Are We Underserving
the Pediatric Ankle?

Supporting Development Through A
Multi-System Approach

Amanda Hall, PT, MPT
Board-Certified Pediatric Clinical Specialist
Assistive Technology Professional

Disclosure

- No relevant financial relationship exists

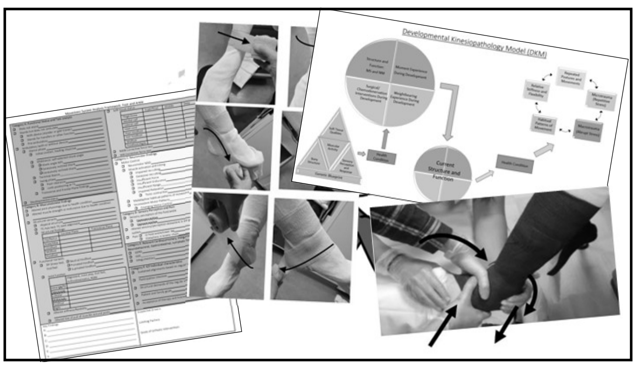
Learning Objectives

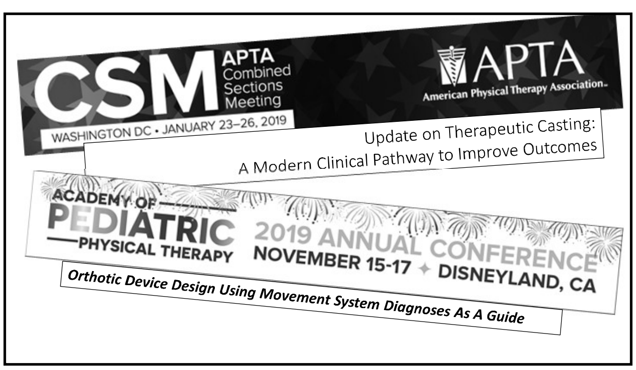
- Recognize the interplay of Musculoskeletal and Neuromuscular Movement System Diagnoses and neuroplastic changes on foot and ankle dysfunction.
- Describe the impact of altered foot and ankle function during development on the structural outcome of the movement system.
- Identify treatment techniques to address relative stiffness and flexibility in foot and ankle mobility and function.
- Design a progressive strengthening program to improve intrinsic stability of the foot and ankle for children with neuromuscular health conditions.

Introduction

Motor Control/Systems Theory
    Anne Shumway-Cook
Shirley Sahrmann
    Movement Systems
    Kinesiopathology
PNF
    Institute of Physical Art
    Mary Massery
Ortho foot and ankle
Pediatric complex care
Therapeutic casting


135 YEARS
THE HSC HEALTH CARE SYSTEM


Developmental Kinesiopathology Model (DKM)


CSM
APTA Combined Sections Meeting
WASHINGTON DC • JANUARY 23–26, 2019
APTA
American Physical Therapy Association
Update on Therapeutic Casting:
A Modern Clinical Pathway to Improve Outcomes
ACADEMY OF PEDIATRIC PHYSICAL THERAPY
2019 ANNUAL CONFERENCE
NOVEMBER 15-17 ✦ DISNEYLAND, CA
Orthotic Device Design Using Movement System Diagnoses As A Guide


madcaster
-SIGN MY CAST? GUYS?
wethepeopledc


Peppa Pig


news
STYLE
A PHYSICAL THERAPIST MAKES CASTS FOR KIDS THAT LOOK LIKE YEEZY BOOSTS
abc NEWS
Tiny 'Star Wars' Cast Latest Creation From 'Madcaster'
Mashable
This Physical Therapist Transforms Casts Into Fun, Wearable Art For Kids

CSM 2019

- Sports Medicine Secrets: Ankle and Foot Strength, Mobility, and Coordination Deficits. S. Bell, M. LeMoine, D. Marcos. *(AOPT)*
- A Foot Core Approach to Treating Plantar Fasciitis. L. Wasserman. *(AOPT)*

CSM 2019

- 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)
- PT from head (motor learning, pain psychology) to toe (foot & ankle mechanics). M. Hastings, R. Chimenti, B. Fisher (AOPT)

CSM 2019

- 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. Low, S. Schmidt, P. Mintken (AHUEPT)

CSM 2019

- Dealing with the Dark Side of Neuroplasticity: **Pain In Neurorehabilitation**. S. Schmidt, A. Low. (ANPT)
- Can **Fear** or Other **Psychological Factors** Alter Movement After **ACL** Reconstruction? T. Chmielewski, A. Meierbachtol, R. Mizner, R. Zarzycki (Section on Research)
- **Science** meets practice: Watch Your Mouth! **Verbal Cues** Effect Lower Extremity Performance. J. Thein-Nissenbaum, M. Paterno, C. Mack (AASPT)

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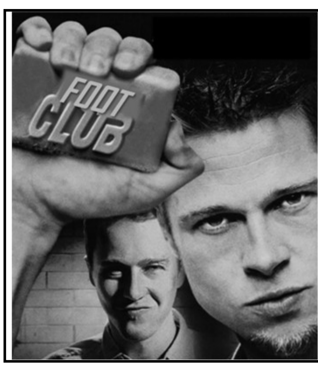
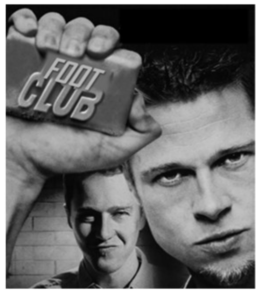


Rules

1. We do not talk about foot club
2. We use relevant adult research to benefit our patients
3. Final Slides:

amandahallpt.com/csm2020

I. Introduction
II. Pediatric Ankle Impairments
III. Do We Need to Intervene?
IV. How Should We Intervene?



What Are We Even Saying?

- Terminology

Terminology: Inconsistency - Neuromotor

*Tone**
*Hypertonus**
*Dynamic spasticity**
*Flatfoot**
*Spastic**
*R1/R2**

Used in current literature describing foot and ankle involvement in the* ***neurotypical* *population*

Terminology: Inconsistency

"You keep using that word. I do not think it means what you think it means."
-Inigo Montoya

Terminology: Inconsistency - Neuromotor

Passive muscle properties are contributing to perceived hyperreflexia in:
- Cerebral palsy
- Acquired brain injury
- Hemiplegia
- Stroke

Terminology: Inconsistency - Neuromotor

Passive muscle properties are altered in children with cerebral palsy before the age of 3 years and are difficult to distinguish clinically from spasticity. (Willerslev-Olsen 2013)
- Only 7/35 children determined as having spasticity via MAS/Tardieu had enhanced stretch reflexes with EMG.
- Enhanced stretch reflexes contributed to muscle stiffness in a **minority** of cases.
- Change in passive muscle properties were much more frequently contributing.

Terminology: Inconsistency - Neuromotor

The relationship between medial gastrocnemius lengthening properties and stretch reflexes in cerebral palsy. (Bar – On 2018)

- “large variability in the amount of muscle lengthening and hyperactive stretch reflex”
- “muscle lengthening and stretch reflex hyperactivity in medial gastrocnemius muscles of children with CP is highly variable and that the two do not necessarily co-exist."
- Authors noted: "muscle stiffness may actually be considered as a protective mechanism"

Terminology: Inconsistency - Neuromotor

Assumptions → Observations

Terminology

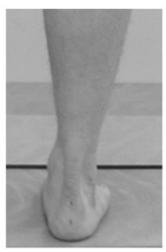
Assumption/Unclear		Specific/Observation
Tight		Short
		Stiff
	→	Increased density
		Increased response to stretch
		Tonically contracting

Terminology

Assumption/Unclear		Specific/Observation
Tight		Short
Spasticity		Stiff
Hypertonia	→	Increased density
Hyperreflexia		**Increased response to stretch**
Guarding		**Tonically contracting**
Fixing		Muscle contraction in ________ (muscles) with ________ (circumstance)

Terminology: Inconsistency

"Flatfoot" *(Pes Planus)*

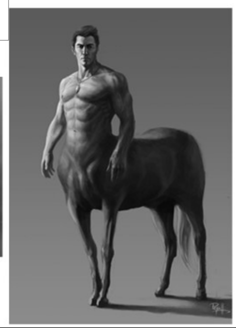


Terminology

Incompatible definitions → Differentiation

Terminology: Inconsistency and Jargon

”Equinus Deformity”



Terminology: Words Have Power

“Contracture”
“Deformity”

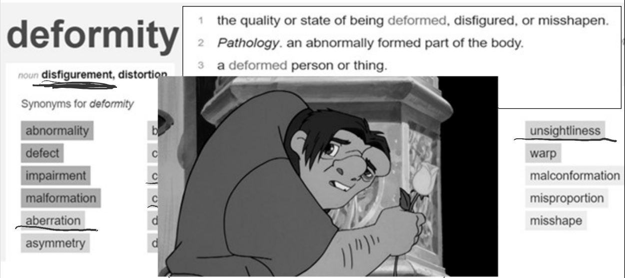
- Implied permanence
- Nocebo effect

Terminology: Words Have Power

Contracture

A muscle contracture is a permanent shortening of a muscle or joint.

www.wikipedia.com



Dictionary.com/Thesaurus.com

Terminology: Words Have Power

Terminology: Words Have Power

Pejorative		Neutral "lay" meaning
Pessimistic	→	Optimistic
Ableist		Positively googleable
Rude		Respectful

Dictionary.com/Thesaurus.com

Terminology: Words Have Power

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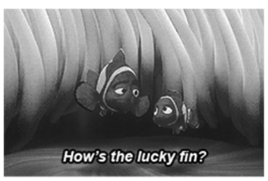
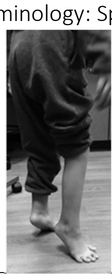


Terminology

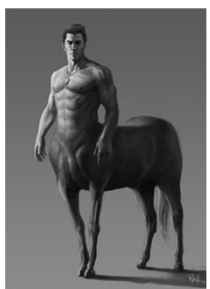
Equinus	→	Plantarflexion
Deformity Contracture	→	Structural variance Restriction Limiting structure Quality of end feel
Flatfoot	→	Everted Pronated

