Extended version of talk…concise version will be delivered at meeting

Leg Pain in Athletes: The Diagnostic Dilemma

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- No corporate disclosures
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Goals of this talk

- Optimize outcomes when you have athletes/ soldiers present with leg pain:
  - By making accurate dx
  - By looking for overlapping diagnoses
  - By choosing targeted/evidence based tx plans
  - By considering a a broader differential with appropriate work-up if presentation is not classic

Challenge 1

21 year collegiate distance runner

- Presents with gradual onset of increased leg pain with running
- Pain is worse with impact
- She has been able to run thru the pain but her times are getting worse

What else would you like to know?
How can you optimize her RTP?

Case challenge 2

19 yo soldier at basic training

- Presents to medic with leg pain that began about 1 week into training
- Pain is worse with impact & on long road hikes.
- Does location of pain effect diagnosis or treatment?
- Does shoe-wear effect risk?

Challenge 3

25 yo active duty male

- 2 year history of calf pain with exertion treated by numerous doctors
- Work-up including radiographs, bone scan, MRI, EMG have been negative
- Treatments including rest, NSAIDS, massage, physical therapy, bracing, and prolotherapy have had no effect

Why is nothing working? What's next?

Case Challenge 4

35 yo officer for fitness test

- Called to see officer in medical tent with increasing pain on the anterolateral aspect of his leg after mile run
- Patient had history of “shin splints” which usually resolved after hikes
- This time pain progressed & didn’t go away.
- NV intact, tender and swollen over antero-lateral leg

RICE? Observation? Referral?

Challenge 5

33 year old female runner

- Mother of 2
- Routine knee scope for meniscus tear
- Discharged home with early mobilization
- Mild leg pain, fatigue, non-productive cough
- POD #3 in your office

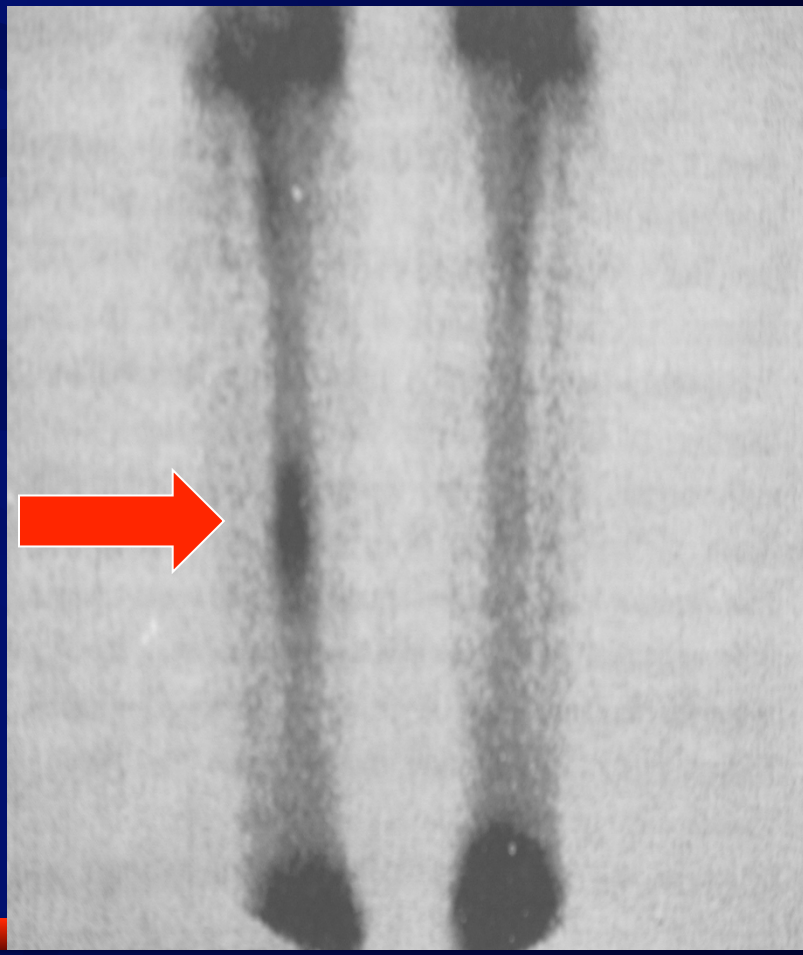
Support? Observation? Referral?

Chronic Leg Pain: The Diagnostic Dilemma

- Exercise related leg pain is common among athletes (15% of runners)
  - Bates, Br J Sports Med, 1985
- "Shin splints" is a wastebasket term that does not specify dx or guide treatment

Top 4 Common Causes of Chronic Leg Pain in Athletes

- CECS
- Stress fractures
- Medial tibial stress syndrome
  - formally periostitis or shin splints
- Chronic muscle strain



Leg Pain in Military

- Milgrom C et al. CORR, 1986
  - 14 wks infantry basic training
  - 41% with leg pain (63% positive bone scan)
- Yates B, White S. AJSM 2004:
  - 10 wks US Navy basic training
  - 53% women, 28% men (relative risk 2.03X)
  - Pronated feet increased relative risk (1.7X)

Leg Pain in Military

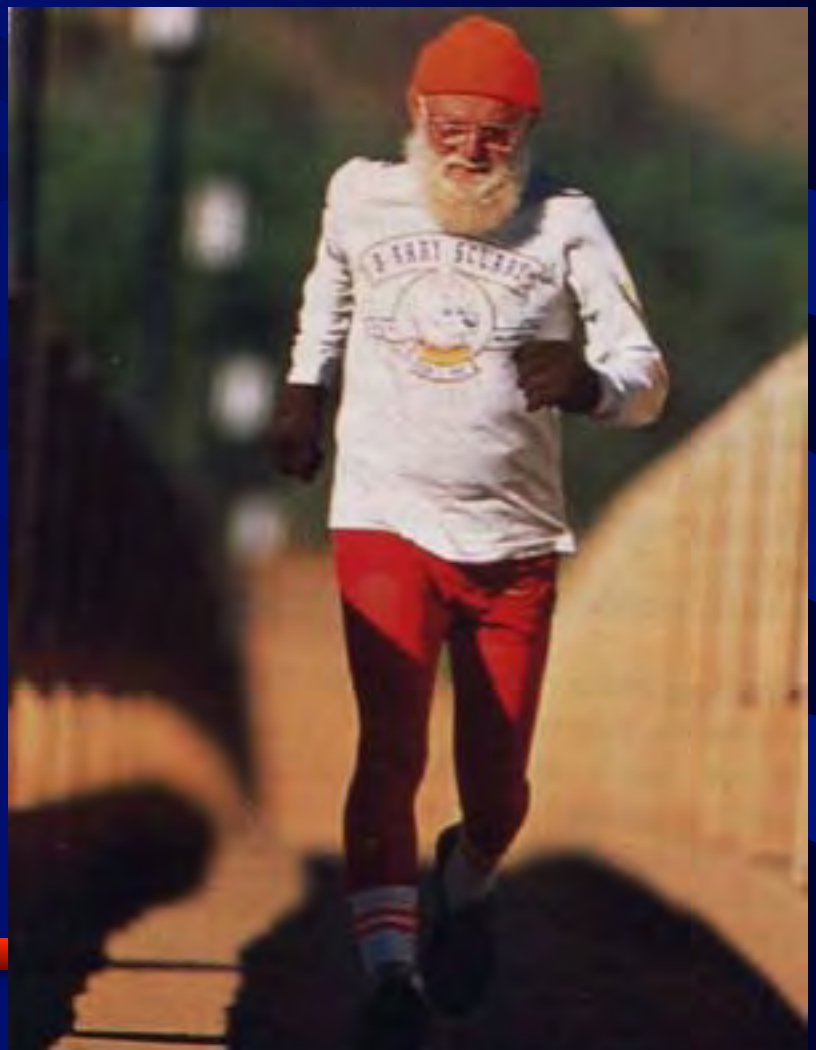
- Swellnius M, Noakes T. AJSM 1990
  - South African military recruits
  - 32% with leg pain (reduced to 23% with use of cushioned orthotics!)
- Kiuri M et al. Military Med, 2003
  - 24 consecutive Finland recruits (44 legs) with pain
  - 35/44 (+) MRI bone stress; 22/44 (+) pressure
- Bar-Dayan Y, et al. Military Med, 2006
  - Israeli Anti-aircraft defense forces
  - 24% women, 11.2% developed stress fx
  - (no comment on other causes of leg pain)

Waterman BR, et al. AJS 2013

- Retrospective review of CECS codes for 5-yrs across United States Military
- 4100 cases
- At risk population 8.3 million
- 0..49 cases per 1000/person
- Does not account for miss-diagnoses, miss-coding, non-presentation

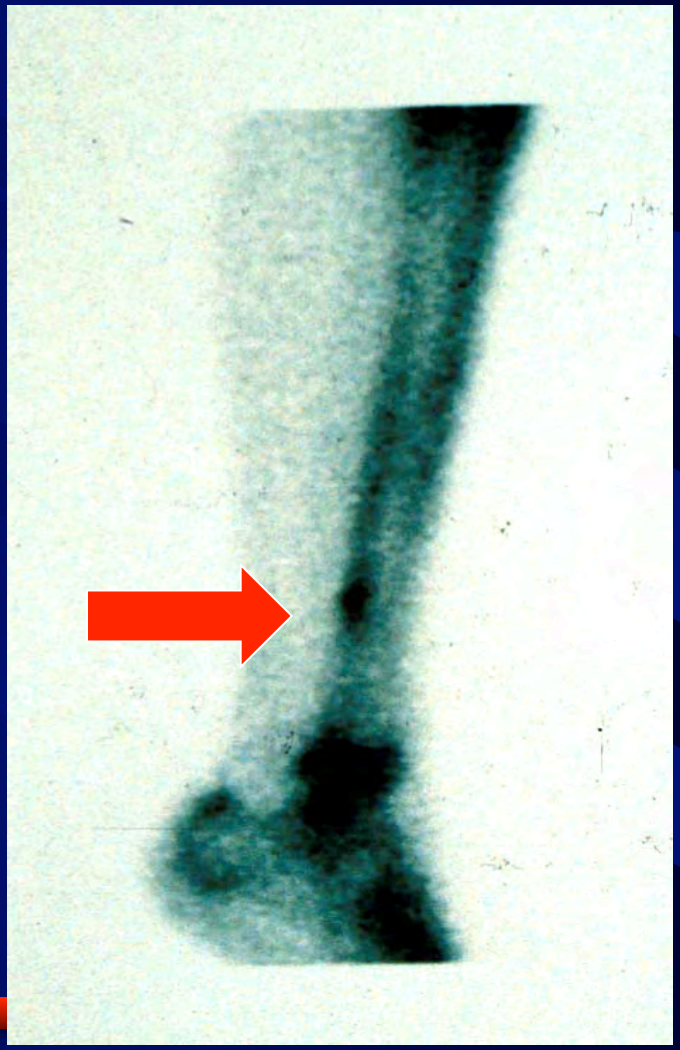
Chronic Leg Pain: The Diagnostic Dilemma

- Beware atypical populations
- Presentation is usually less typical in older or recreational athletes
- **Consider a broader DIFFERENTIAL DX**



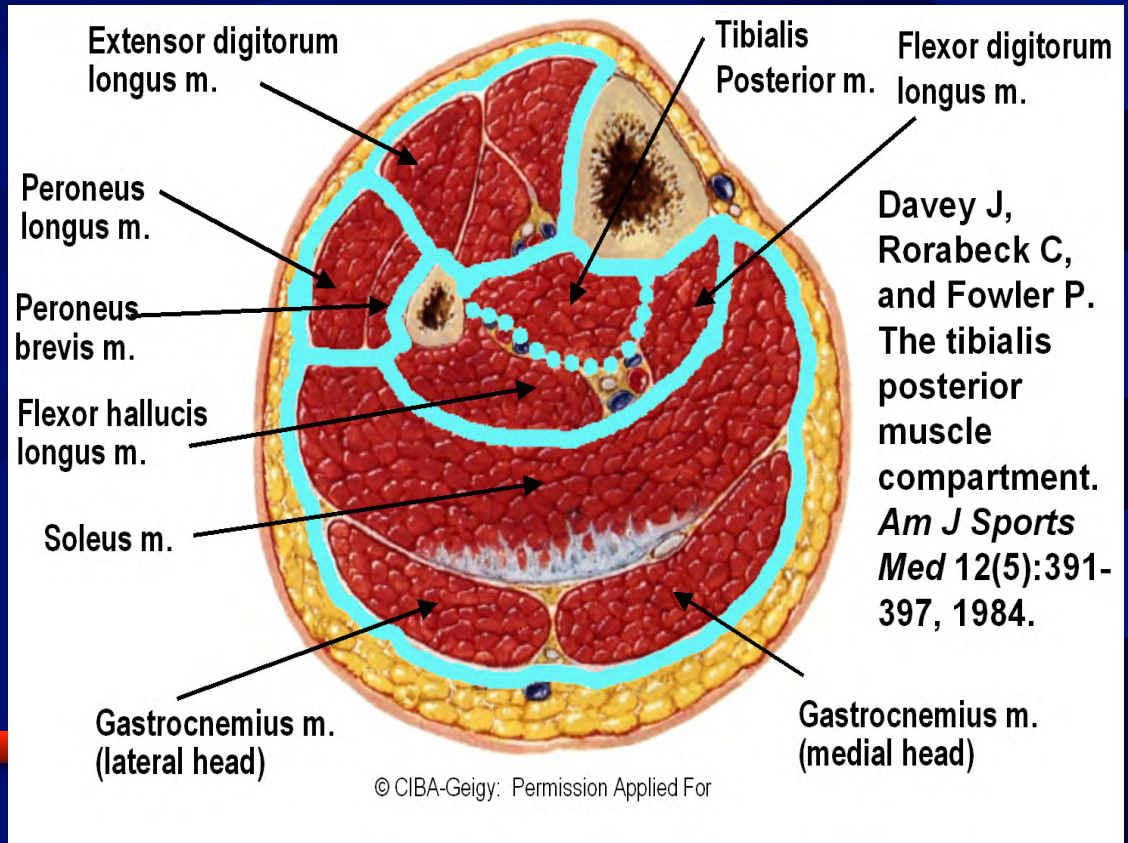
Anatomic Sources of Leg Pain

- Bone
  - A continuum of bone trauma exists from bone strain to stress reaction to stress fracture
- Periosteum (enthesopathy)
  - Inflammation occurs at muscular insertions particular of tibialis posterior and soleus.



