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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<br>Joel Sattgast, PT, DPT, OCS   |
| Tues 3/12  | Injury Prevention in the Adolescent Athlete<br>Identifying Risk Factors and Implementing A Biopsychosocial Perspective<br>Melissa Abesa, PT, DPT, OCS |
| Wed 3/13   | Novel Programming and Early Return to Sport<br>Exposure Following ACL-R<br>Adam Schlitz, PT, DPT, OCS, CSCS   |
| Thurs 3/14 | Physical Therapy Pillars of Success in Working with Distance Runners<br>Christopher Johnson, MPT, MCMT, ITCA  |
| Fri 3/15   | Advances in the Rehabilitation and Medical Management of the Concussed Athlete<br>Jim Chesnutt, MD  |

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# Hamstrung No More: Contemporary Review and Management of Hamstring Injuries

Joel Sattgast, PT, DPT  
Board Certified Orthopedic Clinical Specialist (ABPTS)  
Assistant Professor, Physical Therapist  
March 11, 2019

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@JSattgastPT



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**Nathan Carlson, PT, DPT, USTA**



**Chris Johnson, PT, MPT, ITCA**



<http://www.zerenpt.com/>



**"The Runner's Zone" is an interactive, online, multi-media membership platform designed to share my perspective related to working with runners while building a community of passionate clinicians, coaches, trainers, and runners.**



**The Runner's Zone**

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- Interact with members on a private Facebook group page
- Gain firsthand insight into the numerous videos that I've shared online in recent years
- Get my input on challenging cases
- Immediately and confidently apply what you learn
- Turn injuries into personal records (PRs)
- Get a free copy of my e-book, *Running Drills to Master*




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**Course Description:** Hamstring injury is one of the most common injuries in both recreational and professional sport leading to lost training and competition time. This course will review mechanisms of injury and risk factors, discuss criteria for establishing a return to play timeline utilizing relevant evidence and critical reasoning, and propose interventional training and activities to reduce the risk of recurrent injury.

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## CONTINUED

- Introduction, background and review of outcomes
- Review of anatomy, biomechanics and action of the hip and knee; discussion of performance demands of sport
- Risk factors, injury rates (acute/recurrent) review of current evidence re: prevention
- Diagnostic and clinical examination measures secondary to muscle injury; functional testing
- Establishing return to play criteria and implementation of rehabilitation, strength, and conditioning programs
- Wrap-up: case study application
- Summary – Q&A



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## CONTINUED

### Learning Outcomes

After this course, participants will be able to:

- Describe at least three actions of the hip and knee contractile tissues and non-contractile tissues as they relate to both injury and performance variables.
- Identify at least three main risk factors which lead to both acute and recurrent hamstring injuries across the performance spectrum.
- Compare and contrast various functional outcomes to guide clinical decision making in establishing a timeline for return to play (RTP)
- List multi-dimensional return to play (RTP) criteria for guiding athletes back to participation following a hamstring injury.
- Outline an interventional strength and conditioning program that focuses on rehabilitation for the injured athlete and preventative measures for the non-injured athlete.

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# Overview of Lower Limb and Injury

Anatomy, Biomechanics, and Biology of Injury related to the Performance Demands of Sport

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## Anatomy of the lower limb

- **FEMOROACETABULAR JOINT** (the hip): one of the largest and most stable joints in the body (ball and socket)
  - Injury results in an almost immediate impact on walking, functional mobility
  - Dynamic link between trunk and LE
  - Keeps pelvis and femur balanced
  - Provides LE stability and gross motor control
  - Full movement capacity seldom used

FORCES ACTING ON THE HIP	
Standing (double limb support)	0.3-0.7x BW
Standing (single limb support)	2.4-2.6x BW
Walking	1.3-3.1x BW
Ascending stairs	3x BW
Running	>4-5x BW

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## Anatomy of the lower limb

- **FEMOROTIBIAL JOINT** (the knee):
  - Largest joint in the body – hinge (modified) joint (2 deg. of freedom)
  - Joining of two long-lever arms (tibia and femur)
  - **Susceptible to injury**
  - Highly dependent on:
    - Static restraint of ligaments and **dynamic restraint of muscles**

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## Functional Anatomy: Dynamic Stabilizers

### Muscles of the **HIP**:

- Piriformis
- Glute max, med, min
- Adductors
- Obturators
- Gemelli
- Gemelli
- Iliopsoas/iliacus
- Sartorius

### Muscles of the **KNEE**:

- Quadriceps (vastus lateralis, intermedius, medialis, rectus)
- Hamstring (semimembranosus, semitendinosus, **biceps femoris**)
- Gastrocnemius
- Popliteus
- Plantaris
- Hip adductors
- TFL (acting on the ITB)

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## Functional Anatomy: **Static Stabilizers**

### Non-contractile structures

- Bursa
- Ligaments
- Capsule stabilizes hip joint
- Iliofemoral Ligament
  - Inverted Y shape
  - **Strongest ligament**
  - Protects anterior hip joint
  - Restricts extension

### Static Stabilizers

- Ligaments
- Osteology
- Joint congruency

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## Contractile Problems: Muscle Strains

- Prognosis is multifactorial
- LOTS of different classification systems
  - Primary, secondary, tertiary strains
  - MLG-R – *Valle*
    - M = Mechanism
    - L = Location of injury
    - G = Grading of severity
    - N = Number of re-injuries

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CONTINUED

## Contractile Problems: Muscle Strains

- Muscle Injury
  - Muscle fibers coated by ECM (*extra-cellular matrix*)
  - Gives mechanical structure to myofibers
  - Participates in transmitting force from the muscle to the tendon
    - Epimysium
    - Perimysium
    - Endomysium
  - Linked to prognosis
- Tendon & Ligament Injury
  - Central tendon injury = POOR outcomes
  - INJURY:
    - Disorganized collagen fibers
    - Increased non-collagenous ground substance
    - Tenocyte formation is rounded, with increased numbers
    - Ectopic ossification
    - Fatty deposits
    - Reduced loading capacity
    - **Acute on chronic = common** (re-injury)

