DREXEL UNIVERSITY
Parkway Health & Wellness
College of Nursing and Health Professions

Running Lecture Series

Drexel University

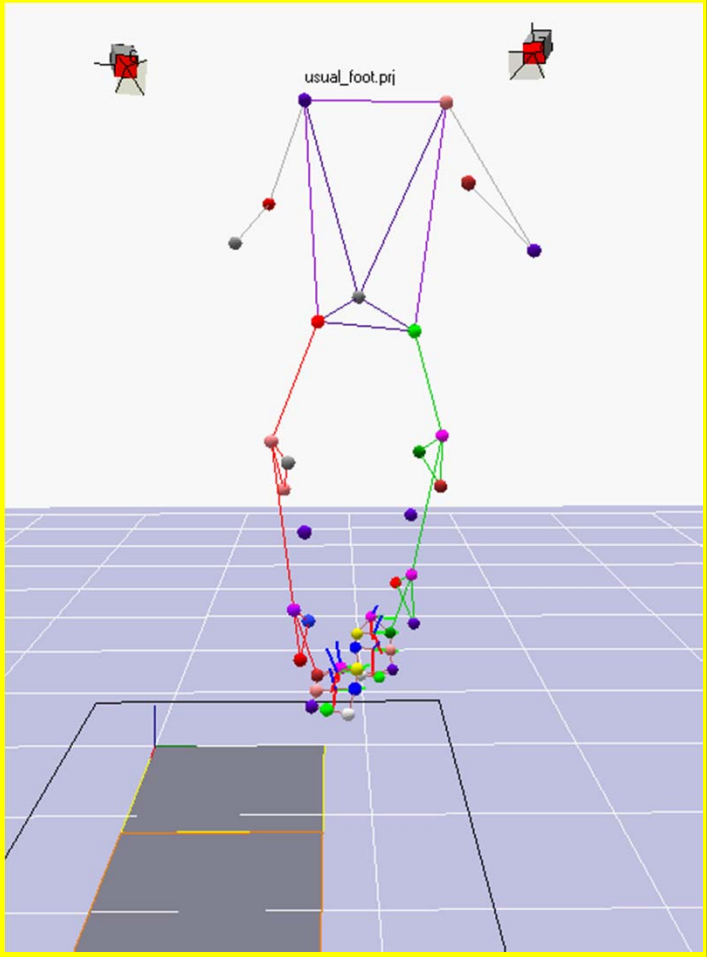
Physical Therapy & Rehabilitation Sciences

Run with the Dragon.

Rob Maschi PT, DPT, OCS, CSCS

Topics

- Running biomechanics and role in injury
  - Over striding (cadence)
  - limb stability
- Strength training:
- Plyometrics
- Core strength training
  - to prevent or recover from injury
  - Improve run performance
- Running gait analysis
  - Motion analysis laboratory
  - Clinical gait analysis