Anatomic Sources of Leg Pain

- Muscles & Compartments
  - 4-5 muscle compartments
  - Chronic strains, acute ruptures and tendinopathy
  - Muscle herniations
- Nerves
  - Tibial nerve
  - Peroneal nerve
  - Sural nerve

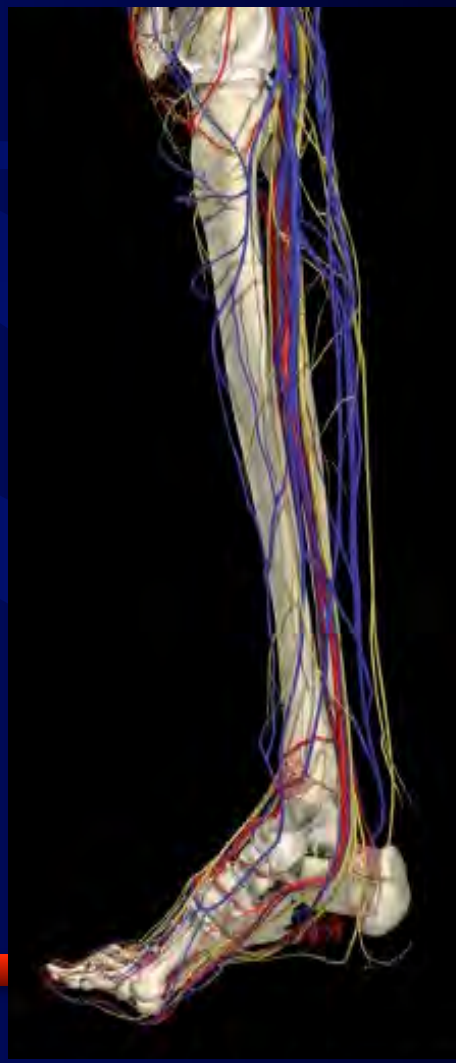


Extended Differential

- Neurologic
  - Chronic regional pain syndrome (RSD)
  - Systemic neuritis (Charcot-Marie Tooth)
  - Peroneal neuropathy
  - Peripheral nerve entrapment
  - Central nerve entrapment (radiculopathy)

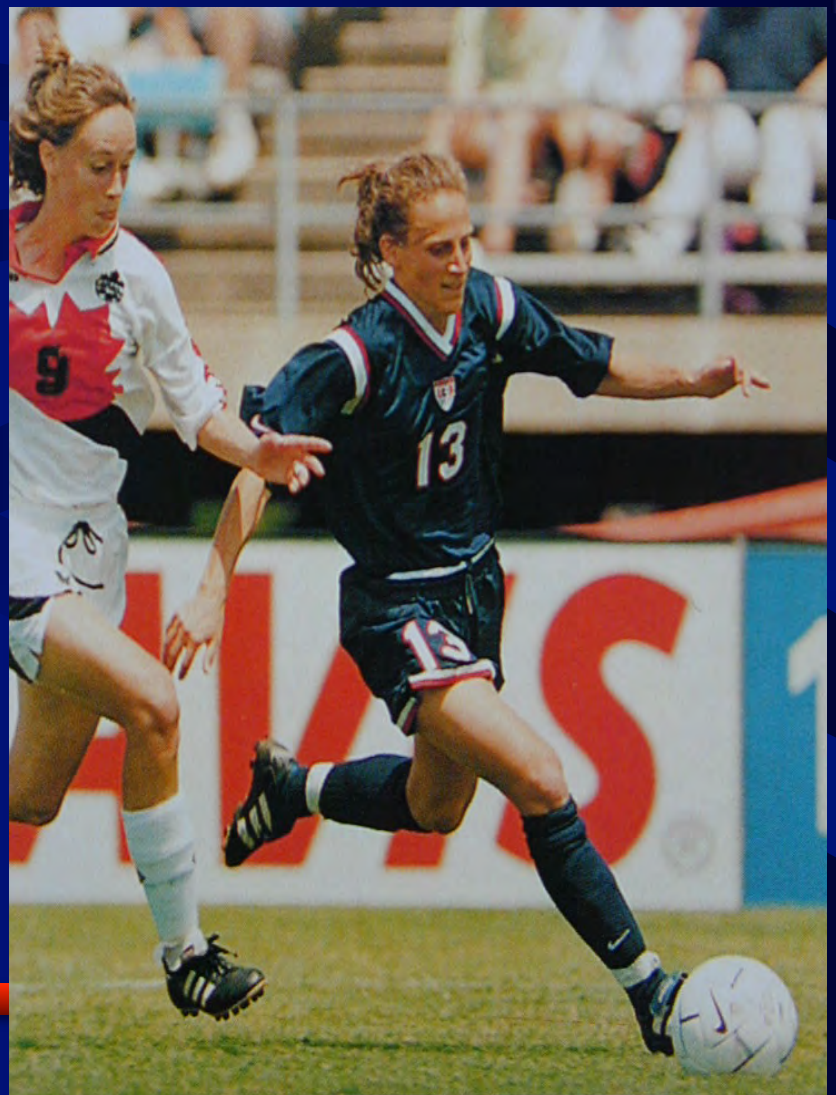
Anatomic Sources of Leg Pain

- Vascular
  - Venous
    - Phlebitis
    - DVT
    - Claudication
    - Venous stasis
  - Arterial
    - Popliteal artery entrapment
    - Atherosclerosis
    - Endothelial arteritis (arterial endofibrosis)



Extended Differential

- **Nutrition**
  - Dehydration
  - Low potassium
  - Low magnesium
- **Metabolic**
  - Rickets
  - Sarcoid
  - Sickle Cell
  - Pagets
  - Hyperparathyroidism



Don't forget the Zebras

- **Tumors**
  - Osteosarcoma
  - Giant Cell Tumor
  - Osteoid osteoma
- **Trauma /Abuse**
- **Infection**
  - TB, syphylis, bacterial, fungal

Chronic Leg Pain: The Diagnostic Dilemma

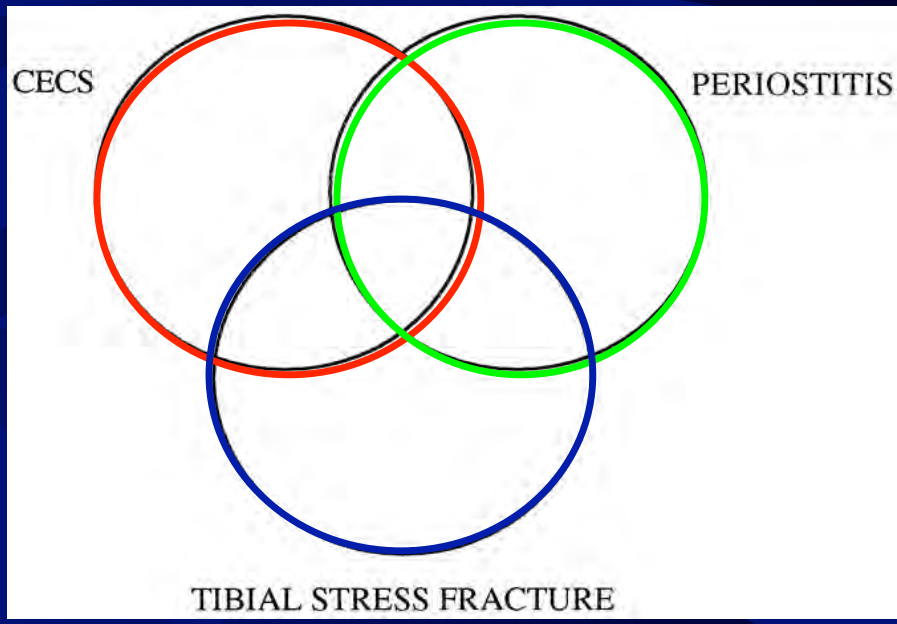
- Associated factors
  - Alignment
  - Gait mechanics
  - **Training intensity**
  - **Shoe wear**
  - Court surface
  - Age
  - Previous trauma or degeneration

Hamstra-Wright, et al. BJSM 2015

- Systematic review/meta-analysis
- 21 studies, 9 risk factors
- Increased risk with increased BMI
- Increased risk with females
- Increase risk with pronated feet
- Increased risk with increased hip ER
- Increased risk with increased plantarflexion
- Increased risk with dorsiflexion (Rauh, Mil Med, 2010)

Chronic Leg Pain: The Diagnostic Dilemma

- Multiple diagnoses are possible
- Failure to make early, accurate diagnosis can lead to resistant, chronic problem.
- Failure to make all diagnoses may lead to treatment failure



Clinical Clues & Pearls

- Pain with 1st impact
  - **Stress fracture**
  - Periostitis
  - Muscle strains and tendinitis
- Diffuse medial bone pain
  - Medial tibial stress syndrome
- Focal bone pain
  - **Stress fracture**, tumor
- Focal muscle pain
  - Strain, Hernia, DVT
- Focal tendon pain
  - Achilles or peroneal tendinopathy

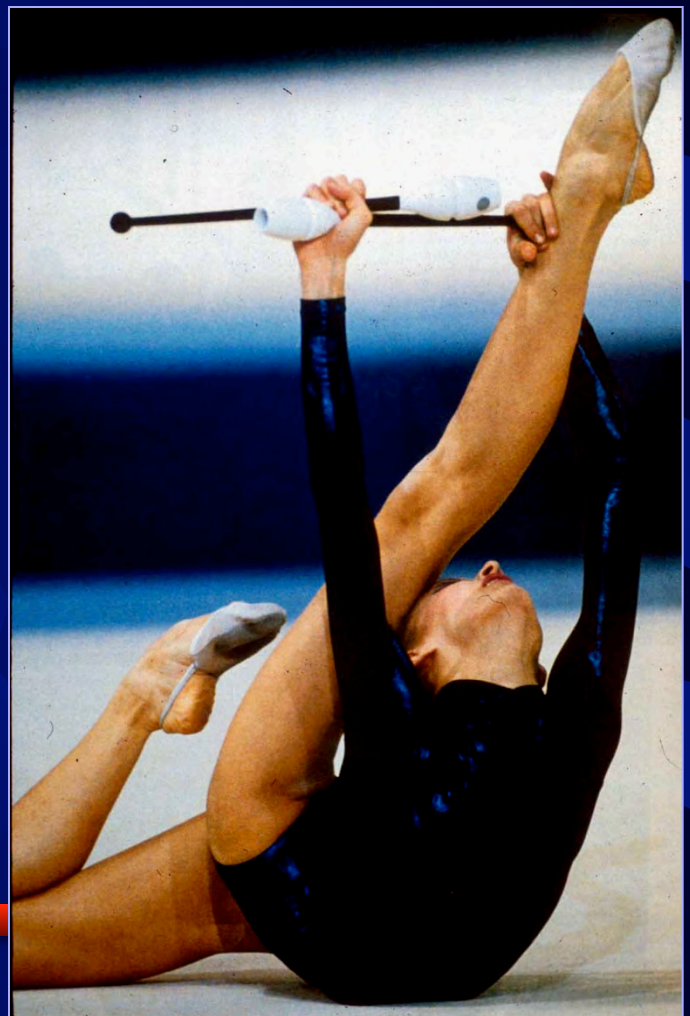
UIC SPORTS MEDICINE

Clinical Clues & Pearls

- Pain with resisted motion
  - **Muscle strains**, DVT, phlebitis, and periostitis
- Pain with vibration
  - **Stress fractures**
- Pain with exertion
  - **CECS,** Popliteal artery entrapment
- Electric or radicular pain
  - **Herniated disc, entrapment**
- Burning pain
  - Infection, Phlebitis, inflammation
- Pain at night
  - **tumors**
- Multiple foci of pain
  - Metabolic stress fxs, abuse. Infection, RSD

