PT FOR RUNNERS:

Practical Considerations for Evaluation, Treatment and Injury Reduction

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Participants will be able to:

- Identify key biomechanical requirements for running.
- Be aware of common running injuries and identify potential causes.
- Be capable of performing a comprehensive evaluation of a runner, including video analysis.
- Summarize current research related to running technique.
- Demonstrate the need for individualized footwear requirements.
Participants will also be able to:

- Be capable of recommending orthotics for runners based on current evidence.
- Identify the potential effects of compression garments on performance and recovery.
- Be capable of implementing appropriate interventions for the running population, including exercise prescription for injury reduction.
Chris Johnson
The Gait Guys
Running Research Junkie
Greg Lehman
Jack Daniels – Run SMART Project
Brian Mackenzie – Crossfit Endurance
Jay DiCharry
Why Run???
Why Run????

- In 2007 37.8 million people ran for exercise
- Social community
  - Running groups
- Minimal barrier to entry
  - Equipment = shoes
  - Time
  - Location
Thoughts?
What is Running?

- Eccentric loading followed by concentric explosion

Implications:
- Plyometric Training
- Power more important than absolute strength.
Phases

- **Initial Contact**
  - Heel, mid-foot, forefoot

- **Mid Stance**
  - Early – 50 msec; pronation
  - Mid and Late – 650 msec; resupinating

- **Terminal Stance**

- **Pre-Swing**

- **Swing**
Biomechanical Requirements

1\textsuperscript{st} Ray Extension:
- Gait = 60 degrees
- Uphill Gait = 80 degrees
- Run = 100 degrees

- DF in subtalar neutral: 20-30 degrees
- Hip Extension: 18 degrees
- Hip ADD: 10 degrees (Ober)
Essential Muscles

- Post Tib and Glute do the same thing?
  - Slow pronation
  - Re-supinate
- Anterior Tib
  - Control PF and pronation
- Fibularis Longus
  - Stabilize 1st Ray
- Primary knee extensor during gait
  - Soleus
Injuries

- Incidence varies from 24-55% of runners
- Consistent Factors
  - Previous injury
  - Less experience – novice = 2-3x more injury
- Age
  - Over 50 or Under 31
- Mileage
  - Rapid increase
  - More than 40 miles/week = 3x more injuries
Common Injuries

- **Tibial Stress Fx**
  - Compressive – loading rate
  - Tensile – Instability/Poor co-contraction (Cue wider gait to decrease eccentric demand on Post Tib)

- **PFPS/ITBS**
  - Often excessive hip IR (Cue knee caps straight)

- **Achilles Tendinopathy**
  - Too Tight?
  - Poor rearfoot to forefoot stability (pushing off in pronation) – most common
  - Positive Ankle Power on Contact – plantarflexing into foot strike
Common Injuries 2

- **HS Tendonopathy**
  - Tight (rare)
  - Poor Rotational Stability – increased force through unstable lever
  - Hip Flexor Tightness

- **Sciatica**
  - Rule out lumbar, scar tissue, neural mobility
  - Possible excess IR

- **LBP**
  - Poor core stability
  - Extending spine instead of hip
Runner Evaluation

- Running Hx
- Injury Hx
- Workouts (running and gym)
- Recovery Strategies
- Footwear
- Biomechanical Evaluation
- Video Analysis
Running Hx

- Years
- Miles/Events/Times
- Style
- Cadence
- Goals
- Recent changes
  - Increase mileage
  - Increase pace
  - Footwear
Footwear

- How often change
- Type
  - Motion Control
  - Stability
  - Neutral
  - Minimal
  - Maximal
Biomechanical Exam

- Posture
  - Anterior, Posterior and Lateral
  - Navicular Drop
- SFMA
- Hallux Extension (weight bearing)
- Closed Chain DF (subtalar neutral)
- Single Limb Squat
Biomechanical Eval 2

- **ROM**
  - Hip, Knee, Tibial Rotation, Foot and Ankle

- **Strength**
  - Core, Hip, Knee, Foot and Ankle

- **Special Tests**
  - Thomas, Ober, Bridge, Posterior Tib. Insuff.

