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Sports Physical Therapy Virtual Conference

Guest Editor: Mike Studer,
PT, MHS, NCS, CEEAA, CWT

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Sports Physical Therapy Virtual Conference

- | | |
|------------|--|
| Mon 3/11 | Hamstrung No More-Contemporary Review and Management of Hamstring Injury Joel Sattgast, PT, DPT, OCS |
| Tues 3/12 | Injury Prevention in the Adolescent Athlete Identifying Risk Factors and Implementing A Biopsychosocial Perspective Melisa Abesa, PT, DPT, OCS |
| Wed 3/13 | Novel Programming and Early Return to Sport Exposure Following ACL-R Adam Schlitz, PT, DPT, OCS, CSCS |
| Thurs 3/14 | Physical Therapy Pillars of Success in Working with Distance Runners Christopher Johnson, MPT, MCMT, ITCA |
| Fri 3/15 | Advances in the Rehabilitation and Medical Management of the Concussed Athlete Jim Chesnutt, MD |

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Injury Prevention in the Adolescent Athlete

*Identifying Risk Factors and
Implementing a Biopsychosocial Model*

Melisa Abesa PT, DPT, OCS

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Learning Outcomes

After this course, participants will be able to:

- Define adolescence and the biological components unique to this developmental phase.
- Identify at least three commonly seen injuries in adolescent athletes.
- Describe modifiable versus non-modifiable factors that contribute to increased risk of injury in adolescent athletes.
- List at least three benefits of strength training in adolescent athletic development.
- Identify an evidence-based program for injury prevention and return to sport.
- The participant will be able to list at least three non-musculoskeletal factors that can contribute to increased risk of injury in the adolescent population.

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Overview

- Defining adolescence, review of biology + psychology
- Injuries (statistics, presentations)
- A biopsychosocial approach – identifying diverse factors
- Non-musculoskeletal contributors: nutrition, female triad/REDS, sleep, and psychosocial factors
- Musculoskeletal based interventions: strength training, prevention programs, and RTS protocols
- Take-Home: clinical application and putting it all together

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Adolescence *defined*

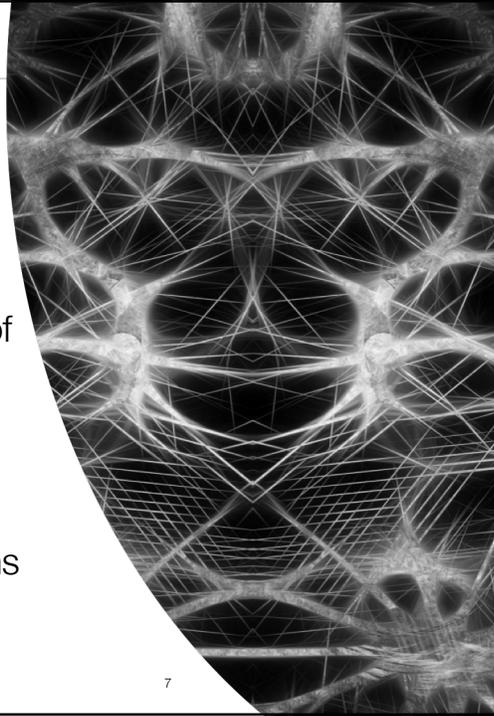
- ~10-20 years old
- *Transition from childhood into adulthood*
- **Physical:** musculoskeletal growth (and “growth spurt”), hormonal changes/secondary sex characteristics
- **Cognitive:** increase in introspective thinking, increase in risk taking
- **Social/emotional:** increased focus on peers vs family; seek like minded/shared interests
- **Environmental:** increase in independence; potential increase in expectations

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Optimal for Learning

- Period of increased rate of brain cell development
- Allows increased skill acquisition
- Pruning – “use or lose it”
- Strengthening connections



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Emotional Changes

- Hormones
- Limited stress management (difficulty internally/biologically moderating the stress response)
- Changes in relationships, expectations, family/community dynamics, etc.
- Difficulty with self esteem and identity
- Increased role of mental health factors/risks

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Limited Impulse Control



- Development of brain occurs at different rates in different regions
- Reward center develops prior to impulse control
- Increase in amygdala use vs frontal cortex

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Adolescent Athletes...

