarus secondary to hemiplegia.*** Gait Posture. 2015 Feb;41(2):402-8.

- Participants ***with hemiplegia and equinovarus*** fell between
  - **Five distinct subgroups -**
- Neurotypical controls were distributed among **4** of the subgroups
- Noted: **inherent variability even in neurotypical, asymptomatic movement systems**

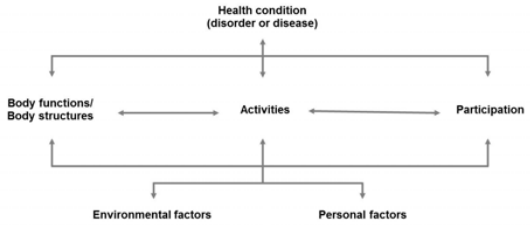
Challenges to EBP: Heterogeneity

Are cohorts meaningful?

Do glasses work for individuals with visual impairment?

Challenges to EBP:

Meaningful Cohorts



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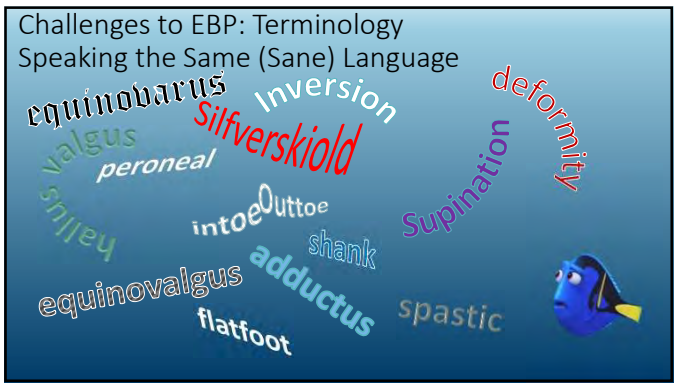
Challenges to EBP: Terminology
Speaking the Same (Sane) Language



Challenges to EBP: Terminology
Inconsistency

Terminology of orthoses

External Supports

Evidence?

- Eddison M. Do research papers provide enough information on design and material used in ankle foot orthoses for children with cerebral palsy? A systematic review. Journal of children's orthopaedics. 2017;11(4):263-271.

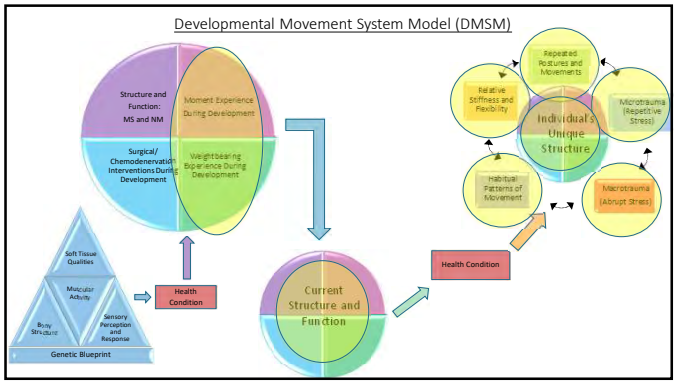
Building an orthotic decision-making framework

External Supports

- Targeted use of external support to guide adaptive tissue-specific stresses
- Adjuncts to joint mobilization/soft tissue interventions

External Supports

- Support for emerging neuromotor control
- Support for mass practice of motor skill
- Supporting repeated movements and sustained alignments that promote best possible structural development



Orthotic Intervention

Developmental Movement System Model

An orthoses can guide forces during repetitive movement and sustained alignments in order to:

- provide stress and strain that encourage tissues to form in a manner compatible with healthy movement patterns.
- reduce the system's tendency to experience microtrauma and macrotrauma in the future.
- provide mass practice of target motor patterns.

Orthotic "Prescription" versus "Design"

- Eddison M. Do research papers provide enough information on design and material used in ankle foot orthoses for children with cerebral palsy? A systematic review. Journal of children's orthopaedics. 2017;11(4):263-271.

Orthotic "Prescription" versus "Design"

Prescription: Capturing the individual characteristics of the movement system, including structural variants and support of compromised or at-risk structures

Design: Selection of brace features

Orthotic "Prescription" versus "Design"

- Prescription: helping the body interface with the world

Orthotic "Prescription"

- Developed from our Movement System Analysis
- This is a KEY ELEMENT of brace design, apart from style selection, and a key fault of ineffective orthoses.
  - If the style selected is correct, but the movement system has not been captured and supported specifically, the brace will not be appropriate.
  - Appropriate prescription may outweigh appropriate design.

Orthotic **Prescription**

- ❑ Structural Findings

  What structural findings need to be captured in the device to allow the movement system to interface with the world?