Terminology: Specificity



Plantarflexion Restriction

Structural Variance



Magical Creature

Terminology: Structure vs. Function

Terminology: Structure vs. Function

Plane	Bone Structure (Adjectives)	Movements & Postures (Verbs) (-ed, -ion, -ing)
Transverse	Adductus – Abductus Med Torsion – Lat Torsion	Adduct (-ed, -ion, -ing) – Abduct (-ed, -ion, -ing)
Coronal	Varus – Valgus	Invert – Evert
Sagittal		Flex – Extend
Triplanar		Supinate – Pronate

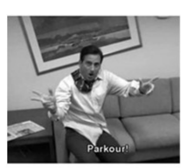
Structure:
Hindfoot varus
Metatarsus adductus, varus

Function:
Supination of hindfoot
Abducted MTPs

Function: ~~“Pes Valgus”~~
Pronated hindfoot, midfoot
Abducted MTPs

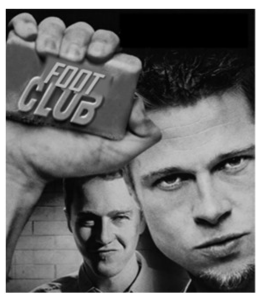
Terminology: Additional Terms

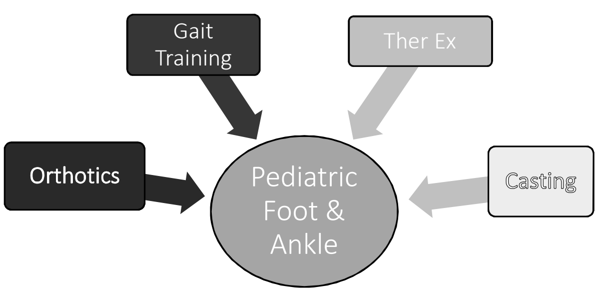
- “Shank”
- “Foot Core”

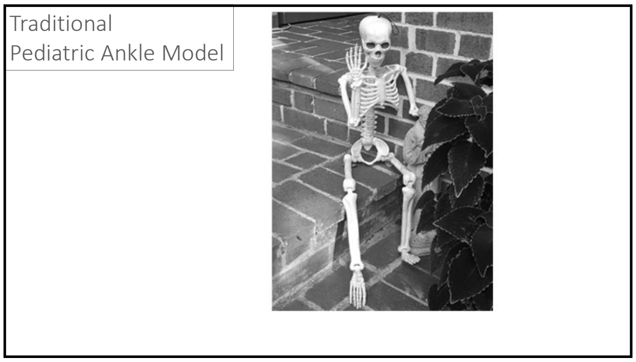


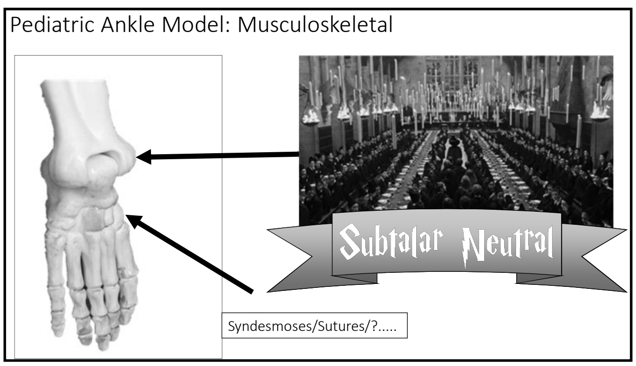
Terminology: Guilt

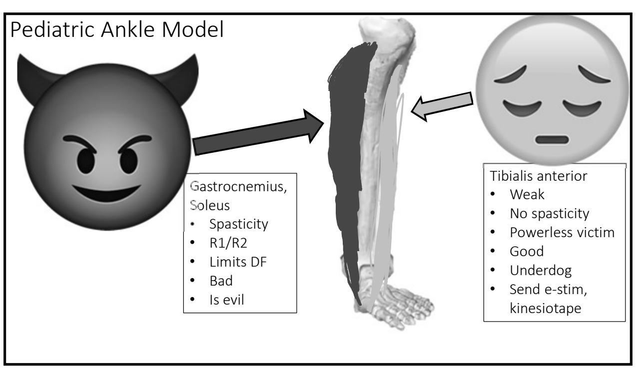
- I. Introduction
- II. **Pediatric Ankle Impairments**
  - A. **Traditional Ankle Model**
  - B. Complex Ankle Model
  - C. Examination
- III. Do We Need to Intervene?
- IV. How Should We Intervene?



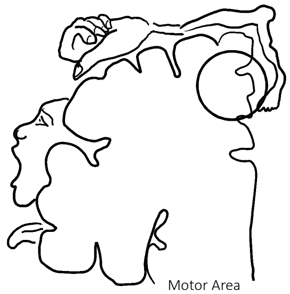



Traditional
Pediatric Ankle Model

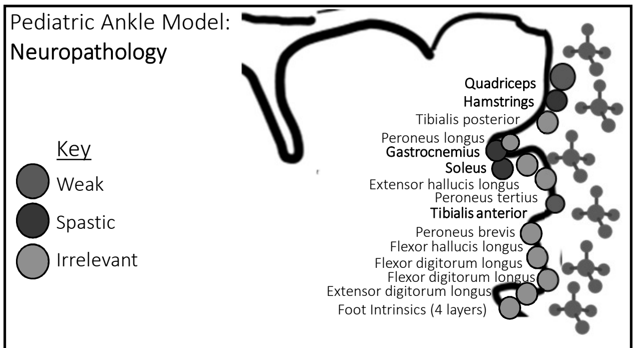

Pediatric Ankle Model: Musculoskeletal
Subtalar Neutral
Syndesmoses/Sutures/?.....

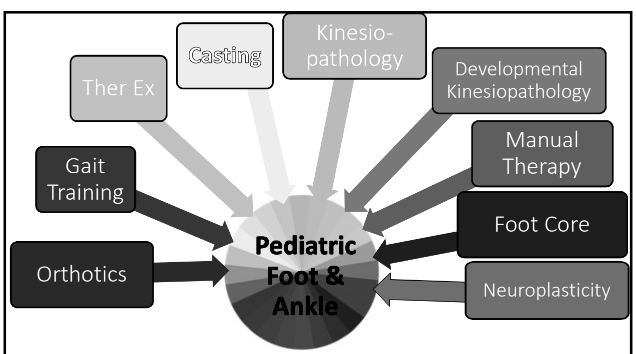

Pediatric Ankle Model
Gastrocnemius,
Soleus
• Spasticity
• R1/R2
• Limits DF
• Bad
• Is evil
Tibialis anterior
• Weak
• No spasticity
• Powerless victim
• Good
• Underdog
• Send e-stim,
kinesiotape

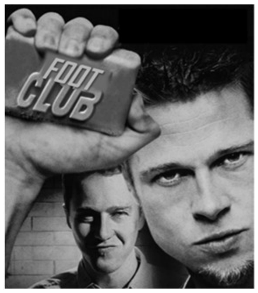
Pediatric Ankle Model:
Neuropathology



Pediatric Ankle Model:
Neuropathology







Building a more complex model

What's unique about the ankle?

What’s unique about the ankle?
A: The ankle is uniquely biased to lose functional ROM

- Intrinsic resistance in posterior structures due to passive-elastic properties of the gastrocsoleus soleus complex

What’s unique about the ankle?
B: The resting position of the ankle when non-weightbearing is in plantarflexion.

What’s unique about the ankle?
C: The key range of motion for *gait* is at end of the range in the direction of DF, not mid-range

Multi-Segment Assessment of Ankle and Foot Kinematics during Elevé Barefoot Demi-Pointe and En Pointe

***Kimberly Perrella Veirs, PT, MPT, ATC**, Josiah R Rippetoe, Jonathan D Baldwin, Kaitlin Lutz, SPT, DPT, Amgad M Haleem and Carol Pierce Dionne, PT, DPT, PhD*

Thursday, February 13, 2020

1:00 PM - 3:00 PM

What's unique about the ankle?

D. Therapeutic Gait

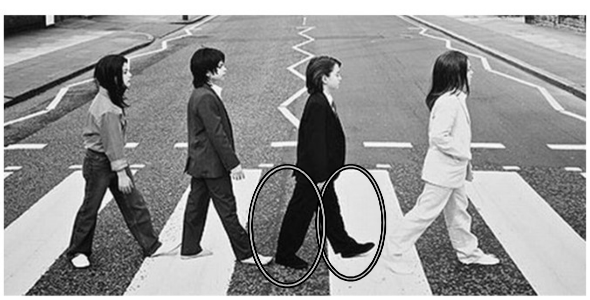
Functional dorsiflexion is achieved

not just *for*

but *through*

regular ambulation!

"Therapeutic Gait" (Elaine Owen)



What's unique about the ankle?
D. Therapeutic Gait

Terminal stance
- Dorsiflexion
- Knee extension
- Hip extension

Functional elongation of:
- GS
- Hip flexors

What's unique about the ankle?
D. Therapeutic Gait

Initial contact
- Dorsiflexion
- Knee extension
- Hip flexion

Functional elongation of:
- GS
- HS

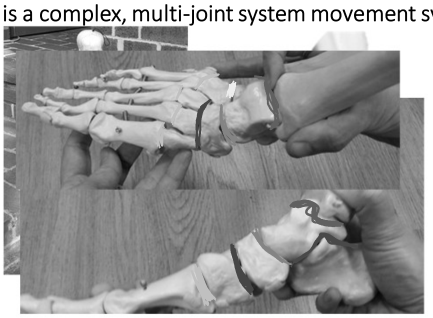
What’s unique about the ankle?

D. Therapeutic Gait

- Functional DF is achieved through regular ambulation
- Anyone lacking this movement experience is at risk for restricted DF
- Shift: foot and ankle impairments in most pediatric health conditions are sequelae of the lack of therapeutic gait

What’s unique about the ankle?

E. Ankle is a complex, multi-joint system movement system



What’s unique about the ankle?

E. Ankle is a complex, multi-joint system movement system

Ankle Structure

Joints - Hindfoot

- Talo-crural (talus-tibia/fibula)
- Subtalar (talus-calcaneous)

Subtalar neutral → Talus on axis

"Clinical fiction" Talocrural dorsiflexion *TC DF*

Challenging the foundations of the clinical model of foot function: further evidence that the **Root Model assessments fail to appropriately classify foot function**. (Jarvis 2017)

If it doesn't work, why do we still do it? The continuing use of Subtalar Joint Neutral Theory in the face of **overpowering** critical research. (Harradine 2018)

E. Ankle is a complex, multi-joint system movement system

Hindfoot
- Talo-crural (talus-tibia/fibula)
- Subtalar (talus-calcaneous)

Midfoot
- Talus-Navicular
- Calcaneous-cuboid
- Navicular-cuneiforms
- Cunieforms/cuboid-metatarsals

What's unique about the ankle?