- Clinical presentation – middle school and high school athletes
- Change in participation (volume, demand/level)
- Increase in peer and performance pressure
- Variability of sleep, nutrition, etc.

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Injuries – What the numbers say

NHSR (2016)

- 8.6 million sports/recreation injuries (per year)
- 2.9 million injuries - "sports facility, athletic field, or playground."
- Males 61% vs 39% females
- Aged 5-24 65%
- 50% requires MD or clinic treatment
- LE 42% vs UE 30% vs head/neck 16%

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Injuries – Unique to Adolescence

- Growth plate/epiphyseal injuries
- Increase in ACL injuries
- Increase in concussions

- Overuse/over-training injuries
- Relationship between injuries and growth cycle

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Peak Height Velocity (growth spurt)

- 2nd largest growth period
- Hormone based
- Earlier in females; more growth in males
- Associated with *increased soft tissue tightness, decreased physeal strength, excessive linear bone growth*
- Impact on performance and injury risk
 - Growth plate injuries
 - Motor control?

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PHV – impact on performance

- Performance based on predicted PHV after 8 week training program.
- Tested 1 RM, max power, jump length, sprint time.
- Greatest changes mid/post PHV.
- Detraining period – pre-PHV ↓ decr in strength/power and post-PHV ↓ sprint speed, but both maintained jump length
 - Strength training less effective prior to PVH.
 - Maintenance required especially strength and power training pre-PHV and speed training post-PHV.

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Epiphyseal Injuries

- Lower extremity vs upper extremity
- Osgood-Schlatter, Sever disease, Sindling-Larsen syndrome
- Gymnast wrist, Little League elbow, Little League shoulder



Henry Vandvke Carter - Henry Gray (1918) Anatomy of the Human Body Bartleby.com; Gray's Anatomy Plate 211

- **Multi-factorial:** *growth, age, size, training volume, injury history*

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Presentation and Management

- At risk populations – throwing athletes
- Increased risk of epiphyseal injury – proximal humerus + medial elbow (epicondylar apophysitis)
 - decreased risk of RTC pathology vs older population; more common = anterior shoulder pain, bicep and labral pathologies
 - epiphyseal vs UCL
- Increased repetition (volume, specifics mechanics)
 - Non-modifiable factors – age, height, BMI
 - Modifiable factors – mechanics, reps/volume, global body control/force transfer
- Interventions – education, risk identification, rehab (past + current injuries), monitoring

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Presentation and Management

- At risk populations – younger population and limited flexibility (LE)
- Assess LE and trunk flexibility and movement mechanics
- Activity modification
- Mobility and conditioning programs

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Over-use Injuries

- **Defined:** “*microtraumatic damage to a bone, muscle, or tendon that has been subjected to repetitive stress without sufficient time to heal or undergo the natural reparative process*”
- **Categorizations/stages:** pain post, pain during, pain during and impacts performance, pain at rest (chronic)
- **Contributing factors:** training volume*, sport specialization*, lack of awareness/education, poor movement mechanics, limited training capacity, biology/development, external stressors/pressures, history of injury

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Interventions/Approaches

- Volume control
- Adequate preparation
- Adequate rest
- Mixed activity (unstructured play, multi-sport)
- Coach improved self-awareness + symptom recognition
- EDUCATION
- COMMUNICATION

According to the
CSMF/AAP:

1 sport per season
10% rule

At least 1 day off/week
2-3 months off same
sport/year

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BIO-PSYCHO-SOCIAL

- Dr. George Engel (1970's)
- Physician and psychiatrist
- Belief that pathologies are a combination of biological/biomedical, social (environment, culture), and psychological (mood, thought processing, etc), factors