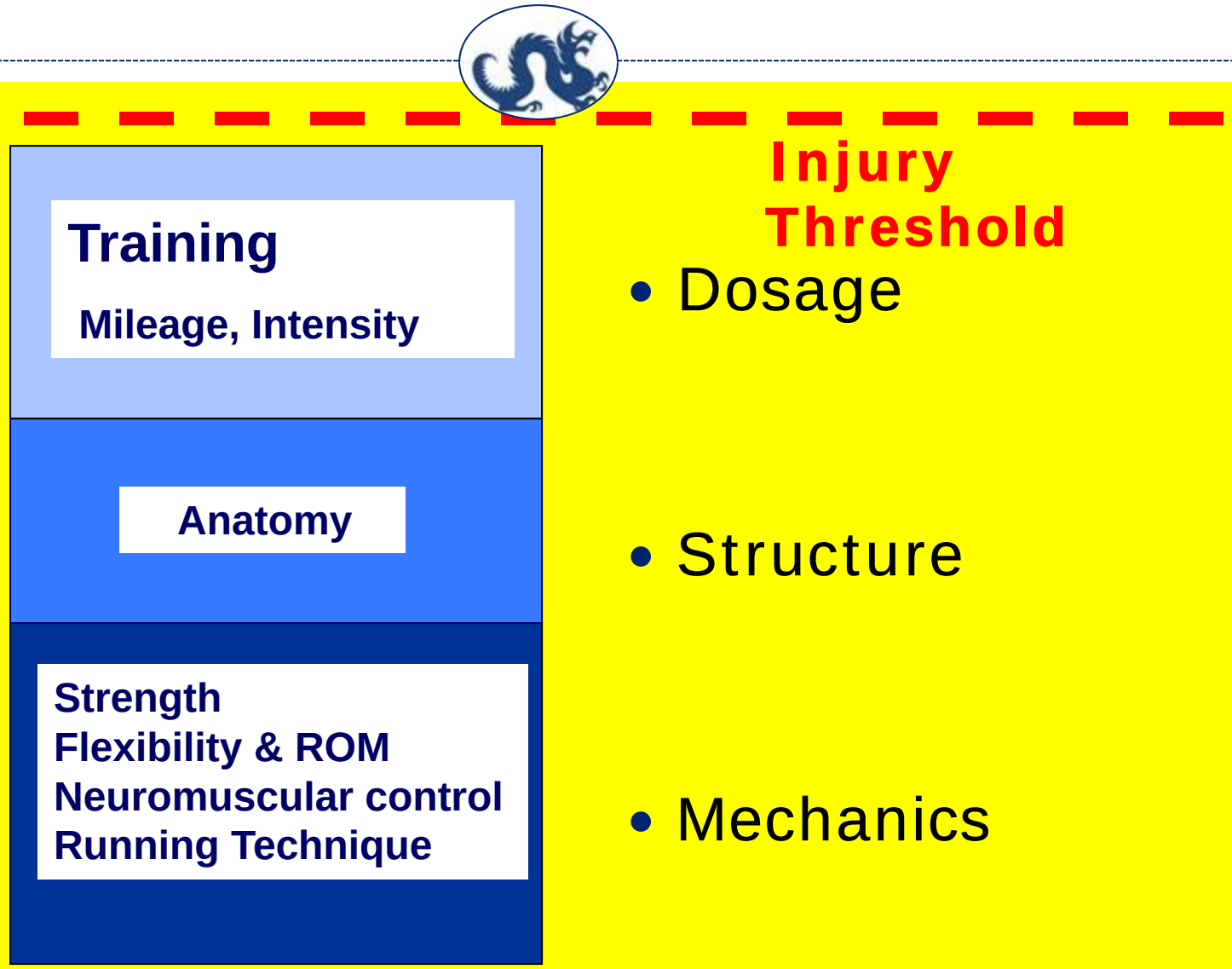


High injury rate in runners…

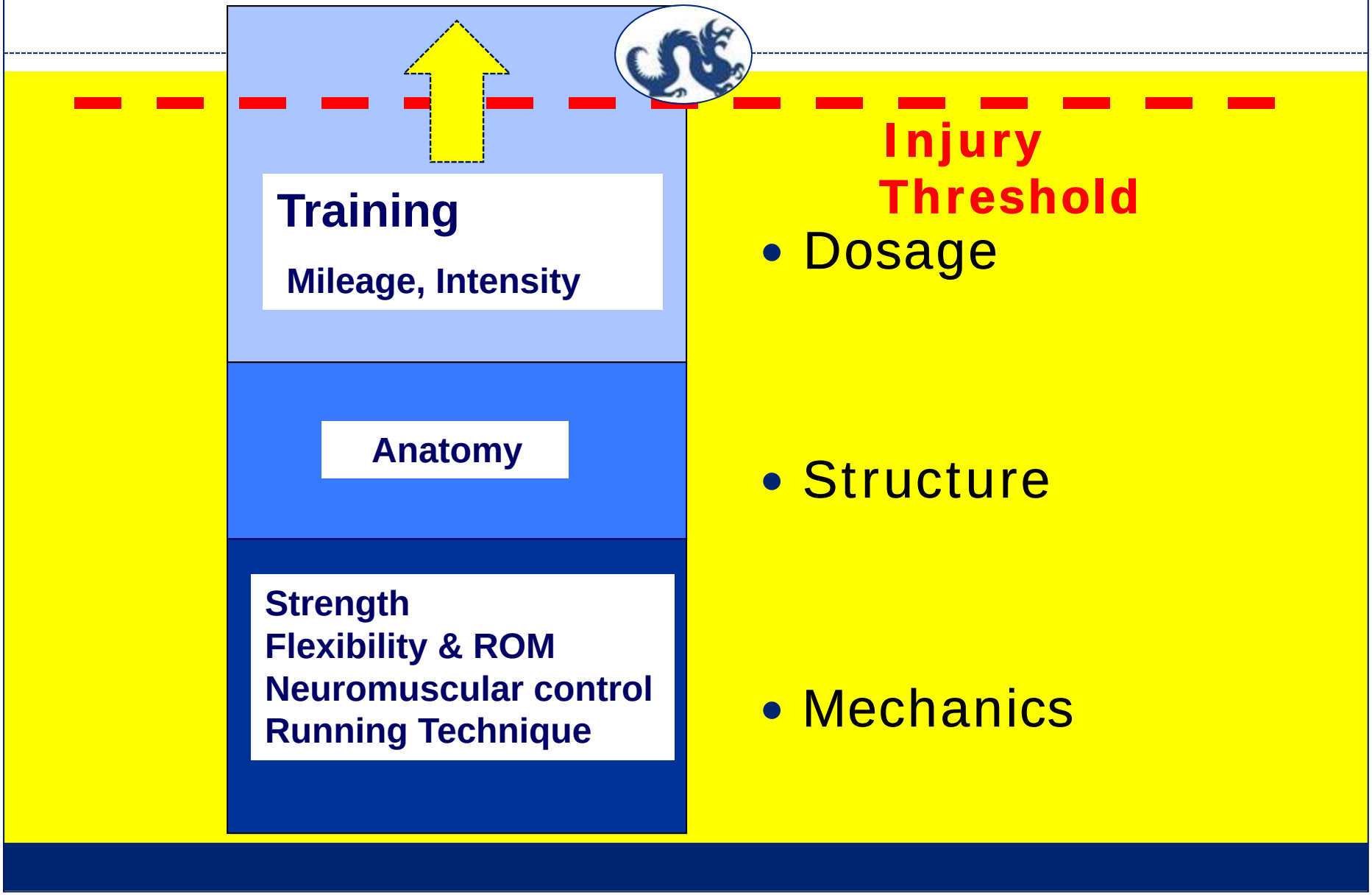
Why do runners get injured?

Overuse is the common mechanism

Cause of Overuse Injury is Multifactorial



Cause of Overuse Injury is Multifactorial



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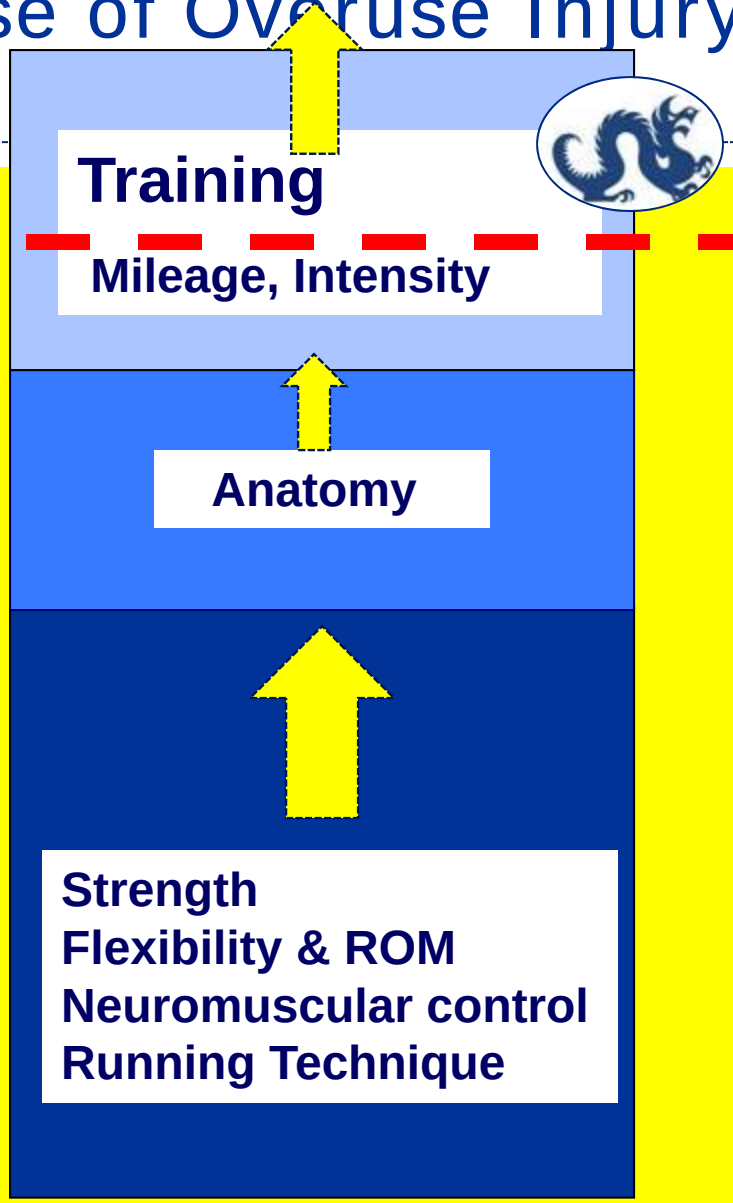


Injury Threshold

- Dosage
- Structure
- Mechanics

Running Mechanics

Is there a correct way to run?

- Incorrect ways to run
- Movement patterns that:
  - increase biomechanical stress to bone and soft tissue
  - Inefficient

Thanks Brian Hoke

Biomechanical Errors

- Over striding
  - Technique issue
- Limb stability
  - Neuromuscular control issue
  - Control in 3 planes of motion
  - Account for most injuries
  - Preventable or fixable

Over striding

- Foot contacts ground too far in front of your body

Over striding- why is it bad?