E. Ankle is a complex, multi-joint system movement system

Due to the complexity of the foot and ankle, there are many ways which the system may compensate for MS or NM dysfunction.

e.g. in some systems, accessory motion is ***relatively*** more flexible than talocrural (TC) DF.

E. Ankle is a complex, multi-joint system movement system

False “DF” occurs to bring the foot toward the tibia but the TC joint does not DF.

Movement Systems: Kinesiopathological Model

Shirley Sahrmann, PT, PhD, FAPTA

Diagnosis and treatment of movement system impairment syndromes. (Sahrmann 2017)

Movement Systems: Kinesiopathological Model

- The body, at the joint level, follows the laws of physics and takes the path of least resistance for movement
- Determinants of the path of motion are
  - intra- and inter-joint relative flexibility
  - relative stiffness of muscle and connective tissue
  - motor control

Diagnosis and treatment of movement system impairment syndromes. (Sahrmann 2017)

Movement Systems: Kinesiopathological Model

- Repetitive movement and sustained alignments can induce pathoanatomical changes in tissues and joint structures

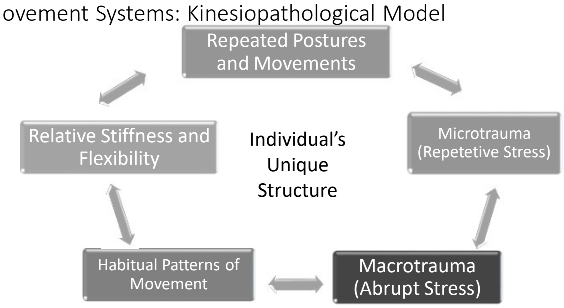
Diagnosis and treatment of movement system impairment syndromes. (Sahrmann 2017)

Movement Systems: Kinesiopathological Model

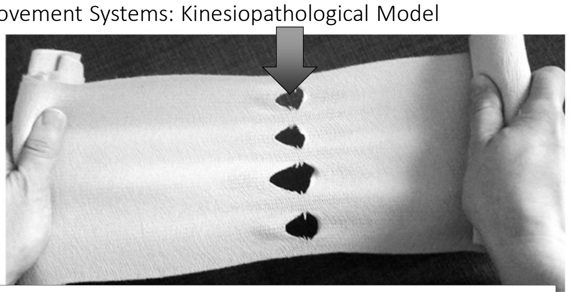
- Sustained alignments and repeated movements associated with daily activities induce tissue adaptations as well as impaired alignment and movement.
- Micro-instability
  - → tissue micro-trauma
    - → macro-trauma

Diagnosis and treatment of movement system impairment syndromes. (Sahrmann 2017)

Movement Systems: Kinesiopathological Model

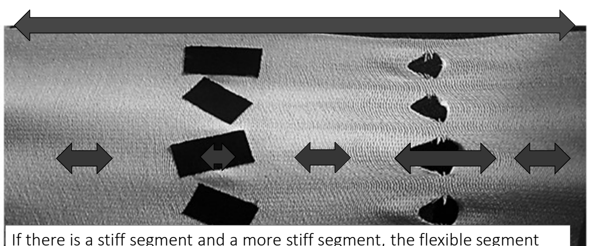


Movement Systems: Kinesiopathological Model



Ace wrap model: In a mechanical system, if a general stretch is applied, the more flexible segment will move the MOST.

Kinesiopathological Model: Relative Flexibility



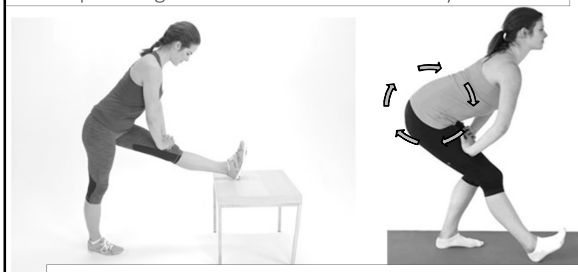
If there is a stiff segment and a more stiff segment, the flexible segment will move most, and the stiff segment will not stretch until all the slack has been taken out of both the flexible segment and the other less-stiff segments.

Kinesiopathological Model: Relative Flexibility

- Lumbar spine model

Yogi 1 is getting HS lengthening. Yogi 2 is getting HS lengthening only after lumbar spine flexion. Every time she does this activity, she makes the lumbar spine more flexible into flexion.

Kinesiopathological Model: Relative Flexibility



The second stretcher is taking up all her lumbar flexion and rotation motion before she gets to HS lengthening.

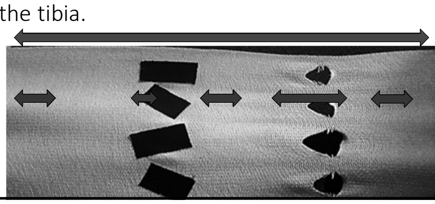
E. Relative Flexibility: The Ankle As A Movement System

Hindfoot
- Talo-crural (talus-tibia/fibula)

Midfoot
- Talus-navicular
- Calcaneous-cuboid
- Navicular-cuneiforms
- Cunieforms/cuboid-metatarsals

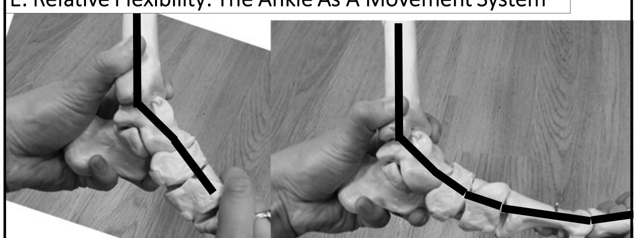
E. Relative Flexibility: The Ankle As A Movement System

DF is a component movement of many of the accessory joints of the system, so when the hindfoot is stiff, the dorsiflexion component of accessory joint motion sometimes becomes the dominant way that the foot moves toward the tibia.



E. Relative Flexibility: The Ankle As A Movement System

E. Relative Flexibility: The Ankle As A Movement System



TC joint in PF, midfoot joints congruent.

TC joint in PF, mi providing “DF” to the system.

E. Relative Flexibility: The Ankle As A Movement System

Forces are mechanically directed to relatively more flexible structures and away from TC dorsiflexion.

What's unique about the ankle?
F. Heterogeneity

Kinematic foot types in youth with equinovarus secondary to hemiplegia. (Krzak 2015)

- Participants ***with hemiplegia and "equinovarus"*** presented with 5 distinct subgroups
- Neurotypical controls were distributed among 4 subgroups
- Noted: inherent variability in foot structure even in neurotypical, asymptomatic movement systems

What's unique about the ankle?
G. The Foot Has A Core?

What's unique about the ankle?
G. Foot Core

The foot core system: a new paradigm for understanding intrinsic foot muscle function. (Mckeon 2015)

What's unique about the ankle?
G. Foot Core: Active Subsystem

- Arch of the foot is controlled by both local stabilizers and global movers of the foot, similar to the lumbopelvic core.
- Local stabilizers ("foot core"):
  - 4 layers of plantar intrinsic muscles that originate and insert on the foot.
  - small moment arms and serve primarily to stabilize the multiple joints of the foot.
  - act to control the degree and velocity of arch deformation with each foot step

What's unique about the ankle?
G. Foot Core: Neural Subsystem

- Intrinsic muscles are advantageously positioned to provide immediate sensory information about changes in the foot posture, via stretch response
- Loss of alignment of the foot leads to loss of this information

The Ankle:

- Heterogeneous in structure
- Prone to impairment
- Complex
  - Anatomy
  - Function
- Intimidating!

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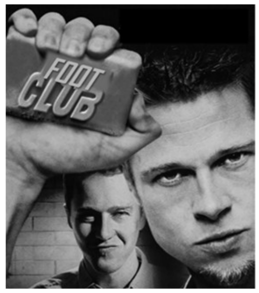
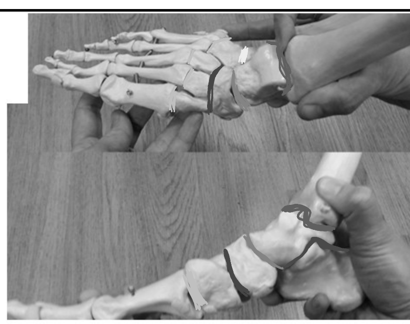




Examination of The Ankle

Special Tests

Movement System Analysis Framework: Foot and Ankle

Exam: Musculoskeletal

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

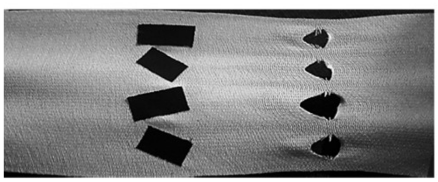
	Alignment, Joint play, End feel, Arthrokinematics, ROM
Distal tib/fib	
Talo-crural	

Dorsiflexion 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?