Orthotic Prescription: Musculoskeletal Findings

- Developing the orthotic prescription

Musculoskeletal Findings

- ❑ Structural variants
  - ❑ Atypical structure
  - ❑ TC Axis test: TC joint alignment
  - ❑ Structural findings:

	Coronal Plane	Transverse Plane
Hip/femur		
Knee/tibia		
Hindfoot		
Midfoot		
Forefoot		

Orthotic **Prescription**: TC Axis Test

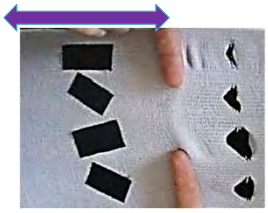
- ❒ Structural variants
  - ❒ Atypical structure
  - ❒ TC Axis test: TC joint alignment
  - ❒ Structural findings:

- Identifying the axis of the talo-crural joint
- Identifying structural variants

Orthotic **Prescription**

❑ Functional Findings

- In what way does the system tend to move?
- What structures need protection?
- What structures need forces directed to them?



Musculoskeletal Findings

❑ Functional Variants
- ❑ DF Stress test, End feel
- ❑ Joint Function
- ❒ Neutral hindfoot
- ❒ Pronated hindfoot
- ❒ Supinated hindfoot

	Alignment, Joint Mobility, End feel, Arthrokinematics, ROM
Distal tib/fib	
Talo-crual	
Subtalar	
Midtarsals	
Forefoot	
Digits	

Orthotic Prescription: DF Stress Test

- ❒ Functional Variants
  - ❒ DF Stress test, End feel
    - ❒1-Neutral hindfoot_____
    - ❒2-Pronated hindfoot_____
    - ❒3-Supinated hindfoot_____

- Where does DF (foot towards tibia) occur when a general stress is applied?
- What structures limit further motion in the direction of foot toward tibia?

Orthotic Prescription: DF Stress Test

- ❒ Functional Variants
  - ❒ DF Stress test, End feel
    - ❒1-Neutral hindfoot_____
    - ❒2-Pronated hindfoot_____
    - ❒3-Supinated hindfoot_____

2. Pronated hindfoot

Orthotic Prescription: DF Stress Test

- ❒ Functional Variants
  - ❒ DF Stress test, End feel
    - ❒1-Neutral hindfoot_____
    - ❒2-Pronated hindfoot_____
    - ❒3-Supinated hindfoot_____

3. Supinated hindfoot

Orthotic Prescription: Musculoskeletal Findings

- Do all individuals with structural or functional variants need orthotics?

Structural Variants



Functional Variants

Functional Variants

Orthotic Prescription: Musculoskeletal Findings

- Joint Function
  - Maladaptive relative stiffness/flexibility
  - Altered line of pull of muscles around joints

Orthotic "Prescription" versus "Design"

Prescription: Capturing the individual characteristics of the movement system, including structural variants and support of compromised or at-risk structures

Design: Selection of brace features

Orthotic Terminology

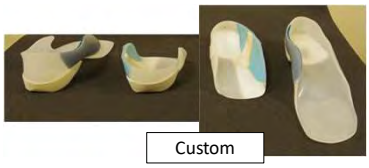
- Eddison M. Do research papers provide enough information on design and material used in ankle foot orthoses for children with cerebral palsy? A systematic review. Journal of children's orthopaedics. 2017;11(4):263-271.

Orthotic Design: Groups

- Group 1: Foot Orthotics (FO)
- Group 2: Supra-Malleolar Orthotics (SMO)
- Group 2+: SMO+
- Group 3: AFO with Movement (AFO-M)
- Group 4: AFO – Solid (AFO-S)
- Group 4D: Solid with Dynamic Element
- Group 5: AFO – Sagittal Plane Only (AFO-Sag)

Group 1: Foot Orthotics (FOs)

Off The Shelf



Custom

Group 2: Supra-Malleolar Orthoses (SMOs)

Custom-from casts

Compression-from measurements

Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Group 3: AFOs with Motion

Group 3: AFOs with Motion
Flexible Upright
(Posterior Leaf Spring)

Group 3: AFOs with Motion
Flexible Upright

Group 3: AFOs with Motion
Articulated

Free DF

DF Assist

Group 4: AFOs – Solid

Group 4: AFOs – Solid

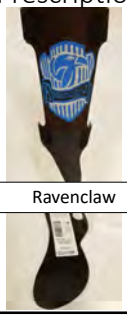
Group 4D: AFOs – Solid With Dynamic Element

Group 5: AFOs – Sagittal Only
No Prescription

Anterior Shell

Posterior Shell

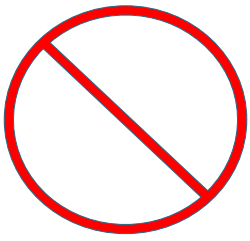
A/P
(+ false coronal)



Ravenclaw

- Questions about groups?

Rules: Remember the Roast!



