ROLE OF FOOTWEAR: FACTORS CONTRIBUTING TO RUNNING INJURIES

FOR PHYSICAL THERAPISTS, FOOTWEAR PROFESSIONALS AND RUNNERS

Michelle Treffer, SPT

"We are attempting to make links between the structural characteristics of the foot, the biomechanics of locomotion and the characteristics of shoe construction" (Barnes 1993)

OBJECTIVES

By the end of this presentation, learners will be able to

- Understand how underlying anatomical issues contribute to stress patterns that are key contributors to running related injuries
- Relate anatomy, soft tissue structures and footwear trends to the incidence of running related injury
- Appreciate how footwear and running trends may contribute to altered functional movement patterns in runners
- Summarize patient presentation, risk factors and general recommendations for four common running related injuries: plantar fasciitis, Achilles tendinopathy, medial tibial stress syndrome (Shin Splints) and Patellofemoral Pain Syndrome

By the time you leave here I hope you will have better understanding of the various complex scenarios that contribute to running related "overuse" injuries

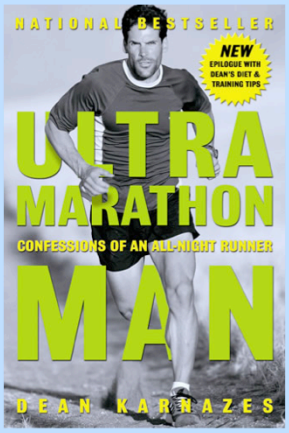
- We would like to match an injury to a particular shoe type BUT there are many variables to consider
- Realistically describe properties and behavior of anatomy and principles of biomechanics to identify how and why specific structures are being injured and from there identify options that will hopefully reduce injury incidence and keep us active

The run injuries that we will cover here today can be categorized as "overuse" type injuries and I will spend a little bit of time explaining the anatomical and physiological factors that contribute to that.

RUNNING RELATED INJURIES

Injury Incidence in Runners

- 50% of runners will experience some type of injury
- 70% at the knee and below
- Many of these injuries could lead to more serious injury, such as stress fracture of bone or degradation of cartilage



Buist 2015

Why can some people run ultramarathons – or 50 marathons in 50 states in 50 Days and not incur injury from overtraining? There are key factors to consider and each person has their own formula to minimize injury

- Each category listed here is a contributor to running injury or overuse type injuries
- Some individuals may have several contributing factors, others may have only one or two
- For the purposes of this presentation, I will give only a brief background on skeletal malalignment issues. If this is suspected as the primary underlying issue, then this must be addressed as part of a comprehensive lower quarter screen.
- **The bottom line is** that there are numerous contributors to overuse type injuries that could lead to more serious injury if not addressed and treated.

Training Errors:
RUNNING RELATED INJURIES

Cause roughly 60 -70%

- Most can be associated with either frequency, duration or intensity
  - Frequency: Recovery time
  - Duration: Long bouts → fatigue
  - Intensity: Sprinting → Strain

Evidence: Excessive mileage is recognized as one of the strongest predictors of running injury

- 30-39 miles per week → 50% incidence (Fields 2010, citing Jacobs)
- 50 -70 miles per week → 50% incidence (O'Toole, citing Newell)
- Increasing miles too quickly
- Change in running surface

O'Toole 1992; Fields 2010; Gross 1995; Gross 1992

Training Errors can include many different variables, but as far as how the tissue is being injured we have 3 categories and when we are considering running related injury this is what we really need to know in order to identify where we need to make changes

- Frequency: Repetitive trauma requires recovery time to repair
- Duration: Long bouts lead to fatigue which decreases the strength of the tissue and leads to injury
- Intensity: High force/power can cause tears or ruptures in tissue

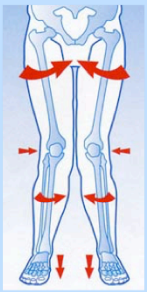
We can link these training errors to biomechanics by considering:

1. How do these structures behave AT impact with the ground AND
2. What stress patterns are affecting joint structures and tissues as a runner moves through the gait cycle

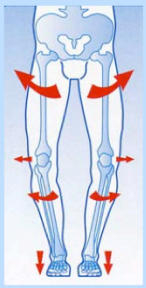
Footwear and run strike patterns can influence #1 and 2

Skeletal Malalignment:
RUNNING RELATED INJURIES

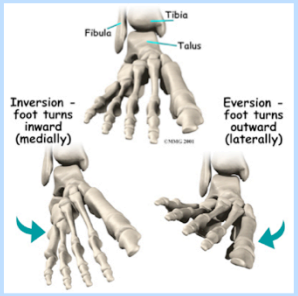
- Leg length discrepancy
- Knees: Genu Varus/Valgus
- Foot Supination/Pronation,
- Forefoot or Rearfoot Varus/ Valgus

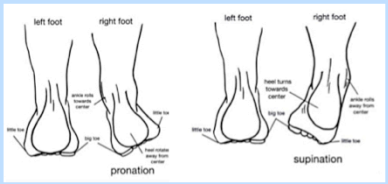


Genu Valgus
"Knock knees"



Genu Varus
"Bow legged"





For the purposes of this presentation, it is important to be aware of the multitude of underlying contributing factors, BUT in order to appropriately assess whether any of these factors are problematic requires a full lower quarter screen by a qualified physical therapist.

