biomechanics
Ankle Foot Orthotics
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Weakness or Absence of Dorsiflexor
Normal function

- **Stance phase**
  - Control plantarflexion from HS to FF
- **Swing phase**
  - Hold ankle plantigrade
Functional Deficits

- **Stance phase**
  - Mild weakness => foot slap
  - Severe weakness or absence => initial forefoot contact

- **Swing phase**
  - Drop foot
  - Compensatory increased hip, knee flexion
Biomechanical Requirements

- Orthotic ankle joint which can resist plantarflexion moment from plantigrade.
- Orthosis/body system which creates dorsiflexion moment
- A “rigid” structure linking the joint to the sites of application of force
free-body diagram
Force analysis
No Dorsiflexion Strength Required
Weakness or Absence of plantarflexor activity
normal function

• Eccentric activity control dorsiflexion from MS until HO.

• Contracts from HO to TO for forward propulsion.
Moment

Plantarflexion Moment
Functional Deficits

- Excessive dorsiflexion from mid-stance
- Loss of active push-off
- Severely reduced walking speed and efficiency
No plantarflexion moment
Biomechanical Requirements

- Orthotic ankle joint which can resist dorsiflexion moment
- Orthosis/body system which creates plantarflexion moment
- A “rigid” orthotic structure linking the joint to the sites of application of force
free-body diagram
Force analysis
force system

W

R3

R2

R1

R4
force system
No plantarflexion strength
orthotic solutions

• Option #1
  ✓ Orthotic ankle joint with free plantarflexion and dorsiflexion “stop” (conventional)

• Option #2
  ✓ Rigid moulded plastic AFO, e.g., Floor Reaction AFO (Glanzy and Lindseth, 1972)
Orthotic solutions

• Option #3

◊ Heel cushion to compensate for restricted plantarflexion
• Rocker sole to compensate for restricted dorsiflexion
◊ Ankle articulation to allow free plantarflexion
Weakness or absence of pronator activity
functional deficits

• Foot drop during swing phase

❖ Initial contact on the lateral border of the heel

• Tendency to supinate during initial loading

❖ Ankle sprain or fracture
Biomechanical requirements

- Orthotic ankle joint which resists supination
- Orthosis/body force system which creates pronation moment
  - A rigid orthotic structure
Orthotic solutions

• Rigid ankle foot orthosis

Or

• Solid ankle foot orthosis
Weakness of absence of supinator activity
Normal function

- Contract from mid-stance to toe-off to resist external pronation moment and thus maintaining uniform foot/ground contact
Functional deficits

- Valgus position of the foot from foot flat until toe-off
- Excessive pressure on medial aspect of the foot
- Planovalgus deformity
Biomechanical requirements

- Orthotic ankle joint which resists pronation moment
- Orthosis/body force system which creates supination moment
- A rigid orthotic structure
Orthotic Solutions

• Rigid ankle foot orthosis

Or

• Solid ankle foot orthosis
Attention!!!

- Pay attention to medial and lateral moments of the knee! The AFO should never cause a medial nor a later thrust (moment) at the knee. This will lead to ligament laxity and future need of a KAFO.
Q&A