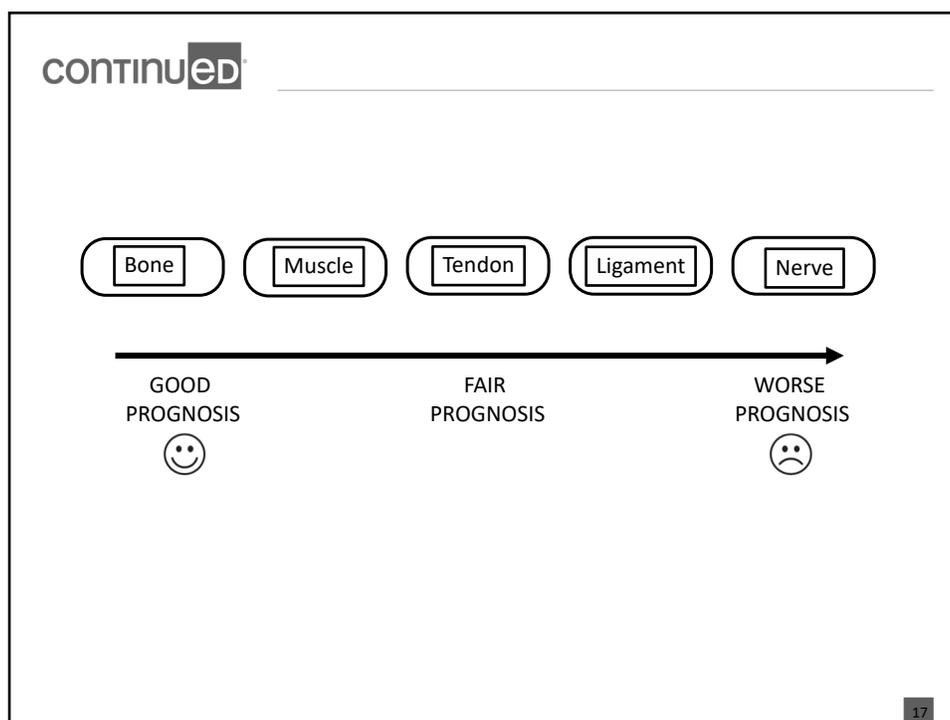
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CONTINUED Contractile Problems: Muscle Strains

- First and second degree strains **frequent** injuries in sports
  - **Grade 0** – DOMS (*prognosis 1-3 days*)
  - **Grade I** – little tissue disruption, inflammatory response (low), no loss of ROM or strength (*prognosis 3-15 days*)
  - **Grade II** – some muscle fiber disruption, strength and ROM are decreased, pain is significant (*prognosis 3-8 weeks*)
    - *Greatest risk for recurrence (~24%)* – DeWitt & Vidale. *IJSPT*. 2014
  - **Grade III** – complete rupture with loss of strength, defect is noticeable upon examination (*prognosis 8-12 weeks*)
- Healing based upon: *general guidelines ONLY*
  - **Inflammation** (~24-48 hrs.)
  - **Proliferation** (most extensive ~21 days s/p)
  - **Maturation** (begins ~3 weeks s/p lasting ~2 months)
    - Remodeling / maturation stage can continuously cycle for up to 2 years
- Healing depends upon:
  - Blood supply
  - Rehab protocol / plan of care
  - Patient specific factors (modifiable vs. non-modifiable factors)

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## Contractile Problems: Muscle Strains

- Mechanosensitive structures – convert mechanical forces and signals to biochemical signals
  - Muscle
  - Tendon
  - Ligament
- Biochemical signals create cellular response (i.e. chemotaxis)
- Helps to restore homeostasis through the inflammation and repair process for soft-tissue injury
- **CRITICAL** to understand when designing a RTP (return to play) and rehabilitation plan of care

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CONTINUED

## Contractile Problems: Glutes

- Gluteus medius and maximus
  - Tears or contusions are rare because they are strong and they are padded by fat
- Can be triggered by sudden falls, prolonged weight bearing on one leg for long periods, activity overuse, sporting injuries
- **Avoid hip abduction strengthening initially as may provoke tendinopathy**

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## Contractile Problems: Adductors

- Adductor longus and gracilis
  - **Eccentric (common - strain)**
    - 'Groin pull' often due to forced hip ER and/or forced hip abduction
      - E.g. Slipping with foot planted
  - Concentric
    - Forceful open chain adduction
    - Imbalance between force and muscle length
      - Forceful contraction in **fully elongated position** (e.g. martial arts, dance, soccer)
- Associated with running, jumping, and twisting
- Often seen in soccer and hockey players
- Risk factors: imbalance between strength and flexibility
- Twinging or stabbing pain in groin
- Pain with passive ABD



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## Contractile Problems: Rectus Femoris

- Rectus femoris
  - **Eccentric** (strain)
    - Hip extension with knee flexion (i.e. hurdles)
  - **Concentric**
    - Forceful or repetitive hip flexion (i.e. sprinting)
  
- Common in sports involving sprinting, jumping, or kicking
- c/o local pain and tenderness in anterior thigh
- Pain with resisted knee extension and passive stretching
- Complete tears are rare

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## Contractile Problems: Hamstring Strains

### HAMSTRING STRAINS

- **Most common strained muscles of hip and knee**
- Caused by rapid extensive contraction or violent stretch of hamstring muscle group
- High recurrence rate
- Often requires prolonged recovery
  
- Hamstrings – occurs fairly frequently
  - Usually muscle belly
  - **Eccentric (common)**
    - Forced hip flexion with knee extension (e.g. deceleration phase (terminal swing) in running)
  - **Concentric (less common)**
    - Forceful hip extension or knee flexion



**“Taking off the shoe”**  
 (+) if reproduction of patient’s comparable sign  
 Sn 100, Sp 100 (ages 17-33 yrs)  
 Reiman, 2016

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## Contractile Problems: Iliopsoas

- Iliopsoas
  - Overuse / overload common
  - Eccentric
    - Forced hip extension → Foot planted, pelvis hit from behind
  - Concentric
    - Forceful, repetitive hip flexion → Cycling, running
  
- Most commonly strained after hamstrings and adductors
- MOI: forced extension of hip while actively flexed
- Pain with attempts of acceleration and high stepping activities
- Increased pain with resisted flexion, adduction and ER
- Recovery length and recurrences frequent

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## Contractile Problems: Piriformis

- Piriformis – pain is described in the gluteal, buttock region; may have radiating S/Sx down the involved leg
  - Common problem is shortness and/or chronic contraction/muscle spasm
  - Sciatic nerve runs through or beneath
    - Muscle contraction compresses nerve
    - Sciatica – pain radiating into buttocks and posterolateral leg
  - Common in runners, bikers and with prolonged standing w/o weight shifting present
  - May have history of trauma, e.g. fall or twisting mechanism