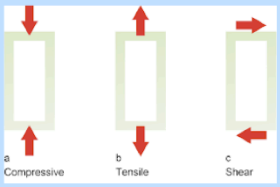
- Here today, we are considering this in order to visualize how these conditions may alter movement and create stress patterns that lead to injury

- Skeletal alignment refers to each individual's anatomy and how the bones are aligned when our feet make contact with the earth. The impact of each foot with the ground has affects all the way up through each joint segment. Ankles, knees, hips, and spine.

- Once we are able to determine the stress pattern, we can use one of our tools (footwear) or strike pattern to help stop that cycle

Soft Tissue Structures:
RUNNING RELATED INJURIES

- **Strength Imbalances**
  - Lead to altered movement patterns
  - Frictional abrasion of joint structures → damage to articular cartilage
- **Extensibility**
  - Hypermobile or Rigid: Amount of collagen in tissues
  - Affects obligatory motion at joints through gait cycle
- **Strain Rate:** Rate of deformation a tissue can withstand until failure
  - Less time of deformation → increased injury



Types of stress leading to injury of Muscle/Tendon

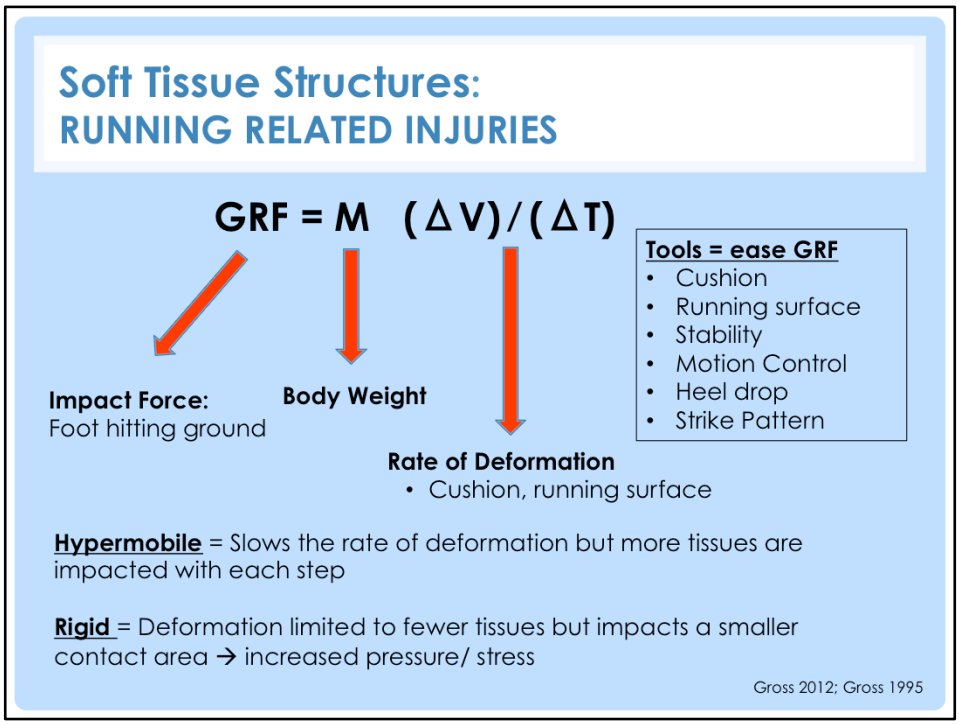
Baeza-Velasco 2013, Gross 1995

Strength Imbalances: Increased frictional abrasion of joint structures in the weaker plane of movement = muscle/ tendon strains + damage to articular cartilage

Hypermobile or Rigid: Stiff or squishy

Strain Rate: How much stretch or strain a tissue can withstand before it fails (tears). Leads us back to

- Frequency
- Duration
- Intensity



GROUND REACTION FORCE:

Contributing factors in WHICH Tissue absorbs that impact:

- Movement patterns (strike patterns) – how you land
- Hypermobile or Rigid tissues
- Structure/Support of shoe
- Angle of running surface

Amount of Force can be decreased by increasing the time of impact, meaning the cushion that you are landing on:

- Hypermobile more
- Rigid less
- Strike pattern: if landing in forefoot strike, the knee is flexed and your muscles are providing the soft landing

OR use **Tools:**

- Stability/motion control – aligns the foot/ankle into a position that allows more or different/stronger tissues to provide this cushion of force
- Running surface: including material and angle
- Cushion of shoes: where is the cushion?
- Heel drop height: If landing on heel you may need more cushion there

Different tissues can withstand various amounts of stress until failure occurs and certain conditions contribute to this. But we will cover that in a minute.