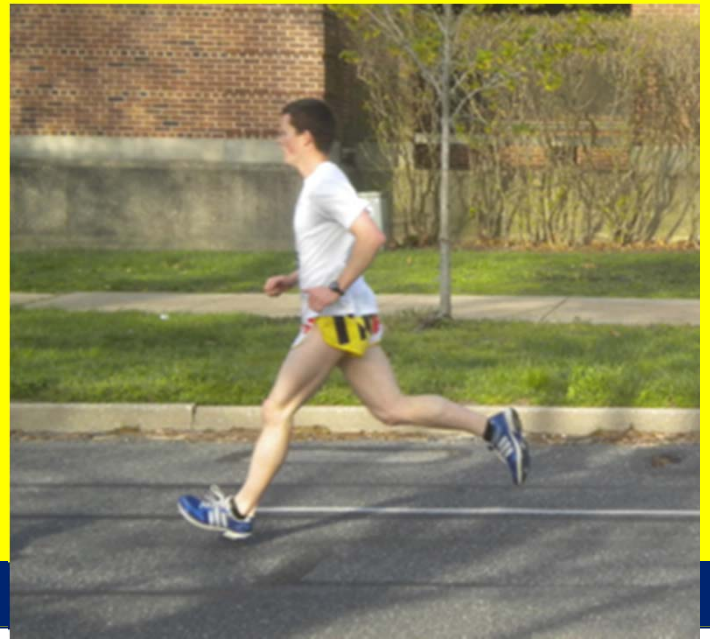
- Larger vertical displacement of COM
- Larger vertical velocity of impact

Greater impact loads

(Magnitude and rate of loading)

- "Putting on the brakes"

Inefficient



How do you reduce over striding?

- Running velocity =

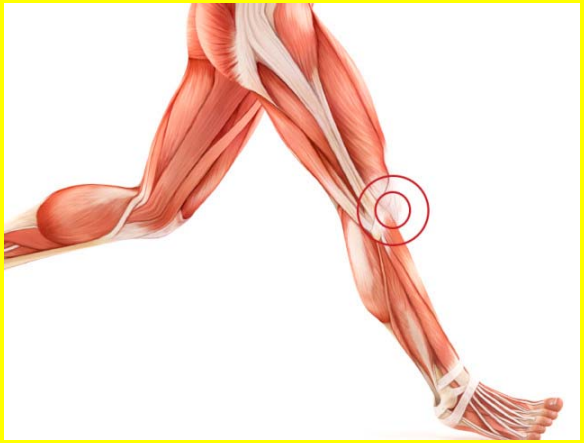
  step length x step frequency (steps/min)

- Variation among runners
  - Elite: 180 steps/min
  - Recreational: 145-160 steps/min

Decrease joint loads

- Small changes in step length equate to large changes in loads across the knee joint

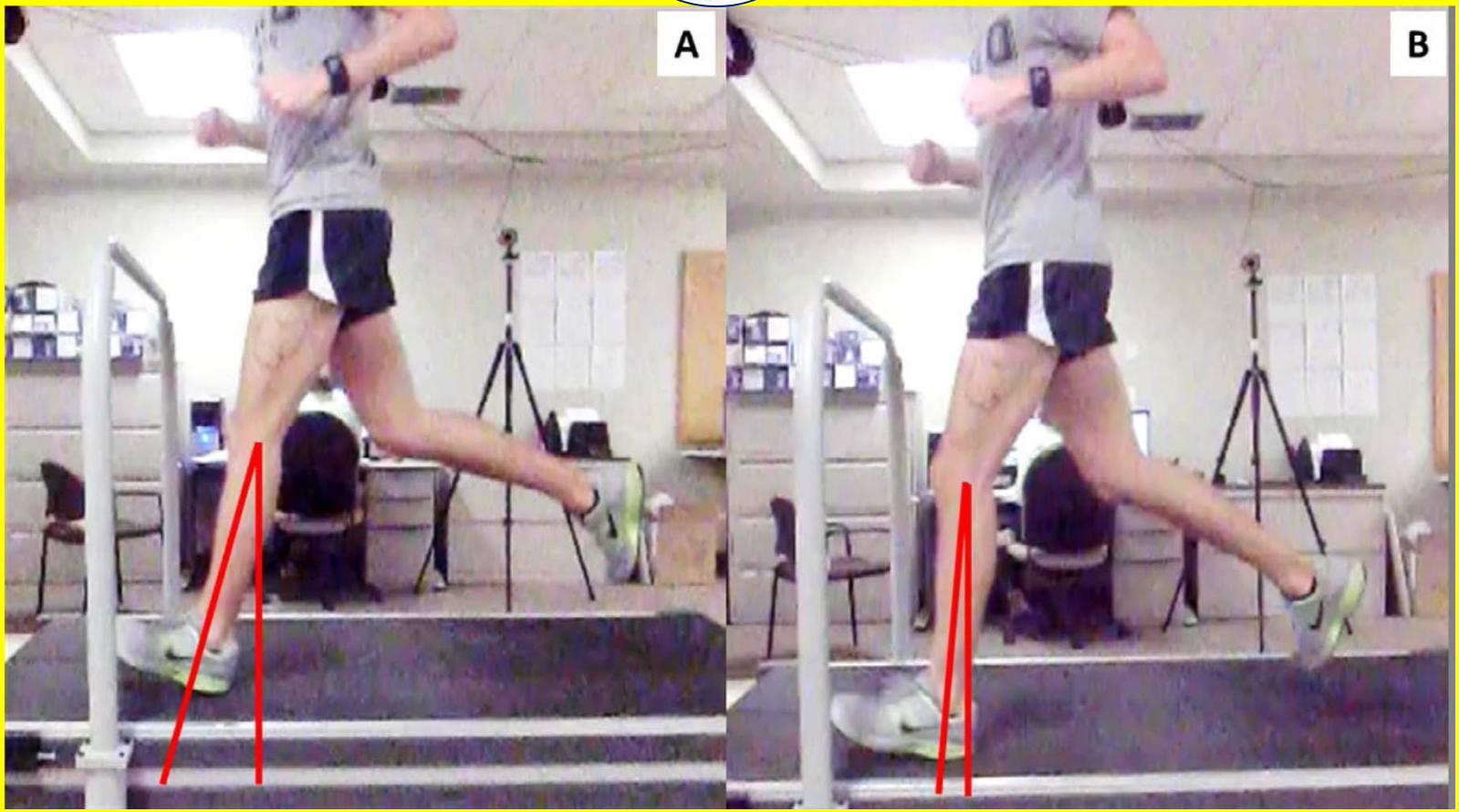
  Willson, Lenhart



- 5% increase in step rate = substantial decrease in energy absorbed at knee

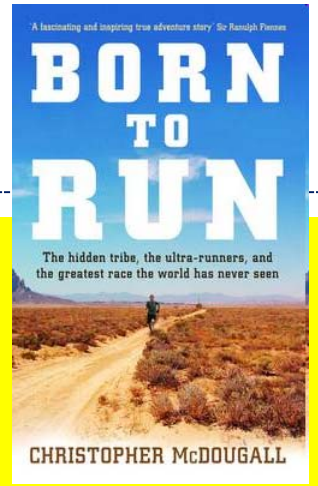
  Heiderscheit

Increase step rate



- Miller A, Willy RW. Retraining fixes faulty gait in injured runners. LER. 2013 5(6): 29-33.

Science behind the fad



- Barefoot running
- Minimalist shoe
- Pose running
  - Common denominator= increased step frequency
  - Position of foot at initial contact closer to COM

Barefoot running

- Change foot strike pattern?

Strike pattern, load and injury

RFS

- Foot and Ankle: lower demand / load
- Knee: higher demand / load

FFS

- knee and hip: lower demand / load
- Foot and Ankle: higher demand / load
  - Daoud 2012

- Injuries in barefoot and minimalist runners
  - Plantar fascia, Achilles tendon, calcaneus, metatarsal stress fractures
  - Transition?

