DREXEL UNIVERSITY
Department of Physical Therapy
and
Rehabilitation Sciences

DREXEL UNIVERSITY
Running Performance
& Research Center
at Parkway Health & Wellness

Clinical Application of Running Biomechanics: How to put Research into Practice.

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Objectives

Upon completion of this session you will be able to:

1. Understand the significance and clinical utility of running biomechanics evidence
2. Identify barriers to utilizing biomechanical evidence in practice and potential solutions.
3. Improve clinical decision making paradigms and strategies to provide successful treatment outcomes in runners
4. Consider and implement the three pillars of evidence-based practice appropriately when working with patients with running-related injuries.

I. Introduction and overview

- Incidence of running related injuries is high
  - Common injury sites
- Treating the symptoms versus fixing the cause

II. Running biomechanics evidence foundation: what does the latest research tell us?

- Evidence exists for:
  - Increasing cadence
  - Shortening stride length
  - Decreasing ground reaction force
  - Increasing stride width
  - Changing strike pattern
  - Decreasing hip adduction
  - Increasing leg stiffness
- How and why do these biomechanical changes work?
- Which runner will benefit from what biomechanical change?
- How much change is needed?
- Do these changes reduce running-related injuries?

III. Barriers to knowledge translation from research to clinical practice

- Lab vs Clinical Measurement
    - 3D and 2D motion capture capabilities
    - Considerations
        - Cost
        - Validity
        - Reliability
        - Kinematics vs Kinetics
        - Environment
    - Options:
        - Motion analysis software
        - IMU devices
        - Wearable technology
        - Considerations

IV. Evidence based practice considerations

- Treatment concepts
    - Evidence based practice
        - Scientific evidence
        - Expert opinion / clinical experience
        - Patient values and needs
    - Examination and Individualized treatment
    - Analyze running mechanics

- Clinical intervention tools available
    - Strength / neuromuscular training / muscle performance
    - Shoe / orthoses modification
    - Manual therapy
    - Training program modifications
    - Gait retraining:
        - Modification of step frequency, step width, strike pattern, stiffness, impact loading variables, proximal movement patterns

V. Applying 3 pillars of evidence-based practice to runners

Case descriptions and clinical strategies:

PFPS:

- *Consider:* increasing step rate, reduce overstriding and impact loading, reduce hip adduction, improve hip muscle performance
- *Rationale:* Visual and verbal cues can reduce peak hip adduction. Gait retraining was demonstrated to change biomechanics and improve symptoms in injured runners (Noehren 2011, Willy 2012). Increasing step rate decreases peak PFJ stress in runners with PFPS (Lenhart 2014, Willson 2014, Willson 2015) and reduces energy absorbed at the knee (Derrick 2000, Heiderscheit 2011). PFPS is associated with reduced hip muscle strength in female runners (Souza 2009). Hip strengthening improves symptoms in runners with PFPS (Neal 2016).

Achilles tendinopathy:

- *Consider***:** reducing overstriding, increase lower limb stiffness, transition away from forefoot strike pattern, improve calf muscle performance.
- *Rationale:* increasing step rate may decrease dorsiflexion at midstance (Lenhart 2014). Transition to a rear foot strike pattern may decrease plantar flexor impulse
(Stearne 2014). Eccentric exercise has been shown to improve symptoms in Achilles tendinopathy (Alfredson 2014).

Iliotibial band syndrome:

- *Consider:* reducing hip adduction, increase step width (eliminate cross over gait),
Improve hip muscle performance.
- *Rationale:* Increasing step width decreases ITB strain and strain rate (Meardon 2012) and decreases peak hip adduction (Brindle 2014, Meardon 2012). Visual and verbal cues can reduce peak hip adduction during running (Noehren 2011, Willy 2012). Hip abductor strength is decreased in runners with ITBS and symptoms improve with strengthening exercises (Fredericson 2000)

Chronic exertional compartment syndrome:

- *Consider:* increasing step rate, reduce overstriding, transition from rearfoot to midfoot or forefoot strike pattern
- *Rationale:* Increasing step rate may decrease ankle dorsiflexion at foot strike
(Kumala 2013). Dorsiflexed foot at initial contact is associated with higher compartment pressures (Kirby 1983).Transition away from rear foot strike pattern may decrease stance phase activation of tibialis anterior (Shih 2013).

Stress fracture

- *Consider:* reduce overstriding and impact loading, reduce hip adduction and increase step width (eliminate cross over gait), transition away from rear foot strike pattern.
- *Rationale:* A history of lower extremity stress fractures is associated with high vertical loading rates (Zadpoor and Nikooyan 2011). Rear foot strike patterns are associated with higher vGRF loading rates (Cavanagh 1980). Increasing step rate may decrease tibial acceleration (Mercer 2003, Hamil 1995). Wider step width is associated with decreased tibial loads (Meardon 2014).

VI. Discussion/Questions

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