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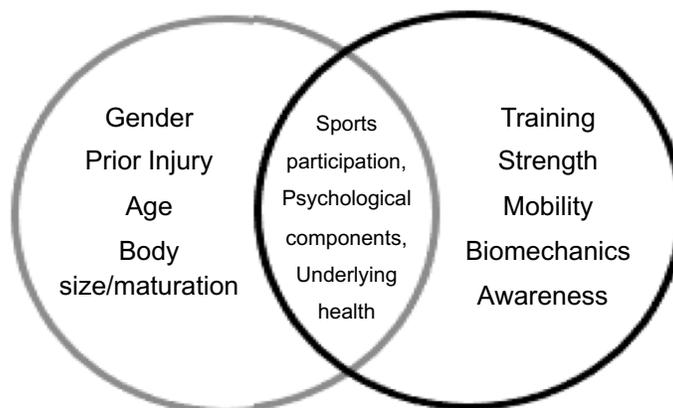
Research Spotlight:

- Multiple factors explain injury risk in adolescent elite athletes: Applying a biopsychosocial perspective (von Rosen, et al. 2017)
- **Biological** (training response, age, gender)
- **Social** (stress, nutrition, sleep)
- **Psychological** (competence-based self-esteem)
- n = 496
- Increased injury risk with increased training load and intensity + decreased sleep volume
- Increased risk with lower self esteem

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Modifiable vs Non-modifiable Factors



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Gender Roles



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- Injury prevalence greater in males overall (*but may be due to increased sport participation*)
- Prevalence varies by injury
 - Calcaneal apophysitis (Sever disease)
 - ACL injury
 - Ankle sprains
- Prevalence varies by sport
 - Increased risk basketball, soccer, baseball (female)

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Gender Roles *cont'd*

- Often females marked as higher risk, especially with ACL injury
- Potential opinions include biomechanics, anatomy, biology, training level, body size, amount of contact... mixed data
- Potential research support:
 - Increased dynamic knee valgus angle with cutting vs male; increased max ankle eversion and decreased max ankle inversion in stance
 - No change in knee flexion angle (Ford 2005)
 - Increased knee laxity based off menstrual cycle.
 - No notable change in movement mechanics, but change in knee LOAD (defined as 3-D torque/twisting load through knee) (Park 2009)

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Social + Environmental Factors

- Often non-modifiable
- Often forgotten
 - Access to equipment
 - Access to care and training
 - Family environment
 - Peer involvement
 - Competition level/environment
 - Schedule



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*So, what CAN we
control/impact?*

Modifiable Factors

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Nutrition

- APTA stance: "the role of the physical therapist to screen for and provide information on diet and nutritional issues to patients, clients, and the community within the scope of physical therapist practice." (House of Delegates P06-15-22-17)
- State laws/expectations vary
 - See state practice act
 - See state law for nutrition

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Nutrition

- Basic requirements:
 - Hydration
 - Overall caloric intake
 - Protein demands 0.8 g/kg BW sedentary vs 1.4-1.5 g endurance vs 1.5-2.2 g strength/power. (Globally accepted at 1.2g-2.0 g across sources)
 - Carb recommendation 6-12 g/kg BW
- *If not met?...*

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The “*Female Triad*”

- Review of the “triad” – energy availability + menstrual cycle + bone health
- Limited caloric intake: fatigue, injury/illness, menstruation impairments, decreased performance, impaired metabolism, impaired immunity, limited recovery/protein synthesis, and impaired CV health
- Lacking MACROnutrients
- Often lacking MICRONutrients (including iron, zinc, calcium, vit D, vit B) – impaired by diet or underlying GI dysfunction (w/ disordered eating).

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REDS – the new “Female Triad”

- REDS: Relative Energy Deficit Syndrome
 - energy expenditure > energy available
- EA can vary – activity level, impaired metabolism (i.e hx of disordered eating)
- Optimal EA

(Mountjoy 2014)



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REDS

- At risk populations: aesthetics, performance, history of disordered eating
- Clinical signs/symptoms: weight loss, loss of menses, hyper-restrictive diet, fixation on caloric intake/output
- Poor growth (youth/adolescent), fatigue, impaired performance, frequent injury, frequent illness
- **What to do?**
 - *Discuss/identify*
 - *Refer out* (nutritionist/dietician, mental health provider)
 - *Encourage communication* – athlete, parent, coach