Dorsiflexion Stress Test



Dorsiflexion Stress Test

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

1. Neutral hindfoot
   End feel/location:
   - GS/Achilles tendon
   - TC joint restriction

Dorsiflexion Stress Test

- ❐ Functional Variants
  - ❐ DF Stress test, End feel ❐1-Neutral hindfoot______ ❐2-Pronated hindfoot____ ❐3-Supinated hindfoot____

2. Pronated hindfoot

   End feel/location:
   - Anterior lateral talar impingement
   - Midfoot mush

Dorsiflexion Stress Test

- ❐ Functional Variants
  - ❐ DF Stress test, End feel ❐1-Neutral hindfoot______ ❐2-Pronated hindfoot____ ❐3-Supinated hindfoot____

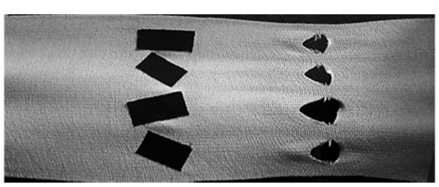
3. Supinated hindfoot

   End feel/location:
   - Anterior-medial talar impingement
   - Lateral talar subluxing

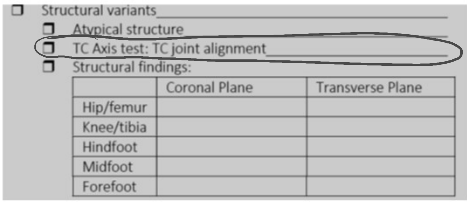
Dorsiflexion Stress Test

Helps to determine

- path of least resistance for DF
- intra- and inter-joint relative flexibility
  - relative stiffness of muscle and connective tissue

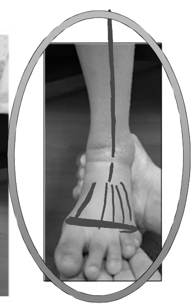


Talocrural Axis Test

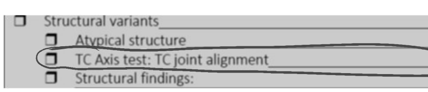

- ❐ Structural variants
  - ❐ Atypical structure
  - ❐ TC Axis test: TC joint alignment
  - ❐ Structural findings:

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





Talocrural Axis Test


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

- Identifying the axis of the talo-crural joint
- "Pure" dorsiflexion without accessory joint motion

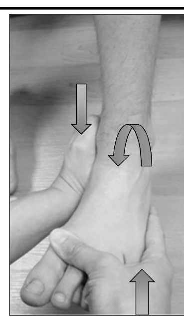
Talocrural Axis Test

- Midfoot joints are taken into the close-packed position (full supination) to isolate motion at the TC

Talocrural Axis Test

Talocrural Axis Test

- Location of axis
- Range – DF *and* PF
- Quality of motion
- Limiting structures
- End feel
  - Location
  - Quality

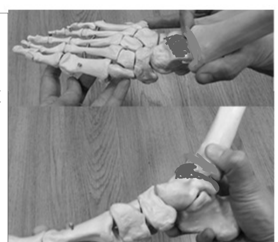


Talocrural Axis Test

Helps to determine
- Location of the axis of talo-crural motion
- Structural versus functional variants

Talocrural Axis Test

Helps to determine
- Quality and quantity of motion specifically of the TC joint without contribution of accessory motion
- Limiting structures for TC DF to guide intervention



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   B. Impact on Developing Systems
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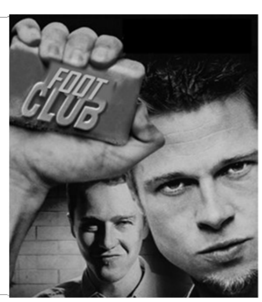

Theories of Intervention

The **Roast** and the **Parachute**

Theories of Intervention:
The Parable of the Roast

Theories of Intervention:
The Systematic Review of the Parachute

Parachute use to prevent death and major trauma related to gravitational challenge: ***systematic review*** of randomised controlled trials. (Smith 2003)

- Authors were unable to identify any randomized controlled trials of parachute intervention.
- "The basis for parachute use is purely observational, and its apparent efficacy could potentially be explained by a 'healthy cohort' effect".
- "As with **many interventions intended to prevent ill health**, the effectiveness of parachutes **has not been subjected to** rigorous evaluation by using **randomised controlled trials**. Advocates of evidence based medicine have criticised the adoption of interventions evaluated by using only observational data.

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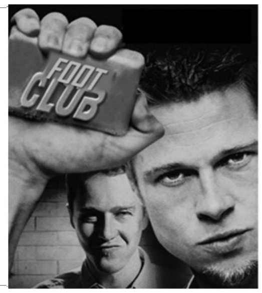


Impacts of Limited DF: Athletes

- The association of dorsiflexion flexibility on knee kinematics and kinetics during a drop vertical jump in healthy female athletes. (Malloy 2015)
- Predictors of frontal plane knee excursion during a drop land in young female soccer players. (Sigward 2008)

Impacts of Limited DF: Neurotypical adults with chronic ankle stability:

- Ankle dorsiflexion range of motion influences dynamic balance in individuals with chronic ankle instability. (Basnett 2013)

Impacts of Limited DF: Neurotypical controls

- The effect of reduced ankle dorsiflexion on lower extremity mechanics during landing: A systematic review. (Mason-Mackay 2017)
- Ankle DF range of motion and landing biomechanics. (Fong 2011)
- Effects of ankle dorsiflexion limitation on lower limb kinematic patterns during a forward step-down test: A reliability and comparative study. (Lebleu 2018)
- Effect of limiting ankle-dorsiflexion range of motion on lower extremity kinematics and muscle-activation patterns during a squat. (Macrum 2012)

Impact of Limited DF Range

Asymptomatic controls & athletes:

- Increased vertical ground reaction force
- Decreased shock absorption

Impact of Limited DF Range

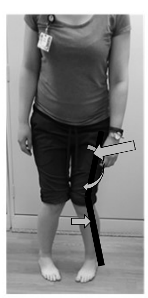
Asymptomatic controls & athletes:

- Increased coronal and transverse plane displacement
  - Greater peak knee abduction angles
  - Greater peak knee abduction moments
  - Increased medial rotation of hip
  - Increased adduction of hip

Impact of Limited DF Range

Asymptomatic controls & athletes:

- Increased coronal and transverse plane displacement
  - Greater peak knee abduction angles
  - Greater peak knee abduction moments
  - Increased medial rotation of hip
  - Increased adduction of hip



Impact of Limited DF Range

Neurotypical adults with chronic ankle stability:

- Decreased performance on ***balance*** testing

- What indicates "limited" DF?

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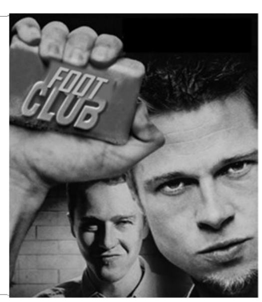


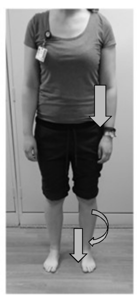
Impact of Excessive Pronation in
Asymptomatic controls, runners

- **The relationship between foot posture and lower limb kinematics during walking: A systematic review (**Buldt 2014)
- **Increased unilateral foot pronation affects lower limbs and pelvic biomechanics during walking.** (Resende 2015)
- **Risk factors associated with medial tibial stress syndrome in runners: a systematic review and meta-analysis.**(Newman 2013)

Impact of Excessive Pronation:

Asymptomatic controls, runners:

- Increased medial tibial rotation
- Increased ipsilateral pelvic drop
- Increased medial stress



Impact of Excessive Pronation:

Asymptomatic controls, runners:

- Increased tibial medial rotation
- Increased ipsilateral pelvic drop
- Increased medial stress

Impact of Excessive Pronation:

Elite baseball players

- Increased shoulder involvement (surgery)

The association of foot arch posture and prior history of shoulder or elbow surgery in elite-level baseball pitchers. (Feigenbaum 2013)

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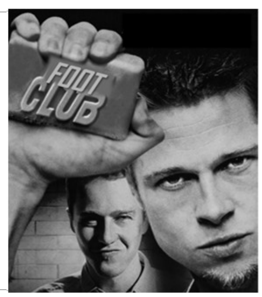


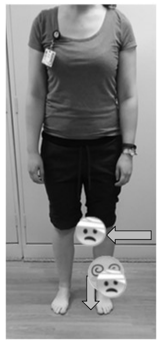
Impact of Impaired Strength in Neurotypical Adults:

- **Lower extremity muscle strength after anterior cruciate ligament injury and reconstruction.** (Thomas 2013)
- **Muscle strength and flexibility characteristics of people displaying excessive medial knee displacement.** (Bell 2008)
- **Eccentric plantar-flexor torque deficits in participants with functional ankle instability.** (Fox 2008)
- **Fatigue of the plantar intrinsic foot muscles increases navicular drop.** (Headlee 2008)

Impact of Insufficient Plantar Flexor Strength:

Neurotypical adults :

- Increased medial knee displacement
- Functional ankle instability
- Increased medial arch loading
- Increased incidence of ankle and knee injury



Impact of Insufficient Plantar Flexor Strength:

Neurotypical adults :

- Increased medial knee displacement
- Functional ankle instability
- Increased medial arch loading
- Increased incidence of ankle and knee injury

Impact of Fatigue of Intrinsic Foot Muscles (Foot Core!):

Neurotypical controls :

- Navicular drop

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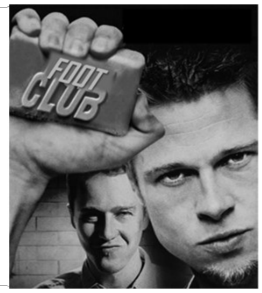

The cortex's multisensory representation of the body and peripersonal space.

(Moseley 2012, Melzack 2005)

Cortical-Body Matrix (Body Map)

Cortical-Body Matrix

- develops in a predictable manner, but development and continued function is **based on experience**
- is highly plastic based on experience, even after development is complete

Cortical mapping changes have been observed in:

- CRPS
- UE pain
- Stroke/CVA
- ACL injury
- Back pain
- Pregnancy
- Aging
- Obesity
- Surgery
- Immobilization
- Frozen shoulder
- Arthritis
- Dystonia

Flor 2000, Maihöfner 2003, Moseley 2008, Stenekes 2009, Moseley 2012, *Toussaint 2013, Meugnot 2014, Louw 2015, Beales 2016, Falling 2016*

Neuroplastic Changes

Neglect and Smudging

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

Neuroplastic Changes

Hyperperception

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

Neuroplastic Changes

Changes Impact:

- Sensory accuracy
- Motor control
- Perception of pain
- Readiness for motor learning

Functional Impact of Neuroplastic Changes:

In **neurotypical systems**:

- Altered somatosensory input and processing
- Altered proprioception
- Altered **motor response**
- Altered **postural control**
- Altered **neuromotor control**

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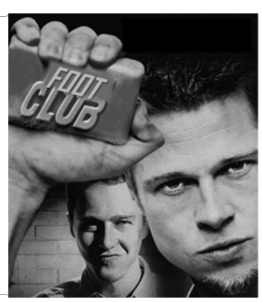


Do we need to intervene?
B. Impact on Developing Systems

- Do children with pediatric health conditions have special protections against the forces that impact adult movement systems?