Orthotic "Prescription" versus "Design"

Prescription: Capturing the individual characteristics of the movement system, including structural variants and support of compromised or at-risk structures

Design: Selection of brace features

Brace "Prescription" versus "Design"

Prescription: Capturing the individual characteristics of the movement system, including structural variants and support of compromised or at-risk structures

Design: Selection of brace features

1. Coronal Plane
2. Sagittal Plane

Orthotic Design Charts: amandahallpt.com/resources

Orthotic Design: Coronal Plane

Orthotic Design: Sagittal Plane

Orthotic **Design: Coronal Plane**

- NWB Corrective Force

  What support is required to:

  Bring the foot and ankle in into position with the joints congruent?

Orthotic **Design: Coronal Plane**

- WB Corrective Force Test

  What support is required to:

  correct alignment of hindfoot and midfoot in the frontal and transverse planes to ***allow dorsiflexion to occur primarily*** at the talocrural joint as the shank advances over the foot?

Orthotic **Design: Coronal Plane**

- WB Corrective Force Test

*Coronal Plane Chart
Orthotic Design: Coronal Plane

Support needed:
Cueing

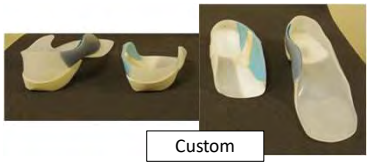
Group 0

- No Intervention
- Monitor
- Stability and foot core training

Support at the calcaneous, medial longitunidal arch

Group 1: Foot Orthotics (FOs)

Off The Shelf



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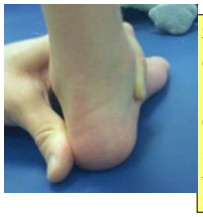


Support at the calcaneous, medial longitunidal arch, shaft of the 5th metatarsal and around the dorsum of the ankle

Group 2: Supra-Malleolar Orthoses (SMOs)
Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Support at the calcaneous, medial longitunidal arch, shaft of the 5th metatarsal, around the dorsum of the ankle, at the tibia for a longer lever arm

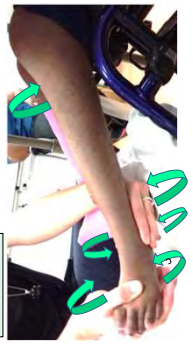
Supinated Hindfoot

- Supinated posture

Group 3: AFOs with Motion

Group 5: AFOs – Sagittal Only

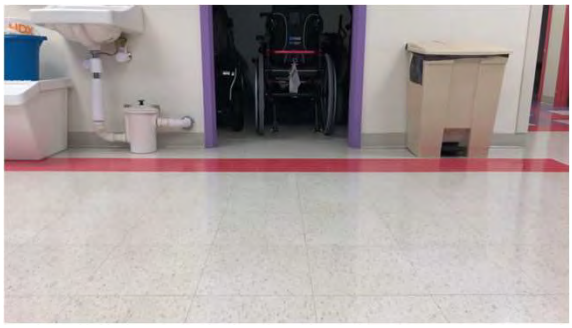
Anterior Shell | Posterior Shell | A/P (+ false coronal)



Triplanar support at the calcaneous, medial longitunidal arch, shaft of the 5th metatarsal, around the dorsum of the ankle, and around tibia

Group 4: AFO – Solid

Group 4: AFO – Solid



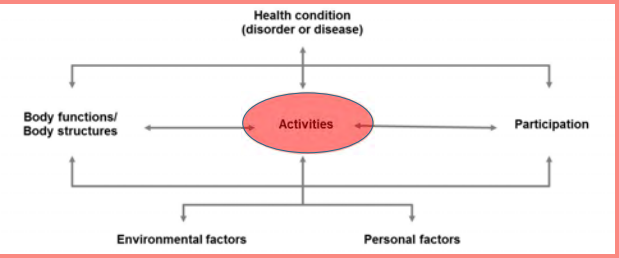
Brace "Prescription" versus "Design"

Prescription: Capturing the individual characteristics of the movement system, including structural variants and support of compromised or at-risk structures

Design: Selection of brace features

1. Coronal Plane
2. Sagittal Plane

Functional Status and Task analysis



Sagittal Plane Chart
Locomotor functions

- Stance stability
- Propulsion
  - Advancement of the body over the supporting foot depends on stance limb mobility
- Shock absorption
- Energy conservation

(Perry)

Orthotic Design: Sagittal Plane

❑Does not stand

❑Stands but does not ambulate
- ❑With device (stander or gait trainer)
- ❑Stands for transfers or other function
- ❑Pre-ambulatory

What support is required to:

→Support the foot and ankle for safety, weightbearing, and the individual's activities?

Does Not Stand/Limited Standing

Group 0: No Orthotic

Does Not Stand/Limited Standing

Group 4: AFO – Solid

Orthotic Design: Sagittal Plane

❑Initial contact, loading response

What support is required to:

→Encourage knee flexion versus extension moment during loading response?