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Sleep

- Decreased sleep can impact global biological functions – physical activity capacity + performance, fatigue, immunity, etc.
- < 8 hours/night = 1.7x increased risk for injury (Milewski 2014)
 - +1 grade = 1.4x increase
- > 8 hours/night = 61% decreased risk for injury (von Rosen 2017)
 - Recommended nutrition intake = 64% decrease



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Psychosocial Factors

- Risk taking behaviors
- Stress + mental health
- Fear
- Prior injuries/prior experience
- Role of adolescence – peer and performance pressures, coaches, parents, etc.
- COMMUNICATION IS KEY

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- Stress
 - Stress response and history of stressors strongly associate with risk of injury
 - Psychological interventions DECREASED INJURY. (Ivarsson 2017)
- Risk Perception and Ability
 - Highest risk of injury = low level of risk perception + high level of ability
 - Estimation of ability correlated to risk taking levels
 - Lowest risk of injury = high level of risk perception (improved awareness) as well as high level of ability
 - Increased risk with low level of ability (Kontos 2004)

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Fear and Injury

- (Paterno 2018): Utilized Tampa Scale-11 (TSK-11), hop testing and quadricep strength with RTS
- Increased TSK-11 ↑↓
 - 4x ↑ report lower level of activity
 - 7x ↑ impaired hop limb symmetry (<95%)
 - 6x ↑ decreased quad strength (<90%)
- Elevated TSK-11 scores for 2nd injury
- Score > 19 at RTS 13x more likely to reinjure within 24 months.

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Fear and Injury

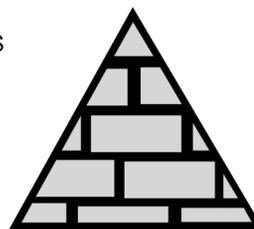
- ↓ fear of reinjury
- ↑ psychological readiness to Return to Sport
- ↑ positive subjective assessment
 - All INCREASE odds of return to same level sport post-ACL injury (Ardern 2017)
- Modifiable factors!
- vs. Non-Modifiable/contextual factors (including female, older, and non-elite sport participation = decrease odds)

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Musculoskeletal Factors + Interventions

- General capacity: strength, power, aerobic, mobility
- Secondary skills: movement mechanics and postures, shock absorption capacity, force transfer
- Application to “sport relevant” movements: multi-directional, multi-speed, reactive, multi-part/sequential, environmental/contextual components

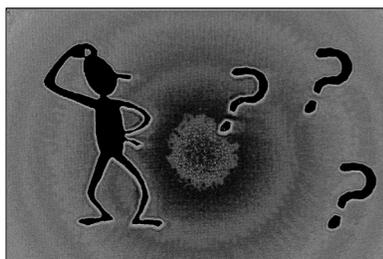


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Injury “prevention”?



Is it possible to PREVENT injury?



- *Injury mitigation, risk identification, risk mitigation*
- Identify the variables, intervene where appropriate
- Most strongly supported = strength training!

• (Laursen 2014)

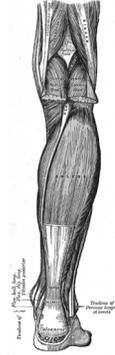
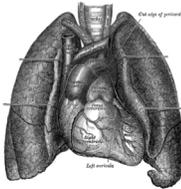
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Strength/Resistance Training

- Anaerobic training
- For improved strength, power, hypertrophy, endurance, motor skills
 - Outcomes vary based off programming
- Adaptations include:
 - NEURAL
 - MUSCULAR
 - CONNECTIVE TISSUE
 - HORMONAL/ENDOCRINE
 - CARDIOVASCULAR



Henry Vanduyke Carter - Henry Gray (1918) *Anatomy of the Human Body* Bartleby.com; Gray's *Anatomy*, Plate 438; Plate 490

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Strength Training: Neural Adaptations

- Increased central activity – primary motor cortex
- Changes in spinal cord (descending corticospinal tracts)
- Improved motor unit recruitment
- Size principle vs selective recruitment
- Potential increase in reflex potentiation
- Cross-education: improved strength in untrained limb
- Bilateral deficit: untrained individuals - decreased combined limb strength vs sum of unilateral