- Barefoot heel strikers
  - significant increase in impact loads

Learning a new strike pattern

- Old dog, new trick…
- inconsistent strike patterns during transition
  - “mixed landing pattern”
  - increased tibial shock
  - May increase injury risk

Cheung 2014, Olin 2013

  - What is injury rate in properly transitioned barefoot runners vs traditional (shod) runners?

Vibram class action law suit

Settlement:

1. $**3.75 million to provide partial refund**

2. Vibram has agreed to discontinue to make any claims that Five Fingers footwear is effective in strengthening muscles or reducing injury in its marketing and advertising campaigns, unless the company discovers new scientific evidence that proves it.

Is it necessary to go barefoot (or minimalist)?

Leave your shoes on and change stride length?

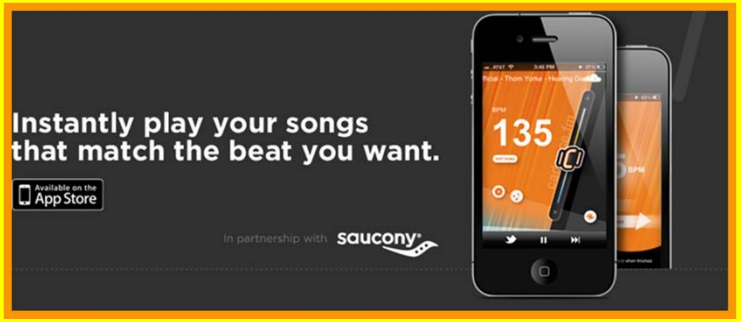
Over striding

- How to fix it:
  - Count cadence
    - Count foot strikes per minute
      - Work towards 90 each side
      - Shorter, quicker strides
  - Drills
    - Arm swing/quick feet
    - Increase leg turnover
  - Run barefoot?
    - Use as a cue to shorter stride,
    - midfoot / forefoot strike
  - Hills
    - Running up hill shortens stride

Over striding

- How to fix it:
  - Set target cadence
  - Use metronome

  - Cadence App
    - Song playlist organized by cadence



Cadence Training Protocol

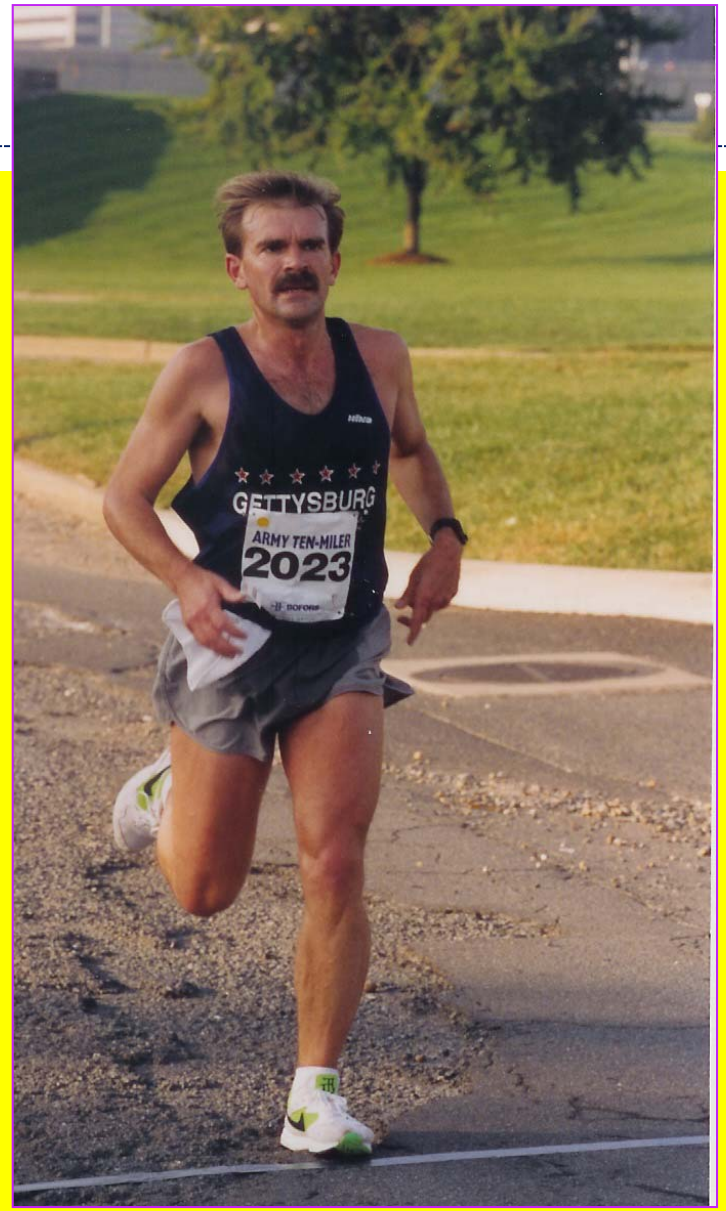
- (Single session)

- 5-10% increase in step rate
  - 2 min with metronome
  - 1 min without metronome
  - 1 min with metronome
  - 1 min without metronome

- Stop, restart
  runner independently produces new pattern
  - Repeat above training if necessary

Limb stability


ENG
PAULA
F4


GETTYSBURG
ARMY TEN-MILER
2023

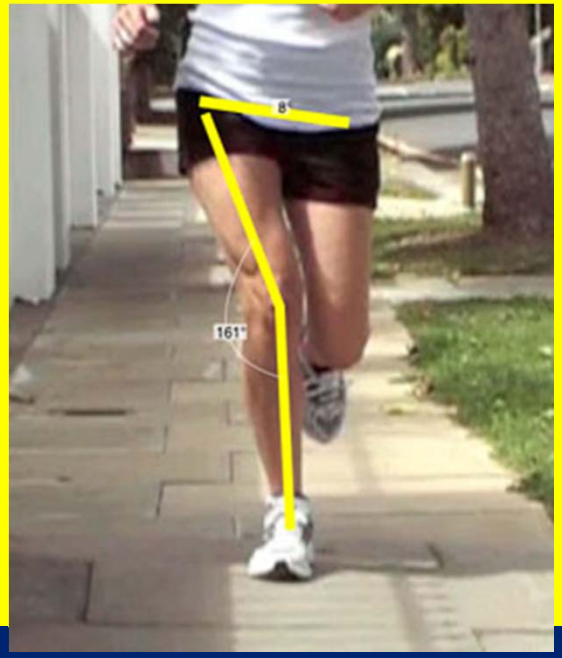
Running is a single leg activity

Must be stable on one leg

Not stable

Why is alignment important?

