Evidence-based rehabilitation of the foot and ankle

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Why an interest in foot/ankle rehab?

- Interested as a student
- Senior symposium
- Worked with Gary Gray on continuing education course that went on to become Scapular Reaction
Objectives

- Demonstrate understanding of foot/ankle anatomy and biomechanics
- Articulate understanding of evidence-based updates for rehabilitation of the foot and ankle as it pertains to
  - Therapeutic exercise
  - Manual therapy
  - Orthotic intervention
Bony structure of foot/ankle
Full disclosure

- Some slides and research taken from MedBridge course by: Alexis Wright PT, PhD, DPT, FAAOMPT
- Not focusing on thrust-type manipulation. Why? Because I don’t want to
- Most research from last 10-years.
- Presenting research can be boring—bear with me
- Majority of literature focuses on ankle sprains, chronic ankle instability (CAI), heel pain syndromes,
Anatomy
Anterior compartment muscles

- NWB action=DF
- FWB action=Decelerate pronation at heelstrike
- Tibialis anterior
- Extensor hallucis longus
- Extensor digitorum longus
- Peroneus tertius
- Innervation from deep peroneal nerve
Lateral compartment muscles

- **NWB**
  - action=Eversion

- **FWB**
  - action=Decelerate inversion/supination

- **Peroneus longus**

- **Peroneus brevis**

- **Innervation from superficial peroneal nerve**
Deep posterior compartment muscles

- NWB action = PF
- FWB action = deceleration of DF through midstance
- Tibialis posterior
- Flexor digitorum longus
- Flexor hallucis longus
- Popliteus
- Innervation from tibial nerve
Superficial posterior compartment muscles

- Same action as deep posterior compartment muscles
- Gastrocnemius
- Soleus
- Popliteus
- Innervation from tibial nerve
The Manual Therapy “Six-pack”
From Whitman et. al.
But wait—there’s more!

- Don’t forget:
  - Intertarsal
  - Tarsometatarsal
  - Intermetatarsal
  - MTP, especially 1st
How ‘bout that foot binding?!?
Manual therapy techniques used

Most may be done as mobilization or manipulation

- Medial/Lateral glides and INV/EVE mobilization/manipulation
- Proximal tibiofibular joint thrust mobilization/manipulation
- Distal tibiofibular joint mobilization/manipulation
- Rearfoot distraction thrust mobilization/manipulation
- Talocrural joint anterior to posterior mobilization/manipulation
- Alternate method of talocrural joint AP mobility (weight-bearing MWM)
Medial/Lateral calcaneal glide

Subtalar mobilization:
- Stabilize talus by table or manually
- Medial glide of calcaneus
- Lateral glide of calcaneus
Rearfoot distraction mobilization

- Wrap fingers around talus and proximal mid-foot
- Provide traction force to distract talus out of ankle mortise
- May be done as a grade 5 manipulation
Proximal tibiofibular mobilization

- Subject’s leg stabilized by table
- Clinician stabilizes tibia
- Anterior/posterior mobilizing force through fibula
- Beware paresthesia and protect peroneal nerve
Talocrural Joint mobilization

- Clinician stabilizes ankle mortise
- Anterior/posterior mobilizing force provided through talus
- I believe this is easier to do with Kaltenborn wedge.
But DON’T do this with it!
Distal Tibiofibular joint mobilization

- Clinician stabilizes Tibia
- Anterior/posterior mobilizing force through fibula
Mobilization With Movement

- Pioneered by Brian Mulligan
- Patient in FWB
- Clinician stabilizes talus
- Clinician provides anterior glide of mortise through belt
- Clinician facilitates DF movement
- Can also be done PWB or NWB
Mobilization with Movement-MWM

**Weight bearing**

**Non weight bearing**

**FIGURE 3.** Weight-bearing mobilization with movement treatment. The belt applies a posteroanterior force to the distal tibia, while the talus and foot remain stationary on the table and the patient actively goes to end of pain-free range dorsiflexion.