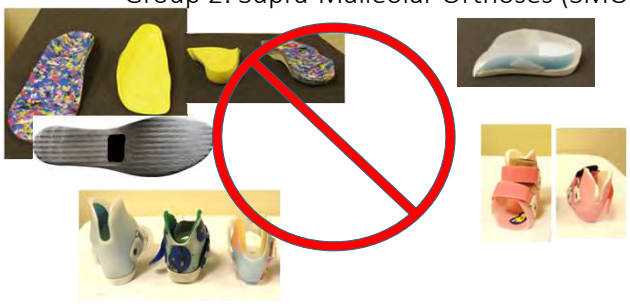
or

→Improve eccentric control of tibial advancement during loading response?

Loading Response

Group 1: Foot Orthotics (FOs)

Group 2: Supra-Malleolar Orthoses (SMOs)



Loading Response

Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Loading Response

Group 3: AFOs with Motion

- DF Assist, DF Free

Loading response: Mechanical Assist to control GRF

Assisted Loading response

- Assist to dampen the impact of GRF through the kinetic chain
- Upright with dynamic element (PLS/PDE = Posterior Leaf Spring/Posterior Dynamic Element)

Loading Response

Group 3: AFOs with Motion

Posterior Leaf Spring - Assist in eccentric slowing of the shank

Loading Response

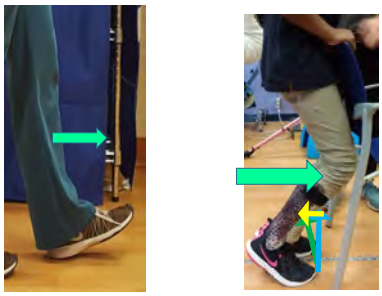
Group 4: AFOs – Solid

Stops progression of shank, chooses one angle and takes you straight there.

Loading Response

Group 4: AFOs – Solid

Stops progression of shank?



Loading Response:
Shank Reversal

Group 5: Sagittal Only AFOs

Anterior Shell

Posterior Shell

Group 5: Sagittal Only AFOs

Loading Response:
Impaired Eccentric Control/
Knee buckling

Anterior Shell

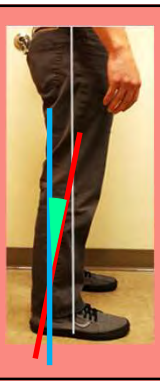
Posterior Shell

Orthotic Design: Sagittal Plane

❑Midstance

What support is required to:

- Obtain 5-15 degree shank angle in midstance/quiet standing?



Inclinometry: Shank Angle

Aligning Orthoses for Therapeutic Gait: Posting

- There can be 2 angles in an AFO:
  - Angle of the ankle in the orthosis
  - Angle of the shank (tibia) to the floor

Aligning Orthoses for Therapeutic Gait: Coronal Plane

- Hindfoot
- Forefoot

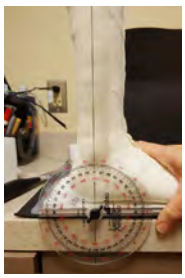
Aligning Orthoses for Therapeutic Gait: Coronal Plane

Aligning Orthoses for Therapeutic Gait: Sagittal Plane

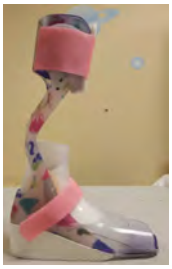


Aligning Orthoses for Therapeutic Gait: Sagittal Plane


Aligning Orthoses for Therapeutic Gait: Sagittal Plane



Aligning Orthoses for Therapeutic Gait: Sagittal Plane


❒1-Shank Angle WFL

Movement system is able to compensate for any changes at the foot/ankle

-or-

The greater movement system is ***driving*** the change in the foot/ankle

I. Shank angle within functional limits

Goals for alignment:

- Heel contact at initial contact
- Hindfoot weightbearing throughout stance
- Increase step length and time in terminal stance
- Angle: typically 3-7 degrees

I. Shank angle within functional limits

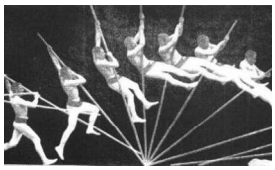
Assisted Initial Contact at heel

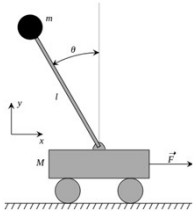
- Heel contact is a vital sensory trigger to stimulate eccentric GS function
- Bring floor up to heel

Midstance: Mechanical Assist for heel contact

Assisted weightbearing through heel

- Heel contact mechanically stabilizes the calcaneus to allow for controlled tibial motion





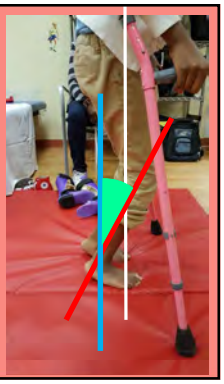
Inverted Pendulum

❑ 2-Excessively inclined shank (crouch)

Weight line

- anterior to hip
- posterior to the knee

Shank angle > 15 degrees



II. Excessively inclined shank (crouch)

Weight line is anterior to the hip and posterior to the knee.