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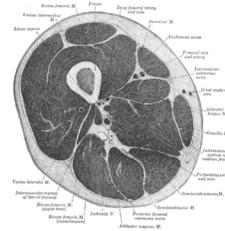
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Strength Training: Muscular Adaptations

- Increase in fiber size
- Potential decrease in capillary density and mitochondrial density (relative to muscle size)
- Structural changes - increased myofibrillar volume, cytoplasmic density, and myosin heavy-chain density; elevated enzyme activity (increase CPK, myokinase, ATPase)
- Increase stored ATP, CP, glycogen

Henry Vandvik Carter - Henry Gray, (1918) *Anatomy of the Human Body* Bartleby.com - Gray's Anatomy, Plate 432



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Strength Training: Connective Tissue Adaptations

- Wolff's Law
- Increase in bone growth – osteogenesis, improved BMD
- May increase strength of ligament, tendon, and collagen (increase in collagen diameter, cross-links within fiber, number of fibrils, and increased density)
- Joint mobility = improved cartilage health

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Strength Training: Adolescent Application

- Current research supports strengthening for youth without excessive risk of skeletal injury
- Increased emphasis on mechanics/skills/competency
- Window for BMD development
- Consider maturity – developmental and psychosocial
- INCREASED SUPERVISION + EDUCATION
- “Resistance training prescription should be based according to training age, motor skill competency, technical proficiency and existing strength levels” (Lloyd 2013)
- Strength gains likely more related to MU activation and coordination than hypertrophy
- Should be fun; goal of lifelong involvement/healthy habits

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Other Training Interventions

- Aerobic
- ROM, mobility
- Balance, proprioception
- Movement mechanics
- EDUCATION

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Clinical Applications

- Considerations for age, ability/education, supervision
- Goals – global capacity (baseline fitness), strength and/or power, skill acquisition, etc.
- Prevention, “Pre-hab”, Rehabilitation (timing of intervention)
- Individualized

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Current “Prevention” Programs

- Currently most research in ACL realm
 - Sportsmetrics, PEP, KIPP, FIFA 11+
- Noyes (2014)
- Systematic Review
- Identify training programs that reduce risk of ACL rates in female athletes
- Emphasis on neuromuscular factors
- Female, <19 years old, non-contact injuries
- (+) Sportsmetrics, PEP, KIPP
- (-) Walden, the 11, HarmoKnee, Olsen, KLIP
 - Still reduced total LE injuries (including other knee injuries and contact ACL injuries)



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Sportsmetrics

- Research backed ACL prevention program
- Created by Dr. Frank Noyes
 - Noyes Knee Institute (Cincinnati Sports Medicine and Orthopedics Center)
- Require training/certification
 - Targets PT, PTA, ATC, PA, ortho MD/surgeons
- Requires filming capacity
- Slight variations cater to different sports programs
- Multi-factorial program – targeting warm-up (dynamic), agility, plyometrics, strength, cardio, mobility
- Education athlete, parent; return to sport criteria and testing
 - Sportsmetrics.org

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- Dynamic Warm-up
- Sport-Specific Agility Drills
- Plyometrics/Jump Training
- High Intensity Strength Training
- Sport-Specific Cardio Workout
- Flexibility Training



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Large emphasis on jumping and landing mechanics



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FIFA 11+

- Soccer specific warm-up
- Developed by FIFA and its Medical Assessment and Research Centre, F-MARC in 2006
 - In collaboration with the Oslo Sports Trauma Research Center and the Santa Monica Orthopaedic and Sports Medicine Center
- FREE and readily accessible
- Minimal equipment necessary
- 3 part program – lower intensity running/agility, strength and movement mechanics, higher intensity running