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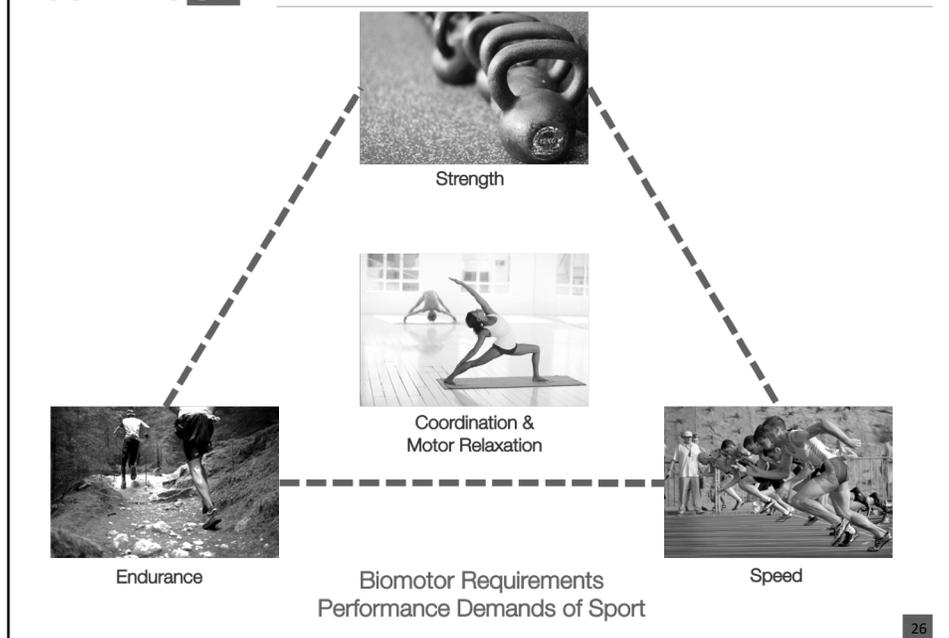
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## Contractile Problems: Contributing Factors

- Previous injury
- Advancing age
- Pelvic obliquity
- Leg-length discrepancy
- Anatomical derangement
- Precipitating activity
- Muscle imbalance
- Decreased flexibility
- Hamstring strength
- Inadequate warm-up
- Fatigue
- Poor coordination

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# Hamstring Injuries

Risk Factors, Injury Rates, and Review of Evidence

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## Flexors of the Knee

### Primary flexors of knee

- Hamstrings
  - Biceps femoris (longus/brevis) = laterally
    - More commonly injured – theorized due to greatest musculotendon stretch
  - Semimembranosus (Large ~50%), semitendinosus (Small ~12%) = medially
    - All but biceps femoris brevis contribute to hip extension as well (~30-50% of hip extension strength)

### Secondary flexors of knee

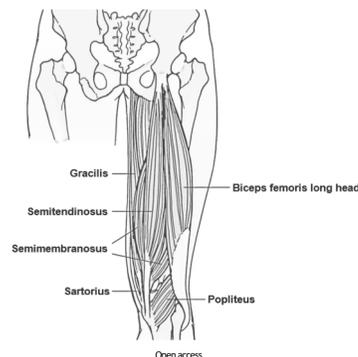
- Popliteus
- Sartorius (also rotation)
- Gracilis (also rotation)
- Gastrocnemius

Oatis, 3<sup>rd</sup> ed. 2017  
Heiderscheit et al. JOSPT. 2010

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## Hamstrings

- Innervation
  - **Semitendinosus** – tibial division of the sciatic nerve (L5-S2)
  - **Semimembranosus** – tibial division of the sciatic nerve (L5-S2)
  - **Biceps femoris** – long head = tibial division of sciatic nerve; short head = common peroneal nerve (L5-S2)
- Attachment
  - **Semitendinosus** – ischial tuberosity (proximally); medial surface of shaft of tibia (distally)
  - **Semimembranosus** – ischial tuberosity (proximally); posteromedial medial tibial condyle (distally)
  - **Biceps femoris** – long head = ischial tuberosity / short head = linea aspera/lateral supracondylar line (proximally); fibular head (distally)



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## Introduction to Hamstring Injury

- Hamstring injuries = common
  - *Most commonly strained / injured muscle in the body*
  - 8-25 days (avg) lost to injury
- Occur with:
  - Sprinting and acceleration (track & field)
  - Kicking and high velocity movement (football, soccer)
  - Skilled movement requiring speed (martial arts, dancing)
  - Muscle lengthening exercises (gymnastics, dancing)
- Running & Sprinting

Erickson & Sherry. *J Sport Health Sci.* 2017  
 Sherry et al. *Clin Sports Med.* 2015  
 Heiderscheit. *JOSPT.* 2010

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## BENEFITS OF RUNNING

Improves cognitive function and mood

Improves muscle strength and cross-sectional area

Reduced risk of obesity

Prevention of hypertension

Improves bone density and prevents muscle atrophy

Facilitates joint mobility

Delays affects of aging



Reduced stress

Sleep quality improvement

Improve cardiovascular function and protects against heart disease

Improved energy and endurance

Promotes improved circulation

Prevents onset of type II diabetes

Lowers incidence and prevalence of cancer

Better reactive and dynamic balance

Improved movement control

**IT'S FUN**

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## Reinjury

- Very common
- ~1/3 recur within 1<sup>st</sup> year of return to play (RTP)
- Subsequent injuries > initial injury (*re: severity*)



DeWitt & Vidale. *IJSPT* 2014  
 Erickson & Sherry. *J Sport Health Sci.* 2017  
 Heiderscheit BC. *J Orthop Sports Phys Ther.* 2010  
 Barcelona Futbol Club. *Apunts Med Esport* 2009;164:179-203

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## Injury Type

- Strains (**MOST COMMON**)
- Partial → Complete tendon avulsion (proximal)
- Apophyseal avulsion (proximal)
- PHT (proximal hamstring tendinopathy)
- Referred pain

Erickson & Sherry. *J Sport Health Sci*. 2017  
Heiderscheit BC. *J Orthop Sports Phys Ther*. 2010

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## Epidemiology:

Incidence & Prevalence

- Erickson & Sherry 2017
  - NFL (1998-2007): 12% of all injuries were hamstring strains – **32% reoccurrence rate!! (1 in 3)**
  - USATF: >75% of all lower limb injuries were hamstring strains; 24.1% of all injuries
- Barcelona Futbol Club
  - UEFA 2003-2007: 175 injuries reported
  - Of these 56 were muscular, accounting for ~32% of all injuries with 14% of these occurring to the hamstring muscles (biceps femoris > semitendinosus)

Erickson & Sherry. *J Sport Health Sci*. 2017  
Heiderscheit BC. *J Orthop Sports Phys Ther*. 2010  
Barcelona Futbol Club. *Apunts Med Esport* 2009;164:179-203

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## Epidemiology:

Incidence & Prevalence

DeWitt & Vidale. *IJSPT* 2014  
 Erickson & Sherry. *J Sport Health Sci.* 2017  
 Heiderscheidt BC. *J Orthop Sports Phys Ther.* 2010  
 Barcelona Futbol Club. *Apunts Med Esport* 2009;164:179-203

- High risk of reinjury
  - Highest within first 2 weeks of return to sport
  - Why?



