LEG PROBLEMS IN ATHLETES

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LEG PROBLEMS

• LIMB THREATENING
  Approach
  – Acute ➞ Emergency treatment
  – Chronic ➞ Urgent workup and treatment

• NOT LIMB THREATENING
  Approach
  – Usually chronic
  – Systematic work up
  – Comprehensive treatment
Limb Threatening Leg Disorders

• Loss of oxygenation
  – Vascular compromise
  – Amputation
  – Crush Injury
  – Acute compartment syndrome

• Vascular compromise
  – NEVER ASSUME ARTERIAL SPASM
  – Vessel compression or injury (tear, laceration)
    • From bone fragment or bone displacement
    • Associated with KNEE dislocation
Limb Threatening Leg Problems

EXTREME SPORTS – NO VEHICLES

• Jumpers
  – Bungee jumpers
  – Helo skiers
  – Parachuters

• Skate boarders

• Skiers

• Parasailers
INJURY COMBINATIONS

• Any lower extremity fracture → acute compartment syndrome
  • Mechanism of injury
  • Other injuries
  • Immobilization
  • Compressive Dressings
Injury Combinations

– Medial tibial plateau fractures → knee dislocation

– Femoral shaft fracture → knee dislocation

(Giannoudis, J Ortho Trauma 2005)
Knee Dislocation

IMMEDIATELY ASSESSMENT: Vascular status

TREATMENT: Reduce and stabilize (Knee immobilizer)
    Restore blood flow
    Manage compartment syndrome

BEWARE: posterolateral dislocations

Photo from C. Roberts, MD
**Limb Threatening Leg Problems**

- **Acute compartment syndrome**
  - Multiple trauma versus isolated injury
  - ATLS
    - Even for isolated trauma
    - ABC’s
    - SAVE THE BRAIN
Limb Threatening Leg Problems: Acute Compartment Syndrome

• Injured muscle in a closed fascial space
  – High risk injuries:
    • Tibial and forearm fx
    • Crush injury
    • Prolonged pressure
    • Reperfusion
    • Burns
    • *Excessive exercise*: Performance enhancing agents, Sickle Cell trait?
  – Mechanism: Direct trauma, constricting bandage or splint/cast, tourniquet, significant overuse
  – Signs: paresthesia, paresis, paralysis, pain with passive stretch, pallor
  – Pulse and cap refill are not reliable
Limb Threatening Leg Problems: Acute Compartment Syndrome

Calf is # 1

- Thigh
- Foot
- Forearm
- Paraspinal
- Pelvic
- Gluteal

Photo courtesy of C Roberts, MD
## Limb Threatening Leg Problems: Acute Compartment Syndrome

<table>
<thead>
<tr>
<th>FINDINGS</th>
<th>%</th>
<th>PAIN</th>
<th>PARESTHESIA</th>
<th>PAIN w/ STRETCH</th>
<th>PARESIS</th>
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<td>1 finding</td>
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<td>pain</td>
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<td>0.13</td>
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<td>paresthesia</td>
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<td>0.98</td>
<td>0.97</td>
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<tr>
<td>pain w/ stretch</td>
<td>25</td>
<td>0.14</td>
<td>0.15</td>
<td>0.14</td>
<td>0.11</td>
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<tr>
<td>paresis</td>
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<tr>
<td>3 findings</td>
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<tr>
<td>4 findings</td>
<td>98</td>
<td></td>
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</tr>
</tbody>
</table>

*Ulmer, J Ortho Trauma 2002*
Limb Threatening Leg Problems:  
Acute Compartment Syndrome

• Diagnosis is Clinical
  – High index of suspicion
  – Pressures for head injured, LOC
    • >35-45 mmHg
    • Must account for systolic BP

• Management
  – Remove constricting dressings, splints, casts, tourniquets
  – FASCIOTOMY
  – IV fluids, oxygenation

OTHER LIMB PROBLEMS
Not Limb Threatening

• Exercise induced leg pain

• ANATOMIC APPROACH
  – Bone and Periosteum
  – Soft Tissue
    • Muscle and Fascia
    • Vessels
    • Nerves
  – Extremity-Gear Interface
Anatomic Sources of Leg Pain: Bone and Periosteum

• Bone
  bone strain $\rightarrow$ stress $\rightarrow$ stress reaction $\rightarrow$ fracture

• Periosteum
  – Inflammation at muscle insertions
    • tibialis posterior
    • soleus

• Both: Shin splints
  – Medial tibial stress reaction

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Anatomic Sources of Leg Pain: Bone

• Stress Fracture
  – Overuse, repetitive loading; change in regimen
  – Location depends on sport
    • Runners: distal 1/3
    • Volleyball, basketball players: upper diaphyseal, proximal metaphyseal
  – Risk factors: previous history
    • BMI
    • Eating habits, nutrition
    • Females: menses, female triad
    • Training equipment
Anatomic Sources of Leg Pain: Medial Tibial Stress Syndrome