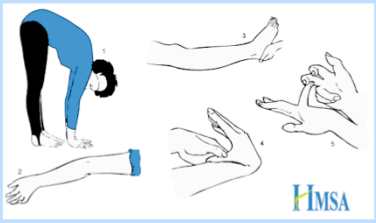
Soft Tissue Structures:
RUNNING RELATED INJURIES

Hypermobile or Rigid?

Hypermobile → Less collagen content

1 point each limb: 4/9 in men or 5/9 in women = Hypermobile

- Can place palms on the ground with legs straight
- Elbow that bends backwards
- Knee that bends backwards
- Thumbs touch forearm when bent backwards
- Little finger that bends backwards beyond 90 degrees



http://hypermobility.org/

This slide is not intended to provide diagnostic criteria.
This information is intended to quickly assess whether an individual has more or less joint mobility. Most individuals will know immediately which category they fall into once the definition is provided.

- This information will help determine how your joints move after impact with the ground

Hypermobile:
- "double jointed"
- Can easily place both palms on the ground without bending knees
- Genetic component – one parent may have similar signs

Rigid:
- Tight, inflexible muscles
- Crack back or neck frequently
- Increasing rigidity with age

Soft Tissue Structures:
RUNNING RELATED INJURIES

How are your joints moving once impact occurs?

Hypermobile: As the foot meets the ground the soft tissues allow collapse of the skeleton from foot to hip in the alignment that is presented

Rigid: Tissues prevent this collapse but must attenuate the force on a smaller contact area

Baeza-Velasco 2013:
Review of literature on advantages and disadvantages in sport

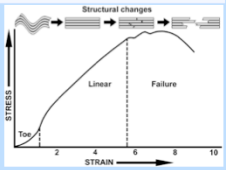
- Hypermobility has been associated with higher incidence of tendon/ligament injury AND slower rehabilitation
- Higher incidence among Asians and Africans
- Women 3x more likely to be hypermobile than men

The images here give us a visual representation of how hypermobility would contribute to pronation (top) – repetitive compression of lateral ankle and tensile stress of medial ankle structures.

Plantar fasciitis (bottom) – repetitive tensile stress, stretching of the two attachments of the fascia on the arch

Soft Tissue Structures:
RUNNING RELATED INJURIES

Strain Rate: Muscle/ Tendon



Factors that decreases strength of tissue:

- Fatigue (overtraining) or disuse atrophy
- Repetitive stress or single high magnitude stress
- Previously injured, scar tissue
- Vascularity, smoking, corticosteroids
- Increased Age decreased amount of reparative cells

Factors that increase strength:

- **Warmed tissue** (Physiologic OR Thermal): Increases ultimate strength and extensibility of muscle & tendon
- Progressive and regular loading of tissues (Hypertrophy)

Gross 1992

Remember: Frequency, duration and intensity

Strain Rate: Rate of deformation (how much stretch or strain) a tissue can withstand until failure

Examples:

- Deconditioned tissues or fatigue (overtraining) → withstand less overall stress until failure
- Previously injured → scar tissue → weaker for 10 days then stronger.
- Effects of Age → decreased cross sectional area of fibers and reparative cells

Increase Strength:

- Tissue should be warmed prior to loading or stretching (external heat is the same as physiological warming) "Improves short-term ultimate strength and extensibility of tissue" (Gross 1992)
- Must build strength slowly

Footwear Trends:
RUNNING RELATED INJURIES

Trends in Footwear and Running Styles

Footwear
- Traditional
- Barefoot/ Minimalist
- Maximalist/ FAT Shoe

Strike Patterns:
- Heel
- Midfoot
- Forefoot

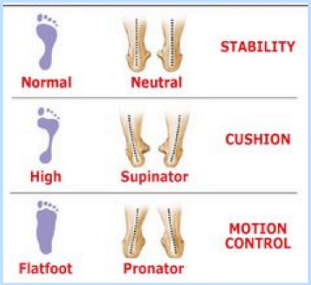
Past twenty – thirty years have seen a series of trends in footwear and running styles.
- Next slides we'll focus on details of these that are relevant to run injury
- Each has pros and cons, which depend on each person's unique anatomical structure

Heel Drop = the difference between the forefoot cushion and rearfoot cushion

Footwear Trends:
RUNNING RELATED INJURIES

Traditional Shoe Prescription

- Based on plantar shape
- Shoe Type: Stability, Cushion, and Motion Control
- Recent research has shown that this method may not be effective at reducing RRIs