- Field > court
- Men (64% more likely) > women
- Non-contact > contact
- Preseason > season > post-season
  - NFL, EPL/MLS/UEFA, T&F

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**"The analogy that injuries in sports are as random as being hit by lightning is apt, but with one caveat. Measurable risk factors can be identified for most injuries. Ignoring those risk factors is akin to allowing an athlete to walk into a lightning storm holding a metal pole above his or her head."**

Malachy McHugh

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## Risk Factors

- Modifiable
  - Muscle weakness
    - Eccentric hamstring
    - Concentric quadricep
  - Fatigue
  - Lack of flexibility
  - Poor coordination
- **MOST SUPPORTED** is an imbalance between the quad:hamstring ratio
- Non-modifiable
  - **Age**
  - **Prior history of injury**
  - Gender
  - Surface / sport (?)
- No influence
  - Height
  - Weight
  - BMI

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### ACUTE PRESENTATION OF HAMSTRING INJURIES

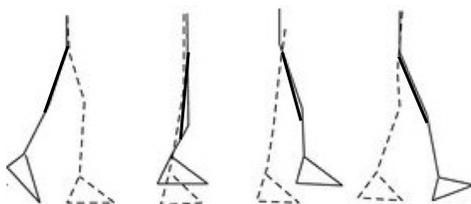
	MILD	MODERATE	SEVERE
Ecchymosis / Swelling	Minimal	Moderate	Severe
SLR	Lacking up to 20 degrees	Lacking 20-40 degrees	Lacking up to 40-50 degrees
Hamstring strength loss	~20% loss	20-40% loss	>50% loss
Pain (with use/play)	Minimal (0-3/10)	Moderate (4-6/10)	Severe (>6/10)
Return to play (length of time)	1-2 weeks	1-5 weeks	4-12 weeks

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## Review of Gait Cycle

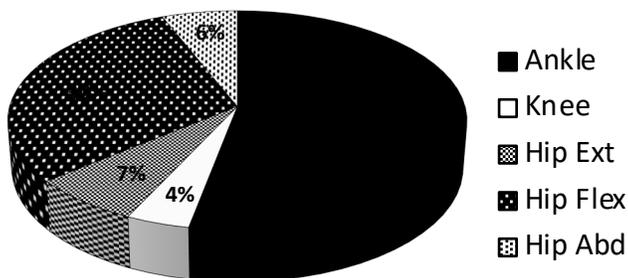
- Hamstrings are active during normal locomotion
- Transition from swing to stance
  - Eccentric knee extension (late swing)
  - Concentric hip extension (early stance)



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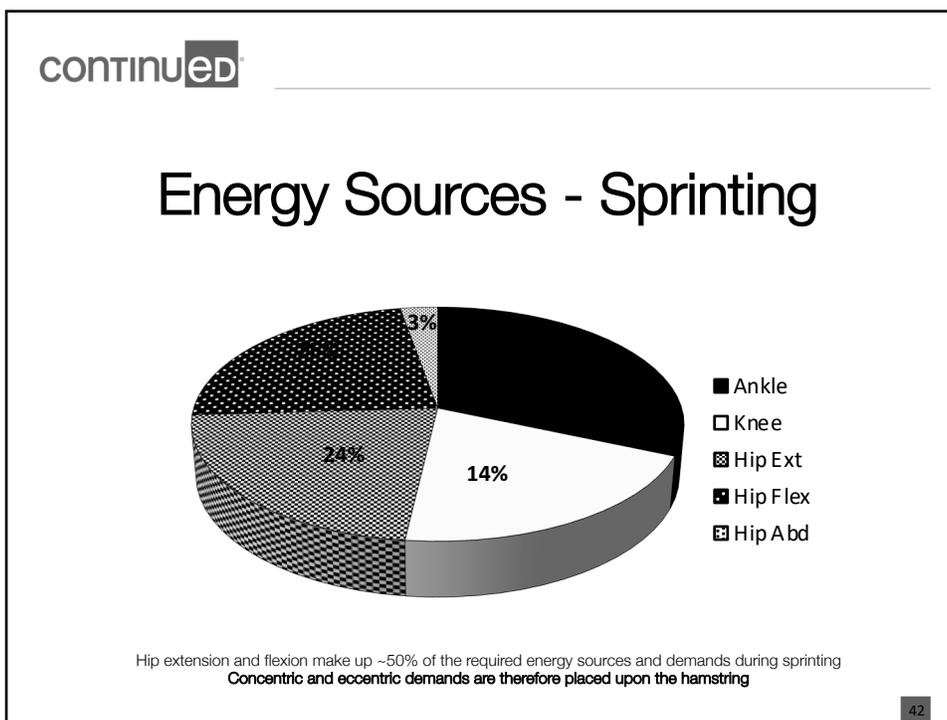
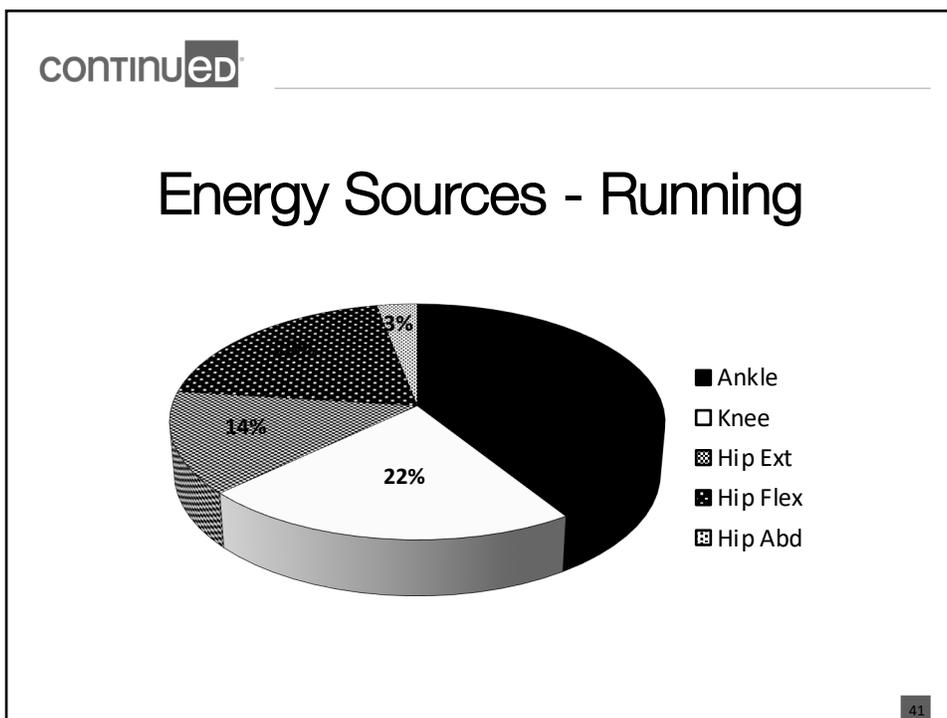
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## Energy Sources - Walking



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**~2.5-3x BW**

- E.g. 165 lb. runner
- $165 * 2.5 = 412.5$  lb.
- $165 * 3 = 495$  lb.