All of the GRF moments are flexion, in all phases of gait.

II. Excessively inclined shank (crouch)

Old conventional wisdom: set shank in a negative angle to push the shank backwards.

In reality, the foot has an inefficient lever arm for this to be effective, and the patient lifts the heel.

II. Excessively inclined shank (crouch)

Current theory: Bring the floor up to the heel to provide:

- Heel contact at initial contact and midstance
- Provide a base for the thigh to move from reclined to inclined

Begin to each the motor system to load through the posterior aspect

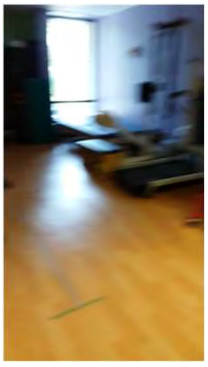
Compromise towards the chosen shank angle to get heel contact

Gradually reduce the shank angle as posterior structures lengthen and motor learning occurs

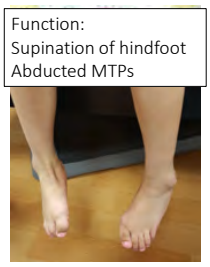
- Angle: typically 15-18 degrees

II. Excessively inclined shank (crouch)

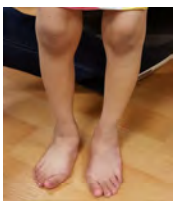
Treatment focuses on learning to bring the thigh from reclined to inclined over a stable base in midstance and quiet stance.



Structure:
Hindfoot varus
Metatarsus adductus, varus



Function:
Supination of hindfoot
Abducted MTPs



Function: ~~"Pes Valgus"~~
Pronated hindfoot, midfoot
Abducted MTPs

- 2-Excessively inclined shank (crouch)

Old conventional wisdom: set shank in a reclined angle angle to push the shank backwards. ("Floor reaction AFO")

In reality, the foot has an inefficient lever arm for this to be effective, and the patient lifts the heel.

❑ 2-Excessively inclined shank (crouch)

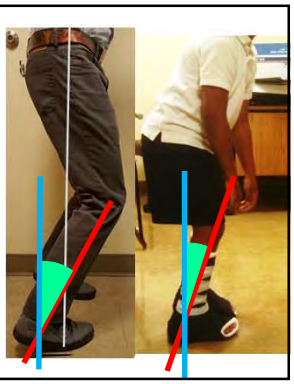
Current theory: Bring the floor up to the heel to provide:

- Heel contact at initial contact and midstance
- Provide a base for the thigh to move from reclined to inclined
- Post to 15-18 degrees, goal to reduce shank angle over time

❑ 2-Excessively inclined shank (crouch)

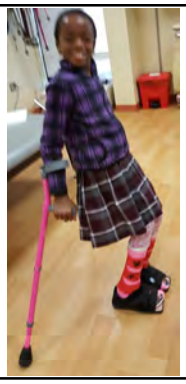
Begin to teach the motor system to load through the posterior aspect

Compromise towards the chosen shank angle to get heel contact



❑ 2-Excessively inclined shank (crouch)

- Gradually reduce the shank angle as posterior structures lengthen and motor learning occurs



Excessively Inclined Shank

Group 1: Foot Orthotics (FOs)
Group 2: Supra-Malleolar Orthoses (SMOs)
Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Excessively Inclined Shank

Group 3: AFOs with Motion

- DF Assist, DF Free

Excessively Inclined Shank

Group 3: AFOs with Motion

Posterior Leaf Spring

Midstance
Mechanical Assist to slow tibial progression

Assisted Midstance:

Dynamic Upright (Posterior Leaf Spring/ Posterior Dynamic Element)

1) Grade tibial progression
2) Stabilize the knee by slowing tibia motion relative to femur motion

Excessively Inclined Shank

Group 4: AFOs – Solid

Removes a degree of freedom—provides a stable base to work on proximal skills for standing and gait alignment.

Highly recommend dynamic solid for shock absorption

Excessively Inclined Shank

Group 5: Sagittal Only AFOs

Anterior Shell

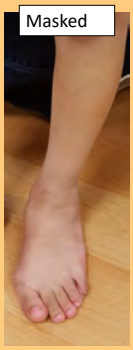
Posterior Shell

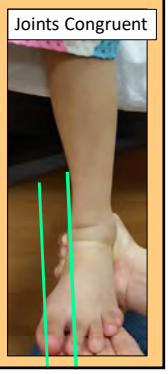
A/P
(+ false coronal)

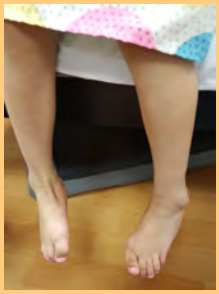
Ravenclaw

❒Structural Variants

	Coronal Plane	Transverse Plane
Midfoot	Metatatarus Varus	Metatarsus Adductus







❑ 2-Excessively inclined shank (crouch)

Treatment focuses on learning to bring the thigh from reclined to inclined over a stable base in midstance and quiet stance.