- **Other**
  - Neural Tension, Repeated Motion, etc...
Why Video?

- Human Eye
  - 16 frames per second
- Traditional Video
  - 30-60 frames per second
- Digital Video
  - ≥1000 frames per second
Video Analysis

- Behind and Lateral
- Virginia University Visual Gait Tool
- Allow 6 minutes of warm-up to normalize form

Motion Analysis
- Dartfish
- Optigait
- Kinovea
- Hudl Technique
Technique

- Traditional
- Pose
- Chi Running
Form and injuries

- **Heel Strike**
  - No differences in injury rates versus mid/forefoot strikers

- **Pose**
  - Changes kinematics but not economy
  - Shortens stride and increases cadence

- **Chi**
  - No evidence supporting decreased injury rate
Running Impact

- Heel Strike increases impact???
  - Need to be 55% stronger to heel strike
- Downhill
  - 9% grade = 50% increased load
- Uphill
  - 4% incline increases glute activity 16%
  - Considerations?
    - DJD
Foot Strike

  - Rearfoot = increased vertical loading rates
  - Midfoot = increased DF ROM
  - Forefoot = greater knee flexion
Foot Orthoses

- **Types:**
  - Prefabricated (Over-the-Counter)
    - Wide range of technology
  - Custom:
    - 3-D Printing or Additive Manufacturing
      - Ability to fuse various materials and shapes throughout orthosis.
      - Able to account for various levels of pressure relief and shock absorption according to region of foot.
    - Molds or Subtractive Manufacturing
      - Casting
      - Impressions
      - Uniform density, stiffness, and pressure relief throughout entire orthosis.
Foot Orthoses Research

- **Additive versus Subtractive**
  - Study by Telfer et al, 2010 noted that the adjustability of the additive manufacturing was able to specifically target areas for pressure relief.
    - Provides increased freedom to individualize orthosis

- **Custom versus Prefabricated**
  - Study by Ring and Otter, 2014 noted that there were no appreciable differences between each orthosis when tested for pain relief.
Do Orthoses Work??

- **Research demonstrates:**
  - Mayer et al, 2007 showed an increase in calf muscle strength. Mechanism unknown.
  - Jung et al, 2011 noted an increase in intrinsic foot muscular strength
  - Limitations:
    - Many studies have not examined orthoses extensively with running specifically.

- **Unpublished study:**
  - Compared Traditional running shoe, minimalist shoe, and foot orthosis.
    - FO group demonstrated the largest improvement in all parameters of ankle and foot strength and endurance, followed by minimalist and then tradition shoe.
Orthotics for PFPS

- Insignificant changes in kinematic in the frontal plane (<6 deg wedge)
- Increase in peak knee ABD moment (valgus?) (<6 deg wedge)
- Kinematics are not always consistent with Sx’s – 2008 study indicated decreased Sx’s with orthotic
- 5 deg wedge shifts peak ABD moment to later in stance = decreased rate of loading
- Minimal changes at the hip recorded
- Improved VMO and glute med activation with Single LE squat and lateral step down but no studies have shown changes in muscle activation during running
Footwear

- $$$ - Big Business and Marketing
- Truth
  - Footwear does affect mechanics
  - Advancements have not prevented injuries or improved performance
  - Not a magic pill – still need to work on self
Categorizing shoes

- Motion control: designed for moderate to severe pronation
- Stability: Utilized for pronation. To a lesser degree than motion control
- Neutral: Designed for neutral runners. No added technology to impact motion.
- Minimalist: Shoes providing minimal interference with natural foot movement.
- Maximalist: Extensive cushioning. Increased stack height.
How to categorize shoes

- **Minimalist**
  - Wide range of shoes that are considered “minimalist”
    - Barefoot, Minimalist, Transitional
  - Team from Laval University developed a Minimalist Index
  - Components: Weight, stack height, heel to toe drop, Motion control and stability technologies, flexibility
Shoe Prescription

- Knapik et al, 2014: Meta-analyses concluded that selecting running shoes based on arch height had little influence on occurrence of injury.