**FIGURE 4.** Non-weight-bearing mobilization with movement. The therapist glides the talus anteroposteriorly against a tibia that is fixed by the treatment table, while the patient actively dorsiflexes the ankle to end of available pain-free dorsiflexion.
What does the literature say?

Prepare now:
- Drink your coffee now
- Steal some of Chris’s 5-hour energy!
Initial Changes in Posterior Talar Glide and Dorsiflexion of the Ankle After Mobilization With Movement in Individuals with Recurrent Ankle Sprain—JOSPT 2006, Branjerdporn et. Al.

Subjects: N = 16 (history of 2 ankle sprains each)
• Treatment conditions: 3 groups
• Weight bearing MWM (10 sec hold x 4 sets of 4 glides)
• Non weight bearing MWM (10 sec hold, 4 sets of 4 glides)
• No treatment control group
• Outcome Measures:
• Posterior talar glide
• Weight-bearing ankle dorsiflexion
Results—Does it work?

- Both MWM treatment techniques significantly improved posterior talar glide deficit by 55% and 50%, respectively.
- Both MWM treatments significantly improved weight-bearing ankle dorsiflexion by 26% compared to 9% for the control condition.

Conclusion: positive effect of a MWM treatment on improving posterior talar glide and dorsiflexion ROM in individuals with chronic recurrent lateral ankle sprain.
Predicting Short-Term Response to Thrust and Non-thrust Manipulation and Exercise in Patients Post Inversion Ankle Sprain-JOSPT 2009, Whitman et. al.

Subjects: N = 85; status post grade I or II inversion ankle sprain within 1 year

Goal: to develop Clinical Prediction Rule (CPR)

• Treatment conditions: 1-2 visits
• Ankle/foot thrust and non-thrust manipulation, ROM/stretching, advice to maintain usual activity, ice and elevation
• 2 manipulation attempts max, 5 x 30 seconds for mobilizations grade III or IV
• Outcome measures: NPRS, Foot and Ankle Ability Measure (FAAM), LEFS, Beck Anxiety Index (BAI), GROC
Exercise techniques used

- Achilles tendon stretch, non-weight bearing with the knee extended (towel stretch)
- Achilles tendon stretch, weight bearing (runner’s stretch)
- Ankle Alphabet exercises
- Ankle eversion self-mobilization
- Dorsiflexion self-mobilization
Results - Does it work?

- 64 of the 85 (75%) participants had a positive result with the treatment program based on outcome measures.
- CPR: Identified 4 predictors of a positive response to rehab:
  - Symptoms worse on standing
  - Night pain
  - Navicular drop > 5mm
  - Distal tibofibular hypomobility

Subjects: 74 patients post inversion ankle sprain

- Treatment Conditions: Manual therapy (from Whitman) plus ther-ex (2x/week x 4 weeks) OR Home exercise program (HEP) only (1x/week x 4 weeks in clinic)
  - Used same exercises for both groups
- Outcomes Measures: FAAM, LEFS, NPRS tested at baseline, 4 weeks, and 6 months
Does it work?

Outcomes: Improvements in all outcome measures and pain significantly greater at both the 4 week and 6 months in favor of the MTEX group.

Conclusions: MTEX is superior to HEP in the treatment of inversion ankle sprains.
Efficacy of Thrust and Nonthrust Manipulation and Exercise With or Without the Addition of Myofascial Therapy for the Management of Acute Inversion Ankle Sprain: A Randomized Clinical Trial, JOSPT 2013, Truyols-Dominguez et. al.

**Subjects:** 50 patients post acute inversion ankle sprain

- **Treatment Conditions (1x/week x 4 weeks):**
  - MTEX (Whitman-again-and traditional ther-ex)
  - MTEX plus myofascial therapy

- **Outcomes Measures:** NPRS, ankle function at Discharge and 1 month
Does it work?

- Kinda:
  - Improvement in MFR group was **statistically significant**
  - However, gains most likely not **clinically significant** based on clinically significant change on outcome measure

Subjects: N = 4; unilateral heel pain or plantar fasciitis

• Treatment conditions:
  1. Calf-stretching, A/P talocrural mobs, subtalar distraction manip
  2. Calf-stretching, A/P talocrural mobs, subtalar distraction manip, lateral subtalar joint glides, A/P – P/A first TMT joint
  3. Subtalar joint distraction manip, stretching, orthosis
  4. Subtalar joint distraction manip, stretching, foot intrinsics

• Outcome Measures: NPRS and Self-reported functional status
Does it work?