- Studies demonstrate poor control of limb position is related to injury



Alignment

Tests for stability

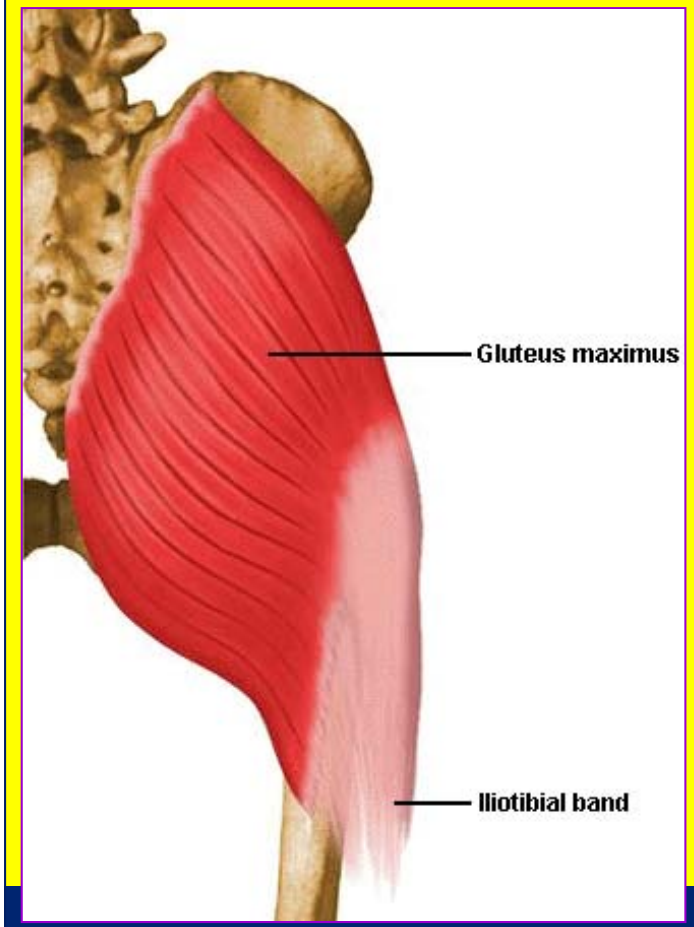
- Single leg squat
- Step down

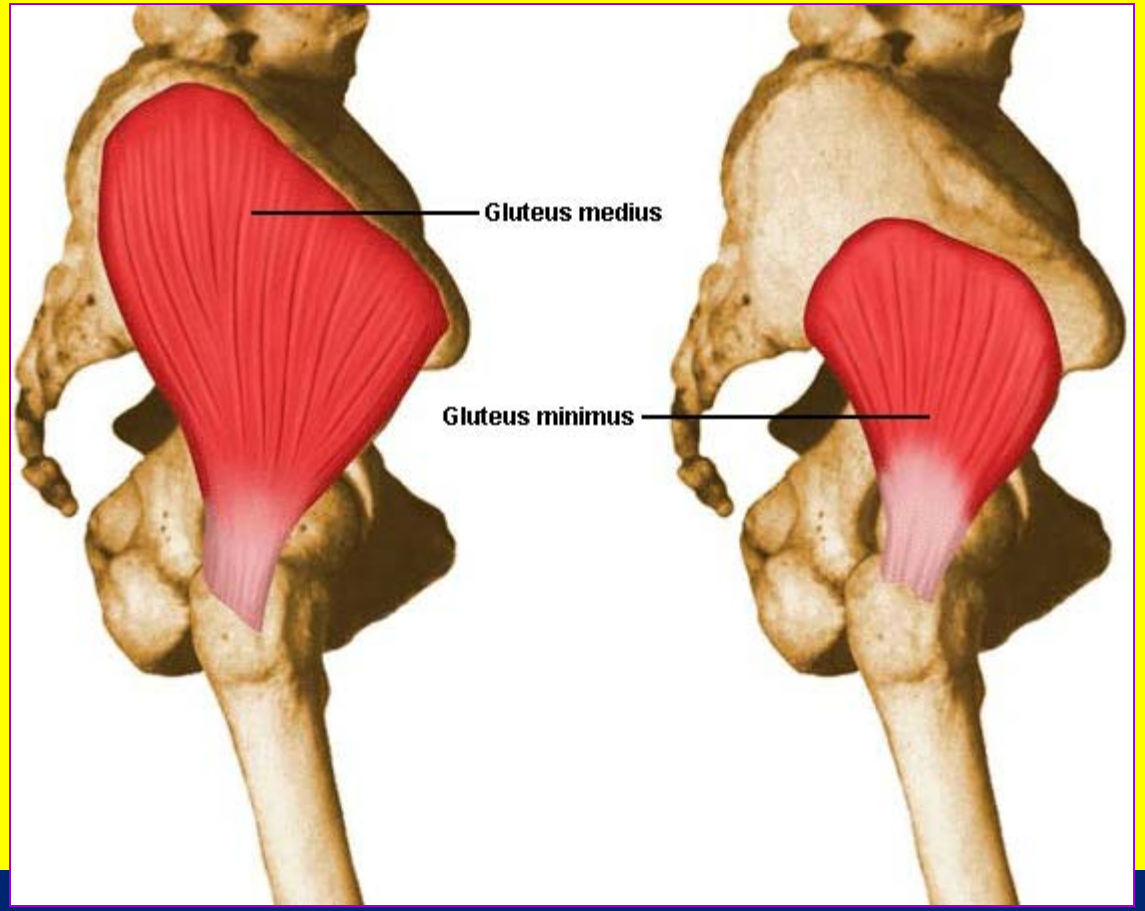
Medial collapse
Pelvic drop

Tests for Stability

How do you improve limb stability?

Strengthen Gluteal muscles!





Gluteal Muscle Strength: Runners with PFPS & ITBS

- Decreased hip <u>abduction</u> strength
  - Powers
  - Ireland
  - Robinson
  - Cichanowski
  - Dierks
  - Souza
  - Fredericson
- Decreased hip <u>extension</u> strength
  - Powers
  - Souza
  - Robinson

Noassatall Syndrome

Typical runners build

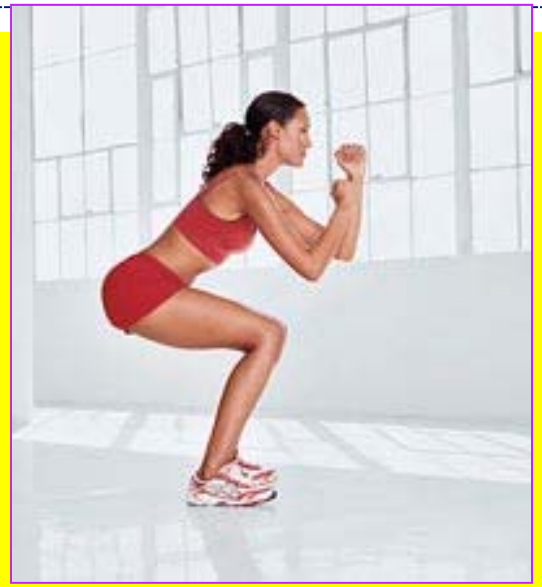
NO GLUTES!

Hip Strengthening: Basic Concepts

- Progress from two leg activity to one leg activity as stability improves
- Emphasize good form and alignment
- High reps, low weight (body weight)

Establishing core strength

- Squats
- Bridges
- Step ups
- Plank



Why Planks and trunk stability?

