

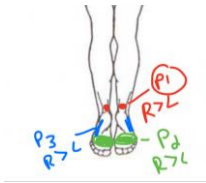
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Young Runner with Recurrent Achilles Pain

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Our runner Her story Her pain diagram



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A message from this mornings lecture "Not every tendon problem is the same"

- This case presentation illustrates:
 - The need for an approach other than eccentric training
 - The need for and value of movement observation, assessment, and intervention
- This talk will provide a framework assessment of the runner
- Laboratory activity will include movement assessment specific to the runner and intervention to improve the running skill

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Our aim



RUN well

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Perform Well



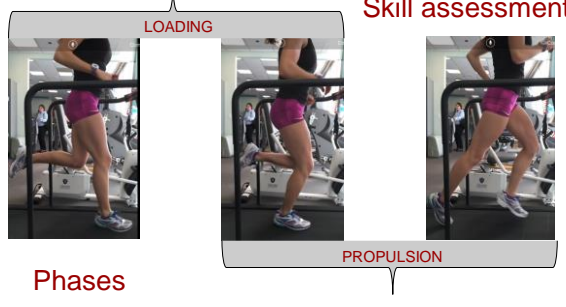
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Our strategy?

Intervention driven by systematic hypothesis based assessment

1. History
 - Training and medical
2. Running mechanics
 - a) Observational gait analysis
 - b) Ground reaction forces
3. Phase specific movement testing
 - a) Motor control
 - b) ROM, power, endurance
4. Local orthopedic examination
 - a) Tissue integrity
 - b) ROM, MMT, accessory motion

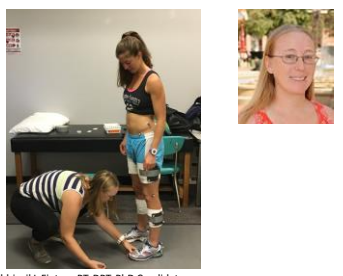
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Musculoskeletal and Biomechanics Research Laboratory



Abbigail L. Fietzer, PT, DPT, PhD Candidate

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Loading Phase

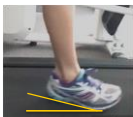
Predictors of vertical ground reaction force



Our runner



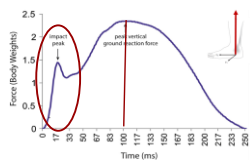
Excessive vertical displacement



Forefoot strike at initial contact

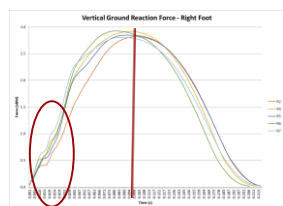
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Our Runner:



Has excessive peak vertical GRF of nearly 3-times body weight

Lacks impact peak



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Loading Phase

Braking/propulsive ground reaction force



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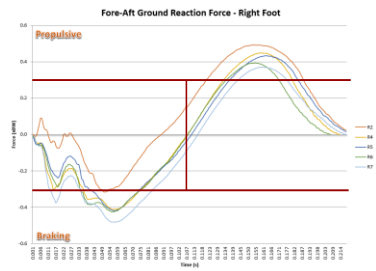
Braking and propulsive GRF

Our runner:

Typical pattern



Above average force



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Predictors of ground reaction forces:
Medial and lateral



Pelvic drop WNL



Foot placement crossing midline

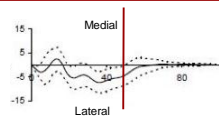


Excessive foot excursion in frontal plane



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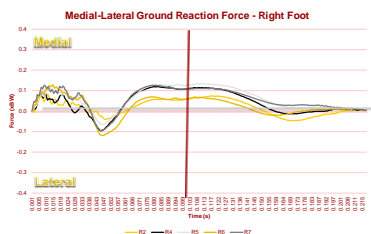
Medial and lateral ground reaction forces