Results:
• Rx duration between 8-49 days
• Sessions ranged from 2-7
• All 4 reported a decrease in NPRS from an average of 5.8±2.2 to 0/10 (>2 significant)

Conclusions:
• Impairment-based PT approach emphasizing manual therapy demonstrated complete pain relief and full return to activities

**Subjects**: N = 60; primary report of plantar heel pain and LEFS ≤ 65
- Treatment conditions: 2x/week x 2 weeks; 1x/week x 2 week; 6 visits total over 4 weeks
- **Control**: Electrophysical agents + exercise (EPAX)
  - Ultrasound, ionto with dexamethasone, ice, gastroc-soleus & plantar fascia stretch, intrinsic foot strengthening, self-mob; 3x/day x 4 weeks
- **Treatment group**: Manual therapy + exercise (MTEX); individualized STM, rearfoot eversion mobilization, ankle eversion self mobs, manual STM of plantar fascia, + gastroc/soleus stretches
- Impairment based mobs at the hip, knee, ankle, foot
- Outcome Measures: 4 weeks; 6 months including LEFS, Foot and Ankle Ability Measure (FAAM), NPRS, Beck Anxiety Index (BAI), Global rating of change scale
Does it work?

- Both groups demonstrated statistically significant improvement in all measures.
- MTEX clinically greater improvement in LEFS and FAAM at 4 & 6 wks.
Acute effects of rearfoot manipulation on dynamic standing balance in healthy individuals; Manual Therapy, Wassinger, et. al., 2014

**Design:**
- 20 healthy participants
- Treatment group underwent rearfoot distraction mobilization
- Control group did nothing
- Both groups tested on Y-balance test

**Results:**
- Dynamic balance improved for overall balance and posteromedial excursion direction
The Effect of Sesamoid Mobilization, Flexor Hallucis Strengthening, and Gait Training on Reducing Pain and Restoring Function in Individuals with Hallux Limitus: A Clinical Trial, JOSPT 2004, Shamus et. al.

**Subjects**: N = 20; hallux limitus ("turf toe", MPJ sprain)

- **Treatment conditions**: 3x/week x 4 weeks
  - Control group: whirlpool, gastroc/hamstring stretch, pulsed ultrasound, PROM 1st MPJ, grade III dorsal glides and distraction 1st MPJ, heel raises, great toe strengthening, e-stim, ice
  - Treatment group: Above + grade III sesamoid joint mobilizations, FHL strengthening, gait training

- **Outcome measures**: ROM, strength
Does it work?

- Control group demonstrated statistically significant improvement in:
  - Pain level (via NPRS)
  - FHL strength
  - MTP extension ROM
Achilles pain, stiffness, and muscle power deficits: Achilles tendinitis; JOSPT, Garcia et. al 2010

- APTA clinical practice guidelines based on meta-analysis
- **Protocol 1:** (Curwin & Stanish)
  - 3 sets of 10 reps eccentrics
  - Increased load weekly
  - Speed of movement changed daily
  - 95% of patients reported symptom resolution in 6-8 weeks
- **Protocol 2:** (Alfredson et al)
  - Unilateral heel raises with no concentric component
  - 3 sets of 15 reps, 2x/day, 12 weeks
Does it work?

- Strong evidence supports use of eccentric loading to resolve symptoms in 6-8 weeks
- Also suggests clinicians consider
  - Modalities (laser, ionto)
  - Manual therapy
  - Other ther ex.