- Activating core improves control of limb movement

- Stable trunk (abdominal muscles) improves hip muscle function

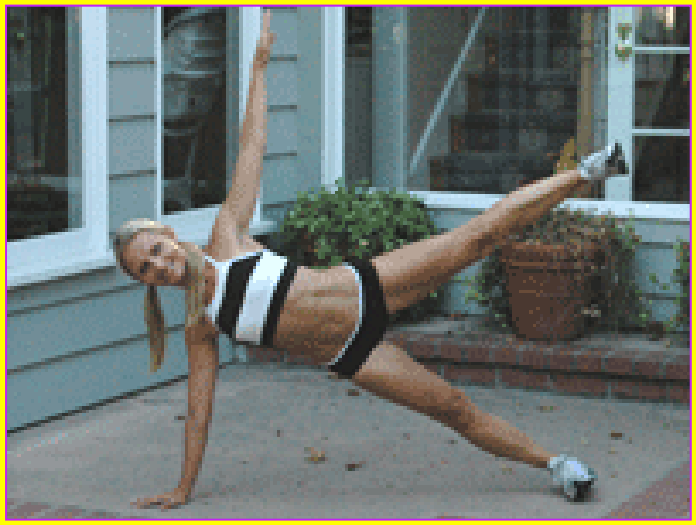
  - Ability to recruit gluteal muscles
  - Ability to generate force

Shirey, Oh, Cynn, Boren

Stable platform

Planks

Side Planks

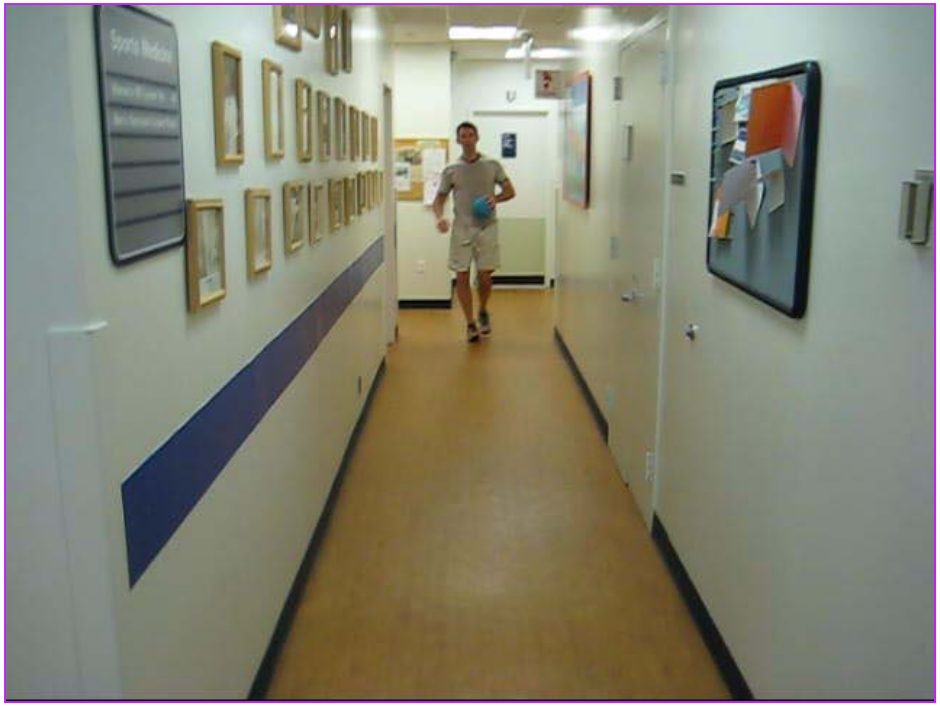


Bridges

Squats

Lunges

Dynamic Lunge



Focus on alignment

Lateral hip strengthening

Single leg training

Run-specific movements

Train for stability

- Unstable surfaces
  - Bosu
  - Foam rollers (1/2 rollers)
  - Wobble boards

Plyometrics

- Technique to develop power
- To train the muscles to become more explosive

- Stretch muscle followed by contraction of muscle
  - Jumping
  - Running
- causes increased force production of same muscle

Plyometrics

Benefits:

- Improved neuromuscular control

Decreased peak landing forces 22%

Hewett

Decreased magnitude and rate of loading

Irmischer

Improved limb stability (decreased hip adduction)

Myer

Plyometrics

Benefits:

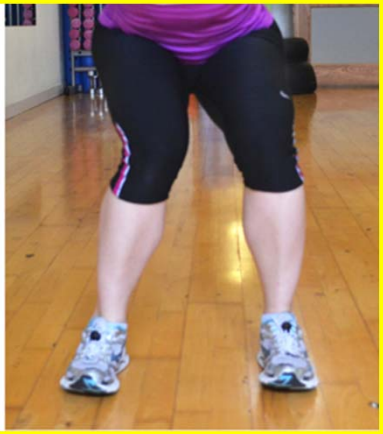
- **Improved Running Economy**
  - (How much O2 is required to perform at a given intensity)

    Jung, Turner
- **Performance times**
  - Sprinters and long distance runners

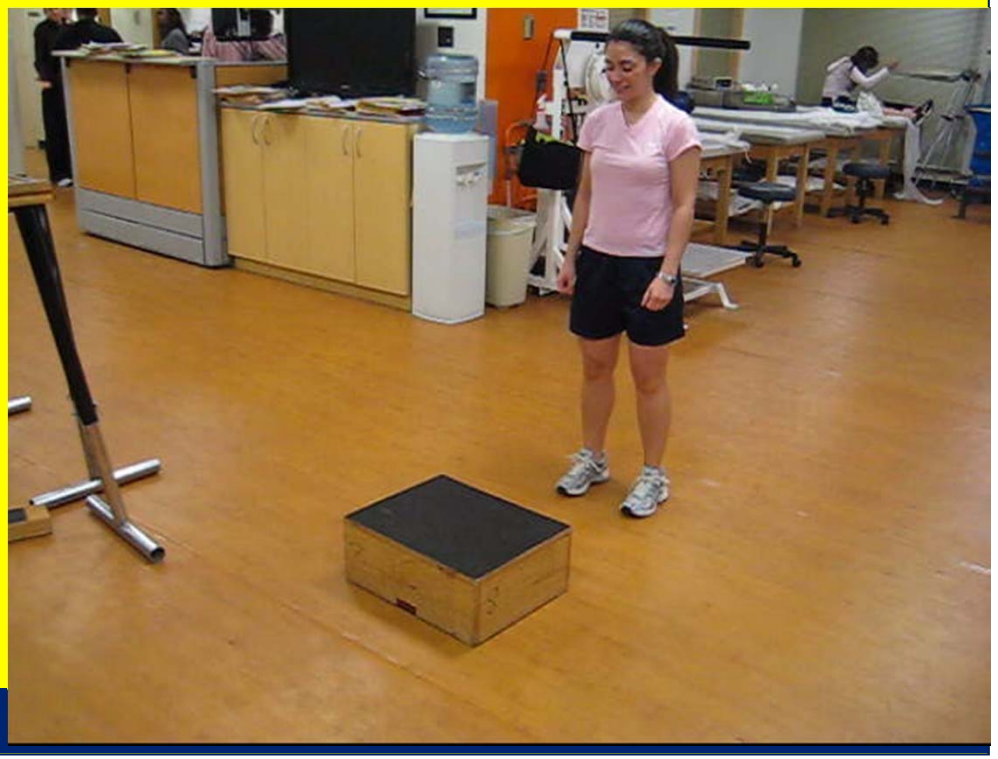
    Paavolainen, Rimmer, Spurrs

Plyometrics

- Good form is essential



Good **Bad**



Plyometric Progression

- Stair hops
- Cone hops
- Cone hops/turns
- Box jumps
  - Front
  - Lateral
- Alternate legs
- Split squat