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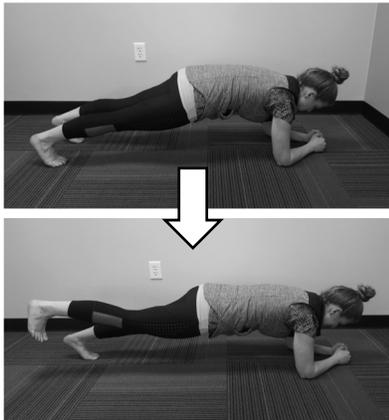
FIFA design

- Meant to be performed at the field
- 1st running component – multi-directional, lower intensity (run, hips in, hips out, partner circle, partner contact, quick forward/back; 8 min)
- Strength/stability/plyometrics (three tiered progressions; 10 min)
- Running component – higher intensity (70-80% run, bound, plank + cut; 2 min)

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Three level progressions



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Return to Sport

- *When is an athlete appropriate to return?*
- RTS PROGRAM:
 - MUSCULOSKELETAL: mobility, anaerobic/strength, aerobic, movement mechanics/motor control
 - Anaerobic: strength, power, shock absorption/force reception, force generation and transfer
 - Aerobic: general CV conditioning, energy system training
 - NON-MSK + PSYCHOLOGICAL: fear based questionnaires; other social/contextual factors (sleep, nutrition, etc.)
- RTS TESTING:
 - STRENGTH: HHD, isokinetics, functional/combined tests (i.e. Y balance)
 - MOBILITY/ROM
 - "FUNCTIONAL" TESTING: jumping/landing, throwing, etc.
 - AEROBIC CAPACITY: endurance (length of training session); performance at fatigue

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Return to Sport

- UE vs LE
 - Same baseline requirements
 - UE less studied
- ROM, strength, endurance
- UE: UQ Y-balance, seated medicine ball throw, CKCUEST, timed push up, modified pull-up
- LE: squat, jump/land, hop tests, Y-balance, modified T-test, shuttle run

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Fear-Based Questionnaires

- ACL-RSI
- Tampa Scale for Kinesiophobia (TSK-11)
- AFAQ
 - Confidence in return to play
 - Lack of understanding of injury
 - Worry of risk of reinjury
 - Concern for change in role and performance

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Clinical Application

- Create multi-faceted and individualized intervention programs
 - Strength
 - Biomechanics and control
 - General fitness (including aerobic capacity)
 - Sport relevant principles – dual tasking, multi-directional, varying speed, reactive, etc.

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Clinical Application

- Don't neglect the non-musculoskeletal components
 - Holistic approach to wellness
 - Sleep, nutrition, mental health
 - Identify and appreciate unique qualities of adolescence, especially physical, emotional, social/environmental context