- Ryan et al, 2010: RCT that reported prescribing pronation control systems based on foot posture is too simplistic.

- Malisoux et al, 2015: Prospective double-blinded RCT demonstrated that only runners with a pronated foot benefited from motion control features.
Effects of Shoes

- Miller et al, 2014: Compared standard and minimalist shoes and found that intrinsic foot musculature strengthened with minimalist shoes.

- Chambon et al, 2015: Found that higher drop shoes had lower loading rates overground than barefoot. And the opposite was true when on treadmill.
Footwear

- Increased cushion = decreased proprioception = increased limb stiffness = increased ground reaction forces
- Eva (foam)
  - Starts to decompose at 200 miles
  - Decomposed at 466 miles
  - Decomposes with time even if not in use
- Kong et al, 2009: footwear changes at 200 miles lead to kinematic changes
Minimal is the Goal?

- Takes time to transition
  - Up to 2 years
    - Increase 10%/week
  - Consider other footwear
  - Consider using different footwear for different training days

- Requirements
  - Normal DF with plantar fascia mobility
  - Normal SLS (30 sec with eyes closed)
  - Ability to isolate FHB in weight-bearing
Minimal vs. Maximal

  - Increased vertical loading rate with high cushion shoes
  - Possible increased pronation
  - Increased cushion = increased leg stiffness
The Risks and Benefits of Running Barefoot or in Minimalist Shoes: A Systematic Review: Sports Health vol.6, No. 6, 2014

- Barefoot: decreased vertical ground reaction force, less extension moment at the knee, decreased ground contact time, shorter stride, increased stride frequency
- NO DEFINITIVE CONCLUSION REGARDING RISKS OR BENEFITS
Other Footwear Considerations

- Comfort = Best Indicator
- Maximalist = Higher Loading Rate
- Minimalist = Altered Tissue Loading Pattern
Compression for Performance

- NO evidence for improved energy expenditure
- NO evidence for improved muscle function
- NO evidence for statistical difference in sprint or endurance distances
- Some individual differences – psychological?
Compression for Recovery

- Some evidence for improvement
- Unclear on physiologic mechanism or benefits
  - May alter inflammatory response and accelerate repair
- Psychological benefits have been demonstrated
Exercise Goals

- Increase Performance: hip, NOT quad dominant
- Decrease Forces (Impact): ~180 cadence
- Improve Endurance/Form:
  - Optimal Form (not the same for all)
  - Low Weight x 15-20 reps
  - Learn Motor Program then Move On
- Increase Strength:
  - HEAVY 5-8 reps x 3-4 sets
- Increase Power:
  - Medium weight (FAST) 2-5 reps x 2-5 sets
Interventions

- **Mobility**
  - Soft Tissue Length: 10 weeks
  - Fascial Mobility: 2-3 weeks

- **Strength/Power**
  - Include foot intrinsics

- **Form/Technique**

- **Breathing**

- **Recovery**
Form Cues

- Cadence
- Be “LIGHT or QUIET”
- Figure “4” position
  - EZ Run Belt

- Shoulders down and back
Exercise (Strength Training)

- Requirement, not supplement
- Plyometrics
  - 30-45 reps 2-3x/wk
- Strength
  - 1x/wk to maintain
  - 2x/wk to improve
  - 3x/wk to gain
- Taper
  - Keep high intensity but decrease volume
What does all of that mean?

- Running is a SKILL
- There is no ONE right way to run
- There is no ONE best shoe
- You NEED to get in shape to run – NOT run to get in shape