Do we need to intervene?
B. Impact on Developing Systems

Kinesiopathological Model

- Repeated movements and sustained alignments influence structure and function

Developmental Kinesiopathological Model

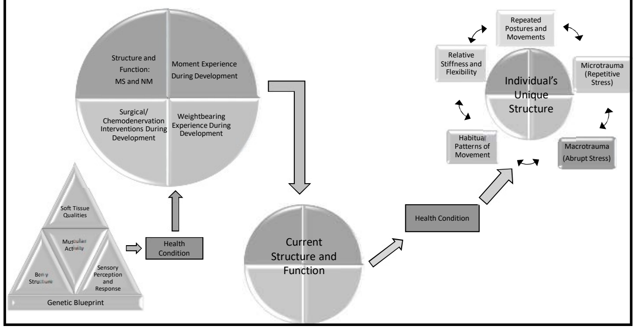
- Repeated movements and sustained alignments during development will influence structural and functional outcomes

Developmental Kinesiopathologal Model

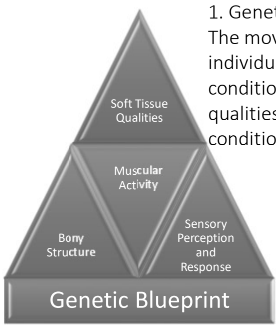
New Paradigm:

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

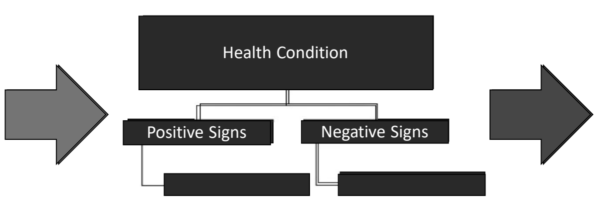
Developmental Kinesiopathological Model (DKM)

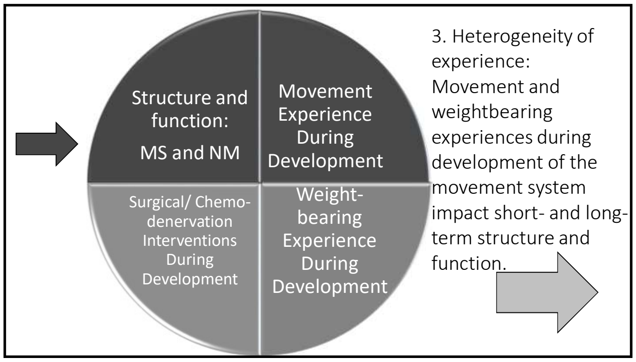


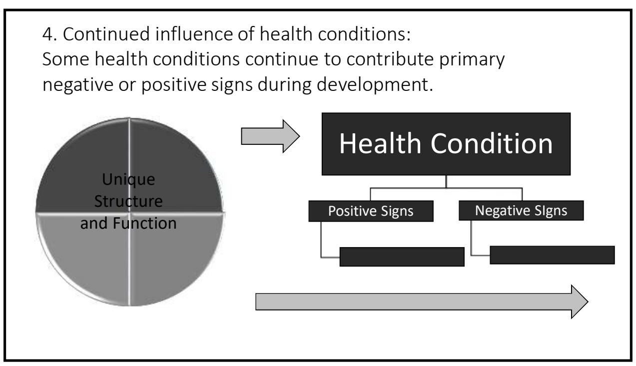
1. Genetic heterogeneity:
The movement system of each individual with a pediatric health condition also has a unique set of qualities, unrelated to the health condition.

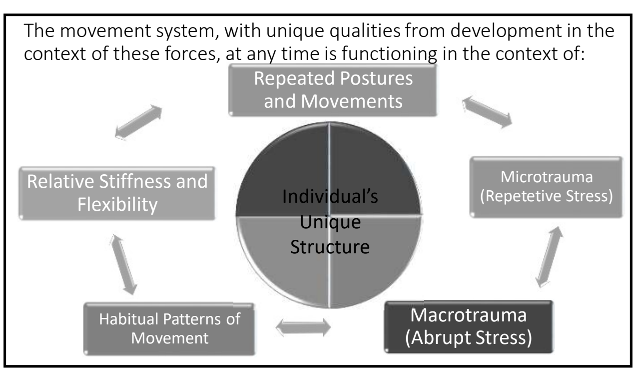


2. Heterogeneity of health conditions:
Health conditions are not homogeneous in their impact on individuals.




3. Heterogeneity of experience:
Movement and weightbearing experiences during development of the movement system impact short- and long-term structure and function.
Structure and function:
MS and NM
Movement Experience During Development
Surgical/ Chemo-denervation Interventions During Development
Weight-bearing Experience During Development


4. Continued influence of health conditions:
Some health conditions continue to contribute primary negative or positive signs during development.
Unique Structure and Function
Health Condition
Positive Signs
Negative SIgns


The movement system, with unique qualities from development in the context of these forces, at any time is functioning in the context of:
Repeated Postures and Movements
Relative Stiffness and Flexibility
Individual's Unique Structure
Microtrauma (Repetetive Stress)
Habitual Patterns of Movement
Macrotrauma (Abrupt Stress)

Developmental Kinesiopathologal Model

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

then

we will influence long-term kinesiopathology with interventions during development.

Developmental Kinesiopathologal Model
Musculoskeletal Development

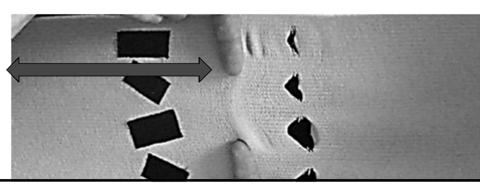
By guiding forces during repetitive movement and sustained alignments, we can:

- 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.

Musculoskeletal Development

For a system that is experiencing atypical stresses during development:

- Goal of interventions might be to **normalize the stresses on the movement system to maximize MS development in the context of a health condition.**



Developmental Kinesiopathologal Model
Neuromotor Development

- Neuroplasticity is greatest before specialization.
- There are critical windows for developing motor patterns.
- Mass practice is required for motor skill development.
- The body becomes efficient in the patterns it performs in mass practice.
- It can be difficult to access new patterns once regular patterns are established.

Developmental Kinesiopathologal Model
Sensory-Perceptual Development

Foot core: neural subsystem

- Loss of alignment of the foot during development impacts the ***development of the perception of this information***
- Biasing the foot intrinsics to develop with typical alignment allows for this information to be available

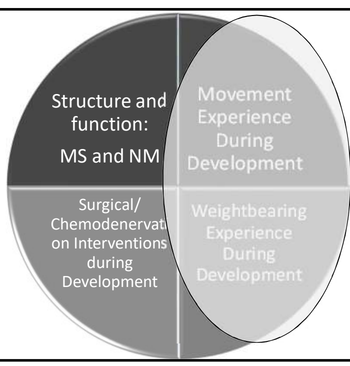
How are the foot intrinsics in each of these feet able to provide information for **the development of** the cortical matrix for balance?

Developmentally Therapeutic Gait

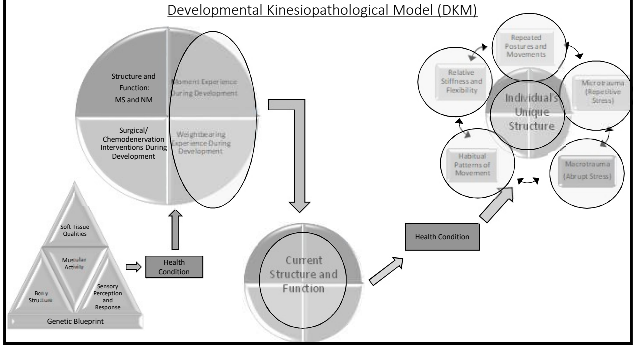
Developmental Kinesiopathologal Model

Developmentally Therapeutic Gait

- Right things happening at the right places at the right times
- Preventing damage
- Providing the conditions for best possible structural development



Developmental Kinesiopathological Model (DKM)



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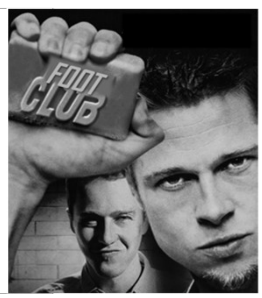
   A. **#Goals**
   B. Motion
   C. Functional Strength
   D. Neuroplasticity
   E. Education
   F. External Supports



A. Goals

What is the goal of intervention?

Goals of Intervention:

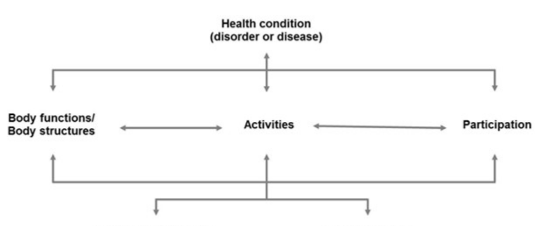
PT's goal:

Patient's goal:

Family's goal:

Other team member's goals:

Goals: Organizing with the ICF Model



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

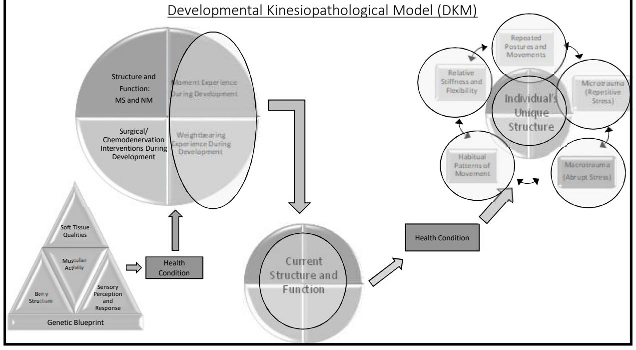
Goals
Environment

- 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

Developmental Kinesiopathological Model (DKM)



Goals

Developmental Kinesiopathological 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 Kinesiopathological 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

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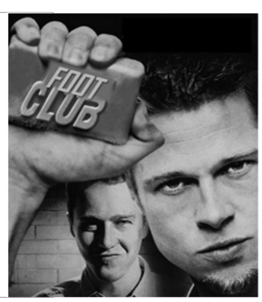


Interventions
Limited Range of Motion

Manual therapy of ankle joints and soft tissues has been shown to improve:

- DF range
- Balance
- Functional goals

Stanek 2018, An 2017, Marrón-Gómez 2015, Zicenzino 2006, Chevutschi 2015, Grieve 2013, Capobianco 2018, Capobianco 2019, Yoon 2014, Weerasekara 2018, Silveira 2016, Lee 2017, Kang 2015, Johanson 2014, Kim 2018, Kwon 2015

Interventions
Limited Range of Motion

Manual Therapy

- Used to address:
  - Hypomobilities/excessive stiffness
  - Maladaptive intra- and inter-joint relative stiffness/ flexibility

Interventions
Limited Range of Motion

Populations

- Acute and chronic ankle instability in orthopedic/neurotypical population
- Athletes
- Adult stroke

Interventions

Limited Range of Motion

- ……..Pediatric health conditions?