Atypical pattern



Excessive force



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Propulsion

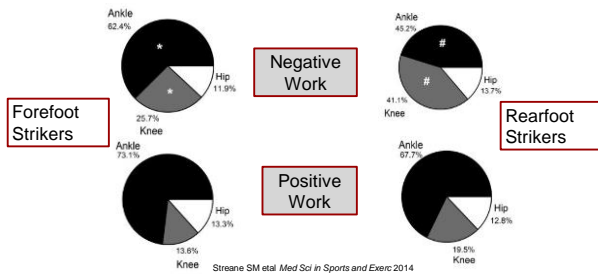


- Our runner supinates late



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Work distributions and foot strike pattern



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Summary of Running Gait Analysis

Loading Phase

- Evidence of increased load on Achilles tendon and plantar flexors
 - Increased vertical displacement
 - Forefoot striker
 - Excessive excursion from inversion to eversion
 - Narrow base of support
- Resulting in:
 - Excessive vertical, braking and medial ground reaction forces
 - Increased work and musculotendinous demand on posterior leg and plantar foot

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Summary of Running Gait Analysis Propulsion Phase

- Evidence of increased load on Achilles tendon and plantar flexors
 - Narrow base of support
 - Prolonged pronation following midstance
- Resulting in:
 - Excessive vertical, propulsive and medial ground reaction forces
 - Increased positive work and musculotendinous demand on posterior leg and plantar foot

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Movement Testing



Based upon skill assessment
 Running phase specific
 Directs the orthopedic examination
 Guides therapeutic exercise selection



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Lab Session

Objectives:

- Perform and manipulate movement tests specific to running phases
- Apply test findings to determine patient specific treatment modalities

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Loading phase specific movement tests

- Anterior lower extremity reach
- Step down test
- Single leg balance anterior ipsilateral UE reach
- Single leg balance frontal plane medial ipsilateral UE reach
- *Triple hop test*
- *Plyometric leap test*

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Loading Tests

- Anterior lower extremity reach
- Step down
 - Observe control of lower extremity loading
 - Foot, knee, hip, pelvis, trunk, upper extremities
 - Manipulate by supporting heel, or midfoot, or forefoot, or femur
 - Determine cause of collapse: Limited foot/ankle mobility? Or limited strength? Impaired control?
- Triple hop test for power

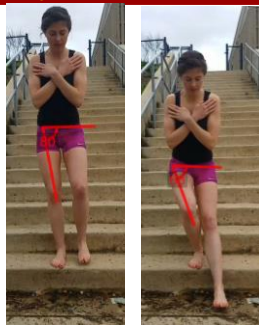
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Anterior LE Reach

- Reach distance
- Dorsiflexion ROM
- Knee and hip flexion
- Trunk lean and rotation

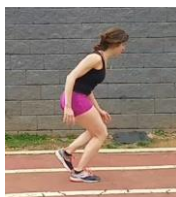
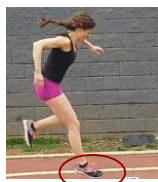
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Step Down

- Look for frontal plane control of trunk, pelvis, hip, knee, and foot
- "Not just a foot problem anymore"
 - Femoral Add/IR
- Excessive foot pronation

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Triple Hop



- Hop distance
- LE and UE alignment
- Trunk lean and rotation

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Loading Treatment

- Tape to support arch, facilitate plantar flexion of first ray, heel lift
- Manipulate midfoot, mobilize talo-crural joint
- Functional mobilization of first ray to facilitate plantar flexion
- Strengthening SLB or SLS squat with UE reaches or wall push for hip ABD/ER

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Loading: TREATMENT



BOSU SL RDL



WALL PUSH



SL SQUAT
UE REACH

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Propulsive phase specific movement tests

- Terminal stance heel raise
- Single leg balance on forefoot
- Toe walk backward/forward
- *Plyometric step up test*
- *Triple hop test*
- *Plyometric leap test*



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Propulsion Tests

- Trailing limb stance HR
- Staggered stance rotation to see if the foot can supinate in stance
 - Watch for supination or rear and midfoot countered with forefoot stability
 - Manipulate/mobilize with movement and re-assess
- Dynamic heel raise
- Plyometric leap test for power

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Terminal stance heel raise

- Number of heel raises
- Heel height/ PF and MTP extension ROM
- Forefoot stability
- Mid/rearfoot supination



