Epidemiology of Running Injuries

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US Marathon Finishers

2009 Running Data

2010 TCM Age Group Winners

Injury: the Big 6

Rates 20-90%

Knee Injuries: 42%
- PFPS: #1 injury (16%)
- ITBFS: #2 injury (6%)

Lower leg/ankle/foot: 36%
- Plantar Fascia: #3 injury
- MTSS: #4 injury
- Achilles: #5 injury

Stress Frx: up to 20%

Taunton JE et al. BJSM. 2002;36:95-101
Injuries in Running

- Knee
- Hip/Pelvis
- Lower Leg
- Foot/Ankle
- Upper Leg
- Achilles
- Low Back
- Other

Risk Factors

Extrinsic (environmental)
- Training errors
- Running surface
- Footwear

Intrinsic (person-related)
- Previous injury
- Running experience
- Flexibility
- Strength
- Anatomy
- Gender

Risk Factors: Training Errors

Too much, too fast!

- 10% rule
- Shoe replacement – 300-500 miles
- Cross training (or lack of!)
  – Strengthening
  – Stretching

Risk Factors: Running Surface

- Asphalt
- Crowned Roads
- Trails
- Hills
- Track – always the same

Risk Factors: Footwear

- Runners adapt mechanics to maintain constant GRF/Impacts (Kong PW et al BJSM 2009)
- Do not reduce injury (Knapik JJ et al. AJSM 2010)
- Differences in shoe mileage b/w injured and controls (Taunton et al. 2003, Duffey et al. 2000)

Risk Factors: Anatomy

- Leg Length Discrepancy: >5 mm? (Soukka et al. 1991)
- Quadriceps Angle: >20°? (Rauh MU et al. JOSPT 2007)
- Arch Type
  – Pes Cavus
  – Pes Planus

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Foot/Arch type

No Difference:
• Thijs Y et al. 2008
• Hreljac et al. 2000
• Taunton JE et al 2002

Increased Risk:
• Buist I et al. 2010 (pes planus for women)
• Van Ginkel A et al. 2009 (pes cavus for AT)
• Ghani Zadeh Hesar N 2009 (pes cavus for any LE injury)
• Duffey MJ 2000 (pes cavus for PFPS)

Risk Factors: Intrinsic

• Experience (Buist I et al 2010, Taunton et al. 2003)
• Previous Injury (Buist I 2010, Taunton JE 2003, Macera MA 1996, Macera MA 1991)
• Flexibility (Van Ginkel A et al 2000, Duffey MJ et al. 2003)
• Strength (Chubonwisi et al 2007, Nairnuth et al 2005, Duffey, 2006)
• BMI
  – High for males (Buist I et al 2010, Taunton et al. 2000)
  – Low for females (Taunton et al 2002)

Risk Factors: the Evidence

Yes!
• Previous Injury
• Training
• BMI
• Weakness
• Gender
• Experience

No???
• Terrain
• Arch type
• Shoe wear
• Anatomic alignment

Grading Running Injuries

• Grade I: pain after running
• Grade II: pain during running, but not restricting training (ie discomfort)
• Grade III: pain during running, which restricts training
• Grade IV: inability to run d/t pain

Injuries in Running

Anterior Knee Pain

Differential Dx:
→PFPS
→Patellar Tendonopathy
→Meniscal Tear
→Quadriceps Tendonopathy
→Fat Pad Impingement
→Stress Fx
→OCD Lesion
→Referred pain from hip/back

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Anterior Knee Pain

Patellofemoral Pain Syndrome (PFPS):
- 62% of knee injuries
- Anterior knee/retropatellar pain
- Pain worsens throughout run
- Peripatellar pain with palpation
- Patellar mal-tracking: OKC vs CKC
- R/O other pathology

Patellofemoral Pain Syndrome

#1 Running Injury
- Females > Males
- Weak Hips:
  - Abduction (Ireland ML et al., 2003; Cichanowski HR et al., 2007; Souza RB & Powers CM, 2009)
  - External rotation (Ireland ML et al., 2003)
  - Extension (Souza RB & Powers CM, 2009)
- Abnormal Alignment?
- Abnormal Mechanics
  (Duffey MJ et al., 2003; Souza RB et al. 2009, Dierks TA et al., 2011)

Patellofemoral Pain Syndrome

Weak Hips + Mal-alignment

PFJ Mal-tracking

Asymmetrical Loading

Lateral Knee Pain

Differential Dx:
- ITB Friction Syndrome
- Meniscus
- Biceps Femoris Injury
- Common Peroneal Nerve
- OA
- Referred pain from hip/back
- Peds: SCFE, Perthes'

ITB Friction Syndrome

#2 Running Injury
- 2X increase since 1980
- Females > Males
- Weak Hips
- Abnormal Mechanics
- Terrain Selection:
  - Crowded roads
  - Descending hills
  - Canted track

ITB Friction Test

- Pt. Stands on test leg with the knee extended
- Examiner applies pressure with their thumb against the lateral epicondyle and pulls the knee into slight varus
- Pt. Bends knee to ~45° of flexion
- Positive: pain @ ~30° KF

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Ober’s Test

- Pt. Is sidelying (test side up)
- With knee flexed and hip in neutral rotation, extend and adduct the hip
- **Positive**: Hip does not adduct and/or knee extends

McMurray’s Test

- **Meniscal Clinical Exam**
  - Medial Meniscus
    - Sens: 57%
    - Spec:
  - Lateral Meniscus
    - Sens: 77%
    - Spec:

Konan S et al. 2009

Thessaly Test

- **Meniscal Clinical Test**
  - Medial Meniscus
    - Sens: 61-94%
  - Lateral Meniscus
    - Sens: 80%-96%

Karachalios T et al. 2005
Konan S et al. 2009
Mirzatolooei F et al. 2010

“My Knee Hurts”

- Side of knee
  - ITB Friction Syndrome
  - Weak Hips
  - Over Pronation
  - Training error: hills, track, country roads

“My Shin Hurts!”