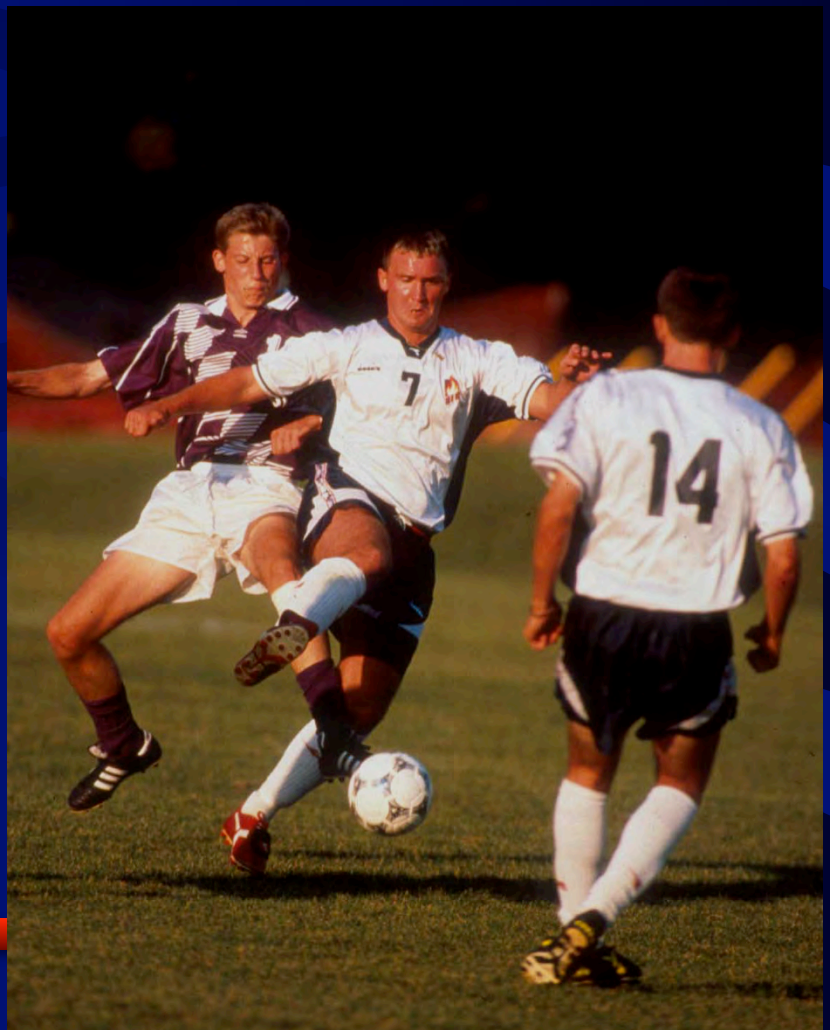
Clinical Clues & Pearls

- Motor weakness
  - **Herniated disc**, muscle-tendon rupture, peroneal neuropathy,
- Paresthesias at rest
  - **Nerve entrapment**
  - **Herniated disc**
- Paresthesias with exertion
  - **CECS**



Clinical Clues & Pearls

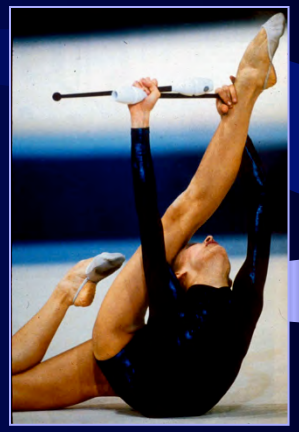
- Diffuse swelling
  - DVT or atherosclerosis
  - CECS
  - Muscle ruptures
  - Tumors
- Focal swelling
  - **Muscle herniation**
  - Ganglion
  - Tumor



Clinical Clues & Pearls

- Cramping or spasm
  - Muscle strain
  - **Dehydration**
  - **Electrolyte imbalance**
  - Vascular claudication
  - Popliteal artery entrapment

How does an athlete/soldier present with….



Compartment Syndrome

- **Acute: Traumatic**
- Secondary to fracture, crush, and reperfusion injuries
- Surgical emergency
- Skin and fascia may both contribute to compartmental restriction and increased pressure
- Non-physiologic swelling secondary to trauma

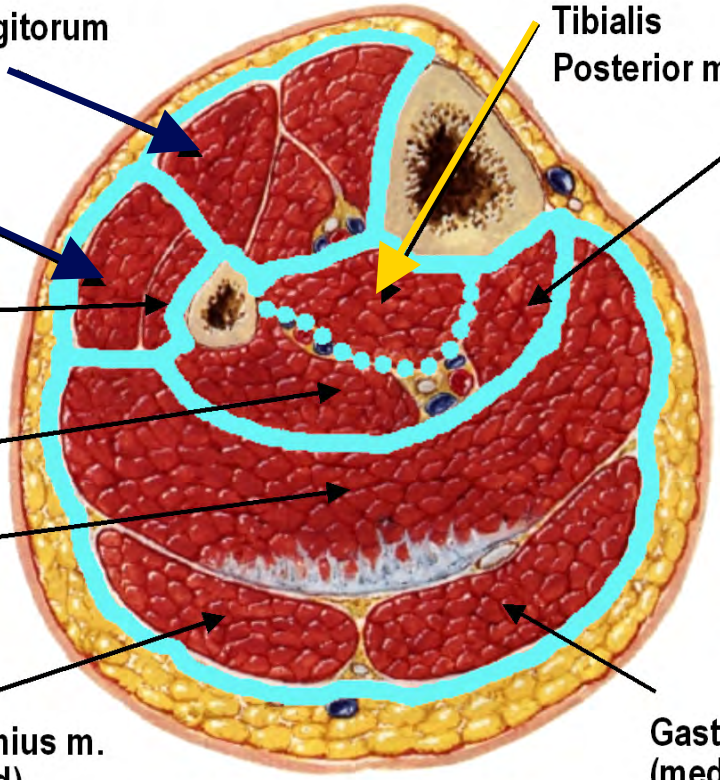
- **Exertional**
- Consistently exercise-induced
- Generally endurance athletes
- 27-33% of leg pain in athletes
- No pain at rest, pain consistently relieved with cessation of sport
- Attributed to restriction of muscle swelling secondary to tight fascial compartments
- Diagnosed with pre and post exercise pressure measurements

What is risk of closed tibial fracture for compartment syndrome?

- Heckman, JBJS, 1994
  - 10% have residual changes that could be attributed to compartment syndrome
  - 20% have impending compartment syndrome by pressure measurements

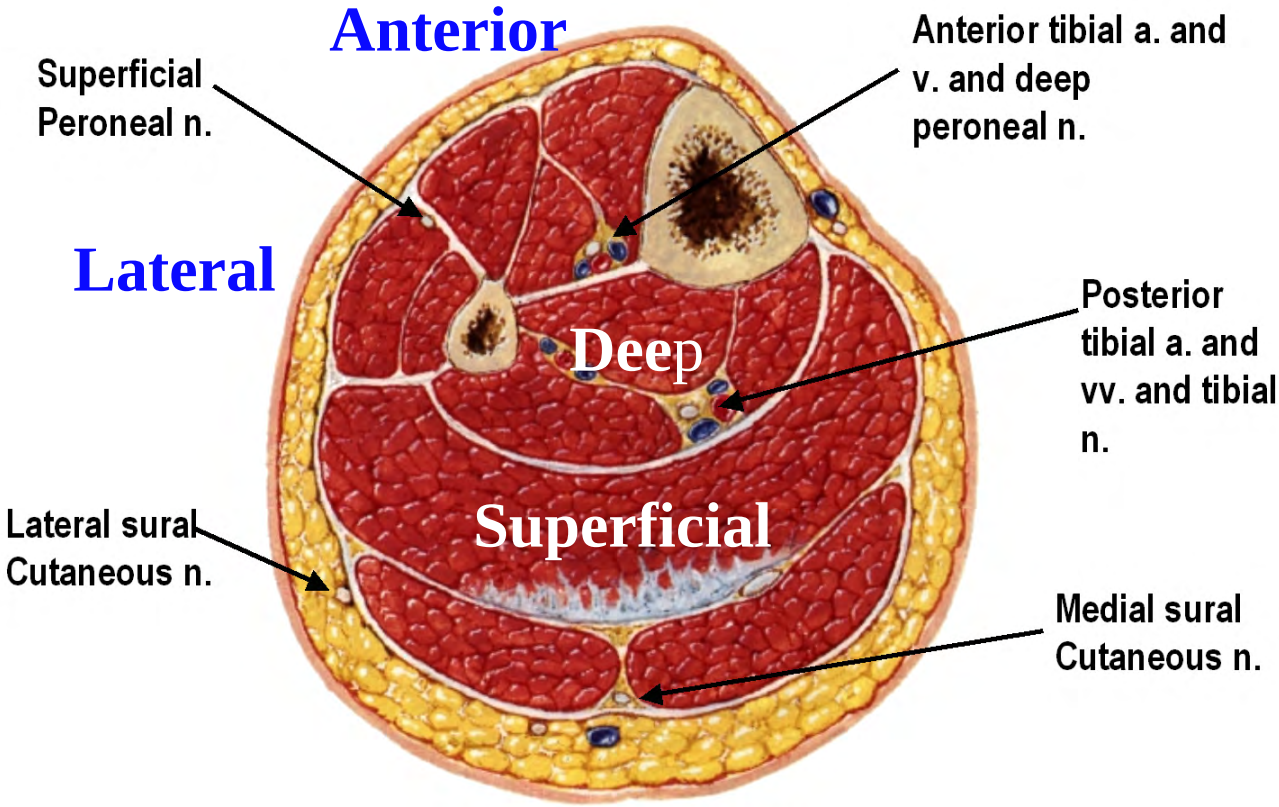
Compartment Anatomy

80% of CECS involve the anterior or lateral compartments (Cross-section just above middle of leg)



Davey J, Rorabeck C, and Fowler P. The tibialis posterior muscle compartment. *Am J Sports Med* 12(5):391-397, 1984.

Compartment Anatomy

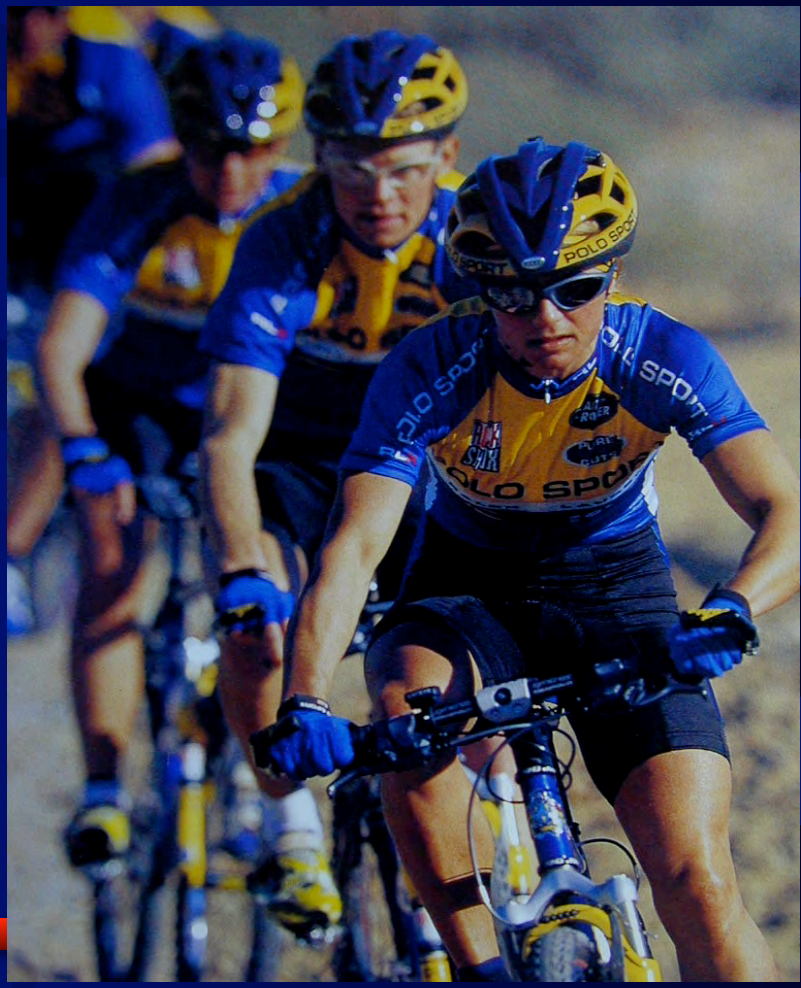


Diagnostic Criteria of CECS?