• Most common exercise induced leg pain
• Location: mid to distal posteromedial tibia > 5cm
• Cause
  – Traction of tibialis posterior on periosteum
  – Overload of the posteromedial tibia → stress → focal osteopenia
    • Posterior compartment muscles do not insert here
    • Area of high loads and tibia bending
• Sx worse with resisted ankle PF
• More common with foot pronation (Yates AJSM 2004)
Bone Tumors

• Consider for poor response or unusual presentation
  – Open physes (primary tumors) versus closed (metastasis)
  – Benign versus malignant
  – Previous history
    • Breast cancer
    • Multiple myeloma
Anatomic Sources of Leg Pain: Soft Tissue

• **Muscles**
  - 4 fascial compartments
  - chronic strains and tendinopathy

• **Nerves**
  - CRPS
  - Radiculopathy
  - Peripheral nerve entrapment
  - Systemic diseases
    - Neuropathy
    - RA, erythema nodosum
Anatomic Sources of Leg Pain: Soft Tissue Exercise Induced Compartment Syndrome

- **Acute:** sudden swelling with very high interstitial pressures associated with a single event
- **Chronic:** recurrent swelling with high pressures from overuse, aggressive training
  - Pathophysiology unclear
  - Increase volume with exercise 20% and poor fascial response
- **Both:** tissue hypoxia with a feedback loop of increased pressure, soft tissue swelling
Anterior and Lateral Compartments

- Extensor digitorum longus m.
- Tibialis anterior m.
- Extensor hallucis longus m.
- Intermuscular septum
- Peroneus longus m.
- Peroneus brevis m.
# Compartment Syndromes

<table>
<thead>
<tr>
<th></th>
<th>ACUTE</th>
<th>CHRONIC EXERCISE INDUCED</th>
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<tbody>
<tr>
<td>Mechanism is</td>
<td>Hypoxia</td>
<td>Exercise, Endurance Sports</td>
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<tr>
<td>Tissue involved</td>
<td>Fracture, Crush, Tourniquet, Reperfusion, Burns</td>
<td>Muscle, Fascia-anterior and lateral compartments</td>
</tr>
<tr>
<td></td>
<td>Muscle, Fascia –any compartment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skin, Dressings</td>
<td></td>
</tr>
<tr>
<td>Pressure measurements</td>
<td>Clinical diagnosis</td>
<td>Helpful pre- and post-exercise</td>
</tr>
<tr>
<td>Urgency</td>
<td>Surgical emergency</td>
<td>Not emergent</td>
</tr>
</tbody>
</table>
80% of CECS involve the anterior or lateral compartments (Cross-section just above middle of leg)

Posterior Compartments:
Deep and Superficial

- Tibialis Posterior m.
- Flexor digitorum longus m.
- Flexor hallucis longus m.
- Soleus m.
- Gastrocnemius m. (lateral head)
- Gastrocnemius m. (medial head)
Compartment Pressures

- Clinical suspicion: imaging to rule out other diagnoses
- Elevated pressures confirm diagnosis

Testing pre- and post-exercise
  - All 4 compartments
  - Time 0 and 1, 5 minutes post exercise

<table>
<thead>
<tr>
<th>Normal control (Aweid 2012)</th>
<th>Time 0, pre</th>
<th>1 min post*</th>
<th>5 min post</th>
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<tbody>
<tr>
<td></td>
<td>&gt;15mmHg</td>
<td>&gt;30mmHg</td>
<td>&gt;20mmHg</td>
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<tr>
<td>Pedowitz 1990</td>
<td>5.7-12mHg</td>
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<td></td>
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</tbody>
</table>

*most accurate by meta-analysis (Aweid 2012)
Know the anatomy before performing compartment testing or surgical releases.
Muscle Hernia?
Think Exercise Induced Compartment Syndrome

- Superficial branch of the peroneal nerve as it exits the fascia
  - Lateral compartment, 73%
  - Anterior compartment, 14%
  - Branches in both, 12%

(Adkison, JBJS Am 1991)

Yochim AJO 2010
Achilles Tightness

• Location: along muscle and tendon
• Cause: microtears and degeneration
• Diagnosis
  – Silfverskiold test: ankle DF with knee extended and flexed to 90 deg
  – Imaging to r/o other causes
Anatomic Sources of Leg Pain: Blood Vessels

• Arterial $\rightarrow$ claudication
  – Atherosclerosis can lead to claudication
  – Popliteal artery entrapment

• Venous
  – Phlebitis
  – Thrombosis

© CIBA-Geigy
Popliteal Artery Entrapment Syndrome

• Most common cause of arterial leg pain in athletes → Claudication in young athlete

• Etiology: dynamic compression of the artery
  – Muscle based: Gastrocnemius
    • Hypertrophy of the heads: thought to be most common
    • Abnormality of the medial slips
  – Arterial based: Congenital anomaly
  – Venous based: Functional compression by the vein