Gravity  
~250-300 %

Friction  
~ 30% BW

Propulsion

Braking Force

Heiderscheit et al. *Med Sci Sports Exerc*, 2011  
 Arellano & Kram, *J Exp Biol*, 2014  
 Moore IS, *Sports Med*, 2016  
 Tartaruga et al. *Res Q Exerc Sport*, 2012

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**CONTINUED**

**Improving Running Economy**

4) Vertical Displacement

2) Arm swing

3) Leg extension at:  
- Initial contact  
- Toe-off

1) Step Rate  
i.e. cadence

3) Shoe-Surface Interface  
<440 g

Heiderscheit et al. *Med Sci Sports Exerc*, 2011  
 Arellano & Kram, *J Exp Biol*, 2014  
 Moore IS, *Sports Med*, 2016  
 Tartaruga et al. *Res Q Exerc Sport*, 2012

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CONTINUED<sup>®</sup>

## Running Efficiency

### “Optimal” State

- Increased running cadence
- Decreased ground contact
- Decreased GRF / impact
- Increased propulsion
- Increased speed

### Fatigued State

- Decreased running cadence
- Increased ground contact
- Increased GRF / impact
- Decreased propulsion
- Decreased speed

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CONTINUED<sup>®</sup>

### Stride Length vs. Step Rate

DECREASES the  
braking force with IC  
closer to CoM



INCREASES the  
braking force with IC  
further from CoM



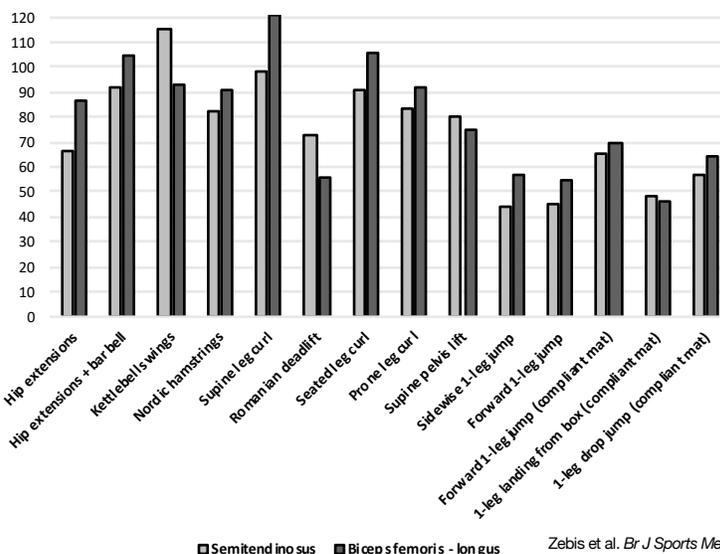
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## Walking vs. Running

- Increased velocity
- Increased GRFs
- Float phase
- No double stance phase
- Decreased stance phase & increased swing phase
- Requires **greater ROM** of all lower limb joints
- Requires **greater eccentric mm contraction**
- Initial contact varies on speed
- Decreased COG with increased speed
- Decreased BOS

Peak Normalized EMG (nEMG) – Hamstrings



# Clinical Examination and Return to Play (RTP)

Diagnostic and Clinical Exam; Objective Measures and Functional Testing

Establishing RTP criteria through rehabilitation, S&C

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## Return to Play

- Understanding pain

- Attitudes
- Beliefs
- Compensations
- Diagnosis (-ses)
- Emotions
- Family (& friends)
- Sport & coaches



<b>NO PAIN</b>	<b>NO TISSUE INJURY</b>
<b>NO PAIN</b>	<b>TISSUE INJURY</b>
<b>PAIN</b>	<b>NO TISSUE INJURY</b>
<b>PAIN</b>	<b>TISSUE INJURY</b>

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## Wilk Staging System

Stage	Definition	RED FLAG
1	Pain upon exertion	Pain that alters mechanics
2	Pain at rest	Pain that prevents rest
3	Pain with ADLs	Avoidance of ADLs
4	Pain managed with meds	Being in stage 4
5	Crippling pain	Being in stage 5

\* *Running Injury Recovery Program*, Bruce Wilk

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## Subjective Examination

### HISTORY

- Onset and behavior of symptoms
- Mechanism of injury
- Chief complaint
- Age
- Pain location
- Symptom fluctuation (SINSs)
- Motion restrictions

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## Subjective Examination

- Double limb vs. Single limb Stance
- Swelling
- Gait
- Systems review
- Referral pain
  - Lumbosacral spine, hip (thigh, groin), knee

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CONTINUED

## Objective Examination: Screening

**NOTE: all aspects performed on a firm surface, barefoot (preferably)**

- Free standing squat (DL and/or SL)
- Unilateral stance (SLS) – EO/EC
- Toe yoga (i.e. toe dexterity)
- Lower limb twist
- Lateral step down (~6 in. height)
- Single leg hop (in place, front-to-back, side-to-side)
- Lunge (forward / reverse)
- Lumbar screen (flexion, extension, side-bend, rotation, side-glide)

Duckworth et al. *Foot Ankle* 1982  
Tanak et al. *JOSPT* 1996  
Chou et al 2008

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CONTINUED

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Lower limb twist



Toe dexterity

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CONTINUED Table (seated, supine, prone, S/L)

- **Seated:**
    - Hip flexion, knee flexion / extension (MMT)
    - Hip ER/IR
    - Reflexes (patellar / Achilles – screen)
  - **Supine:**
    - Visual assessment (position / appearance of each limb – hip, knee, foot)
    - Stroke test (knee)
    - SLR (passive) with/without neural tensioner + 90-90° testing
    - Hip, knee, ankle A/PROM
      - Thomas test
      - SI screen
      - Arthrokinematics (e.g. FAI, ankle impingement, hallux valgus, etc.)
    - Table test – Chris Johnson, PT
    - Bridge test (DL, SL)
  - **S/L:**
    - Hip abductor (MMT)
    - Ober's (modified)
  - **Prone:**
    - Hip A/PROM (spec. flex, ER/IR, ext) – MMT
    - Ankle DF (knee flexed to 90°)
    - Passive leg extension (hip ext)
    - Forefoot on rear-foot orientation
      - Calcaneal valgus / varus
  - **General:**
    - Breathing (upper vs. diaphragmatic)
- <https://youtu.be/6WJKFNkhLIM>