Knapik Studies: (2009,2010, 2010)

- 1000 male, 450 female in each group (x3)
- Control group: all subjects prescribed stability shoes
- Experimental group: all subjects prescribed based on plantar shape
- Wore prescribed shoes for 1-1.5 hours of running and/or strength training 4-6 days per week
- No significant differences in injury incidence between the groups

Traditional prescription: (Knapik 2009)

- Low arch = presumed greater rearfoot and midfoot mobility = pronation in stance phase of gait = motion control shoes
- High arch = presumed rigid or inflexible feet = underpronate = increased GRF = cushion shoe to help attenuate GRF and allow movement into pronation

Studies conducted have focused on military basic training (Army, Air Force and Navy specifically) because this is the method they have been practicing for years.

- This basic model of shoe prescription is based solely on static, weight bearing plantar shape and follows the principle that the bottom example is an overpronator and should be prescribed a stiff shoe to limit rearfoot valgus and subsequent medial columnar collapse (arch collapse). This scenario is most often associated with Genu Valgus
- The middle example: High arch would be presumed to have a cavus foot, with underpronation (supination) and most likely rigid soft tissue extensibility. This scenario is most often associated with Genu Varus.

However, recent research has shown that this approach does not have a significant affect on reducing run related injury

Footwear Trends:
RUNNING RELATED INJURIES

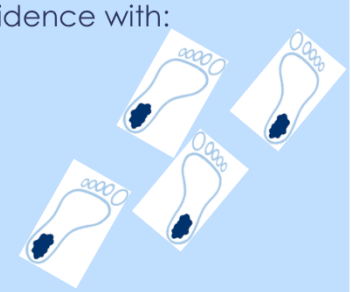
Knapic Studies: The authors point out that:

- Even in subjects at extremes of pronation (flat feet) and supination (high arch), this method of shoe prescription did not reduce the risk of injury - in some cases may have increased it

The authors found the highest injury incidence with:

- Older age
- Lower overall fitness
- Cigarette smoking
- Previous lower extremity injury
- High Arch (presumed rigid)

Repeat Offenders!



Higher Injury risk was associated with:

- older age
- Lower self reported physical fitness
- Slower 2 mile run pace
- More days of cigarette smoking in the previous 30 dyas
- Previous lower extremity injury (women)
- High ached Men

The authors point out that even in individuals with extreme overpronation or extremely high arches, this method of shoe prescription did not reduce the risk of injury and in some cases may have increased it.

Repeat offenders: Relating to factors that decrease the ultimate strength of the tissue (Strain Rate) **Slide 11**

Footwear Trends:
RUNNING RELATED INJURIES

Barefoot/ Minimalist

- Trend Background/Origin
  - Robbins (1987)
  - Born To Run
- Footwear
  - Little or No cushion
  - Zero heel drop or negative heel drop (Newton)
- Strike Pattern
  - Forefoot
  - Self-reported vs. Actual
  - Stride frequency

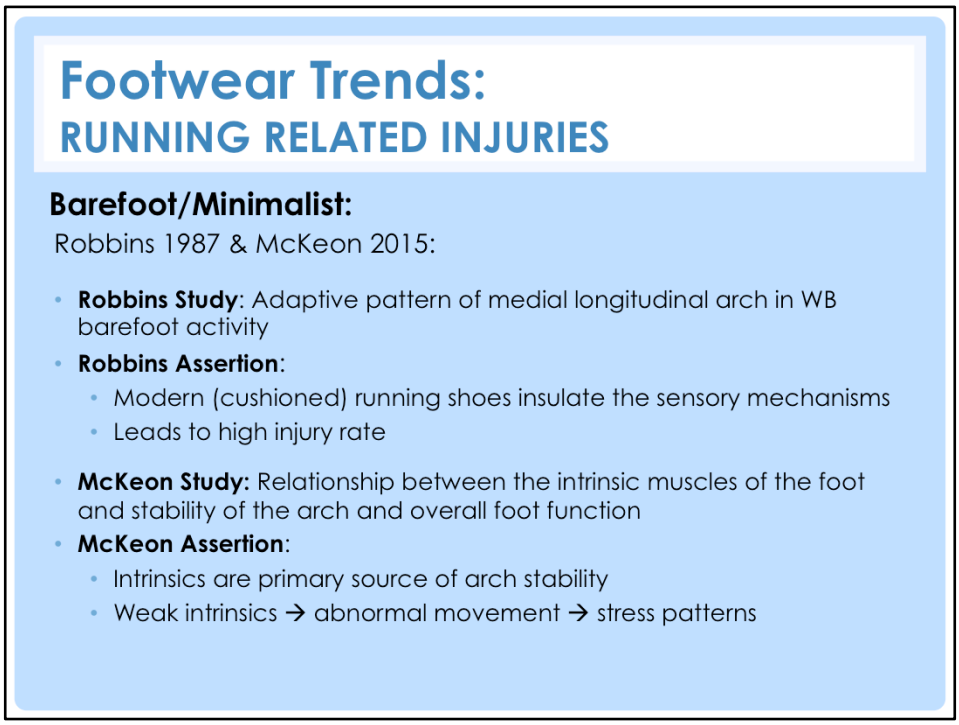
Goss 2015, Robbins 1987, Gross 2012, McKeon 2015,