Excessively Inclined Shank

Group 5: Sagittal Only AFOs

Anterior Shell

Posterior Shell

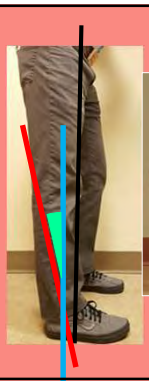
A/P
(+ false coronal)

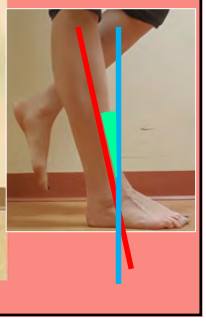
Ravenclaw

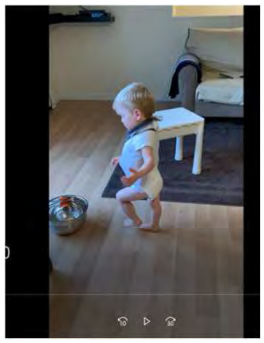
- 3-Excessively reclined shank (knee hyperextension)

Weight line

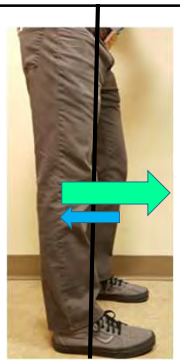
- anterior to hip
- anterior to the knee







- 3-Excessively reclined shank (knee hyperextension)
  - Goal: bring the shank angle forward enough to overcome the tendency for the system to create an extension moment.



Excessively Reclined Shank

Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Excessively Reclined Shank

Group 3: AFOs with Motion

- DF Assist, DF Free
- If set with a PF block, may overcome reclined shank moment while allowing the gastrocsoleus perform eccentric control of DF.

Excessively Reclined Shank

Group 3: AFOs with Motion

Posterior Leaf Spring

Excessively Reclined Shank

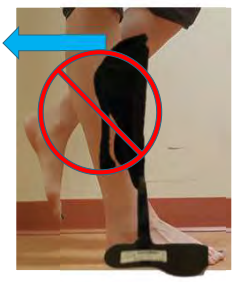
Group 4: AFOs – Solid

- Removes a degree of freedom—provides a stable base to work on proximal skills for standing and gait alignment.
- This stability may assist with motor learning to increase loading through the limb.

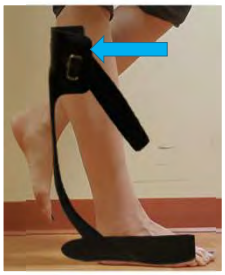
Excessively Reclined Shank

Group 5: Sagittal Only AFOs

Anterior Shell



Posterior Shell

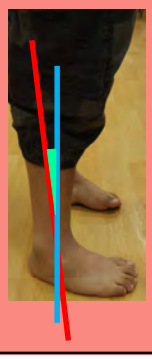


Special cases

- Primary muscular weakness

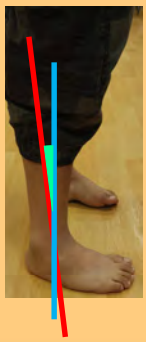
❑ 3-Excessively reclined shank (knee hyperextension)

Weight line
- anterior to hip
- anterior to the knee



Musculoskeletal Findings

❑Altered muscle strength or endurance due to health condition
- Weight line is aligned anterior to knee to maintain knee stability
- Shank angle reclined
- Forcing the shank forward will cause uncontrolled knee flexion (buckling) and loss of stability in standing



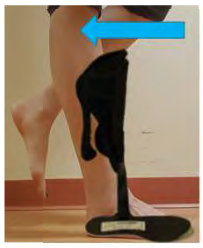
Excessively Reclined Shank + Primary lower extremity weakness

Group 4: AFO – Solid

Excessively Reclined Shank + Primary lower extremity weakness

Group 5: Sagittal Only AFOs

Anterior Shell



Posterior Shell

- "B"

Excessively Reclined Shank +
Primary lower extremity weakness

Excessively Reclined Shank +
Primary lower extremity weakness

- Terminal Stance
  3rd Rocker

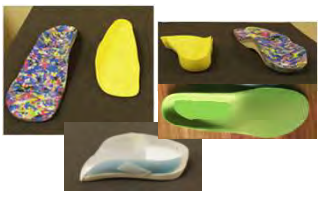
What support is required for:
→Heel contact
→with knee extension
and
→hip extension

3rd Rocker

Group 1: Foot Orthotics (FOs)