Pedowitz et al, AJSM, 1990

- Normal 0-10 mmHg
- Resting >15 mm Hg
  - Styf says >30mmHg
- Post exertion > 30 mmHg
- Delayed > 20 mm Hg

Recent international debate regarding reproducibility and validity.



Don't be afraid to test!

Further international debate: tranducer tips?
All 4 compartments? Do you need delayed test?

Alternative guidelines

- Allen & Barnes, 1986
  - Dynamic test greater than 50
- Dharm-Datta et al, Ortho Proceed, 2011
  - Continuous pressures, combat ready protocol
  - Abnormal > 100
- Roscoe et al. AJSM, 2014
  - Standing resting pressures (abn 35, nl 20; p <0.006)
  - **Continuous pressures** (abn 105, nl 65,; p < 0.001
  - Sensitivity 63%, Specificity 95%

Amplitude of Pulse-Synchronous Intramuscular Pressure Oscillations

- Nilsen et al, OJSM, 2014
- Continuous pressure monitor placed
- Amplitude of pressure measures recorded
- Absolute measure 1 min post > 50 mmHg
- And amplitude > 5 (less than was normal)
- 96% sensitive, 94% specific
- 94% positive predictive, 94% neg predictive

Diagnostic Technique

What's the challenge with continuous monitor ?

Exertional MRI

Postexercise (forced dorsiflexion) magnetic resonance imaging revealed increased T2 signal intensity in the entire anterior muscle compartment.

Lauder, Amer J Phys Rehabil, Vol 81(4) April 2002 315-319

American Journal of Sports Medicine, May 2005

The Diagnostic Value of Intracompartmental Pressure Measurement, Magnetic Resonance Imaging, and Near-Infrared Spectroscopy in Chronic Exertional Compartment Syndrome

A Prospective Study in 50 Patients

Johan G. H. van den Brand,*† MD, PhD, Teresa Nelson,‡ MS,
Egbert J. M. M. Verleisdonk,† MD, PhD, and Christian van der Werken,† MD, PhD
From the †Department of General Surgery, University Medical Center & Central Military Hospital, Utrecht, the Netherlands, and the ‡Regulatory and Clinical Research Institute, Minneapolis, Minnesota

Near infrared spectroscopy is 75-85% sensitive
Equal in this study to intra-compartment pressures but not invasive!!!!

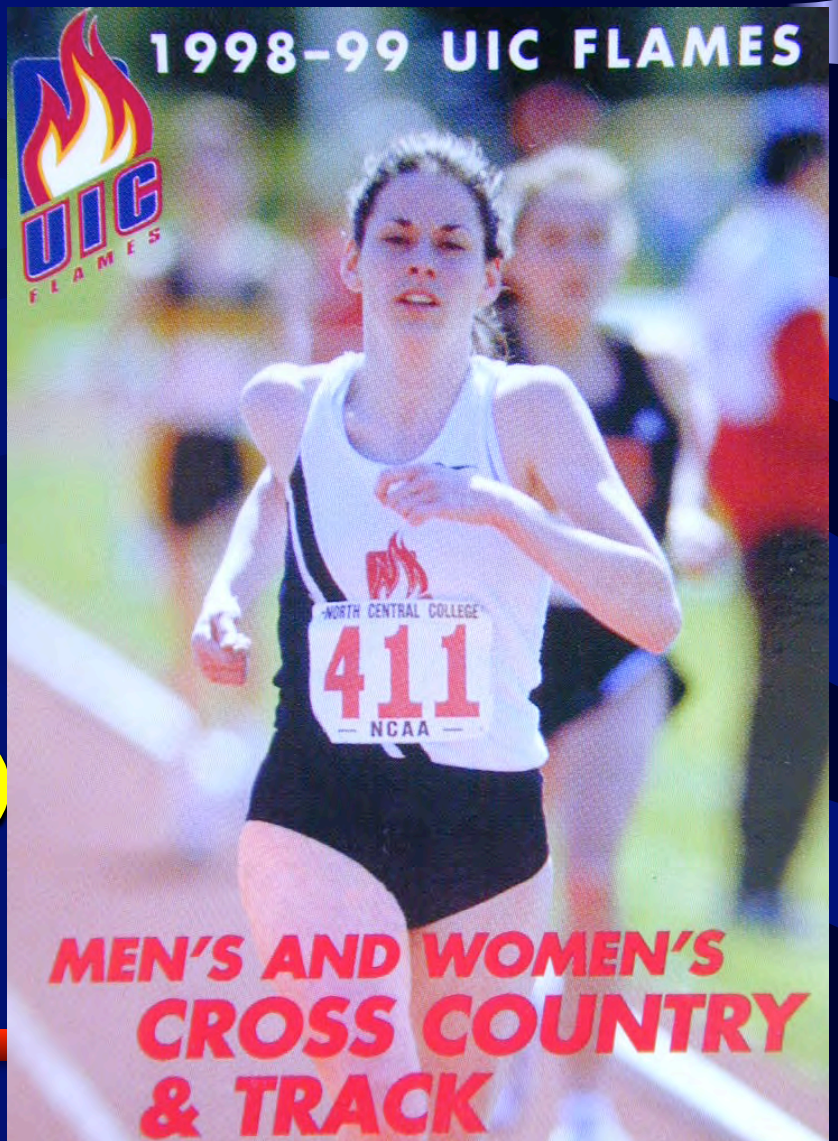
Unfortunately, too expensive

$18,000!!!

Hutchinson Technologies

Treatment Options for CECS

- NSAIDS (-)
- Massage (-)
- Rest (+/-)
- Stretching and strengthening (-)
- Modalities (-)
- Shoe/surface (+/-)
- **Toe running (ACSM13)**
- Fascial release (+)
- **Botulin (AJSM 2013)**



Evidence for Toe Running

- **Gait re-training to alleviate the symptoms of anterior exertional lower leg pain: a case series.** Breen DT,Int J Sports Phys Ther. 2015 **(LOE IV)**
  - 70% pain free after retrained to midfoot **(N=10), no pressures**
- **Forefoot running improves pain and disability associated with chronic exertional compartment syndrome.** Diebal AR, Am J Sports Med. 2012 **(LOE IV)**
  - 100% pain free no surgeries **(N=2), no pressures**
- **Effects of forefoot running on chronic exertional compartment syndrome: a case series.**Diebal AR, Int J Sports Phys Ther. 2011 **(LOE IV)**
  - 100% pain free no surgeries **(N=10), no pressures**

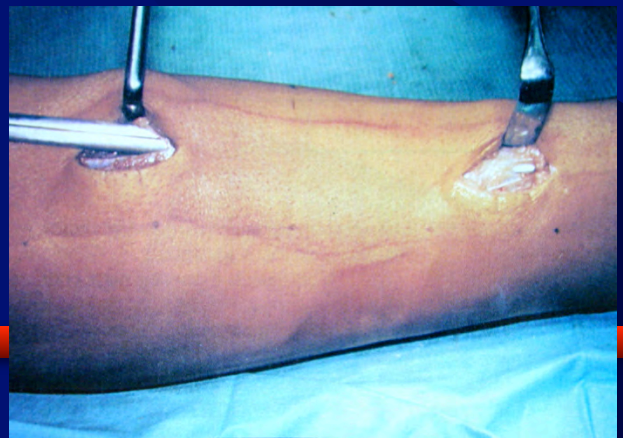
Botox:
Why weaken muscles in athletes/soldiers?

- Horobeti et al, AJSM, 2013
  - 16 patients
  - 25 anterior compartments/ 17 lateral
  - Pressures fell 63-68%!
  - Pain relieved in 15 patients (94%)
  - **69% of patients had decreased strength (3.5-4.5/5)**

Options of Surgical Technique

- Formal fascial release
- Fasciectomy
- Percutaneous **(+/- US)**
- Dual incision mini approach
- Single incision mini approach
- Endoscopically assisted **(70-80% = complete release. AJSM 2013**

Surface Anatomy



Surgical Outcomes

- Classically:

  What we told our patients
  - Return to sport: 8-12 wks
  - 80-90% good-to-excellent
  - Slightly less in females
    - Micheli, AJSM, 1999
  - Complications
    - Stiffness, scar tissue, post surgical cellulitis, nerve injuries

Surgical Outcomes

Packer, AJSM, 2014

- Sx 81% vs non sx 41% happy
- College 94%, High School 89%
- Isolated anterior: 100%

Winkes, BJSM, 2014

- **Only 35-60% success with posterior releases**

Outcomes in Military

- Recent literature
  - Waterman, JBJS 2013
    - Only 41% return to active duty
  - McCallum, Foot/Ankle 2014
    - 44% recurrence, 17% medical discharge

Outcomes in Military

- Dunn JC, Waterman BR. Clin Sp Med, 2014
  - 611 service members/754 releases
  - 78% success (free from discharge/revision)
    - Comparable to Norway 73% success)
  - 28% unable to return to full duty
  - 45% incomplete relief of symptoms
    - Comparable to UK only 47% improvement

Why so bad? Missed dx? Incomplete dx? Incomplete release? Secondary gain? Rigorous demands on return?

UIC Outcomes

WHY? Careful confirmation of specific diagnosis/diagnoses

- Over 400 endoscopic releases since 1996
- 90% significant resolution and RTP
  - 4 injuries to branch of superficial peroneal nerve
  - 18 post operative cellulits resolved with antibiotics
  - 15 stiffness improved with deep massage and PT

Lessons learned: Technical pearls

- 2 incision endoscopic > 1 incision
- Within 2 cm, just a flashlight
- Release only involved compartment
- Long right angle retractors help
- **70-80% = 100% (AJSM 2013)**
- Alternate polar care post op
- Post-op early motion important
- 2-3 days Perioperative antibiotics

How does an athlete/soldier present with…..

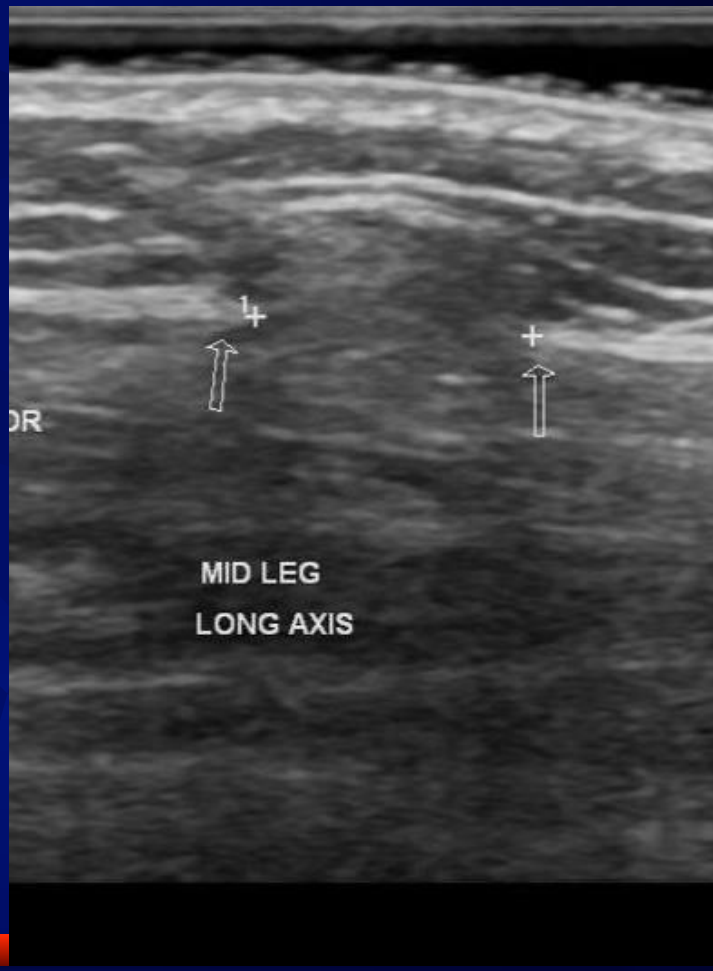
Muscle Herniation

- Focal weakness in fascia
- May be related to trauma
- Often related to CECS
- Usually associated with penetrating nerve or vessel (especially Superficial Peroneal)

How does an athlete/soldier present with…..