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## Stroke Test

Grade	Test Result
Zero	No wave produced on downstroke
Trace	Small wave on medial side with downstroke
1+	Large bulge on medial side with downstroke
2+	Effusion spontaneously returns upstroke
3+	Unable to move effusion out of medial aspect of knee



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## Requirements prior to run assessment

- 1. No S/S of inflammation
- 2. Ability to fully weight bear through affected region(s)
- 3. Toe dexterity
- 4. Ability to balance in a wobble free manner for >30 sec
- 5. At least 30° of great toe extension in WB-ing
- 6. Ability to progress the leg over the foot (~20° DF)
- 7. Tolerance to OKC / CKC single-leg activities
- 8. Good frontal plane stability especially at hip and trunk
- 9. Tolerate fitness walking (>3.5mph)
- 10. Tolerance to progressive walk-glide routine
- 11. Ability to hop in multiple directions on each leg

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> 20° of CC DF

**Johnson Table Test**

- Increased roll out in supine
- Greater hip ER in supine at 90°
- Asymmetrical toe out with full depth squat
- Toe out or dynamic knee valgus +/- IR with LSD
- Loss of ankle DF in prone with knee flexed to 90°

<https://www.youtube.com/watch?v=3o8aKlJKdwE>

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Watch them run!!!



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## Rehabilitation Program → RTP

- Precise prognosis is an ever-moving target
- Primary goal = RTP (return to play)
  - With minimal risk of re-injury
- Rehabilitation should target modifiable risk factors
  - ROM, intensity of rehabilitation are progressed as tolerable by patient
  - Return to play / sport is intentional and deliberate
- “Time to *try* to return to sport...”
  - *What is the implicit message?*



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## RTP Criteria

- No palpable tenderness
- 5/5 MMT at 15° knee flexion (neutral, IR, ER)
- Active knee extension <10° with hip at 90°
- <10% isokinetic hamstring strength difference vs. uninvolved
  - Eccentric hamstring 30-60°/sec, concentric quadriceps 240°/sec ratio
- <10% difference – hopping, S/L bridge, etc.
- **No insecurity with H-test** (Askling et al)
- Replication of sport specific movements with no pain

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## Goals of Rehab & Strength Training

- Build resiliency and capacity
- Improve injury resistance
- Gain neural adaptations
  - Increasing muscle fiber recruitment
- Improve rate of force development (RFD)
- Stretching (??)

Developed in consultation with Chris Johnson, PT and Nathan Carlson, DPT – Zeren PT & Performance Magness, 2013

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CONTINUED

## Enhancing Performance

- Improving static and dynamic alignment
  - Postural awareness = “alignment”
- Improving recruitment and capacity
  - NM activation
  - Force
  - RFD
- Building resiliency

Running Drills to Master  
[https://www.youtube.com/watch?v=gsUlh\\_AYkE4](https://www.youtube.com/watch?v=gsUlh_AYkE4)

Developed in consultation with Chris Johnson, PT and Nathan Carlson, DPT – Zeren PT & Performance

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## Operative Management

- Severe disruptions warrant a surgical approach
  - E.g. complete rupture of proximal origin (avulsion fx)
- (+) Bowstring sign
- Rehabilitation:
  - Immediate – goal is protection
  - 6-8 weeks PWB
  - Avoiding any excessive strain through the hamstring
  - Precaution: DVT

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## Phase I: (~0-4 weeks)

- GOAL:
  - Protection and healing
  - Minimize swelling, edema and pain
  
- AREAS TO FOCUS:
  - Isometrics
  - Single limb balance
  - IASTM (as appropriate)
  - AROM PRE (*avoiding eccentrics*)
  
- CRITERIA TO ADVANCE:
  - Hip flexion >70° with 90° knee flexion – pain free
  - Walking program, progressing to walk-glide

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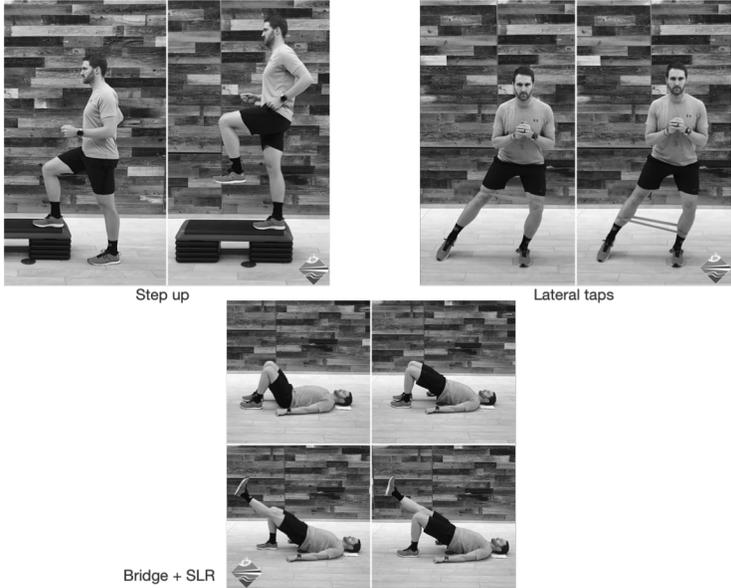
## Phase I: (~0-4 weeks)

- AREAS TO FOCUS:
  - Isometrics
  - Single limb balance
  - IASTM (as appropriate)
  - AROM PRE (*avoiding eccentrics*)
  
- **Exercises to consider:**
  - Bridge (focus on isometric hold to build lumbosacral stability)
  - Marching
  - Loaded carries (slow motion – heel-to-toe, flat foot; fwd / reverse)
  - Step up / step down
  - Supine hip flexion (march)
  - Toe dexterity

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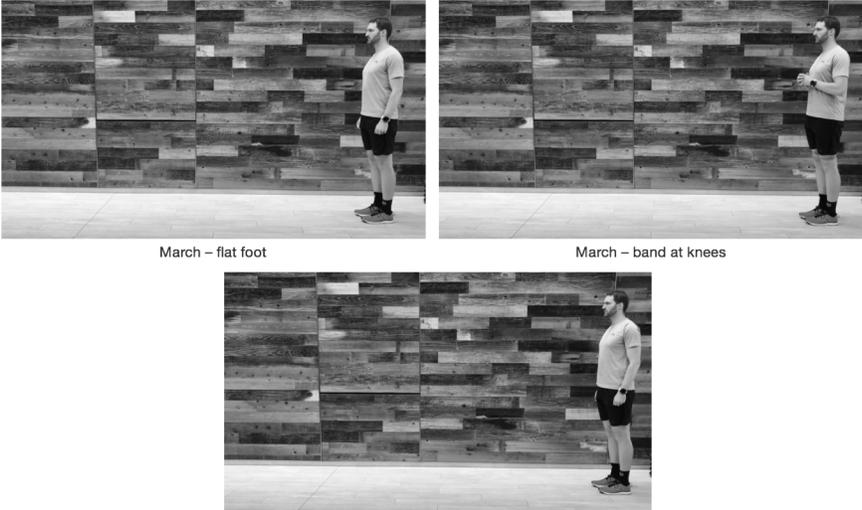
Step up