- **Differential Dx:**
  - Medial Tibial Stress Syndrome (Shin Splints)
  - Tibial Stress Fx
  - Compartment Syndrome
  - Referred pain
  - Tumors, Infections etc

Medial Tibial Stress Syndrome

- Pain with palpation of posteromedial tibial border
- Pain decreases with warm-up
- Pain returns during run
- Traction perostitis
  - Soleus
  - Flexor digitorum longus

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Medial Tibial Stress Syndrome

- Poor cushioning
- Overpronation
- High arches
- Out of Shape
- Training Errors: Running with fatigue, increased mileage, overstriding

“My Calf Hurts”

Differential Dx:
- Achilles Tendonosis
- Achilles tendon rupture
- Compartment Syndrome
- Stress Fracture
- Popliteal Artery Entrapment
- DVT
- Sever’s disease
- Posterior impingement syndrome

Achilles Tendonosis

- Pain to palpation of the tendon 2-6 cm superior to insertion
- Pain with active plantar flexion
- Pain and limited ROM with passive DF
- Palpable thickening and/or crepitus

Etiology:
- Middle-aged males
- Greater BMI
- Weak gastroc/soleus
- Overpronation
- Tight calves
- Training error: increased mileage

Achilles Tendonopathy

Physiologic Changes:
- Increased thickness
- Increased compliance of the tendon
- Increased tendon-aponeurosis strain

“My Foot Hurts”

Differential Dx:
- Calcaneal stress fracture
- Bone bruise
- Fat pad atrophy
- Tarsal Tunnel Syndrome
- Cancer-related pain
- Paget disease of bone
- Sever’s Disease
- S1 radiculopathy

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“My Foot Hurts”

- Bottom of Foot/Heel
  ➔ Plantar Fasciosis

  - 8% of running injuries (Tauton et al. 2002)
  - 2 million Americans/year (Riddle et al. 2003)
  - 10% of people (Riddle et al., 2003)
  - Training error: increased mileage

Plantar Fasciosis

**Etiology:**

- Tight calves
- Over Pronation?
- Decreased 1st MTP mobility
- Overweight
- Training error: increased mileage

**Examination:**

- Palpation
- Active and Passive ROM
- Tarsal Tunnel syndrome testing
- Windlass test
- Longitudinal arch angle

Windlass Test

- Perform both NWB and weight-bearing
- Examiner stabilizes the ankle joint in neutral
- Examiner extends the 1st MTP, while allowing the IP to flex
- Positive: reproduction of pain

Tarsal Tunnel Syndrome Test

- Pt. Sitting with legs off table/plinth
- Examiner maximally DF and everts the ankle and extends the toes
- Position is held for 5-10 seconds, While tapping over the tarsal tunnel
- Positive: increased numbness and/or pain

Longitudinal Arch Angle

- Pt. Standing with equal weight on both feet
- Measure the angle of: medial malleolus-navicular tuberosity-medial prominence of the 1st MTP head
- Highly predictive of dynamic foot posture

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“This Stress Fracture is Killing Me!”

Progression:
Pain during run → pain during and after run → pain with all weight-bearing activities

• 20% incidence in runners (<1% in general pop.)

“High Risk Stress Fx”:
- Femoral Neck (tension)
- Femoral Shaft
- anterior-tibia
- Medial malleolus
- Base of the 5th metatarsal
- Navicular
- Sesamoids

Stress Fractures

Risk Factors:
• >40 miles/week
• Training errors
• Female
• High arch
• Nutrition

Female Athlete Triad

Stress Fractures: Diagnosis

• MRI is the gold standard
• Bone Scan is a close second

Physical Exam:
- Point tenderness
- 30 second Hop Test
- Fulcrum Test
- Percussion/vibration Testing

Hop Test

• Femoral Stress Fx
  – 70% of pts had pain with hopping
  – 24% had abnormal x-rays

Clement DB et al. 1993
**Fulcrum Test**

- For femoral stress fx
- Pt. is seated with legs over the table/plinth
- Clinician puts their fist under the distal thigh
- Clinician places pressure with other hand on thigh distal to their other fist
- Attempt to bow the femur

**Vibration Testing**

- Tuning fork or U/S
- Place on bone (i.e. anterior tibia)
- Positive: reproduction of pain
- Sens: 75%, Spec: 67%
- PPV 77%, NPV 63%

**Epidemiology & Etiology**

- High incidence of injury
- Causes are multi-factorial
- LE injuries predominate
- Need a runner-specific exam
- PTs are Key!