The plantar arch → should adapt to imposed stress to provide shock absorption

Using minimalist footwear may be beneficial to some individuals and act to reduce run related injury in those people

Using minimalist footwear could lead to more severe injury in some or injury of different structures, for example the forefoot or ankle may be more at risk of increased strain

Failing to adapt appropriate mechanics on an individual basis can lead to grater injury as well



Robbins 1987:

- presented research asserting that this adaption is induced by a sensory feedback mechanism
- Modern cushioned running shoe insulated this sensory mechanism and has contributed to the high injury rate today
  - Consequence of barefoot activity – Adaptations of arch
  - Rigid foot associated with cushioned shoe population
  - Sensory feedback from glabrous epithelium of foot is what induced these adaptations

McKeon 2015:

- Asserts that the foot intrinsic muscles are the primary source of stability and support protecting against excessive arch deformation
- When these muscles are deconditioned and weak it doesn't function properly and abnormal movement occurs with each step – this leads to the stress patterns that were discussed previously

Goss 2012:

- Barefoot/minimalist with mid or forefoot strike = increased stride frequency and shorter step length → more impacts per unit of time
- Less knee and hip loading, BUT greater impact and strain on metatarsals (Toes)
- Combined = increased cumulative metatarsal strain (overuse)

Goss 2015: Barefoot and minimalist runners accurately report their strike pattern 57% of the time

- Barefoot or minimalist forefoot strike = greater strain on ankle PF than traditional (Achilles, MTSS)
- Barefoot or minimalist rearfoot strike = greatest vertical loading rates and greater strain on ankle PF than traditional (Achilles, PF, PFPS)

*** PF negative work** = DF portion of stance phase (just before toe off) → in Barefoot minimalist runners the dampening of this force must be attenuated by the ankle PFlexors

- Traditionalist accurately reported strike 90% of the time
- Traditional = greater negative work for ankle DF and knee extension (Achilles, PFPS)
- Landing in knee extension and eccentric work of bringing the forefoot to the ground after heel strike

*Negative work was calculated to determine how much kinetic energy was dampened at the ankle and knee joints.

Footwear Trends:
RUNNING RELATED INJURIES

Maximalist/FAT Shoe Revolution

- Stack heights 21mm-32mm
- Anywhere from 0 -10mm heel drop
- Front Rocker – decrease work at toe off

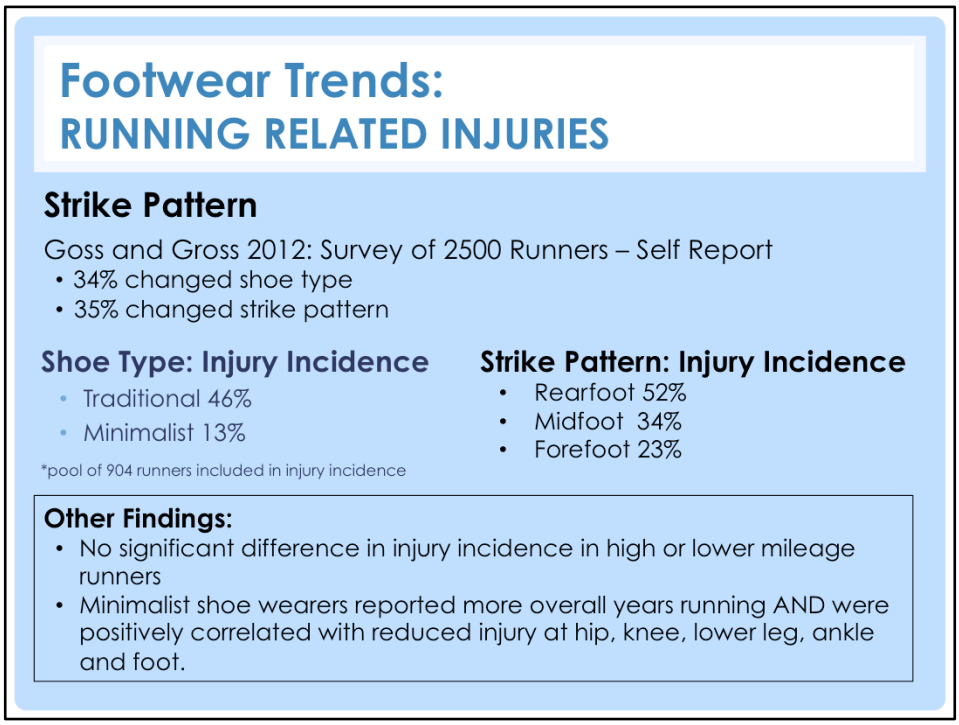
McKeon 2015:

Assertion: Sensory Implications

- Plantar intrinsic muscles stabilize the arches and sensory feedback is the primary source of stability for balance and gait
- When intrinsics are deconditioned, abnormal movement patterns cause foot and ankle injury

Fields 2010

Maximalist shoes may diminish important aspects from which the "barefoot" revolution was based…– "the strengthening of key intrinsic muscles and sensory (proprioception) feedback mechanisms that are supremely important in stability, balance and gait patterns" (McKeon 2015)



Conducted a survey of over 2500 runners to assess the association of self reported run strike pattern and shoe selection with injury incidence.

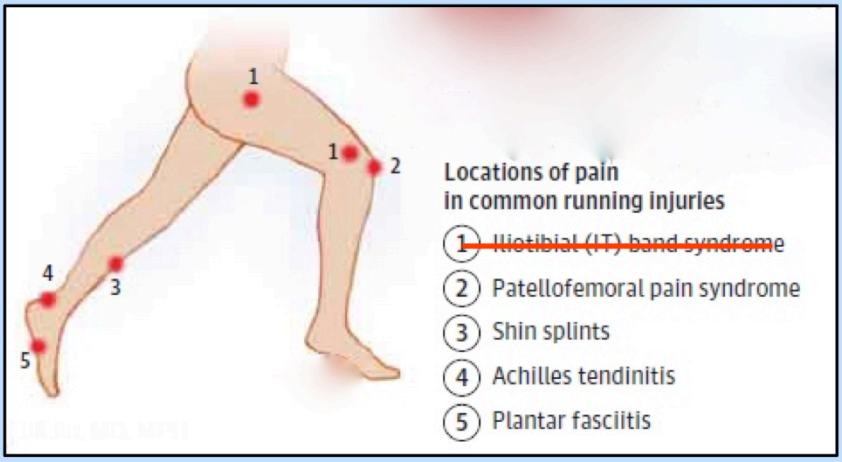
- Minimalist shoe wearers had switched from traditional and running in minimalist an average of 26 months
- Traditional 3.4x more likely to report injury

Keep in mind that this research is a self reported survey and earlier I presented information that self reported foot strike patterns may not be accurate. I feel this is still relevant because is shows us how many individuals are switching shoe types and strike patterns due to injury.

About half of those surveyed changed shoe type or strike pattern due to injury

83% - 702/838 reported changing from tradition shoes
82% - 707/866 reported changing from rearfoot strike

Questions?



(Pause for questions)

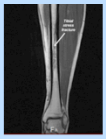
We will cover numbers 2 through 5: Common injuries distal to the knee

ROLE OF FOOTWEAR: RUNNING RELATED INJURIES

Progression of common injuries:

- **Plantar Fasciitis** → Heel Spur (bone growth)

- **Achilles Tendinopathy** → Complete Tendon Rupture
- **MTSS (Shin Splints)** → Stress Fracture



- **PFPS** → Damage to AC→ Knee Osteoarthritis

- If changing training and/or footwear does not stop the acute injury cycle, the underlying problem must be addressed

Whether you are a new runner training for your first event or a seasoned runner training for a longer distance, an injury can sneak up on you at any time for a multitude or reasons; here are some of the more common injuries and the progression that can occur if not treated appropriately and quickly.

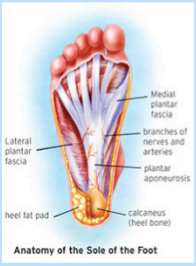
-- Will discuss each of these in more detail in following slides.

Plantar Fasciitis:
RUNNING RELATED INJURIES

25% of athletes affected

Etiology:

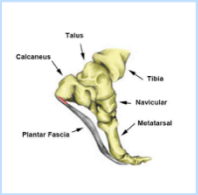
- Aponeuroses: 4 layers of tendon
- Tensile OR Compressive stress on attachment sites



Anatomy of the Sole of the Foot

Presentation: Heel Pain

- Point tenderness at the medial tubercle of calcaneus (side of inner heel)
- Pain comes gradually
- Most pronounced after resting – 1st steps in morning

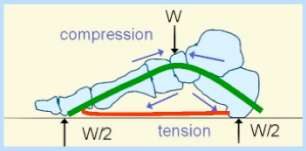


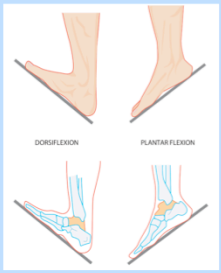
Pujalte 2014; Murphy 2013; Goss 2012; Khan 2013; Lopes 2012; McPoil 2008

