Toward evidence-informed AFO prescription: Identifying factors that guide clinician decision-making

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Outline

• AFO prescription decisions are based on limited evidence

• We are conducting 2 studies to improve our understanding of:
  1. Clinician experiences with AFO prescription
     ➢ Prescription evolves as part of a collaborative process
     ➢ Challenges and strengths of the current process
  2. How the angle of the ankle in the AFO affects walking in children with CP
Cerebral palsy

- Injury to the developing brain
- Impaired movement and posture
  - Varied impairments (e.g., spasticity, weakness, contracture, deformity) and gait patterns
- ~50% wear AFOs (Wingstrand, 2014)
Ankle-foot orthoses (AFOs)

• Apply forces to prevent unwanted movement
  • Control motion, compensate for weakness or abnormal distal motor control

• Control position of ground reaction force relative to lower extremity joints
  • By altering moments, AFOs affect muscle activity and movement

(e.g., Butler & Nene, 1991; Owen, 2005; Meadows et al., 2008)
Not all AFO prescriptions are created equal

- AFOs can improve gait quality  
  (Bowers & Ross, 2009; Figueiredo et al., 2008; Morris, 2002a; Owen, 2010)
- Effect may not be optimal  
  - Current AFO maximized gait quality only 37% of the time  
    (Ries et al., 2014)
- Reasons behind this are not understood  
  - Matching AFO design to child’s impairments/ gait pattern is important  
    (Davids, 2007)
  - Lack of evidence to guide clinical decisions  
    (Morris, 2002b; Ries et al., 2014, 2015)
AFO prescription
Clinician experiences and considerations
Purpose

• To explore clinician perspectives & experiences with AFO prescription for children with CP
  • Learn about *factors that influence AFO prescription* for children with CP in Canada
  • Gain insight into *potential ways to improve the process* and outcomes for children who wear AFOs
Methods

• Focus groups conducted at 5 rehabilitation facilities in 4 provinces
• 32 clinicians who work with children who have CP
  • 4 MDs, 10 orthotists, 17 PTs, 1 kinesiologist
Semi-structured interviews

• Purpose and types of AFOs
• Process to obtain AFO
• Roles of team members
• Clinical evaluation
• Facility processes:
  • What works well?
  • What could be changed?
  • Ideal process?
Analysis - Interpretive Description

• An approach to qualitative inquiry into health-related experiences (Thorne et al., 1997, 2004)
  • Captures themes & patterns within subjective perceptions
  • Goes beyond description, to explore meanings & explanations of experiences
  • Generates an interpretive description that can inform clinical knowledge

• 3 researchers participated in coding to establish categories and themes
Results

• Categories:
  • Processes to obtain and monitor AFO
  • Information that affects choice of AFO design
  • Factors that challenge or strengthen treatment outcomes

• Theme:
  • Prescription as a collaborative, iterative, and individualized process
Simplified process to obtain & monitor AFO

- **Prescriber** writes requisition
- **Orthotist** casts for AFO
- **Orthotist** fits AFO
- **Physical Therapy** follow-up

**Waitlist**

Revisit prescription if a team member decides goals are not being met

Orthotist follow-up (fit issues)

Ongoing evaluation, communication, adjustments to AFO (orthotist & PT, sometimes MD)
## Factors that challenge or strengthen outcomes

<table>
<thead>
<tr>
<th>Category</th>
<th>Challenges</th>
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</thead>
<tbody>
<tr>
<td>System issues</td>
<td>• Waitlist</td>
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<tr>
<td></td>
<td>• Staffing budget</td>
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<tr>
<td>Team</td>
<td>• Proximity to other team members</td>
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<tr>
<td>Equipment</td>
<td>• Competing priorities</td>
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<td></td>
<td>• 1 design may not achieve all goals</td>
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<tr>
<td>Parent/child</td>
<td>• Compliance, acceptance of AFO</td>
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Potential significance

• A comprehensive understanding of the factors influencing the process may benefit clinical practice
  • Identifying these factors may be a first step toward the development of guidelines to help clinicians improve AFO prescription for children with CP
Angle of the ankle in the AFO (AA-AFO)

Effect on walking mechanics in children with CP
Does the AA-AFO impact walking?