Stiff 3rd rocker

Flexible or free 3rd rocker

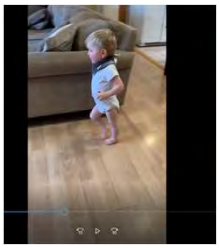


3rd Rocker

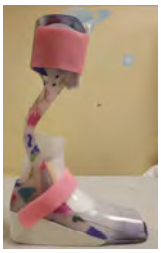
Group 2: Supra-Malleolar Orthoses (SMOs)
Group 2+: Supra-Malleolar Orthoses+ (SMO+)

Stiff 3rd rocker

Flexible or free 3rd rocker



Group 3: AFOs with Motion
Flexible Upright



Group 3: AFOs with Motion
Articulated


Free DF

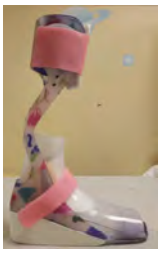

DF Assist

- Terminal Stance
  4th Rocker

What support is required to:
→Store energy to assist with push-off
→Move from stance to swing efficiently?
→(Heel whip)

Energy Storage

Group 3: AFOs with Motion
Flexible Upright



Energy Storage





Mechanical Assist for "spring off"

Assisted terminal stance

- Upright with dynamic element (Posterior Leaf Spring/ Posterior Dynamic Element)

Energy Storage

Group 3: AFOs with Motion
rticulated

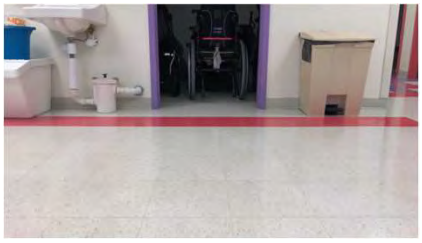
Free DF

DF Assist

Energy Storage

Group 4: AFOs – Solid

Posterior Leaf Spring/ Posterior Dynamic Element



Energy Storage

Group 5: Sagittal Only AFOs

Anterior Shell

Posterior Shell

A/P
(+ false coronal)

Functional Status and Task analysis

Swing phase
- ❑Foot clearance

What support is required for:
→Foot clearance

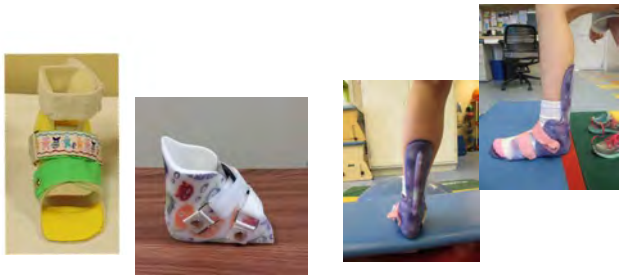
→Limb positioning at terminal stance

Swing

Group 1: Foot Orthotics (FOs)
Group 2: Supra-Malleolar Orthoses (SMOs)

Swing

Group 2+: Supra-Malleolar Orthoses+ (SMO+)



Swing

Group 3: AFOs with Motion
Flexible Upright

Swing

Group 3: AFOs with Motion rticulated

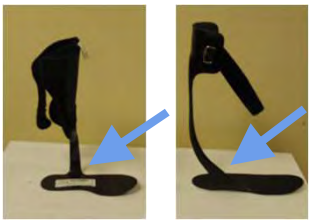
Free DF

DF Assist

Group 4: AFOs – Solid

Swing

Group 5: Sagittal Only AFOs



2 points of control, depend on shoe for the 3rd.

Effective to support clearance and pre-positioning with
- Weakness
- Cueing

not against active resistance.

Functional Status and Task analysis

- Transverse and Coronal Plane findings

Posting

Loading response: Mechanical Assist to control GRF

Assisted Initial Contact at heel

- Heel contact is a vital sensory trigger to stimulate eccentric GS function
- Bring floor up to heel

Midstance:
Mechanical Assist for heel contact

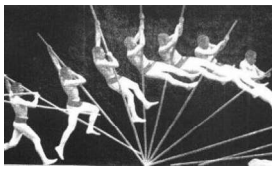
Assisted weightbearing through heel

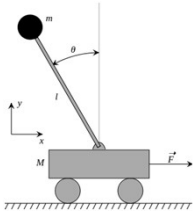
- Heel contact is a vital sensory trigger to stimulate eccentric GS function
- Heel contact mechanically stabilizes the calcaneus to allow for controlled tibial motion

Midstance:
Mechanical Assist for heel contact

Assisted weightbearing through heel

- Heel contact mechanically stabilizes the calcaneus to allow for controlled tibial motion





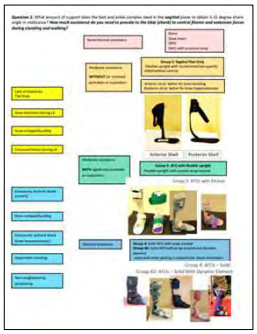
Inverted Pendulum

Midstance:
Mechanical Assist for heel contact

Assisted weightbearing through heel

- Heel contact is a vital sensory trigger to stimulate eccentric GS function
- Heel contact mechanically stabilizes the calcaneus to allow for controlled tibial motion
- Relative stiffness of the GS and ankle are common; posting the heel may decrease functional resistance to forward movement of the shank
- Bring floor up to heel

