Could this Research Change the Way You Treat Hallux Limitus?

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Disclosure: Medical Director, ProLab Orthotics
Goals

- Review underlying cause of functional hallux limitus (FHL)
- Review three (3) peer-reviewed studies related to mechanical treatment of FHL
- Apply this evidence to the orthotic prescription for FHL
Review

- **Definition**
  - Greater than 50° dorsiflexion NWB
  - Less than 14° dorsiflexion in stance
  - No trauma or arthritis

- **Associated deformities**
  - Hallux rigidus
  - Hallux valgus

*Scherer PR, et.al. Effect of functional foot orthoses on first MPJ dorsiflexion in stance and gait. JAPMA, 96(6):474-81, 2006*
Mechanical Cause of FHL

Windlass function blocked by forces driving the 1st ray up

- Prevents 1st ray plantarflexion
- Hallux can not dorsiflex
- 1st MPJ compression increases
Etiology of FHL

- Three foot types cause increased force under the first metatarsal head
  - Everted calcaneus
  - Everted forefoot resulting from flexible forefoot valgus
  - Everted forefoot resulting from planterflexed first ray
Increased force under 1\textsuperscript{st} metatarsal = decreased hallux dorsiflexion

- Ground reactive forces against the 1\textsuperscript{st} MPJ prevent 1\textsuperscript{st} ray plantarflexion
- Lack of 1\textsuperscript{st} ray plantarflexion will limit 1\textsuperscript{st} MPJ dorsiflexion.
- 100\% of subjects, dorsiflexion is decreased

Rearfoot eversion and hallux dorsiflexion

- “Eversion of the rearfoot will lower the maximal hallux dorsiflexion”
  - No wedge: 85.91
  - 3° wedge: 68.23
  - 5° wedge: 58.80
- First ray dorsiflexion
- Hallux dorsiflexion decreased

Scherer, et al. JAPMA 2006

- Evaluated the influence of functional orthoses on the ROM in stance and gait of the first MTP joint
- Defined FHL as $> 50^\circ$ dorsiflexion NWB and $< 14^\circ$ dorsiflexion in stance
- Casted with 1st ray plantarflexed (based on Roukis)
- Custom functional orthoses
  - minimum cast fill (Roukis)
  - 14 mm heel cup (Harradine)
  - 2mm medial heel skive (Harradine)
  - wide width (Harradine)
  - Reverse Morton’s extension (Roukis)

Stance
  • Hallux dorsiflexion measured in stance with and without orthosis.

Gait
  • Decrease in hallux pressure at heel off = increase in 1st MTPJ motion
  • Greater 1st MTPJ motion = less pressure under hallux

Scherer, et al. JAPMA 2006

- **Study #1: Weight Bearing Dorsiflexion**
  - When orthotics used in stance, hallux dorsiflexion mean increase 90%

- **Study #2: Sub-hallux pressure in gait**
  - When orthotics used in gait, sub-hallux pressures mean reduction of 14.8%

Applying the Evidence to the FHL Orthotic Rx

- **Plantarflex first ray** *(Roukis/Scherer)*
  - Bring first ray down when casting
  - Maintain close contour with medial arch
  - Reverse Morton’s extension

- **Reduce rearfoot eversion** *(Harradine)*
  - Deep heel cup
  - Increased width
  - Medial skive
Casting Technique

• Plantarflex 1st ray or dorsiflex hallux
What Happens If You Don’t Plantarflex the First Ray When Casting?

Excess varus captured
   In negative cast

Excess varus captured
   In positive cast

Excess varus captured
   In orthosis
Foot Scanners That Allow NWB

- Meets EBM
What Happens If You Don’t Plantarflex First Ray When Casting?

- No Orthosis
- First ray dorsiflexed
- Orthosis from cast w/ 1st ray not plantarflexed
- First ray plantarflexed
- Orthosis from cast w/ 1st ray plantarflexed
Material Choice

- Material: Semi-rigid
Castwork

**Heel Cup Depth**
- □ Shallow (10mm)
- □ Normal (14mm)
- ✗ Deep (18mm)
- □ ______ mm

**Orthotic Width**
- □ Narrow
- □ Normal
- ✗ Wide
- □ Extra Wide Arch
- □ Medial Flange
MEDIAL HEEL SKIVE
(minimum heel cup depth)

2mm  R  L  (10mm)
4mm  R  L  (14mm)
6mm  R  L  (18mm)
How Tight Should the Orthoses Conform to the Arch of the Foot?

Tighter orthotic supports base of first ray to allow first ray to plantarflex
Cast Fill / Inversion

- **Cast Fill**
  - Prescribe minimum fill
  - Ensure that the lab does not overfill the medial arch
  - Excess plaster expansion in the arch reduces the chance of arch irritation, but also reduces effectiveness

- **Inversion**
Reverse Morton’s Extension
# Hallux Limitus Prescription

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<tbody>
<tr>
<td><strong>Casting</strong></td>
<td>First ray plantarflexed</td>
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<tr>
<td><strong>Material</strong></td>
<td>Semi-rigid polypropylene</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>Wide</td>
</tr>
<tr>
<td><strong>Heel Cup Height</strong></td>
<td>Standard or deep depending on heel eversion</td>
</tr>
<tr>
<td><strong>Positive Cast Corrections</strong></td>
<td>4mm medial heel skive if heel everted</td>
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<tr>
<td></td>
<td>2° inversion</td>
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<tr>
<td><strong>Posting</strong></td>
<td>0/0 EVA rearfoot post</td>
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<tr>
<td><strong>Covers</strong></td>
<td>EVA to toes</td>
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<tr>
<td><strong>Accommodations</strong></td>
<td>Reverse Morton’s extension</td>
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Take Home

- Plantarflex the first ray when casting
- Positive castwork critical to outcome
- Prescribe to prevent rearfoot eversion
- Prescribe to decrease force under the first metatarsal head
Thank You