Lateral taps

Bridge + SLR

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**CONTINUED**



March - flat foot

March - band at knees

March - prisoner position (hands behind head)

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CONTINUED

## Phase II: (~5-8 weeks)

- GOAL:
  - Normalization of gait, mobility
- AREAS TO FOCUS:
  - Lumbopelvic static and dynamic stability
  - Initiation of bridging (isometric → concentric)
- CRITERIA TO ADVANCE:
  - Normalization of gait
  - <20% different involved to uninvolved – hamstring **mobility**
  - >50% isometric hamstring **strength** – involved to uninvolved
  - Tolerance to conservative jog/run (fwd/bwd)

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CONTINUED

## Phase II: (~5-8 weeks)

- AREAS TO FOCUS:
  - Lumbopelvic static and dynamic stability
  - Initiation of bridging (isometric → concentric)
    - *Can progress to controlled eccentrics at very end as is tolerable by patient*
- **Exercises to consider:**
  - Bridging progressions (on step, long-lever)
  - Hip airplane
  - Lunge (fwd / rev)
  - Walking hamstring mobilization + tensioner
  - Squat progressions (DL, SL, RFES)
  - Askling Protocol (**NOTE: may be stage II & stage III due to eccentric load tolerance needed**)
  - Dynamic lumbopelvis stability and motor control training
    - BUG progressions
    - Plank progressions

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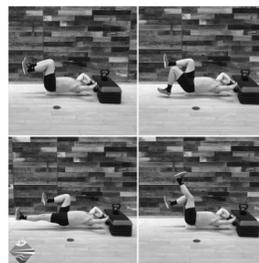
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Hip airplane



DL and RDL (S/L DL)



Foam roll bug progression



Walking HS mob + tensioner



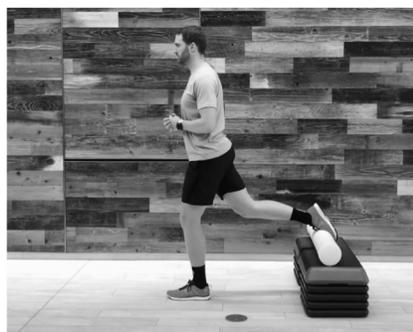
Bridge + march (band)



Bridge + long-lever (band)

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RFES (AROM)



RFES + KB (20kg)

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## Asklings Protocol

- **L1: “The Extender”**
  - Supine, involved hip at 90° with active knee extension and ankle DF
- **L2: “The Diver”**
  - Perform as a simulated dive, stretching arms forward while hinging at the waist and allowing maximal hip extension of the lifted leg while keeping pelvis stable.
  - Angle at the knee should be ~10-20° in the stance limb and 90° in trailing leg
- **L3: “The Glider”**
  - All BW should be on the heel of the “involved” limb – glide backward with the opposite limb, using the arm to stabilize and assist as needed

Asklings et al. *Br J Sports Med.* 2013

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## Asklings Protocol



The glider (L1)



The diver (L2)



The slider (L3)

Asklings et al. *Br J Sports Med.* 2013

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## Phase III: (~8-12 weeks)

- GOAL: *(to begin – asymptomatic with all activities from phase II)*
  - Eccentric tolerance
  - Sport specific training (e.g. running, sprinting)
  
- AREAS TO FOCUS:
  - Isolated hamstring strengthening in lengthened state (eccentrics)
  - Trunk stability – dynamic
  
- CRITERIA TO ADVANCE:
  - No insecurity with H-test
  - No palpable tenderness
  - 5/5 MMT at 15° knee flexion (neutral, IR, ER)
  - Active knee extension <10° with hip at 90°
  - <10% difference – hopping, S/L bridge...

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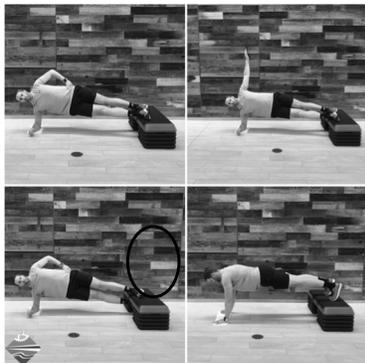
## Phase III: (~8-12 weeks)

- AREAS TO FOCUS:
  - Isolated hamstring strengthening in lengthened state (eccentrics)
  - Trunk stability – dynamic
  - Jumping and landing tasks
  
- **Exercises to consider:** *(progress eccentrics from end of stage II)*
  - Deadlifts – DL, SL
  - TRX (suspension strap) bridge, march, long-lever
  - Bridge - long-lever, walkouts
  - Lunge + warrior pose
  - Glute-ham raise / rev. hyper
  - Rhythmic stabilization
  - Split jump / hopping (4-square)
  - Swiss/med ball progressions
  - Nordic hamstring (modified vs. BW)

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- Plank progression:
- Side-plank
  - Side-plank + hip add.
  - Push-up hold



S/L RDL + KB

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Rev. lunge + warrior



Bridge + walkouts

**CONTINUED**

Lateral tap progressions

Medball bridge + SLR

Medball bridge + HS curl

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**CONTINUED** Phase IV: (4-6 months)

- GOAL:
  - Return to sport (RTP)
  - **PREVENTION!!**
- AREAS TO FOCUS:
  - Jumping and landing tasks
  - Running (shifting / changing speeds)
    - (A, B, C skips)
  - Sprinting (strides)
  - Agility
- CRITERIA TO ADVANCE:
  - Advancement is RTP (return to play)
  - Complete all activities without S/Sx, no hesitation
  - **H-test!!**

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## S & C in Pre-habilitation

- Deadlift (SL / DL)
- Step up (+ variations)
- Squat (front / back / split)
- Lunge (fwd / rev)
- Loaded Carries (+ suitcase)
- Row (isometric, concentric)
- Push-up hold
- Lateral taps
- March (and variations)
- Bridge (SL / DL)