Plantar Fasciitis:
RUNNING RELATED INJURIES

Risk Factors:

- Tight tricep surae (Calf muscles): Reduced ankle dorsiflexion (lifting ankle up) has been called the most significant risk factor" (Murphy, Pujalte)
- High BMI and long periods of standing
- Minimalist shoes with heel strike





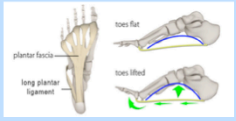
Pujalte 2014; Murphy 2013; Gross 2012, Khan 2013; Lopes 2012; McPoil 2008

Plantar Fasciitis:
RUNNING RELATED INJURIES

Recommendations:

Pain at Heel Strike:
- Cushioned shoes – Traditional or FAT

Pain with Mid/ Forefoot Strike or though Mid-stance:
- Hypermobile
  - Motion Control shoe
  - Arch support - decrease compressive stress/ collapse of arch
- Rigid
  - Front Rocker w stiff toe break
  - Neutral soft flexible shoe to allow pronation
  - Arch support to decrease tensile stress /stretching of attachments
- Other:
  - Custom orthotics
  - Strength the foot core system



Pujalte 2014; Murphy 2013; Goss 2012; Khan 2013; Lopes 2012; McPoil 2008; McKeon 2015

When do you feel the pain?

McKeon:
Strengthen foot core system: Draws arch up, shorten foot length, important for plantar sensory input → postural stability, dynamic gait patterns.(McKeon)

Goss12
Forefoot strike can increase risk of developing Achilles Tendonitis.

Achilles Tendinopathy:
RUNNING RELATED INJURIES

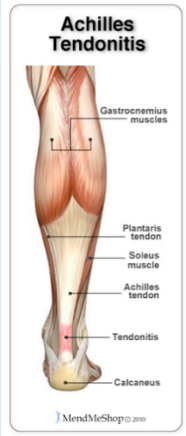
Etiology

Tendon strain: Repeat Offenders (strain rate)

- Fatigue (frequency/duration)
- Previously injured → scar tissue
- Smoking, corticosteroids → decreased blood flow
- Older Age

Presentation

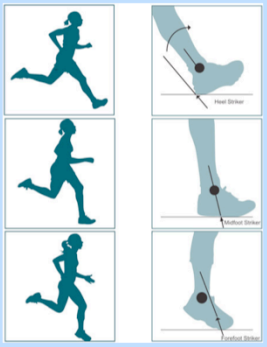
- Point tenderness 2-5 cm above insertion, at insertion or mid calf
- Recent changes in training or shoes
- Nodules, thickening or inflamed
- Pain felt toward end of exercise session → progresses to pain through excersize



Pujalte 2014; Murphy 2013; Goss 2012; Carcia 2010; Wearing 2014, Siobani 2015

Achilles Tendinopathy:
RUNNING RELATED INJURIES

- Risk Factors
  - Tight tricep surae (calf muscles)
  - Pronation
  - Rigid foot
  - Weak plantar flexors → increased loading eccentric phase of gait
  - Recent change to shoes or strike pattern
    - Shoes with < 10mm heel drop
    - Change to forefoot strike pattern



Pujalte 2014; Murphy 2013; Goss 2012; Carcia 2010; Wearing 2014

Achilles Tendinopathy:
RUNNING RELATED INJURIES

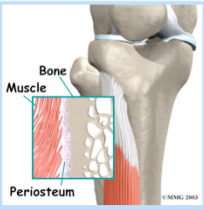
Recommendations:
Footwear is the most common cause

- Pain at Heel Strike:
  - Cushioned shoes with > 13mm heel toe offset
  - Heel Lift or cushioned heel cup
- Pain with Mid/ Forefoot Strike or though Mid-stance:
  - Consider switching to traditional cushioned shoe and heel strike
- Other:
  - Haglund's Deformity (pump bump) → wider heel counter

Pujalte 2014; Murphy 2013; Goss 2012; Wearing 2014; Siobani 2015

Medial Tibial Stress Syndrome:
RUNNING RELATED INJURIES

6-35% of all RRIs

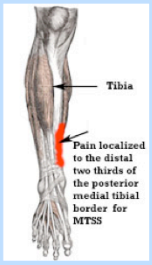


Etiology: Evidence is mixed

- Tensile stress to the periosteum of tibia
- Compressive stress to deconditioned or weakened bone → inflammation of periosteum

Presentation:

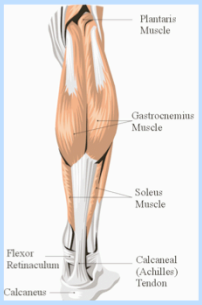
- Bilateral pain
- Tender at posterior distal medial border of Tibia
- Pain with toe walking
- Pain may subside after tissues warm up