Muscle Herniation

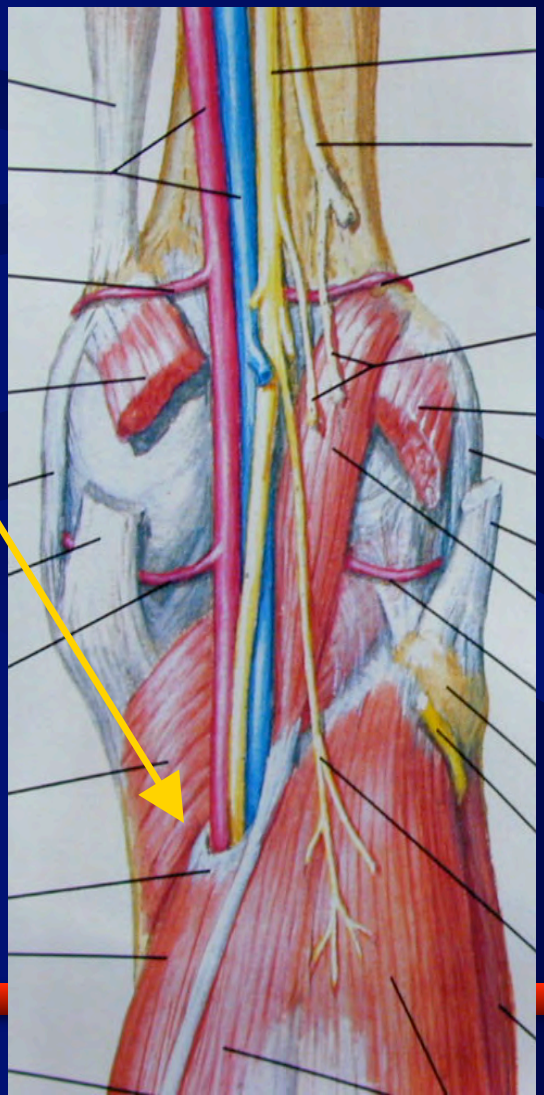
- Presentation
  - Focal muscular pain
  - Associated soft tissue mass
  - Exacerbated by exertion
  - +/- distal paresthesias
- Treatment
  - Repair ?
  - **Fascial release is best!**



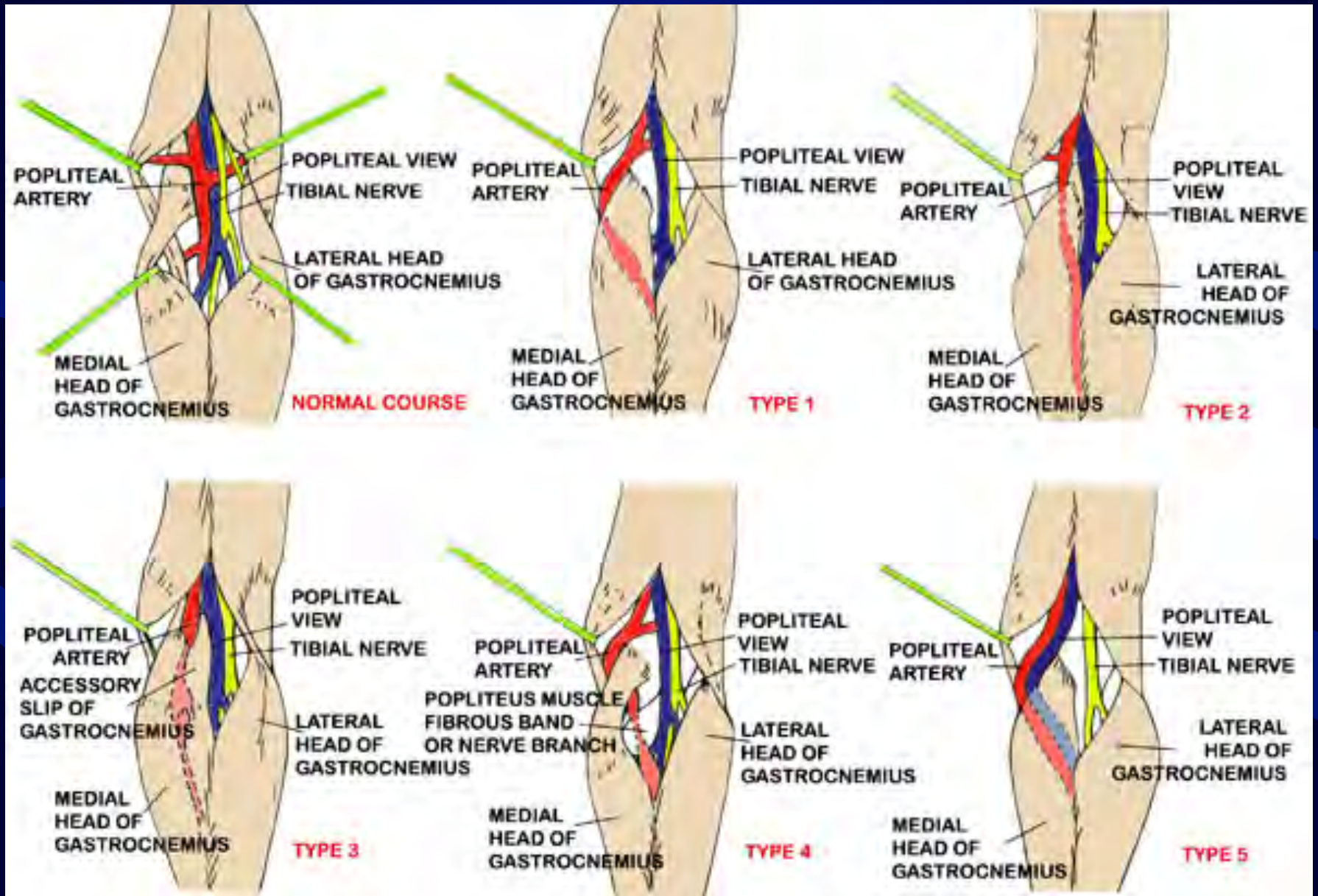
How does an athlete/soldier present with…..

Popliteal Artery Entrapment

- May present with suspicion of **deep posterior** CECS
- Pain with exertion
- Diminished distal pulses
- Borderline compartment pressures
- Uncommon (0.6-3.5% of leg pain in athletes)



Anatomic variations leading to Popliteal entrapment…



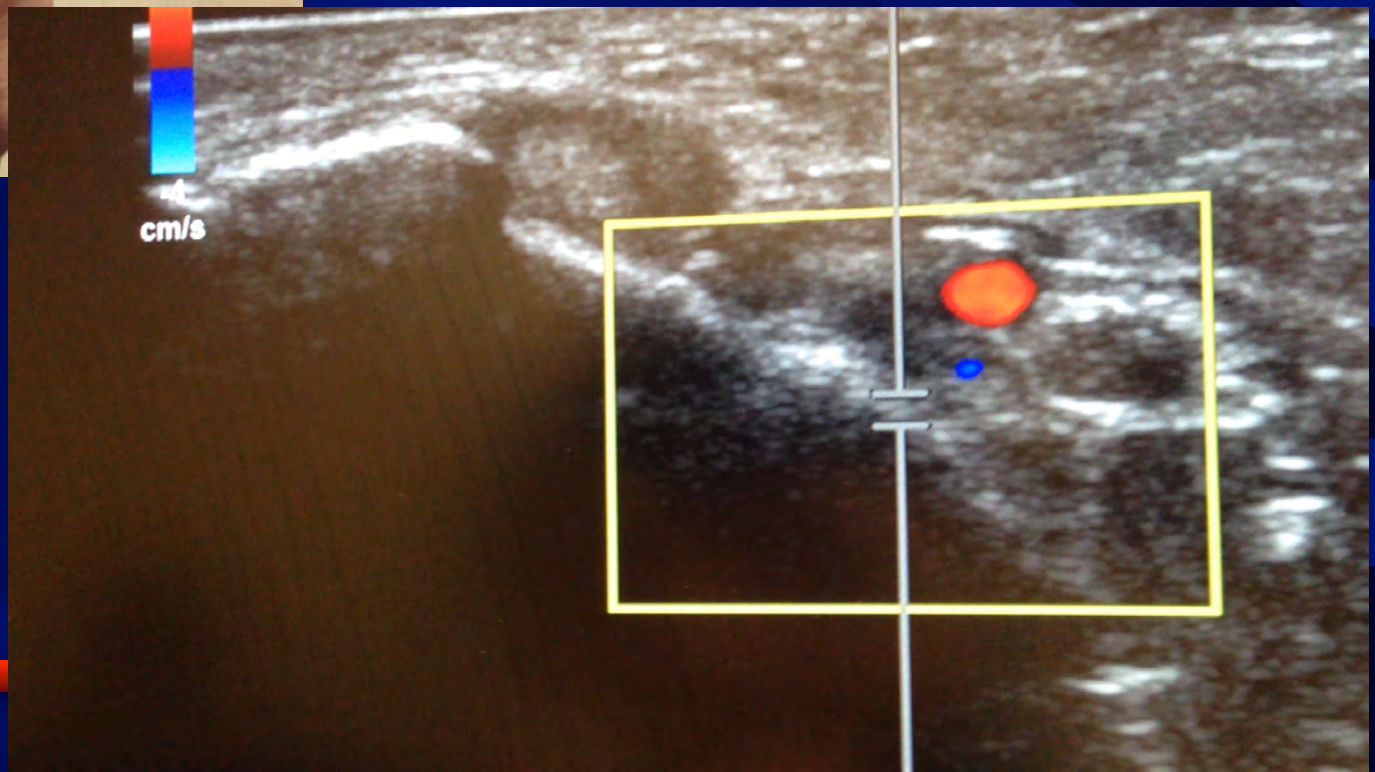
In office screening…..

Popliteal Artery Entrapment

- Listen for bruit
- Reassess with ankle flexion and extension
- Doppler Ultrasound
- Reassess with ankle flexion and extension

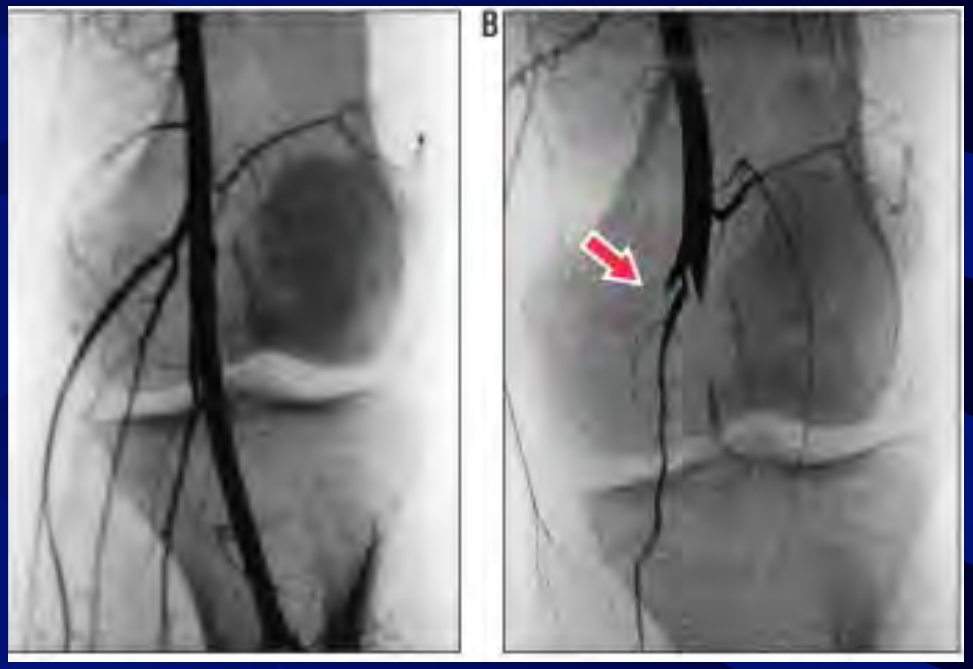
In office screening…..