- AFOs are typically fabricated with the ankle at 90°
  
  - **Erroneous belief** that at midstance the shank is vertical and the ankle is 90°
  
  - **Unfounded assumption** that this position is necessary to maintain ankle plantarflexor muscle flexibility

- This practice may be problematic for children with tight/stiff gastrocnemius (GN) muscles (e.g., CP)

(Owen, 2010, 2014; Meadows et al., 2008; Morris et al., 2011; Nuzzo, 1983, 1986)
Consequences of inappropriate AA-AFO

- Bracing the ankle in a position that demands too much length from GN may cause
  - Foot damage (midfoot break, skin lesions)
  - Knee flexion during gait
  - Contractures

(Owen, 2014; Karas, 2002)
Positioning the ankle in plantarflexion will cause loss of muscle length... Myth?

- Accommodate GN tone/stiffness to treat it (Owen, 2010)
  - Positioning the ankle in plantarflexion may allow the GN to function more effectively and may increase muscle length

- Fears may not be warranted
  - AFOs have not been proven to prevent deformity or contractures (Morris et al., 2011)
  - GN contracture may be easier to correct than a rocker bottom foot or knee flexion contracture
Purpose and hypothesis

• Purpose: Examine effects of individualized AA-AFO
• AA-AFO based on clinical measures of calf muscle state (as described by Owen, 2005, 2010) will result in more normal
  • Joint motion
  • Muscle excursion
  • Muscle activation
  • Functional performance
1. Available muscle length?
2. How stiff is the muscle?
3. Any bony alignment issues?
4. Risk of losing muscle length?

Owen (2005, 2010)
Methodology

• Participants: children with CP, GN tightness, wear AFOs

• Compare 3 walking conditions:
  1. Shoes only
  2. Child’s usual AFO (tuned)
  3. Solid AFO with individualized AA-AFO (tuned)

• Biomechanical measures:
  • 3D gait analysis
  • Surface EMG
  • Computerized muscle length modelling

• Functional measures
  • Pediatric Balance Scale
  • 10-meter walk test

(Owen, 2004)
Results: Shank to vertical angle (right leg)

- Shoes: 24°
- Usual AFO (Hinged AFO): 22°
- Solid AFO with individualized AA (20° PF): 12°
Right knee flexion/extension

Phase of Gait Cycle

- Stance
- Swing

Degrees

Flexible AFO

Shoes

Usual AFO

Solid AFO (20° AA)
Right ankle dorsiflexion/plantarflexion

Phase of Gait Cycle

-30 -25 -20 -15 -10 -5 0 5 10 15

Shoes
Usual AFO
Solid AFO (20° AA)

Stance Swing
Potential significance

• Inform best practice by indicating how the AA-AFO can affect mobility
• Reduce costly trial-and-error decision-making in the AFO prescription process
• Improve mobility outcomes for children
Take away points

• Limited understanding of how AFOs are prescribed
• Successful AFO prescription requires teamwork –
  • Child, family, orthotist, PT, MD at all stages (assessment, goal setting, prescription, fitting, tuning, follow-up...)
  • Allows the prescription to evolve
• One research priority is to understand the effects of aspects of the prescription such as the AA-AFO
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References and further reading

- Owen, E. (2014). Pediatric gait analysis and orthotic management with AFO footwear combinations: A segmental kinematic approach to rehabilitation; Course notes.
Information that affects AFO design

- Physical exam (MD, often PT)
- Frequent prescribers (ortho. surgeon, physiatrist)
- Other prescribers (pediatrician, neurologist...)
- Knowledge of types of AFOs
- Purpose of AFOs
- Parent/guardian
- Child
- Goals of stakeholders
- PT’s input & knowledge of child
- orthotist input (?)
- MD expertise & comfort affect amount of input
- Goals
  - Type
  - Ankle ROM (?)
Factors that challenge or strengthen outcomes

- Space & technology
  - Competing priorities & potential negative effects of AFO
  - Lack of evidence
  - Availability of orthoses for trial

- Professional education
  - Community & school PTs
  - Relative proximity of team members

- Equipment

- Team

- System
  - Waitlist
  - Funding for orthotic devices
  - Budget for staffing

- Parent/child
  - Growth
  - Footwear
  - Discomfort due to AFO
  - Compliance & acceptance of AFO

- Choice of provider
- Family context
- Language barrier