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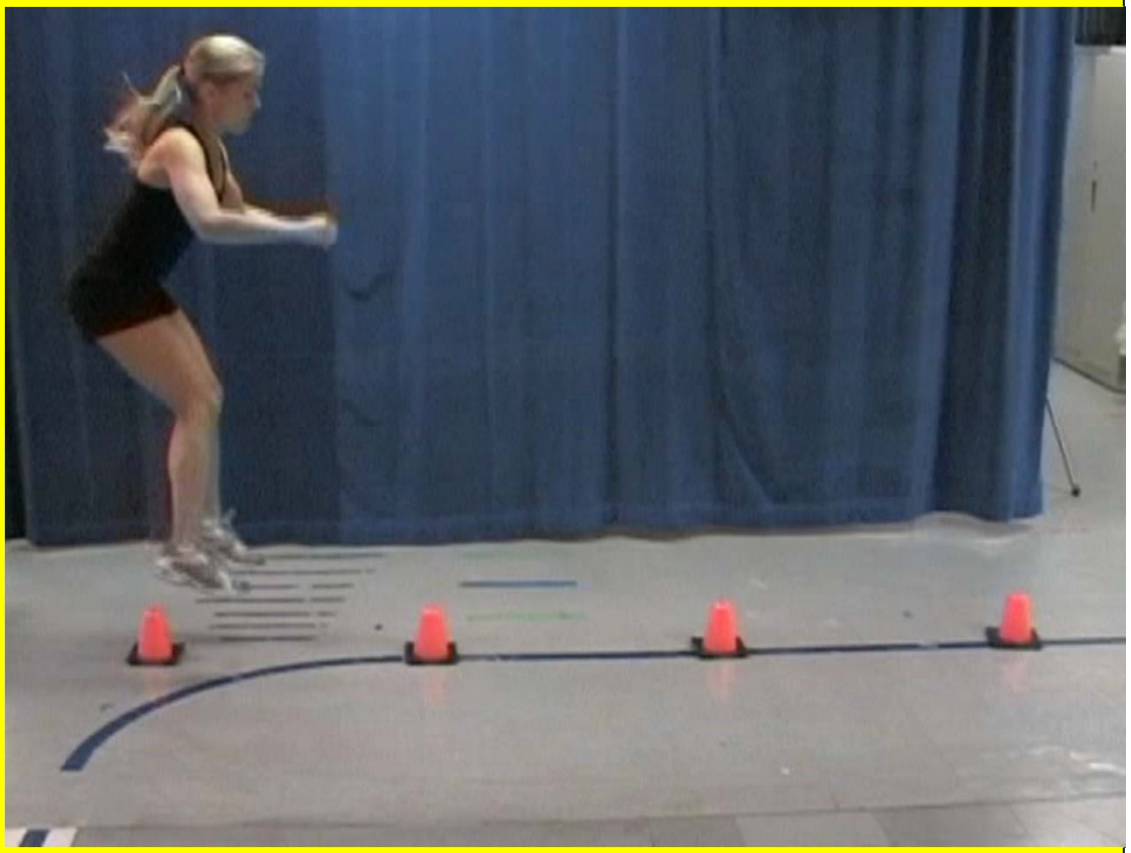

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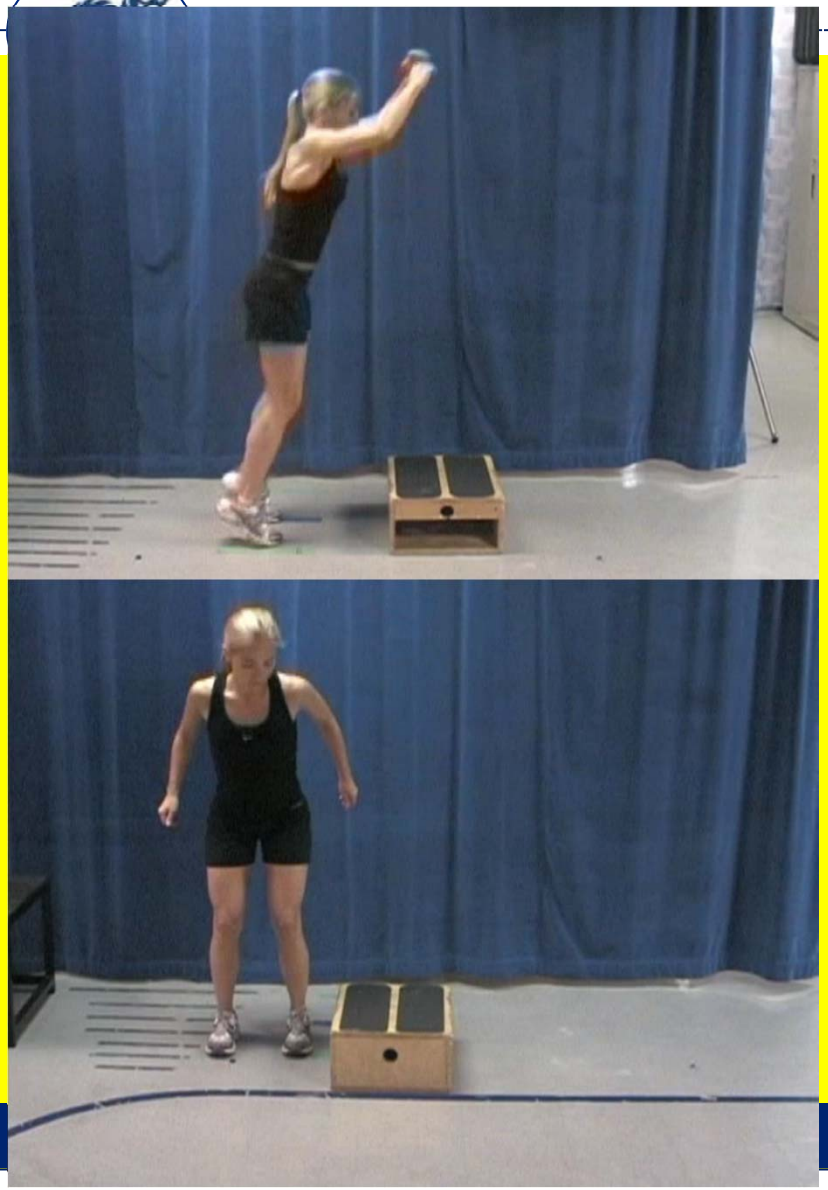