Popliteal Artery Entrapment



Popliteal Artery Entrapment

- Diagnostic tests
  - **Angiography/MRA**
  - Doppler ultrasound
  - Exam +/- exertion
  - Exam +/- flexion vs extension
- Treatment
  - Conservative ?
  - Surgical release
    - Fascia
    - Medial gastroc resection



A dynamic Ankle/Brachial index is not easy to perform.
Hislop, BJSM, 2014

PAES Outcomes & Alternatives

- Sx release is > 90% successful with Anatomic PAES
- Sx release is only 77% successful in Functional PAES
- Guided Botulinum toxin (BOTOX) has been proposed with prior success in hemi-diaphragm/renal artery and piriformis/sciatica

» **Hislop M, BJSM, 2014**

How does a athlete/soldier present with…

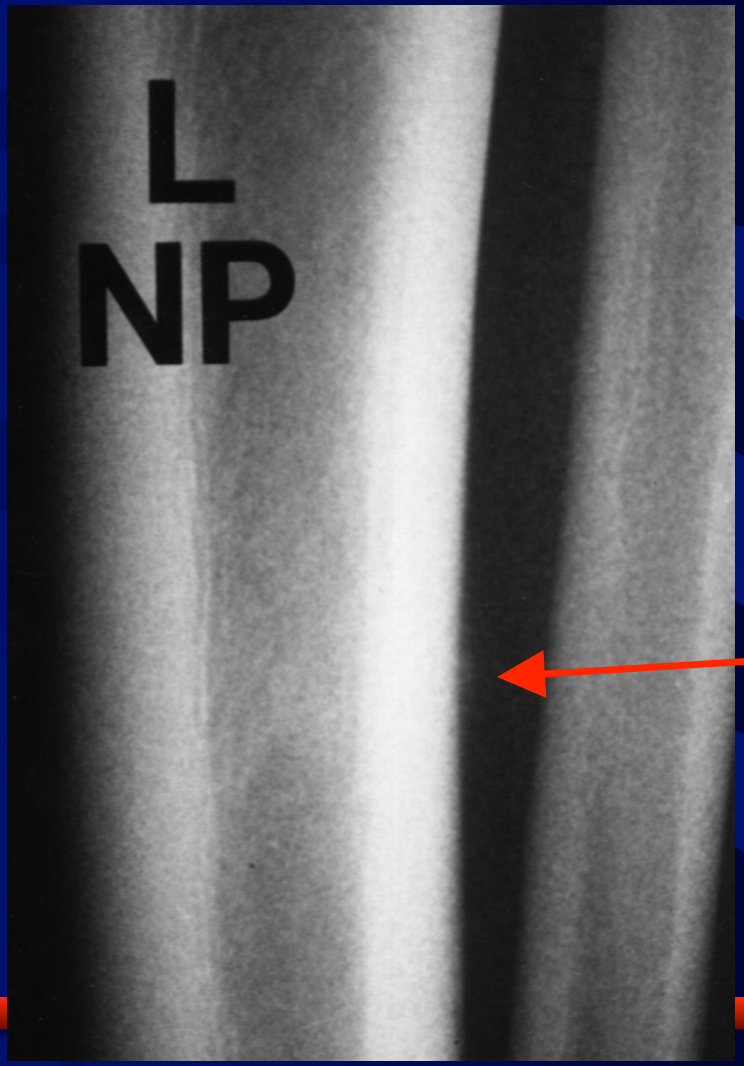
Stress Fracture

- 1855 Breihaupt first reported stress fractures in military recruits. “March Fx”
- 1-5% of athletic related injuries
- 1-25% of exercise related leg pain

Stress Fracture

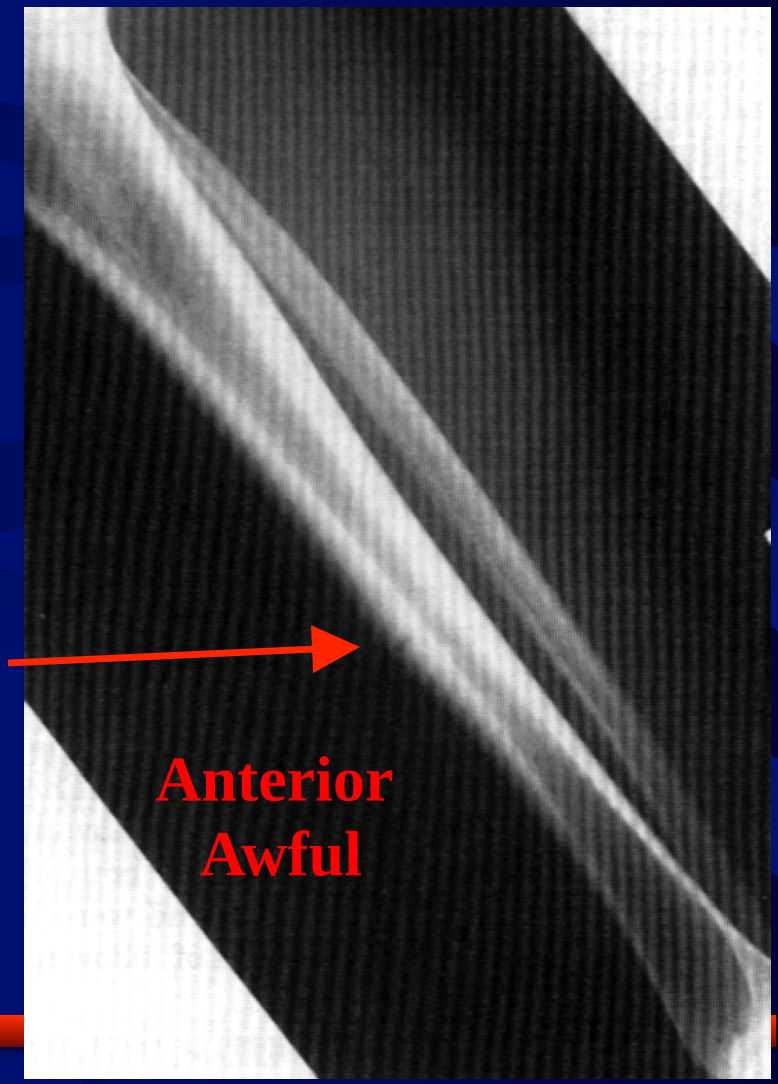
- Tibia -Most common (44%)
- Fibula – 16%
- Metatarsals – 16%
- Tarsal bones – 9%
- Femur – 8%

McKeag & Dolan 1989



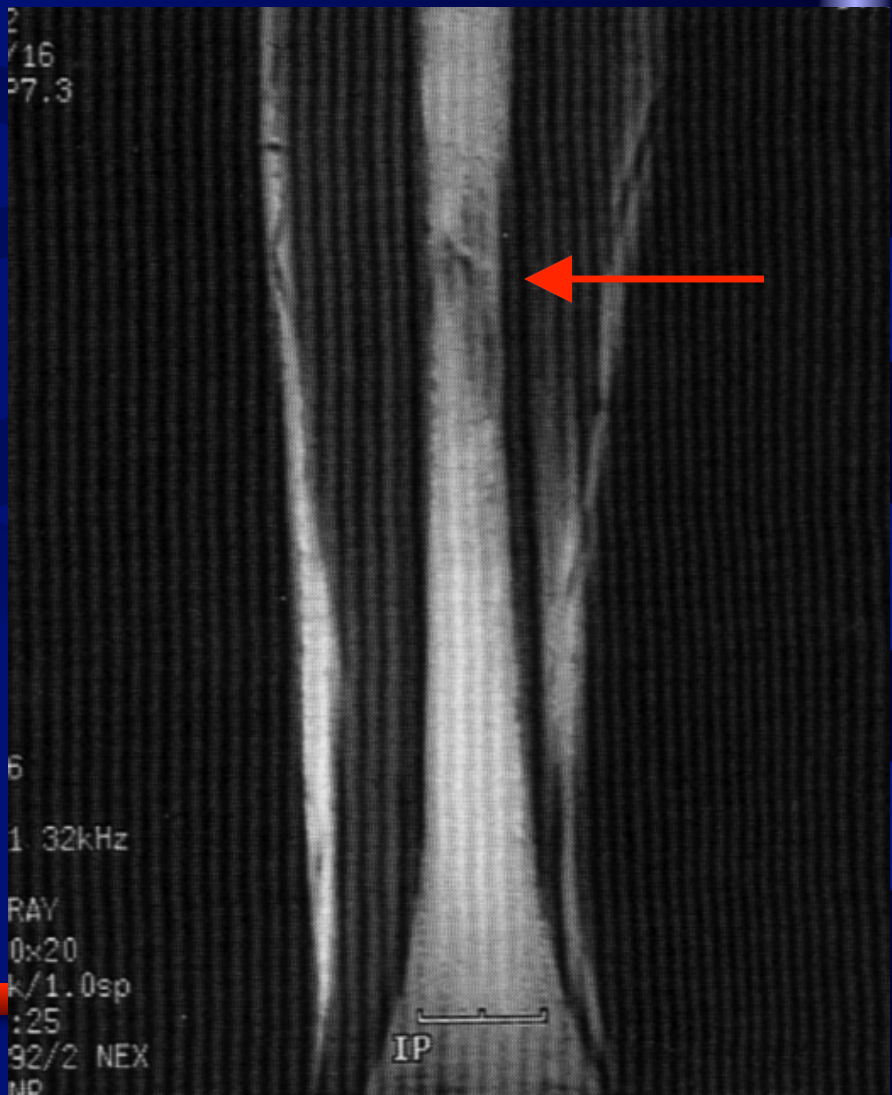
Tibial Stress Fractures

- Posterior-medial
  - Compression side of bone
  - Usually heal
- Anterior-lateral
  - Tension side of bone
  - “Dreaded black line”
  - More resistant



Risk Factors for Stress Fx

- Mechanical
  - Leg length discrepancy > 10mm – 3X risk (75% in longer leg
  - **Acute increase in training intensity (aka boot camp)**
  - Hard training surfaces.
  - **Poor shock absorption in footwear**
  - Miserable malalignment



Risk Factors for Stress Fx

- **Female athlete triad**
  - Energy deficit: Stress fx -8X more common with eating disorders
  - Osteopenia: Prior stress fx greatest predictor of future stress fx
  - Hormonal dysfunction:
    1. Stress fx -2.6X risk with each year delayed menarche
    2. Stress fx: 6X risk with rare or absent menses

Be Alert

Stress fx is common Triad presentation to orthopaedic surgeon

Stress Fractures - Treatment

- Rest
- Immobilization
- Anti-inflammatories?
- Air-Stirrup
  - Early return to sport (from 77 to 21 days)
  - No reported cases of catastrophic failure

Svenson, DeHaven, et al. AJSM, 1997.

Knee high air stirrup
NOT mid-tibia!!!

Stress Fracture - Treatment

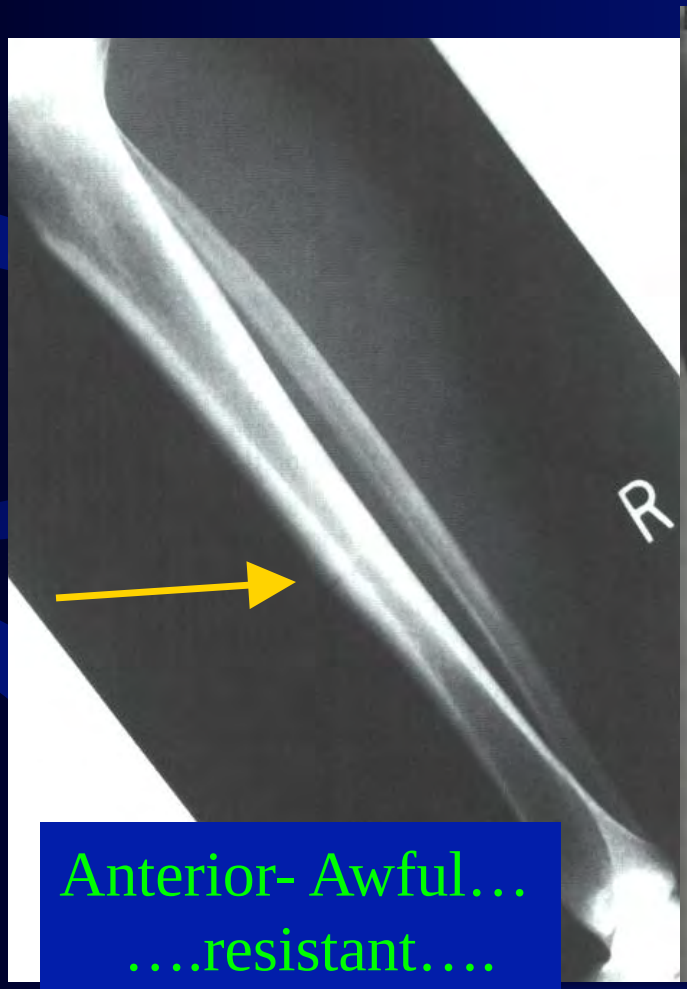
- Don't play through pain
- Catastrophic failure is possible

Stress Fractures - Treatment

- Consider metabolic work-up if recurrent
- Optimize nutrition
  - Evaluate energy deficits
- Bone stimulation?
  - Electromagnetic
  - Pulsed low intensity ultrasound (Exogen)
  - Anecdotal evidence in athletes

Video courtesy of Exogen

Resistant Stress Fx Treatment: Intramedullary rodding



Anterior- Awful…
….resistant….

How does an athlete/soldier present with…..