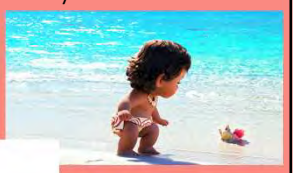
Coronal Plane

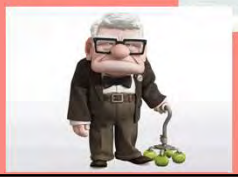


Sagittal Plane

Functional Status and Task analysis

- ***Lifespan*** Status
  Goals related to movement experiences based on current developmental status.





Lifespan Status

Older Adults

- Falls associated with:
  - Foot pain
  - Abducted 1st ray (Hallux valgus)
  - Lesser toe abduction/malalignment
  - Chronic midfoot pronation posture

Lifespan Status

Older Adults

- Foot problems are associated with:
  - Falls
  - Frailty level
  - Decreased motor performance

Lifespan Status

Older Adults

- Age-related changes
  - LE muscle strength and power
    - specifically great toe and ankle muscles
    - contribute decreases in balance and gait
  - Skin and soft tissue changes to the plantar surface
    - associated with:
      - decreased balance
      - increased fall risk

Fall Risk Reduction in Older Adults

- Safer with shoes at all times, even in the house, especially for people with diabetes.
- The lower the top of the shoe is, the less stability and input it provides.
- Orthotics can improve sensory and mechanoreceptor input.
- AFOs improve stability and sensory input to improve balance and reduce fall risk.

Orthotic Design: Neuromotor

- What external support is needed for mass practice of target motor skills?
- What external support decreases tonic contractions which lead to sustained alignments that would contribute to pathoanatomical changes?

→Foot and ankle
→Elsewhere in kinetic chain

Sensory Perception and Pain

Informs
- Orthotic design

What support is needed for the foot intrinsics to receive relevant balance information?

Relevant Systems

Informs
- Orthotic decision
- Orthotic design

Individual Characteristics

Informs
- Orthotic decision
- Orthotic design
- Orthotic aesthetics
- Orthotic dosage

Minimizing Negative Impacts of Orthotic Intervention on Activities and Participation

Individual Characteristics: Aesthetics

What are our beliefs around the rights of individuals with complex healthcare needs and:

- Fault
- Self Expression
- Autonomy
- Body boundaries

?

Individual Characteristics: Aesthetics

- Physical therapists have an ethical responsibility to support the autonomy of patients, especially those who may have decreased abilities to make choices in their lives and particularly to set boundaries around their bodies.
- We should avoid adding "insult to injury" with ugly orthoses.

Special cases

- Limited DF ROM
  - Stretching orthotics

Comprehensive Treatment Plan

- Consider the cost of removing a degree of freedom
- Bracing, even solid-ankle does not mean no other intervention to the foot and ankle
- We should always look for opportunities to mobilize, strengthen, and support motor learning
- Dosage can be key for multiple movement experiences

- Do you resist to strengthen or support/assist?

Comprehensive Treatment Plan

Orthotic Plan		
	Setting	Schedule
No Device		
Device 1		
Device 2		
Device 3		

Physical Therapy:
Home Program:
Community Exercise Activity:

Orthotics

Dosage and plan

What do your orthotic recommendations take away from the system?

How will you reduce this harm?

Case Studies

1. Exam What are you suspicions in each area?
   - What do you want to test further?
   - What is your theory for the drivers and limiting factors
2. Goals

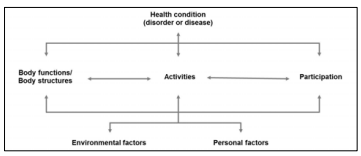
   What are your goals in different areas of the ICF?
   - 1 month/6 months/1 years/5 years/10 years/20 years?
3. Manual therapy
4. Therapeutic Exercise
5. Neuroplasticity
   - *Novel activity*
6. Education
7. Orthotic
   - Consider multiple devices
   - Dosage and plan

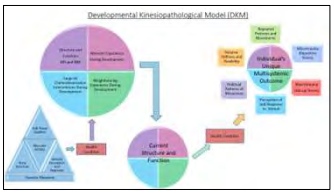
- Going above the knee

- Ethics wheels versus walking

Take Home

Evidence: roast, parachute, stool
DMSM: treating the future of the patient
Exam: Finding true TC joint motion
Mobilizations:
↓calcaneal with post talus
soft tissue
Ther ex:
resisted diagonal step down
Neuroplasticity: Emoji therapy
Therapeutic alliance: Challenge yourself to use positive language only
Foot club box
Orthotics: Coronal versus sagittal plane decision making





Thank you!!!!!!!!

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