Ill tempered sea-bass?
Eccentric overload training in patients with chronic Achilles tendinopathy: a systematic review; British Journal of Sports Med; Kingma et. al

- Similar results found by:
  - Kingma et. al.
  - Root et. al. *
  - Mafi et. al. *
  - Alfredson et. al. *
  - Silbernagel et. al. *

*Articles not available on pub med
Nonsurgical Management of Posterior Tibial Tendon Dysfunction With Orthoses and Resistive Exercise: A Randomized Controlled Trial; Physical Therapy; Kulig et. al. 2009

**Subjects:** 36 adults with stage 1 or 2 posterior tibial tendinopathy
- **Treatment conditions:** 12 week program
  - Orthotics & stretching
  - Orthotics, stretching, concentric PREs
  - Orthotics, stretching, eccentric PREs
- **Outcomes Measures:** FFI, 5 minute walk, pain

**Results:**
- All groups improved
- Orthotics, stretching, and ECCENTRIC PRE group improved most
- Orthotic and stretching only group improved least
Effectiveness of exercise therapy and manual mobilisation in ankle sprain and functional instability: a systematic review; Aust J Physio; Wees et al. 2006

- Meta-analysis of 17 studies
- Moderate evidence exists that:
  - TherEx (including wobble board) effective in preventing recurrent ankle sprains for both acute sprain and CAI
  - No effect on postural sway
  - Initial improvement in ankle DF
Six Weeks of Balance Training Improves Sensorimotor Function in Individuals With Chronic Ankle Instability; JOSPT, Sefton et. al. 2009

**Subjects**: N = 21; 12 w/CAI and 9 healthy

**Treatment group**: 3x/week x 6 weeks consisting primarily of balance-board training

**Control group**: continue with normal ADLs

**Outcome Measures**: baseline & 6 weeks
- Ankle Injury History Questionnaire
- Functional Ankle Instability Index (FAII)
- Single limb stance
- Star excursion balance test
- Motoneuron pool excitability recurrent inhibition protocol (EMG)
- Joint kinesthesia measurements (Biodex)

**Results**:  
- Enhanced dynamic balance  
- Inversion joint position sense  
- Changes in motorneuron pool excitability compared to healthy controls who did not train

**Conclusions**: Balance board training protocols may produce improvements in the daily functioning of individuals with CAI.
Wobble Board Training After Partial Sprains of the Lateral Ligaments of the Ankle: A Prospective Randomized Study; JOSPT; Wester et al. 1996

**Subjects:** N = 48; primary ankle sprains
- **Treatment group:** 12 week training program with a wobble board 15 min/day
- **Control:** no training
- **Outcome measures:**
  - Volumetric measures
  - Resting pain
  - Walking pain
  - Recurrent ankle sprains

**Results:**
- Recurrent ankle sprains: 25% in treatment group; 54% in control
- Edema: no differences between groups
- Return to sport: no differences

**Conclusions:**
Wobble board training for 12 weeks beginning 1 week after the ankle sprain was effective in reducing the number of recurrent ankle sprains and prevent functional instability of the ankle in patients with primary ankle sprains.
Patellofemoral Joint and Achilles Tendon Loads During Overground and Treadmill Running; JOSPT, Willy et. al. 2016

**Design:**
- 18 healthy runners on treadmill and over ground
- 3-D motion analysis analyzing PF Joint and Achilles Tendon:
  - Peak load
  - Rate of loading
  - Cumulative load / 1K of running

**Results:**
- No differences at PF Joint for treadmill or road running
- Significant differences in all 3 measures for Achilles tendon worse for treadmill
The effect of stride length on the dynamics of barefoot and shod running; Journal of Biomechanics; Thompson et. al.; 2014

- Evaluated effect of footwear and stride length on LE biomechanics during running
- N=11 healthy runners
- Ran over ground at normal stride and at +/- 5 & 10% (metronome induced) both barefoot and shod

- Evaluated 3-D motion capture and force-plate analysis of:
  - A/P GFRs
  - Vertical GFRs
  - Sagittal plane motion of knee, foot, and ankle

**Conclusion**: At same stride length, no difference in LE biomechanics between barefoot and shod running

- Stride-length may be injury-reducing factor
Overall conclusions

- Rehabilitation can treat a myriad of foot/ankle conditions
- Manual therapy works—use it
- Therapeutic exercise works—use it
- There is a place for modalities—especially low-level laser
References


References (cont)


References (cont)