Passive muscle properties are altered in children with cerebral palsy before the age of 3 years and are difficult to distinguish clinically from spasticity. (Willerslev-Olsen 2013)

- Change in passive muscle properties was present in the **majority** of subjects.

Interventions

Manual Therapy: Posterior Talar Glide

Interventions

Manual Therapy: Posterior Talar Glide

With inferior glide of calcaneous/talar complex

Interventions

Manual Therapy: Posterior Talar Glide

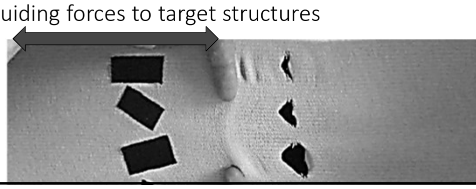
With inferior glide of calcaneous/talar complex

Interventions

Manual Therapy: Posterior Talar Glide

Mobilizing the talo-crural joint within in context of the ankle movement system

- Protecting over-stretched structures
- Guiding forces to target structures



Talo-crural mobilization for the pronated hindfoot

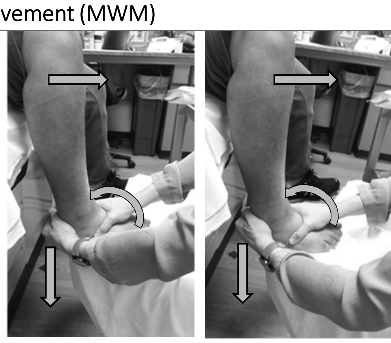
- Midfoot and forefoot in close-packed position to overcome relative flexibility

Interventions

Posterior Talar Glide with:
Calcaneal inferior glide and triplanar guidance

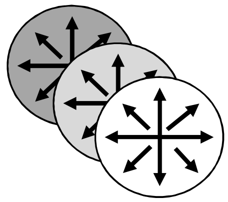
Mobilization With Movement (MWM)

HEP:
- Taping
- Therapeutic casting



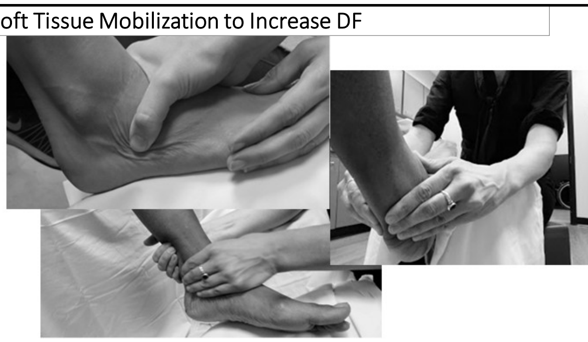
Soft Tissue Mobilization to Increase DF

- Ability of tissues to lengthen, shorten, fold, glide and slide
- Multi-layer
- Multi-directional



Soft Tissue Mobilization to Increase DF

Soft Tissue Mobilization to Increase DF



Soft Tissue Mobilization to Increase DF

Manual Therapy Progression

Supinated Posture

Manual Therapy Progression

Supinated Posture

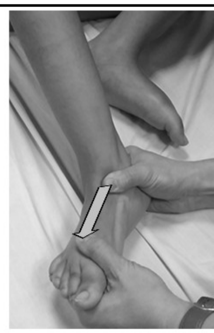
- Calcaneal inferior glide with eversion
- Posterior-medial talar mobilization

Manual Therapy Progression
Supinated Posture

- Anterior hindfoot – medial soft tissue mobilization
- 1st ray: plantarflexion mob
- TC plantarflexion with elongation of TA/EHL

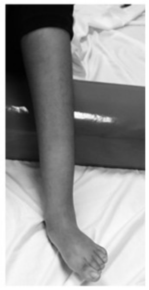
Manual Therapy Progression
Supinated Posture

- Distraction with PF mobilization for midfoot and first ray
- Extension of MTPs
- Elongation of plantar fascia



Instrument Assisted Soft Tissue Mobilization (IASTM)

Manual Therapy Progression
Pronated Posture

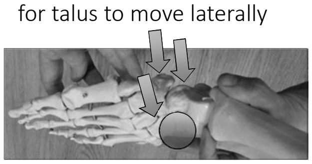


Manual Therapy Progression
Pronated Posture

- Inferior/ inversion mobilization of calcaneus
- Medial/superior mobilization of navicular

Manual Therapy Progression
Pronated Posture

- Release of soft tissue at lateral talar head to allow for talus to move laterally



Manual Therapy Progression
Pronated Posture

- PF of 1st ray and midfoot with hindfoot stablized

Manual Therapy Progression
Pronated Posture

- PF of 1st ray and midfoot with hindfoot stabilized

Manual Therapy Progression
Pronated Posture

- Joint and soft tissue mobilization of abducted digits

Mobilizations:
"Frozen Ankle" Hypothesis

- The Frozen Shoulder Has A Brain. A. Low, S. Schmidt, P. Mintken (CSM 2019--AHUEPT)
- Might stiffness be adaptive? 
- We must provide the system with an adaptive path to stability if we are to add degrees of freedom.

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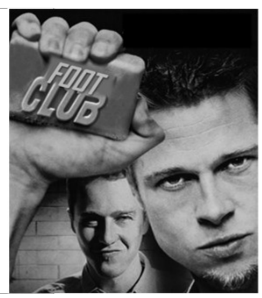
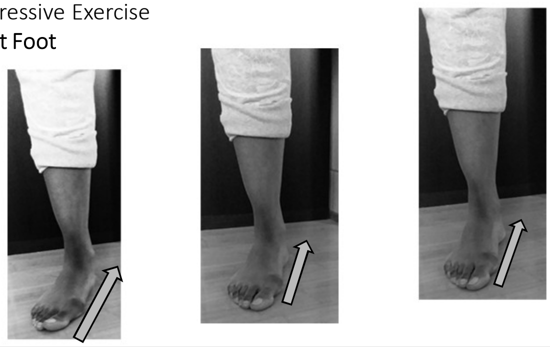


Improving Intrinsic Stability Through Progressive Strengthening

- Immediate effect of short-foot exercise on dynamic balance of subjects with excessively pronated feet. (Moon 2014)
- The effects of short foot exercises and arch support insoles on improvement in the medial longitudinal arch and dynamic balance of flexible flatfoot patients. (Kim 2016)
- Effect of plantar intrinsic muscle training on medial longitudinal arch morphology and dynamic function. (Mulligan 2013)
- Strength training for plantar fasciitis and the intrinsic foot musculature: a systematic review. (Huffer 2017)

Progressive Exercise
Short Foot



Progressive Exercise
Short Foot

Progressive Exercise
Short Foot

Progressive Exercise

Short Foot

- But….

Improving Motor Control: Observation and Imagery

- Graded motor imagery for patients with stroke: a non-randomized controlled trial of a new approach. (Polli 2017)
- Training the motor cortex by observing the actions of others during immobilization. (Bassolino 2014)
- Best practice for motor imagery: a systematic literature review on motor imagery training elements in five different disciplines. (Schuster 2011
- Clinical assessment of motor imagery after stroke. (Malouin 2008)
- Mental practice for relearning locomotor skills. (Malouin 2010)
- Graded motor imagery for pathologic pain: a randomized controlled trial. (Moseley 2006)
-)

Improving Motor Control: Observation and Imagery

Progression

- Action observation
- Motor imagery
- Motor performance

Improving Motor Control: Observation and Imagery

Observation

- Adult model
- *Peer* model
  - Live
  - Video

Improving Motor Control: Observation and Imagery

Transitioning from observation to visualization

- *Self* model

Improving Motor Control: Observation and Imagery

Self model for visualization:

- Mirror therapy

Mirror Therapy

- Mirror therapy for improving motor function after stroke--Cochrane Review (Thieme 2018)
- Mirror Box Training in Hemiplegic Stroke Patients Affects Body Representation. (Tosi 2017)
- Effect of Mirror Therapy on Recovery of Stroke Survivors: A Systematic Review and Network Meta-analysis. (Yang 2018)
- The Activation of the Mirror Neuron System during Action Observation and Action Execution with Mirror Visual Feedback in Stroke: A Systematic Review. (Zhang 2018)
- The effect of tactile discrimination training is enhanced when patients watch the reflected image of their unaffected limb during training. (Moseley 2009)

Mirror Therapy

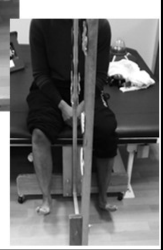
- Visualization: self-model

Mirror Therapy

With visual attention to reflection of stronger side in mirror

Progression (involved side)

- No movement
- Imagine movement
- Imitate, minimal effort
- Imitate, full effort



Mirror Therapy

With attention to reflection of stronger side in mirror

Progression

- Imitate, full effort
- Resistance to stronger side
- Resistance to involved side

Mirror Therapy

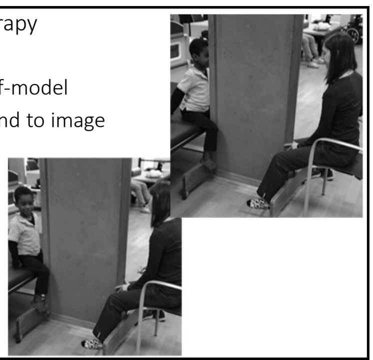
With attention to reflection of stronger side in mirror

Progression

- Foot doming in mirror for visual feedback

Observation + Mirror Therapy

- Adult model with self-model
- Neglect: cues to attend to image



Visualization

Improving Foot and Ankle Motor Control
Electric Stimulation

Impact of e-stim training to "foot core"

- Decreased navicular drop and decreased vertical GRF

The effect of additional activation of the plantar intrinsic foot muscles on foot dynamics during gait. (Okamura 2018)