Medial Tibial Stress Syndrome

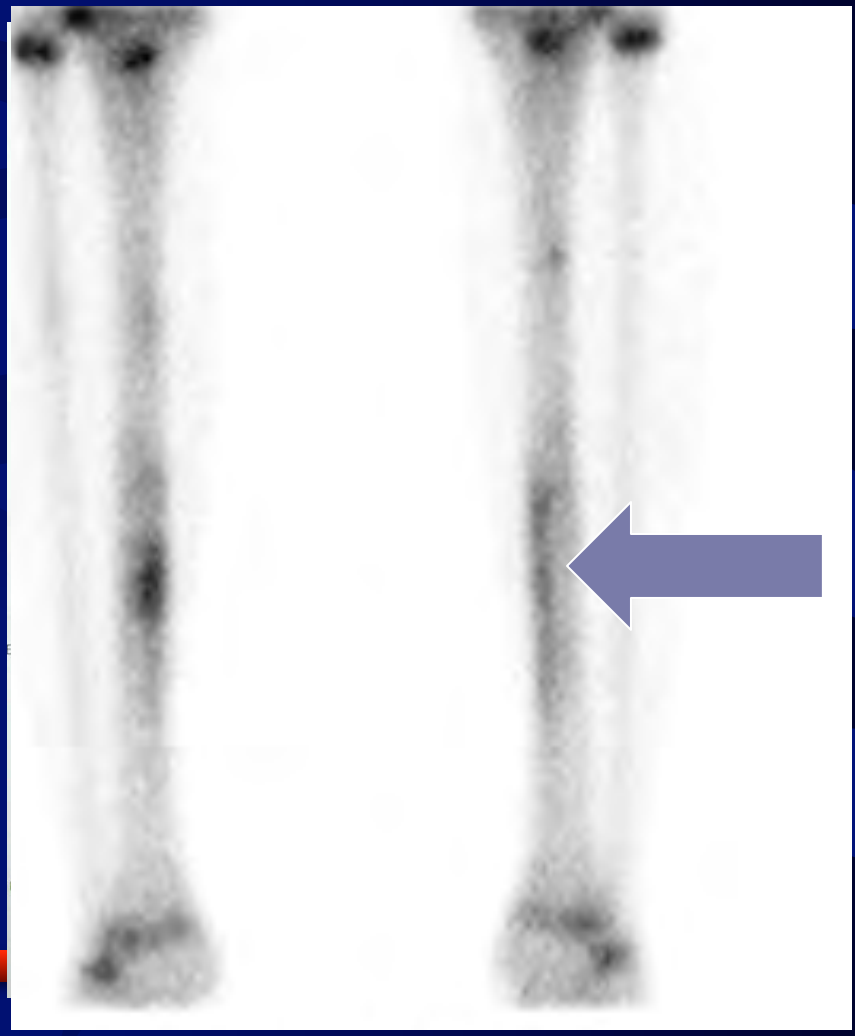
- Exercise induced pain in mid posterior leg
- Contributing factors include **varus hindfoot, excessive forefoot pronation, genu valgum, excessive femoral anteversion, & external tibial torsion**
- Rare before age 15
- 13-42% of athletic leg pain

Medial Tibial Stress Syndrome

- Pathophysiology is unclear:
  - May be related to chronic traction injury leading to periostitis near origin of soleus & FDL muscle origins (probably not tibialias posterior)
  - **Current theory: diffuse bone stress injury**

Medial Tibial Stress Syndrome

- **Tx: similar to stress fx**
  - Rest
  - **Knee high air stirrup**
  - Anti-inflammatories?
  - Stretching especially posterior tibia
  - Taping
  - Shoes/Boots/Orthotics
  - **Prolotherapy or PRP?**
  - Periosteal ablation?



What is Shin Bang?

- Tibia pain
- Common with Mogul skiing

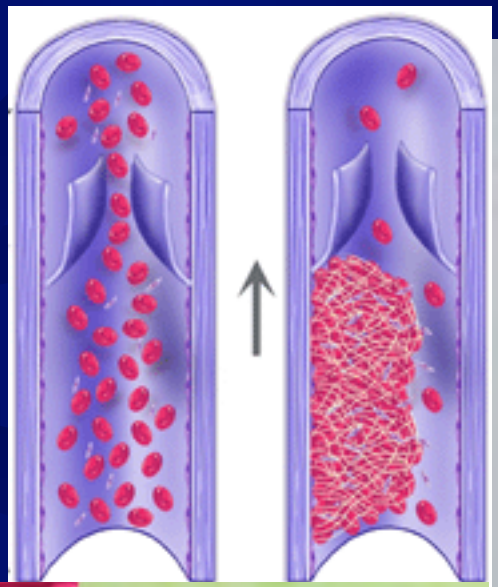
SAY GOODBYE TO SHIN PAIN

Designed and tested by skiers for skiers

How does an athlete/soldier present with…..

Deep Venous Thrombosis

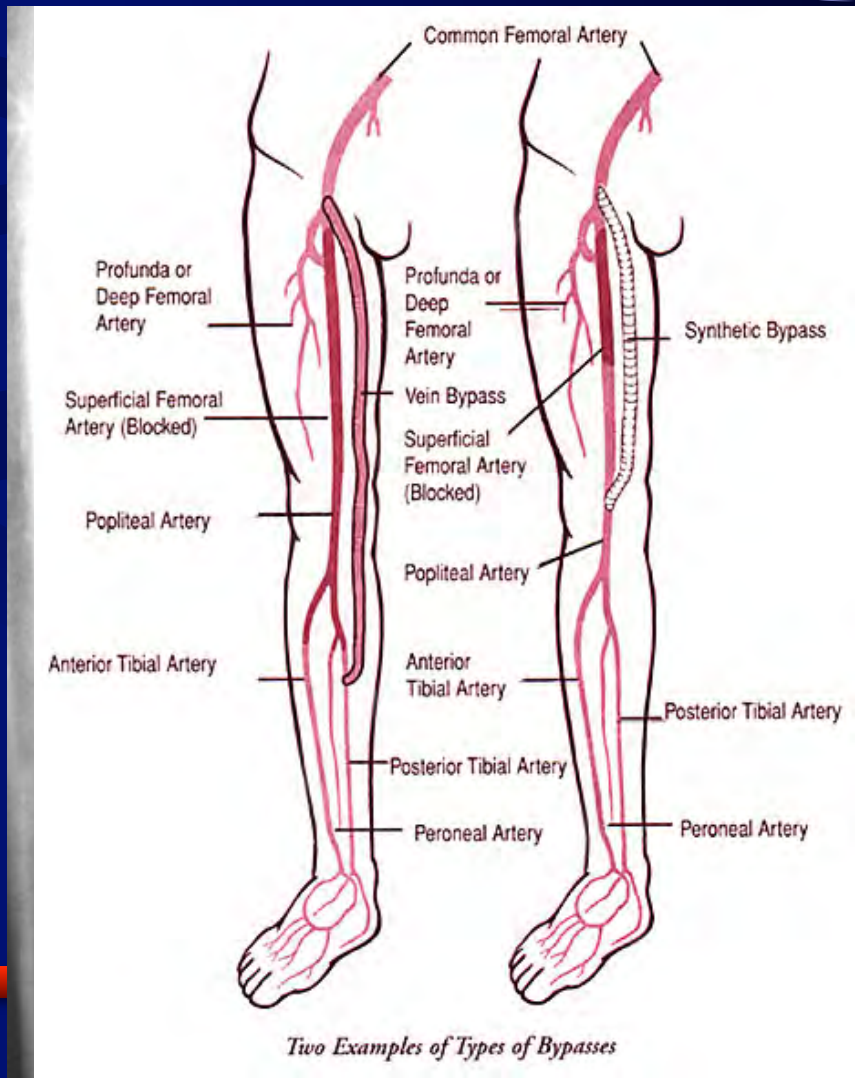
- Older population
- Swelling
- Posterior calf pain
- Increased risk with
  - **OCPs**
  - **Obesity**
  - **Immobilization**
  - **Recent travel**
  - **Surgery**



How does an athlete/soldier present with…..

Vascular Claudication

- 5% males > 50 have intermittent claudication
- 5% progress to ischemia per year
- **75% respond to tx**
  - Lipid control
  - Anti-platelet medication
  - Good diabetic control
  - Decrease smoking



Two Examples of Types of Bypasses

How does an athlete present with…..

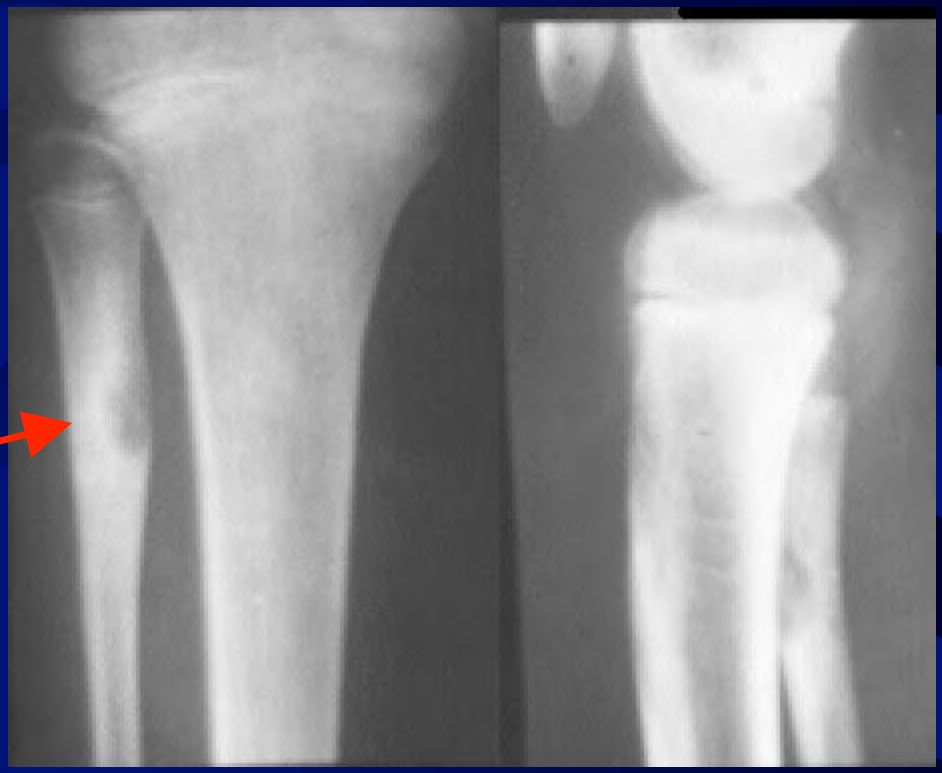
Muscle Cramping

- Chronic ache
- Usually related to effort
- Failed massage and rest
- Restless leg syndrome
- Dehydration?
- Metabolic abnormalities?
  - Potassium
  - Magnesium
  - Calcium
  - Thyroid

How does an athlete present with…..

Tumors

- Progressive pain
- Atypical bone pain
- Night pain
- Pain responds to Aspirin (osteoid osteoma)
- Systemic findings
  - Weight-loss
  - Lethargy



Plan of Attack for Atypical Leg Pain

- Recognize atypical presentation or population
- Create differential dx based on history and anatomic examination
- Target work-up by stepwise addressing most likely diagnosis with some consideration for expense or test that might rule out multiple diagnoses

Complete Work-up for Atypical Leg Pain

- Laboratory
  - CBC with diff (r/o sickle cell, infection)
  - Sed rate (r/o infection, rheumatolgic problems)
  - UA, urine myoglobin (r/o rhabdomyolysis)
  - Metabolic panel (Ca, K, Mg, electrolytes, pH)
  - D-dimer, PT. PTT (r/o DVT)
  - CPK, myoglobin (r/o rhabdomyolosis)
  - T3, T4. TSH (r/o thyroid myopathy)

Complete Work-up for Atypical Leg Pain

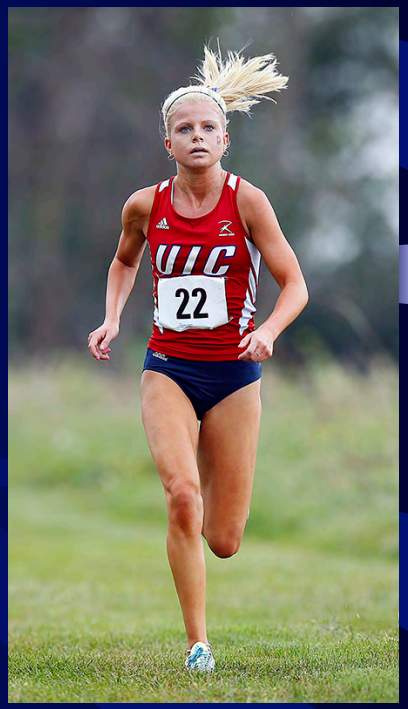
- X-ray (AP, lateral, obliques): R/O stress fx, periostitis, and tumors
- Bone scan (nonspecific but sensitive for tumor, stress fx, medial tibial periostitis
- CT leg (defines bone pathology)
- CT myelogram vs MRI lumbar spine (r/o radiculopathy)
- MRI leg (r/o cyst, soft tissue tumors, muscle herniation, stress fractures, periostitis

Complete Work-up for Atypical Leg Pain

- Neurovascular work-up
  - EMG/NCV (r/o peripheral nerve entrapments and some metabolic disorders)
  - Doppler US (r/o vascular pathology, popliteal artery entrapment)
  - Arteriography (r/o claudication)
  - MRA (r/o popliteal artery entrapment)

Challenge 1

21 year collegiate runner



- Presents with gradual onset of increased leg pain with running
- Pain is worse with impact
- She has been able to run thru the pain but her times are getting worse.
- Pain is focal on exam at the junction of the mid to proximal tibia.

What else would you like to know?

What is her prognosis?