Fullem 2015; Pujalte 2014; Khan 2013; Reshef 2012; Lopes 2012

Medial Tibial Stress Syndrome:
RUNNING RELATED INJURIES

- Risk Factors
  - Overpronation
  - Muscle imbalances
  - Female
  - Decreased Bone Mineral Density
  - High BMI
  - Shoes > 6 months old
  - Previous stress fracture of tibia

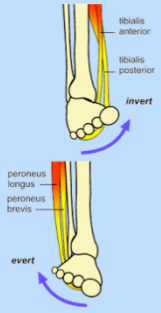


Fullem 2015, Pujalte 2014, Khan 2013, Reshef 2012, Lopes 2012

Medial Tibial Stress Syndrome: RUNNING RELATED INJURIES

Recommendations: Must consider bone health implications

- Pain at Heel Strike:
  - Cushioned heel
  - Decrease heel offset (slightly)
- Pain with Mid/ Forefoot Strike or though Mid-stance:
  - Cushion insert
- Hypermobile
  - Motion Control shoe
- Rigid
  - Neutral soft flexible shoe to allow pronation
- Other:
  - Shock absorbing insoles (off the shelf)
  - Custom orthotics with ample cushion



Pujalte 2014; Khan 2013; Reshef 2012

Decrease heel offset to reduce the eccentric DF phase

Gait Mechanics:

- Forefoot Strike → Plantar flexors providing force attenuation
- Supinators → Invertors working against collapse of medial arch
- Pronators → Tensile stress medially

As this type of injury relates to footwear – the solution lies in adding cushion and re evaluating strike pattern

Patellofemoral Pain Syndrome:
RUNNING RELATED INJURIES

20% of all Run Injuries

Etiology: No Consensus

- Increased compression on the knee
- Knee Tracking Malalignment
- Excessive Q angle (Females)

Presentation:

- Pain in front of knee joint
- Swelling and/or point tender at knee
- Pain after long period of sitting with knees flexed (theater sign), climbing stairs or running
- Popping, grinding or snapping under patella
- Feeling of instability or knee giving way

Pujalte 2014; Fields 2010; Murphy 2013; Goss 2012; Khan 2013; Lopes 2012

Image:
www.bodyheal.com.au

Patellofemoral Pain Syndrome:
RUNNING RELATED INJURIES

Risk Factors: Best consensus → Muscle imbalances

- Imbalance → hip adductors and abductors
- Weak quadriceps or adductors
- Ankle supination:
  - knee varus, cavus foot
- Excessive pronation
- Increased body weight

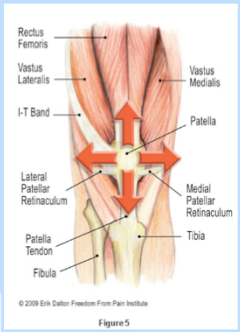


Figure 5

Pujalte 2014; Fields 2010; Murphy 2013; Goss 2012; Khan 2013; Lopes 2012

- Fields at al cite several sources reporting that PFPS is most commonly associated with Knee Varus, ankle supination (rear foot varus) and cavus foot – which all indicate a Rigid, underpronated foot

- However, Goss 2012 reports and cites several other causal mechanisms which lead to the opposite – overpronation and increased stress on the knee joint

- Pujalte et at. 2013 and Lopes et al 2012 assert that the direct cause of PFPS is unknown, but attribute this pain to be a direct result of excess stress or compressive loads about the knee joint which leads to degredation of articular cartilage.

All of these factors, while they are conflicting, do have one common thread. They all increase stress at the knee joint by creating a tug of war between compressive and tensile stress and in some case even frictional abrasion. All of these mechanisms will eventually lead to degredation of articular cartilage in the knee
Once articular cartilage is damaged, there is no longer a protective mechanism for subchondral bone → painful → Knee osteoarthritis which can be debilitating.

Patellofemoral Pain Syndrome: RUNNING RELATED INJURIES

Recommendations

Very complex - depends on the underlying issues

- Rearfoot striking: dorsiflexed ankle and extended knee
  - Knee extensors must attenuate vertical GRF eccentrically
  - Repetitive use of knee extensors may increase patellofemoral compression and tibioemoral joint stress (Goss 2012, Murphy 2013)
- Overpronating runners may benefit from prefabricated foot orthotics (Khan 2013)
- Stronger evidence supporting orthotics (Pujalte 2014, Gross 1995)
- Heat molded orthotics (Pujalte 2014)

Each of these recommendations suggest that interventions which correct the underlying problem are the best solution. So, just as we determined in the previous slide with regard to causal mechanisms, each individual must determine their specific need and move forward with treatment from there.

Thank you!

All Presentation Materials Online:
www.DPTCapstone.web.unc.edu :"Treffer, Michelle"