Improving Foot and Ankle Motor Control
Electric Stimulation

Progression

- Non-weightbearing

Improving Foot and Ankle Motor Control

Electric Stimulation

Progression

- Weightbearing in sitting
- Semi-standing

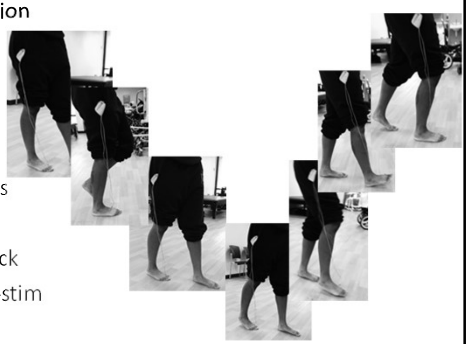
Improving Foot and Ankle Motor Control

Electric Stimulation

Progression

- Sit to stand
  - Progression within controlled range

Electric Stimulation



Progression

- Gait training
  - Verbal cues
  - Mirror
  - No feedback
  - Remove e-stim

Improving Foot and Ankle Motor Control

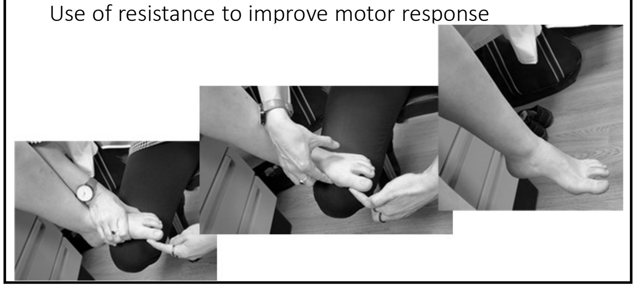
Welcome to The Resistance

Use of resistance to improve motor response

Improving Foot and Ankle Motor Control

Welcome to The Resistance

Use of resistance to improve motor response



Improving Foot and Ankle Motor Control

Electric Stimulation + Resistance

Improving Foot and Ankle Motor Control
Taping
1. Longitudinal foot core

Improving Foot and Ankle Motor Control
Taping
2. Spiral foot core

Improving Foot and Ankle Motor Control
Taping
2. Spiral foot core

Improving Foot and Ankle Motor Control

Enhanced Feedback for Motor Exploration

Use of technology to increase:

- Feedback
- Opportunities for success

Improving Foot and Ankle Motor Control

Enhanced Feedback for Motor Exploration

Novel activities **Feopardy**

- Placement
- Timing

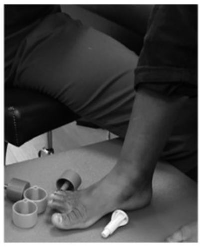
Improving Foot and Ankle Motor Control

Enhanced Feedback for Motor Exploration

Low tech



Improving Foot and Ankle Motor Control
Partial Weightbearing With Motor Task



Improving Foot and Ankle Motor Control
Partial Weightbearing With Motor Task

Toe Tower

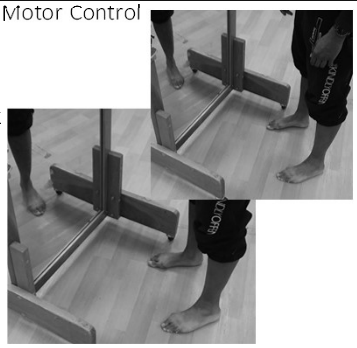
Improving Foot and Ankle Motor Control
Progressive Exercise

Short foot
- Sitting
- Semi-standing

Improving Foot and Ankle Motor Control
Progressive Exercise

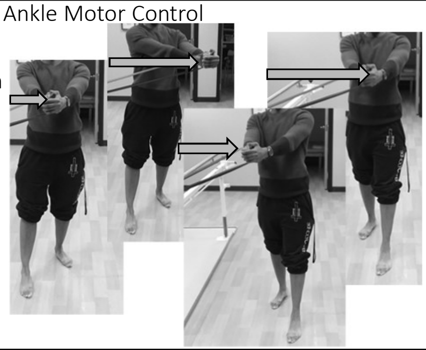
Short foot

- With visual feedback



Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted rotation in split stance



Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted rotation in split stance

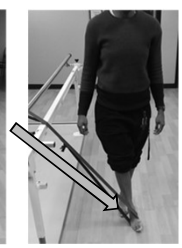
Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted side step


Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted diagonal step-down*

- Progression:
  - Sitting
  - Semi-standing
  - Standing with UE s
  - SLS

Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted diagonal step-down

- Sitting, semi-standing
  - Direct assist/cues for alignment of stance foot


Improving Foot and Ankle Motor Control
Progressive Exercise

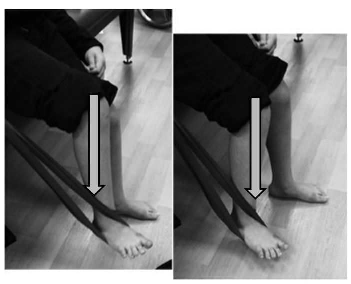
Resisted diagonal step-down

- Sitting, semi-standing
  - Indirect assist to align stance limb

Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted diagonal step-down

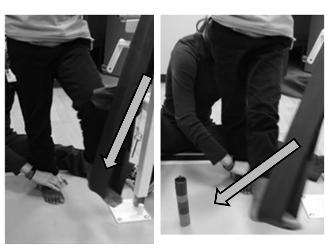
- Sitting, semi-standing
  - No assist



Improving Foot and Ankle Motor Control
Progressive Exercise

Resisted diagonal step-down

- Standing
  - Assist to align stance foot



Improving Foot and Ankle Motor Control

Progressive Exercise

Resisted diagonal step-down

- Standing
  - Standing with UE support

Improving Foot and Ankle Motor Control

Progressive Exercise

Resisted diagonal step-down

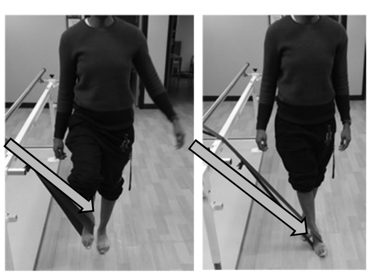
- Standing
  - SLS

Improving Foot and Ankle Motor Control

Progressive Exercise

Resisted diagonal step-down

- Standing
  - SLS

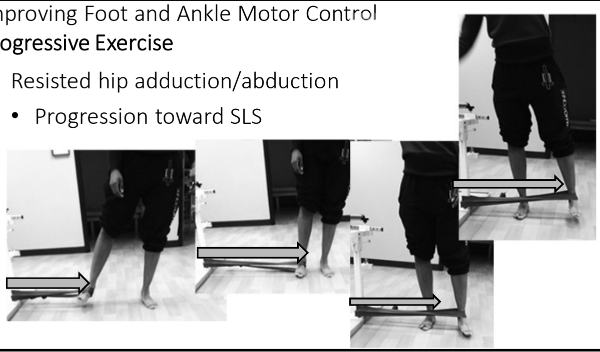


Improving Foot and Ankle Motor Control

Progressive Exercise

Resisted hip adduction/abduction

- Progression toward SLS

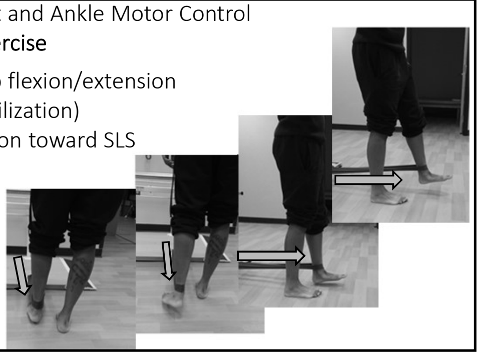


Improving Foot and Ankle Motor Control

Progressive Exercise

Resisted hip flexion/extension
(1st ray stabilization)

- Progression toward SLS



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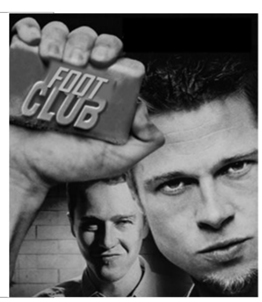


How does the developing movement system create a useful cortical matrix of the foot and ankle?

Visual Exploration

Sensory exploration with upper extremities (and mouth)