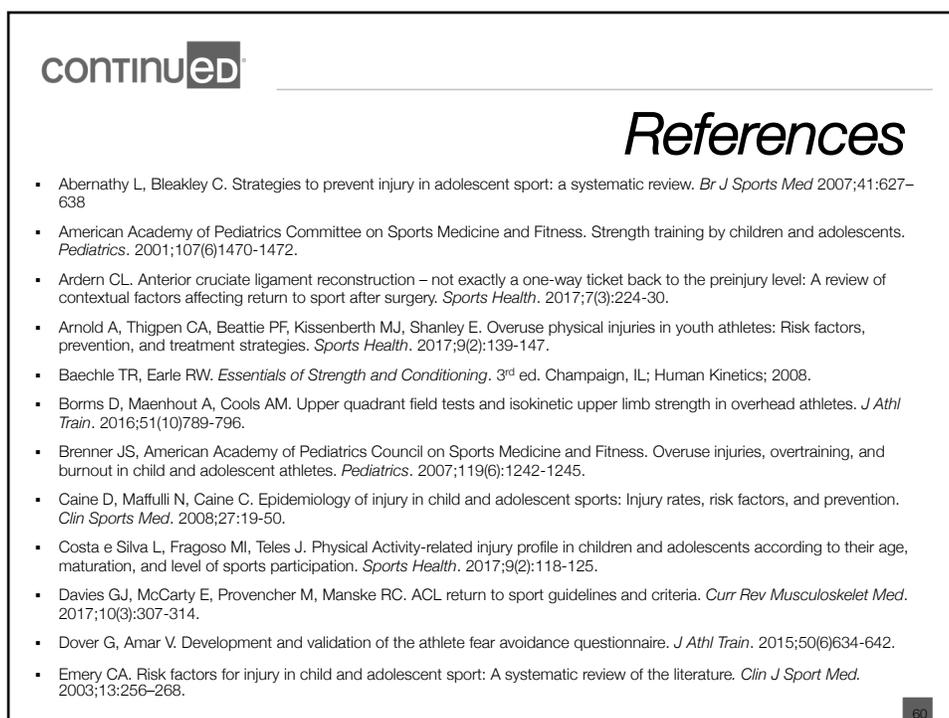
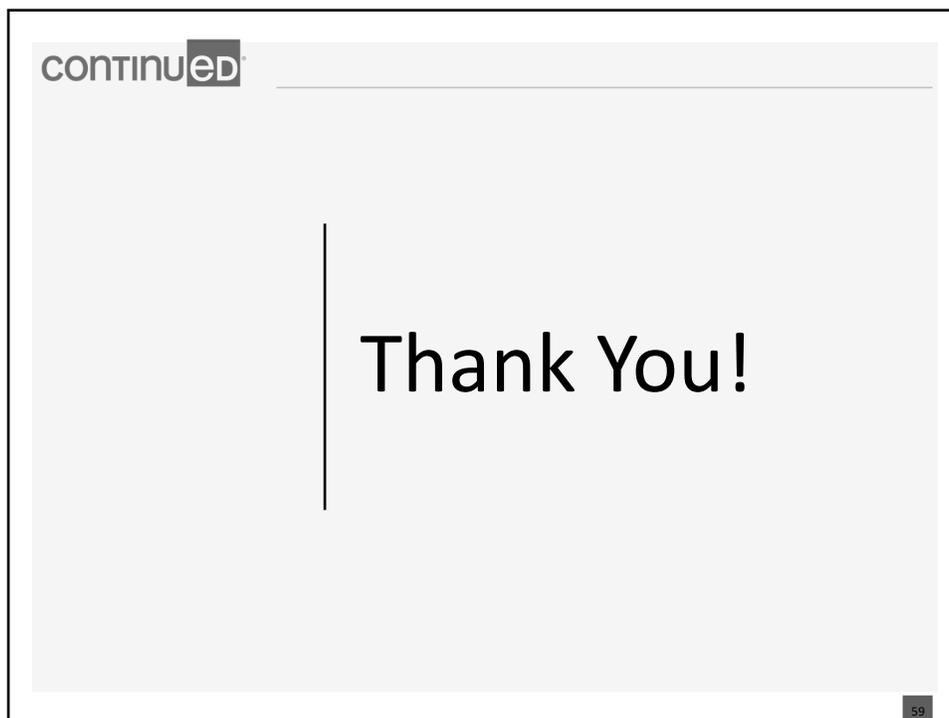
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Clinical Application

- Our role – clinic and otherwise
 - Emphasis on multi-factorial nature
 - Emphasis on team approach as appropriate
 - Emphasis on education
 - Emphasis on communication (coaches, parents, etc)
- Prepare current patients (prevent re-injury)
- Provide education/lifelong habits
- Communication
 - Coaches, other providers, ATCs, etc
 - Community outreach?

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CONTINUED[®] Sports Physical Therapy Virtual Conference

- Mon 3/11 Hamstring No More-Contemporary Review and Management of Hamstring Injury
Joel Sattgast, PT, DPT, OCS
- Tues 3/12 Injury Prevention in the Adolescent Athlete
Identifying Risk Factors and Implementing A Biopsychosocial Perspective
Melissa Abesa, PT, DPT, OCS
- Wed 3/13 Novel Programming and Early Return to Sport
Exposure Following ACL-R
Adam Schlitz, PT, DPT, OCS, CSCS
- Thurs 3/14 Physical Therapy Pillars of Success in Working with
Distance Runners
Christopher Johnson, MPT, MCMT, ITCA
- Fri 3/15 Advances in the Rehabilitation and Medical
Management of the Concussed Athlete
Jim Chesnutt, MD

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