• Pain with plantar flexion
Effort Induced Deep Venous Thrombosis

- More common in upper extremity
  - Subclavian vein
  - Brachial vein

- Lower extremity
  - May Thurner Syndrome: left leg
Effort Induced DVT Risk Factors

“Extrinsic”
- Long distance travel
- Dehydration
- Trauma
- Immobilization
- Lower extremity fracture or surgery
- Hormones
  - BCP
  - Pregnancy
  - HRT

“Intrinsic”
- Personal or family history of DVT or PE
- Inherited or acquired clotting disorder
  - Factor V Leiden
  - prothrombin 20210 mutation
  - antiphospholipid antibodies,
- Congenital anomaly
DVT

• Physical exam
  – Sensitivity 11%, PV 25%
    • Homan’s sign is 60-88% sensitivity and 30-70% specific
  – Specificity 76-85%

• Best test: Duplex US
  – Sensitivity 93-98%
  – Specificity 98%
Peripheral Nerve Entrapment

Motor and Sensory Nerves

Pell JAAOS 2004
Nerves (Cross-section just above middle of leg)

- Superficial Peroneal n.
- Anterior tibial a. and v. and deep peroneal n.
- Posterior tibial a. and vv. and tibial n.
- Lateral sural Cutaneous n.
- Medial sural Cutaneous n.
Nerve Entrapment

• Common peroneal nerve
  – Inversion/eversion
  – Running, cycling

• Superficial peroneal nerve
  – PF/DF
  – Dancers, body builders, soccer, tennis, jockeys, runners
  – Muscle hernia

• Saphenous nerve
  – Knee flexion
  – Cyclists, rowers

• Sural nerve
  – Compression by crural fascia
  – Runners, track
REFERRED PAIN

• Spine: pseudo claudication
  – Calf pain with walking
  – Improves with “stooped” posture

• Hip: SCFE in young, overweight athlete

• Knee: ITB, tibiofibular joint
“FOOT” NOTE

• Special concerns
  – Endocrine
    • Diabetic athlete
    • Metabolic syndrome
  – High BMI or Obese athlete: Gear limb interface
  – Chronic lymphedema

• Compression
  – Neuropathies
  – Blisters and Pressure lesions
SPORT SPECIFIC CONDITIONS

• Mechanism of Injury
  – Acute
  – Overuse, chronic

• Type and duration of energy and loads
  – Movement patterns
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Stress Fx</th>
<th>Medial Tibial Stress Rxn</th>
<th>Tenosynovitis</th>
<th>CRPS</th>
<th>Radiculopathy</th>
<th>Periph Nerve Entrap</th>
<th>Veno Stasis</th>
<th>DVT</th>
<th>Arterial Dis.</th>
<th>PAE</th>
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<tbody>
<tr>
<td><strong>H&amp;P</strong></td>
<td>Sx w/ Loads, Bone pain</td>
<td>PF &amp; Inv--&gt; pain @ post medial tibia</td>
<td>Pain over the tendon</td>
<td>Allo-dynia Skin</td>
<td>Sens Motor DTR</td>
<td>Sens Tinel’s</td>
<td>Skin</td>
<td>Calf Pain STS Cord</td>
<td>Claudication</td>
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<tr>
<td><strong>Test</strong></td>
<td>Vibration Sens75% Spec67%</td>
<td>BS High ResCT Sen42-100% Spec88-100 MRI Sen78=89% Spec33-100%</td>
<td>MRI</td>
<td>BS Block MRI</td>
<td>EMG</td>
<td>EMG</td>
<td>US</td>
<td>US Sens93-97% Spec98 % Venograph</td>
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<td>X-ray BS MRI</td>
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<td>US</td>
<td></td>
<td>ABI</td>
</tr>
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</table>

Faipont, JAAOS 2003  
Burrus. AJSM 2014
Differential Diagnosis

• Pain with initial impact
  – Stress fracture
  – Periostitis
  – Muscle strains and tendinitis

• Focal bone pain
  – Stress fracture

• Diffuse medial bone pain
  – Medial tibial periostitis

• Focal muscle pain
  – Strain or Hernia
Differential Diagnosis

• Pain with resisted motion
  – Muscle strains and periostitis
• Pain with vibration
  – Stress fractures
• Pain at night
  – Tumors
• Pain with exertion
  – CECS, Popliteal artery entrapment

• Paresthesias at rest
  – Nerve entrapment
• Paresthesias with exertion
  – CECS
• Electrical shooting pain
  – Radicular pain from back
Differential Diagnosis

• Diffuse swelling
  – DVT
  – CECS
  – Muscle ruptures

• Focal swelling
  – Muscle herniation
  – Ganglion
  – Tumor

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Differential Diagnosis

**Chronic Leg Pain in Athletes**

- CECS
- Muscle herniation
- Stress fractures
- Medial tibial periostitis (shin splints)
- Chronic muscle strain
- Popliteal artery entrapment
- Referred pain

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CONCLUSION

Extreme Sports

• Be a “trauma doc” first and a “sports doc” second
• Consider ATLS Certification