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Propulsion: Assessment



Stride Stance Rot

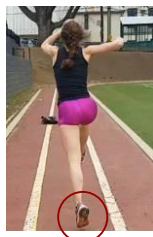


Dynamic Heel Rise

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Plyometric leap test

- Efficiency of push off with maximum effort
- Leap distance
- Extremity alignment
- Trunk alignment



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Propulsion Treatment

- Functional calcaneal inversion, navicular elevation, 1st ray plantar flexion, 1st MTP ext
- Single limb balance rotation
- Single limb balance 3-D woodpecker
- Plyometric step up

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Open Chain
1st Ray Plantar Flexion

Open Chain Calcaneal Inversion with Midfoot and Forefoot Eversion, Navicular, PF 1st Ray



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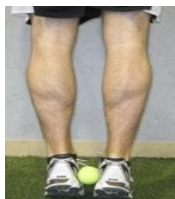
Treatments: PROPULSION



Transverse Plane Heel Rise

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Treatments: PROPULSION



Heel Rise focus on inversion



3D Woodpeckers

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Trunk Control & Endurance Tests

- Quadruped alternate arm/leg raise
- Quadruped ipsilateral arm/leg raise
- Bear crawl
- Front plank
 - Add extremity raise
- Side plank
 - Add extremity raise



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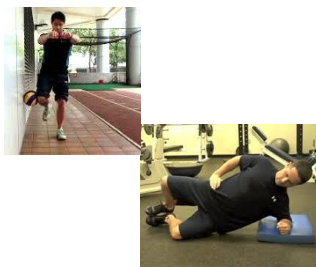
Side Plank Top Leg Up for Time

- Lateral trunk and hip endurance
- A) >60 seconds R&L
- B) Left: 43 seconds
Right: 29 seconds

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Trunk Control & Endurance Treatment

- Standing static and dynamic lower extremity wall push
- Static and dynamic resisted side plank on knees with hip ABD/ER



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Integrating the local orthopedic examination



MMT's and strength
 4/5: Post Tib, Peroneous Longus, Flexor Hallicis Longus
 Heel raise L=16, R=13

ROM and foot posture:
 Dorsiflexion limited
 Right 1st MTP ext: 55°
 Right forefoot varus



Joint play:
 Hypomobile TC jt
 Impaired locking CC jt

Tender to palpation R>L
 Achilles tendon insertion
 Med>Lat, plantar, lateral posterior leg, plantar navicular and cuboid

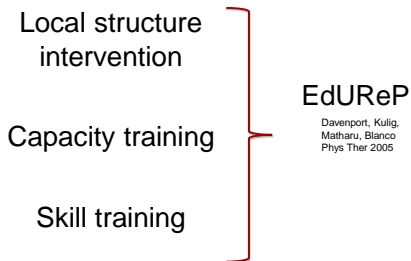
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Patient Problem Summary

- **Local**
 - Pain at the teno-osseous junction, hypermobility midfoot, hypomobility ankle
- **Capacity**
 - Weakness Gastrocsoleus, PT, PL, FHL, decreased dorsiflexion ROM, impaired lateral trunk/hip muscle endurance
- **Skill**
 - Increased load on Achilles tendon, posterior leg, plantar foot based upon GRF and kinematic analysis

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Intervention



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Heel lift, taping & orthoses



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Joint mobilization
Soft tissue mobilization



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Local capacity



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Movement tests become exercise

- Loading
 - Anterior LE and UE reaches, Wall push static and dynamic hip ABD/ER
- Propulsion
 - Single limb balance with rotation
 - Single limb balance 3D woodpecker
 - Plyometric step up with knee drive
- Trunk
 - Dynamic side plank on knees for hip extension/ABD/ER with resistance band

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Neuromuscular drills for running skill deficits

- When? Prior to run as part of warm up
- Dosage: Novice 2+ x 15-25m; Competitive 2+ x 50m
 - Crouched gait
 - Eversion/duck walk
 - Backward walk
 - Wide base walk/jog
 - Midfoot strike with lunge walk and knee drive
 - Plyometric step ups and knee drive

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Running gait re-training

- Cyclical and interval based focus on specific elements of skill
 - Foot placement
 - Mid foot strike
 - Step width
 - Vertical displacement
- Motor learning focus 1:4-5 minutes

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