Strength Training for Runners

<https://www.youtube.com/channel/UCZ-jzVh85zi6Myrcevdcaaw>

Developed in consultation with Chris Johnson, PT and Nathan Carlson, DPT – Zeren PT & Performance

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## S & C Guidelines

- Running comes first – this is their primary sport
  - 80% rule (*Dan John*)
- As time allows: (*general guidelines*)
  - Duration = 20-45 min.
  - No. of exercises = 3-7
  - Reps = dependent
  - Load = moderate to heavy (repetition dependent)
  - **Avoid going to failure**

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## S & C – focusing on “C”

### Power Training

- Goals
  - Improve fiber recruitment
  - Emphasis on force development in short period of time
- Select exercises that mimic running
- *Power Training* – concerned with single explosive movement followed by brief rest then repeating

### Plyometric Training

- Goals
  - Geared towards explosiveness
- Running is a plyometric activity in and of itself
- Best plyo = **SPRINTING**
- *Plyometric Training* – series of movements one after the another with goal of minimizing time on ground

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## S & C – focusing on “C”

### Power Training

- Squat Jumps
- Split Squat Jumps
- Box Jumps
- Standing Long Jumps
- Steep Hill Sprints

### Plyometric Training

- Quick Taps – platform & soccer ball
- 2:2 hopping >> 1:1 hopping
- Skipping
- High Knees
- Skipping (A, B, C skips)
- Explosive skipping
- Bounding

<https://vimeo.com/180208061>

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## S & C – focusing on “C”

### Power Training

- No. of exercises = 3-7
- No. of sets = dependent
- Total no. of reps = 4-12 (pending weight)
- Rest between sets = 30-90s
- External load should be light (i.e. 30% BW Max)
  - Weight vest

### Plyometric Training

- No. of drills / activities = 3-7
- No. of sets = dependent
- Total no. of reps = dependent
- Rest between sets = 30-90s
- External load = typically none; performed at BW

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## The 11 – FIFA Program (F-MARC)

- “The 11+” is a 20-minute, warm-up program developed by F-MARC
  - FIFA Medical Assessment and Research Center
- 2x weekly → reduce injuries by up to 50 %.
- Prior to matches, only running exercises (parts 1 and 3) should be performed.
- After the basic warm-up is mastered, players should progress to the intermediate and advanced strength, plyometric and balance exercises.

<http://www.yrsa.ca/fifa-11.html>

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## The 11+ Program

- Running (8 minutes)
  - 1) Straight ahead
  - 2) Hip out
  - 3) Hip in
  - 4) Circling partner
  - 5) Shoulder contact
  - 6) Quick forwards & backwards
- Running (2 minutes)
  - 1) Strides
  - 2) Bounding
  - 3) Plant & cut - agility
- Strength / Plyo / Balance (10 minutes)
  - 1) Plank
  - 2) Side-plank
  - 3) Hamstrings – Nordic
  - 4) SLS
  - 5) Squat – with toe raise
  - 6) Jump – vertical

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## Footwear Prescription

*“Provide **shock absorption** and **pronation control** at foot strike and stabilizing through the transition in supination during push off...”*

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### Objective Exam: Footwear Evaluation & Prescription

- General guidelines
  - Used for ...stepping, walking, gliding, hopping, running
  - Supportive, breaks in the right place, and does not twist excessively in the middle
- Shoes should be level
- L/R shoe should have symmetry
- Center-line of each shoe should be vertical
- Press down and rock each shoe from side to side
- Check air pockets or gel pockets
  - Inflated or Deflated?
- Materials have a limited shelf life
  - Foams, gels, rubbers
- Shoe selection should be current:
  - Running specialty shoe store
  - Trusted online retailer
  - Avoid: aftermarket. Internet deals, department stores / big box stores
- **Shoes should capture the foot**
- **Be free of defect**
- **Appropriate for the MSK condition**

<https://www.youtube.com/watch?v=pqZ4hYucEs>  
 Developed in consultation with Chris Johnson, PT and Nathan Carlson, DPT – Zeren PT & Performance

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## Case Study

Application of concepts

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## Acute Hamstring Strain: Case Study

- 20-year-old male (Div. I soccer player)
- Was sprinting and had to quickly change direction
  - Turf was wet and foot “slipped”
  - Felt a “twinge” in his right hamstring
- 3 days s/p injury – FWBAT
- Has completed PRICE for past 3 days
  - Wearing a compression sleeve while awake
  - VAS 2-3/10 with stair ambulation, faster walking
  - Slight reported pain radiating into his right glute and posterior knee
- PMHx: 2<sup>nd</sup> hamstring strain (ipsilateral); 3x grade II ankle sprains (inversion – 2x right, 1x left); hx of myositis ossificans; 3 concussions (sport related)
- Goal: 6 weeks left in season – both athlete and coach want him to return to play

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## Acute Hamstring Strain: **Case Study**

- What other questions would you ask this athlete / coach?
- What other tests and measures would you perform?
- What is your diagnosis?
- How would you treat this patient?

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## Acute Hamstring Strain: **Case Study**

- Treatment
  - Interdisciplinary treatment and **communication**
  - Consider the setting: S&C, ATC, PT, ortho/MD, coaching staff, athlete
- Initial Exam:
  - MOI = traumatic
  - SINSs
  - Restrictions = hip and knee extension/flexion
  - Baseline assessment – balance, mobility, dexterity, provocation, functional strength

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## Acute Hamstring Strain: **Case Study**

- The call is yours...

Does the athlete return this season?

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## Wrap Up

After this course, participants will be able to:

- Describe at least three actions of the hip and knee contractile tissues and non-contractile tissues as they relate to both injury and performance variables.
- Identify at least three main risk factors which lead to both acute and recurrent hamstring injuries across the performance spectrum.
- Compare and contrast various functional outcomes to guide clinical decision making in establishing a timeline for return to play (RTP)
- List multi-dimensional return to play (RTP) criteria for guiding athletes back to participation following a hamstring injury.
- Outline an interventional strength and conditioning program that focuses on rehabilitation for the injured athlete and preventative measures for the non-injured athlete.

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Transforming  
society...

...by optimizing  
movement...

...to improve the  
human experience

*APTA Vision Statement - 2020*

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Transforming  
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...by optimizing  
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*APTA Vision Statement - 2020*

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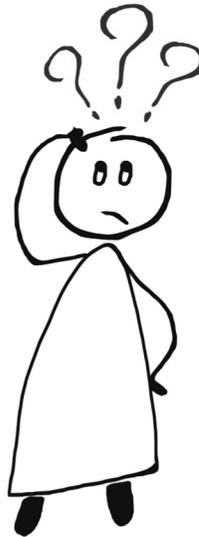
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Questions??



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**CONTINUED<sup>®</sup> Sports Physical Therapy Virtual Conference**

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