Bilateral LE sensory exploration

Motor exploration with sensory experiences with the environment

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

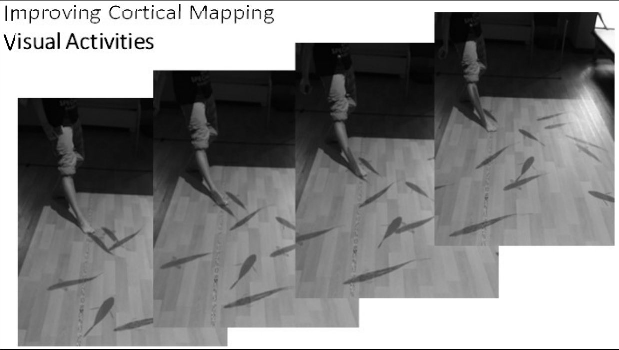
Improving Cortical Mapping

Auditory Activities

- Boa Constrictor

Improving Cortical Mapping

Visual Activities



Improving Cortical Mapping

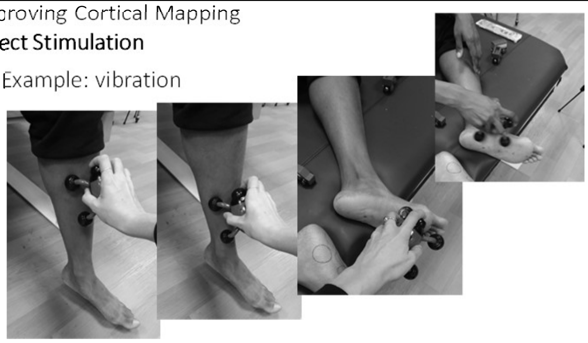
Direct Stimulation

- External
- 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

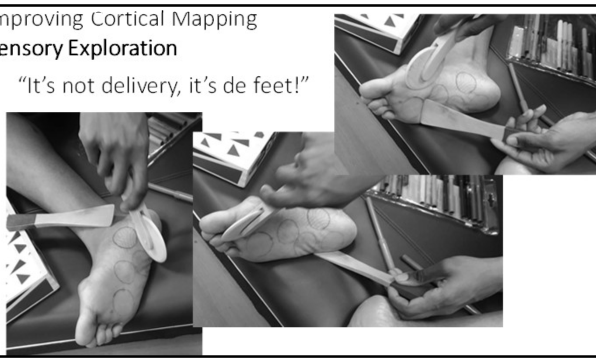
Sensory Exploration

Feet pizza

Improving Cortical Mapping

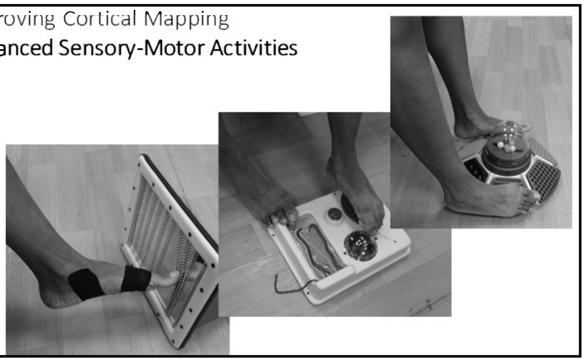
Sensory Exploration

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



Improving Cortical Mapping

Enhanced Sensory-Motor Activities



Improving Cortical Mapping

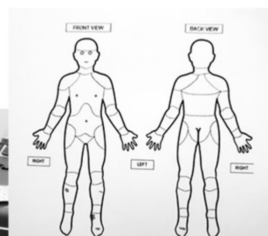
Mapping Activities

Sticker matching: contralateral

Improving Cortical Mapping

Mapping Activities

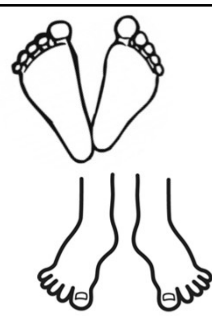
Sticker matching: paper map



Improving Cortical Mapping

Mapping Activities

Sticker matching: paper map



Improving Cortical Mapping

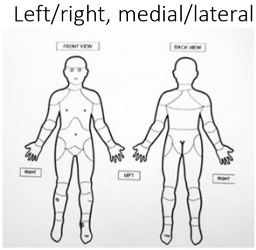
Mapping Activities

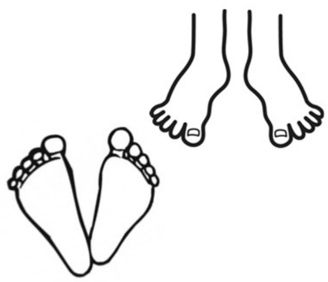
- Assisted map building
- Color zones

Improving Cortical Mapping

Mapping Activities

- Left/right, medial/lateral





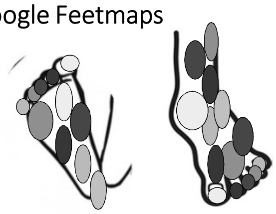
Improving Cortical Mapping

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 kinesthesia and motor response

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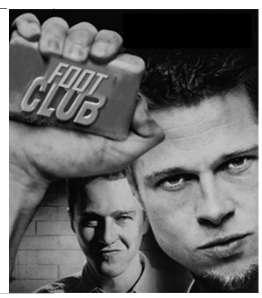


Pain Neuroscience Education (PNE)

- Pain Neuroscience Education: State of the Art and Application in Pediatrics. (Hannah 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)

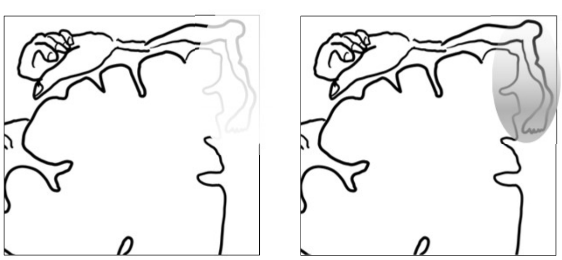
Pain Neuroscience Education (PNE)

What individuals need:

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

Developmental Pain Neuroscience Education (D-PNE)

Supporting the individual to develop a developmentally-appropriate, personal system for describing discomfort and pain



Developmental Pain Neuroscience Education (D-PNE)

- 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
- Listen, **believe**, explore, educate, and **learn**

D-PNE

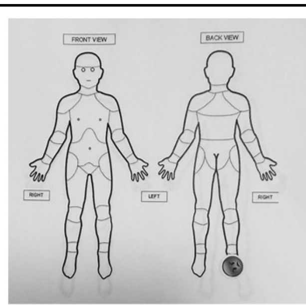
Emoji therapy: direct

- Acknowledging pain

D-PNE

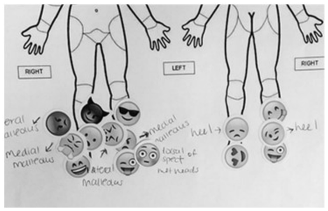
Emoji therapy: indirect

- Acknowledging pain
- Directing attention



D-PNE

Emoji therapy: indirect
- Acknowledging pain
- Directing attention



D-PNE

Emoji therapy: indirect
- Acknowledging pain
- Directing attention

D-PNE

Progressing input
- Finding the borders of pain
- *Anxiety with loss of pain

D-PNE

Emoji therapy: direct

- Acknowledging pain

D-PNE

Emoji therapy: direct

- Acknowledging pain

Health Condition Education

- Meet patient where they are
- Use the ICF Model as a guide
- Ask *if* and *what* they want to know about their health condition
- Use **positive**, developmentally appropriate stories
  - "Sticky" stories

Health Condition Education

Sticky stories

Therapeutic Alliance

In neurotypical adults, athletes, older adults:

- Kinesiophobia and low self-efficacy are associated with decreased:
  - Postural control, range of motion, gait parameters
- High self-efficacy is associated with increased performance

Therapeutic Alliance

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

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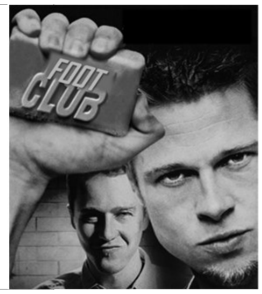


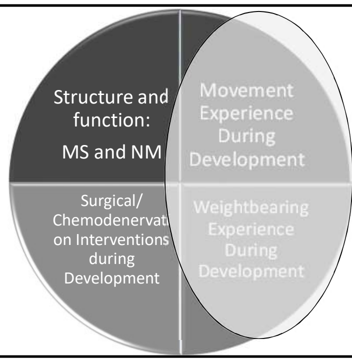
External Supports
Taping, Orthotics, and Casting

External Supports

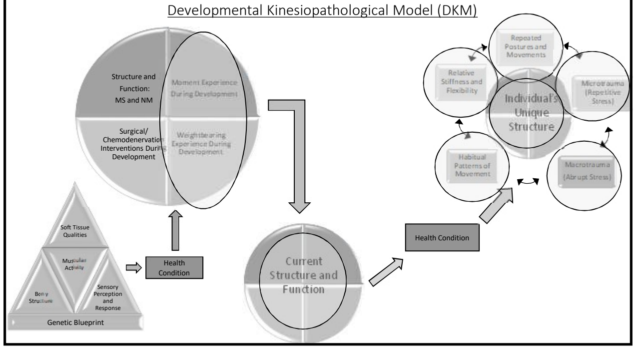
- Targeted use of external support to guide adaptive tissue-specific stresses
- Adjuncts to joint mobilization/soft tissue interventions

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



Developmental Kinesiopathological Model (DKM)



Orthotic Intervention

Developmental Kinesiopathology

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.

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

Brace "Prescription" versus "Design"

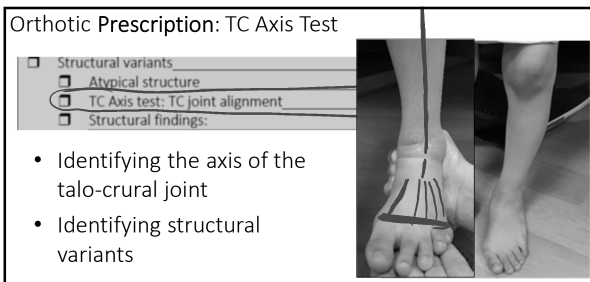
- Prescription: helping the body interface with the world

Orthotic **Prescription**

- ❑ Structural Findings

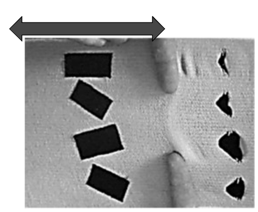
  What structural findings need to be captured in the device to allow the movement system to interface with the world?

Orthotic **Prescription**: TC Axis Test



- 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?

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?

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

2. Pronated hindfoot

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

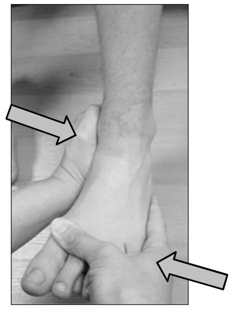
3. Supinated hindfoot

Orthotic **Design**

- NWB Corrective Force

  What support is required to:

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



Orthotic **Design**

- 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**

- WB Corrective Force Test

Orthotic **Design**: Sagittal Plane

- ❑ Midstance

What support is required to:

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

Orthotic **Design**

Individual Characteristics: Aesthetics

What are our beliefs around the rights of children with special healthcare needs and:

- Fault
- Choice
- Self expression
- Autonomy
- Body boundaries

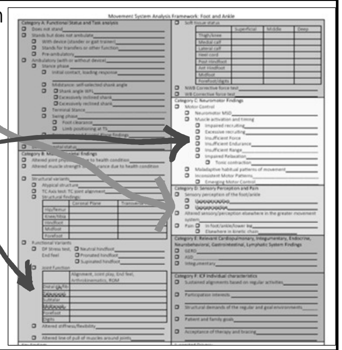
Individual Characteristics: Aesthetics

- 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.

Comprehensive Orthotic Plan

Suspected drivers:

Limiting factors:



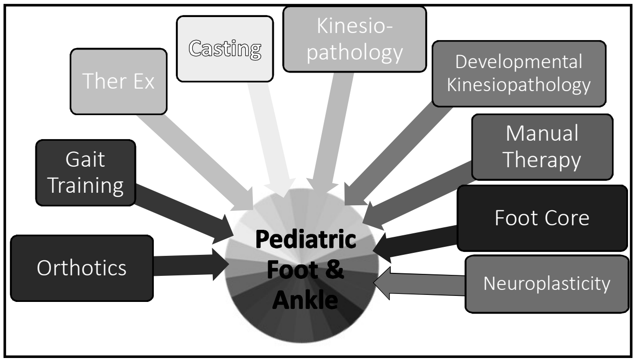
Comprehensive Orthotic Plan

- 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

Comprehensive Treatment Plan

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

Physical Therapy:
Home Program:
Community Exercise Activity:



Thank you!

Questions?

email: amanda@allstaralignment.com

Slides: amandahallpt.com/CSM2020

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