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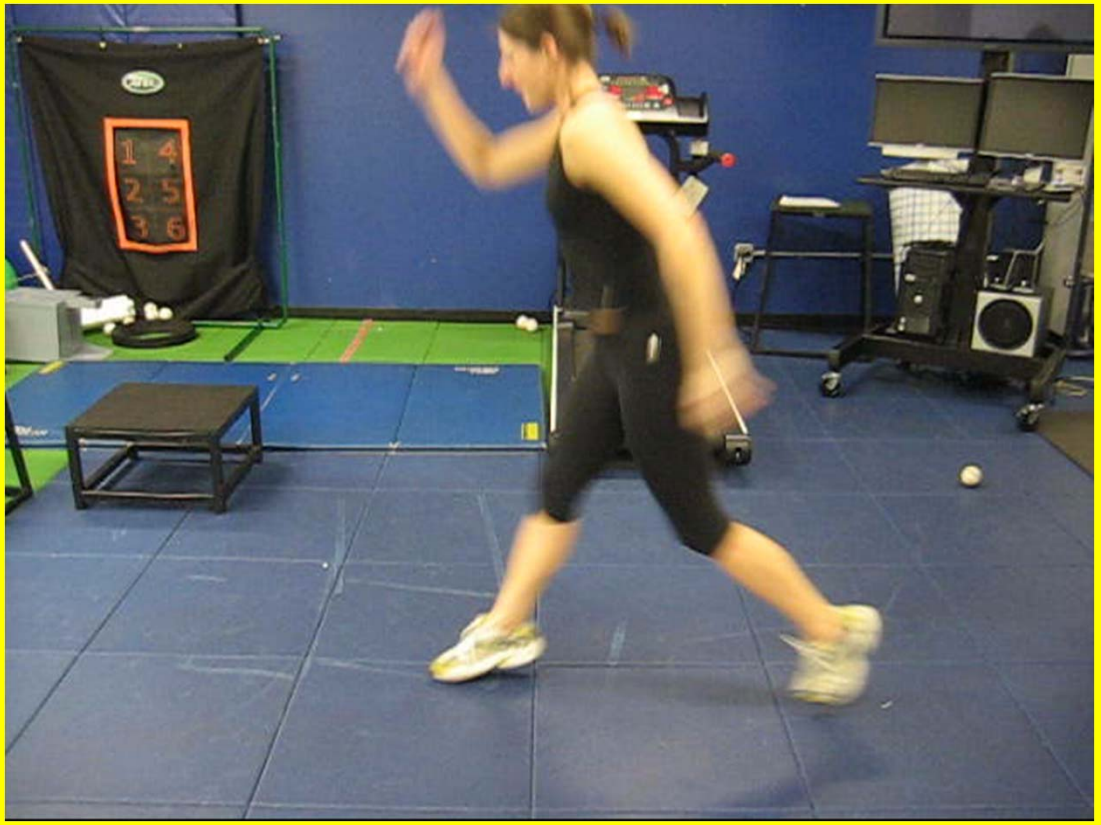


Video gait analysis

- Motion analysis laboratory
  - collecting data to answer research questions about groups /sub groups of runners.

- Clinical running analysis
  - runner wants to know about their own unique biomechanics (running form)
  - Am I running properly?

Clinical Running analysis

– Review training and injury history

– Musculoskeletal exam

- Strength , flexibility, core control, structure

– Movement screening

- Information about muscle strength and activation patterns

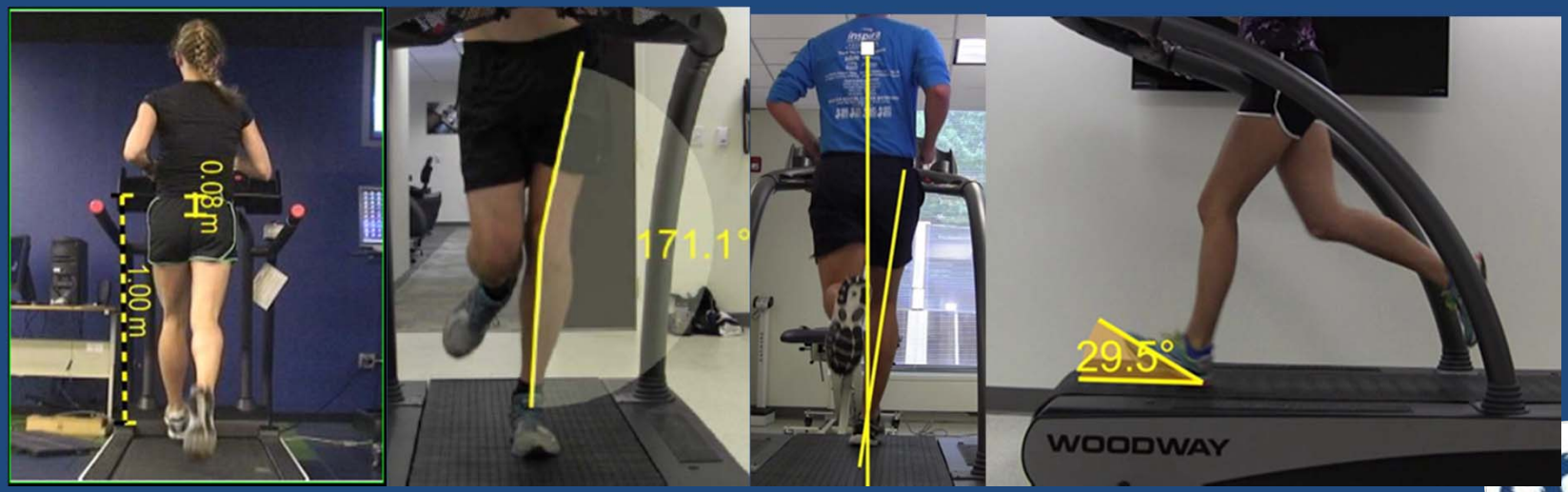
Clinical Running Analysis

- Video analysis
- Dartfish 2-D motion capture software
  - One camera / No markers

Gait analysis

Biomechanical analysis

- Assess movement patterns related to injury risk



Running analysis

- Report:

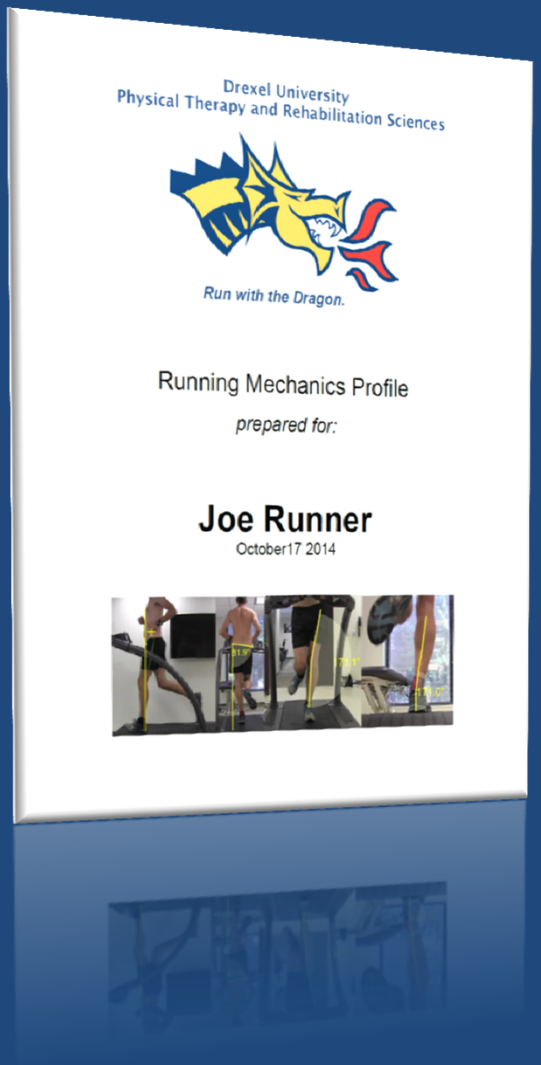
  Recommendations:

  – shoes/orthotics

  – gait retraining/form changes

  – exercise/treatment suggestions

  – training modifications.



Thank You

Go Dragons!

Questions?