Additional history

- Irregular menses
- Poor energy balance
- History of previous stress fx (common predictor of subsequent injury)
- Needed multi-specialty team approach
- Proximal tibial stress fx don't respond to bracing as well

RTP after nutritional contract, gradual progressive increase intensity, and long-term monitoring

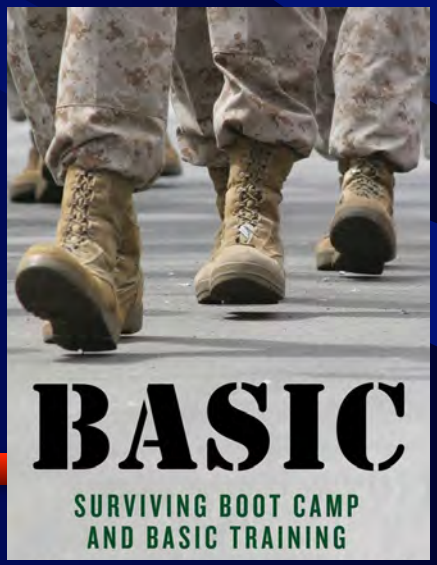
Case challenge 2

19 yo soldier at basic training

- Presents to medic with leg pain that began about 1 week into training
- Pain is worse with impact & on long road hikes.
- Does location of pain effect diagnosis or treatment
- Does shoe-wear effect risk?

19 yo soldier in basic training

- Leg pain is VERY common complaint
- Related to brisk advancement of training intensity: **controlled progression / pre-training to reduce injury**
- May be related to shoe wear: **(orthotics reduce incidence)**
- Focal pain…stress fracture
- Diffuse pain....MTSS
- Similar treatment



Challenge 3

25 yo active duty male

Gaunder C et al. Case report from San Antonio Military Medical Center

- 2 year history of calf pain with exertion treated by numerous doctors
- Work-up including radiographs, bone scan, MRI, EMG have been negative
- Treatments including rest, NSAIDS, massage, physical therapy, bracing, and prolotherapy have had no effect

Why is nothing working? What's next?

Carefully consider broader differential diagnosis

- CECS mild elevation/ Failed releases
- Decreased pulses with Doppler US
- Positive Bruit with auscultation
- Positive MRA
- Symptoms resolved with rest

Treated successfully with surgical release of PAES with full return service

Case Challenge 4

35 yo officer for fitness test

- Called to see soldier in medical tent with increasing pain on the anterolateral aspect of his leg
- Patient had history of “shin splints” which usually resolved after hikes
- This time pain progressed & didn’t go away.
- NV intact, tender over anterior compartment with increased tenseness

RICE? Observation? Referral?

35 yo officer for fitness test

- Compartment pressures measured on-site revealed 50mmHg in the anterior & medial compartment (<20 in deep and sup post)
- **CECS converted to Acute**
- Patient taken for immediate fascial release
- Mini-incision, endoscopic assisted release performed (not open release)

Returned to training 6 weeks later with no symptoms

How much ischemia time leads to permanent damage?

- Total ischemia
  - > 8 hours complete irreversible changes
  - > 6 hours variable results
  - < 3-4 hours no residual motor damage nerve usually responds by paresthesias may be delayed

Is compartment syndrome total ischemia?
Is acute on exertional compartmetn syndrome the same time line?
When does the clock start?

Challenge 5

33 yo female runner

- Mother of 2
- Routine knee arthroscopy for meniscus
- Discharged home with early mobilization
- Calls office at POD 3 with leg pain, “feeling fatigued, can’t seem to get up stairs without catching her breath”

Support? Observation? Referral?

Additional Hx & Px

- On oral contraceptives
- Evaluated in office
- Lungs clear, normal vital signs
- Mild calf pain, mild pain with squeeze, no cords, no distal swelling
- Discharged home, “call if any problems”

Good choice?

Catastrophe occurs

- Collapses at Denny's on the way home
- Short of breath
- Emergency transport to hospital
- Course waxes and wanes in ER
- Fatal PE during VQ scan

Should we be prophylazing knee scopes?

What are indications?

- Routine formal prophylaxis? (Europeans)
- Previous blood clot
- Oral contraceptives (stop them preop!)
- Major joint reconstruction (ACL's?)
- Leiden deficiency
- ?Family history

RECOMMEND chemoprophylaxis (aspirin) & mechanical prophylaxis (compression stockings)

My favorite story of how leg pain effects outcome…..

15 yo elite level gymnast

- Ramping up training for trials competition for international event
- Develops leg pain that is worse with impact related to landings and tumbling runs
- **What is the next best step?**
- **What factors will effect her ability to compete in 6 weeks?**

Dominique Moceanu

- Rest (avoid landings)
- Bone stim (2 types)
- Bracing
- Competed at Olympic Games (Gold Medal)
- Forced Kerri Strug's sensational vault

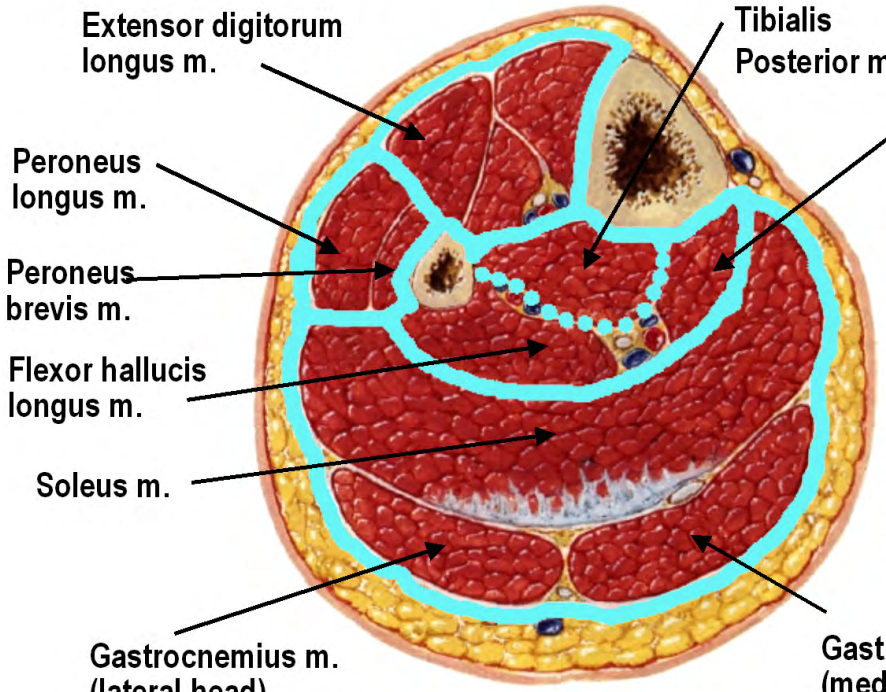
Avoid non-diagnostic terminology

Lesson 2

Think Anatomically

80% of CECS involve the anterior or lateral compartments

(Cross-section just above middle of leg)



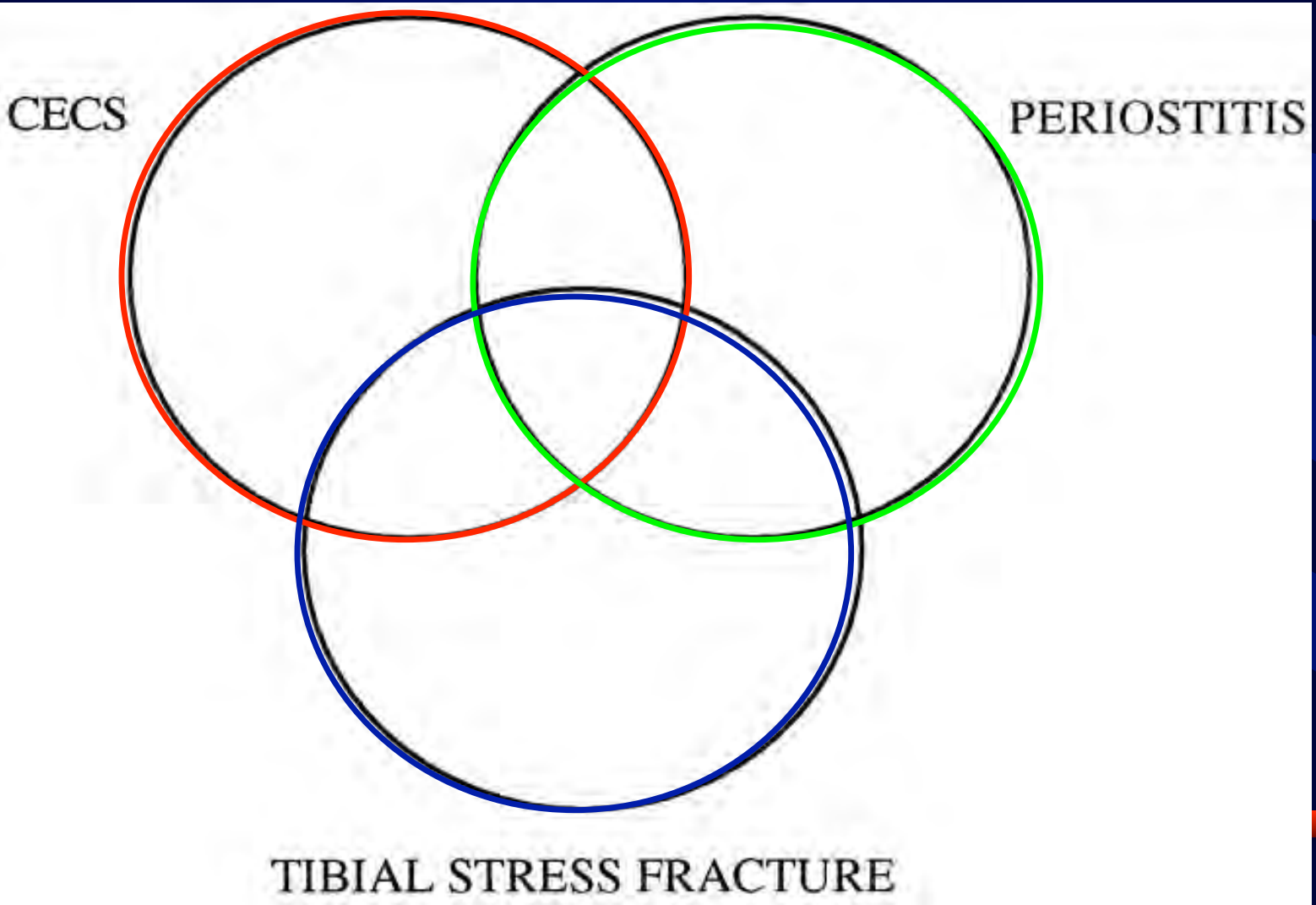
Davey J, Rorabeck C, and Fowler P. The tibialis posterior muscle compartment. *Am J Sports Med* 12(5):391-397, 1984.

Lesson 3

Common things are common but

Lesson 4

Beware overlapping diagnoses

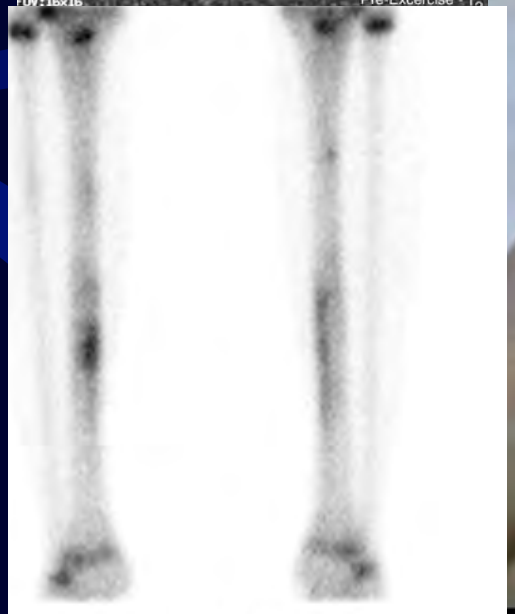


Consider all contributing factors

- Associated factors
  - Alignment
  - Gait mechanics
  - **Training intensity**
  - **Shoe wear**
  - Court surface
  - Age
  - Previous trauma or degeneration
  - Nutrition & electrolytes

Lesson 6

Target the most likely diagnosis



Lesson 7

Don't be afraid: Compartment testing is easy

- Always test all 4 compartments
- Pre and post only (5 minute not needed)
- Re-orient needle every time
- Tell patient numbers apriori
- Reproduce symptoms plus 5 minutes

Lesson 8

Always screen 1st time stress fx in female athletes/soldiers

Use best evidence available when choosing treatment options

- Stay current and be open minded
- Beware bandwagon treatments
- Most stress fractures & MTSS resolve with immobilization and gradual return of intensity
- Most pressure proven CECS and MRI (+) PAES require surgical release

Lesson 10

The Team Approach is Best:

Surgeon, Chiro, 1 Care, PT, ATC, Radiology


Thank you